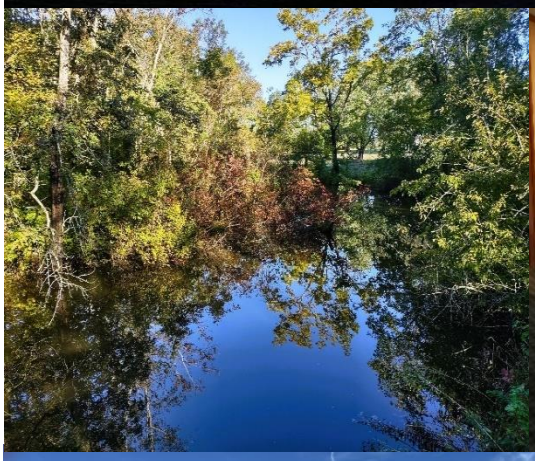
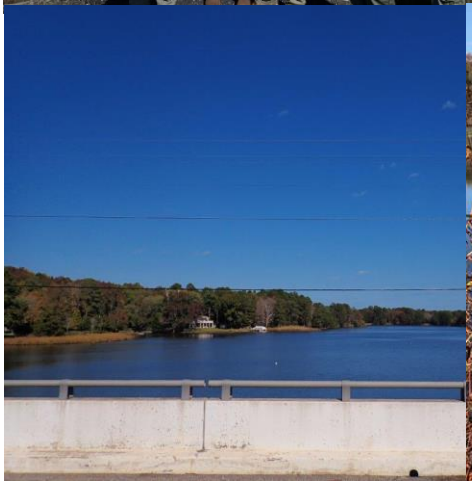
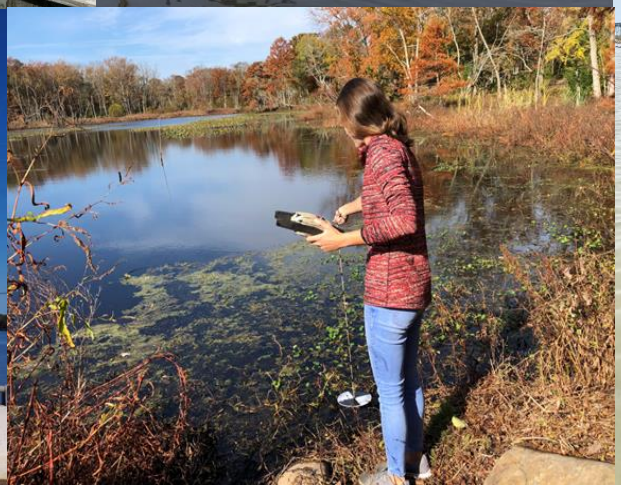
Maryland Coastal Bays Volunteer Water Quality Report 2005 - 2022

Toulan, C. Jesien, R., Weiland, B, Keeley,E. (2023)







Acknowledgements:

Our monitoring efforts would not be as successful or expansive without the help of our past and current volunteers who have dedicated countless hours towards helping MCPB assess the health of our waterways. MCBP would like to personally thank two volunteers, John McFalls and Alice Tweedy who dedicated 25 years of their lives braving the elements each month to collect their water quality samples. It is the dedication to make a difference in their community that make all our volunteers stewards of the Coastal Bays. We appreciate all your efforts and contributions to making this program so successful over the past 27 years. Below is the list of volunteers who have contributed to our water quality data over the years; this report is dedicated to them.

Alan Wierengo
Alice Tweedy
Anj Young
Annette Cropper
Beth Gismondi
Bill Blackmore
Bill Edmanson
Bill Everett
Bill Killinger
Brooks Olney
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Chris Wade
Dave & Janis Foley
Dawn Scher
Dee Rigsby
Don Winslow
Erin Fitzsimmons
Ernie Emond
Evelyn Adams
Fred Dinges
George Seymore
George Staples
Hobie Kernan
Hollis Martin
Jack McAllister
James & Nancy Harvey
Janet Cherrix
Jeff Anderson
Jeff Figgs
Jim & Barbara Spang
Jim Packer
Jim Spicknall
Joan Hersey
Joe O'Hara
Joel Mitchell
John Clifton
John Kelly
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Mary Ochse
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Mike Evans
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Nancy Zeller
Phyllis Koenings
Ralph Jones
Ray Jackson
Richard Mueller
Robert Bowen
Sandy Miller
Stacy Ryan
Sue Latour
Terry Bell
Tessa Foster
Tom & Tina Cropper
Tom Patton
Tom Wentz
Walter Powers
Wayne & Paula Faircloth

MCBP would also like to thank our partner organizations (listed below), numerous interns, seasonals, and staff members who have helped collect, analyze, and synthesize our water quality data throughout this time. Special thanks to former Environmental Scientists Carol Cain who spearheaded the program in the early years, Amanda Poskaitis who took up the torch and former CCC member, Virginia Parker, for starting this report.

Table of Contents

Who We Are

The Maryland Coastal Bays Program (MCBP) is one of 28 National Estuary Programs (NEP) across the country that receives funding from the US Environmental Protection Agency (EPA) to restore and protect "estuaries of national significance". The Program is a collaboration of local municipalities, county, state, and federal agencies and organizations, and local citizens working to meet this goal. The Coastal Bays are one of the most ecologically diverse regions in the state. The watershed encompasses approximately 175 square miles of Maryland's coastal plain that drains to the Atlantic Ocean. It consists of five bays- Assawoman, Isle of Wight, Sinepuxent, Newport, and Chincoteague, and one major tributary, the St. Martin River. These watersheds support numerous rare and threatened plant and animal species. The bays, forests, streams, and wetlands are vital to migratory songbirds, waterfowl, fishes, and insects as well as numerous important commercial and recreational fish and shellfish species. The Maryland Coastal Bays Foundation is the incorporated portion of MCBP. The Foundation is a private, non-profit corporation that exists under the laws of the State of Maryland exclusively for charitable, educational, scientific, and conservation purposes. The Foundation assists MCBP in the development and implementation of its Comprehensive Conservation Management Plan (CCMP) for conservation and educational activities by the Program and its stakeholders and partners.

