



Tinker's Creek and Brandywine Creek Watersheds 2022 Water Quality Report



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Introduction

About TCWP

Tinker's Creek Watershed Partners (TCWP) is a non-profit, 501(c)(3) watershed organization officially established in 2006. Our mission is to protect and restore water quality and habitats of the Tinker's Creek and Brandywine Creek watersheds through community partnerships. The Tinker's Creek watershed drains 96.4 square miles and is the largest tributary to the Cuyahoga River. The watershed area spans 24 communities in Cuyahoga, Summit, Portage, and Geauga counties. The Brandywine Creek watershed spans approximately 27 square miles in Cuyahoga and Summit counties.

TCWP is governed by a 15-member, volunteer Board of Directors that brings a variety of expertise in the fields of stormwater management, environmental education, engineering, natural resources, conservation, planning, and economic development. TCWP is guided in their efforts to protect and restore the watershed and educate the public by four Ohio and USEPA-endorsed nonpoint source implementation strategic plans (NPS-IS Plans). Each plan encompasses a subset of the Tinker's Creek watershed and Brandywine Creek watershed. They can be found at www.tinkerscreek.org. The group's mission, along with the NPS-IS Plans, shape the goals of TCWP.

The goals of Tinker's Creek Watershed Partners are to:

- **Increase community and municipal understanding** of the ecological and economic benefits of protecting water quality by delivering targeted education, technical assistance, and outreach programs across all watershed communities.
- **Promote adoption of sustainable stormwater and land-use practices** that reduce runoff, restore natural hydrology, and protect sensitive habitats through demonstration projects, workshops, and partnerships with local governments and developers.
- **Empower residents and stakeholders** to reduce pollution at the source by providing education on everyday behaviors that affect water quality and sharing practical, nature-based alternatives.
- **Protect and restore wetlands within the watershed**, advocating for local mitigation and "no-net-loss" policies that maintain ecological function and strengthen community resilience.
- **Advance watershed-based decision-making** by fostering coordination among municipalities, agencies, and organizations to align policies and restoration efforts that improve water quality and habitat connectivity.
- **Enhance recreational and ecological connectivity** by supporting projects that link greenways, riparian corridors, and trails to improve both public access and habitat continuity throughout the watershed.

PROGRAM OVERVIEW

Tinker's Creek Watershed Partners initiated its water quality monitoring program in 2018 with support from EarthEcho International, Dominion Energy, and the Western Reserve Land Conservancy. EarthEcho International supplied water quality test kits that enabled volunteers to measure core parameters such as temperature, pH, turbidity, and dissolved oxygen (DO). Funding from the Dominion Energy and Western Reserve Land Conservancy Watershed Mini-Grant Program further supported the acquisition of essential field equipment, including HDPE sample bottles, chest waders, and an Oakton DO 6+ portable dissolved oxygen meter.

The 2018 pilot year focused on evaluating program feasibility, site accessibility, and sampling methodology. Staff and volunteers conducted sampling at 10 sites between June and August, establishing baseline procedures. During this period, TCWP also developed a key partnership with the Twinsburg Wastewater Treatment Plant (WWTP) to conduct laboratory analyses—an important step toward ensuring consistent and reliable data quality.

In 2019, TCWP carried out its first full monitoring season, expanding to 12 sites sampled monthly from May through September. Trained volunteers formed the backbone of the program, providing consistent, repeatable sampling efforts across the watershed.

Monitoring continued in 2020 at the same 12 locations, supported by an increasingly experienced volunteer team. With each additional year of data, emerging trends began to illuminate seasonal patterns and spatial variation in water quality throughout the Tinker's Creek watershed.

The 2021 season marked a significant expansion of the program. One Tinker's Creek site was retired, and five new sites were added in the Brandywine Creek watershed—two on Indian Creek and three on Brandywine Creek—bringing the total to 16 active monitoring locations. That same year, TCWP invested in upgraded instrumentation, including a YSI Quatro multiparameter probe and a Hach pH meter, further enhancing measurement accuracy and data reliability.

Today, TCWP's water quality monitoring program continues to advance through a combination of volunteer engagement, technical rigor, and long-term data collection designed to assess the condition of the Tinker's Creek and Brandywine Creek watersheds. The dataset generated through this program directly informs TCWP's work—from identifying impaired stream segments and guiding restoration priorities to evaluating the effectiveness of completed restoration projects. By sustaining high-quality, consistent monitoring, TCWP provides communities, partner organizations, and funding agencies with the scientific basis needed to support informed decision-making and improve watershed resilience.

PROGRAM GOALS

TCWP's water quality monitoring program fulfills several interconnected purposes. By engaging volunteers as citizen scientists, TCWP not only expands its monitoring capacity but also fosters local stewardship and community ownership of watershed health. Volunteers who adopt monitoring sites visit the same locations each month, developing an understanding of baseline, or "normal", conditions. This consistency allows them to function as an early warning system, identifying unusual readings, visible pollution, or signs of illicit discharge and reporting them to TCWP and local municipalities for further investigation.

The program also provides critical baseline data for evaluating long-term water quality trends. Prior to TCWP's monitoring efforts, Tinker's Creek was sampled only intermittently, typically every few years. With monthly sampling at 16 sites across the Tinker's Creek and Brandywine Creek watersheds, TCWP can now detect emerging water quality issues and subtle changes more rapidly and accurately. This high-resolution dataset enables timely, data-driven responses from municipalities, partner organizations, and regulatory agencies.

Furthermore, TCWP's monitoring extends well beyond the short-term post-construction assessments commonly required for restoration projects. By continuing data collection for years after project completion, the program can reveal long-term trends, providing evidence of restoration and stormwater mitigation effectiveness—or identifying areas where challenges persist. This sustained, longitudinal monitoring allows TCWP to evaluate the cumulative impact of watershed restoration efforts and to inform strategic decisions for future conservation

The overarching goals of TCWP's water quality monitoring program are to:

- **Train and engage citizen scientists** to collect reliable water quality data.
- **Build community stewardship** and awareness of local water resources.
- **Detect potential water quality issues** early, including signs of pollution or illicit discharge.
- **Establish and maintain** a comprehensive, long-term dataset on water quality and major impairment throughout the watershed.
- **Evaluate the long-term effectiveness** of stream restoration and stormwater mitigation projects within the Tinker's Creek and Brandywine Creek watersheds.

