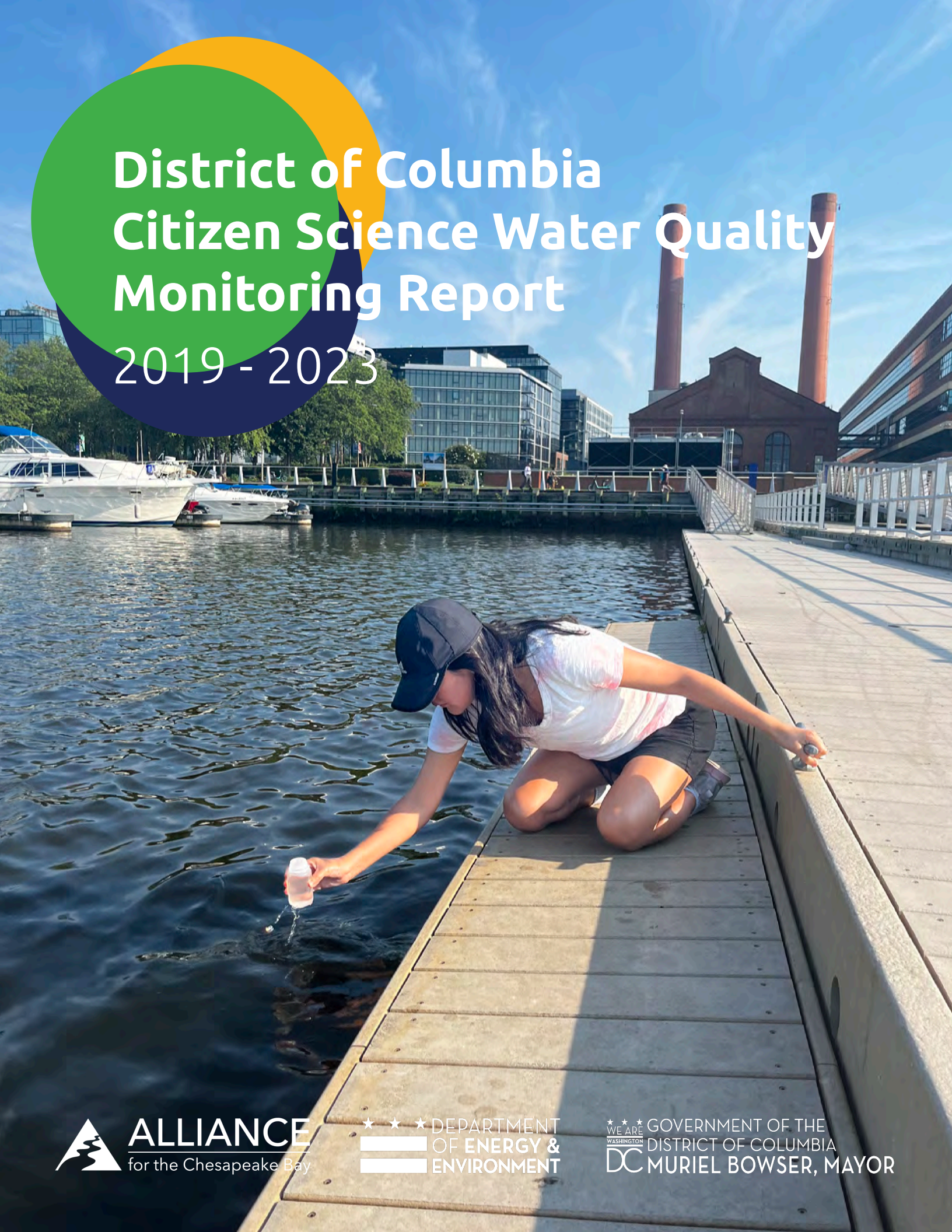
District of Columbia Citizen Science Water Quality Monitoring Report

2019 - 2023



ALLIANCE for the Chesapeake Bay

DEPARTMENT OF ENERGY & ENVIRONMENT

WE ARE WASHINGTON DC GOVERNMENT OF THE DISTRICT OF COLUMBIA
MURIEL BOWSER, MAYOR

Executive Summary

The DC Citizen Science Water Quality Program has gathered and shared water quality data for 24 sites since 2019. With five years of data, we can examine trends in *E. coli* bacteria levels, turbidity, pH, and water temperature. This has helped us understand which sites consistently have good water quality, where restoration is needed, and how rain events influence water quality. We've found a few key takeaways:

1 Precipitation

After rain, pollutants including bacteria can be washed into streams and rivers across DC through **stormwater runoff.** We consistently found higher bacteria levels after rain.

2 Mainstem vs. Tributaries

Mainstem river sites have higher **water volume** than streams, which helps dilute bacteria. Streams usually weave closer to urbanized areas, so stormwater runoff has a more immediate effect on them.

3 Wastewater infrastructure

A major source of bacteria is wastewater systems. DC Water's Clean Rivers project builds new overflow tunnels and fixes aging sewer pipes. Sites affected by completed projects have better water quality.

Better Sites

Tidal Basin (PR-6)
Columbia Island (PR-7)
Kingman Island (AR-3)
Buzzard Point (AR-6)
Washington Channel (AR-7)

What do these have in common?

They are on the **mainstem** of rivers, so they get a lot of water flowing through the site. They are also generally further **downstream** and far from combined sewer outfalls.

Worse Sites

Normanstone Run (RC-7)
Pinehurst Branch (RC-2)
Hickey Run (AR-2)
Watts Branch (WB-1 & WB-2)
Battery Kemble (PR-1)

What do these have in common?

They are small **streams**, so they have relatively little water flow. These sites are in need of major repairs to local sewer infrastructure.

We encourage you to check the water quality before recreating and avoid contact with water for 72 hours after rain. During the summer, weekly results can be found on the Swim Guide app, the Alliance for the Chesapeake Bay website, and social media. Share this data and knowledge with your community to raise awareness about water quality in the District.

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Introduction

Swimming has been illegal in District waters since the 1970s. The swim ban was established as a human health protection as waters throughout the District have historically suffered from poor water quality. Today, recreation along waters in the District is increasingly popular with thousands of residents and visitors rowing, boating, and splashing in streams, despite variable water quality. In order for people to safely enjoy our local waterways, timely water quality data needs to be available to the public so they can make informed decisions about their potential recreation.

In 2018, the Department of Energy and Environment (DOEE) awarded a grant to Anacostia Riverkeeper and their partners to establish a volunteer-based water quality monitoring program in District waters and provide up-to-date information about the safety of the water near popular recreation sites. The summer of 2023 marked the fifth year of this project, with Alliance for the Chesapeake Bay currently implementing the project along with partners; Anacostia Riverkeeper, Nature Forward (formerly Audubon Naturalist Society), and Rock Creek Conservancy.

As in most urban watersheds, sewage and stormwater runoff are the biggest contributors to high bacteria levels in District waters. DC's wastewater system is split into two types: a combined sewer system (CSS) and a Municipal Separate Stormwater Sewer System (MS4). In areas serviced by CSS, rainwater and sewage are combined, which can lead to overflows of sewage (CSOs) into rivers after rain events. MS4 maintains separate piping for rainwater and sewage, and rainwater flows directly into waterways without being treated.

Climate change is leading to more significant storm events, increasing stormwater runoff and the frequency of CSOs. Infrastructural improvements have made important strides in mitigating stormwater and improving water quality across the District. Tunnels built by the DC Water Clean Rivers Project have reduced CSOs by holding excess water from heavy rain events that would otherwise overflow into the river. The Anacostia Tunnel was completed in 2018, the Northeast Boundary Tunnel completed in late summer 2023, and the Potomac River Tunnel is set to begin construction in 2024.

This report covers key data and takeaways from citizen science monitoring from 2019-2023 and gives insight on water quality near popular recreation sites across the District.

Project Overview

Volunteer citizen science monitors collect water quality samples and measurements on Wednesday mornings from 24 sites across the Anacostia River, Potomac River, and Rock Creek for 20 weeks from May to September. At each site, monitors measure air temperature, water temperature, and pH, collect water samples for bacteria and turbidity analysis, and record observations about the site (stream flow, odor, debris, recreation, etc.). Water samples are then analyzed at Anacostia Riverkeeper's lab with results reported weekly on social media, the Swim Guide app, and the Chesapeake Monitoring Cooperative's Data Explorer.

What are we monitoring?

Fecal Indicator Bacteria (*E. coli*)

Bacteria can enter waterways from sewage and stormwater runoff. The program analyzes *E. coli*, which serves as an "indicator" bacteria for other more harmful bacteria that can cause illness in humans.

