

March 2018

Interstate Waters



Riparian Buffers

Nature at Work

Also:

Courts Churn the Meaning of 'Waters'

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Established by an Act of Congress in 1947, the New England Interstate Water Pollution Control Commission is a not-for-profit interstate agency that meets the water-related needs of our member states: Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. The NEIWPC Commissioners from each member state are appointed by their state governors.

Interstate Waters

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Editor: Adam Auster

Managing Editor: Anna Meyer

Contributing Editor: Michelle St. John

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New England Interstate Water Pollution Control Commission
650 Suffolk Street, Suite 410, Lowell, MA 01854

Tel: 978-323-7929

www.neiwpc.org

From the Executive Director

Save the Chelmsford Lab

A REGIONAL ENVIRONMENTAL PROTECTION Agency laboratory in Chelmsford that provides emergency response services faces possible closure. The NEIWPC states have responded with support for the facility.

When a chemical plant exploded in Danvers, Massachusetts, the day before Thanksgiving in 2006, the Chelmsford lab responded within hours. The blast damaged more than ninety homes, knocking some off their foundations.

First responders used the lab's chemical analysis to assess air quality and water runoff hazards. It was the Chelmsford lab that confirmed when the cleanup criteria had been met.

In 2011, Tropical Storm Irene left a Vermont state laboratory in Waterbury underwater. The Chelmsford lab stepped in and performed critical analyses required under the Clean Air Act.

The lab's work includes assessing hazardous waste sites, training, and support for environmental cleanups around the region. It performs work that is essential to state environmental protection efforts at no charge, part of the federal government's mission to protect the public from environmental hazards.

Closing the Chelmsford lab will require the region's state governments to hire private labs to conduct sample analysis, a new cost.

Turnaround will generally take longer, hindering the region's environmental monitoring and emergency-response systems.

The plan to shutter the lab is part of a national push to close or consolidate EPA facilities. Under the plan, some work, including time-critical responses to crises, will shift to other labs in Rhode Island and New Jersey.

The central location of the Chelmsford lab, however, is critical in emergencies and helpful for normal operations such as training New England's state agencies in the latest field-monitoring techniques. Dissolving the lab will introduce delays and hardships to programs that protect the health and wellbeing of everyone in New England.

News of plans to close or consolidate EPA laboratories reached the nation as Hurricane Harvey flooded Houston. Extreme weather events can create environmental emergencies even as they disrupt state and local capacity to monitor and map the extent of problems.

Powerful storms and flooding are growing more frequent. In this environment, we call on Congress and EPA Administrator Scott Pruitt to maintain a robust system of analytical laboratories, in Chelmsford and elsewhere.

Sincerely,



Susan Sullivan

NEIWPC Executive Director



NEWIPCC EXECUTIVE DIRECTOR **Susan Sullivan** is one of three delegates from the **New England Water Environment Association (NEWEA)** to the House of Delegates of the international Water Environment Federation (WEF). She serves on that body's Membership, Nominating, and Steering committees. The other New England delegates are **Matthew Formica** of **AECOM** and **Frederick McNeill**, who is the chief engineer of Manchester, New Hampshire's Environmental Protection Division and a NEIWPCC Commissioner. **Howard Carter**, who directs the Water Resources Recovery Department for Saco, Maine, recently completed a one-year term as Speaker of WEF's House of Delegates.

NEIWPCC Commissioner **Janine Burke-Wells** started her term as president of NEWEA on January 24, the last day of the association's Annual Conference and Exhibit. Burke-Wells is the executive director of the Warwick, Rhode Island, Sewer Authority. Also during the NEWEA conference in Boston, NEIWPCC training coordinator **James LaLiberte** and **Paul Dombrowski**, a Woodard & Curran practice leader and NEIWPCC instructor, each received the Wastewater Trainer of the Year Award from the **Environmental Protection Agency's New England Region**. Dombrowski was also named a Federation Fellow by the **Water Environment Federation** last October.



NEIWPCC environmental analyst Eivy Monroy with the award-winning poster.

Meanwhile, NEIWPCC training coordinator **Donald Kennedy** received the NEWEA Collection Systems Committee's Golden Manhole Award. Also, NEWEA gave the **Town of Essex, Vermont**, its Energy Management Achievement Award; NEIWPCC Commissioner **Dennis Lutz** is that community's public works director.

In December, the U.S. Senate confirmed

David Ross to head the **EPA's Office of Water**.

"Status and Trends of Narragansett Bay and its Watershed: A Geographical Approach," a poster, won two honors at the November conference of the **Northeast Arc Users Group**. The poster was a collaboration among many, including **Eivy Monroy** and **Julia Twichell**, both of the **Narragansett Bay Estuary Program** and NEIWPCC. The other collaborators were **Anne Kuhn** of the EPA's **Atlantic Ecology Division**, **Mike Charpentier** of **CSRA**, **Juliet Swigor** of the **Massachusetts Department of Environmental Protection**, **Peter August** and **Jessica Cressman** of the **University of Rhode Island's Environmental Data Center**, and **Paul Jordan** of the **Rhode Island Department of Environmental Management**. The poster won both People's Choice and Best Overall.

Long Island Sound Study Science Coordinator and NEIWPCC staff member **James Ammerman** spoke during the October 20 Long Island Sound Conference. Ammerman talked about climate change, rising sea levels, the acidification of ocean waters, the impact of invasive species, and the loss of wetlands. The event, "Orchestrating Both Coasts for a Better Sound II," recalled efforts to clean up the sound over the past twenty years since the first conference brought officials from both sides of Long Island Sound together to address pollution caused by sewage spills and elevated nitrogen levels. Today, nitrogen levels are 58.5 percent less than in 1997.

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NEIWPCC Wastewater Training Coordinator James LaLiberte (center) accepts the EPA's 2017 Regional Wastewater Trainer of the Year Excellence Award during NEWEA's annual conference. He is flanked by EPA New England Regional Pretreatment Coordinator Jay Pimpare (left) and EPA Drinking Water Program Region Chief Mark Spinale (right).

Spotlight


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NEIWPCC Commissioners **Basil Seggos** and **Robert Klee** also spoke at the conference. Seggos, the commissioner of the **New York State Department of Environmental Conservation**, called Long Island Sound “our national park... our Yellowstone, our Yosemite.” Klee is commissioner of the **Connecticut Department of Energy and Environmental Protection**.

NEIWPCC is grateful to U.S. Senator **Jeanne Shaheen** (N.H.) for authoring legislation that establishes the first nationwide study of perfluoroalkyl substances in drinking water. This study will be conducted by the Department of Defense and follows decades of use of these synthetic chemicals by the Department in firefighting foams. These compounds are of mounting concern due to their persistence and potential to bioaccumulate. Shaheen persuaded the Senate to include the study in the National Defense Authorization Act. President **Trump** signed the Act into law on December 12.

On October 12, more than 5,500 students in New York, from New York City to Troy, participated in **A Day in the Life of the Hudson River and Estuary**. The event, held annually since 2003, involves students collecting data from 100 locations along the river. Helping to make this event a success were NEIWPCC staff members from both the **Hudson River Estuary Program** and the **Hudson River National Estuarine Research Reserve** (HRNERR): **Kacie Giuliano, Michele Golden, Rebecca Houser, Sarah Mount, Susan Pepe, and Maude Salinger**.

