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NY's clean water advocate

HOW'S THE WATER? 2015

Fecal Contamination in the Hudson River and its Tributaries

Riverkeeper is a member-supported organization. Our mission is to protect the environmental, recreational and commercial integrity of the Hudson River and its tributaries, and to safeguard the drinking water of nine million New York City and Hudson Valley residents.

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ABOUT THIS REPORT

2014 Water Quality Program

John Lipscomb, Riverkeeper, *director*
Dan Shapley, Riverkeeper, *manager and author*
Jennifer Epstein, Riverkeeper, *associate*
Dr. Gregory O'Mullan, CUNY Queens College, *science advisor*
Dr. Andrew Juhl, Lamont-Doherty Earth Observatory of Columbia University, *science advisor*
Carol Knudson, Lamont-Doherty Earth Observatory of Columbia University, *research assistant*

Questions?
Contact Dan Shapley at dshapley@riverkeeper.org or 914-478-4501 x226

2015 Report
In addition to the Water Quality Program team, assistance in preparing this report came from Paul Gallay, Missy Falkenberg, Kara Matthews, Sean Dixon, Chloe Heintz, Tara D'Andrea, John Mickelson and Kaitlyn Shaw.

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Swimmers in the Hudson River at Croton Point, courtesy Toughman Triathlon.

Data Use Policy

These water quality data are made freely available to the public, and we encourage their wide use. However, if you use the data for research, policy, or educational purposes, we ask for notification. Data should not be posted on any website, but links can be made to riverkeeper.org. If the Riverkeeper data are used as background or ancillary information for any presentation, publication, website, or educational product, please cite its source. This report summarizes data gathered by different groups, and each set of data should be cited differently:

- Hudson River Estuary data:
  "Data collected by O'Mullan GD, Juhl AR, and Lipscomb J, available at www.riverkeeper.org."
- Tributary community science data:
  "Data collected by Riverkeeper in partnership with residents of the Hudson Valley, available at www.riverkeeper.org."
- New York City community science data:
  "Data collected by New York City Water Trail Association and The River Project, in partnership with more than 20 community boathouses, community groups, and waterfront parks."

Visit riverkeeper.org/water-quality for additional data, including from samples gathered in 2015.

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ACKNOWLEDGEMENTS

Over nearly 10 years, many people and organizations have contributed to the funding, study design, data collection, data analysis, data presentation, and advocacy related to Riverkeeper's Water Quality Program. These acknowledgements focus on those who contributed in 2014, but we wish to thank all who have assisted, including Tracy Brown, Director of Western Sound Programs for Save the Sound; Brian Brigham, research assistant at CUNY Queens College; and the data visualization team at NiJeL.

2014 Community Science Partners

Many groups and individuals have participated in the community science projects described in this report. While all individuals are not listed here, we thank them all. Listed here are groups that have collected and processed samples:

- Catskill Creek Watershed Awareness Project
- Gardiner Environmental Conservation Commission
- Montgomery Conservation Advisory Council
- New York City Water Trail Association and The River Project, which partner with more than 20 community boathouses, community groups, waterfront parks, and labs
- Quassaick Creek Watershed Alliance (data available at riverkeeper.org)
- Rochester Environmental Conservation Commission
- Rosendale Commission for Conservation of the Environment
- Sparkill Creek Watershed Alliance
- Wawarsing Environmental Conservation Commission

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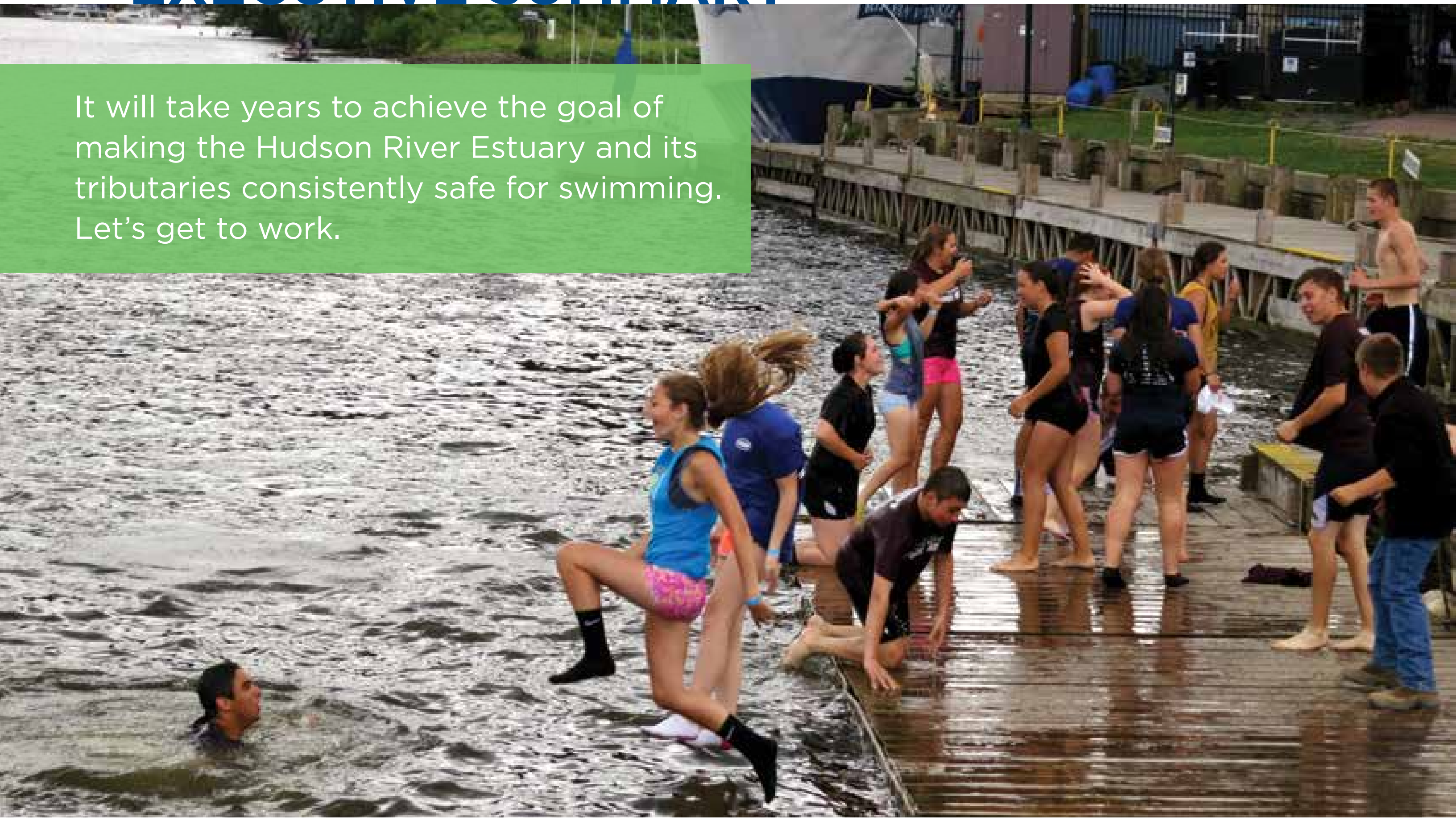
The contents of this report do not necessarily reflect the views and policies of NEIWPCC or any other funder, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

Riverkeeper's citizen sampling program is recognized by the Clinton Global Initiative as a Commitment to Action—a plan for addressing a significant global challenge.

EXECUTIVE SUMMARY

It will take years to achieve the goal of making the Hudson River Estuary and its tributaries consistently safe for swimming. Let's get to work.



Kids leap into the tidal Rondout Creek in Kingston. *Photo by John Lipscomb/Riverkeeper*

Investments in clean water infrastructure over decades have dramatically improved water quality On many days, in many places throughout the Hudson River Estuary, water quality is excellent for swimming.

In 2014, nearly 6,500 people swam in organized public swim events in the Hudson River Estuary and New York Harbor,[1] and thousands more swam at public beaches or other water access points.[2]

While the people of the Hudson Valley have made much progress toward achieving the Clean Water Act goal of making the watershed safe for swimming, we are failing to adequately protect these waters—the public's beach. There is a documented immediate need for more than 315 Hudson Valley and New York City wastewater projects, at a cost of $5.9 billion.[3]

This report demonstrates the cost of failing to make those investments, and of failing to adequately enforce the Clean Water Act, particularly in the tributaries of the Hudson. The information presented here is based on more than 6,000 water samples collected in the Hudson River estuary by Riverkeeper, CUNY Queens and Lamont-Doherty Earth Observatory; and in Hudson River tributaries and at New York City public water access points by dozens of community scientists. As measured against the Environmental Protection Agency's recommended Beach Action Value for safe swimming:

- **23% of Hudson River estuary samples fail.**
- **72% of Hudson River tributary samples fail.**
- **48% of New York City-area water access point samples fail.**

After periods of dry weather, the Hudson River Estuary is safe for swimming in many locations. But after rain, the water is more likely to be contaminated, especially in areas affected by combined sewer overflows and streetwater runoff. [4]

Rain also dramatically increases the degree of fecal contamination in the tributaries we have sampled with community science[5] partners. The sources of this contamination are likely complex, which points to the steep challenge of achieving improvements in water quality. Sources are known or suspected to include—each to an unknown degree—nearly 1,000 permitted wastewater discharge outfalls,[6] thousands of streetwater outfalls,[7] hundreds of thousands of septic systems, [8] thousands of farms[9] and countless wild animals.

The Hudson River Valley has been a laboratory for the environmental movement since its inception, and our ingenuity will be tested by this problem. The good news is that there are success stories for reducing contamination from complex sources such as these[10] —but success relies on the full implementation of the Clean Water Act. To make progress, we must:

1. **Improve monitoring, modeling and public notification**, both so the public is well informed about present risks associated with known contamination, and so water quality is properly assessed so investments can be prioritized.
2. **Invest in clean water**, including sewage infrastructure; watershed protection plan implementation; green infrastructure; and management of animal feeding operations, farms and septic systems.
3. **Enforce the Clean Water Act** by verifying impairments identified by citizen water sampling, tightening pollution discharge permit conditions and enforcing compliance, and prioritizing projects to reduce pollution.
4. **Develop new science-based tools** to better understand pollution sources, wastewater contaminants, and their impacts on human and environmental health.

Riverkeeper's work gathering and publicizing water quality data has led to enforcement against polluters, the passage of the Sewage Pollution Right to Know Law, and millions of dollars in infrastructure investments from New York City to the Capital District.

Riverkeeper's water quality program has also invigorated grassroots water-protection efforts. To be effective partners to these efforts, environmental and health departments need sufficient staffing, budget and leadership. And yet at the Department of Environmental Conservation, staffing is down 10% over the past decade, and budget is projected to decline 25% by 2020.[11]

It will take years to achieve the goal of making the Hudson River Estuary and its tributaries consistently safe for swimming. Let's get to work.

FINDINGS AT A GLANCE

CONTAMINATION VARIES
At Hudson River Estuary sites sampled, contamination varies from location to location, and over time at all locations. Sites vary in both frequency and degree of contamination. The degree of risk varies based on when and where one enters the water.

RAIN INCREASES CONTAMINATION
At Hudson River Estuary sites sampled, the failure rate against the Environmental Protection Agency (EPA)'s recommended Beach Action Value (BAV) is 12% after periods of dry weather, but 35% after rain. The increase in contamination is most pronounced near communities with combined sewers, in tidal tributaries and urban near-shore areas.

CONTAMINATION IS GREATER IN TRIBUTARIES
At Hudson River Estuary sites sampled, the failure rate against the EPA's recommended BAV is 18% in the mid-channel and near-shore areas tested by Riverkeeper, but twice that – 36% – in and at the mouths of tidal tributaries.

CONTAMINATION LEVELS DIFFER BY TRIBUTARY*
At non-tidal tributary sites sampled, the frequency and degree of contamination is greater than in the Hudson River estuary, including the tidal portions of its tributaries. But the frequency and degree of contamination vary among tributaries.

RAIN INCREASES CONTAMINATION IN TRIBUTARIES*
At non-tidal tributary sites sampled, the failure rate against the EPA's recommended BAV is 59% after periods of dry weather, but 85% after rain.

* Findings based on data gathered by community scientists.

To keep informed about these issues, please visit riverkeeper.org and sign up to receive updates by e-mail.

SOURCES OF FECAL CONTAMINATION IN OUR

A sewer failure in July 2013 led to the discharge of raw sewage into the Twaalsfkill, a tributary of the Rondout Creek.
Photo by Dan Shapley/Riverkeeper

Riverkeeper's water quality monitoring projects are limited primarily to bacterial indicators of sewage and other fecal contamination, not other types of pollution such as toxic chemicals.[12] Our projects are designed to identify trends in fecal contamination and to make broad assessments of water quality, not to define specific sources. A number of known and suspected sources of fecal contamination can be surmised from a review of land uses and scientifically verified sources of fecal contamination in the Hudson River Watershed and nationwide. Identifying the specific sources of contamination is critical to solving water quality problems.