Restoration Projects

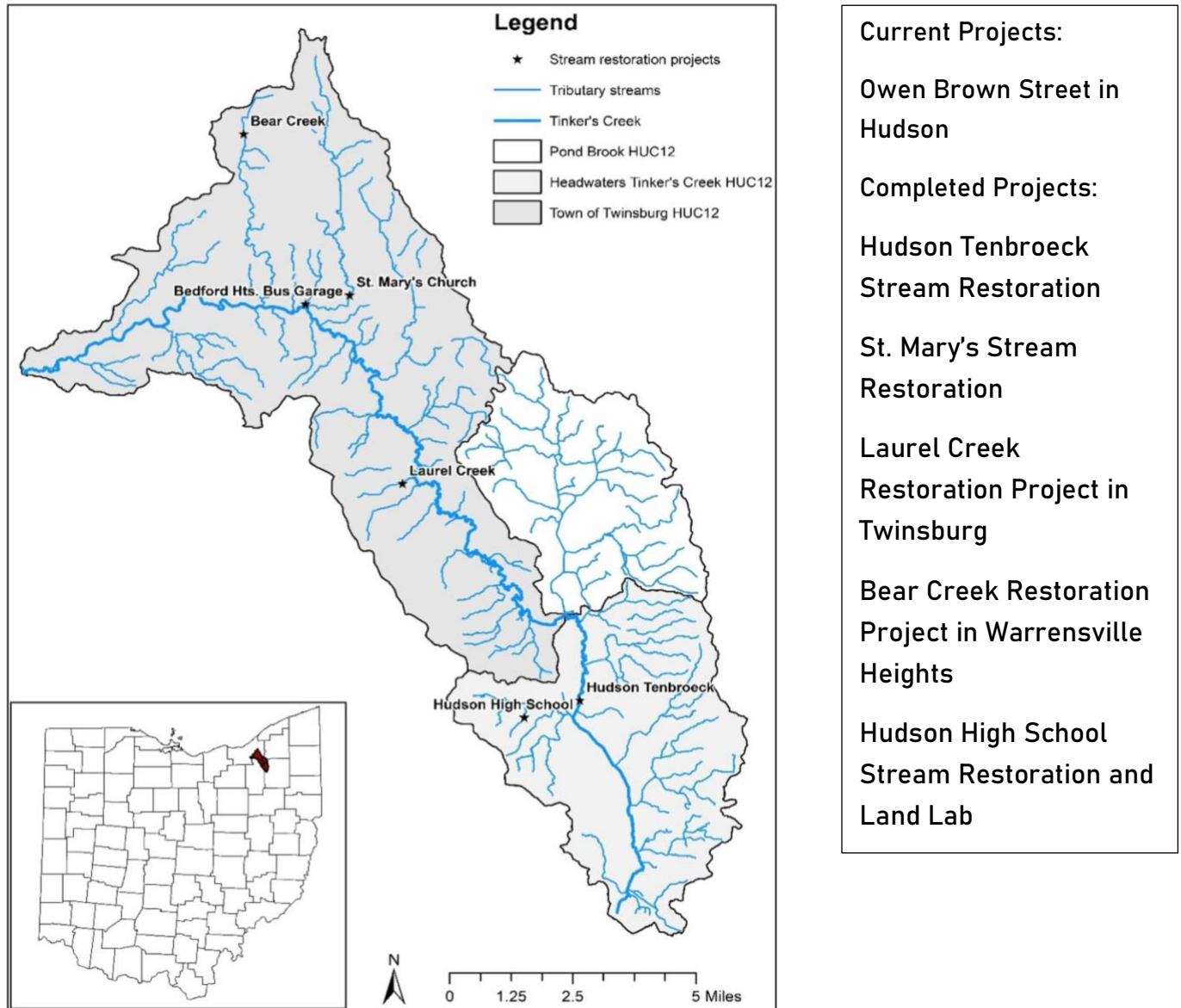


Figure 1. Map showing recent restoration projects in Tinker's Creek Watershed.

Major stream restoration projects are not the only means of improving water quality and overall watershed health. TCWP also partners with local communities, nonprofits, schools, and property owners to implement targeted stormwater management practices, including rain barrels, rain gardens, and native plantings. These practices help slow, capture, and infiltrate stormwater, reducing the delivery of sediment, nutrients, and other pollutants to Tinker's Creek and Brandywine Creek. By mitigating these inputs, such interventions contribute to measurable improvements in water quality parameters, such as turbidity, nutrient concentrations, and

dissolved oxygen levels, while also supporting the long-term ecological resilience of the watershed.

Methodology

At each site, TCWP staff and/or volunteers measured water temperature, air temperature and pH using a Hach Pocket Pro + pH meter. Dissolved oxygen, O₂ pressure, conductivity, nitrate, and chloride were collected using a YSI ProQuatro multi-parameter meter. Each site was also scanned for any unusual discharges or surface oils. Staff and/or volunteers noted weather conditions, wildlife, and any other items of interest.

A water sample was collected at each site. Samples were transported to Twinsburg WWTP for analysis of *E. coli* levels.

Table 1. Field parameters collected by TCWP.

Parameter	Units
Water Temperature	Degrees Celsius (°C)
pH	S.U.
Dissolved Oxygen	Mg/L and percent saturation (%)
O ₂ Pressure	mmHg
Conductivity	C-mS/cm
Nitrate Range	mg/L
Chloride Range	mg/L

Table 2. Water quality parameters analyzed by Twinsburg WWTP.

Compound Name	Units
<i>E. coli</i>	Cfu/100mL

2022 Water Quality Sites

Each of the 16 sites were sampled monthly between May and September 2022 (Table 3). These sites are located throughout the Tinker’s Creek and Brandywine Creek watersheds from the headwaters to the confluence of Tinker’s Creek and the Cuyahoga River.

Table 3. Water quality sites sampled during 2022.