During the celebration of HRNERR’s thirty-fifth anniversary on October 3, NEIWPCC environmental analyst and research assistant **Christopher Mitchell** received a certificate of acknowledgment from the **National Oceanic and Atmospheric Administration** in recognition of his work to bring online the Turkey Point Tide Station. The monitoring station improves NOAA’s National Water Level Observation Network and addresses a key observational gap on the Hudson River. Turkey Point was established by HRNERR and the **New York State Department of Environmental Conservation**, with support from NOAA.

On November 15, Mitchell received a Technical Service Award from the **National Estuarine Research Reserve System** (NERRS). HRNERR Manager **Betsy Blair** received a NERRS Award for Outstanding Contributions at the same event. 

Commission Changes

NEIWPCC WELCOMES TWO NEW COMMISSIONERS. **Travis Noyes** and **Jana Ferguson** have both recently joined NEIWPCC’s governing board. Noyes, of Maine, is the executive vice president and Engineering Division director at CES Inc. He has more than two decades of experience in civil engineering relating to site development and infrastructure design and analysis.

Ferguson is the director of the Bureau of Environmental Health at the Massachusetts Department of Public Health. She has also served as deputy director and as the chief of regional environmental health operations.

NEIWPCC wishes to thank outgoing Commissioners **Jane Sexton** of Maine and **Michael Celona** of the Massachusetts Department of Public Health. Both had served on the Commission since 2013.

In September, NEIWPCC’s governing Commission elected new officers for one-year terms. **Douglas Fine**, who had been serving as vice chair, is NEIWPCC’s new chair; he is the assistant commissioner of water resources at the Massachusetts Department of Environmental Protection. The new vice chair is **Mark Klotz**, the director of the New York State Department of Environmental Conservation’s Division of Water. **Richard Kotelly** was reelected treasurer.

NEIWPCC’s previous chair, **Mick Kuhns**, remains an active member of the Commission. He is the director of the Bureau of Water Quality at the Maine Department of Environmental Protection.



Clockwise from top left: Douglas Fine, Mark Klotz, Travis Noyes, and Jana Ferguson.



29th Annual Nonpoint Source Pollution Conference

Glens Falls, New York • April 25–26, 2018

The Meaning of 'Waters'

A Divided Supreme Court Creates a Legal Thicket

BY ADAM AUSTER

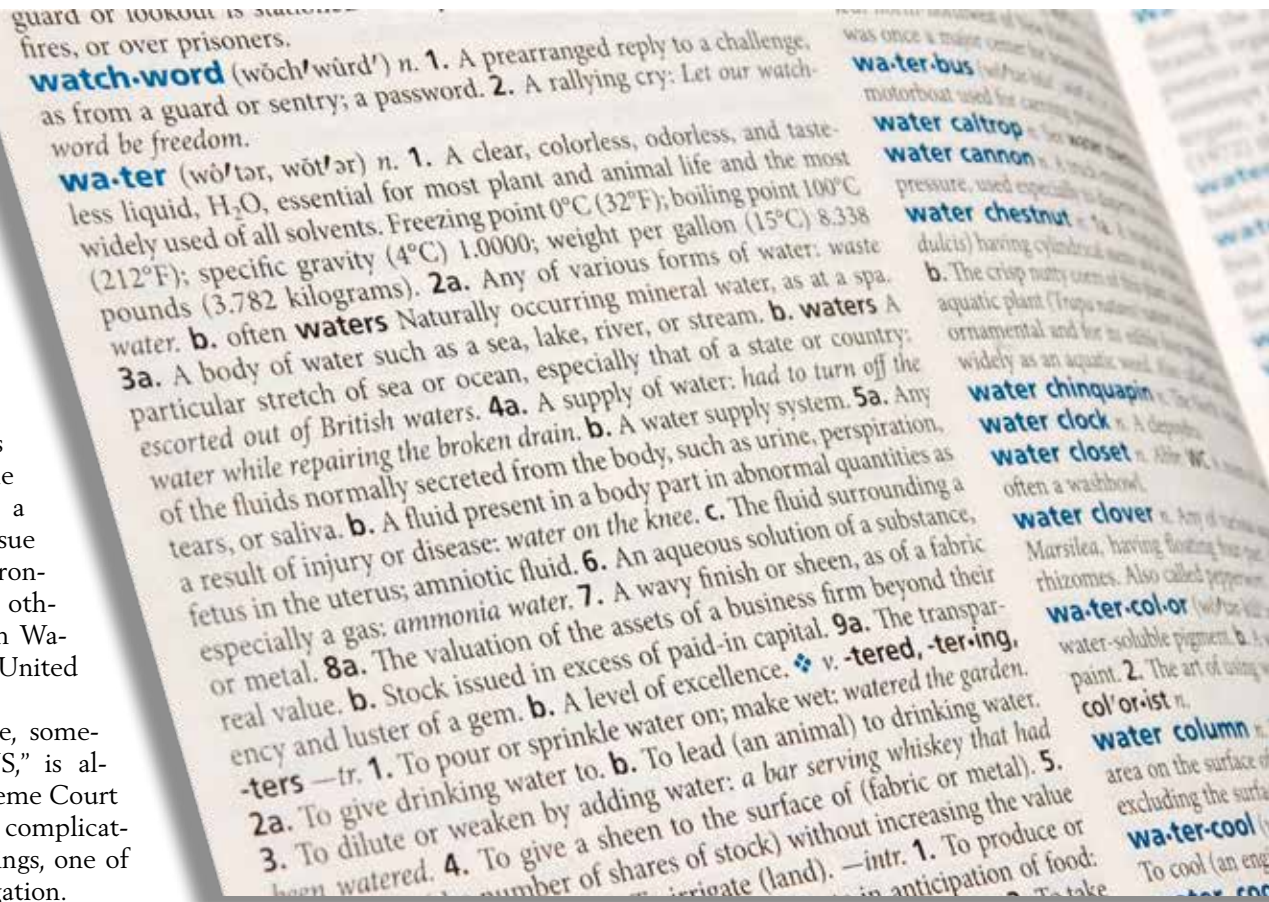
DOES FEDERAL law have jurisdiction over seasonal water bodies and wetlands that are not always contiguous with open water?

As a matter of science, such places are important parts of the natural systems that the U.S. Clean Water Act was established to protect. As a matter of policy, however, the Act's mandate is clouded by a thicket of legal questions. At issue is the authority of the U.S. Environmental Protection Agency and others to regulate what the Clean Water Act calls the "waters of the United States."

The meaning of that phrase, sometimes abbreviated as "WOTUS," is already the subject of three Supreme Court decisions. The issue is further complicated by a flurry of EPA rulemakings, one of which is also the subject of litigation.

On behalf of its seven member states, NEIWPC has weighed in with comments to the EPA arguing against the narrowest interpretation of "waters." That legal construction would exclude from federal regulation seasonal streams and wetlands that are not directly contiguous with a jurisdictional water.

In a second comment, the Commission expressed concern about a proposal to repeal outright the federal Clean Water Rule, which the EPA adopted in 2015 to provide clarity and guidance in light of federal court decisions limiting the scope of the Clean Water Act. The EPA and U.S. Army



Corps of Engineers proposed repealing the rule last summer in response to a presidential executive order.

The Commission was also critical of the apparent influence of an economic analysis in the agencies' deliberations on this question.

A Legal Labyrinth

The phrase "waters of the United States" in the Clean Water Act (33 U.S. Code § 1362 (7)) has neither scientific nor settled legal meaning. In 2001, the Supreme Court rebuked an attempt by the U.S. Army Corps of Engineers to extend jurisdiction based on the significance of waters, including wetlands, to migratory waterfowl. The standard then used by the Corps would

have protected nearly every wetland in the country.