Combined Sewer Overflows

Combined sewers carry both sewage and streetwater in the same pipes, and when rain or snowmelt overwhelms wastewater treatment plant or pipe capacity, untreated sewage will overflow to prevent treatment plant failures. In the Hudson River Watershed, including the East and Harlem rivers, there are more than 660 Combined Sewer Overflow (CSO) outfalls. To reduce these discharges, the Department of Environmental Conservation is implementing CSO Long Term Control Plans under the Clean Water Act over the next decade or more in the Capital District, New York City and several other river cities.

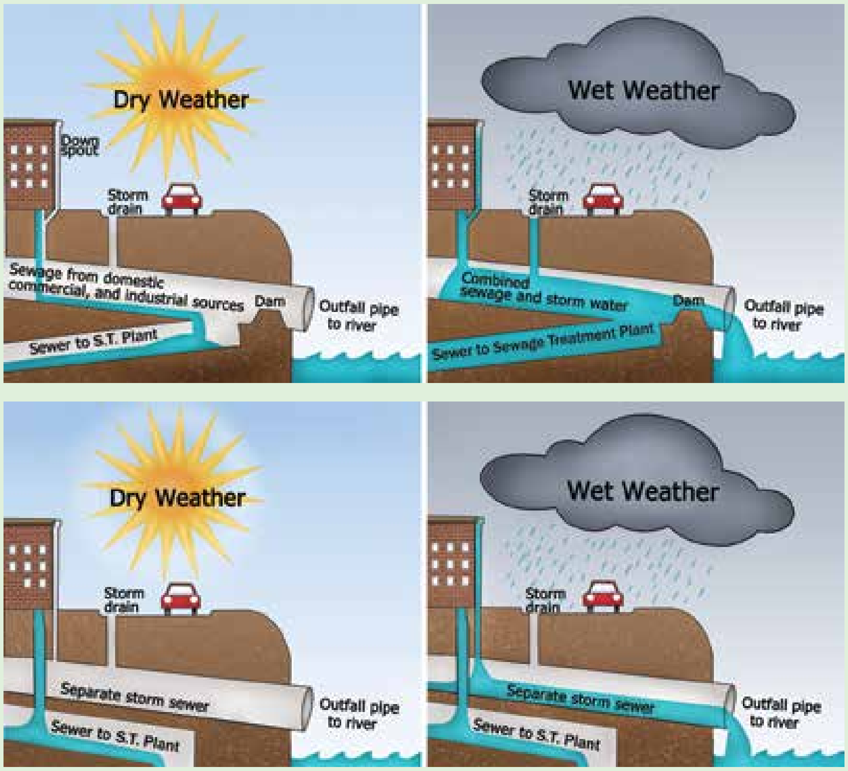
HUDSON RIVER WATERSHED CSO OUTFALLS

New York City[i]	426
Capital District[ii]	92
Hudson Estuary[iii]	58
Mohawk River[iv]	52
New Jersey[v]	26
Upper Hudson[vi]	12

i Approximately 20% of NYC outfalls discharge to waters not part of the Hudson Estuary, such as Long Island Sound and Jamaica Bay.
ii Albany, Cohoes, Green Island, Rensselaer, Troy and Watervliet.
iii Catskill, Hudson, Kingston, Newburgh, Poughkeepsie, West Point and Westchester County.
iv Amsterdam, Little Falls, Schenectady and Utica.
v Bayonne, Fort Lee, Guttenberg, Jersey City, North Bergen and North Hudson County.
vi Glens Falls, Washington County and Waterford.

Sources: NYS DEC, NY/NJ Baykeeper

SEWER SYSTEMS AT-A-GLANCE



COMBINED SEWER SYSTEMS

Sewage and streetwater are transported by the same pipes. To avoid sewage plant failures when rain or snowmelt enters pipes, sewage is discharged, untreated or partially treated, to water.

SEPARATE SEWER SYSTEMS

Sewage is transported to treatment plants in one set of pipes. Storm drains carry streetwater in a separate set of pipes.

(Graphic Source: US EPA)

Sewage Infrastructure Failures

There over 190 publicly owned systems that collect and/or treat sewage in the Hudson River Estuary watershed (and more in New York City and New Jersey, and in the Upper Hudson and Mohawk River watersheds). Well-run plants with sufficient capacity and good collection systems effectively treat sewage. But most were built decades ago, and today rely on aging, leaking pipes. In some cases these systems fail to treat all sewage. Overflows from sewer systems can be triggered by bypasses of treatment processes to alleviate streetwater inflow and infiltration, as well as pipe breaks and blockages. Further, smaller treatment plants are held to inadequate monitoring requirements, requiring only one sample of effluent per month to demonstrate compliance with pollution limits.

At least 29 of these municipal wastewater treatment plants have had effluent violations within the past three years.[13]

In addition to municipally owned plants, 850 other permits allow discharges of sewage or other wastewater into the Hudson River Estuary watershed from private, commercial or institutional facilities. More than 50 of these private, commercial or institutional facilities have had effluent violations in the past three years.[14] Many of the plants designed to treat sewage do not disinfect effluent before discharge, allowing the ongoing discharge of potentially harmful microbes.

Effluent violations are often identified only if self-reported by a facility. More than 175 facilities in the Hudson River Estuary watershed violated reporting requirements in the last three years.[15] Each year a fraction of these permits are reviewed or facilities inspected.[16]

A pipe discharges treated sewage effluent on the Indian Kill, a tributary of the Hudson River. *Photo by Dan Shapley/Riverkeeper.*

A farm adjacent to the Wallkill River. *Photo by Dan Shapley/Riverkeeper.*

Runoff from Streets

In addition to at least 3,500 streetwater outfalls in New York City[17] there are thousands of regulated outfalls in 150 Hudson River Estuary watershed communities[18] and northern New Jersey, as well as many unregulated outfalls.

Other studies have documented extremely high levels of fecal indicating bacteria in discharges of streetwater from storm sewer outfalls.[19] In addition, streetwater carries litter, sediment, salt, oil and other contaminants that can damage environmental or public health.

Sources of fecal indicating bacteria in streetwater may include:[20]

- human waste, including from illicit sanitary sewer connections or leaky sanitary sewers that infiltrate stormwater pipes, illegal dumping, or encampments of homeless or transient people;
- dog and other domestic pet waste;
- dumpsters, garbage cans and garbage trucks;
- urban wildlife such as pigeons, raccoons, feral cats and squirrels; and,
- biofilms, decaying plant matter, litter and sediment in storm drains (and on streets).[21]

Runoff from Agriculture

Runoff from farms and animal feeding operations (AFOs) can be a significant source of pathogens[22] and other pollutants, if manure spread as fertilizer or generated by livestock is not managed to avoid contaminating water. There are thousands of farms in the Hudson River watershed,[23] with varying degrees of regulation and investment in best management practices to avoid runoff and erosion, exclude cattle from streams, and manage manure and manure applications. While the risk of exposure to water contaminated by animals varies, the risk from cattle waste is comparable to human waste. [24]

REDUCING AGRICULTURAL RUNOFF

There are several "best management practices" farmers can employ to reduce runoff of pathogens, nutrients and soil, including:

- plant cover crops
- plant or protect streamside and flood plain vegetation
- don't spread manure in winter, when the ground is frozen
- build manure storage facilities
- compost manure
- fence streams to exclude cattle; and,
- build berms to control runoff.

Streetwater flows into a storm drain. *Photo by Riverkeeper.*

Canada geese on the Hudson River.
Photo by John Lipscomb/Riverkeeper

Septic System Failures

There are hundreds of thousands of septic systems[25] in the Hudson-Mohawk watershed[26]. All but the largest require no state permit, and despite the availability of voluntary EPA management guidelines,[27] only a handful of communities regulate operation and maintenance of systems at private homes. The failure rate has been estimated at 10% nationwide,[28] and as high as 70% in some communities. The local failure rate is unknown, but the state has identified failing septic systems as a top water quality issue.[29] Most failures are identified when the pooling of sewage in yards or odors are reported to a county Department of Health—which typically occurs long after the system has been polluting groundwater, and potentially nearby surface water. Routine inspection and maintenance would catch these problems earlier, at lower cost to homeowners and the environment.

The EPA recommends community level management of septic systems in areas with increased risk to water, ranging from homeowner education to the creation of public septic districts. Key concepts include:

- **inventorying existing systems and their level of performance at a minimum;**
- **requiring operating permits for large systems and clusters of systems;**
- **requiring discharge permits for systems that discharge to surface waters;**
- **increased requirements for certification and licensing of practitioners; and,**
- **elimination of illicit discharges to storm drains or sewers.**

Wildlife

Even in relatively urbanized areas of the Hudson River Estuary watershed, our waterways provide habitat for geese, deer and other animals. Fecal contamination from many types of animals, with notable exceptions such as cattle, generally poses less of a risk than fecal contamination from humans. The degree to which fecal indicators reflect wildlife sources is not known, but given the degree of human development in the watersheds we have studied, and the increase in contamination seen in more urbanized watersheds relative to less urbanized watersheds, Riverkeeper's working assumption is that human and human-related sources (agriculture, pets) are often dominant.

RIVERKEEPER'S WATER QUALITY MONITORING

Riverkeeper's Water Quality Program conducts the most comprehensive study of fecal contamination in the Hudson River estuary and its watershed.

Carol Knudson, of Columbia University's Lamont-Doherty Earth Observatory, takes a water sample from the Hudson River.
Photo by Leah Rae/Riverkeeper

Riverkeeper samples for fecal contamination using *Enterococcus* (Entero), the only Environmental Protection Agency (EPA)-recommended indicator for use in both fresh and salt waters.[32] The EPA has estimated that as many as 3.5 million Americans are sickened each year from contact with recreational water,[33] primarily due to pathogens associated with sewage and other fecal contamination. (*See Appendix A*) While Entero is not usually harmful, it indicates that disease-causing pathogens associated with fecal contamination are likely to be present.

Since 2008, in collaboration with our science partners at CUNY Queens College and Columbia University's Lamont-Doherty Earth Observatory, Riverkeeper has sampled 74 locations on 150 miles of the Hudson River Estuary between New York Harbor and Waterford, monthly from May to October. The samples were processed using an IDEXX Enterolert[34] system aboard the Riverkeeper patrol boat, the *R. Ian Fletcher*. In addition to Entero, we measure basic water quality parameters including temperature, salinity, turbidity, chlorophyll and dissolved oxygen. In 2014, Riverkeeper also supported research projects conducted by our science partners, including DNA-based surveys of the broader Hudson River microbial community, and measures of carbon dioxide and methane.

Building on this core study, Riverkeeper has begun working with a variety of community groups and individuals to sample Entero at tributary and water access points—148 locations in 2014. Tributary samples presented here were processed in Riverkeeper's lab. Only tributary studies with at least two seasons of data are reported here. All data are available at riverkeeper.org.

Riverkeeper's sampling protocols in the Hudson River Estuary and its tributaries are consistent with Quality Assurance Project Plans[35] approved for the 2014 sampling season by the New England Interstate Water Pollution Control Commission.

Also presented are data at water access points gathered by New York City Water Trail Association, The River Project, and more than 20 partners. These samples are processed at five labs—The River Project, O'Mullan Lab/CUNY Queens College, McGillis Lab/Columbia Earth Institute, Durand Lab/LaGuardia Community College and the Bronx River Alliance.

Riverkeeper bases assessments of water quality on the EPA's science-based 2012 Recreational Water Quality Criteria,[36] which define recommended concentrations of Entero per 100 ml of water ("Entero count") consistent with "primary contact recreation," which includes swimming, bathing, surfing, water skiing, tubing, skin diving, water play by children and other activities where ingestion of water or full immersion of the body is likely.[37] The EPA guidelines used here are designed to prevent more than 32 illnesses per 1,000 people,[38] and are protective regardless of whether the fecal contamination source is primarily human or animal.[39] They are recommended for use in any waters designated for primary contact recreation, even if there are no designated public beaches.[40]

HOW TO READ RIVERKEEPER'S DATA CHARTS

Riverkeeper uses Environmental Protection Agency (EPA) Water Quality Criteria to understand data gathered.

Riverkeeper samples the water less frequently than the EPA recommends. Our GM and STV calculations are based on our entire study period, using monthly sampling, rather than monthly calculations based on at least weekly sampling. While we assume they will have similar a probability distribution, our reported GM and STV values will be less sensitive to changes in water quality, and we support higher frequency sampling.

		GM	%STV	MIN	MAX
Piermont Pier	19 / 81	13.9	13	<10	1248

Managing Swimming Areas

The red bar shows the percentage of single samples that exceeded an Entero count of 60, the EPA-recommended Beach Action Value. Above this level, the EPA recommends public notification, and possible temporary beach closure.

Regulating Water Quality

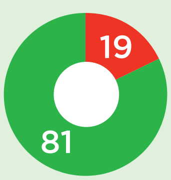
The Geometric Mean (GM) and the Statistical Threshold Value (STV) are measures of the degree and frequency of contamination. They describe the maximum allowable Entero counts to protect the health of swimmers, as measured by multiple samples over time at any given location.