To accomplish the CCMP goals, the Program engages federal, state, and local partners and citizens in defining the health concerns and conservation needs of the Coastal Bays watershed. The Program:

- Implements management strategies defined in the CCMP in accordance with the Federal Clean Water Act as the Maryland Coastal Bays Program;
- Develops and uses factual scientific information to assess and improve the health and sustainable use of the Coastal Bays watershed;
- Promotes responsible stewardship and actions to improve the Coastal Bays watershed through public outreach and education; and
- Conducts fundraising activities to secure public and private grants and donations to support environmental improvements beyond those provided by existing funding sources.

A vital component of the management strategy is monitoring the varied components of the watershed. The MCBP Water Quality Monitoring program was established in 1997 and is currently made up of volunteers who sample local waters at 12 stations. These results are combined with 64 additional stations sampled by DNR and the National Park Service and are used in the annual report cards that assess and describe the health of the waters within the watershed. Since there is a direct relationship between water quality and harmful algal blooms (HABs), eutrophication (excessive nutrient enrichment), fish kills, submerged aquatic vegetation (SAV) health, human health, and other environmental issues, these data form the basis of our ability to evaluate the health of the entire watershed.

This report summarizes the results of the MCBP volunteer sites from 2005 – 2022.

Introduction

Water is a very special substance, it's the only naturally occurring liquid, the only one that occurs in three phases, a solid, liquid and gas, and without it, life on Earth would not be possible. There are records dating as far back to Ancient Greece (470 BCE) of people studying the impacts of water quality on humans and the environment (Juuti et al., 2016). Due to technological advances, our ability to measure and detect changes in water quality characteristics has improved dramatically in the past 100 years, however, even today we still use traditional forms of measuring water quality parameters. For example, water clarity has been measured using various devices for centuries to help navigate oceans and other bodies of water. However, it is Alessandra Cialdi and Father Angelo Secchi who are credited with the invention of the secchi disk while demonstrating it to Pope Pius IX on his boat in 1865 (Pitarch, 2020). Today, **secchi depth,** a consistent way to measure water clarity, is still a widely used measurement in the science community.

In the 1920's scientists used the ability of water to carry an electrical charge to survey a variety of lakes in northern Wisconsin. They found that lakes with a greater ability to conduct the charge were more productive because they had more dissolved matter than lakes with lower ability. At that time, to find the dissolved portion, a known amount of water had to be evaporated in a small dish, and the amount of salt that remained in the dish was weighed, which was a very labor-intensive method. Using the electrical properties of water to quickly measure dissolved material was a significant step forward. As instrumentation improved, by the 1970's water's ability to conduct the charge, termed **conductivity**, was an accepted way of calculating ocean salinity. With continued improvements in technology, **salinity** and conductivity can be measured using a small handheld instrument and is now an accepted measure of the **total dissolved solids (TDS)** in water. Since conductivity increases with temperature, **specific conductance** is conductivity standardized to 25°C. Changes in conductivity can signal changes in inputs from land or water sources.

Up to a few years ago, **dissolved oxygen**, the total amount of oxygen available to living organisms, was measured using titrations and the result related to a particular color which required an array of instruments and bottles to be taken into the field. With advances in technology, using electrical properties of water, small handheld instruments can now very quickly and accurately determine dissolved oxygen content in water. The amount of oxygen in water is related to temperature, the lower the temperature, the greater the potential amount of oxygen. Water that holds as much oxygen as possible is said to be 100% saturated. Biological activity can have a major impact on dissolved oxygen levels. Plants produce oxygen during photosynthesis but use up oxygen at night when they respire. If respiration from fish, and other organisms, including bacteria, in the water exceeds the amount produced by photosynthesis, then oxygen levels drop.

Plants use the sun's energy to convert simple elements such as carbon, **nitrogen, and phosphorus,** into a form that our bodies can use and produce oxygen in the process. Oxygen is very reactive; before plants existed, there was no oxygen in our atmosphere since it would quickly combine with other elements., Plants are able to transform oxygen through photosynthesis which allows it to exist as a gas and eventually; over millions of years, accumulated in the atmosphere to the levels we see today. Nitrogen and phosphorus are especially important in forming the basic building blocks of all organisms. However, in excess, these nutrients can cause excessive plant growth which can lead to harmful algal blooms (HABs) and other issues. High algal production results in high oxygen levels during the day often resulting in very low oxygen at night when the high algal biomass, along with other organisms, use up the oxygen in respiration. Too low oxygen will result in death of the organisms in the surrounding area.

Field instruments are not quite adequate yet, so water samples are sent to a laboratory for analysis. Analytical procedures have progressed to the point where automatic analyzers quickly determine concentrations. Total nitrogen and phosphorus are determined from the whole water sample, and dissolved nutrients (**NH4, NO3, PO4**) from filtered samples.

Chlorophyll levels found in a sample are directly related to the amount of algae present in the water. Plants use several different pigments to capture sunlight in the photosynthesis process. Chlorophyll *a* is a common plant pigment and relatively easy to measure compared to the other pigments. Water samples are passed through a filter that captures the algae particles. The filter is then taken to the laboratory where the chlorophyll *a* is extracted. The amount is determined by a spectrophotometer which measures the intensity of light at a particular wavelength that passes through the sample.