In 2006, the Court veered into uncertainty with a split decision in a case involving a developer who had filled in some wetlands on his property. The wetlands were not contiguous with "navigable waters." A non-majority decision in that case authored by Justice Antonin Scalia articulated a new standard that would restrict the applicability of the Clean Water Act compared to that in the 2001 decision.

To cloud these waters further, Justice Anthony Kennedy's opinion in the case was itself split. Kennedy concurred with Scalia's judgment to remand the case back

Adam Auster is NEIWPC's Communications Director.

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The Promise and Pitfalls of Citizen Science

VOLUNTEER CITIZEN SCIENTISTS are monitoring water bodies and wetlands across the region, collecting a significant body of data. But are the data good enough to use?

That was the question that gave rise to NEIWPCCC's new **Monitoring Workgroup**, which held its organizational first meeting on October 18 by conference call.

The eagerness of volunteers for their efforts to be useful is matched by the desire of state agencies and others to use the data collected. At a time when state budgets are stretched thin, states lack the resources to track the health of every water body.

To be useful and credible for such purposes as tracking long term trends and assessing impairment, data must be collected in ways that are scientific, consistent, and well documented.

For example, to prevent chemical and biological processes from altering the constituents of water samples before analysis, samples must be kept cold. A combination of techniques and supplies prevent contamination. For data to be used in long-term monitoring, samples must also be collected at a consistent location and time of day. All of these variables affect the resulting data's quality, that is, its trait of being credible and defensible.

For many state agencies, finding resources to communicate quality assurance protocols to volunteer groups and provide necessary training is challenging.

The goal of NEIWPCCC's new Monitoring Workgroup is to improve the ability of states to accept and work with monitoring data collected by volunteers.

The workgroup comprises personnel from the environmental agencies of all seven of NEIWPCCC's member states. They have responsibilities such as providing technical support to volunteer groups or reviewing submitted data.

The workgroup's first project is to compile links to existing online resources for volunteers and other interested parties to learn about the kinds of data each state accepts for various purposes.

For a more-detailed account of some citizen-science projects in the region, and a look at the challenge of data quality, see "Growing a Web of Citizen Science" in the September, 2016, issue of the *Interstate Water Report*, the predecessor to *Interstate Waters*.

One of NEIWPCCC's roles in the Monitoring Workgroup, as in all of its workgroups, is to bring together counterparts from around the region. Since the last issue of *Interstate Waters* went to press last summer, members of NEIWPCCC's other workgroups have been soaking up one another's words of experience and hearing presentations on regionally relevant topics. All of the meetings described below took place at NEIWPCCC's headquarters in Lowell, Massachusetts, or by conference call.

Stormwater and Permits

A new online tool for managing nonpoint source pollution is also applicable to stormwater-pollution plans. Meanwhile, each state has its own path to meeting the stormwater-pollution requirements of the Clean Water Act.

Polluted stormwater, discharged into water bodies, is subject to regulation by the states and the EPA. Many municipal separate storm sewer systems (MS4s) must satisfy permits that require stormwater-management programs and practices to reduce the pollutants discharged.

Most systems meet this requirement through a single general MS4 permit for each state. States and municipalities rely on the latest technology and techniques to manage stormwater in the most cost-effective ways.

At the September 6 meeting of NEIWPCCC's **Nonpoint Source Workgroup**, Malcolm Harper of the Massachusetts Department of Environmental Protection described a web application for developing watershed-based plans for watersheds of any size, or for an area subject to an MS4 permit. The tool helps identify causes of nonpoint source pollution and prioritize implementation of best management practices.

The Bay State is promoting the tool as a way for watersheds to qualify for Section 319 funds for projects that implement nonpoint-source management programs. It was developed for the Massachusetts DEP by Geosyntec Consultants Inc. and launched last fall.

Members of NEIWPCCC's **Stormwater Workgroup** met on October 9 and discussed the status of MS4 permits in their states. Connecticut has a new general permit for MS4s, which went into effect in July. The Maine Department of Environmental Protection is working on a new version of its MS4 general permit.

Massachusetts and New Hampshire are the only states in the Northeast that do not write their own permits. Massachusetts is seeking, and New Hampshire is exploring, the delegation of permitting authority from the EPA, which has issued new MS4 permits for both effective on July 1. The EPA has delayed the MS4 general permit it wrote for Massachusetts in response to litigation by advocacy groups and some municipal governments. The permit for New Hampshire also faces litigation.

Mixing Zones and Variances

States seldom grant variances to water quality standards in the Northeast. Such variances, granted in coordination with the EPA, temporarily modify a receiving water's standard for a single contaminant. Permits here, however, often define mixing zones where water quality may exceed otherwise-specified criteria.

State and federal officials met last fall to explore whether variances have a role as a tool for permit writers under the National Pollution Discharge Elimination System (NPDES). Separately, on September 6 and 7, many members of the **NPDES Workgroup** visited NEIWPCCC's Lowell office for a workshop on the science of dilution in mixing zones, and the associated permit requirements.

A mixing zone is a set area at a point of discharge where wastewater from a permitted facility mixes with the waters it

Workgroup Roundup



A volunteer with Clean Ocean Access measures water temperature in a stream in Newport, Rhode Island.

enters. A NPDES permit may allow deviations from water-quality criteria in a mixing zone. EPA staff members led the workshop.

NEIWPCC convened a meeting on water-quality-standard variances on October 3. These variances may be granted temporarily when circumstances prevent a permittee from immediately meeting a permit limit. The workshop included presentations from EPA staff members and a roundtable discussion with state and federal officials.

Variances are uncommon in the Northeast. Here, practice generally favors including a compliance schedule as part of the permit if needed to accommodate special circumstances. However, other parts of the country are using variances with increasing frequency. In the Northeast, a variance has been used in Boston Harbor.

The goal of the workshop was to familiarize participants with a potentially useful permitting tool. State-agency personnel from NEIWPCC's **Water Quality Standards** and **NPDES** workgroups attended, as well as staff members from EPA Regions 1 and 2.

Tanks, Vets, and More

NEIWPCC's **Residuals Workgroup** comprises state personnel involved with the regu-

lation of the solid byproducts of wastewater treatment. On August 24, workgroup members heard a presentation by the executive director of the North East Biosolids and Residuals Association on the potential presence of perfluorinated alkyl substances in wastewater-treatment residuals, and the challenges associated with mitigating these contaminants.

At their August 17 meeting, members of NEIWPCC's **Onsite Wastewater Workgroup** heard from George Heufelder, director of the Massachusetts Alternative Septic System Test Center. Heufelder described advances in septic system design for optimizing the removal of pathogens and nitrogen.

At the September 28 meeting of the Commission's **Underground Storage Tanks Workgroup**, Jim Fitting of Connecticut's Department of Energy and Environmental Protection demonstrated how a geographic information system (GIS) can assist with the prioritization of leaking-underground-storage-tank sites. DEEP used GIS to consider multiple factors about each site such as whether it is in an aquifer protection area, its proximity to drinking-water-supply wells, and the population at and around a site.

At the workgroup's December 8 meeting, personnel from Maine DEP described

outreach efforts that have driven high compliance with the state's warranty-based closure requirement.

A main topic at the August 24 meeting of the **Wastewater Certification Workgroup** was a movement to attract veterans of the U.S. Armed Forces to the drinking-water and wastewater fields. Dustin Price, a naval veteran who chairs the Veterans Workforce Development Committee of the New England Water Environment Association, told the group about ways that states can change their wastewater-certification processes to support the recruitment and retention of veterans. These changes include counting some kinds of military training and experience toward the education and work-experience requirements.