Turbidity

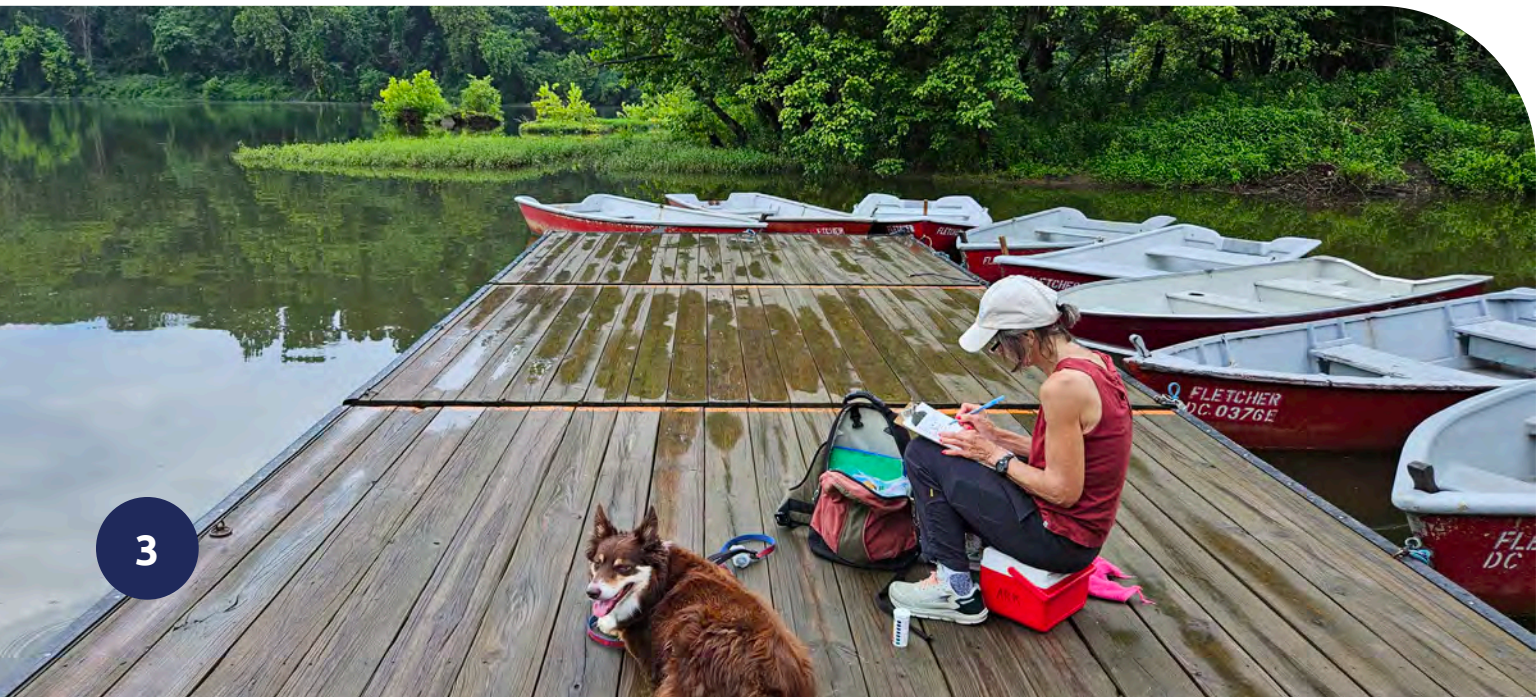
Turbidity is a measure of water clarity, or how much "stuff" is suspended in the water. Suspended sediment can act as a vector for bacteria, so higher turbidity is thought to be associated with higher bacteria.

Acidity or Alkalinity (pH)

pH is the measure of how acidic or alkaline a waterbody is on a scale of 0 (very acidic) to 14 (very alkaline).

Water and Air Temperature

Temperature has daily and seasonal cycles and affects both biological and physical characteristics of an ecosystem.



When is water safe for recreation?

While there are natural bacteria that occur in our waterways, harmful bacteria from the feces of humans and other warm blooded animals can enter waterways through sewer systems and stormwater runoff. *E. coli* is used as an indicator of potentially harmful pathogens that may be present in the water. The District has recreational water quality standards based on the Environmental Protection Agency's (EPA) standards to reduce risk of illness from accidental water ingestion while recreating. When a site passes these standards, we can say it's safe for water-based recreation.

Bacteria *(E. coli)*		Turbidity	pH
Single-sample value (SSV): SSV shows bacteria levels at a specific time and place. If SSV is below 410 MPN then the site is safe for recreation.	**<410 MPN/100 mL**	<20 NTU above ambient	6 - 8.5
Geometric mean (GeoMean): GeoMean is a five-week average for a specific place. If Geo-Mean is below 126 MPN then the site is safe for recreation.	**<126 MPN/100 mL**		

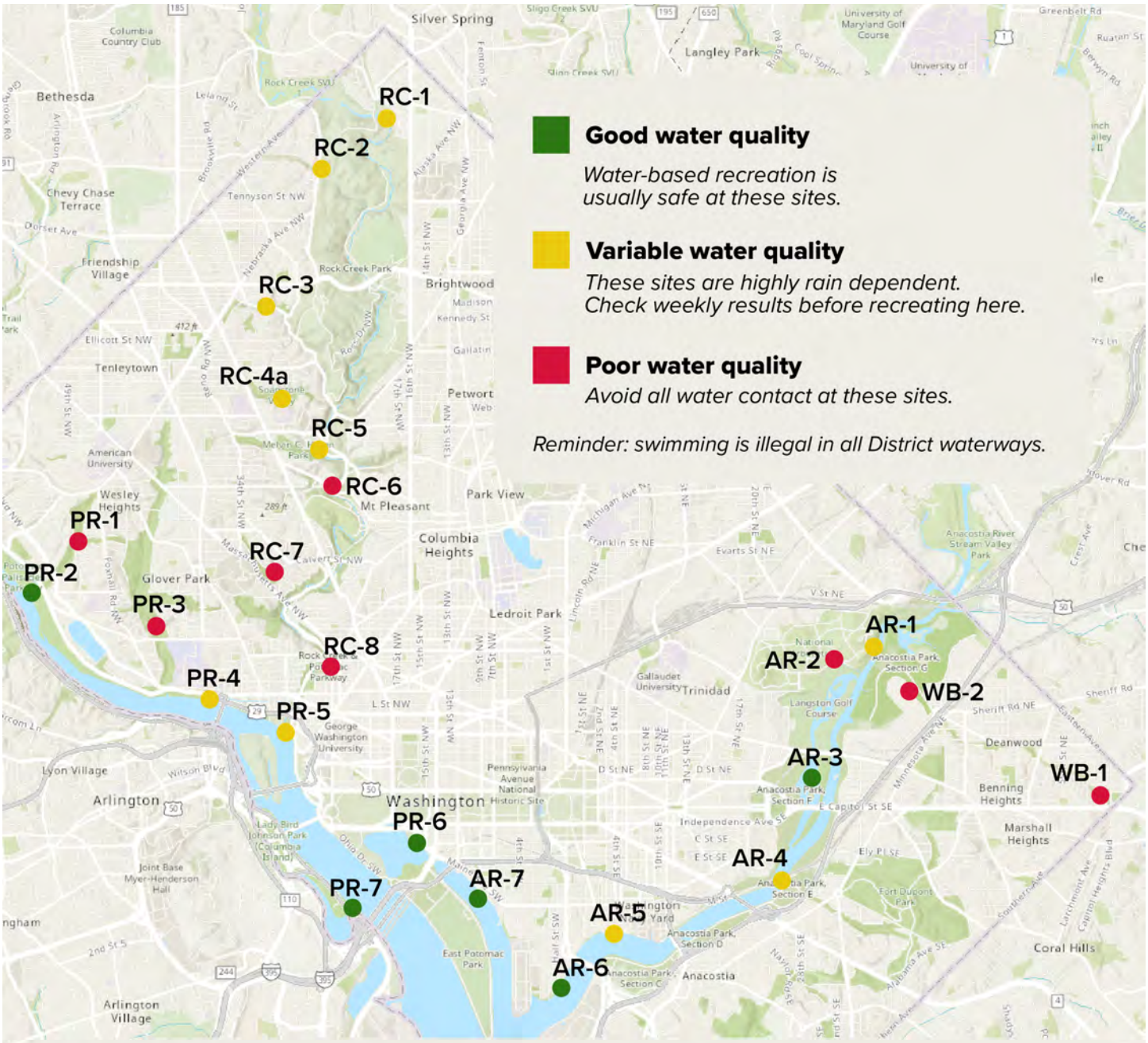
Water quality is generally worse after rain. To track trends with rain, we define "dry" and "wet" conditions, where a "wet" day indicates there was more than half an inch of rain in the 72-hours before sampling.

How do we analyze samples?

Monitors collect two water samples per site and deliver them to Anacostia Riverkeeper's lab to analyze *E. coli* and turbidity. *E. coli* samples are analyzed using the IDEXX Colilert system. Each sample is mixed with a Colilert reagent, poured into a quanti-tray, and placed in an incubator at 35℃ for 24 hours. The quanti-tray is then examined under blacklight to count how many wells glow, indicating the amount of *E. coli* in the sample. *E. coli* is reported in Most Probable Number of Coliform Forming Units (MPN) per 100mL of sample.

Turbidity samples are assessed using a LaMotte 2020we/wi turbidimeter, which passes light through the sample to determine its clarity. If a lot of light passes through, then turbidity is low, and vice versa.

2023 DC Water Quality Snapshot



Rock Creek Sites

- RC-1: Juniper St
- RC-2: Pinehurst Branch
- RC-3: Broad Branch
- RC-4a: Soapstone Creek
- RC-5: Reservation 630
- RC-6: Below Piney Branch
- RC-7: Normanstone Run
- RC-8: P St Beach

Potomac Sites

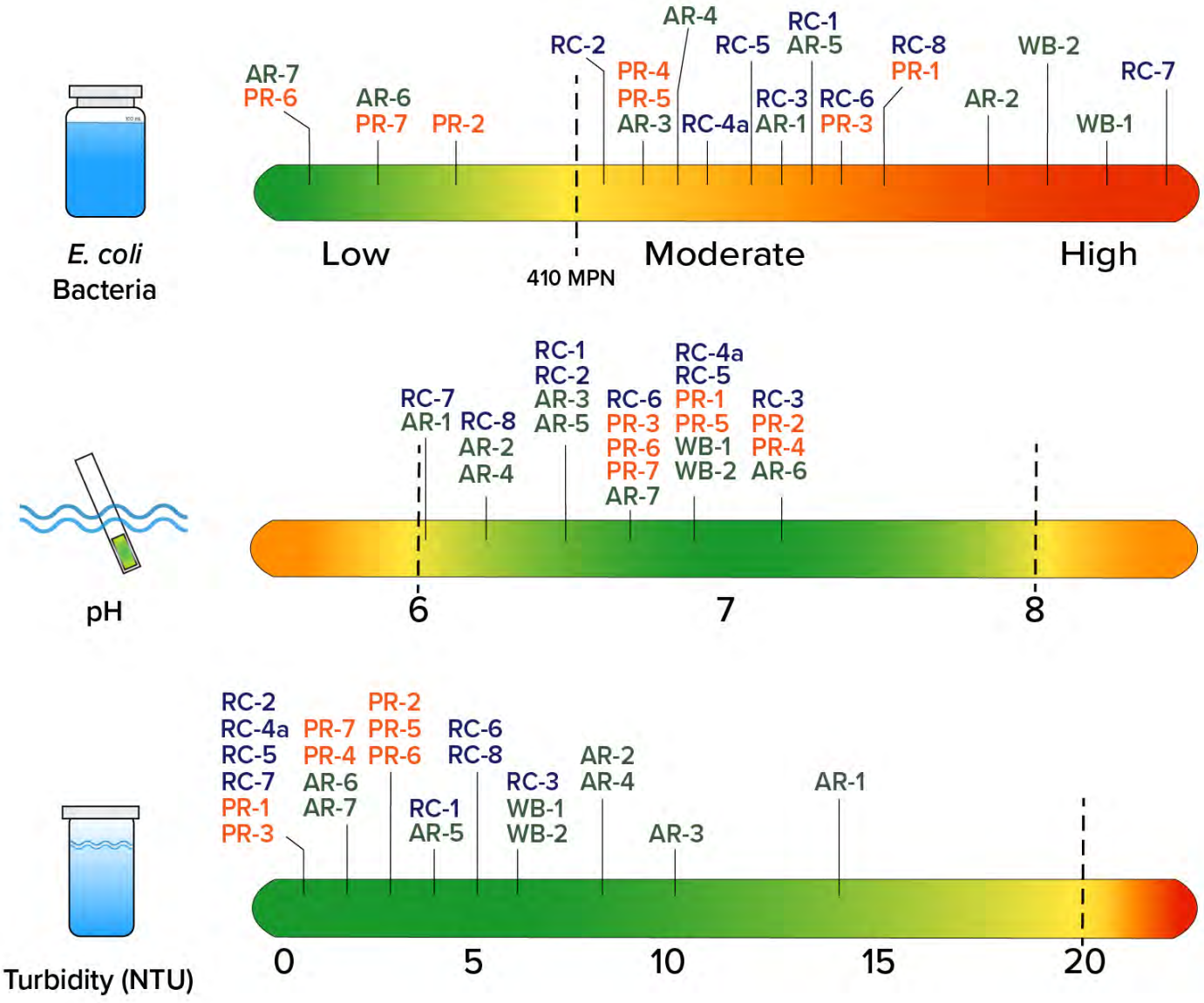
- PR-1: Battery Kemble Park
- PR-2: Fletchers Cove
- PR-3: Foundry Branch
- PR-4: Washington Canoe
- PR-5: Thompson Boat Center
- PR-6: Tidal Basin
- PR-7: Columbia Island

