Charles River Watershed Association

RIVER SCIENCE PROGRAM

Annual Water Quality Report

JANUARY – DECEMBER 2022

MONITORING WATER QUALITY TO PROTECT PUBLIC HEALTH

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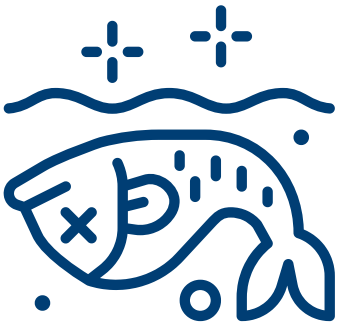
OUR MISSION

We work to protect, restore, and enhance the Charles River and its watershed through science, advocacy, and the law. CRWA develops nature-based strategies to increase resilience, protect public health, and promote environmental equity as we confront a changing climate.

We humbly acknowledge our work is carried out across the traditional territory of the Massachusett, Nipmuc, and Wampanoag nations and recognize them as past, present, and future caretakers of this land.

By the Numbers

DRIEST SUMMER IN 138 YEARS



5 AREAS UNDER HALF A FOOT DEEP

647 WATER QUALITY SAMPLES

1,114 TOTAL VOLUNTEERS

99 FLAGGING PROGRAM SAMPLES · 37 CYANOBACTERIA SAMPLES · 496 VOLUNTEER MONTHLY MONITOR SAMPLES · 15 BENTHIC MACROINVERTEBRATE SITES

About the River Science Program

This year marked the 50th anniversary of the Clean Water Act, the landmark legislation established in 1972 that called for all waterways in America to be "fishable and swimmable" by 1983, and the elimination of all discharges of pollutants into navigable waters by 1985.

While this ambitious goal has yet to be achieved, we know it can be—in the five decades since its passage, your vital support has guided the **transformation of our river from the "Dirty Water" of the past**—rife with industrial pollution, sewage, trash, and even cars—**to the Charles River we know and love today, one of the cleanest, most celebrated urban rivers in the country.**

Since 1995, our River Science Program has formed the backbone of our work. Today, our work to monitor water quality to protect public health is as important as ever.

But the work is far from over—climate change is bringing new challenges for water quality, ecosystem health, public safety, and enjoyment of our beloved Charles River. That's why our work to monitor water quality and protect public health is as important as ever.

The data we collect is vital—both the Environmental Protection Agency and the Massachusetts Department of Environmental Protection depend on CRWA's sampling data to develop and enforce water quality standards and track pollution. And, as climate change brings more frequent cyanobacteria blooms, severe droughts, combined sewer overflows, and more—our robust understanding of water quality and quantity provides us with the data we need to **advocate for protections for our communities and ensure a clean, climate-resilient Charles River for future generations.**

THIS IS ALL THANKS TO YOUR VITAL SUPPORT!

Meet the Sampling Programs

VOLUNTEER MONTHLY MONITORS

Each month, over 80 community scientists collect water samples at 35 sites and record temperature, depth, and river conditions to track changes in river health.

FLAGGING PROGRAM

The Flagging Program provides live water quality alerts for river users from Watertown to Boston. Recreational safety is predicted by models of bacteria levels, sampling results, sewage overflows, and cyanobacteria blooms. Boathouses then fly red and blue flags to keep river users informed.

CYANOBACTERIA

Each summer, we monitor cyanobacteria levels in the Lower Basin. With high heat and excess nutrients, cyanobacteria can explode into a toxic bloom, which is dangerous for humans and pets alike. We report data to the Department of Public Health and inform river users.

SEWER OVERFLOWS

CRWA closely tracks combined sewer overflows (CSOs), which occur when our aging sewer systems discharge untreated wastewater into our waterways, threatening public health and ecosystem health. We then inform the public through our Flagging Program and monitor ecosystem impacts.

BIOLOGICAL MONITORING

Volunteers sample for benthic macroinvertebrates (BMIs), or small river bugs that live in streams, and conduct habitat assessments to track overall stream health in the tribuaries of the Charles River. This data is then used to identify restoration projects.

CHLORIDE MONITORING

Chloride monitoring allows us to assess the impacts of road salt on aquatic life in our tributaries. High amounts of salt in rivers and streams can be toxic to freshwater life, so we are monitoring conductivity to track impacts and inform restoration.