Results of Water Sampling

This report shows results of the analysis of water samples collected from the stations listed below. It is worth noting that there are two additional sites not included in this report. Because sampling began in 2021, stations 36 and 37 are not included in this analysis as it is too early to draw conclusions or determine long-term trends. Water samples from the 12 stations were collected monthly from January 2005 through December 2007, then continuously from March 2010 to December 2022. Samples were not collected from 2007 – 2009. Results of analysis for total nitrogen (TN), total phosphorus (TP), dissolved oxygen (DO) and chlorophyll *a* are presented for the 12 individual stations. Threshold values are used to evaluate the water quality of the stations. These thresholds are based on literature values for nontidal streams that are not affected by human activity. The percentage of times that the thresholds are met are considered "passing" whereas percent "failure" represents the times the threshold was exceeded.

Of the 12 sites, 4 are freshwater and 8 are brackish water, meaning a combination of fresh and salt water (Table 1). Salinity and pH are two water quality parameters that are used to assess site conditions and can vary with weather, water flow, storms, and pollutant input. Below is a table showing the mean values for salinity and pH for each site. This table can be used as a reference for collecting water quality data. If values are drastically different from these averages an MCBP staff member should be notified.

Table 1. Expected salinity and pH at the 12 sampling locations.

Stream	Site Number	Salinity (ppt)	pH
Hudson Branch	4	<1.0	5.99
Ocean Pines Canal	9	23.6	7.85
South Point	10	27.3	8.02
Mason Branch	12	14.5	7.31
Newport Bay Golf Course	15	22.0	7.85
Figgs Landing	18	29.4	8.02
Trappe Creek	23	<2.0	6.43
Bassett Creek	28	<1.0	6.36
Turville Creek	30	18.7	7.12
Snug Harbor	31	29.5	7.92
Ayers Creek	33	9.9	7.34
Bottle Branch	35	<1.0	6.56

Are Conditions Improving?

To see if conditions improved over the years, a statistical procedure, called regression analysis, was used to evaluate each of the parameters over the sampling years. Results of the analyses are presented in Table 2. No trends indicate that the parameter values were so variable that no trend could be determined. An increasing trend indicates that the parameters increased over the years. No trend was observed for most stations. Nine of the twelve stations showed decreases in either TN, TP, or chlorophyll *a*.

The dissolved portions generally followed the TN and TP. A decrease in these parameters is an indication of improving water quality and are coded in green in the table below. However, one station, Station 4 showed an increase in TN, and a decrease in DO and is coded in red. Increasing trends in DO is a positive outcome, so the six stations that showed that trend in DO are coded in green in the table below. For stations that showed significant trends, graphs are included to illustrate the rate of change over the 17-year study.

Table 2. Summary of regression analysis to determine if conditions are improving (green) or declining (red)

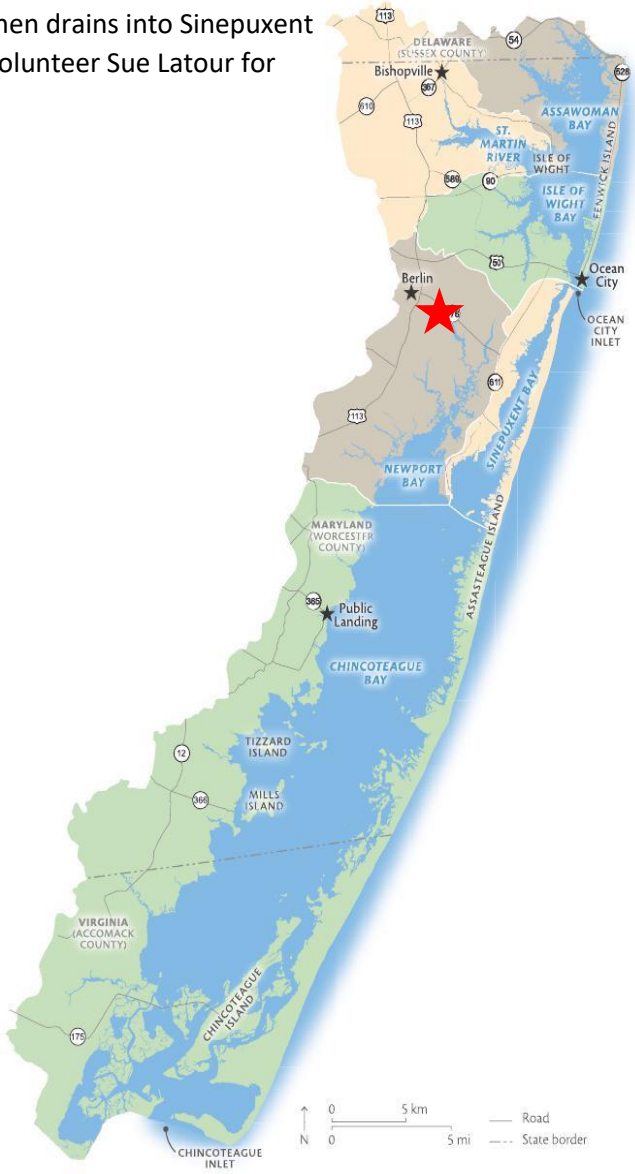
Stream	Site Number	TN Trend	TP Trend	DO Trend	Chlorophyll *a* Trend
Hudson Branch	4	Inc	Dec	Dec	Dec
Ocean Pines Canal	9	No Trend	Dec	No Trend	No Trend
South Point	10	Dec	Dec	Inc	Dec
Mason Branch	12	Dec	No Trend	Inc	No Trend
Newport Bay Golf Course	15	Dec	No Trend	Inc	No Trend
Figgs Landing	18	No Trend	No Trend	Inc	No Trend
Trappe Creek	23	Dec	No Trend	Inc	No Trend
Bassett Creek	28	No Trend	No Trend	No Trend	No Trend
Turville Creek	30	No Trend	No Trend	No Trend	No Trend
Snug Harbor	31	No Trend	Dec	No Trend	No Trend
Ayers Creek	33	Dec	No Trend	Inc	Dec
Bottle Branch	35	Dec	Dec	No Trend	No Trend