Anacostia Sites

- AR-1: National Arboretum
- AR-2: Hickey Run
- AR-3: Kingman Island
- AR-4: Anacostia Park
- AR-5: Yards Marina
- AR-6: Buzzard Point
- AR-7: Washington Channel
- WB-1: Watts Branch at Marvin Gaye Park
- WB-2: Watts Branch at Kenilworth Park

2023 Water Quality Averages for All Sites

In 2023, water quality results showed similar trends to previous years, with some improvements at certain sites. The graphic below shows the average values for all water quality parameters for every site in 2023. The dashed line shows the “passing” level for recreational standards. While bacteria levels ranged across the monitored sites, all other measures of water quality including pH and turbidity were almost always within the acceptable range.

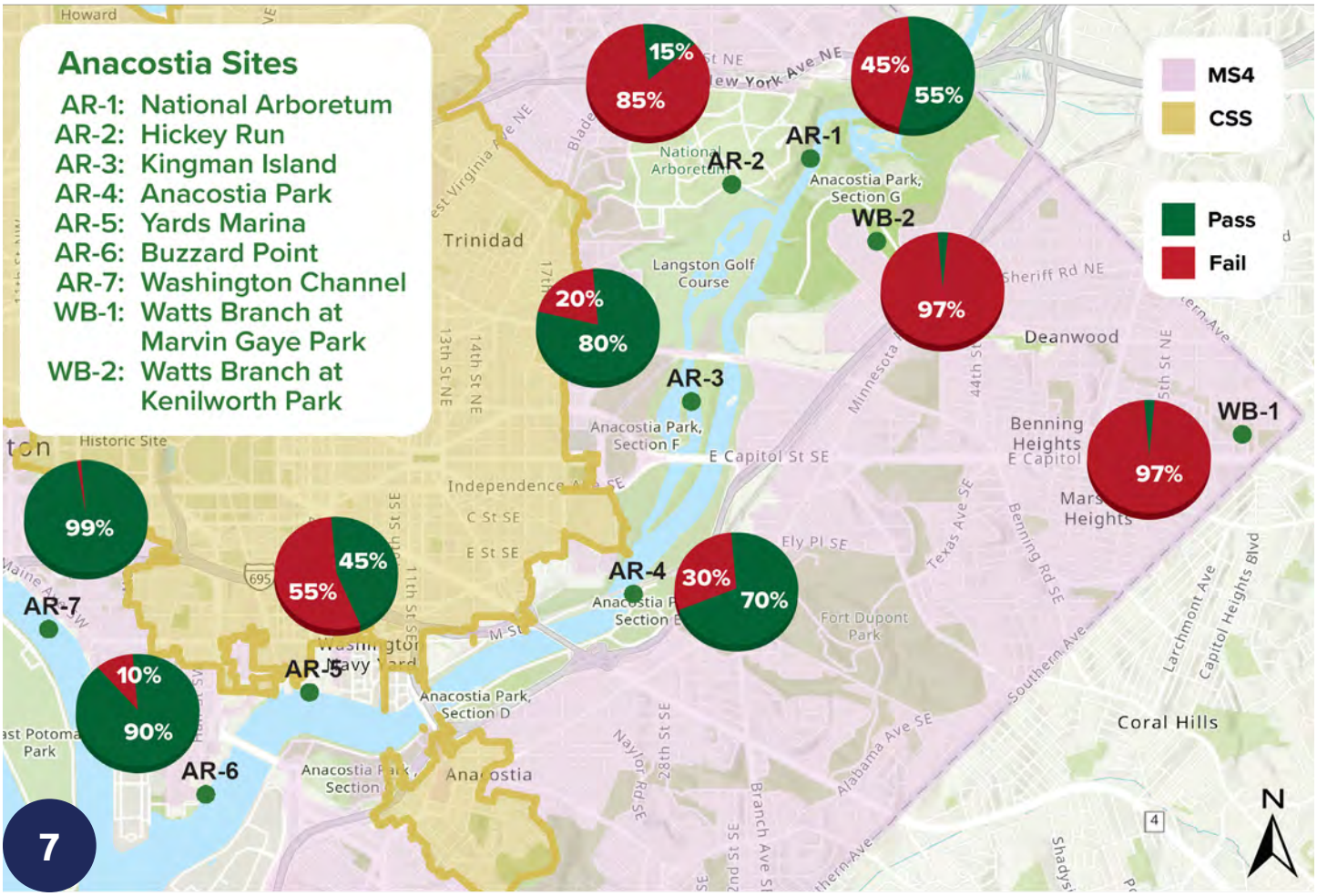


*Value is the mean per site for each water quality parameter for the 2023 season.

Anacostia River

The program monitors at nine sites in the Anacostia watershed: six sites on the mainstem of the river and three in tributary streams. Mainstem sites show consistently better water quality than tributaries, given the increased flow and volume of water. Multiple mainstem locations, especially those far from CSOs, have shown consistently passing water quality over the past five years — Washington Channel (AR-7), Buzzard Point (AR-6), and Kingman Island (AR-3). The Washington Channel only failed to reach recreational standards once in 100 weeks of sampling. The National Arboretum (AR-1), Anacostia Park (AR-4), and Yards Park (AR-5) had more variable results, with bacteria levels heavily tied to rain. Watts Branch (WB-1 and WB-2), a major tributary flowing through Ward 7, failed water quality almost every week even in dry conditions. DOEE's Illicit Discharge Branch is working to identify and remedy illicit connections to stormwater pipes in this area. Future monitoring will show if these corrections have an impact on high *E. coli* results in Watts Branch and Hickey Run.

Percentage of weeks each site passed bacteria standards (2019-2023)



*Graphic shows percent passing for *E. coli* single sample value (SSV). See Appendix Fig 1 for Geometric Mean data.

The Clean Rivers Project Tunnels

The program has been able to monitor the impact of the Clean Rivers Anacostia River Tunnel that came online in 2018 and has diverted 90% of combined sewer overflows from entering the river. In July-August 2023, this tunnel was inactive due to construction of the Northeast Boundary Tunnel. On rainy weeks during this time, some Anacostia sites had much higher bacteria levels compared to previous wet weeks (Appendix: Fig 11). Though limited data, this could support the effectiveness of the Clean Rivers tunnels in preventing CSOs and improving water quality.

Precipitation Trends

Trends between bacteria levels and rain underscore a key takeaway – **bacteria levels are higher after rain**. Over 5 years, mainstem sites passed recreational standards 81% of the time in dry conditions versus only 61% of the time in wet conditions.

There was also a trend of improvement to mainstem sites in “dry conditions” over time—the number of sites that passed recreational standards on dry days increased consistently from only 69% in 2019 to 95% in 2023 (Appendix: Figure 6). This suggests greater reliability for overall water quality in the Anacostia River in dry conditions.

> “I started water quality monitoring because I thought it would be fun to get involved in local citizen science.
>
> **- Kori Majeed**

Anacostia Watershed Summary

Better Water Quality for Recreation

Washington Channel (AR-7)
Buzzard Point (AR-6)
Kingman Island (AR-3)
Anacostia Park (AR-4)