Tracking Drought

DRIEST SUMMER IN 138 YEARS

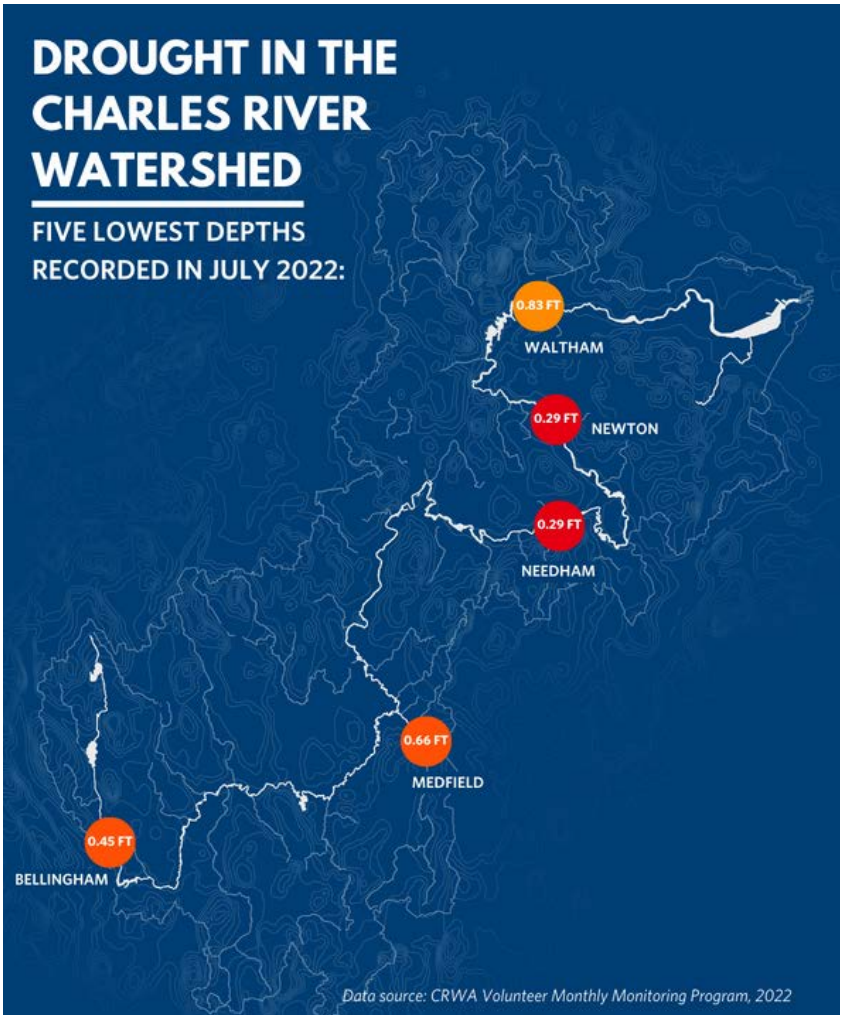
5 AREAS UNDER HALF A FOOT DEEP

With climate change, droughts are becoming more frequent, long-lasting, and severe. In 2016, our watershed experienced the most significant drought since the 1960s. Then, another severe drought again in 2020. And now, in 2022.

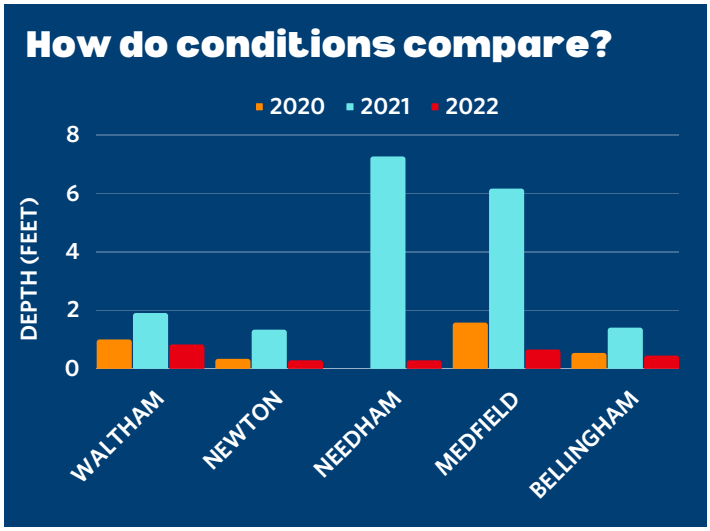
Closely monitoring drought conditions is crucial for tracking ecosystem impacts, educating the public on water conservation, and advocating for better policies and practices to ensure adequate water quantity and quality in summers to come.

DROUGHT IN THE CHARLES RIVER WATERSHED

FIVE LOWEST DEPTHS RECORDED IN JULY 2022:



How do conditions compare?