Site ID	Site Name	Stream Name	Coordinates
UnHw001	Darrow Road Park	Unnamed headwaters	41.263752, -81.431937
PB001	Liberty Park Pond Brook Conservation Area	Pond Brook	41.305938, -81.399144
TC001	Hudson-Tenbroeck Project	Tinker’s Mainstem	41.262003, -81.394144
TC002	Trumbull Woods Park	Tinker’s Mainstem	41.269070, -81.392790
TC006	Tinker’s Creek at Bissell	Tinker’s Mainstem	41.287499, -81.401056
TC003	East Idlewood Park	Tinker’s Mainstem	41.336324, -81.457075
TC004	Broadway Trailhead near Bridal Veil Falls	Tinker’s Mainstem	41.385043, -81.525098
TC005	Tinker’s Creek Aqueduct	Tinker’s Mainstem	41.365475, -81.608117
HmC001	Bedford Reservation Hemlock Creek Picnic Area	Hemlock Creek	41.375314, -81.574836
Un001	Highland Woods Apartments	Unnamed tributary	41.432241, -81.490515
Un002	Bedford Heights Bus Garage	Malicki Creek	41.432241 -81.490515
BC-EH1	Brandywine Creek East Hines Hill	Brandywine Creek	41.260278, -81.489167
BC-ET1	Brandywine Creek East Twinsburg	Brandywine Creek	41.283056, -81.504444
BC-SS1	Brandywine Creek Service Station	Brandywine Creek	41.293889, -81,522778
IC-AN1	Indian Creek Achieve Nutrition	Indian Creek	41.313333, -81.508611
IC-SR1	Indian Creek Schoeffler Residence	Indian Creek	41.338056, -81.506389

2022 Water Quality Sites Map

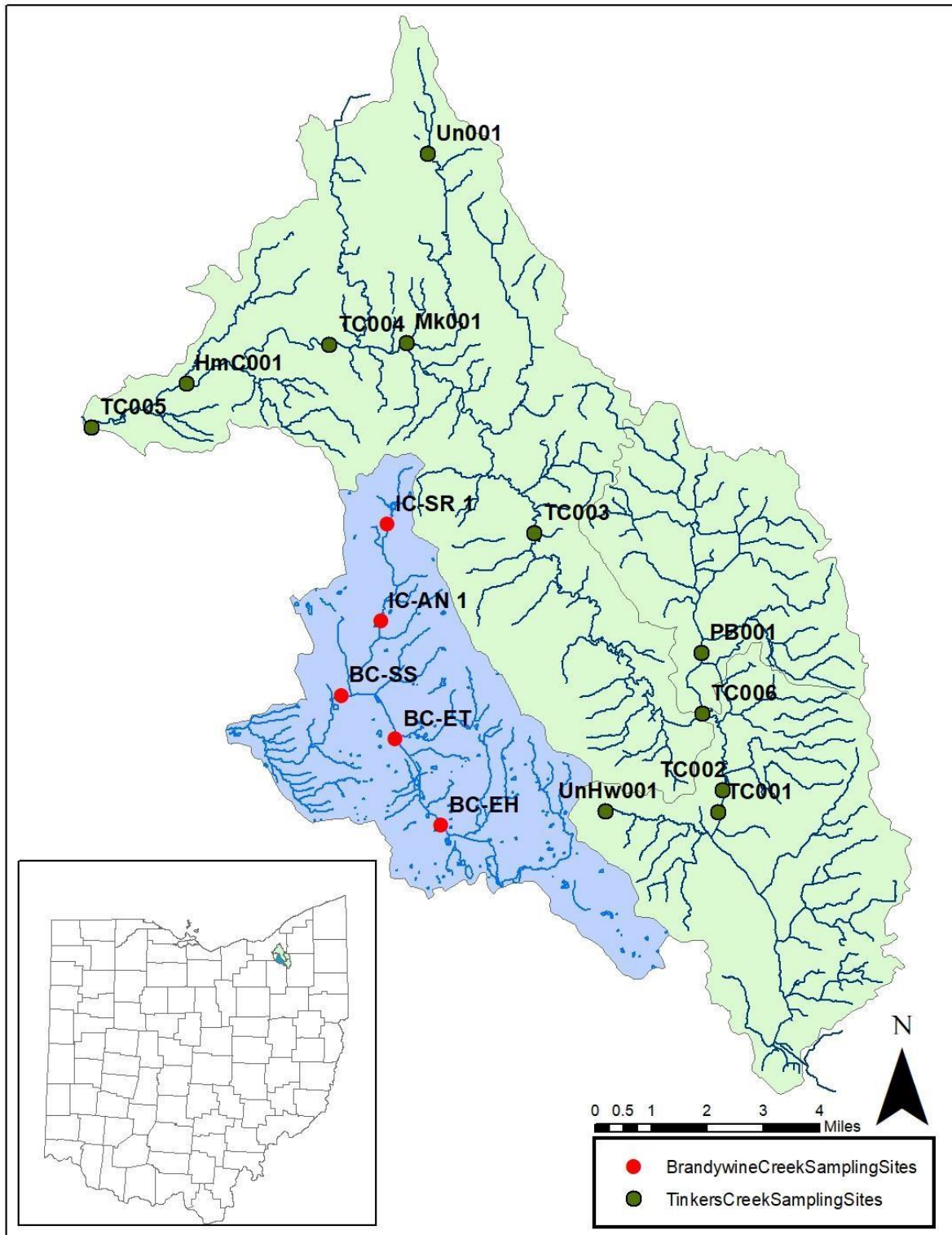


Figure 2. 2022 water quality site map

2022 Monitoring Results

pH

An important water quality parameter, pH measures how acidic/ basic a substance is. Values below 7 are acidic, values above 7 are basic (or alkaline), and 7 itself is considered neutral. This parameter influences both the solubility and bioavailability of nutrients and pollutants, affecting overall aquatic ecosystem function. It is commonly referred to as one of the major criteria for aquatic life, as many organisms can only survive within a specified pH range in freshwater environments. We expect to see some degree of fluctuation in pH throughout the year as water temperatures, weather patterns, and flow regimes change throughout the seasons.

Maintaining pH within a healthy range is critical for supporting aquatic life. The U.S. Environmental Protection Agency (EPA) recommends a pH between 6.0 and 9.0 for freshwater streams, with most organisms thriving in a narrower range of 6.5–8.0. All sites monitored in this study fell within this threshold, indicating generally favorable conditions for aquatic organisms across the watershed. Variation in pH among sites may reflect local watershed characteristics and land-use impacts. The highest average reading (8.0) was recorded at Hudson Tenbroek (TC001), while the lowest average (6.7) occurred at Liberty Park Pond Brook Conservation Area in Twinsburg (PB001). These results demonstrate that, while overall stream pH remains within an acceptable range, local site conditions can subtly influence water chemistry and highlight areas where continued monitoring and watershed management are important.