mainstem sites pass

73%

of the time

tributary sites pass

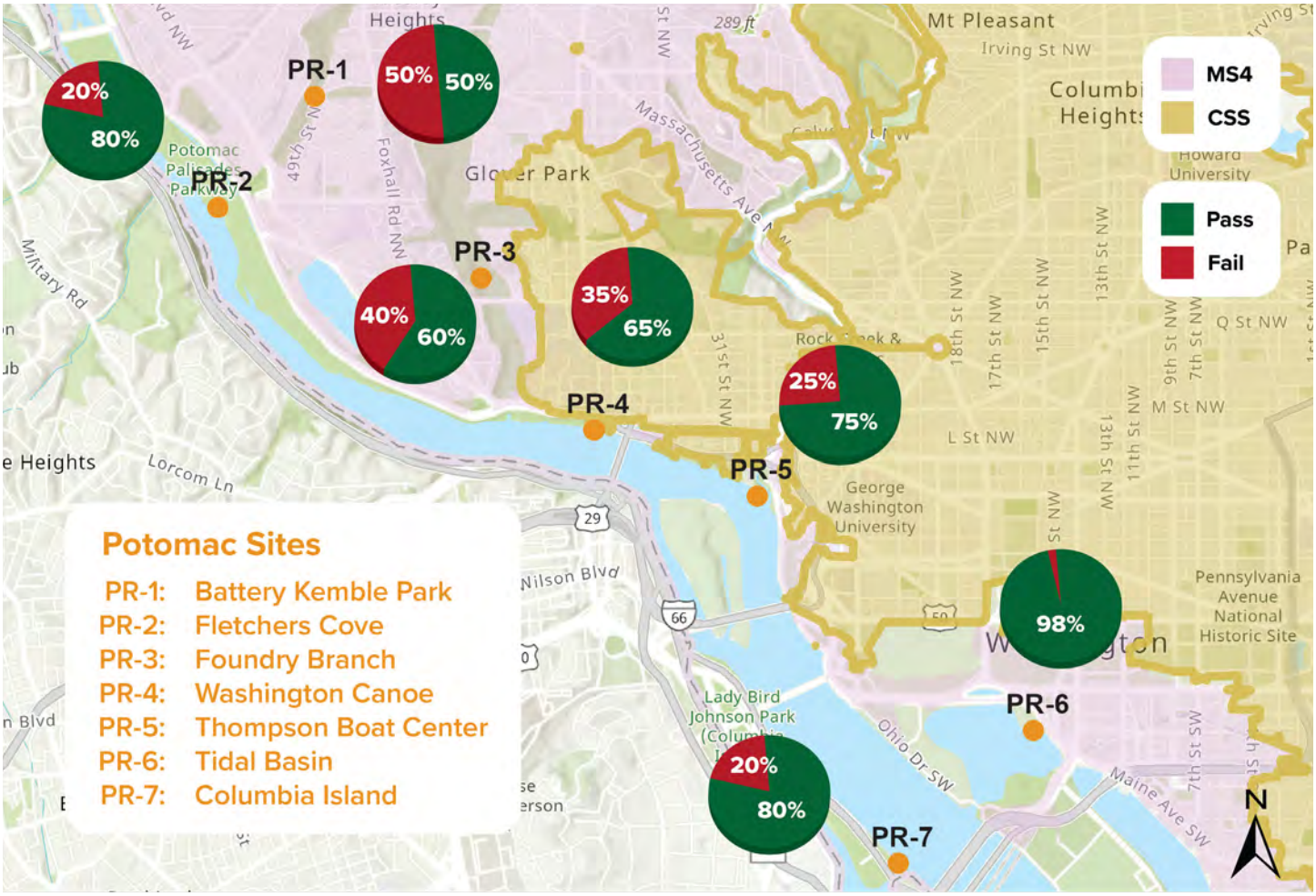
7%

of the time

Potomac River

The Potomac River watershed has better overall water quality in comparison to Anacostia River and Rock Creek. There are seven sites monitored in the Potomac watershed, with five on the mainstem and two in tributaries within the District. Tidal Basin (PR-6), a mainstem site with popular paddle boat rentals, had consistently excellent water quality rain or shine. Fletcher's Cove (PR-2), Thompson Boat Center (PR-5), and Columbia Island (PR-7) were reliably safe during dry conditions, but bacteria levels increased when it rained. However, Washington Canoe Club (PR-4), which is located directly next to a combined sewer outfall, and tributary sites Battery Kemble Park (PR-1) and Foundry Branch (PR-3) had extremely variable results in both dry and wet conditions. Hikers should be cautious on trails that involve stream crossings in this region.

Percentage of weeks each site passed bacteria standards (2019-2023)



*Graphic shows percent passing for *E. coli* single sample value (SSV). See Appendix Fig 2 for Geometric Mean data.

> "It not only provides a greater depth of knowledge but also a sense of ownership and responsibility for things that are often taken for granted, like our local waterways.
>
> **- Christina Hernandez**

Wastewater: CSS vs. MS4

Water quality in the Potomac River is highly influenced by the type of sewer system in that area. Washington Canoe Club (PR4) and Thompson Boat Center (PR5) are near or directly downstream from CSOs, meaning the water quality has a higher potential to be impacted by heavy rain than those in other areas of DC serviced by MS4. Foundry Branch (PR1) is serviced by MS4 and in a direct drainage area, which means stormwater drains directly into the stream. This site had the most variable water quality of all the Potomac River sites. **Reducing CSOs and overall stormwater runoff is key to making recreation safer.**

Precipitation Trends

While most Potomac sites often passed recreational water quality standards in dry conditions, water quality in the Potomac River was extremely variable in wet conditions (Appendix: Fig 8). This is consistent with precipitation trends across the city – **water quality is worse after rain**. We encourage you to avoid contact with water for 72 hours after rain.

Potomac River Watershed Summary

Better Water Quality for Recreation

Tidal Basin (PR-6)
Columbia Island (PR-7)
Fletcher's Cove (PR-2)
Thompson Boat Center (PR-5)

mainstem sites pass

79%

of the time

tributary sites pass

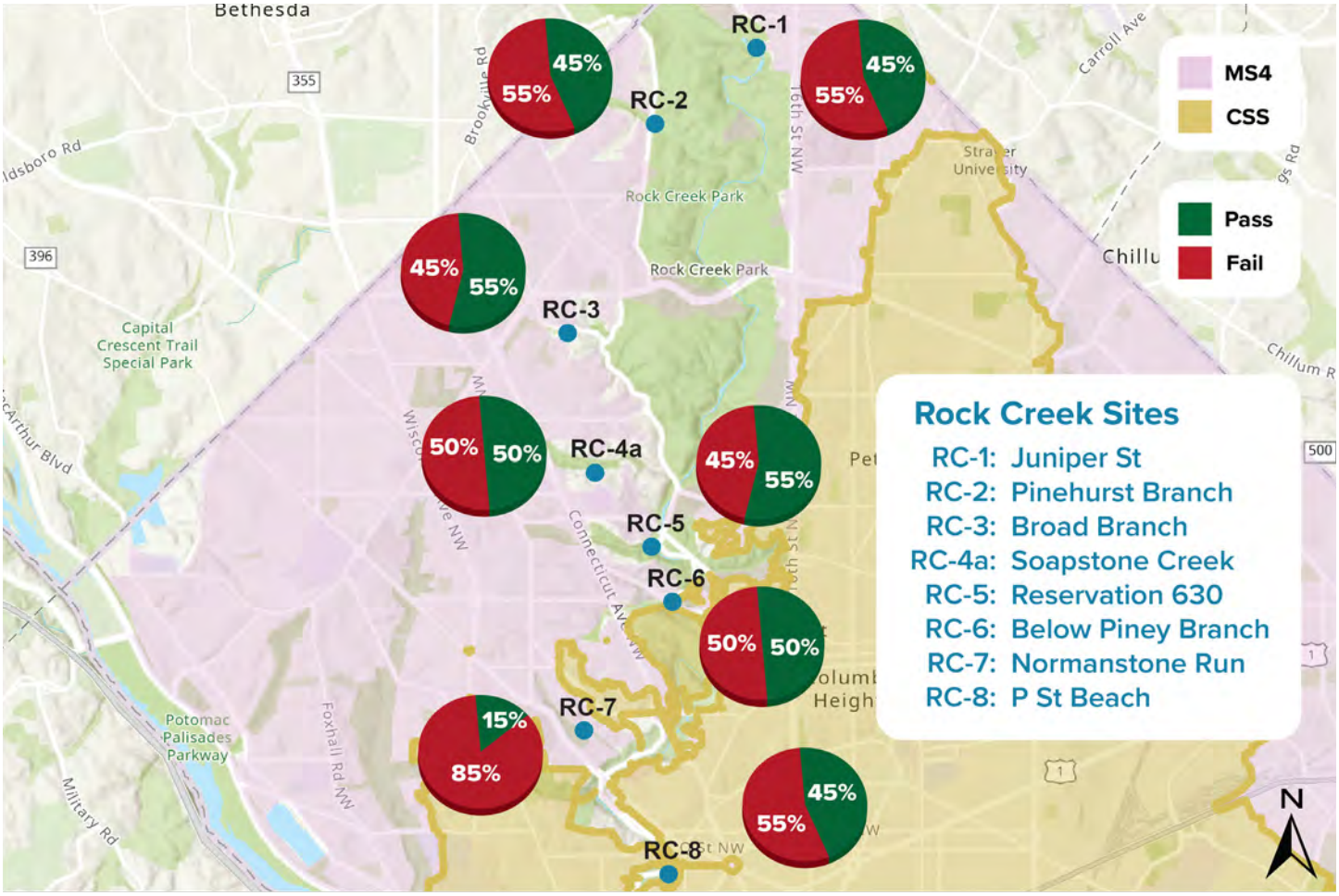
53%

of the time

Rock Creek

Monitoring sites in Rock Creek span from the northern point of DC down to near where Rock Creek converges with the Potomac River. Despite its recreational popularity, Rock Creek and its streams have seen poor overall water quality in the five years of the project, with less than half of collected samples passing recreational standards. Normanstone Run (RC-7) had the worst water quality, rarely passing water quality standards even in dry conditions. Its consistently high bacteria levels are concerning, especially given it is a heavily visited area of the park. Some upstream sites (RC1-4a) saw improvements in 2023, which gives us hope for future water quality, but caution should still be taken in all Rock Creek streams. DOEE is actively investigating illicit sanitary discharges in Pinehurst Branch (RC-2), Soapstone Creek (RC-4a), and Normanstone Run (RC-7) and will continue to find and repair illicit connections.

Percentage of weeks each site passed bacteria standards (2019-2023)



*Graphic shows percent passing for *E. coli* single sample value (SSV). See Appendix Fig 3 for Geometric Mean data.

Soapstone Creek - Sewer Rehabilitation Project

DC Water began the Soapstone Valley Sewer Rehabilitation Project in 2021 to address aging and defective sewer pipes. This site (RC-4a) had much lower bacteria levels in 2023 than previous years. Continued monitoring will help understand if the infrastructure repairs have impacted water quality. Other planned infrastructure projects offer additional hope for Rock Creek.