To avoid exposure to chronic contamination, the GM, a weighted average, should not exceed 30. To avoid exposure to occasional high levels of contamination, no more than 10% of those samples should exceed 110, the STV. In our figures, failures of either criterion are listed in red. If a site fails one or both criteria, steps should be taken to reduce pollution.

Range

The minimum (Min) and maximum (Max) refer to the lowest and highest Entero counts observed at each site. A greater-than or less-than symbol indicates a sample beyond the detection limits of our lab.

■ % Beach Advisory
■ % Acceptable



BAV data are displayed both as bar and pie charts.

On the Web

Visit riverkeeper.org/water-quality for:

- **Results of every sample at every location**
- **Charts for comparing results in dry and wet weather**
- **Maps showing watershed areas and sampling locations**
- **Tools for watershed research**
- **Reports**
- **Also see our Boat Blog at riverkeeper.org/blog/patrol for ongoing updates.**

FINDINGS: HUDSON RIVER ESTUARY

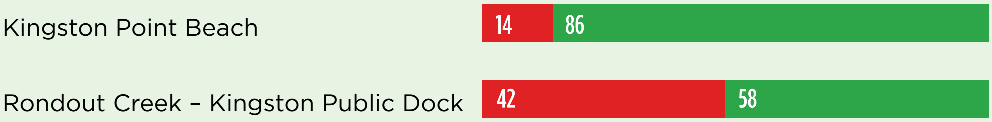
Based on analysis of more than 3,100 Enterococcus samples taken from 74 locations in the Hudson River estuary since 2008, Riverkeeper and scientists at CUNY Queens and Lamont-Doherty Earth Observatory have identified several patterns.

1

Contamination Varies

Contamination varies from location to location

On any given day the water quality may vary at different locations, even those near one another. Water quality may be suitable for swimming at one location, and exceed safe-swimming guidelines at another. The bar charts show percentage of samples above the EPA-recommended Beach Action Value and can be used to compare frequency of contamination.



Contamination varies over time at all locations

At all locations, we have measured bacteria at levels that exceed safe-swimming guidelines at times. At all locations, we have also measured water quality fit for swimming at times. The min/max figures are a quick way to see how widely contamination levels vary at any given site.

	Min	Max
Kingston Point Beach	<1	219
Rondout Creek – Kingston Public Dock	5	>2,420

Sites vary in both frequency and degree of contamination

The more frequently a location has fecal contamination, the greater the chance of exposure. The greater the degree of fecal contamination at the time of exposure, the greater the chance of getting sick. A site with infrequent but very high levels of contamination poses an elevated risk, just as a site that is frequently contaminated to a lesser degree. Water at a site with a high Geometric Mean (GM) has a high average level of contamination. Water at a site with a high percentage of samples above the Statistical Threshold Value (STV) has frequent episodes of high contamination. All Riverkeeper sample sites that fail the GM criterion also fail the STV criterion. But several fail only the STV criterion, because average contamination levels are not excessive, but occasional spikes of high-level contamination present a risk.

	GM	%STV
Kingston Point Beach	8.9	7
Rondout Creek – Kingston Public Dock	65.6	36

2 Contamination is Greater in Tributaries

Both the frequency and degree of contamination tend to be higher in tributaries.

Site Type	BAV	GM	%STV
Estuary Mid-Channel	18 / 82	9	12
Estuary Near Shore	18 / 82	14	12
Tidal Tributaries	36 / 64	35	29

3 Rain Increases Contamination

The frequency and degree of fecal contamination increases during and after rainfall. Overall the percentage of Hudson River Estuary samples, 2008-2014, that failed EPA safe-swimming guidelines increased from 12% in dry weather to 35% after rain. The response to rain is most pronounced in areas of the Hudson affected by combined sewer overflows (CSOs), and in tributaries. Rain also correlates with spikes of contamination along some urban waterfronts, suggesting streetwater runoff and/or infrastructure failures there may be important sources in some areas. (*For more, see Rain Analysis, next page.*)

Site Type	BAV	GM	%STV
All Weather	23 / 77	16	16
Wet	35 / 65	29	26
Dry	12 / 88	10	7

FINDINGS: HUDSON RIVER ESTUARY/RAIN ANALYSIS

Rain has a profound effect on water quality in the Hudson River estuary. The failure rate against the Environmental Protection Agency's Beach Action Value increases from 12% in dry weather to 35% during and after rain (defined as at least 0.25 inch of rain, cumulative, in the three days prior to sampling).

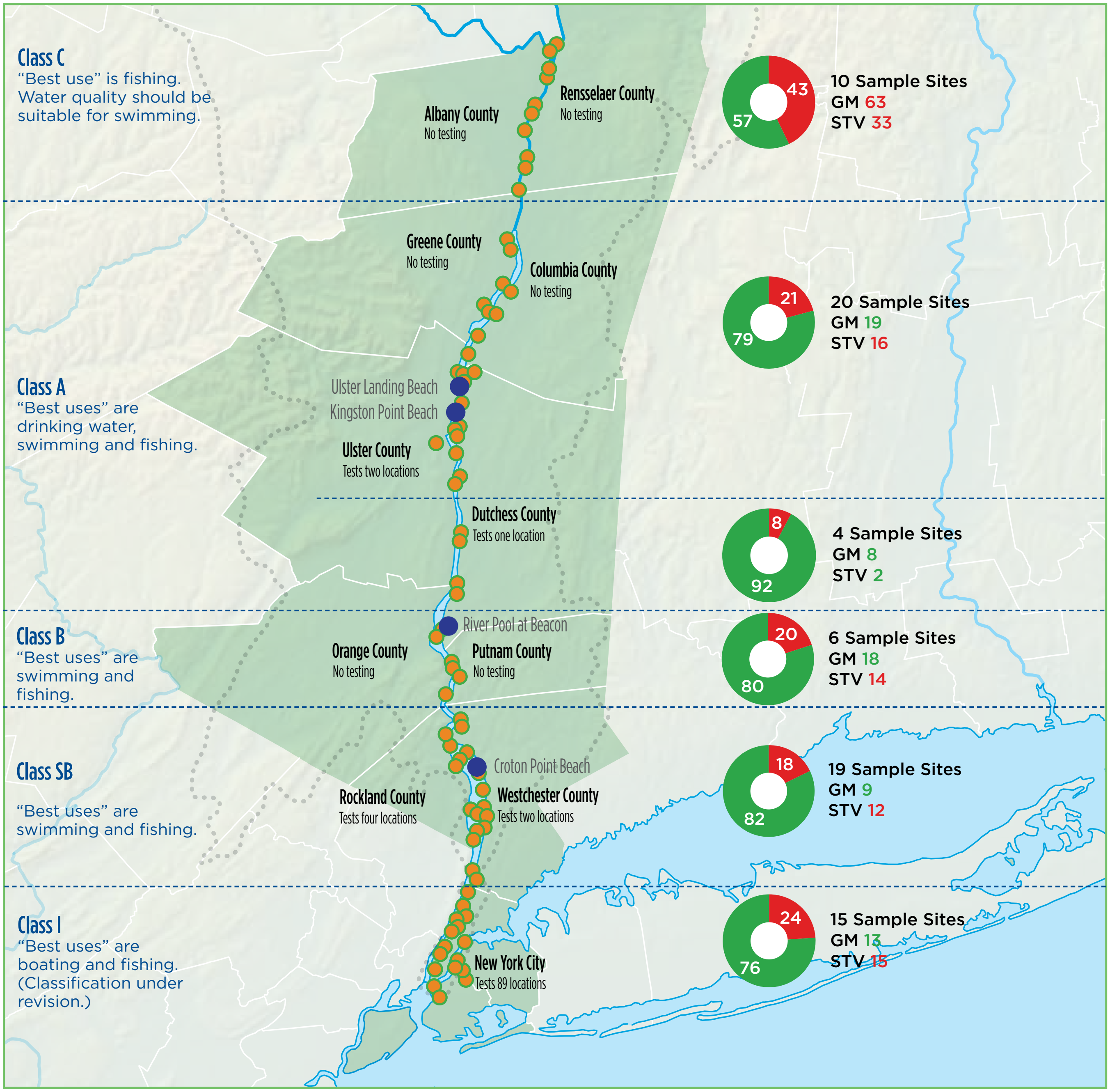
Rain affects different types of sampling locations to different degrees. Riverkeeper divides our Hudson River Estuary sampling locations into different categories – mid-channel, near shore, tributary (in or at the mouths of tidal tributaries), and near sewage treatment plant outfalls.

(*See which sites in our Hudson River Estuary study are most affected by rain on pages 20-21.*)

EFFECT OF RAIN VARIES BY TYPE OF SITE

Site Type	# of Sites	BAV	GM	%STV
Mid-Channel				
Wet	19	27 / 73	16	20
Dry		8 / 92	5	3
Near Shore				
Wet	34	29 / 71	24	21
Dry		10 / 90	9	5
Tidal Tributaries				
Wet	16	57 / 43	96	48
Dry		17 / 83	14	12
Sewage Treatment Plant				
Wet	5	30 / 70	25	18
Dry		30 / 70	21	19

The Department of Environmental Conservation (DEC) classifies waterbody segments based on their "best uses"— a statement of goals, not an assessment of water quality. Classification guides the permitting of pollution discharges with the intention of preserving water quality sufficient to support the designated uses. This chart shows data summarized by region, loosely based[41] on DEC segments. Each site was sampled between 40-45 times[42] between 2008 and 2014.



- Riverkeeper Test Site
- Official Public Swimming Area
- Hudson River watershed boundary
- **Acceptable** = Passes EPA guidelines for safe swimming. (Single-sample Entero counts 60 or less.)
- **Beach Advisory** = Fails EPA's recommended Beach Advisory Value (BAV), and should result in closure of swimming area.

GM = A weighted average of contamination. Red is a failure of EPA criterion.
STV = A measure of frequency of high-level contamination. Red is a failure of EPA criterion.

FINDINGS: HUDSON RIVER TRIBUTARIES/REGIONAL ANALYSIS

Based on an analysis of 1,485 samples taken by community scientists in six Hudson River tributaries, Riverkeeper has identified several patterns.

1

Contamination Levels Differ by Tributary

The level of contamination in non-tidal portion of tributaries, where community scientists sample, is significantly higher than the Hudson itself—with 99% of sites sampled failing EPA-recommended criteria (exceeding GM, STV or both) for safe swimming. But the frequency and degree of contamination vary among tributaries.

Site	# Samples	BAV		GM	% STV
Hudson River Estuary	3,203	23%	77%	16	16
Catskill Creek*	157	34%	66%	48	21
Esopus Creek*	150	33%	67%	37	23
Rondout Creek*	293	68%	32%	157	55
Wallkill River*	377	87%	13%	426	81
Sparkill Creek*	288	95%	5%	844	90
Pocantico River*	220	87%	13%	396	82

2

The Tidal Portions of Tributaries Are Less Contaminated

Riverkeeper has sampled in the tidal portions of three tributaries – Catskill, Esopus and Rondout creeks – since 2008. Community scientists have sampled the non-tidal portions of the same tributaries since 2012. Contamination levels are generally higher upstream of the first dam, though sources of contamination in the tidal portion may also have a significant effect on water quality.

Site	BAV		GM	% STV
Rondout Creek (Tidal)	67%	33%	46	26
Rondout Creek (Non-Tidal)*	68%	32%	157	55
Wallkill River (Non-Tidal)*	87%	13%	426	81
Esopus Creek (Tidal)	23%	77%	19	11
Esopus Creek (Non-Tidal)*	33%	67%	37	23
Catskill Creek (Tidal)	22%	78%	21	18
Catskill Creek (Non-Tidal)*	34%	66%	48	21

*Based on data gathered by community scientists.