The September 8 meeting of the Commission's **Climate Change Workgroup** was an opportunity for state agency personnel to update one another on work in their states related to resiliency and climate change. Workgroup members from NOAA and EPA Region 1 described regional resiliency-related initiatives by their agencies. In general, the meeting was part of an ongoing effort to determine how NEIWPCC might supplement planning, outreach, and other work that is being done around the region. 💧



Watersheds and Buffers

Letting Nature Do the Work

BY PAUL STACEY

LANDSCAPE DISTURBANCE AND ASSOCIATED polluted runoff and habitat destruction present vexing environmental management and economic challenges to local communities. Our lifestyle places growing pressures on watersheds as forests and wetlands are replaced with houses, businesses, and roads. These threats are diffuse and pervasive throughout the landscape, testing our ability to balance social, economic, and environmental burdens in ways that sustain the well-being of both ecosystems and humans.

Lands that once provided habitat and controlled pollution now contaminate runoff and groundwater with fertilizers, pesticides, sediments, and toxic chemicals that impair the health of aquatic and terrestrial ecosystems. Consequently, much of our attention is directed at managing damaged ecosystem functions, a very difficult and costly proposition.

As an environmental scientist and manager, my goal is to facilitate and guide management of natural assets. Preserving and

Paul Stacey, the owner of Footprints In The Water LLC, is the former research coordinator for the Great Bay National Estuarine Research Reserve. Copyright © 2018 Paul E. Stacey, Footprints In The Water LLC.

guiding recovery of natural ecosystem functions is the most important and effective action we can take to protect and improve ecosystem integrity. Though highly relevant, the science we provide is not always accessible or comprehensible to local decision makers and the public, and action may be forestalled. To bridge this gap, I constructed an empirically based, user-friendly, watershed and buffer decision-support framework to assess watershed and buffer ecosystem health, and guide management. The framework uses basic land cover data.

Nature Answers

Nature may provide the best answer. Forest ecosystems offer a natural solution that is the epitome of functionality and is perfectly designed and adaptable to change. As forest ecosystems are increasingly supplanted by other uses, however, nature's ability to mitigate growing threats from over-use of the land declines. Pressures from climate change, development, and other drivers of change compound this challenge. Fortunately, we can manage these ecosystems almost passively through conservation, natural rejuvenation, and guided recovery.

Forests are natural assets that provide a measure of ecosystem wealth that is easily quantified, much as dollars represent economic wealth. They are the self-sustaining foundation of ecosystem health and resili-

ence and adapt to changing conditions.

While the pre-Colonial Northeast likely came close to full forestation, by the Civil War forest cover reached its nadir, possibly as low as 25% in Connecticut when agriculture flourished and industry began to grow. By the 1950s, forest cover had rebounded to about 60% of the state's land cover, primarily from natural processes of recovery and rejuvenation in former farmlands. Today, forest cover can range from none to 100% in a given locale. This provides an ideal metric of ecosystem assets that can be easily translated into a condition index that ranges from 0 (unhealthy, i.e., forest asset exhaustion) to 1.0 (healthy, i.e., forest asset abundance).

The beneficial functions and value of forested lands go well beyond the usual water-quality-protection and pollution-control attributes. Forests provide habitat and migratory corridors for fish and wildlife. They control erosion and protect upland property by dissipating energy from floods and storm surge. There are also cultural and economic benefits including fishing, hunting, hiking, and related activities that provide us with a sense of place. Environmental scientists and managers champion the concept of ecosystem services as a way to put the myriad natural asset benefits into context with economic gains, and to identify unavoidable trade-offs.



Will Parson/Chesapeake Bay Program

Riparian Buffers

Riparian buffers are defined in many ways depending on application and legal underpinning. For the purposes of my analysis, they can be simply defined as management areas that line streams. Ideally, they are protected areas that are naturally and fully forested to afford the highest level of functionality and protection for aquatic ecosystems. In addition to recognized ecosystem benefits, setback zones may also reduce vulnerability from extreme weather events. This is both an economic benefit and a way to reduce the risk of injury or death.

In Connecticut, land use decisions, including establishing riparian buffers, are made almost exclusively at the local level. Each of the state's 169 municipalities injects its own flavor into land-management practices and regulation, in accordance with local character, goals, and rules for protecting the environment in the context of human health and welfare.

Traditionally, riparian buffers have been adopted in fixed widths, often 100, 200, or 300 feet or wider, depending on the interplay of environmental, social, and economic conditions and objectives. Science generally supports environmental benefits from this tiered application. 100 feet in a buffer generally provide such physical benefits as trapping pollutants, shad-

ing, and erosion control. 200 feet improve runoff volume control and habitat benefits and enhance biological and/or microbial mediation of pollutants. 300 feet support additional natural runoff-absorption and groundwater-transport capacities, floodplain function, and increased pollutant-removal benefits. 300 feet also support habitat and migratory corridors for wildlife and connectivity to upland and upstream areas, wetlands, and aquatic habitats.

I think of these as low, medium, and high levels of protection, with correlative increases in ecosystem functionality and benefits associated with greater widths.

Beyond Three Tiers

However, I question whether any fixed-width buffer would consistently deliver the expected habitat and water-quality protection benefits for the waters they are intended to shield. Buffers cannot be managed in isolation from conditions in the contributing watershed. Here's why.

First, watersheds come in various sizes and stream-network densities. Hence, buffer widths should be sized according to those characteristics, which the fixed-width approach does not consider. Using just two measurements—stream miles and watershed area—buffer widths can be easily scaled to stream density, which is the total miles of stream in the watershed divided by the watershed area.

Second, buffer design should accommodate the actual runoff and groundwater pollution loads from contributing watersheds. More-developed watersheds, for example, contribute a higher pollutant load and, thus, require the higher treatment capacity afforded by greater buffer widths. Conversely, buffer widths could be reduced in more natural, heavily forested watersheds.

To meet this analytical need, I devised a Watershed Condition Index (WCI) based on the forest condition index, as introduced above, that ranges from 0 (minimal forest cover) to 1.0 (maximum forest cover).

The analysis and management values were strengthened by using fragmented and core forest sub-categories for forest cover in the WCI calculus, representing two levels of ecosystem functionality. Core forests afford higher ecosystem functionality, while fragmented forests are less structurally diverse and dense and cannot provide the same level of ecosystem benefits.

Finally, I considered a third attribute in my analysis: buffer integrity, quantified in a Buffer Condition Index (BCI) that parallels the WCI, but is applied only in the riparian buffer area. A buffer is a protected

area that should be fully forested, i.e., the BCI should approach 1.0. However, that is not always the case because of legacy land-use patterns and historical development, often water dependent, that have replaced natural forest assets. Those lost assets reduce a buffer's ability to treat or mitigate upland impacts as effectively as a fully forested buffer.

If natural recovery or rejuvenation is not an option, buffers with lower BCIs must be proportionally widened to compensate for lost treatment capacity.

The decision-support framework comprises user-friendly calculators that adjust buffer-width recommendations based on the three determining factors: stream density, watershed condition, and buffer condition.

Only a small suite of land-cover metrics are necessary to guide and test management scenarios and design buffers that meet user-defined targets. The calculators are also scalable to any size watershed, jurisdiction, or sub-unit for which the basic input data are available.