Rock Creek Watershed Summary

sites pass

54%

of the time in dry conditions

> "I like learning about the environmental challenges that come from living in a city and thinking about how to raise awareness about them.
>
> **- Douglas McRae**

sites pass

28%

of the time after rain

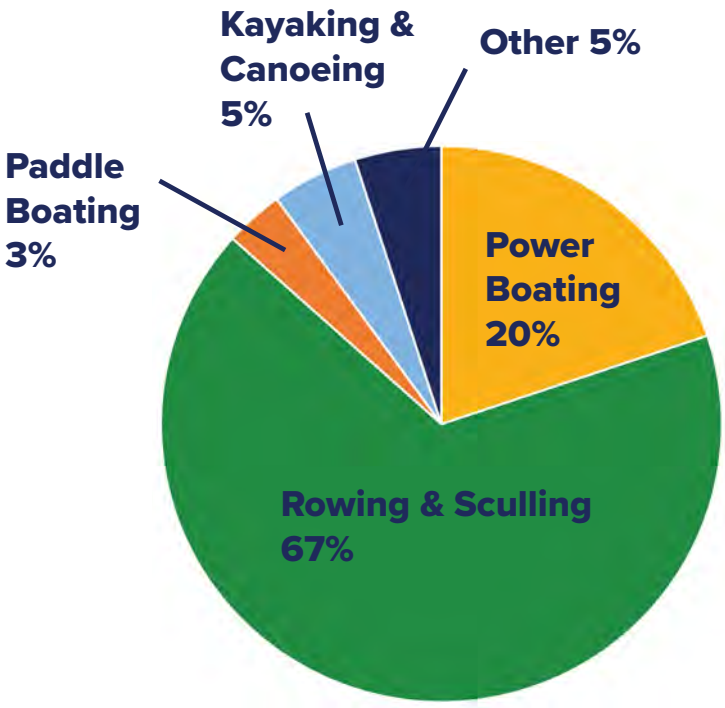
#RecreateResponsibly Campaign

Rock Creek has the perception of being a clean, urban oasis, however the data indicates it often has poor water quality. Rock Creek Conservancy and NPS implemented the #RecreateResponsibly campaign in 2020 to educate visitors about safe ways to enjoy Rock Creek. Signage in both English and Spanish near stream entry points warn people to "Stay Dry, Stay Safe." Recreation on the water dropped by more than 50% since 2020, suggesting similar signage could be effective at other sites with poor water quality.

Recreational Use

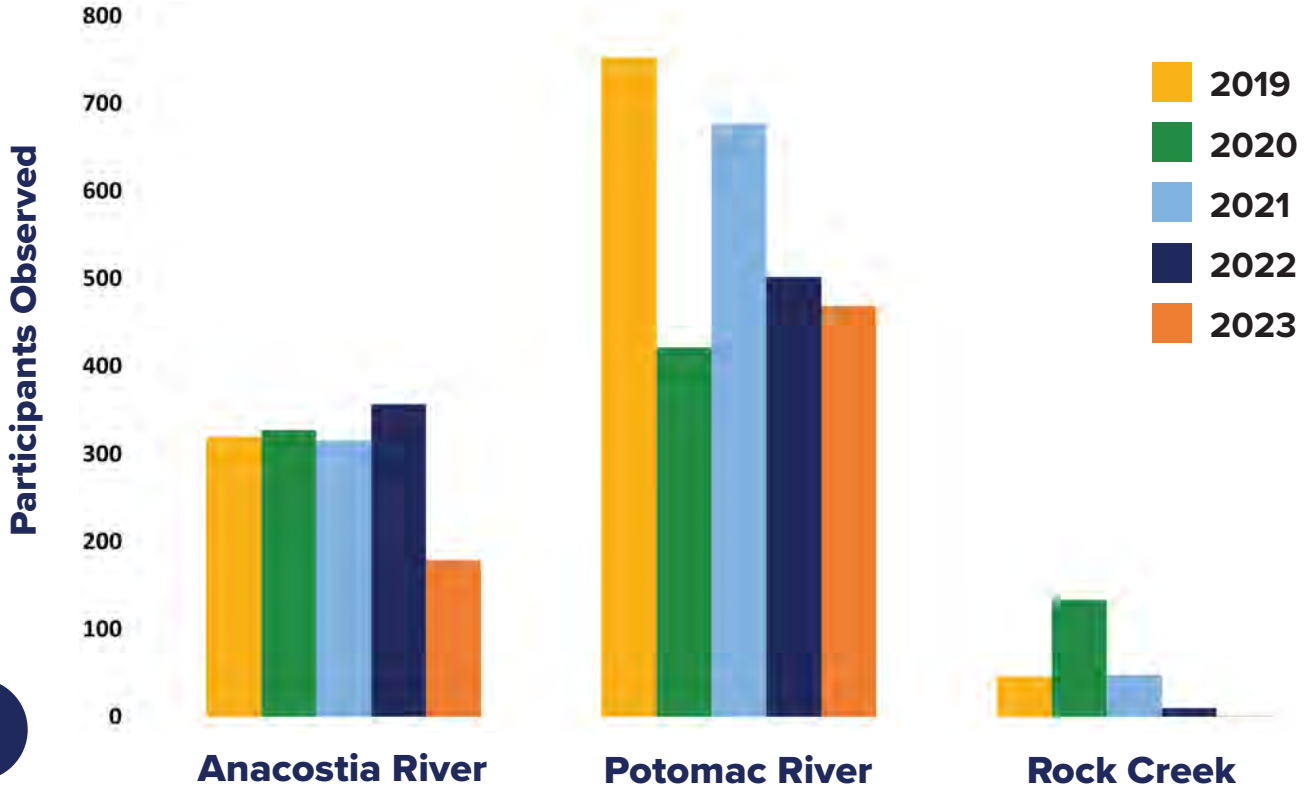
Monitors recorded observations of water activities at sites to gather data on the amount and type of recreation prevalent across District waters during their Wednesday morning monitoring efforts. The most common activities were rowing/sculling, primarily observed at sites near docks and boat launches on the Potomac and Anacostia Rivers. Many power boats were also observed, especially at downstream sites with good water quality. Monitors often observed continued recreation on days after heavy rain, especially around Thompson Boat Center and other popular rowing locations. More outreach to these communities is needed to raise awareness about water quality trends with precipitation.

Most Common Water Activites



Water-based recreation in Rock Creek declined from 2020-2023, suggesting the #RecreateResponsibly campaign has been successful in increasing awareness about Rock Creek's poor water quality. Dogs are still often observed in the water, however, which poses health risks to pets and their owners. While Rock Creek's poor water quality persists, expanding access to free and safe places for water play, like pools and splash pads, is essential to ensuring all residents have access to clean water for recreation.

Total Recreation Observed in District Waters from 2019-2023



THANK YOU TO OUR VOLUNTEERS!

This project would not succeed without the dedication of all our citizen science volunteers who, for the past five years, have spent their Wednesday mornings collecting samples for this project. We thank them for their time, enthusiasm, and commitment to the District's waterways.

Over the past five years, the program has trained over 400 volunteers from all 8 DC wards, collected over 5,000 water samples, and provided over 13,500 data points in weekly water quality updates to DC recreators. We look forward to growing the program to continue protecting District waters.

"I monitor because it helps to make DC feel more like home, it connects me to the waterways, and helps me care for my community.

- Andrea Contreras

"I live on a boat full-time at The Wharf Marina in SW DC so water quality is always top of mind! Playing a small role in the process is important to me.

- Stefanie Brown

"I would like to see our rivers be safe and enjoyable places to recreate. It is important to regularly test the waters to monitor the progress being made.

- Richard Viola

Program Summary

13,500+
data points

2,500+
bacteria samples

400+
volunteers

21.5 mi.
of water monitored

Conclusion

Based on the last 5 years of data, we have found the Tidal Basin, Washington Channel, Buzzard Point, Kingman Island, and Fletcher's Cove are the better sites for water recreation, as they consistently pass recreational water quality standards regardless of rainfall. Other sites need more caution and tributary streams should generally be avoided. We encourage everyone to check the data weekly during the summer and avoid contact with water for 72-hours after heavy rain.

DOEE has funded our work in order to advance scientific and community understanding of safety in our beautiful waterways. Ultimately, all District waterways should be safe and clean enough to support swimming, fishing, and other recreation as well as a healthy aquatic ecosystem. We look forward to measuring the impact of the newly opened Northeast Boundary Tunnel and start of construction of the Potomac River Tunnel next year. The need to reduce bacterial pollution continues, not only in places where CSOs continue to discharge sewage but also in the smaller tributaries. Let's get the bacteria out and DC back in the water.

Want to become a monitor?

Training for the new wave of volunteers will begin in April 2024. The interest form can be found on the Alliance for the Chesapeake Bay's monitoring page. Follow us on social media or reach out to monitor@anacostiariverkeeper.org to stay updated on future trainings.

Interested in the data?

Check out the Chesapeake Monitoring Cooperative's Data Explorer to see the full data, or email monitor@anacostiariverkeeper.org for specific questions. During the summer, check Swim Guide and social media for weekly results.