Site Summaries

The following pages provide summaries of each volunteer water quality location. Each page includes a map with a red star to show the location of the site, a photo of where the sample is collected, a brief description of the site, and a table with a description that explains the trends seen for each water quality parameter. Sites that have significant increases/decreases in trends have graphs associated with them to see changes over time.

HUDSON BRANCH - SITE #4:

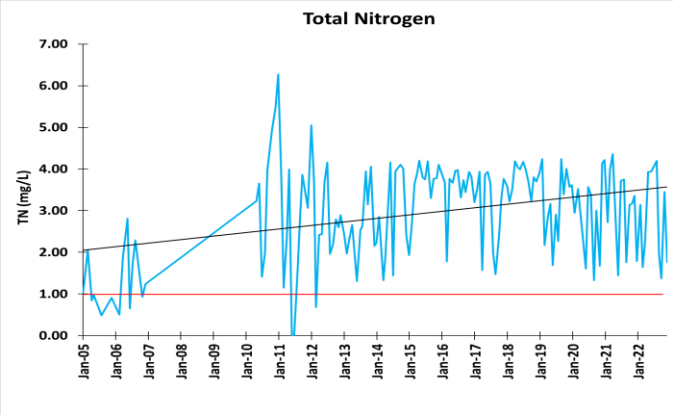
The Hudson Branch location, site #4, is located at the corner of Bottle Branch Rd and Assateague Rd. Hudson Branch drains into Ayers Creek which then drains into Sinepuxent Bay. Hudson Branch is surrounded by a tree buffer. We thank volunteer Sue Latour for monitoring this site.

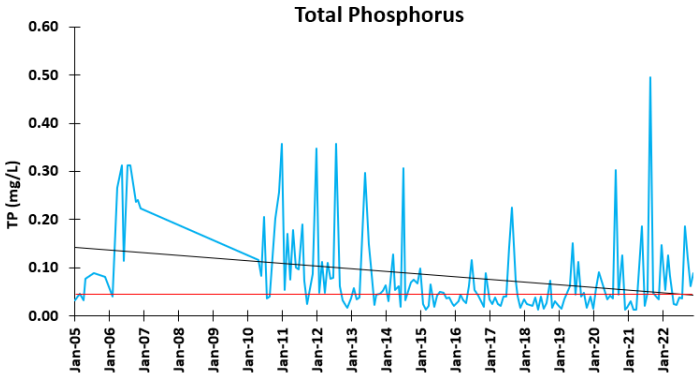


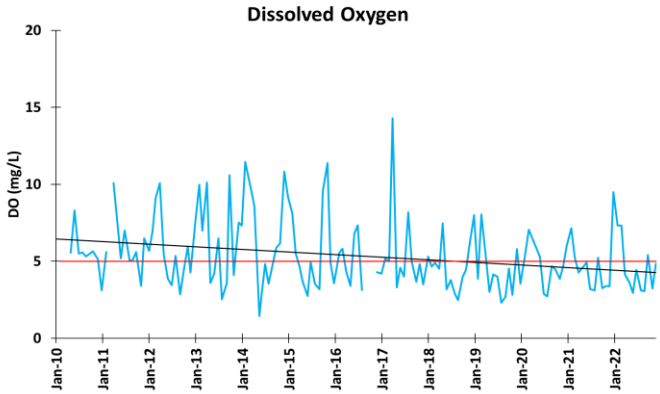
Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) mg/L	> 1.00	7%	93%
Total Phosphorus (TP) mg/L	> 0.044	49%	51%
Chlorophyll *a*	> 15.00	90%	10%
Dissolved Oxygen (DO) mg/L	≥ 5.00	33%	67%

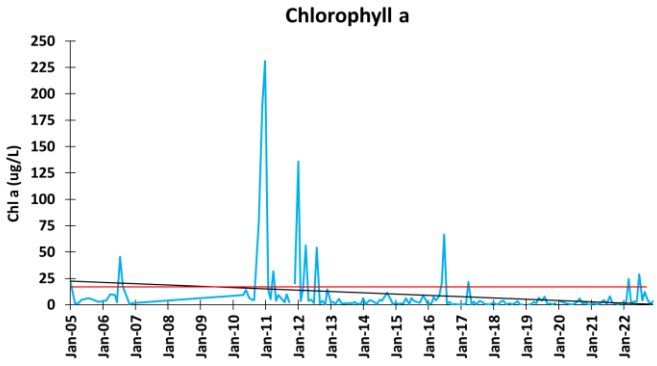
This stream is impacted by high TN and TP levels and low DO. Chlorophyll *a* is relatively low most likely because trees along the banks block a good deal of sunlight that is needed for algae to thrive and produce high amounts of chlorophyll *a*. All four parameters show significant trends in data. The decline in TP and chlorophyll *a* indicate improvement, while the increase in TN and decline in DO indicate degradation. This is the only site that showed an increase in TN over the study period.

Data for Hudson Branch (Site 4) in blue. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.