The framework also incorporates a nitrogen-load calculator that estimates nitrogen export. That assessment is based on an estimate of attenuation in buffers and is expressed both as a mass load (ton/yr.) and loading rate (lb./acre-yr.) for any scenario being tested. The only additional input data required for the nitrogen load calculations are acres of urban and agricultural (including grass cover) land areas.

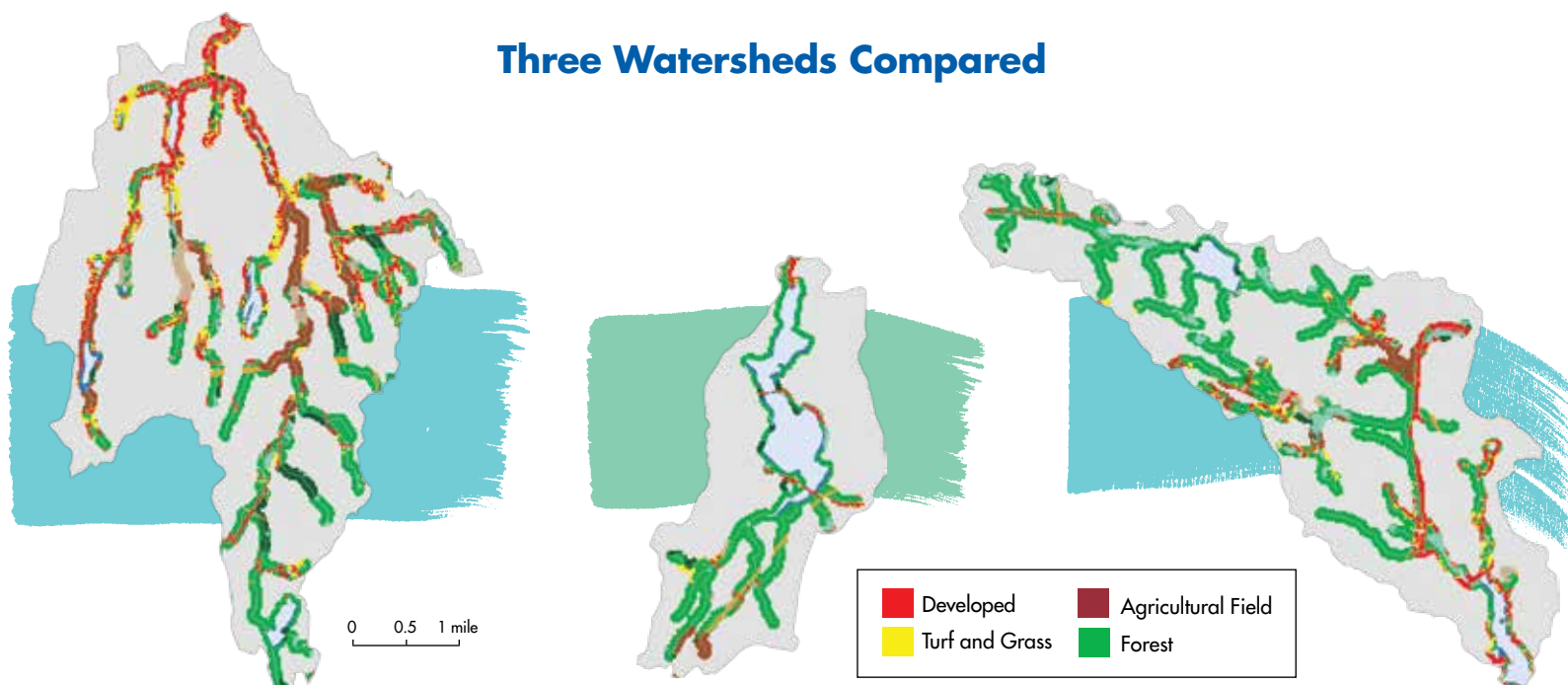
Management of nutrients, especially nitrogen, is of paramount concern in many if not all coastal areas because of human-driven estuarine eutrophication and consequent hypoxia and loss of submerged aquatic vegetation.

Assessing Connecticut Watersheds

The University of Connecticut's Center for Land Use Education and Research (CLEAR), on its forest-fragmentation and riparian-buffer web pages, provided all the data necessary for my analysis. I simply downloaded data for 160 sub-watersheds in thirty-five Connecticut towns and cities, and went to work. The watersheds range from 1,400 to 46,500 acres, with a median size of 7,000 acres. They afford a wide range of sizes and conditions to calibrate and test the framework.

The framework translates these data to produce watershed and buffer condition indexes (i.e., WCIs and BCIs). The indexes in turn are used to design and tailor buffer widths in three protection categories (low, medium, and high) to watershed condition

Three Watersheds Compared



Sumner Brook

- Largest watershed area
- Largest percentage of buffer area as non-forest cover

Broad Brook

- Smallest watershed area
- Lowest stream density
- Smallest percentage of buffer area as non-forest cover

Horton Cove Brook

- Highest stream density
- Mix of forest and non-forest cover

2010 land cover within 300 feet of streams, rivers, and water bodies.

Maps: UConn CLEAR

and management needs consistent with local targets. Users can test and set management targets relevant to desired levels of protection. Although not used in my analysis, the CLEAR site also provides downloadable maps helpful to local decision makers and the public in their assessment, planning, and communication processes.

The framework recommends buffer widths scaled to three protection levels (low, medium, and high) based on the following inputs:

- geographic (e.g., watershed, jurisdictional) areas (acres)
- stream length (miles)
- core forest area (acres)
- fragmented forest area (acres)
- developed area (acres)
- agricultural area (acres)
- 100-, 200- and 300-foot buffer areas (acres)
- 100-, 200- and 300-foot buffer as forest or wetlands area (acres)

Watershed-Specific Buffers

Let's take the framework for a test drive using three examples from the 160 watersheds in the CLEAR database. The watersheds have watershed condition indexes (WCIs) ranging from 0.04 to 0.89. Twenty-five percent of those watersheds have WCIs less than that of the Sumner Brook watershed (a WCI of 0.26), fifty percent have WCIs less than that of the Broad Brook watershed (0.45), and seventy-five percent have WCIs less than that of Horton Cove Brook watershed (0.57).

Although the framework calculates low-, medium-, and high-protection-level buffer widths concurrently, only the high-protection-level outputs are presented here and in the table opposite, under "Results" and "Buffers Adjusted for Target Conditions."

First, the framework adjusts the standard 300-foot buffer for the first factor, stream density. These factors increase buffers in the Sumner Brook watershed only slightly, from the 300-foot fixed width to 307 feet. By contrast, buffers in the Broad Brook watershed increase significantly to

370 feet although the watershed area is smaller. That reflects stream density lower than that in the Sumner Brook watershed, which means the buffer areas are consequently distributed over a smaller network. The greater stream density of Horton Cove Brook, on the other hand, reduces the recommended buffer width to 269 feet.

The next step generates buffer widths considering the second factor, current watershed condition. This step requires the framework's user, such as a municipal planner, to choose a local benchmark between 0 and 1 against which to compare the watershed condition index (WCI). A benchmark of 0.5, the default value for the framework, means that the buffer widths generated by this step in the framework would adequately treat pollutants and stormwater from a watershed that is at least 50% forested.

If the default benchmark of 0.5 is inappropriate to local conditions or management goals, users may select a higher benchmark to afford a higher level of buffer protection. Similarly, framework users in cities with minimal forestation may

choose to set the benchmark to a lower level such as 0.2. At that setting, the suggested buffer widths would correspond to a pollutant load from watersheds that are no more than 20% forested. Alternatively, the benchmark may be set to the current WCI to calculate buffer widths that would protect the watershed from degradation.