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ANACOSTIA RIVERKEEPER®

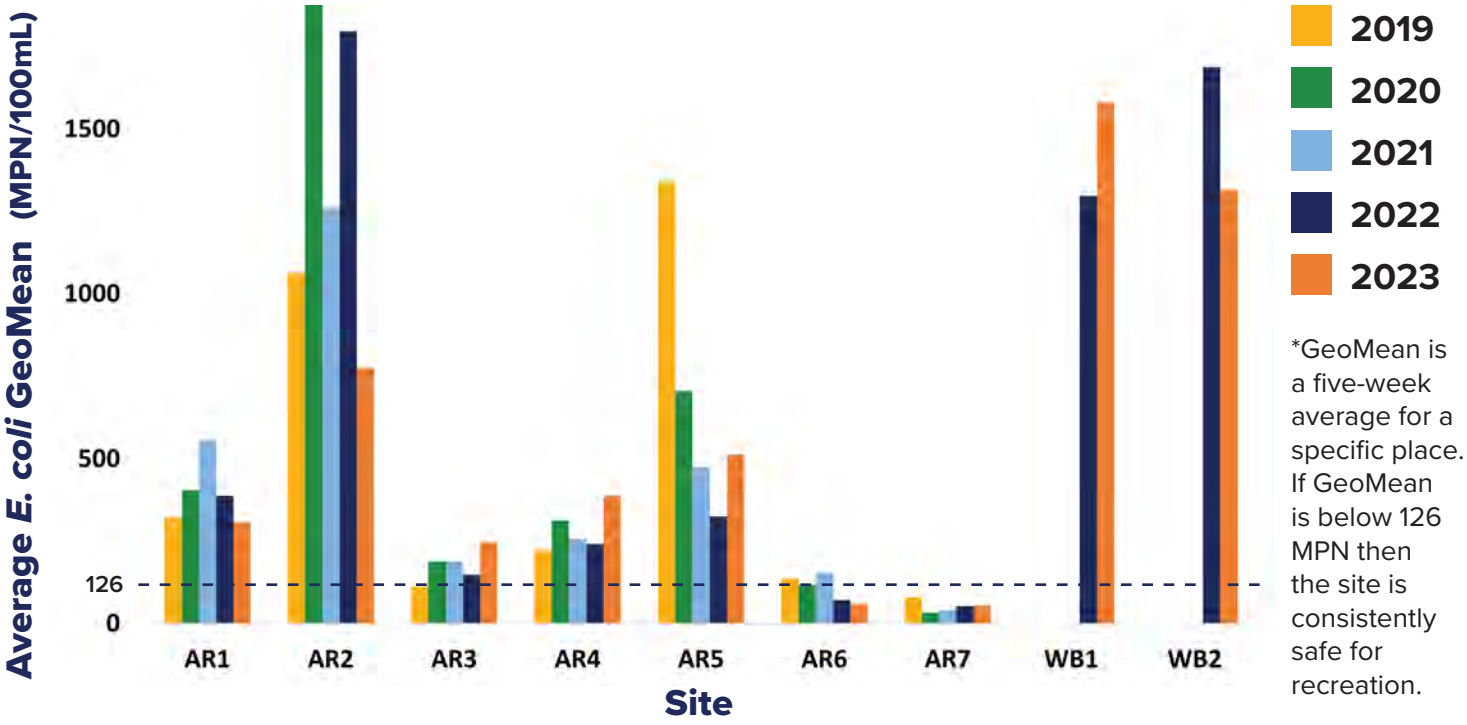
ROCK CREEK CONSERVANCY

nature forward

Appendix

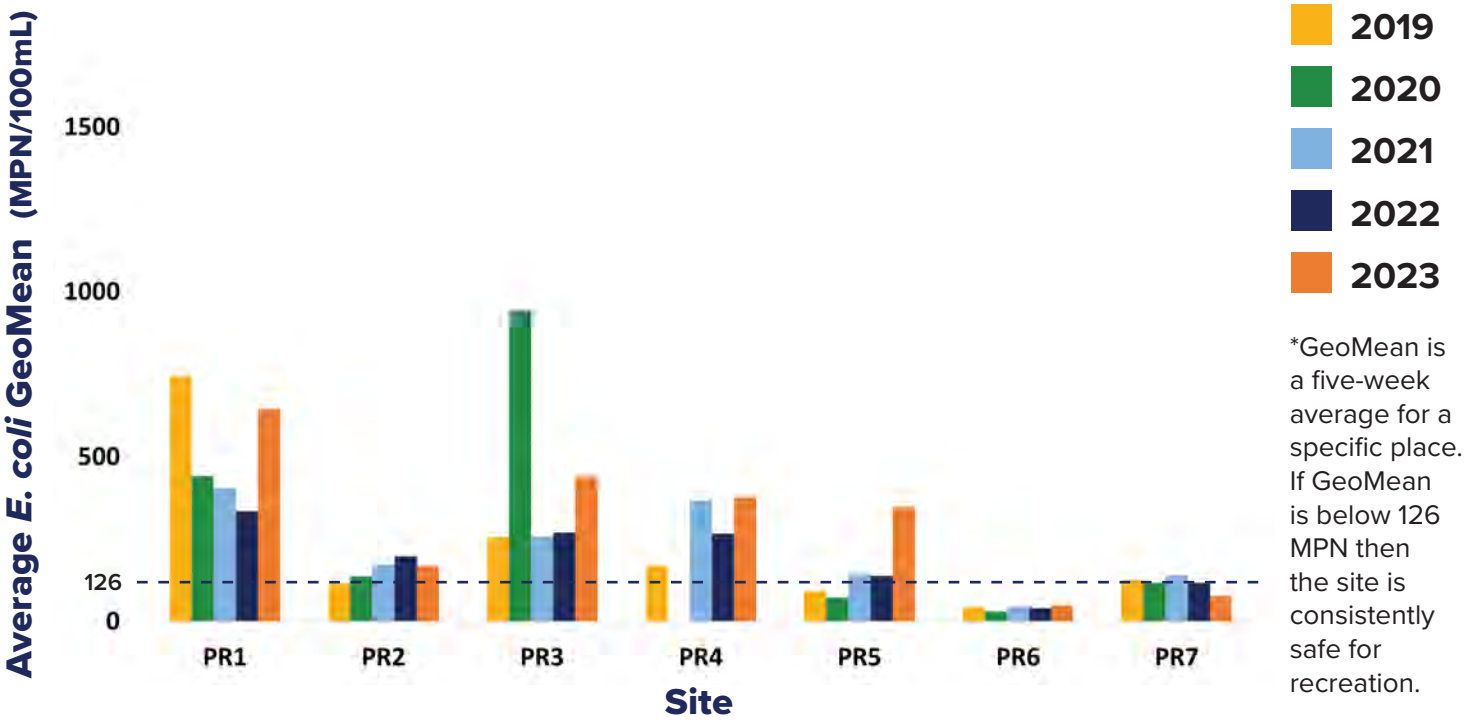
Do you want to dig into the data more? You'll find more graphics displaying water quality data from the past five years below. Questions? Contact monitor@anacostiariverkeeper.org

Fig. 1: Anacostia River Average *E. coli* Geometric Mean (2019-2023)



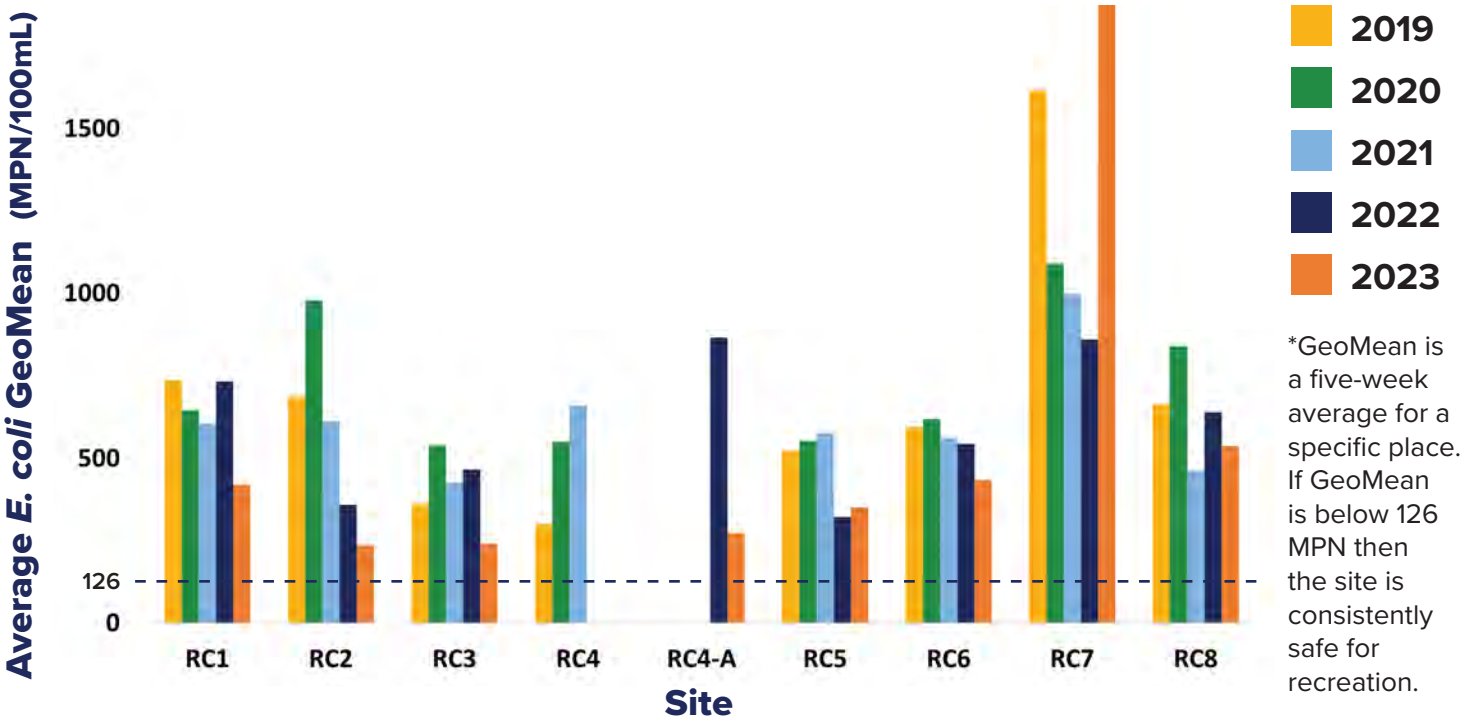
*GeoMean is a five-week average for a specific place. If GeoMean is below 126 MPN then the site is consistently safe for recreation.

Fig. 2: Potomac River Average *E. coli* Geometric Mean (2019-2023)



*GeoMean is a five-week average for a specific place. If GeoMean is below 126 MPN then the site is consistently safe for recreation.

Fig. 3: Rock Creek Average *E. coli* Geometric Mean (2019-2023)



*GeoMean is a five-week average for a specific place. If GeoMean is below 126 MPN then the site is consistently safe for recreation.