Understanding the data:

After weeks of little rain and record-breaking extreme heat, the Charles River was reduced to a mere stream in Millennium Park, tributaries disappeared entirely, and volunteers recorded some of the lowest water levels ever observed. **This has devastating consequences for the river ecosystem, wildlife, and all of us who depend on healthy rivers for drinking water, recreation, and enjoyment.**

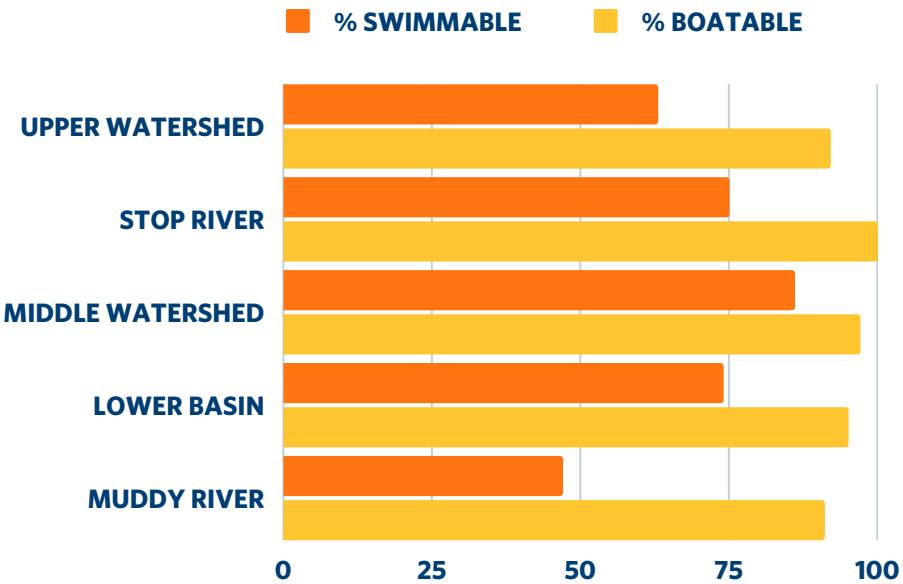
Bacterial Contamination

Escherichia coli (E. coli) concentration is monitored to track if the river is safe for recreation. High concentrations of *E. coli* can indicate the presence of other pathogens that may be harmful to human health. In 2022, CRWA's VMM and Flagging programs collected 440 and 99 *E. coli* bacteria samples respectively.

Bacterial contamination varies widely along the Charles River. Changes in land use impact the amount of pollution in the Charles River. Areas with more impervious cover—roads, sidewalks, and buildings—see more runoff and bacterial contamination. Here, we compare these levels to the following standards for contact: 235 cfu/100mL for swimming and 1260 cfu/100mL for boating.

In most sections, excluding the middle reach from Medfield to Newton, **swimming in the Charles is unsafe 25-50% of the year, especially after large rain storms.**

HOW OFTEN COULD YOU SWIM & BOAT IN THE CHARLES RIVER?



RECREATIONAL HEALTH OF THE RIVER Percentage of samples meeting *E. coli* boating + swimming standards in each segment of the Charles River.

91 VOLUNTEERS

35 LOCATIONS

539 TOTAL E.COLI SAMPLES

Understanding the Data

UPPER WATERSHED

As the river flows from its source in Hopkinton, it runs along the I-495 corridor, which is experiencing rapid development, meaning more impervious cover and pollution. Additionally, a significant drought in 2022 lowered water levels, resulting in more concentrated pollution. **Because of this, the river only met swimming standards 63% of the time.**

LOWER WATERSHED + MUDDY RIVER

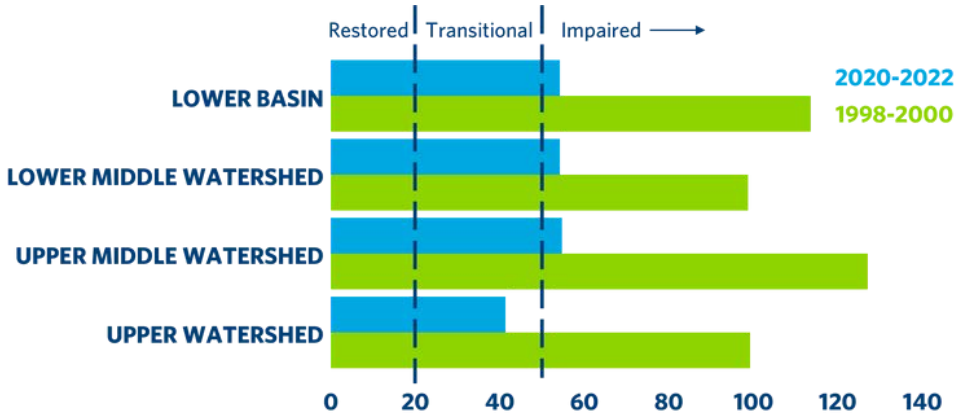
From Watertown to the Boston Harbor, the river passes through high-density urban areas, and aging, combined sewer systems frequently overflow, contributing to more bacterial pollution.
As a result, the Lower Basin only met swimming standards 74% of the time. The Muddy River, the most polluted tributary of the Charles, was unsafe for swimming more than 50% of the time.