The Sumner Brook and Broad Brook watersheds have WCIs (0.26 and 0.45, respectively) that are lower than the default benchmark of 0.5. There, buffers increase to accommodate the higher stress level expected in the poorer-condition watersheds. Conversely, Horton Cove Brook's relatively healthy WCI of 0.57, which exceeds the 0.5 benchmark, leads to a reduction in suggested buffer width from 269 to 251.

The third factor, the buffer condition index (BCI), complements the WCI to adjust buffer widths based on the buffer's condition. A BCI of 1.0 would represent a perfectly functional, densely forested buffer. Because all three example watersheds have BCIs less than 1.0, the framework suggests wider buffers are needed in all three watersheds to compensate. The framework therefore adjusts the buffers in Sumner Brook watershed the most, from 382 to 582 feet, because of that watershed's low BCI of 0.48 relative to a 1.0 yardstick.

Looking Ahead

Watershed and buffer conditions may change over time with new development, ecosystem recovery, or management actions. The support framework accommodates user-defined target WCIs and BCIs and predicts buffer widths based on those future conditions, both positive and negative.

To see how those changes in condition affect buffer widths, consider hypothetical management scenarios for the three demonstration watersheds. The outputs are shown in the bottom two lines of the table. For the Sumner Brook watershed, the WCI is expected to improve from the current 0.26 to a predicted target of 0.35 over time. Under that scenario, the recommended buffer width (already adjusted for stream density) would narrow from the current 382 feet to 353 feet.

Management plans might also identify good recovery potential and restoration opportunities in the buffer, yielding a BCI improvement from today's 0.48 to 0.75. That would allow a substantial reduction in buffer width from 582 feet (WCI and BCI adjusted) to 442 feet with no loss of mitigative performance.

Although Broad Brook has a relatively low current WCI of 0.45, in a hypothetical scenario, existing zoning and projected

Buffer Calculations for Three Connecticut Watersheds

Major Basin	Sumner Brook Connecticut River	Broad Brook Quinnipiac River	Horton Cove Brook Thames River
Inputs			
Watershed Size (acres)	8217	3080	6362
Stream Length (miles)	33.1	10.3	29.3
Stream Density (ft/acre)	21.3	17.7	24.3
Forest Cover (acres)	3567	1836	4501
Core	1380	880	2454
Fragmented	2187	956	2047
Non-Forest Cover (acres)	4457	873	1611
Water and Wetlands (acres)	193	371	250
300-Foot Buffer Area (acres)	2374	728	2076
Forest Cover	1136	616	1596
Non-forest Cover	1238	112	479
Results			
Watershed Condition Index (WCI)	0.26	0.45	0.57
Buffer Condition Index (BCI)	0.48	0.85	0.77
<i>Buffer Width (feet)</i>			
Fixed Width	300	300	300
Stream Density Adjusted	307	370	269
Size + WCI Adjusted	382	389	251
Size + WCI + BCI Adjusted	582	449	309
Buffers Adjusted for Target Conditions			
Target WCI	0.35	0.40	0.70
Target BCI	0.75	0.85	0.95
<i>Buffer Width (feet)</i>			
Density + Target WCI Adjusted	353	407	215
Density + Target WCI + Target BCI Adjusted	442	470	226

population growth is expected to reduce the WCI to 0.40, even with careful attention to recovery and restoration opportunities. This change would increase the recommended buffer width from the current 389 feet to 407 feet.

If the BCI merely held steady over time at 0.85, rather than attaining a target approaching 1.0, the buffer width would need to further increase to 470 feet. This is wider than the current condition of 449 feet because of the lower WCI target (0.40) in this scenario, demonstrating the interactive effect of both indexes.

Finally, for the relatively healthy Horton Cove Brook watershed, hypothetical improvements from recovery of fallow agricultural fields might justify a predicted WCI goal of 0.70. This improvement would reduce the buffer width requirement substantially to 215 feet without compromising performance. In the highly functional buffer zone of Horton Cove

Brook, a projected BCI of 0.95 is an improvement over the current 0.77. Nonetheless, any BCI that falls short of 1.0 increases recommended buffer width. In this case, the increase is only from 215 to 226 feet, but still well below the current condition width of 309 feet.

Nitrogen

How does a buffer's capacity to remove excess nitrogen respond to changes in watershed condition index, buffer condition index, and levels of protection (low, medium, and high)? The additional metrics needed to calculate nitrogen export, in pounds per acre per year, are watershed acres in development, in agriculture, and in forest and wetland.

Using the Sumner Brook watershed as an example, the buffer widths that have been adjusted for stream density are independently tested for nitrogen loads for the

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to lower courts, but disputed Scalia on many of the points related to jurisdiction. In particular, Kennedy suggested that the Clean Water Act applied to all waterbodies and wetlands with a “significant nexus” to navigable waters. This standard had been applied by the district court. Scalia, meanwhile, disputed the “significant nexus” standard at length.

Kennedy’s concurrence to remand gave Scalia’s judgment the status of a ruling of the full court. However, as a non-majority decision, the rest of Scalia’s opinion is not binding on lower courts, since a majority of the Court did not agree with Scalia’s more-limiting standard. Subsequent lower-court decisions generally followed Kennedy’s significant-nexus standard, and the EPA and Corps have been applying that rule on a case-by-case basis.

The case-by-case approach has been resource intensive for the agencies and has led to uncertainty for those regulated. Meanwhile, the developer and the U.S. Department of Justice settled out of court in 2008, leaving the split decision as a legacy.

The potential implications for watersheds and estuaries in some other parts of the country are serious. Furthermore, a national “race to the bottom” on state watershed rules could create economic pressure on states in the Northeast to relax their standards.

The Clean Water Rule

The 2015 Clean Water Rule was an effort by the EPA and Corps of Engineers to cut through this fog of legal ambiguity and produce a standard that would be clearer and easier to apply. The rule relied generally on Kennedy’s “significant nexus.” It was supported by a survey of more than 1,200 articles in peer-reviewed scientific publications about the ways that streams and wetlands affect downstream waters.

However, eighteen states immediately sued to block the rule. The Sixth Circuit

Court of Appeals stayed the rule before it took effect, pending resolution of the court challenge.

In the summer of 2017, the Trump Administration started the process of repealing the rule and gave notice of its intent to write a new one based on the Scalia standard. Also, an organizer of the eighteen-state lawsuit, then Oklahoma’s attorney general, is now the administrator of the EPA.

At the end of November, the EPA and Corps initiated another rulemaking that would delay the effectiveness of the Clean Water Rule, still stayed by the appeals court, by an additional two years. This delay was formally adopted on January 31. By February 1, the New York Attorney General had already announced his intention to sue to block the delay.

Several other court decisions have further clouded the future of the “significant nexus” standard, the Clean Water Rule, and attempts to recast the rule according to the Scalia opinion. There was even a dispute over which courts should hear the clean-water-rule lawsuit, resolved by the U.S. Supreme Court in January of 2018.

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Waters of the United States: A History

1972—Congress adopts the Clean Water Act, which includes the phrase “waters of the United States.”

1985—In *U.S. v. Riverside*, the U.S. Supreme Court upholds broad authority to regulate wetlands under the Act.