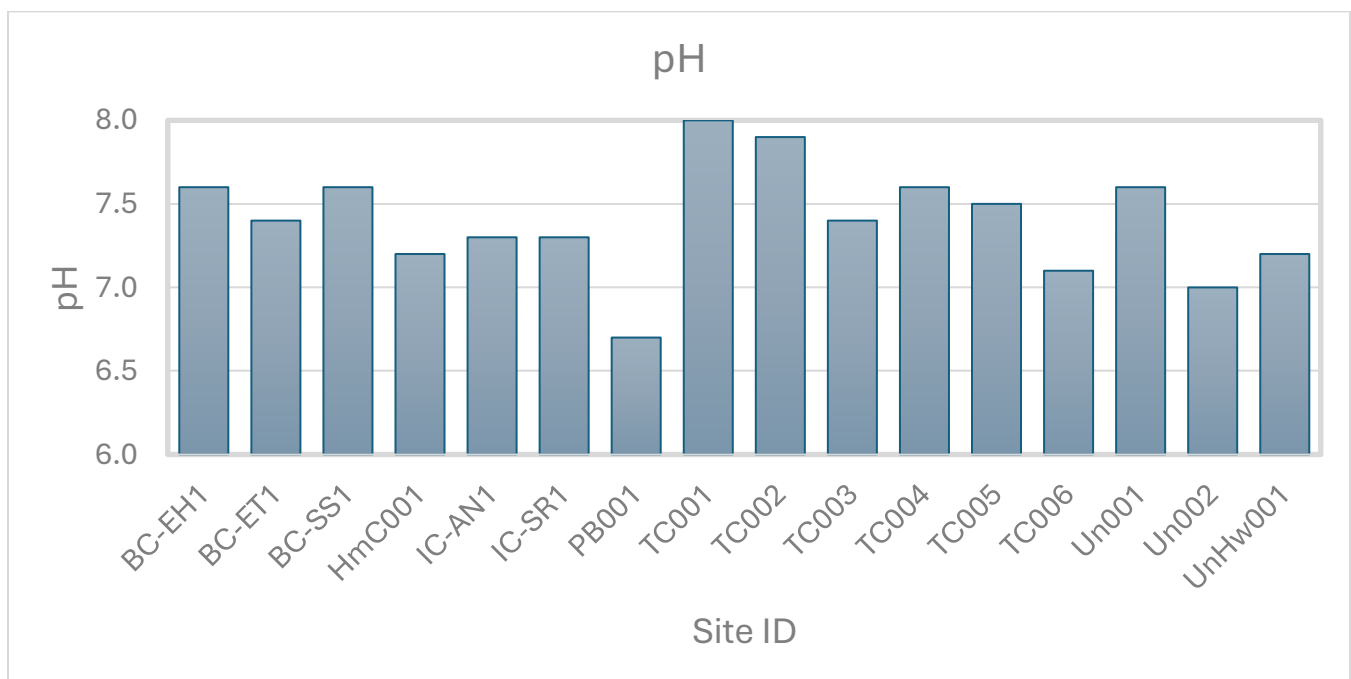


Figure 3. 2022 average pH levels across all testing sites.

Dissolved Oxygen

Dissolved oxygen (DO) refers to the concentration of molecular oxygen present in water and is a key indicator of stream health and biological productivity. Oxygen enters aquatic systems through atmospheric exchange (aeration), photosynthetic activity of aquatic plants and algae, and groundwater inputs. Dissolved oxygen levels are influenced by water temperature, nutrient enrichment, streamflow conditions, and physical channel conditions. Like pH, it is often referred to as one of the major criteria for aquatic life.

Low DO concentrations can limit biological productivity and impair the survival, growth, and reproduction of aquatic organisms. Prolonged low DO levels may result in fish kills or shifts in biological communities, where sensitive species are replaced by more tolerant, generalist taxa. Conversely, DO concentrations that are excessively high can lead to gas-bubble disease, a condition in which oxygen bubbles form in the bloodstream of organisms and disrupt circulation, similar to decompression sickness in divers.

A minimum average DO concentration of 5 mg/L is generally required to support fish populations in Ohio's streams. Of the 16 sites sampled, only one average fell below this threshold. The lowest average dissolved oxygen concentration (3.5 mg/L) was recorded at Darrow Road Park (UnHw001), and the highest average concentration (9.4 mg/L) was observed at Tinker's Creek Aqueduct (TC005).

Spatial differences in DO across monitoring sites likely reflect variations in streamflow, shading from riparian vegetation, temperature, and local nutrient inputs. The low average DO recorded at Darrow Road Park suggests the potential influence of reduced flow, elevated organic loading, or thermal stress, while higher DO at the Tinker's Creek Aqueduct indicates well-aerated conditions and strong reaeration associated with higher velocity flow and channel structure. Continued long-term monitoring will help determine whether these patterns are persistent or seasonally driven.