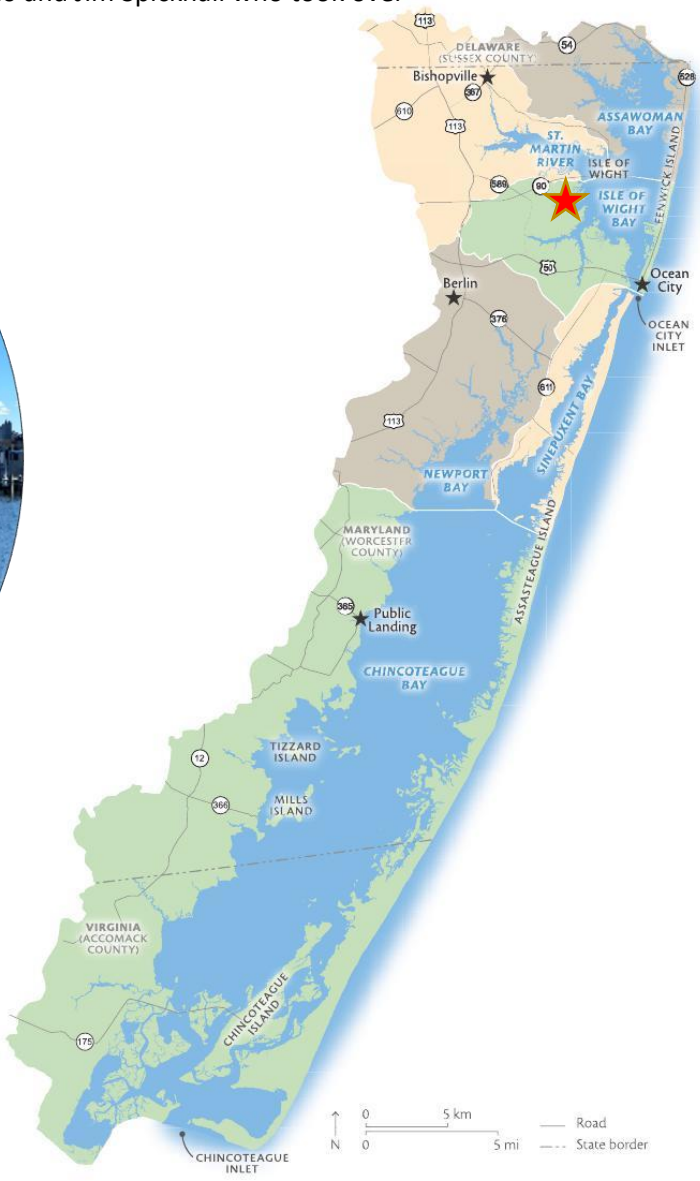






Ocean Pines Canal - Site #9:

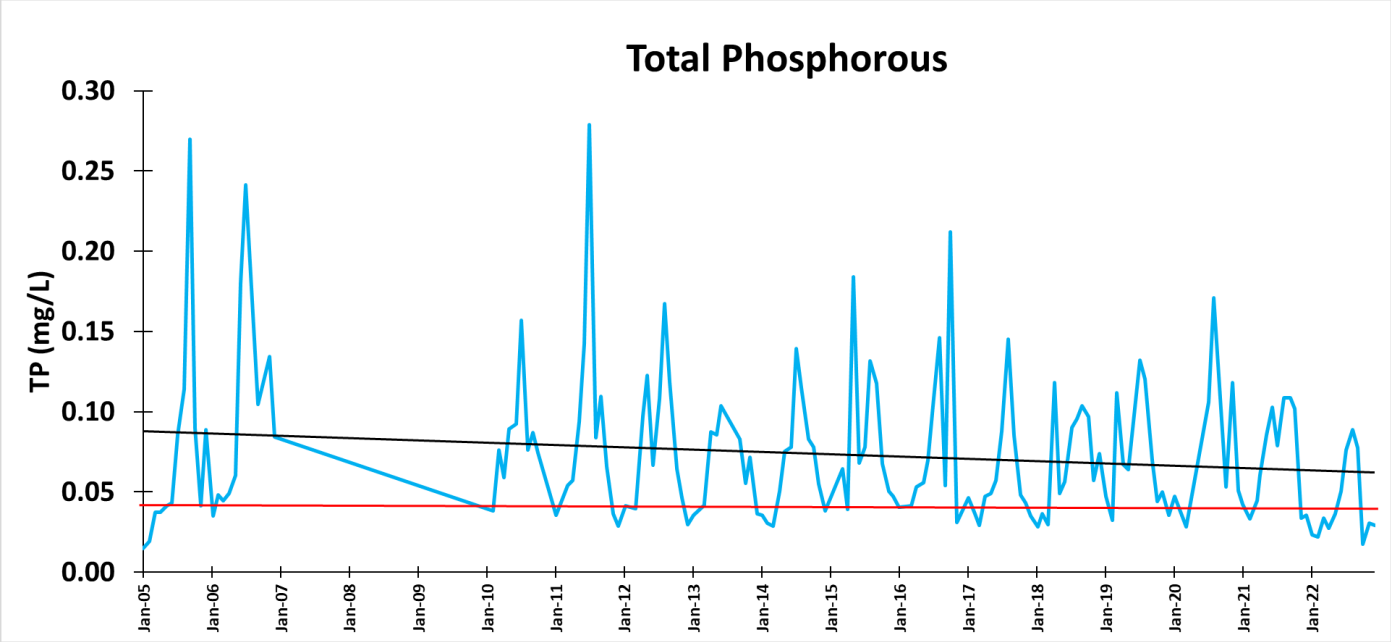
The Ocean Pines Canal, site #9, is located along the north side of Manklin Creek which drains into Isle of Wight Bay. The site is within a canal where the shoreline is entirely bulkheaded. Special thanks to John McFalls who monitored this site from 1997 – 2020 and Jim Spicknall who took over the site in 2020.



Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	93%	7%
Total Phosphorus (TP) (mg/L)	> 0.044	27%	73%
Chlorophyll *a* (ug/L)	> 15.00	77%	23%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	69%	31%

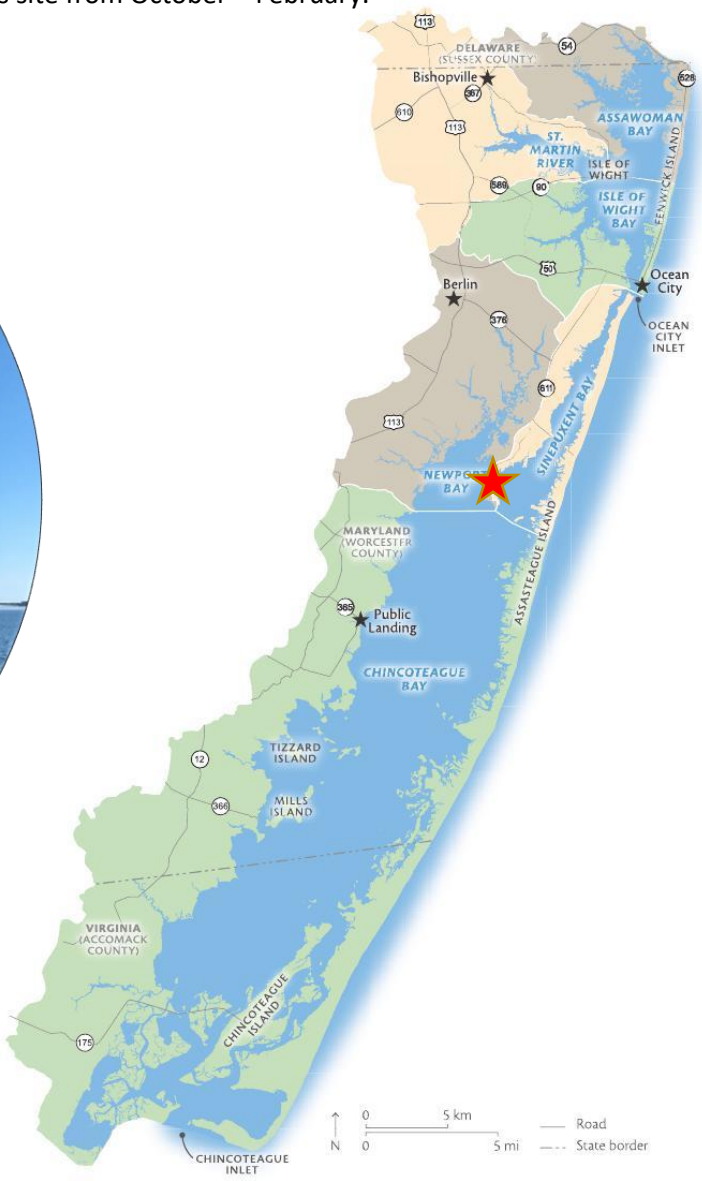
This station is most negatively affected by TP levels, failing to fall below the threshold 73% of the time. There is little TN contamination at this site, with thresholds being met 93% of the time. The chlorophyll *a* levels have led some algae blooms to be found here and low DO is present about 1/3 of the time.

Data for Hudson Branch (Site 9) in blue. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.



SOUTH POINT LANDING – SITE 10

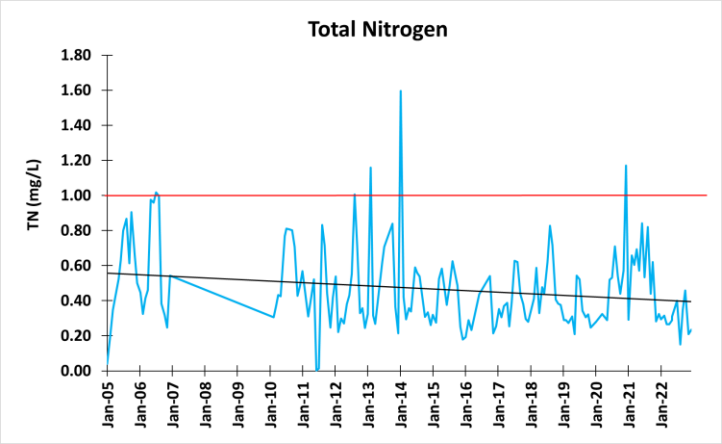
South Point Landing, site #10, is located at the South Point Boat Launch which is located on Sinepuxent Bay. Land use around this area is mostly residential and wetlands with some forests. Special thanks to the Maryland Conservation Corps who assists MCBP in sampling this site from October – February.