2001—The Court, in *SWANCC v. U.S. Army Corps*, bars the U.S. Army Corps of Engineers from applying the “waterfowl standard” (based on impacts to migratory waterfowl) to determine what are “waters of the United States.”

2006—The Court, in *Rapanos v. U.S.*, is split over Justice Kennedy’s “significant nexus” standard versus Justice Scalia’s more restrictive rule.

2007—Subsequent lower-court decisions often rely on the significant-nexus standard. The EPA and U.S. Army Corps of Engineers begin applying this standard on a case-by-case basis.

2015—The EPA and Corps issue the Clean Water Rule. A federal court stays the rule before it can take effect, pending the outcome of a lawsuit brought by eighteen states.

2017 (February)—President Trump issues Executive Order 13778 requiring agencies to consider revising the Clean Water Rule to be consistent with the Scalia rule.

2017 (June)—The EPA and Corps propose “recodifying” existing WOTUS rules, and invite comments about what the process should be for this revision.

NEIWPCC’s comments focus on the need to consult states, the ambiguities of the Scalia decision, and the importance of basing rules on the best available science.

2017 (July)—The EPA and Corps, in Docket No. EPA-HQ-OW-2017-0203, propose to repeal the Clean Water Rule, and give notice of intent to “conduct a substantive re-evaluation of the definition of ‘waters of the United States.’”

2017 (September)—NEIWPCC comments in EPA-HQ-OW-2017-0203 express regret at the proposal to rescind the Clean Water Rule and recommend the EPA’s Science Advisory Board’s 2014 literature review on hydraulic connectivity as a sound basis for determining WOTUS applicability. The comments criticize the apparent influence on decision making of an economic analysis cited by the agencies. NEIWPCC also request that the agencies engage with the states throughout the rulemaking process.

2017 (November)—The EPA and Corps propose postponing the effectiveness of the Clean Water Rule by two years. This amendment to the rule would block the rule’s other provisions if the 2015 stay is lifted before the rule is rescinded.

2018 (January and February)—The EPA amends the rule to postpone its effectiveness until 2020. Eleven states file suit seeking to invalidate the postponement.

NEIWPCC Weighs In for States

THE COMMISSION RESPONDS TO regional and federal plans and proposals from the EPA and others that affect the states. From a proposed aluminum standard to a plan to close an EPA lab in Massachusetts, NEIWPCC made the following formal comments in 2017.

Assessment Measures

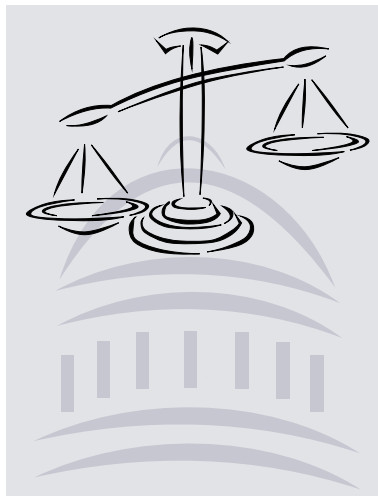
In April, NEIWPCC was generally supportive of a draft of field-based methods for developing aquatic-life criteria for specific conductivity, a measure of salinity. The draft, which would impose no binding requirements on any state, was proposed in EPA-HQ-OW-2016-0353.

NEIWPCC requested assurances that the method would be optional for states and tribes to use at their discretion. Comments also conveyed particular concerns of Massachusetts and of Rhode Island about the proposed methods.

Waters of the U.S.

In June, NEIWPCC expressed concerns about a proposal to recodify the U.S. Clean Water Rule, and made suggestions about the best ways to proceed.

In September, NEIWPCC was critical of a proposal to rescind the rule. In comments to the docket, EPA-HQ-OW-2017-0203, NEIWPCC praised the use of science to inform policy decisions, and urged the EPA and others to heed the comments of the states. (See the related story in this issue for more information.)



Chelmsford Lab

The Commission has been outspoken in its opposition to the EPA's plan to close its regional laboratory in Chelmsford, Massachusetts. Closing the lab would shift work to expensive private contractors and to EPA facilities in Rhode Island and New Jersey.

The current location allows for a rapid response to floods or fires or algal blooms. The lab's mobile facilities can reach anywhere in New England in five hours. The lab is also a regional training facility that is centrally located. Shifting training to more-remote locations would compromise the success of these programs.

NEIWPCC Executive Director Susan Sullivan made these and other points in an August 15 letter to EPA Administrator Scott Pruitt.


Aluminum

In October, in comments in EPA-HQ-OW-2017-0260, NEIWPCC was generally supportive of proposed draft criteria for freshwater aluminum. The Commission staff provided several pages of technical criticism, including information about the range of aluminum concentrations found in water bodies in the region. Comments also noted an apparent contradiction in the way different parts of the draft appraise the potential bioavailability of aluminum.

Invasives

In December NEIWPCC weighed in on legislation that would strip states of their ability to regulate the discharge of ballast water. Such water may be contaminated with invasive species. NEIWPCC wrote to Senator Dan Sullivan, (R-AK), who chairs the Senate Subcommittee on Oceans, Atmosphere, Fisheries, and Coast Guard, about those provisions of the proposed Coast Guard Authorization Act of 2017, Senate Bill 1129.

While generally supportive of the bill as a whole, NEIWPCC expressed concern that as written the proposed law would "preclude the states from regulating this pollution source" and "leave state waters more susceptible to harmful aquatic invasive species."

These methods, rules, bills, and other matters were all still pending as this issue of *Interstate Waters* was going to press. 

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States Respond

Against this background, NEIWPCC has formally commented on the proposals to repeal the Clean Water Rule and on plans to write a new rule to take its place. These comments include substantive remarks about how scientific knowledge should inform any new rules. The Commission also urged the EPA and Corps to heed comments from individual states.

As this issue of *Interstate Waters* was going to press, the Clean Water Rule was still on the books but delayed from taking effect until 2020. The Trump Administra-


tion's proposal to rescind the rule could take effect as early as fall of 2018, though further delays are possible. The current standard at press time remains the case-by-case application of the significant-nexus standard.

Meanwhile, the EPA has removed its Clean Water Rule website, though the materials were still available on the EPA's internet-based archive in early 2018.

As a practical matter, a new rule that applies the Scalia standard exclusively would likely have little immediate effect on the regulation of wetlands and waterbodies in NEIWPCC states. The geology of the Northeast, coupled with the existence of additional state regulations here, would

minimize the impact of such a change.

Nonetheless, the potential implications for watersheds and estuaries in some other parts of the country are serious. Furthermore, a national "race to the bottom" on state watershed rules could create economic pressure on states in the Northeast to relax their standards.

Finally, it is in the interest of NEIWPCC states that the work and requirements of its federal partners be grounded in defensible science. As the Commission said in its June comments, "Ensuring that the resulting rule and definitions are regionally practical and justified by scientific study... is the difficult yet necessary task ahead of EPA." 

Buffers

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low, medium, and high protection-level scenarios (102, 205, and 307 feet, respectively). These scenario tests can guide users towards potential watershed and buffer management options that meet nitrogen control objectives. With the current WCI of 0.26 and BCIs of 0.53, 0.50, and 0.48 at the respective levels of protection, export of nitrogen would be 5.30, 4.79, and 4.44 lb./acre-yr., respectively. See “Nitrogen Export for Sumner Brook.”