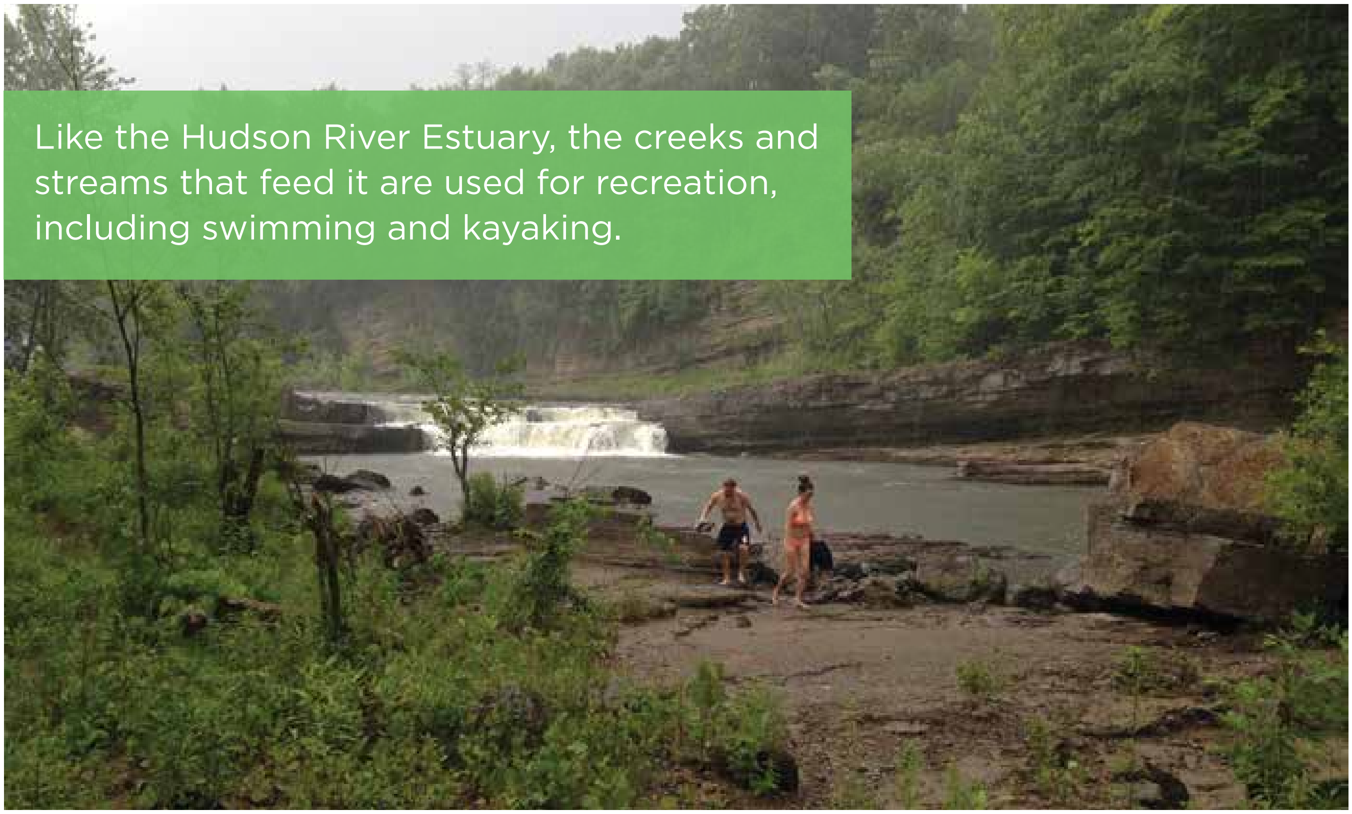
Overall, 99% of tributary sites sampled and 92% of New York City water access points sampled by community scientists failed to meet EPA criteria for safe swimming (exceeding GM, STV or both). At the sites tested, rain, defined as at least a quarter inch cumulative rainfall in the three days preceding a sample, has a great effect on the contamination levels in tributaries, and less dramatic effects at New York City water access points.

1

Rain Increases Contamination

Sample Site Type	# Sites	BAV		GM	% > STV
Hudson River Estuary					
Dry	74	12%	88%	10	7
Wet		35%	65%	29	26
Non-Tidal Tributaries					
Dry*	96	59%	41%	113	50
Wet*		85%	15%	465	77
NYC Water Access Points					
Dry*	38	43%	57%	42	32
Wet*		51%	49%	61	36

*Data collected by community scientists.



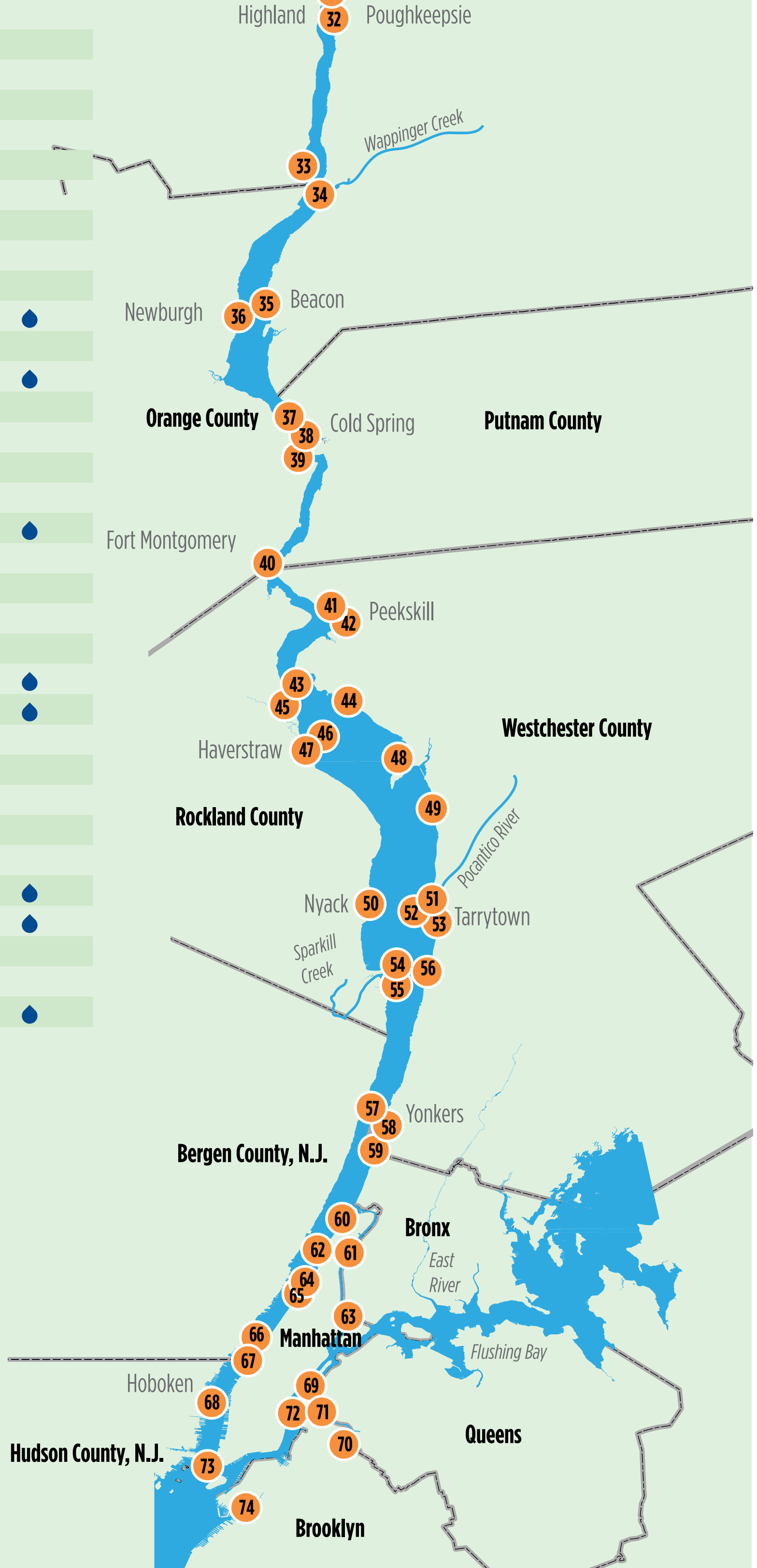
Swimmers in the Rondout Creek near High Falls.

HUDSON RIVER ESTUARY:
DATA BY SAMPLING SITE

NO.	SITE	TYPE	BAV (red)	BAV (green)	GM	% STV	MIN	MAX	RAIN RESPONSIVE
1	Hudson above Mohawk River	M	22	78	26.7	20	<1	>2420	●
2	Mohawk River at Waterford	T	68	32	187.5	61	4	>2420	●
3	Hudson River above Troy Lock	M	65	35	119	42	4	>2420	●
4	Congress St. Bridge- Troy	M	41	59	76.4	30	6	>2420	●
5	Albany Rowing Dock	N	45	55	80.4	31	3	>2420	●
6	Dunn Memorial Bridge- Albany	M	55	45	98.8	41	3	>2420	●
7	Island Creek/Normans Kill	T	49	51	102.9	41	2	>2420	●
8	Bethlehem Launch Ramp	N	24	76	32.3	17	1	>2420	●
9	Castleton	N	29	71	31.4	24	<1	1733	●
10	Coeymans Landing	N	26	74	23.3	21	<1	1986	●
11	Coxsackie Waterfront Park	N	23	78	25.9	15	<1	2420	●
12	Gay's Point mid-channel	M	19	81	16.9	19	1	2420	●
13	Athens	N	34	66	43.5	17	5	>2420	●
14	Hudson Landing Ramp	N	28	72	28.9	16	4	>2420	●
15	Catskill Creek– First Bridge	T	26	74	24.8	26	<1	>2420	●
16	Catskill Creek– East End	T	23	77	24	20	1	>2420	●
17	Catskill Launch Ramp	N	16	84	16.8	16	1	>2420	
18	Inbocht Bay	M	10	90	11.3	10	<1	>2420	
19	Malden Launch Ramp	N	12	88	15.4	12	<1	1986	
20	Esopus Creek West	T	22	78	24.9	16	<1	>2420	●
21	Esopus Creek Entrance	T	22	78	21.8	18	<1	>2420	
22	Tivoli Landing	N	9	91	7.2	9	<1	>2420	
23	Ulster Landing Beach	N	12	88	9.5	7	<1	2420	
24	Rondout Creek- Eddyville Anchorage	T	24	76	36	18	1	>2420	●
25	Rondout Creek- Kingston Public Dock	T	42	58	65.6	36	5	>2420	●
26	Rondout Creek- Kingston STP Outfall	O	50	50	91.7	35	2	>2420	
27	Kingston Point Beach	N	14	86	8.9	7	<1	219	
28	Port Ewen Drinking Water Intake	N	7	93	5.1	7	<1	1733	
29	Norrie Point Yacht Basin	N	21	79	22.9	19	1	>2420	●
30	Norrie Point mid-channel	M	7	93	3.6	5	<1	1203	
31	Poughkeepsie Drinking Water Intake	M	2	98	4.5	0	<1	76	
32	Poughkeepsie Launch Ramp	N	9	91	11	0	3	91	
33	Marlboro Landing	N	7	93	10.2	5	1	>2420	
34	Wappingers- New Hamburg	N	15	85	10.5	5	1	411	
35	Beacon Harbor	N	18	82	19.2	9	<1	816	
36	Newburgh Launch Ramp	N	61	39	124.9	55	1	2420	●
37	Little Stony Point	N	5	95	7.9	2	<1	166	
38	Cold Spring Harbor	N	7	93	11.8	2	<1	184	
39	West Point STP Outfall	O	17	83	9.8	7	<1	>2420	
40	Fort Montgomery	N	7	93	13.1	5	<1	>2420	

41	Annesville Creek	T	20	80	11.1	14	<10	2098	
42	Peekskill Riverfront Green Park	N	20	80	15.3	11	<10	4352	
43	Stony Point mid-channel	M	2	98	3.7	0	<10	86	
44	Furnace Brook	T	20	80	11.3	16	<10	4106	
45	Cedar Pond Brook	T	20	80	11.3	18	<10	5794	
46	Haverstraw Bay mid-channel	M	5	95	2.6	0	<10	86	
47	Emeline Beach- Haverstraw	N	7	93	6.5	7	<10	10462	
48	Croton Point Beach	N	4	96	3.7	4	<10	241	
49	Ossining Beach	N	16	84	8.4	11	<10	4611	
50	Nyack Launch Ramp	N	26	74	10.3	16	<10	663	
51	Kingsland Pt. Park- Pocantico River	T	21	79	12.2	21	<10	>24196	💧
52	TZ Bridge mid-channel	M	2	98	1.9	2	<10	142	
53	Tarrytown Marina	N	45	55	49.5	21	<10	>24196	💧
54	Piermont Pier	N	19	81	13.9	13	<10	1248	
55	Orangetown STP Outfall	O	38	62	32.8	24	<10	10112	
56	Irvington Beach	N	5	95	3.5	5	<10	464	
57	Yonkers mid-channel	M	5	95	3.3	2	<10	410	
58	Saw Mill River	T	59	41	96.6	41	<10	>24196	💧
59	Yonkers STP Outfall	O	5	95	5.4	0	<10	85	
60	Dyckman Street Beach	N	12	88	9	2	<10	144	
61	Harlem River- Washington Bridge	M	33	67	22.6	14	<10	1670	
62	GW Bridge mid-channel	M	7	93	4.4	2	<10	134	
63	Harlem River- Willis Ave. Bridge	M	25	75	13.2	18	<10	5635	💧
64	North River STP @145th	O	37	63	31.9	26	<10	2987	💧
65	125th St. Pier	N	23	77	12	14	<10	272	
66	79th St. mid-channel	M	7	93	4.7	2	<10	161	
67	Pier 96 Kayak Launch	N	18	82	7.7	5	<10	331	
68	Castle Point, NJ	N	9	91	9	7	<10	231	
69	East River at Roosevelt Island	M	20	80	6.5	9	<10	275	
70	Newtown Creek- Metropolitan Ave. Bridge	T	55	45	102.8	45	<10	>24196	💧
71	Newtown Creek- Dutch Kills	T	41	59	29.1	31	<10	>24196	💧
72	East River mid-channel at 23rd St.	M	13	88	5.4	8	<10	399	
73	The Battery mid-channel	M	7	93	4.5	2	<10	134	
74	Gowanus Canal	T	58	42	90.6	42	<10	>24196	💧

Data gathered by Riverkeeper, CUNY Queens and Lamont-Doherty Earth Observatory of Columbia University.