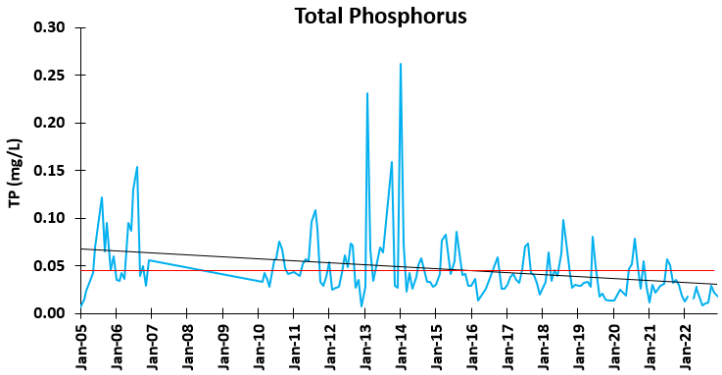


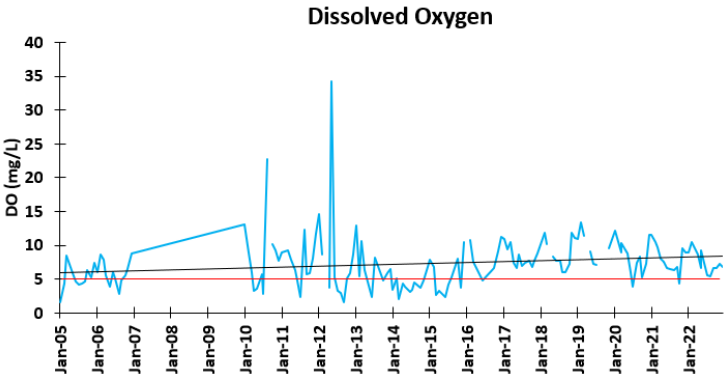
Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	97%	3%
Total Phosphorus (TP) (mg/L)	> 0.044	60%	40%
Chlorophyll *a* (ug/L)	> 15.00	92%	8%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	75%	25%

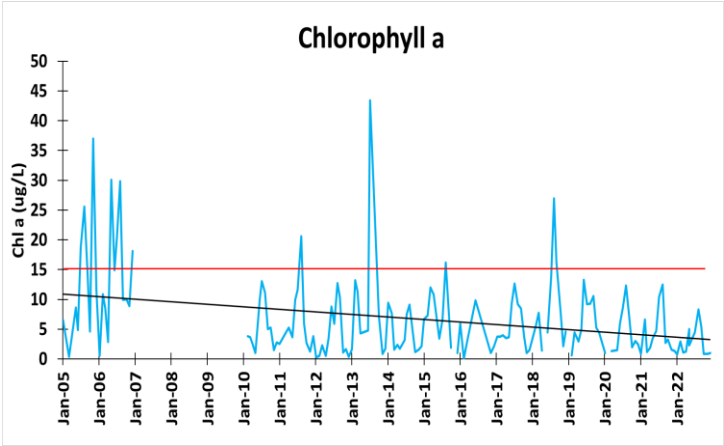
This station is most affected by TP, however, this general decrease of TP over time is significant according to the linear regression model. There is little TN contamination at this site, low concentrations of chlorophyll *a*, and generally good DO levels. All four parameters for this site indicate significant water quality improvement.

Data for South Point Landing (Site 10) from 2005 -2021 in blue. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.