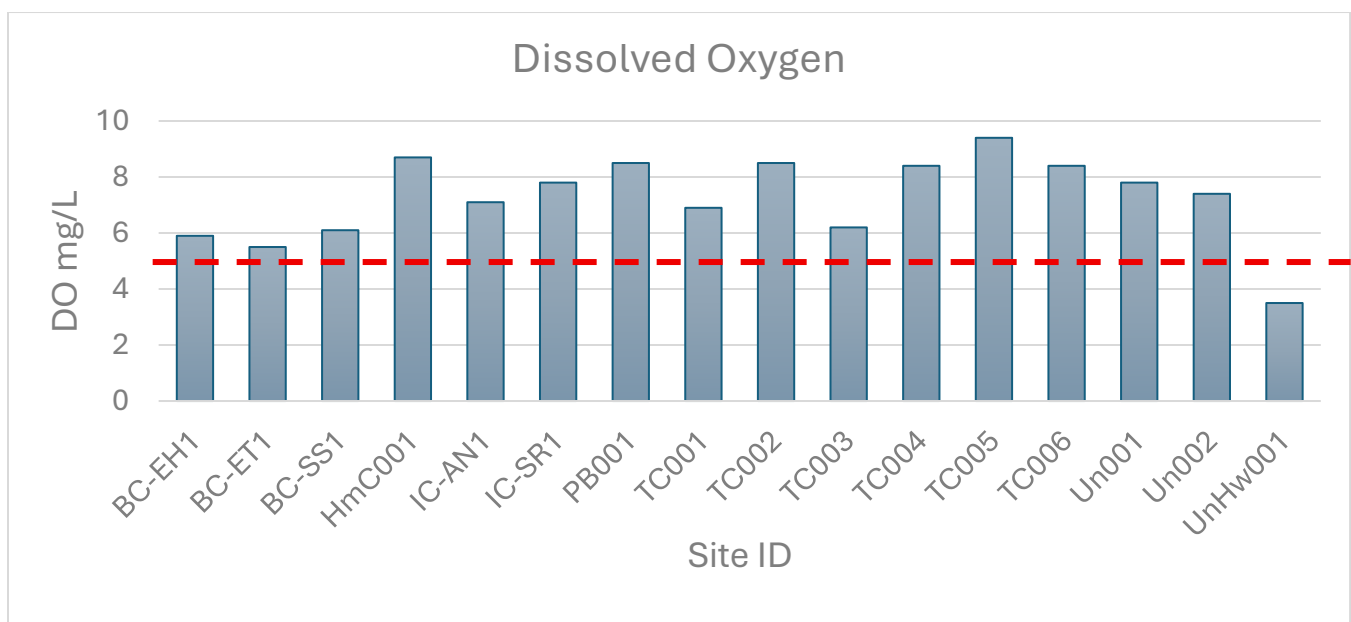


Figure 4. 2022 average Dissolved Oxygen levels across all testing sites.

Dissolved Oxygen Percent Saturation (DO%)

Dissolved oxygen percent saturation (DO%) represents the amount of oxygen in water relative to its maximum at the prevailing temperature and atmospheric pressure. Values near 100% reflect equilibrium with the atmosphere. Values below 100% indicate potential oxygen stress, while those above 100% suggest supersaturation, often from photosynthesis or turbulence. Average DO% ranged from 37% to 103% across all sites, with most sites supporting healthy aquatic conditions (70–100%). Overall, DO% trends align with concentration-based measurements, indicating generally adequate oxygen conditions across most sites with localized impairment at a few locations influenced by specific hydrology and land-use factors.

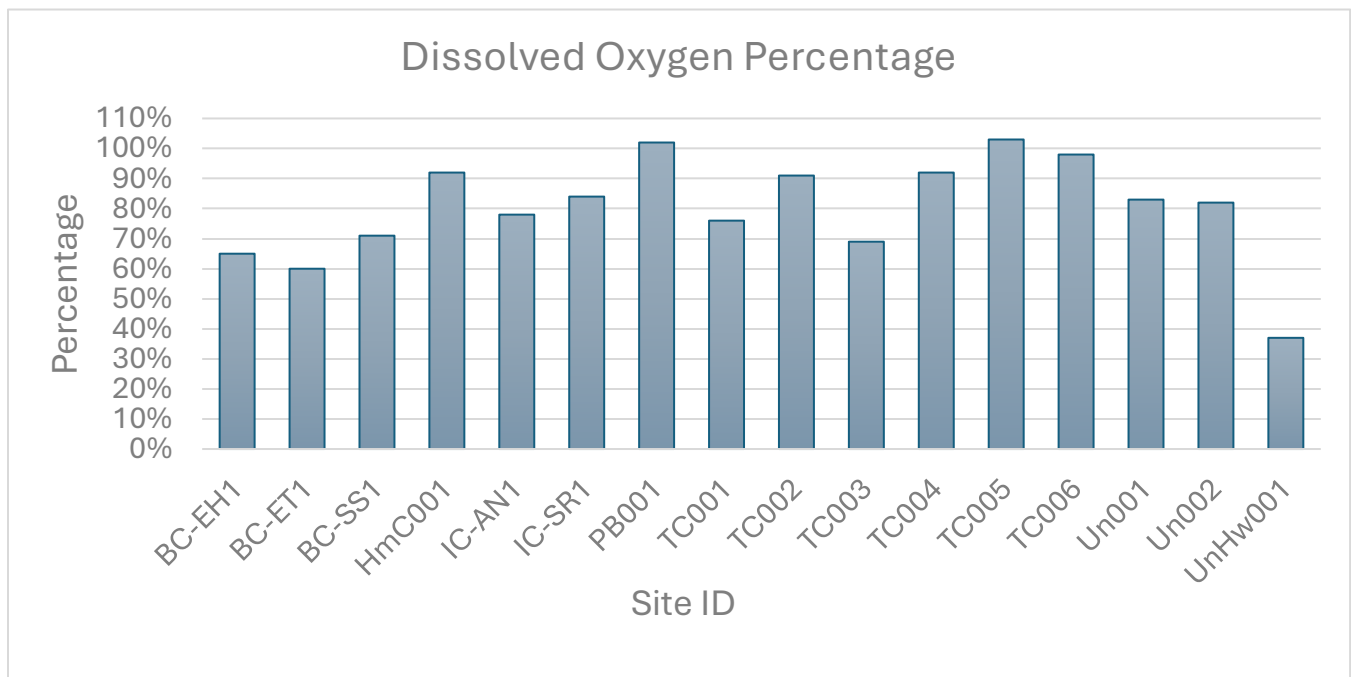


Figure 5. 2022 average Dissolved Oxygen Percentage, or percent air saturation, for each sample site.

E. coli Results

Escherichia coli (E. coli) is a fecal indicator bacterium commonly found in the digestive tract of warm-blooded animals. Its presence in surface waters indicates potential fecal contamination and the possible presence of disease-causing microorganisms. E. coli can enter streams through sources such as agricultural runoff, sanitary sewer overflows, failing septic systems, urban stormwater runoff, and wildlife activity. While low concentrations may occur naturally, elevated levels pose a human health risk during recreational water use. E. coli concentrations are commonly reported in colony forming units (cfu).

In Ohio, E. coli standards are established by the Ohio Environmental Protection Agency (OEPA). For primary contact recreation (PCR) waters, the standard is 126 cfu/100 mL, and for warmwater habitat

(WWH) waters, the threshold is 1,030 cfu/100 mL. All but three monitoring sites were below the WWH threshold; however, none of the sites met both the PCR and WWH standards.

The lowest average E. coli concentrations were observed at East Idlewood Park (TC003; 160 cfu/100 mL) and the Bedford Heights Bus Garage (Un002; 161 cfu/100 mL). The highest average E. coli concentrations occurred at the Bedford Reservation Hemlock Creek Picnic Area (HmC001; 2,022 cfu/100 mL), which exceeded the WWH standard. Several sites experienced one or two unusually high readings associated with storm events and increased runoff. TCWP notified the Northeast Ohio Regional Sewer District (NEORS), and follow-up sampling showed concentrations returning closer to regulatory thresholds.