Stormwater Pollution

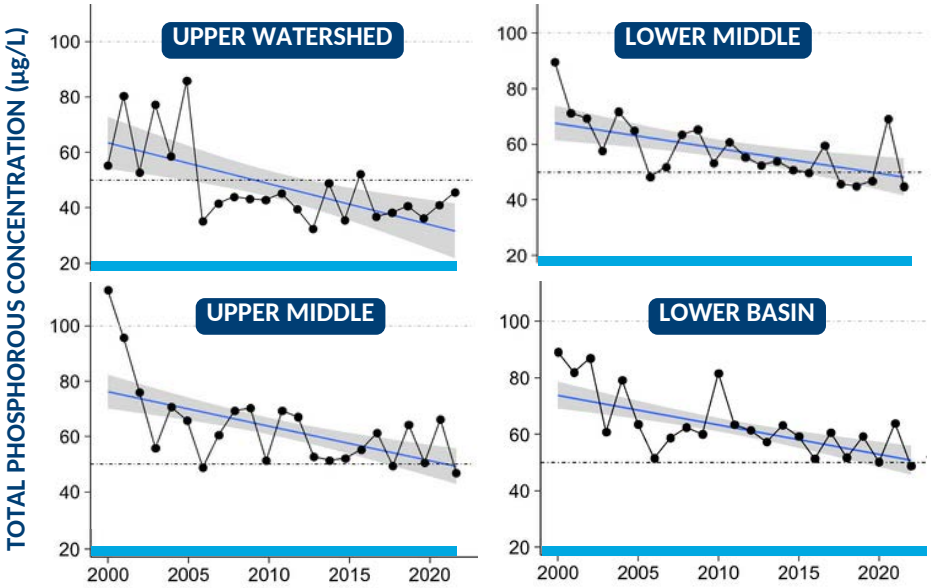
40 PHOSPHORUS
40 NITROGEN
80 TOTAL NUTRIENT SAMPLES

Phosphorus is one of the most important parameters to track to understand the ecological health of the river. Excess nutrients enter the Charles from stormwater runoff—contributing to the growth of invasive plants, harmful cyanobacteria blooms, and even fish kills. While there is no single phosphorus threshold for a healthy ecosystem, concentrations above 50 µg/L are considered unhealthy. Healthy streams tend to have concentrations below 20 µg/L.

PHOSPHORUS: IN 2022 + OVER TIME



PHOSPHORUS IN 2022 Average total phosphorus concentrations (µg/L) in all reaches fell near the 50 µg/L transitional threshold, but remain elevated.



PHOSPHORUS OVER TIME Total phosphorus concentrations (µg/L) over the past two decades of sampling show significant progress, but ongoing challenges exist.

Understanding the Data

Since we began monitoring phosphorus **25 years ago**, we have seen significant reductions in pollution. In 2022, average phosphorus levels fell just below the 50 µg/L threshold in all sections of the Charles River.

However, in recent decades, progress has slowed. At our current rate, it would take **over 60 years to approach healthy phosphorous levels!** And, weather extremes of climate change bring additional challanges.