Fig. 4: Percent of All DC Sites Passing Single Sample *E. coli* vs. Rain-

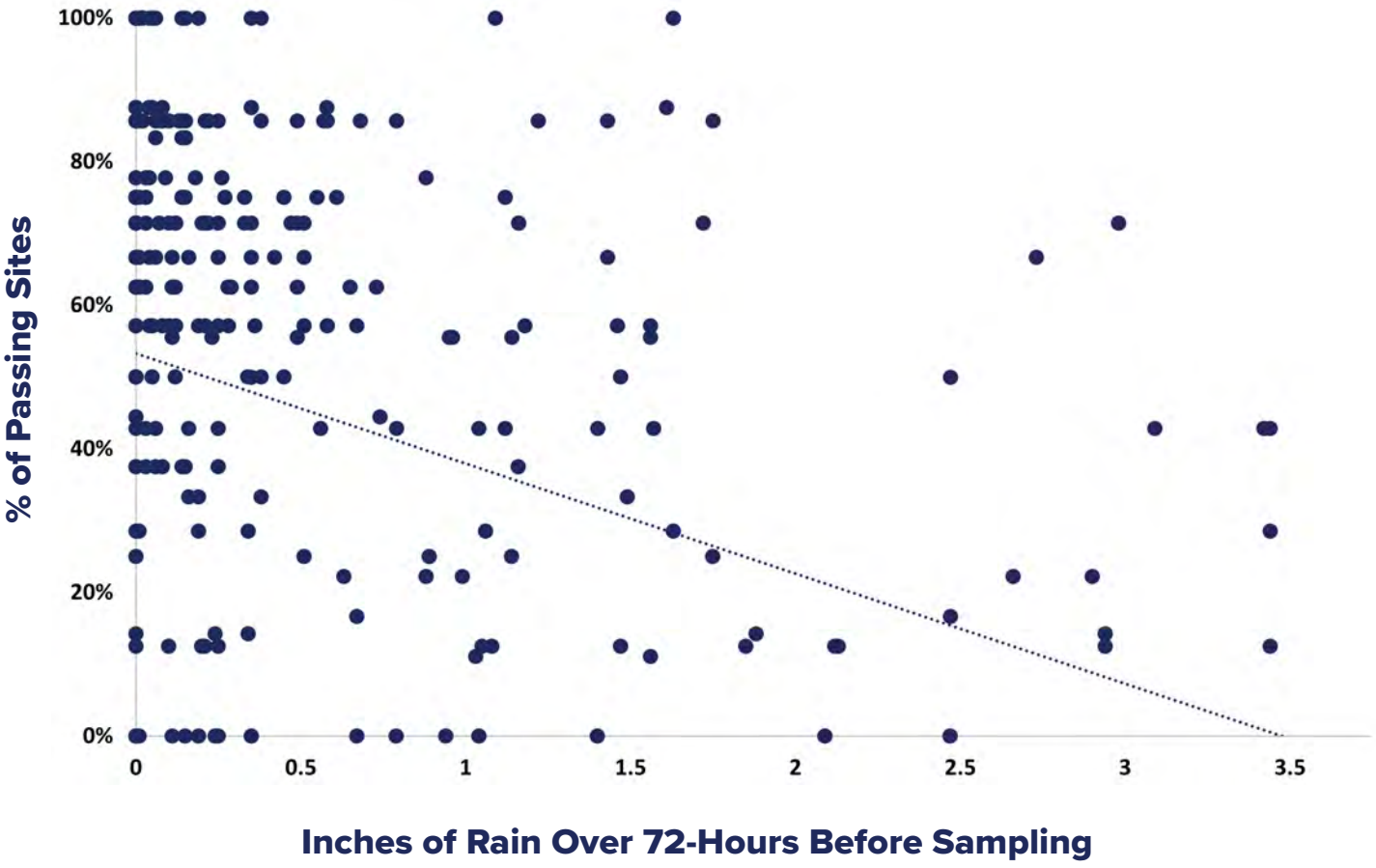


Fig. 5: Anacostia River Single Sample *E. coli* and Rainfall (2023)

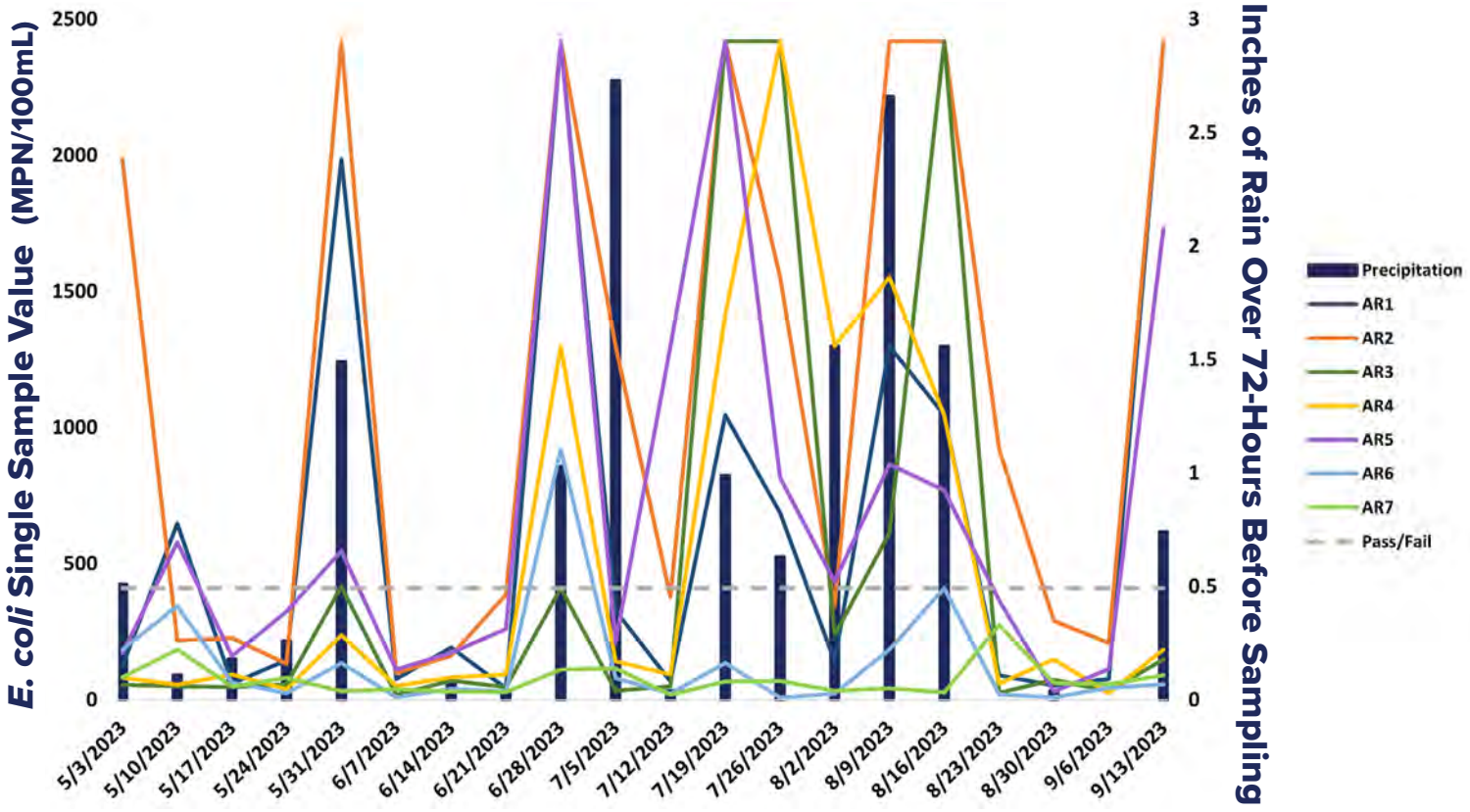


Fig. 6: Anacostia River Percent of Sites Passing *E. coli* Standards Under Dry and Wet Conditions (2019-2023)*

Year	All Sites		Mainstem Sites		Tributary Streams		% of weeks that had Wet Conditions	Total Seasonal Rainfall (in.)
	Dry Conditions	Wet Conditions	Dry Conditions	Wet Conditions	Dry Conditions	Wet Conditions		
2019	61%	67%	69%	78%	12%	0%	15%	18.0
2020	77%	35%	80%	38%	0%	0%	20%	26.8
2021	70%	57%	80%	67%	13%	0%	25%	26.6
2022	54%	51%	81%	71%	0%	10%	35%	21.6
2023	73%	36%	95%	52%	30%	3%	50%	17.2

*"Passing" indicates *E. coli* single sample values (SSV) were below 410 MPN/100mL. "Wet" conditions are defined as more than 0.5 inches of rain in the 72 hours before sampling with rain data from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). Total seasonal rainfall is for all precipitation between May-September with rain data from NOAA's DCA guage. Note that trends in overall rainfall do not necessarily match % of weeks characterized as wet. For example, 2023 had lower total rainfall, but much fell on Mondays and Tuesdays, so many sampling events had wet conditions.

Fig. 7: Potomac River Single Sample *E. coli* and Rainfall (2023)