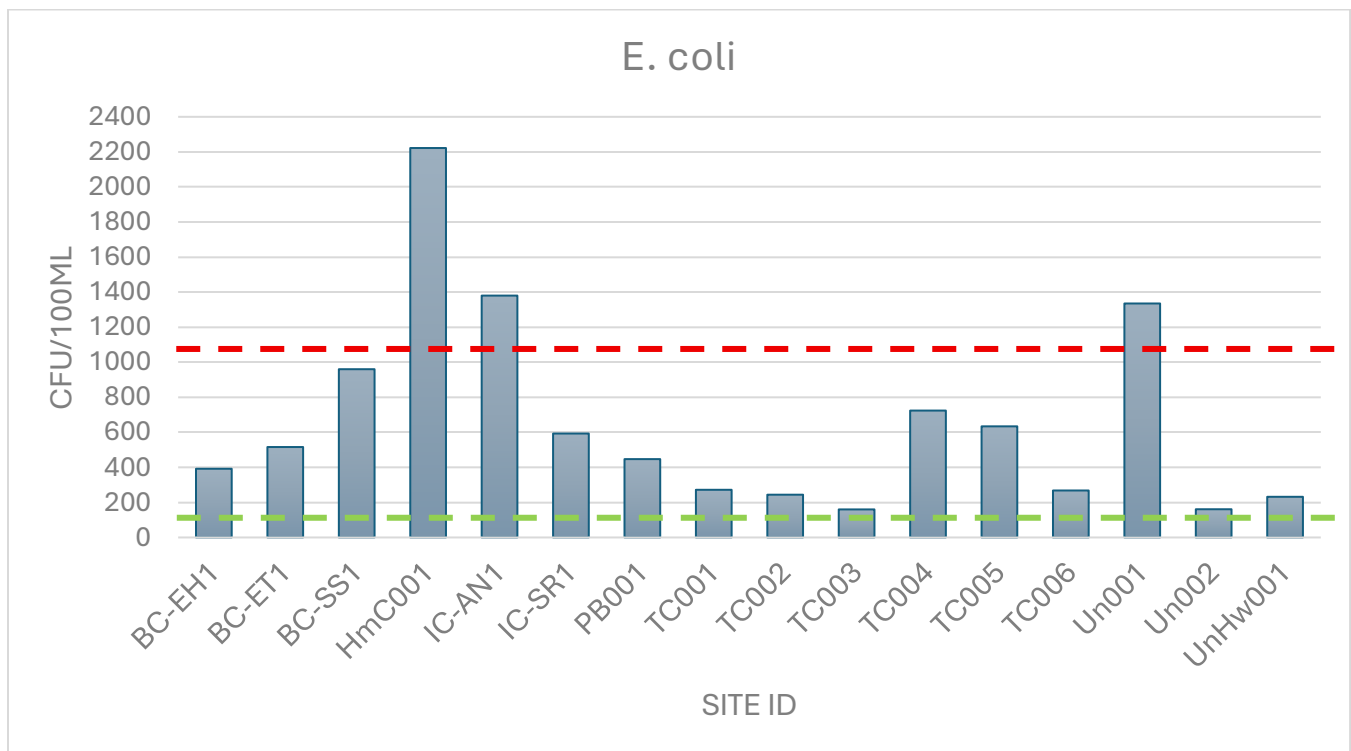


Figure 6. 2022 E. coli values for each sample site showing recreation and warmwater thresholds.

Nitrate

Nitrate, a naturally occurring form of nitrogen, is essential for aquatic life. It typically occurs at low concentrations in streams, where nitrogen is often a limiting nutrient. Elevated nitrate levels can increase algal growth, lower dissolved oxygen, and, in extreme cases, cause fish kills. Agricultural runoff is a common cause of high nitrate levels in Ohio.

Across the 16 monitoring sites, average nitrate concentrations ranged from 4.21 mg/L at Liberty Park Pond Brook Conservation Area in Twinsburg (PB001) to 65.95 mg/L at Highland Woods Apartments in Warrensville Heights (Un001). Short-term spikes on one or two sampling days contributed to higher

average values at some sites, which may indicate episodic inputs from stormwater runoff or other localized sources. Overall, most sites exhibited nitrate levels within acceptable ranges for regional streams, while the highest values indicate localized nitrogen enrichment that could stress aquatic ecosystems if sustained.