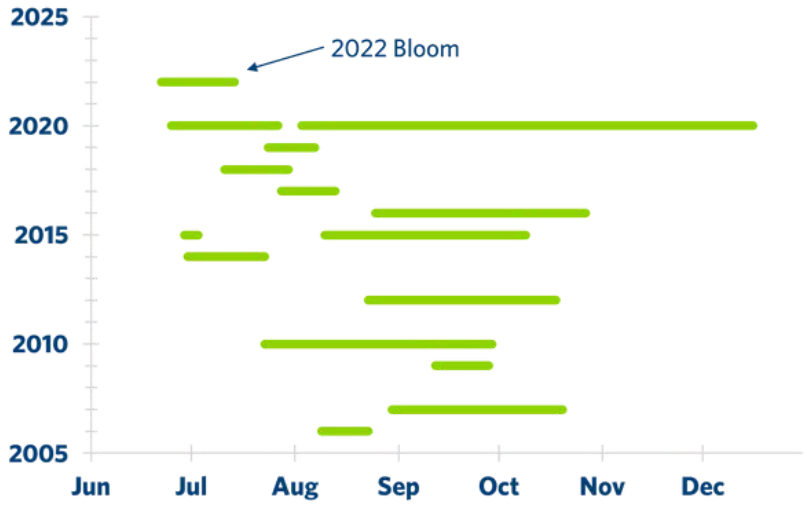
Cyanobacteria Monitoring

CYANOBACTERIA
37 SAMPLES
50 VISUAL OBSERVATIONS

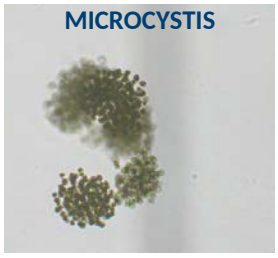
Cyanobacteria, also known as blue-green algae, are naturally occurring microorganisms found in our rivers, lakes, and ponds. Excess phosphorus from stormwater runoff + warmer temperatures can cause cyanobacteria populations to **explode into a toxic bloom**, releasing dangerous cyanotoxins that **threaten public health, are fatal to pets, and harmful to the ecosystem.**

Each summer, we measure cyanobacteria concentrations on a weekly basis in the Lower Basin of Charles River in Boston and Cambridge and report high levels to the MA Department of Public Health (DPH).

LOWER BASIN CYANOBACTERIA BLOOMS



CYANOBACTERIA BLOOMS OVER TIME Public advisories issued by the MA DPH for the Lower Charles River Basin.



CYANOBACTERIA SPECIES IN THE CHARLES Photographs of the three main types of cyanobacteria found in the Charles River, under the microscope.

Understanding the Data

CRWA has tracked recurring cyanobacteria blooms in the Lower Basin since 2006. Since then, **public advisories have affected recreation an average of 37 days per year**. The location and intensity of blooms vary due to precipitation, wind direction, and nutrient availability. **In 2022, the bloom advisory lasted 23 days.**

In 2022, CRWA focused on modernizing our monitoring protocols. In addition to quantifying the intensity of phycocyanin, the primary pigment in cyanobacteria, we now analyze water samples under the microscope to identify specific species of cyanobacteria. Different species release different toxins, so understanding the species makeup of a bloom tells us more about how dangerous recreation is during a given bloom.

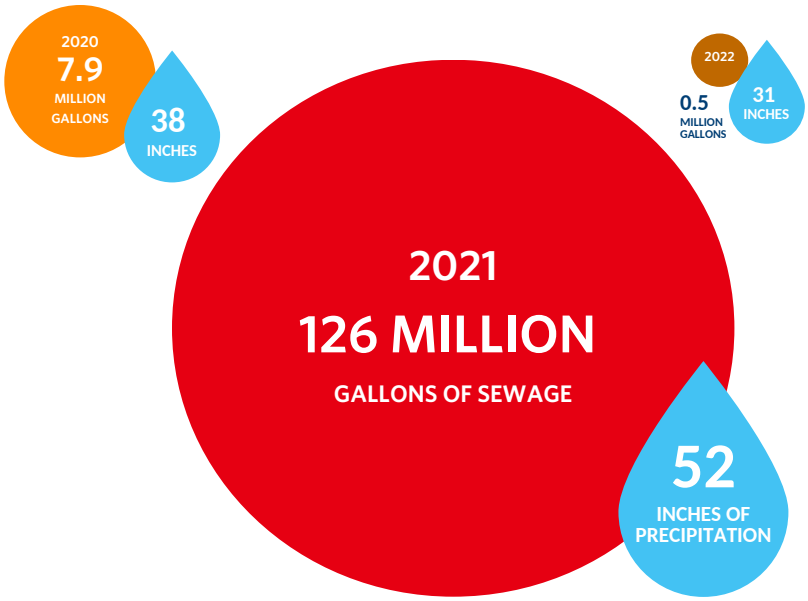
Combined Sewer Overflows

Combined Sewer Overflows (CSOs) occur when heavy rain and intense storms cause our outdated combined sewer system to reach capacity and overflow into waterways, **carrying pollutants like bacteria, viruses, excess nutrients, pharmaceuticals, and trash straight into our rivers.**

There are currently **ten active CSO outfall**s that discharge into the Charles and Muddy Rivers, managed by the Massachusetts Water Resources Authority (MWRA), City of Cambridge, and Boston Water and Sewer Commission (BWSC).

CRWA closely tracks the impacts of these overflows on water quality and ecosystem health, provides notifications to the public through the Flagging Program, and advocates for the total elimination of sewage discharges, once and for all.