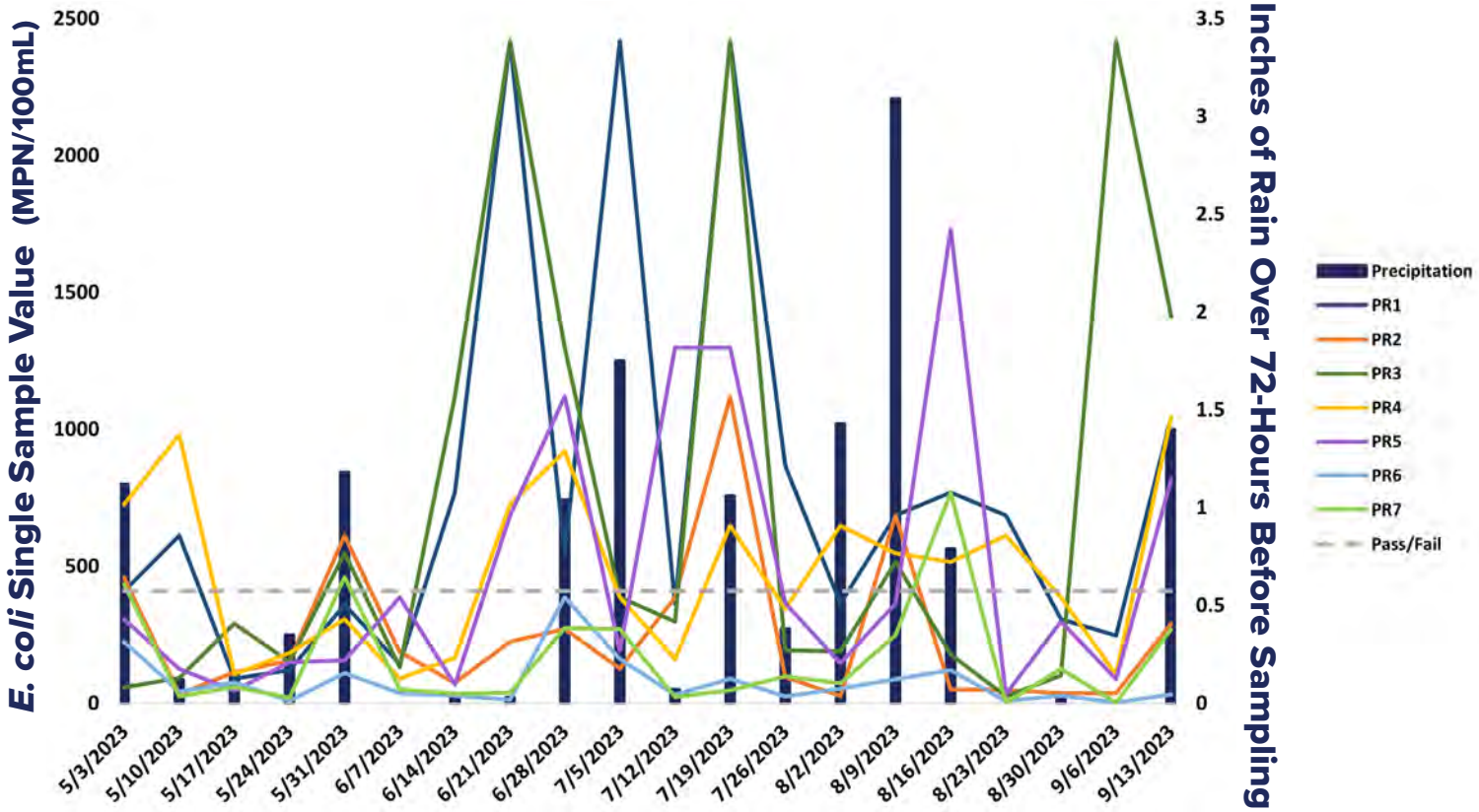


Fig. 8: Potomac River Percent of Sites Passing *E. coli* Standards Under Dry and Wet Conditions (2019-2023)*

Year	All Sites		Mainstem Sites		Tributary Streams		% of weeks that had Wet Conditions	Total Seasonal Rainfall (in.)
	Dry Conditions	Wet Conditions	Dry Conditions	Wet Conditions	Dry Conditions	Wet Conditions		
2019	77%	52%	88%	53%	50%	50%	15%	18.0
2020	78%	36%	85%	45%	53%	13%	20%	26.8
2021	75%	64%	80%	75%	59%	38%	20%	26.6
2022	74%	70%	78%	73%	63%	63%	40%	21.6
2023	83%	52%	91%	60%	64%	33%	45%	17.2

*"Passing" indicates *E. coli* single sample values (SSV) were below 410 MPN/100mL. "Wet" conditions are defined as more than 0.5 inches of rain in the 72 hours before sampling with rain data from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). Total seasonal rainfall is for all precipitation between May-September with rain data from NOAA's DCA guage. Note that trends in overall rainfall do not necessarily match % of weeks characterized as wet. For example, 2023 had lower total rainfall, but much fell on Mondays and Tuesdays, so many sampling events had wet conditions.

Fig. 9: Rock Creek Single Sample *E. coli* and Rainfall (2023)

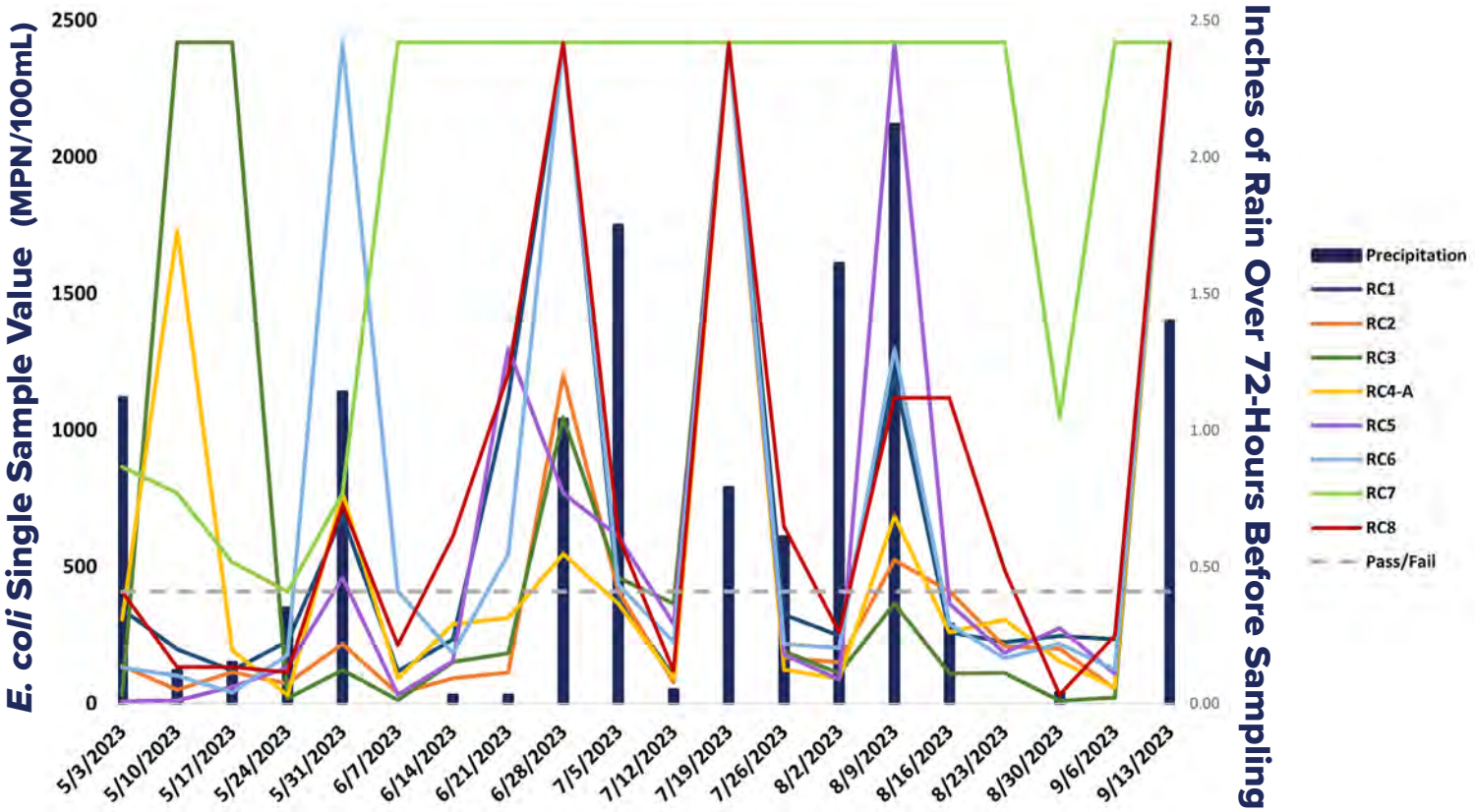


Fig. 10: Rock Creek Percent of Sites Passing *E. coli* Standards Under Dry and Wet Conditions (2019-2023)*

Year	All Sites		% of weeks that had Wet Conditions	Total Seasonal Rainfall (in.)
	Dry Conditions	Wet Conditions		
2019	45%	46%	15%	18.0
2020	51%	9%	20%	26.8
2021	55%	32%	35%	26.6
2022	45%	19%	30%	21.6
2023	74%	33%	45%	17.2

*All Rock Creek sites are considered tributaries

**"Passing" indicates *E. coli* single sample values (SSV) were below 410 MPN/100mL.

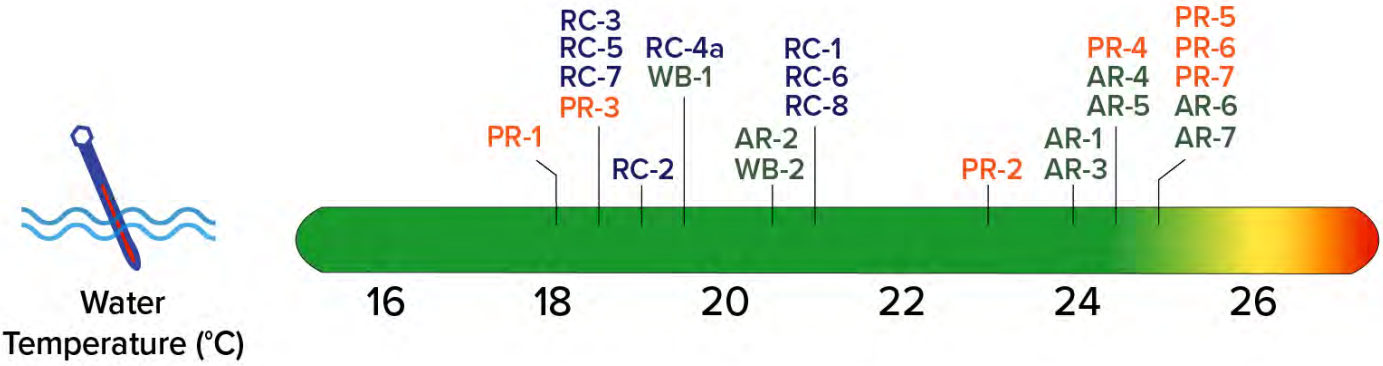
***"Wet" conditions are defined as more than 0.5 inches of rain in the 72 hours before sampling with rain data from the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). Total seasonal rainfall is for all precipitation between May-September with rain data from NOAA's DCA guage. Note that trends in overall rainfall do not necessarily match % of weeks characterized as wet. For example, 2023 had lower total rainfall, but much fell on Mondays and Tuesdays, so many sampling events had wet conditions.

Fig. 11: Anacostia River Single Sample *E. coli* Values Comparing Clean Rivers Tunnel Online vs. Offline During Wet Conditions (2023)

Site	Mean *E. coli* Single Sample Value (MPN/100mL)	
	Tunnel Online	Tunnel Offline
AR-3	258	1357
AR-4	451	1312
AR-5	1218	920
AR-6	325	140
Average	563	932

During July-August 2023, the Anacostia River Clean Rivers Project Tunnel was inactive due to construction of the Northeast Boundary Tunnel. This table shows the average single sample *E. coli* value for "wet" weeks in 2023 for the sites possibly affected by the tunnel comparing when the tunnel was online during May, June and September versus offline during July and August. AR-3 and AR-4 had considerably higher *E. coli* levels on "wet" weeks when the tunnel was offline.

Fig. 12: Average Water Temperature for All Sites (2023)



*Value is the mean per site for the 2023 season.