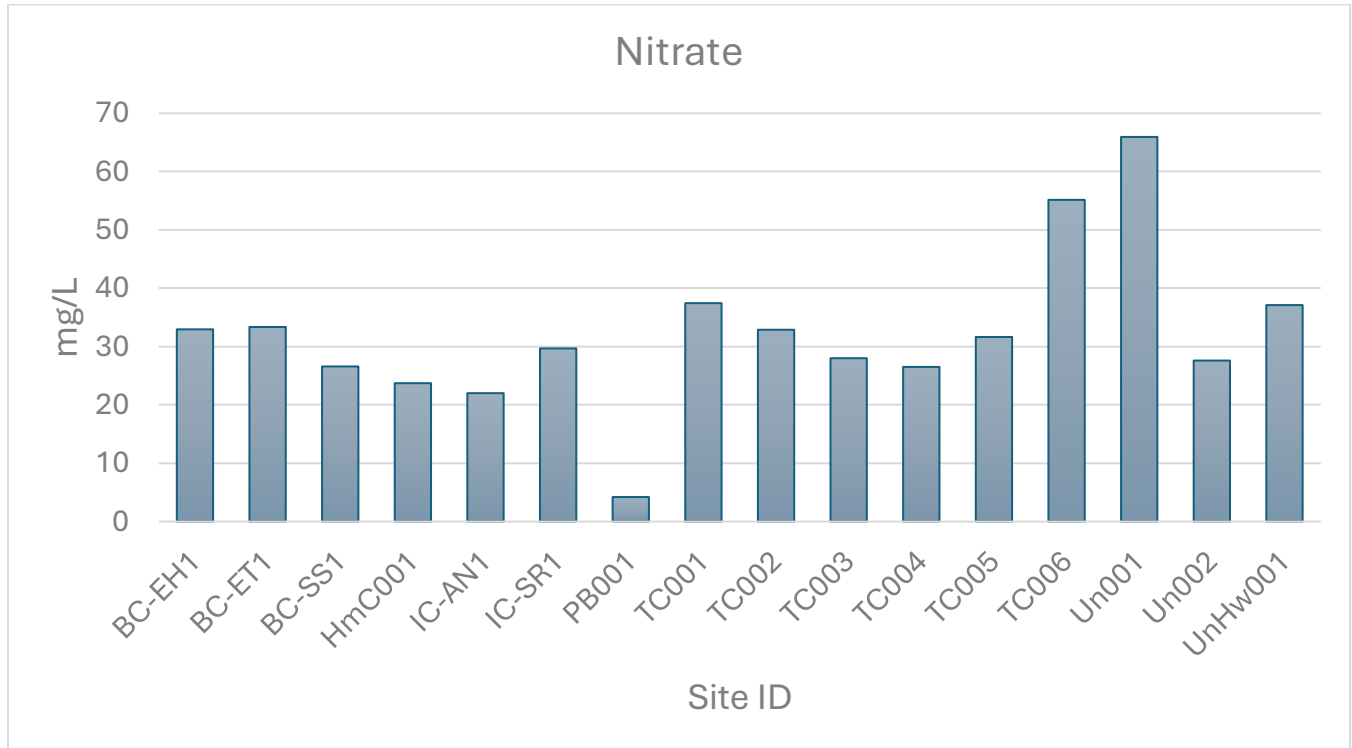


Figure 7. 2022 Nitrate values for each sample site.

Chloride

Chloride is a naturally occurring anion in streams and rivers, but it can reach ecologically harmful levels due to human activities. Road salt, as well as inputs from wastewater and other urban sources, are common sources of excess chloride. The highest average chloride concentration (631.47 mg/L) was observed at Tinker’s Creek at Bissel (TC006). However, chloride data for this site were limited, and the average was likely influenced by a single, unusually high measurement that may reflect episodic inputs. Continued monitoring at this location will be important to better characterize long-term chloride trends and potential ecological impacts.

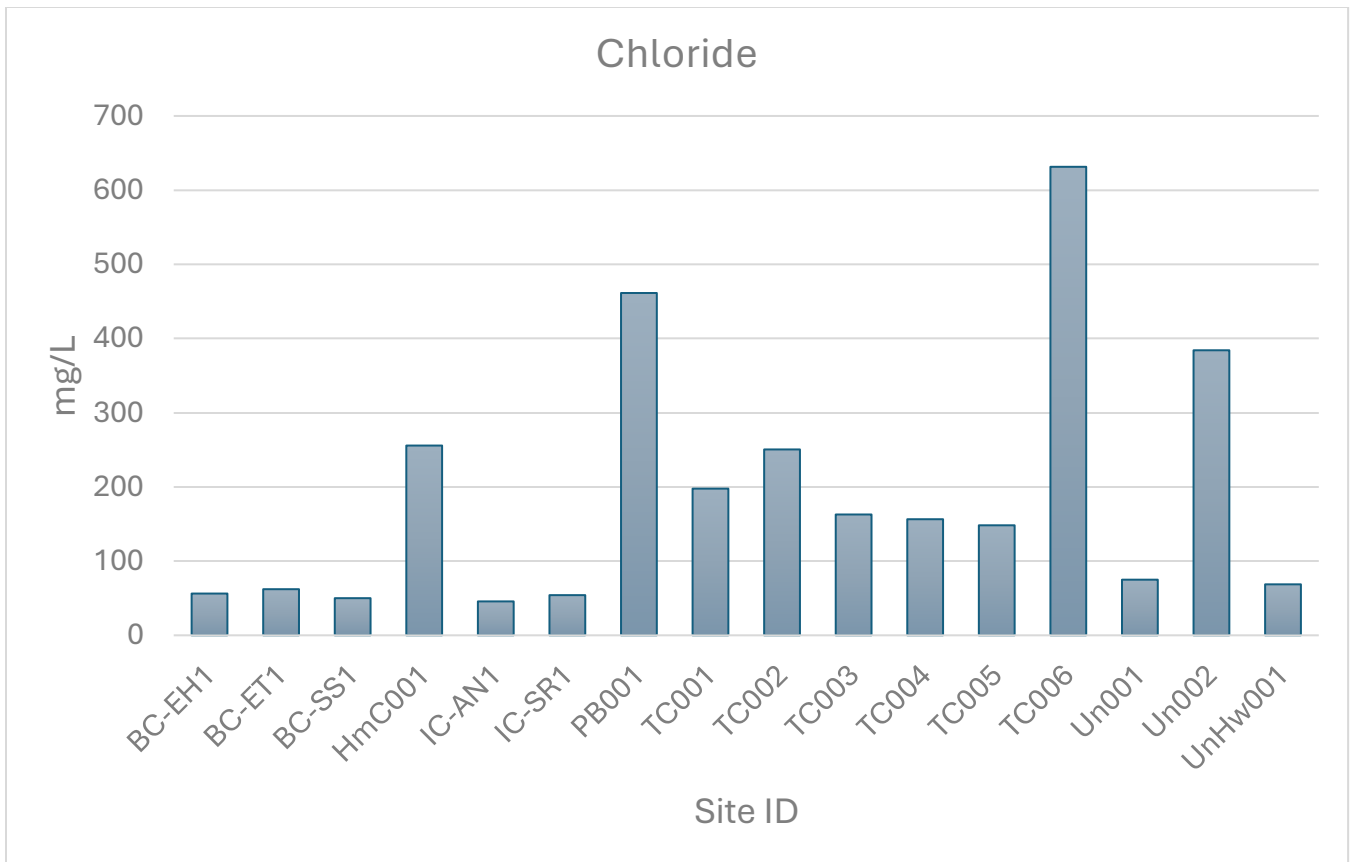


Figure 8. 2022 Chloride values for each sample site.

Specific Conductance

Specific conductance (SPC) is a measure of water’s ability to conduct an electrical current, standardized to a temperature of 25°C. It reflects the total concentration of dissolved ions in the water, including salts, nutrients, and inorganic minerals. Because dissolved ionic compounds conduct electricity, higher SPC values indicate greater concentrations of dissolved solids. SPC is closely related to salinity and is commonly used as an indicator of urban stormwater influence, road salt inputs, wastewater contributions, and overall ionic strength in a stream.

In freshwater systems, SPC is influenced by natural factors such as geology and groundwater inputs, as well as anthropogenic sources including road deicing salts, wastewater discharges, and runoff from developed areas. Elevated SPC levels can affect aquatic organisms directly by increasing osmotic stress and indirectly by altering water chemistry and nutrient availability. Specific conductivity was recorded in microsiemens per centimeter.