COMBINED SEWER OVERFLOWS (CSOs) IN THE CHARLES RIVER



EXTREME PRECIPITATION & SEWER OVERFLOWS As our climate changes, we are seeing both droughts, as in 2020 and 2022, and more intense, heavy rainfall events that cause combined sewer overflows, as in 2021.

4 CSOs RELEASED HALF A MILLION GALLONS OF SEWAGE

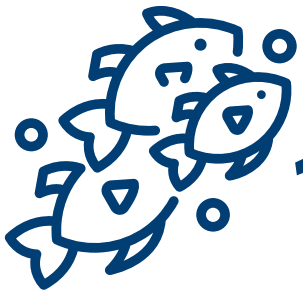
Understanding the Data

Since severe, prolonged drought characterized much of 2022, we saw very few intense, extreme storms that typically cause combined-sewer overflows. **Therefore, only four CSOs occurred, releasing half a million gallons of sewage.**

In contrast, in 2021, **CSOs were triggered nearly 50 times,** discharging over 126 million gallons of sewage and stormwater into the Charles River. **That's about the volume of 36 Olympic-sized swimming pools.**

With climate change bringing more frequent, intense rainfall events overall, we will likely see more CSOs in the future.

Biological Monitoring

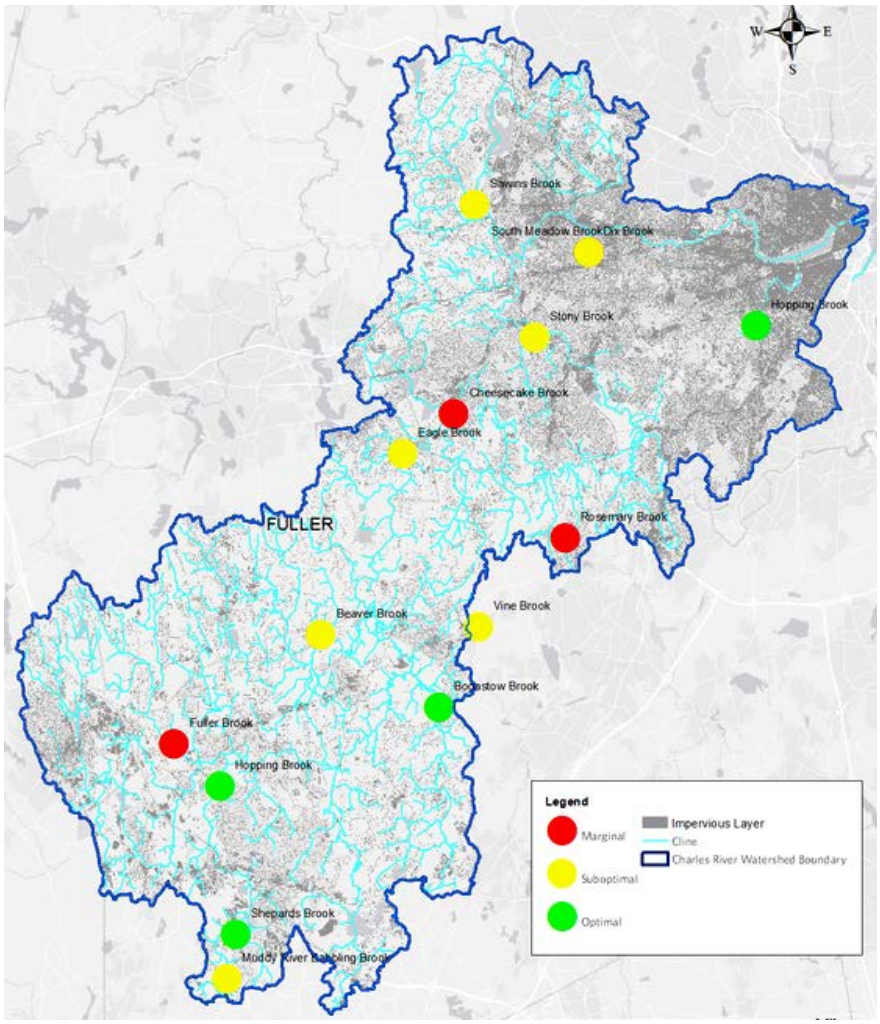


60 VOLUNTEERS

15 STREAMS ASSESSED

Tributaries provide critical aquatic habitat—yet these important streams are uniquely sensitive to disturbances of pollution from increased development and climate changes. Through the biological monitoring program, volunteers conducted benthic macroinvertebrate sampling and habitat assessments at **15 tributaries** throughout the watershed. Using EPA Bioassessment + Habitat Assessment methods, this data is combined into a score to track ecosystem health.