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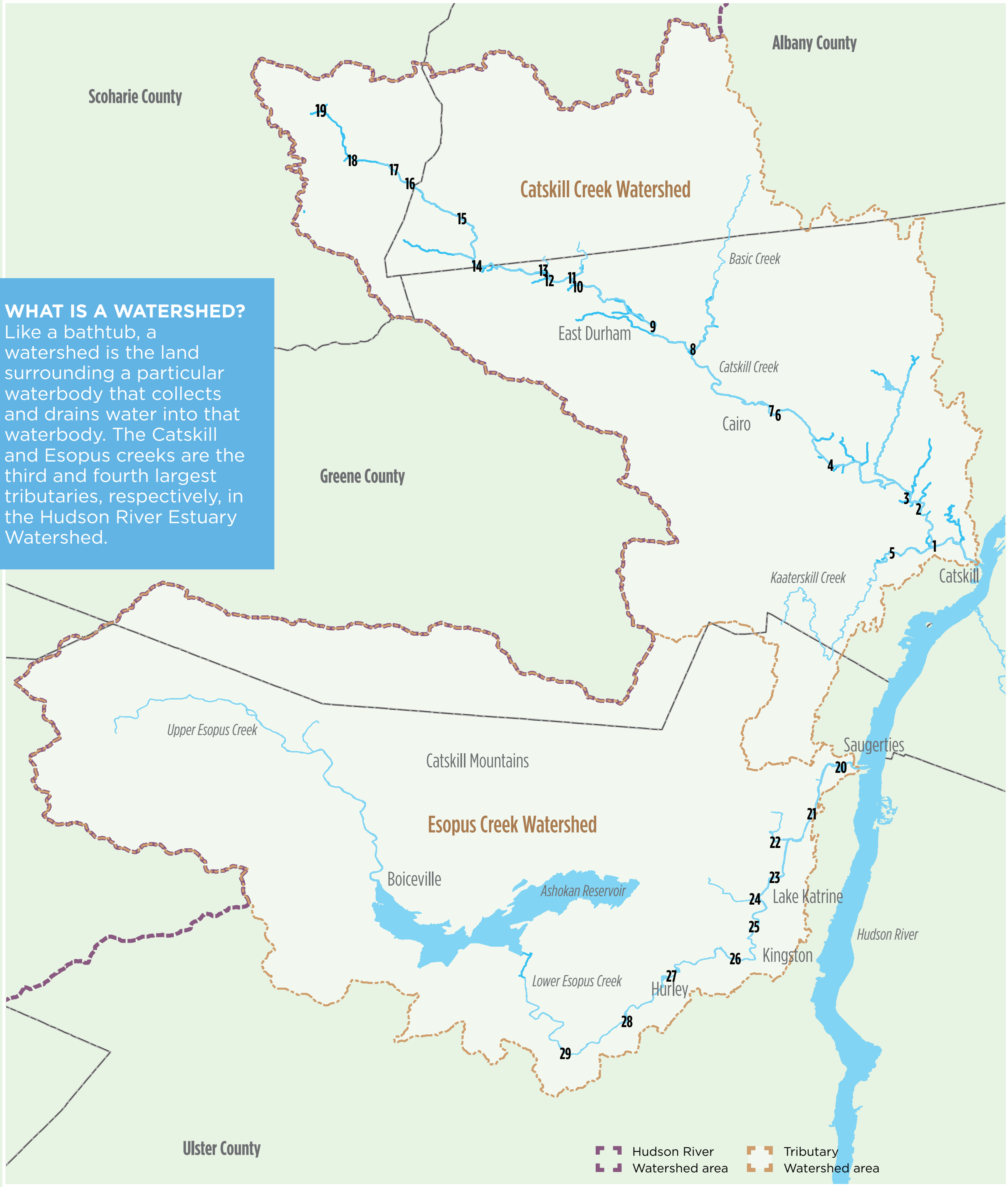
M = Main Channel / **N** = Near Shore / **O** = Sewage Treatment Plant Outfall / **T** = Tributary

💧 = Sites where rain has the most pronounced influence on water quality (an increase in GM of at least 30 comparing dry samples to wet)

HUDSON RIVER WATERSHED:
DATA BY SAMPLING SITE

CATSKILL CREEK AND ESOPUS CREEK

WHAT IS A WATERSHED?
Like a bathtub, a watershed is the land surrounding a particular waterbody that collects and drains water into that waterbody. The Catskill and Esopus creeks are the third and fourth largest tributaries, respectively, in the Hudson River Estuary Watershed.



No	Site Name	# Samples	BAV	GM	% STV	Min	Max
CATSKILL CREEK							
1	Jefferson Heights – West Main Street	17	29% / 71%	27	12%	2	>2420
2	Cauterskill – Rt 23 Bridge swimming hole	16	19% / 81%	29	13%	3	>2420
3	Leeds – Fire Department intake	17	47% / 53%	59	24%	1	1986
4	South Cairo Bridge	17	47% / 53%	72	35%	7	>2420
5	Cauterskill – Kaaterskill Creek tributary	6	17% / 83%	60	17%	12	>2420
6	Cairo – Below STP outfall	6	17% / 83%	25	17%	3	1300
7	Cairo – Above STP outfall	6	33% / 67%	29	17%	3	816
8	Freehold – Basic Creek tributary	6	50% / 50%	94	17%	32	1553
9	East Durham – Route 67/67A swimming hole	6	33% / 67%	88	33%	11	>2420
10	Durham – Dean's Mill swimming hole	6	33% / 67%	52	17%	16	>2420
11	Durham – Ten Mile Creek tributary	6	33% / 67%	34	17%	1	1300
12	Oak Hill – Brandow Memorial Park	6	17% / 83%	48	17%	19	>2420
13	Oak Hill – Above Oak Hill	6	33% / 67%	52	17%	12	>2420
14	Potter Hollow – Route 145/81 fishing access	6	17% / 83%	28	17%	3	>2420
15	Preston Hollow – Cheese Hill Road fishing access	6	33% / 67%	44	17%	6	>2420
16	Livingstonville – CCC Camp Road fishing access	6	33% / 67%	68	33%	4	2420
17	Livingstonville – Route 145	6	50% / 50%	88	33%	12	1986
18	Livingstonville – Stone Store Road	6	50% / 50%	151	33%	17	>2420
19	Middleburgh – The Vlaie fishing & boating access	6	33% / 67%	41	17%	17	206

No	Site Name	# Samples	BAV	GM	% STV	Min	Max
ESOPUS CREEK							
20	Saugerties Village Beach	19	26% / 74%	27	21%	1	517
21	Mt Marion – USGS Streamgage	19	42% / 58%	44	32%	2	921
22	Lake Katrine – Plattekill Creek tributary	6	33% / 67%	51	33%	13	365
23	Lake Katrine – Leggs Mill Bridge	19	53% / 47%	43	32%	3	816
24	Lake Katrine – Sawkill Creek tributary	6	67% / 33%	78	33%	12	548
25	Lincoln Park – Orlando Park	19	42% / 58%	54	26%	4	1300
26	Kingston – Washington Avenue Bridge	19	16% / 84%	34	16%	6	921
27	Hurley – Wyncoop Rd Bridge Fire Dept intake	19	32% / 68%	32	26%	1	>2420
28	Marbletown – Route 209 fishing access	5	100%	26	0%	16	36
29	Marbletown – Tongore Park swimming beach	19	16% / 84%	24	11%	2	1300

See "How to Read Riverkeeper's Data Charts," Page 11
All data gathered by community scientists.

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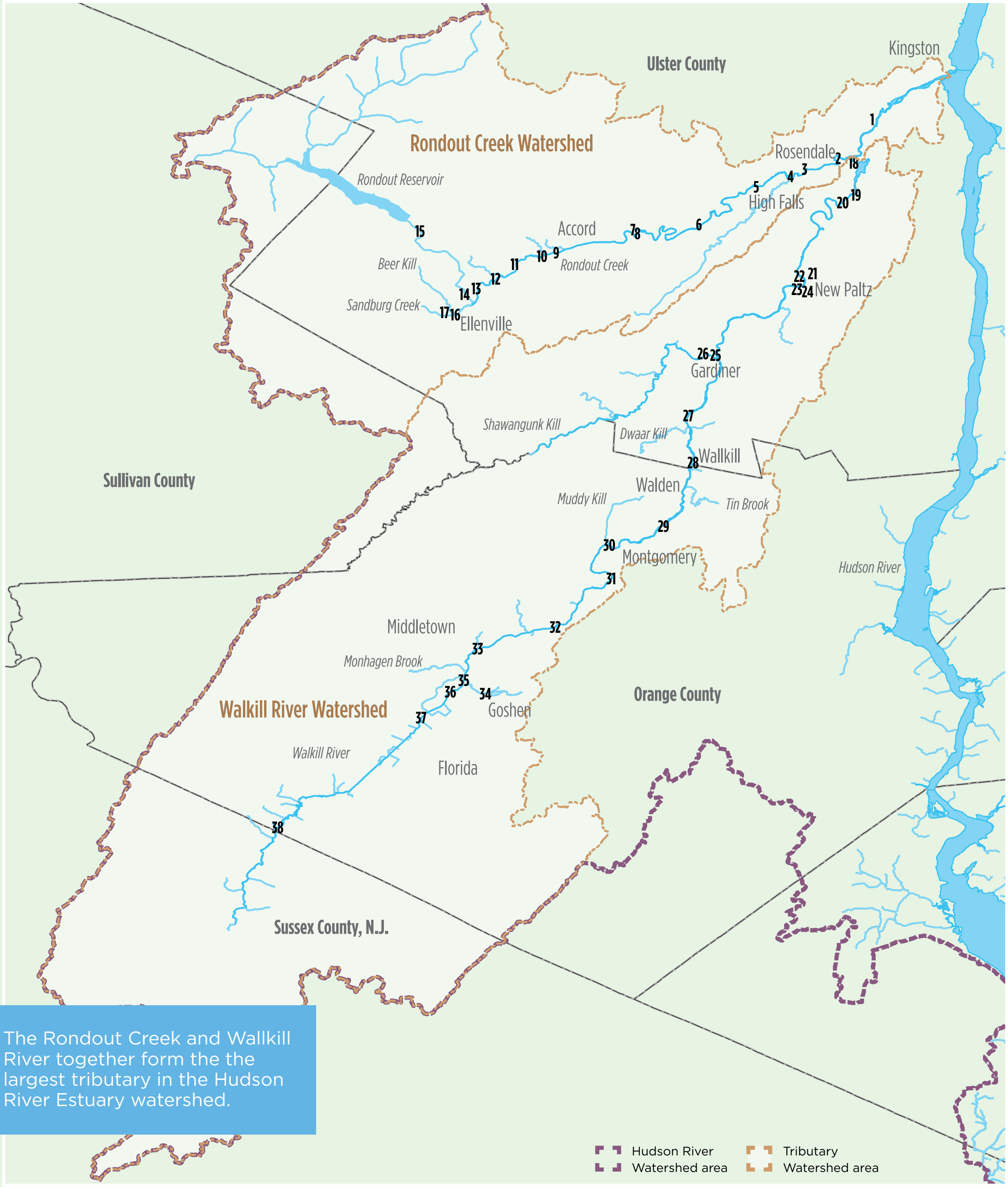
RONDOUT CREEK AND WALLKILL RIVER



The Rondout Creek and Wallkill River together form the the largest tributary in the Hudson River Estuary watershed.