During the monitoring period, SPC values across the watershed ranged from 835.4 $\mu\text{S}/\text{cm}$ at Bedford Reservation Hemlock Picnic Area (HmC001) to 1,824 $\mu\text{S}/\text{cm}$ at Highland Woods Apartments in

Warrensville Heights (Un001). Spatial patterns in SPC likely reflect differences in surrounding land use, proximity to roadways, groundwater influence, and the extent of urban stormwater inputs.

Overall, SPC values at most sites were above expected background levels for freshwater streams*, which may be the result of external sources such as stormwater runoff. Continued long-term monitoring will help determine whether elevated SPC at select sites represents episodic storm-driven inputs or persistent chronic loading.

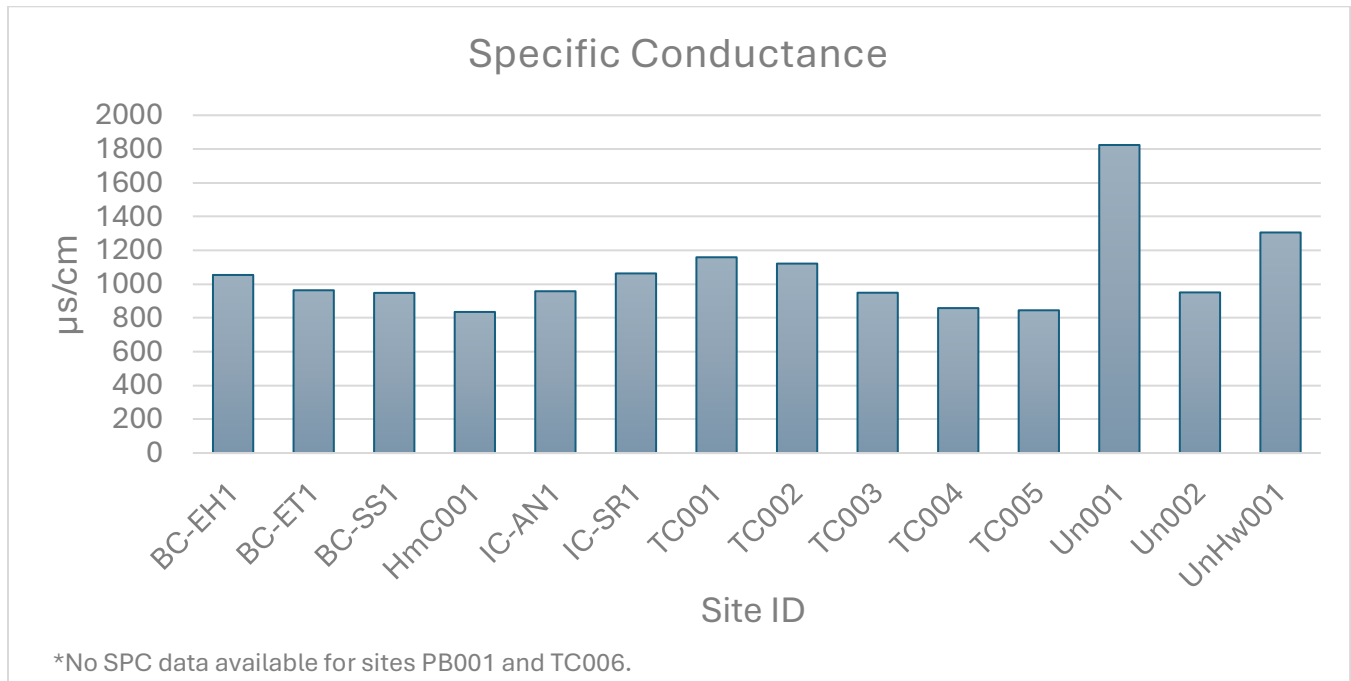


Figure 9. 2022 Specific Conductance values for each sample site.

Conclusions

The majority of our sites produced water quality data within acceptable thresholds for aquatic life. While some sites produced high levels of nitrate, chloride, and E. coli at times, continued monitoring is required to determine if these were outliers or common occurrences at those locations. Water quality datasets typically require a few years of data collection before strong trends can be identified. We are, however, cautiously optimistic that water quality is on an upward trend in both the Tinker's Creek and Brandywine Creek watersheds. Additional studies, such as aquatic macroinvertebrate or fish sampling, would be useful in the future to get an idea of the state of the organisms that live in both streams. Detection of sensitive species would be great indicators of the overall health of our local waterways. TCWP will continue to monitor these sites in order to produce even stronger data that can tell a more complete story for each stream.

Appendix A: Definitions

Air Temperature: Degrees in Celsius of the air.

Chloride: Naturally occurring anion of Chlorine, that is often associated with high levels of salinity within a water body. Forms a bond with Sodium to form Sodium Chloride (table salt).

Conductivity: The measure of how well an electric current can pass through a solution. Pure water has a conductivity of 0, but when salts and other dissolved molecules/particles are present in the water column, the solution will have a higher conductivity value.

Dissolved Oxygen: Concentration of Oxygen molecules present in a solution.

E. coli: A form of coliform bacteria that is present in the digestive tract of most animals, including humans and birds. May lead to illness if ingested. Dangerous to interact with the water if levels are too high.

Limiting Nutrient: A nutrient that is present in small quantities, limiting the growth and number of organisms present within an ecosystem (i.e., Nitrogen, Phosphorus)

Nitrate: Naturally occurring form of Nitrogen, that normally is present in small quantities. Pollution and runoff from agriculture leads to increase levels of Nitrate, potentially causing algal blooms and fish kills.

Nutrient Loading: When a nutrient that is normally limited within an ecosystem is brought into that system in large, unnatural quantities.

Salinity: The measure of salts within a solution.

Water Temperature: Degrees in Celsius of the water. Impacts life in the stream, as well as other water quality parameters. **pH:** Ranging from 0-14, the measure of how acidic or basic a solution is.

Watershed: An area of land where all the water flows into a single larger water body.

Appendix B: Additional Resources

Dominion Energy and Western Reserve Land Conservancy Watershed Mini Grant Program

Retrieved from

<https://www.wrlandconservancy.org/articles/tag/dominion><https://www.wrlandconservancy.org/articles/tag/dominion-energy-watershed-mini-grant-program/energy-watershed-mini-grant-program/>.

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Tinker's Creek Nine-Element Non-Point Source Implementation Strategic Plan: Headwaters Tinker's

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Tinker's Creek Nine-Element Non-Point Source Implementation Strategic Plan: Town of Twinsburg

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