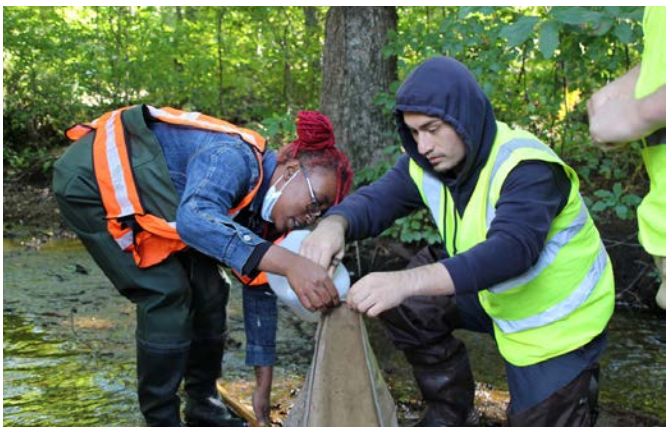
STREAM SCORES + IMPERVIOUS COVER



STREAM SCORES IN 2022 Significant drought and stormwater pollution negatively impacted stream health in many areas of the watershed.

Understanding the Data

Habitat assessment scores varied widely across the watershed—reflecting differences in land use and impacts of severe drought. Streams near more impervious cover—roads, buildings, parking lots—like South Meadow Brook and Cheesecake Brook in Newton had the lowest scores, while Bogastow Brook in Millis and Stop River in Medfield—near more forests + wetlands—had the highest scores.



Chloride Monitoring

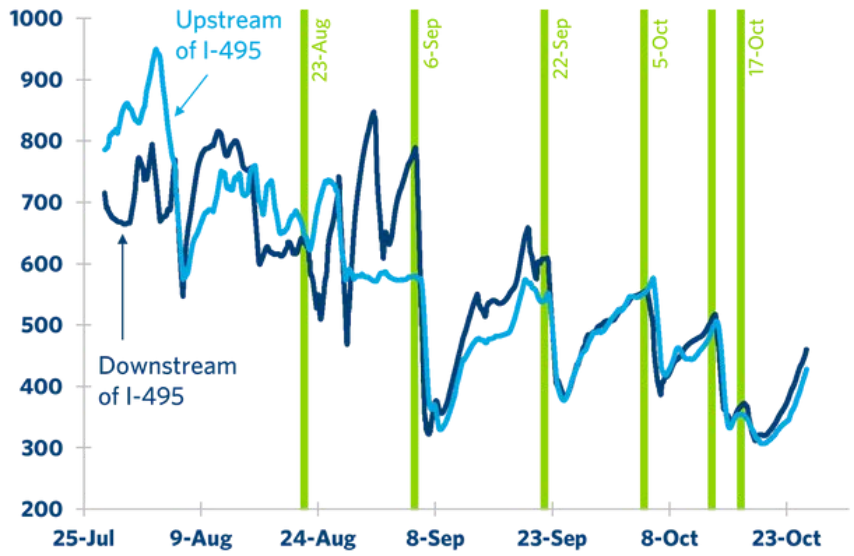
3 STREAMS MONITORED

90 DAYS OF DATA

Road salt is a potential source of pollution for our streams—aquatic life is very sensitive and adapted to a certain salinity in our freshwater streams. Any change in salinity can be harmful to these creatures and overall biodiversity in rivers and streams.

In 2022, CRWA partnered with other watersheds to measure the impact of road salt on three streams—Huckleberry Brook, Stall Brook, and Mine Brook—placing data loggers upstream and downstream of major roads from July-October and January-April to compare conditions.

MINE BROOK BASELINE CONDUCTIVITY



CONDUCTIVITY IN MINE BROOK (FRANKLIN) IN 2022 Conductivity (µS/cm) decreased suddenly after rainfall events (>0.5 in. in 24 hrs), as indicated by green lines, and steadily climbed again between storms.