No	Site Name	# Samples	BAV		GM	STV	Min	Max
RONDOUT CREEK								
1	Eddyville – Creek Locks fishing access	18	72%	28%	149	50%	12	>2420
2	Tillson – NY Thruway Crossing	18	61%	39%	151	44%	10	3448
3	Rosendale Trestle swimming hole	18	78%	22%	246	72%	26	>2420
4	Rosendale – AJ Snyder Field swimming hole	18	78%	22%	270	72%	21	>2420
5	High Falls swimming hole	18	67%	33%	124	39%	8	>2420
6	Alligerville – Route 6 Bridge swimming hole	18	56%	44%	119	50%	10	>2420
7	Accord – Rochester Creek tributary	18	61%	39%	149	61%	14	3448
8	Accord – Route 209 & River Street	18	72%	28%	117	56%	9	>2420
9	Kerhonkson – 42nd Street Bridge	18	72%	28%	172	61%	9	>2420
10	Kerhonkson – Route 44/55 Bridge	18	83%	17%	204	56%	29	>2420
11	Wawarsing – Foordemoore Road Bridge	18	89%	11%	211	61%	41	>2420
12	Wawarsing – Port Ben Road	18	78%	22%	212	67%	45	>2420
13	Napanoch – State Prison	18	72%	28%	195	50%	37	2420
14	Napanoch – Route 209	17	71%	29%	236	65%	13	>2420
15	Wawarsing – Below Rondout Reservoir	18	22%	78%	35	17%	6	548
16	Ellenville – Sandburg Creek tributary	6	67%	33%	163	50%	47	1120
17	Ellenville – Beer Kill tributary	18	61%	39%	148	56%	7	>2420
WALKILL RIVER								
18	Tillson – Coutant Rd below Sturgeon Pool	18	44%	56%	88	33%	2	>2420
19	Rifton – Cow Hough Road fishing access	18	72%	28%	180	56%	10	>2420
20	Tillson – Rt 32 Bridge fishing access	18	67%	33%	256	67%	15	4611
21	New Paltz – Mill Brook tributary	17	94%	6%	560	82%	32	3076
22	New Paltz – Springtown Road boat launch	18	89%	11%	397	83%	20	10462
23	New Paltz – Saw Mill Brook tributary	18	100%		598	94%	80	>2420
24	New Paltz – Plains Road boat launch	18	83%	17%	297	72%	25	10462
25	Gardiner – USGS Streamgage	19	84%	16%	383	79%	14	>2420
26	Gardiner – Shawangunk Kill tributary	18	89%	11%	368	78%	36	9804
27	Shawangunk – Galeville Bridge	18	100%		506	89%	78	>2420
28	Shawangunk – Orange/Ulster Line fishing access	18	83%	17%	221	67%	2	>2420
29	Montgomery – Riverfront Park fishing access	18	89%	11%	571	89%	28	>2420
30	Montgomery – Benedict Farm Park floating dock	18	94%	6%	504	89%	54	6488
31	Montgomery – I-84 Crossing	18	100%		712	83%	78	>2420
32	Middletown – Stony Ford Road	18	89%	11%	505	89%	28	>2420
33	Middletown – Cemetery Road	18	100%		738	100%	137	6131
34	Goshen – Rio Grande tributary at Heritage Trail	18	100%		1369	100%	192	>2420
35	Goshen – Echo Lake Road	18	94%	6%	533	94%	44	3784
36	Goshen – Route 6/17M	18	94%	6%	712	89%	60	6867
37	Wawayanda – Pellets Island Bridge	18	94%	6%	635	94%	32	4884
38	Unionville – National Wildlife Refuge	17	71%	29%	260	65%	24	>2420

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SPARKILL CREEK AND POCANTICO RIVER

The Sparkill Creek and Pocantico River are tributaries within the Hudson River watershed.

No	Site Name	# Samples	BAV		GM	STV	Min	Max
SPARKILL CREEK								
1	Piermont – Pirelli Park	10	30%	70%	29	10%	<10	420
2	Piermont – Old Draw Bridge	18	94%	6%	748	94%	31	>24196
3	Piermont – Skating Pond	18	100%		1454	100%	173	>2420
4	Sparkill – Route 340	18	100%		1305	100%	219	>2420
5	Tappan – Moturis	18	100%		1945	100%	238	>24196
6	Rockleigh, NJ – Sparkill Brook tributary	18	94%	6%	1027	94%	50	>2420
7	Tappan – State Line	18	94%	6%	1056	94%	49	>2420
8	Tappan – Oak Tree Road	18	94%	6%	1082	89%	29	>2420
9	Tappan – Route 303	19	95%	5%	922	95%	48	>2420
10	Orangeburg – Orangetown STP	17	94%	6%	1005	94%	37	>2420
11	Orangeburg – Route 303/340	18	94%	6%	1065	94%	49	>2420
12	Blauvelt – Blauvelt Arm tributary	18	100%		571	89%	96	>2420
13	Blauvelt – Clausland Arm	18	94%	6%	772	89%	42	>2420
14	Blauvelt – Tackamack tributary	18	83%	17%	184	56%	6	>2420
15	Orangeburg – Tackamack tributary	18	89%	11%	341	67%	6	>2420
16	Blauvelt – Spruce Street	18	100%		1132	94%	89	>2420
17	Blauvelt – Marsico Court	18	89%	11%	668	83%	30	>2420
POCANTICO RIVER								
18	Sleepy Hollow – Philipsburg Manor	18	89%	11%	479	78%	7	>2420
19	Sleepy Hollow Cemetery	18	94%	6%	457	83%	21	>2420
20	Sleepy Hollow – Rockefeller Park	18	83%	17%	361	83%	13	>2420
21	Sleepy Hollow – Gory Brook tributary	18	78%	22%	434	78%	6	>2420
22	Sleepy Hollow – DEP Spillway	18	89%	11%	404	78%	28	>2420
23	Sleepy Hollow – Rockefeller Brook	5	100%		952	100%	281	>2420
24	Briarcliff Manor – Below Pocantico Lake	18	78%	22%	314	78%	2	>2420
25	Briarcliff Manor – Caney Brook tributary	18	78%	22%	475	67%	30	>2420
26	Briarcliff Manor – Above Pocantico Lake	18	89%	11%	508	78%	50	>2420
27	Briarcliff Manor – Long Hill Road	18	72%	28%	345	72%	13	>2420
28	Briarcliff Manor – North County Trail	18	89%	11%	327	78%	24	>2420
29	Briarcliff Manor – Stone Creek Lane	18	83%	17%	485	83%	24	>2420
30	New Castle – Echo Lake	17	71%	29%	198	53%	12	>2420

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NEW YORK CITY AREA

The East River, Harlem River, Newtown Creek and Gowanus Canal are part of the Hudson River Estuary.

* Yonkers sites are not depicted here, due to space.

No	Site Name	# Samples	BAV	GM	STV	Min	Max
NEW YORK CITY							
1	*Yonkers – JFK Marina boat launch	53	42% / 58%	37	28%	<10	6488
2	*Yonkers Paddling and Rowing Club	54	46% / 54%	44	24%	<10	>24196
3	*Yonkers – Saw Mill River, daylighted section	37	100%	697	100%	160	>24196
4	Inwood Canoe Club floating dock	53	32% / 68%	25	21%	<10	4884
5	Washington Heights – W 154th St, Riverside Park	18	78% / 22%	128	61%	10	862
6	West Harlem Piers Park kayak dock	36	56% / 44%	64	39%	<10	5247
7	Upper West Side – West 72nd Street kayak launch	24	58% / 42%	46	17%	<10	537
8	Upper West Side – Pier 96, Hudson River Park	16	19% / 81%	18	6%	<10	132
9	Hell's Kitchen – Pier 84, Hudson River Park	38	39% / 61%	43	24%	<10	2046
10	Hell's Kitchen – Pier 66, Hudson River Park	57	28% / 72%	19	16%	<10	2254
11	West Village – Pier 40 dock, Hudson River Park	59	14% / 86%	10	10%	<10	19863
12	Tribeca – Pier 26 dock, Hudson River Park	40	15% / 85%	17	13%	<10	1234
13	Hoboken – Pier 13	19	42% / 58%	44	16%	10	2187
14	Hoboken Cove Beach boathouse	18	50% / 50%	70	39%	<10	1455
15	Inwood – Harlem River, Muscota Marsh rowing dock	19	32% / 68%	49	21%	<10	6867
16	Inwood – Harlem River, P.J. Sharp Boathouse	39	51% / 49%	44	33%	<10	2603
17	NY Botanical Garden – Bronx River boat access	16	63% / 37%	99	50%	<10	>24196
18	Soundview – Bronx River, Starlight Park dock	31	94% / 6%	346	81%	20	>24196
19	Hunts Point Riverside Park Beach, Bronx River	32	94% / 6%	421	69%	41	>24196
20	Randall's Island – Bronx Kill, east landing	16	75% / 25%	152	69%	<10	15531
21	Randall's Island – Bronx Kill, west landing	27	85% / 15%	225	56%	20	>24196
22	Flushing Meadows – Willow Lake	13	92% / 8%	291	69%	10	1455
23	Flushing Bay, World's Fair Marina	58	43% / 57%	38	40%	<10	>24196
24	Astoria – East River, Hallets Cove beach	54	69% / 31%	105	46%	<10	3076
25	Long Island City – East River, Anable Basin dock	53	34% / 66%	32	21%	<10	24196
26	Long Island City – East River, Gantry State Park	18	22% / 78%	25	6%	<10	687
27	Greenpoint – Newtown Creek, N Brooklyn Boat Club	57	46% / 54%	39	30%	<10	19863
28	Alphabet City – East River, Stuyvesant Cove landing	58	47% / 53%	45	29%	<10	5172
29	Brooklyn Navy Yard – East River, Wallabout Channel	54	43% / 57%	42	28%	<10	>24196
30	Lower East Side – East River, Pier 42	58	28% / 72%	20	24%	<10	2143
31	Dumbo – East River, Main Street beach	49	35% / 65%	26	22%	<10	591
32	Financial District – East River, Brooklyn Br. beach	50	24% / 76%	22	8%	<10	305
33	Brooklyn Heights – East River, Pier 2 kayak dock	19	11% / 89%	5	11%	<10	201
34	Brooklyn Heights – East River, Pier 4 beach	19	37% / 63%	34	21%	<10	512
35	Red Hook – Valentino Pier beach	53	43% / 57%	47	26%	<10	1789
36	Gowanus Canal, 2nd Street boat launch	57	74% / 26%	241	58%	<10	>24196
37	Gowanus Canal, 4th Street, Vechtes Brook	20	85% / 15%	353	85%	<10	4106
38	Gowanus Canal, 2nd Avenue rain garden	37	81% / 19%	314	57%	10	>24196
39	Canarsie- Paerdegat Basin, Sebago Canoe Club	22	41% / 59%	65	32%	<10	>24196

See "How to Read Riverkeeper's Data Charts," Page 11
All data gathered by community scientists.

■ **Acceptable** = Passes EPA guidelines for safe swimming. (Single-sample Entero counts 60 or less.)
■ **Beach Advisory** = Fails EPA's recommended Beach Advisory Value (BAV), and should result in closure of swimming area. (Single-sample Entero count greater than 60.)
GM (Geometric Mean) = Weighted average of Entero counts that dampens the effect of very high or low values. A GM of 30 or more indicates water does not meet EPA's recommended criteria for safe swimming, and appears in red.
STV (Statistical Threshold Value) = Percentage of samples with Entero count above 110. Greater than 10% failure rate indicates water does not meet EPA's recommended criteria for safe swimming, and appears in red.
Min = The lowest Entero count recorded at this site. / **Max** = The highest Entero count recorded at this site.

ACTION AGENDA

Our goal is not just to assess water quality — but to improve it. That will take actions from a broad set of stakeholders.

Swimmers in the Hudson River at Croton Point. *Photo Courtesy Toughman Triathlon*

1

IMPROVE MONITORING AND PUBLIC NOTIFICATION

County Health Departments and the Department of Environmental Conservation (DEC) need staff, budget and leadership from the Governor and Legislature to effectively protect the public's use of recreational water.

- **Sample water quality at least weekly[43] at public beaches and river pools**, expand testing in other waters designated for primary contact recreation, and post the data online immediately.
- **Develop models for public bathing areas based on high-frequency sampling data**, such as those in use today on Great Lakes, Long Island Sound and Atlantic coast beaches in New York. [44, 45]
- **Increase New York State's budget for monitoring pathogens in ambient water**, so impairments can be identified or verified and documented in the Waterbody Inventory and Priority Waterbodies List, and/or the 303(d) list of impaired waters.
- **Require wastewater treatment facility operators to test receiving waters**, in addition to testing the facilities' effluent.
- **Expand the Sewage Pollution Right to Know Law** to include all discharges of raw or partially treated sewage, with no exceptions, and set penalties to ensure compliance.

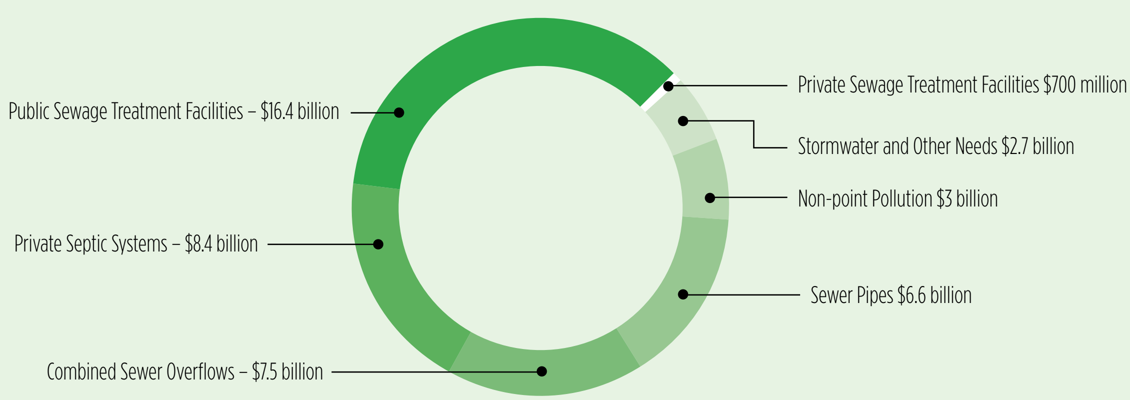
2

INVEST IN CLEAN WATER

The need for investments in wastewater infrastructure statewide, including for managing streetwater and farm runoff, has been estimated at $45 billion over 20 years.[46] The Governor and Legislature need to increase resources for DEC and other state and local partners.