Consider 3.0 lb./acre-yr. of nitrogen export to approximate a threshold for declining receiving water quality. In that case, a design buffer width approaching 1,200 feet would be required to reduce nitrogen loading below the threshold! This is well beyond the 582-foot, high-protection-level buffer width that accounts for current watershed and buffer integrity condition, and likely a political, if not physical, impracticality. However, with a modest improvement in WCI from 0.26 to 0.35, the hypothetical management example would yield nitrogen loading below 4 lb./acre-yr. at the 307-foot width. If the BCI could be improved to 0.75, the nitrogen loading prediction would fall to 2.84 lb./acre-yr.—a very good outcome.

As shown in the Sumner Brook scenarios, nitrogen loading can be reduced by increasing buffer widths, or improving WCI and BCI, with effects that are easily tested in the framework for any watershed or potential user-defined scenario. Furthermore, if specific changes in forest cover acreage are known from watershed conservation plans or build-out scenarios, those

Nitrogen Export for Sumner Brook, Range of Scenarios

Land cover (acres): Forest 3,621, Agriculture 1,393, Developed 3,064

WCI	BCI L/M/H	Nitrogen Export (lb./acre-yr.)			
		No Buffer 0 feet	Low Level 102 feet	Mid Level 205 feet	High Level 307 feet
0.26	.53/.50/.48	7.90	5.30	4.79	4.44
0.35	.53/.50/.48	6.93	4.65	4.20	3.90
0.35	.75/.75/.75	6.93	3.62	3.14	2.84

Nitrogen export varies by buffer width and by the conditions of the watershed and the buffer expressed as WCI and BCI. BCIs reflect low-, medium-, and high-protection cases.


data could be used to adjust the WCI up or down to provide an estimate of future nitrogen loading based on those changes. This helps demonstrate how complementary target setting between watersheds and buffers might yield a realistic and pragmatic solution that attains a difficult target.

Science for the People

Local policy-makers, land managers, planners, and the public must balance environmental, health, and welfare benefits. They face difficult land and buffer management decisions every day. The decision-support framework can inform the discussion. The current state, future conditions, and the potential for natural conservation and recovery in both watersheds and buffers must all be considered if sustainable levels of protection and conditions that meet local environmental and socioeconomic goals are to be achieved.

Letting nature do the work, through conservation, natural recovery, and trans-

formative rejuvenation, is the ideal adaptive management strategy. This approach offers a strategic management advantage over engineered best management practices by preserving what is already good and allowing nature to take the lead, again.

The author acknowledges with appreciation the valuable data from the excellent work of the Center for Land Use Education and Research at the University of Connecticut. He also thanks the Great Bay National Estuarine Research Reserve for its support, especially during the author's involvement with the National Estuarine Research Reserve System Science Collaborative Project "Exploring the Trends, the Science, and the Options of Buffer Management in the Great Bay Watershed," on which the decision-support framework is partially based. Please contact the author for more information about the decision-support framework: Footprints InTheWater@outlook.com. 



**National Tanks
Conference and
Exposition**
**Galt House Hotel
Louisville, Kentucky
September 11-13, 2018**



Parting Shot



ON JUNE 29, 2017, CONSULTING biologist Chris Graham conducts field survey monitoring in the Binnen Kill, a tributary of the Hudson River, and its tidal wetlands. In this picture, Graham is identifying plants that may be rare or invasive species.

All rare and invasive species observations made during the day's monitoring activities were photographed, catalogued, and recorded.

The data were then combined with other observations and mapped to illustrate the distribution of important natural communities throughout the site.

These data contributed to the final assessment, which will be used as a basis for developing a management consensus that reconciles existing natural functions, conservation priorities, and potential future management actions with the needs and rights of existing landowners.


Graham, of Hudsonia Ltd., was accompanied by NEIWPCC environmental analysts Daniel Miller and Kacie Giuliano, who work at the New York State Department of Environmental Conservation's Hudson River Estuary Program (HREP). Miller is the habitat restoration coordinator at HREP. Michael Jennings, a NEIWPCC senior program manager, was also present.

A total of three field monitoring surveys were completed to support the natural resource inventory and assessment of conservation priorities for the Binnen Kill and its tidal habitats. Each survey was scheduled to capture different parts of the growing season (spring, summer and late fall).

The June 29 visit found several variations of two endangered plant species. The team also found the following six invasive plants: mugwort, Canada thistle, yellow iris, purple loosestrife, prickly sedge, and reed canary grass.

The Binnen Kill is located on the Hudson River's western shore on the borders of Bethlehem and Selkirk, New York, near Albany. It is surrounded by a complex of tidal wetlands, upland forests, non-tidal swamps and wet meadows, and farmland.

Part of the site has been designated as a significant coastal fish and wildlife habitat by the New York State Department of Environmental Conservation (NYSDEC). It includes resident and migratory fish spawning and nursery habitat, and habitat for protected birds.

The report was produced by Louis Berger U.S. Inc. and Hudsonia Ltd. for NEIWPCC, NYSDEC, HREP, and the Hudson River National Estuarine Research Reserve. Miller and Giuliano provided project management and technical support, while Jennings gave quality-assurance-plan oversight. Jennings took the above photo as part of his quality-assurance assessment. 

Events

March 19–20, Washington, D.C.: Association of Clean Water Administrators *Mid-Year Meeting*. acwa-us.org/event/mid-year-meeting-2018.

March 20–22, St. Paul, Minn.: The Environmental Council of States Spring Meeting *Getting to Results*. ecos.org/event/2018-ecos-spring-meeting.

March 23, Plymouth, N.H.: The Center for the Environment at Plymouth State University's *New Hampshire Water and Watershed Conference*. campus.plymouth.edu/cfe/2018-nh-water-watershed-conference.

April 4–5, Worcester, Mass.: New England Water Works Association *Spring Conference and Exhibition*. newwa.org/Events/SpringConference.aspx.

April 15–21, Washington, D.C.: National Association of Clean Water Agencies *Water Week 2018*. tinyurl.com/na-cwa-ww2018.

April 25–26, Glens Falls, N.Y.: *29th Annual Nonpoint Source Conference*. Coordinated by NEIWPCC, the State of New York, and the EPA. This event is the premier regional forum on nonpoint source pollution. This year's theme is Innovation. Some sessions will address novel techniques for quantifying and communicating program successes while other sessions will describe pioneering technologies and methods for nutrient removal. neiwpcc.org/our-programs/nps/annual-nps-conference.

May 3–4, Woodstock, Vt.: Spring meeting of NEIWPCC's governing Commission.

June 3–6, Newport, R.I.: New England Water Environment Association *Spring Meeting*. springmeeting.newea.org.

June 18–21, Raleigh, N.C.: Water Environment Federation *Nutrient Removal and Recovery Conference* "Innovating, Optimizing, and Planning." wef.org/events/conferences/upcoming-conferences/nutrients.

Sept. 11–13, Louisville, Ky.: *National Tanks Conference*. Cosponsored by NEIWPCC and the EPA. The twenty-sixth annual conference brings together UST inspectors, LUST cleanup specialists, manufacturers, representatives from tribes and territories, and the state and federal regula-

tory community to discuss policy, equipment, emerging issues, and more. neiwpcc.org/our-programs/underground-storage-tanks/national-tanks-conference.

Nov. 5–8, Colorado Springs, Colo.: *National Nonpoint Source Training Workshop*. Co-sponsored by NEIWPCC and the EPA. neiwpcc.org/our-programs/nps/national-nps-training-workshops/.

Ongoing, Various Locations: Courses and workshops around the region for wastewater and drinking water professionals. For the full course catalog and online registration information visit tinyurl.com/neiwpcc-training.