Understanding the Data

Conductivity, a proxy for salt content in streams, showed a response to rainfall in 2022. After rainfall, conductivity in the streams decreased, indicating the pollutants were flushed out. Then, conductivity slowly increased as pollutants accumulated again. Drought conditions in 2022 likely contributed to **prolonged high conductivity in streams.**

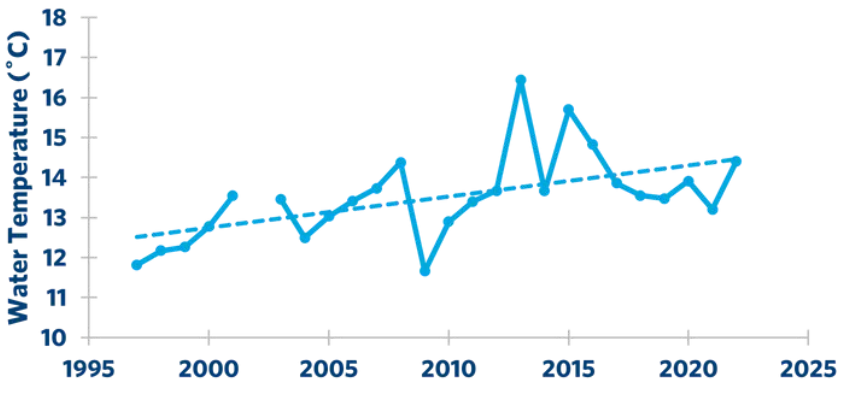
In Mine Brook, stations upstream and downstream of I-495 showed similar trends, but mean conductivity was **slightly higher downstream of the highway.**

Our Changing Climate

Climate change isn't coming—it's already here. Each year, another unprecedented drought, flood, extreme storm, and heatwave put our river and all who depend on it at risk. And this is only the beginning.

What does this mean for water quality? Increased precipitation brings more pollution, sewer overflows, cyanobacteria blooms, and invasive species. Drought means low water levels, biodiversity loss, concentrated pollution, and rising water temperatures. All of these impacts spell trouble for river health and safe recreation, at a time when people and wildlife alike rely on healthy ecosystems the most.

As our climate continues to change, our steadfast commitment to closely monitoring water quality to track changes in the Charles River is as important as ever, and it allows us to utilize our robust dataset to advocate for solutions and build resilience to protect our river.



RISING TEMPERATURES

Our robust dataset confirms climate change is already impacting the Charles River ecosystem. Over the past decades, water temperatures are steadily rising, with an average temperature of 60° F in 2022. **This has consequences for aquatic life and public health.**

What's Being Done

We celebrated a lot of successes in 2022, but the work is far from over. Charles River Watershed Association will continue to use sound science to develop nature-based solutions to protect public health, advocate for environmental equity, and restore a clean, resilient river for future generations.

CURBING STORMWATER POLLUTION

After years of advocacy from CRWA + Conservation Law Foundation—including the threat of litigation—U.S. EPA will now require certain **large private property owners to do their share** and manage their own stormwater, reducing pollution in Boston's three urban rivers; the Charles, Mystic, and Neponset. **This is a first-in-the-nation big deal.** Stormwater pollution is the greatest threat to healthy urban rivers, carrying excess phosphorus and nitrogen that causes toxic cyanobacteria blooms, rampant invasive species growth, and fish kills. **Large impervious surfaces, including big box stores and malls, only make up 20% of our watershed, yet are the source of up to 50% of the stormwater pollution**. Now, under residual designation authority (RDA) of the Clean Water Act, these polluters will be required to obtain permits and reduce stormwater runoff, giving our cities and towns a fighting chance to meet goals for reducing phosphorus and nitrogen.

WATER FOR RIVERS, NOT LAWNS

This year we secured a big win for our rivers—after years of advocacy, with your support, the Massachusetts Department of Environmental Protection strengthened protections for our vital water resources! For the first time, **63 public water suppliers and 87 golf courses** will now be required to conserve water during droughts, closing a long-standing loophole that excluded certain water users and allowed the overuse of water resources at the expense of our rivers. **And this is only the beginning**! Together, we can secure further protection for our beloved river in times of drought by passing the **Drought Management Bill** in the coming year.

IT'S THE PEOPLE'S RIVER!

Over fifty years ago, Massachusetts voters like you approved Article 97 of the state constitution to protect our vital public open spaces. Now, after twenty years of relentless advocacy, we put this intent into practice by enacting the Public Lands Preservation Act! **The Public Lands Preservation Act ensures "no net loss" of our vital protected lands**—requiring anyone looking to sell or develop public green space to replace it with land of comparable acreage, location, and natural resource value. This law will ensure that we don't lose critical open spaces—for example, a small pocket park in an otherwise highly developed area—that are playing such an important role in reducing flooding, cleaning the air and water, and mitigating urban heat island effect. **This is a momentous step to ensure that public lands remain protected and open to all!**

Acknowledgments

Charles River Watershed Association is immensely grateful to all our vital partners. Without you, we would not be able to continue monitoring the health of the Charles River, or effectively address the challenges caused by pollution, contamination and runoff, and climate change. Thank you for all that you do!

FUNDERS

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Clif Family Foundation
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MWRA Deer Island Laboratory
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Acknowledgments

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