- **Increase annual wastewater infrastructure funding by $800 million** to meet the documented annual need,[47] and exempt water and sewer investments from the 2% tax cap to remove a barrier to longterm investment.
- **Increase funding for the Environmental Protection Fund** to cover pollution control[48] and watershed planning.[49] Watershed plans should be consistent with the goals of the EPA's 9-element watershed planning process.[50]
- **Implement CSO Long Term Control Plans**, and re-invest where necessary if fully implemented plans fail to result in water quality that meets safe-swimming standards.
- **Adopt asset management strategies**, including mapping of wastewater and stormwater systems, so communities invest wisely in maintenance.
- **Disinfect effluent from sewage treatment facilities that lack disinfection**, including both public and private facilities, and prioritize UV disinfection over chlorination.
- **Implement best management practices for farms and animal feeding operations (AFOs)**, including runoff, erosion and manure management; and protection of streams and stream buffers.
- **Implement septic management programs** to ensure proper operation and maintenance.
- **Organize and support watershed groups** to effectively advocate for water quality protection and restoration.

NEW YORK STATE WASTEWATER INFRASTRUCTURE NEEDS



Source: NYS Department of Environmental Conservation, "Wastewater Infrastructure Needs of New York State," 2008

Urban Swim swimmers. *Photo courtesy Greg Porteus/Launch 5*

3

ENFORCE LAWS AND IMPROVE REGULATION

The Clean Water Act provides powerful tools for cleaning our waters. The DEC needs the resources and leadership from the Governor and Legislature to implement the law.

- **Restore and increase funding for the DEC Division of Water**, which has 30% fewer staff and about one-seventh the budget, in today's dollars, as it did a quarter century ago.[51]
- **Restore inspection, compliance and enforcement staff and budgets**. Over the last decade, staff reductions have disproportionately affected DEC's divisions of enforcement (down 18.6%) and air and water quality management (down 16.8%).[52]
- **Verify water quality impairments documented by citizen scientists**, list waters as appropriate on Priority Waterbodies List to give communities access to state grants or low-cost loans, or the 303(d) list to prioritize source trackdown and elimination.
- **Tighten existing State Pollution Discharge Elimination System (SPDES) permits** where discharges may cause exceedance of water quality standards, and increase effluent monitoring requirements to ensure compliance.[53]
- **Set protective recreational water quality standards consistent** with EPA recommendations.

Andy Juhl of Columbia University's Lamont-Doherty Earth Observatory works aboard the Riverkeeper patrol boat in 2014.
Photo by John Lipscomb/Riverkeeper

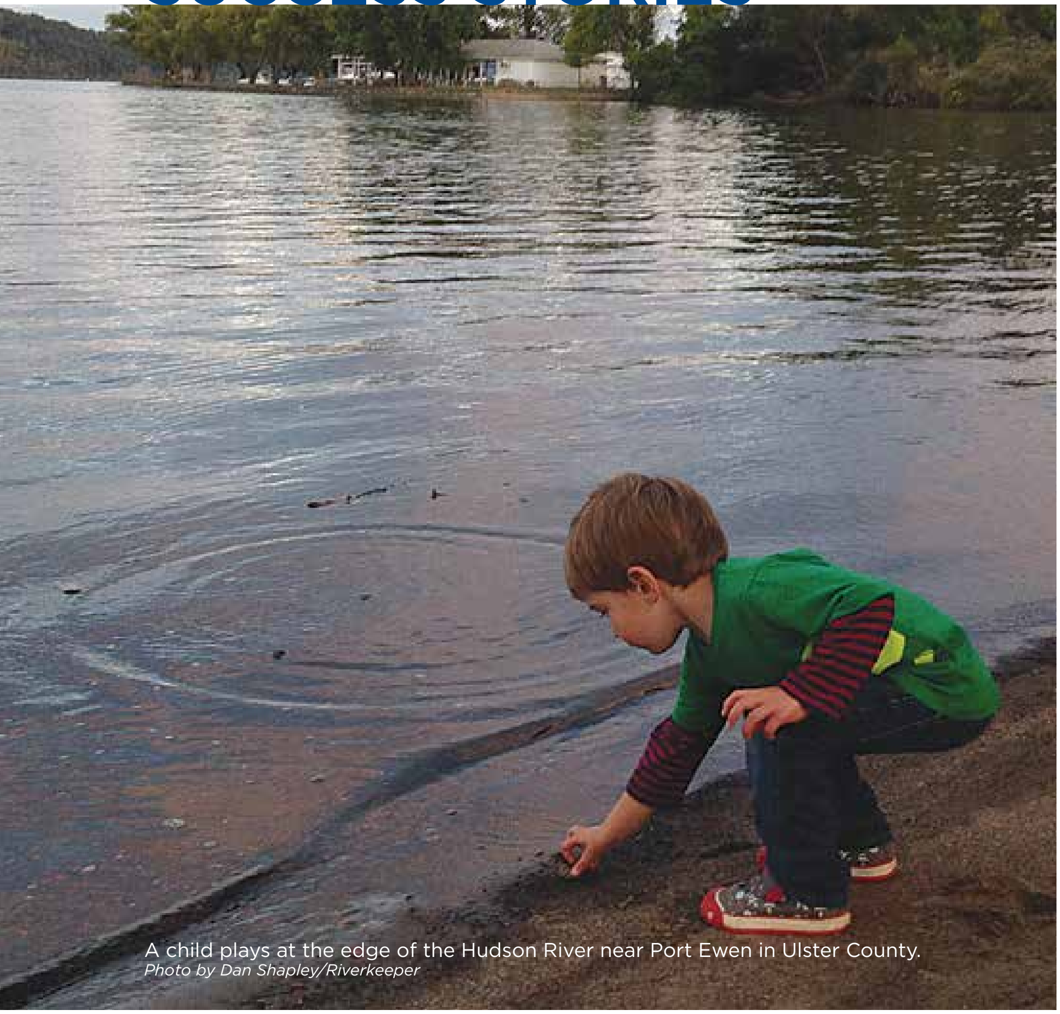
4

CONTINUE RESEARCH AND DEVELOP NEW SCIENCE-BASED TOOLS

Nationally, the scientific community needs to continue to address gaps in our understanding of water quality, how to test and model it, and how to restore waters. Some key needs include:

- **Increase Understanding of Fecal Indicators** – Study sediment transport, residence time and association with pathogens over time.
- **Develop New Fecal Indicators** – Both near-real time bacteriological tests and viral fecal indicators could be valuable tools in source trackdown and beach management.
- **Develop and Use Source Trackdown Techniques** – In waters where complex mixes of contaminant sources are suspected, the challenge of prioritizing projects to reduce pollution would be eased with source trackdown procedures and techniques.
- **Define Secondary Contact Standards** – People engaged in boating and other activities that involve wading and skin contact, but not fully body immersion or ingestion of water should know if primary contact recreation standards are applicable.
- **Understand Other Wastewater Contaminants** – Research is needed into the ecological and human health effects of wastewater-derived contaminants, including pharmaceuticals, personal care products and industrial wastes.

SUCCESS STORIES



A child plays at the edge of the Hudson River near Port Ewen in Ulster County.
Photo by Dan Shapley/Riverkeeper

Striped bass anglers dot the water in Newburgh Bay on the Hudson River in May 2014.
Photo by John Lipscomb/Riverkeeper

We follow a simple mantra: "Let the data do the talking." Where the data show problems, solutions often follow. It should be noted that in none of these cases were lawsuits filed or threatened; the Water Quality Program uses advocacy and communications as its main tools for effecting change. Here's a look at some of the accomplishments that have resulted, in whole or in part, from gathering and publicizing water quality data:

Infrastructure Investment

- The Governor and Legislature created a new $200 million grant program for drinking water and wastewater infrastructure in the FY2015 budget.
- The CSO Long Term Control Plan for the Capital District set as its goal "swimmable" water quality.
- Westchester County committed to a $9.9 million upgrade to a failing pumping station in Tarrytown.
- The Town of Catskill approved a sewer line extension to the hamlet of Leeds to replace failing septics there.
- The Town of Orangetown approved a $100,000 fix for a 50-year-old failing pump station on the Sparkill Creek.

Enforcement

- New York City found and eliminated an illegal sewer hookup that was contaminating Hallets Cove on the East River.
- The Department of Environmental Conservation prosecuted a polluter for an illegal hookup to a storm drain on the Catskill Creek.
- The City of Newburgh identified and eliminated several illegal sewer hookups to storm drains that had been contaminating the Hudson River.

Susan Antenen and James West sample the Pocantico River.
Photo by Tracy Brown/Riverkeeper

Public Notification

- The Sewage Pollution Right to Know Law has resulted in the public reporting of thousands of discharges, and the first-ever electronic public alerts.
- The Capital District and Kingston now report publicly online when sewage overflows.
- The Village of New Paltz has posted signs at village hall, on the Web and at public access points on the Wallkill River, to notify the public about testing data.

Watershed Protection efforts

- Water quality monitoring was the first project of the Sparkill Creek Watershed Alliance, which grows more sophisticated in its efforts to protect the creek each year.
- A Future of the Wallkill River event organized by the Village of New Paltz, SUNY New Paltz and others kicked off a new watershed protection effort.
- Environmental advisory boards in the Rondout Creek Watershed towns of Wawarsing, Rochester and Rosendale are creating a common stream walk protocol to investigate pollution and other creek issues.
- A new watershed planning effort is taking shape on the Pocantico River, following a Hudson River Watershed Alliance event.
- Several IDEXX Enterolert labs have been purchased to outfit labs in the Hudson River watershed. And Save the Sound, Charleston Waterkeeper, Peconic Baykeeper, EPA in Washington, D.C., and Waterkeepers Nepal have, or are interested in, starting similar sampling programs of their own.

Visit the Boat Blog at riverkeeper.org/patrol for more success stories and updates on the Water Quality Program.

WHAT YOU CAN DO

Kayakers get ready to clean trash from the banks of the Wallkill River as part of the 2015 Riverkeeper Sweep. *Photo by Dan Shapley/Riverkeeper*

At Home

- **Don't flush anything but toilet paper.** Many things—even facial tissues—can interfere with the mechanical or biological function of septic and sewer systems.
- **Inspect and pump your septic system.** If you don't rely on public sewers, it's your responsibility to prevent your waste from contaminating the water. For tips, visit water.epa.gov/infrastructure/septic
- **Conserve water.** The less water used at home, the less processed by the treatment plant. For tips, visit epa.gov/watersense
- **Keep yards and streets clean.** Rain and snow melt flush litter, oils, dog waste, lawn pesticides and fertilizers, and other pollution from our streets and yards into water. Keep your streets clean.

In Your Community

- **Get Involved.** Join your town's conservation advisory council, a watershed protection group, or a community science water quality sampling team.
- **Get Informed.** Sign up to receive Riverkeeper email alerts at tinyurl.com/rvk-eml, and state Sewage Pollution Right to Know discharge alerts at dec.ny.gov/chemical/90315.html.
- **Volunteer.** Join the Riverkeeper Sweep, our annual day of service for the Hudson River, a DEC Trees for Tribs planting or other activity to protect and restore a local stream.

With Riverkeeper

- **Report Pollution.** Timely reports are needed to identify and stop pollution.
- **Advocate.** Visit tinyurl.com/rvk-eml to sign up to receive action alerts.
- **Donate.** Support our work by making a donation at tinyurl.com/rvk-donate to become a Riverkeeper member.

DO NOT FLUSH THESE

- Baby wipes and diapers. Even those marked "flushable" should be tossed in the trash.
- Fats, oils, grease and food scraps. Toss them in the trash, or compost.
- Chemicals. Dispose of harsh cleaners, paints and solvents at community hazardous waste drop-off events.
- Trash. Feminine hygiene products, condoms, paper towels and dental floss should be tossed in the trash.
- Pharmaceuticals. Visit dec.ny.gov/chemical/63826.html to find secure drop off locations or events.

HOW TO MAKE A POLLUTION REPORT

Include these observations in your report:

- Date/Time/Weather Conditions
- Location
- Details – sight/smell/frequency
- Photos, video, narrative
- Your contact information

Send your reports promptly:

DEC Spills Hotline: 1-800-457-7362

Riverkeeper: 914-478-4501, ext 231

Report online: tinyurl.com/rvk-watchdog

APPENDIX
WATERBORNE ILLNESSES AND HUMAN HEALTH

Most waterborne disease-causing microorganisms are found in human and animal feces. A drop of fecal matter can contain millions of microorganisms of many types, some of which are disease-causing pathogens.[54]

The most common types of waterborne illnesses are short-term gastrointestinal infections that cause stomachaches and/or diarrhea. The elderly, children, pregnant women and people with compromised immune systems are at greater risk of getting sick.

A survey by the Center for Disease Control and Prevention found over 4,000 documented illnesses from recreational waters in the U.S. in 2005-2006.[55] However this number is assumed to be low because waterborne illnesses are underreported. The EPA has estimated that as many as 3.5 million Americans are sickened each year from contact with recreational water. People often associate the most common ailments with what they ate for lunch instead of contact with water. Still, reports of illness resulting from swimming are on the rise.

ACUTE AND CHRONIC HEALTH EFFECTS ASSOCIATED WITH WATERBORNE PATHOGENS[56]

TYPE and AGENT	ACUTE EFFECTS	CHRONIC OR ULTIMATE EFFECTS
BACTERIA		
E. coli O157:H7	Diarrhea	Adults: death (thrombocytopenia)
Legionella pneumoniae	Fever, pneumonia	Elderly: death
Helicobacter pylori	Gastritis	Ulcers and stomach cancer
Vibrio cholerae	Diarrhea	Death
Vibrio vulnificus	Skin & tissue infection	Death in those with liver disorders or problems
Campylobacter	Diarrhea	Death: Guillain-Barré syndrome
Salmonella	Diarrhea	Reactive arthritis
Yersinia	Diarrhea	Reactive arthritis
Shigella	Diarrhea	Reactive arthritis
Cyanobacteria (blue-green algae) and their toxins	Diarrhea	Potential cancer
Leptospirosis	Fever, headache, chills, muscle aches, vomiting	Weil's Disease, death (not common)
Aeromonas hydrophila	Diarrhea	
PARASITES		
Giardia lamblia	Diarrhea	Failure to thrive, lactose intolerance, severe hypothyroidism, joint pain
Cryptosporidium	Diarrhea	Death in immune-compromised host
Toxoplasma gondii	Newborn syndrome, hearing and vision loss, brain damage, diarrhea	Dementia and/or seizures
Acanthamoeba	Eye infections	
Microsporidia (Enterocytozoon & Septata)	Diarrhea	
VIRUSES		
Hepatitis viruses	Liver infection	Liver failure
Adenoviruses	Eye infections, diarrhea	
Calici-, Norwalk and small round structured viruses	Diarrhea	
Coxsackie viruses	Encephalitis, aseptic meningitis, diarrhea, respiratory disease	Heart disease (Myocarditis), reactive insulin-dependent diabetes
Echoviruses	Aseptic meningitis	

ENDNOTES

1 Riverkeeper research, based on published result and personal communications with the organizers of 36 swim events.

2 Riverkeeper has documented swimming and other primary contact recreation throughout the Hudson River estuary during 15 years of monthly boat patrols of from New York City to Waterford.

3 Riverkeeper, "Communities Need $12.7 billion in State Aid to Protect Clean Water," analysis of 2015 Multi Year Intended Use Plan for State Clean Water Revolving Loan Fund, http://www.riverkeeper.org/news-events/news/water-quality/communities-need-12-7-billion-in-state-aid-to-protect-clean-water/

4 We use the term "streetwater" instead of "stormwater" because it evokes the mix of contaminants found in urban runoff.

5 We use the term "community science" rather than the more commonly used "citizen science" because it better reflects the community groups that typify the partners we work with.

6 Riverkeeper analysis of State Pollution Discharge Elimination System (SPDES) permits.

7 In addition to New York City and northern New Jersey communities, the DEC identifies 475 regulated municipal separate storm sewer system (MS4) areas in 150 Hudson River Estuary watershed communities. Each has multiple outfalls, and there are also many unregulated separate stormwater systems.

8 An estimated 484,000 septic systems are present in counties that are part of the Hudson-Mohawk watershed, according to unpublished research, presented at the 2014 Community Development Institute, September 2014. Vedachalam, S., Joo, T. and Riha, S.J. Using Geospatial Data to Analyze Trends in Onsite Wastewater Systems Use. Manuscript in preparation. Ithaca, NY: Cornell University.

9 As of 2007, there were 5,326 farms in the Hudson Valley counties between Washington and Saratoga in the north, and Rockland and Westchester in the South, according to "The State of Agriculture in the Hudson Valley," Glynwood, 2010, last accessed at http://www.glynwood.org/files/2011/02/State_of_Ag_2010.pdf

10 Riverkeeper, Boat Blog, "Using the Clean Water Act to Address Pathogen Pollution" http://www.riverkeeper.org/patrol/using-the-clean-water-act-to-address-pathogen-pollution

11 "The size of the DEC workforce declined 10.4 percent, from 3,256 full-time equivalents (FTEs) in SFY 2003-04 to 2,917 FTEs in SFY 2013-14," New York State Comptroller, "Environmental Funding in New York State," December 2014. www.osc.state.ny.us/reports/environmental/environmental_funding_nys_2014.pdf

12 Other Riverkeeper programs focus on identification and reduction of toxic pollution. See http://www.riverkeeper.org/campaigns/stop-polluters/contaminated-sites/

13 EPA Enforcement Compliance History Online (ECHO), analysis February-March 2015. http://echo.epa.gov/

14 ibid

15 ibid

16 State Pollution Discharge Elimination System (SPDES) Permits are renewed every five years (or 10, for groundwater discharges), with full technical reviews done of a subset of permits based on the DEC's Environmental Benefit Permit Strategy. Modifications are proposed for this subset of permits based on "a change in regulations, a change in the operation of the industry or compliance issues." http://www.dec.ny.gov/docs/water_pdf/togs122.pdf

17 New York City Department of Environmental Protection, "2013-2014 MS4 Draft Annual Report," www.nyc.gov/html/dep/pdf/ms4/nycdep_ms4_annual_report_2014_draft.pdf

18 See Endnote 7 Also see http://crreo.newpaltz.edu/ms4 to see outfalls in Dutchess, Orange and Ulster counties.

19 "FIB concentrations in wet weather urban discharges from separate storm sewer systems are typically orders of magnitude above primary contact recreation standards, regardless of the land use." "Pathogens in Urban Stormwater Systems," August 2014, Urban Water Resources Research Council of the Environmental and Water Resources Institute of the American Society of Civil Engineers, Page xix

20 "Pathogens in Urban Stormwater Systems," August 2014, Urban Water Resources Research Council of the Environmental and Water Resources Institute of the American Society of Civil Engineers

21 Based on unpublished research by Dr. Greg O'Mullan.

22 "Pollutants that result from farming and ranching include sediment, nutrients, pathogens, pesticides, metals, and salts." EPA, Nonpoint Source Factsheet http://water.epa.gov/polwaste/nps/agriculture_facts.cfm

23 See Endnote 9.

24 "EPA's research also indicates that some nonhuman fecal sources (cattle in particular) may pose risks comparable to those risks from human sources." EPA, 2012 Recreational Water Quality Criteria, Page 37, http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf

25 Increasingly, regulators refer to these as "onsite wastewater treatment systems."

26 See Endnote 8

27 EPA, "Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems," http://water.epa.gov/scitech/wastetech/upload/septic_guidelines.pdf

28 EPA, "Frequently asked questions and answers for the Decentralized (Septic) Program," http://water.epa.gov/infrastructure/septic/FAQs.cfm#faq15

29 Top Ten Water Quality Issues in New York State, http://www.dec.ny.gov/docs/water_pdf/305btopten10.pdf

30 "The first step in addressing [fecal indicating bacteria] impairments is to inventory the various [fecal indicating bacteria] sources specific to the watershed, and prioritize human [fecal indicating bacteria] sources first, given the greater public health risks they may present." Urban Water Resources Research Council of the Environmental and Water Resources Institute of the American Society of Civil Engineers "Pathogens in Urban Stormwater Systems," August 2014, , page xix

31 “Human pathogens are present in animal fecal matter, and there is, therefore, a potential risk from recreational exposure to human pathogens in animal-impacted waters that must be accounted for in the 2012 [Recreational Water Quality Criteria]. For waters dominated by nonhuman sources and in the absence of site-specific criteria, EPA recommends that the national criteria be used to develop [Water Quality Standards] for all waters including those impacted by point and nonpoint sources.” EPA, 2012 Recreational Water Quality Criteria, page 38 http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf

32 “EPA recommends using the fecal indicator bacteria (FIB) enterococci and Escherichia coli (E. coli) as indicators of fecal contamination for fresh water and enterococci for marine water.” USEPA Recreational Water Quality Criteria, 2012, Page 2, http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf

33 U.S. Environmental Protection Agency (EPA), Notice of Proposed Rulemaking, NPDES Permit Requirements for Municipal Sanitary Sewer Collection Systems, Municipal Satellite Collection Systems, and Sanitary Sewer Overflows, January 4, 2001, withdrawn January 20, 2001.

34 IDEXX Enterolert, https://www.idexx.com/water/products/enterolert.html

35 “Quality Assurance Project Plan Citizen Science Water Quality Testing Program” and “Quality Assurance Project Plan Hudson River Water Quality Testing Program” are available at http://www.riverkeeper.org/water-quality/testing/

36 EPA, 2012 Recreational Water Quality Criteria, http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/RWQC2012.pdf

37 “Primary contact recreation typically includes activities where immersion and ingestion are likely and there is a high degree of bodily contact with the water, such as swimming, bathing, surfing, water skiing, tubing, skin diving, water play by children, or similar water-contact activities.” Ibid. Page 6.

38 Ibid. Page 6

39 Ibid. Page 38

40 “EPA’s 2012 RWQC are for all waters in the United States including marine, estuarine, Great Lakes, and inland waters that are designated for primary contact recreation.” Ibid. Page 6.

41 The tidal portions of the Catskill, Esopus and Rondout creeks are part of the Hudson River Estuary, which is class A in this stretch, but the creeks are designated Class C. The Gowanus Canal and Newtown Creek are Class SD.

42 Four exceptions include Tarrytown Marina (33 samples), Gowanus Canal (36 samples) and the two Newtown Creek locations (51 samples).

43 “When identifying sampling frequency as part of a state’s monitoring plan, a state may consider that, typically, a larger dataset will more accurately characterize the water quality in a waterbody, which may result in more meaningful attainment determinations. Therefore, EPA is recommending that states conduct at least weekly sampling to evaluate the GM and STV over a 30-day period and encourages more frequent sampling at more densely populated beaches.” EPA 2012 Recreational Water Quality Criteria, Page 42.

44 See National Association of City and County Health Organizations, “Statement of Policy on Recreational Water Safety” www.riverkeeper.org/wp-content/uploads/2015/03/NACCHO-15-01-recreational-water-safety-march-2015.pdf

45 EPA, “Models for Predicting Beach Water Quality,” http://www2.epa.gov/beach-tech/models-predicting-beach-water-quality

46 NYS Department of Environmental Conservation, “Wastewater Infrastructure Needs of New York State” http://www.dec.ny.gov/docs/water_pdf/infrastructurerpt.pdf

47 NYS Comptroller, “Growing Cracks in the Foundation: Local Governments Still Challenged to Keep Up with Local Infrastructure Needs” http://www.osc.state.ny.us/press/releases/sept14/090914b.htm

48 The Environmental Protection Fund lines should be increased for “Wastewater Treatment Improvement Projects,” “Non-Agricultural non-point Source Abatement and Control Projects” and “Agricultural non-point Source Abatement and Control Projects.”

49 Including the Department of Environmental Conservation’s Hudson River Estuary and Water Quality Improvement Project programs, and the Department of State’s Local Waterfront Revitalization Program.

50 EPA, “Nine Minimum Elements to Be Included in a Watershed Plan for Impaired Waters Funded Using Incremental Section 319 Funds” http://www.epa.gov/region9/water/nonpoint/9elements-WtrshdPlan-EpaHndbk.pdf

51 DEC Division of Water presentation to Water Management Advisory Committee, Nov. 20, 2014

52 While the number of facilities with water discharge permits in significant non-compliance rose 18.6% from 2010 to 2014, the number of enforcement actions fell 64.2%. NYS Comptroller, “Environmental Funding in New York State,” December 2014, www.osc.state.ny.us/reports/environmental/environmental_funding_nys_2014.pdf

53 Sampling frequency for fecal indicating bacteria at municipal wastewater treatment plants is determined by a 1973 agreement between the Environmental Protection Agency and Department of Environmental Conservation that sets limits based on the volume of discharge, with the smallest plants required to test effluent only twice per year. DEC, “Division of Water Technical and Operational Guidance Series (1.3.3) SPDES PERMIT DEVELOPMENT FOR POTWS” Appendix A www.dec.ny.gov/docs/water_pdf/togs133.pdf

54 Rose, J.B., et al., “Microbial Pollutants in Our Nation’s Waters: Environmental and Public Health Issues, American Society for Microbiology, Washington, D.C., 1999, p. 8.

55 Yoder, J., et al., Surveillance for Waterborne Disease and Outbreaks Associated with Recreational Water Use and Other Aquatic Facility-Associated Health Events, Center for Disease Control, Washington D.C., 2008.

56 Centers for Disease Control and Prevention. Emerging Infectious Diseases, vol. 3, no. 4, Oct-Dec 1997.

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NY's clean water advocate

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