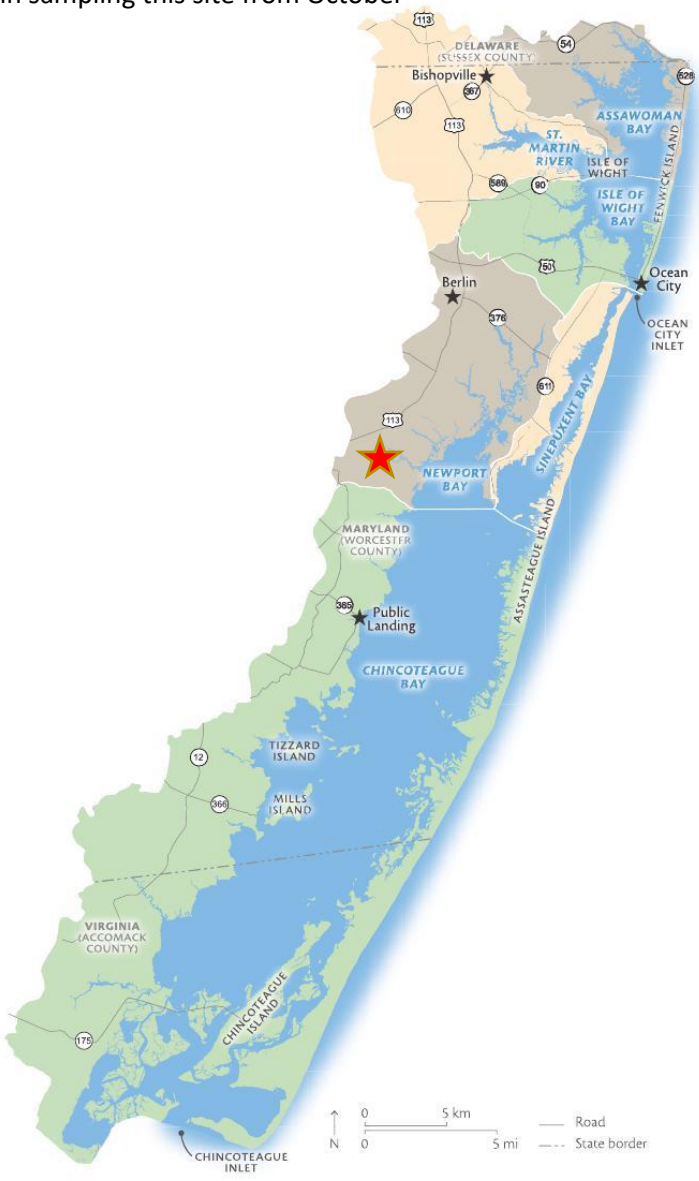






Mason Landing – Site 12

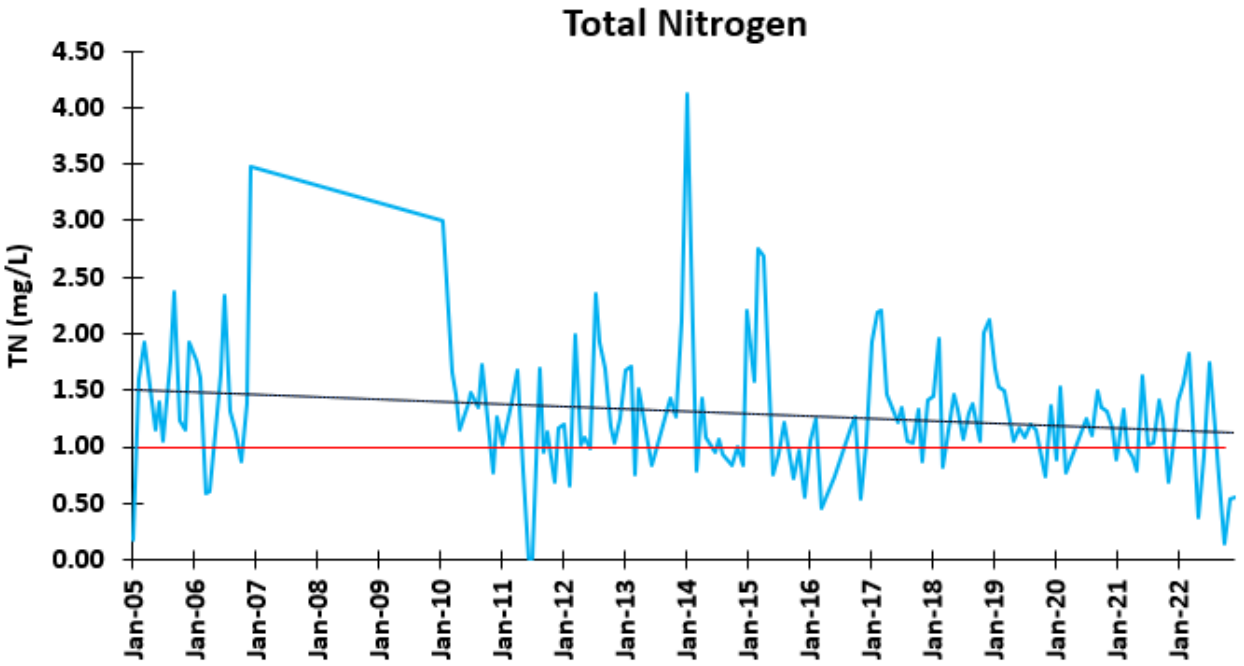
Mason Landing, site #12, is located at the end of Marshall Creek Rd, which drains into Newport Bay. Land use around this area is mostly wetlands and natural forest with some residential development. Special thanks to the Maryland Conservation Corps who assists MCBP in sampling this site from October – February.

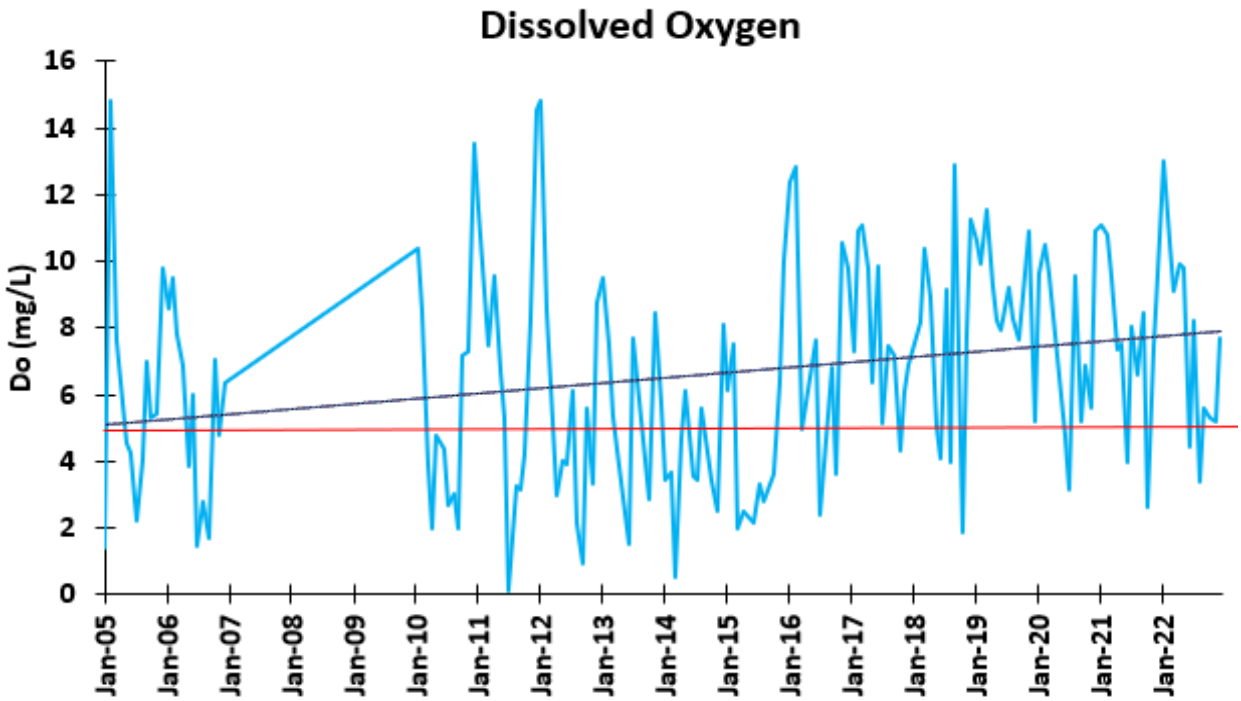


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	26%	74%
Total Phosphorus (TP) (mg/L)	> 0.044	17%	83%
Chlorophyll *a* (ug/L)	> 15.00	55%	45%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	64%	36%

This site is most negatively affected by high TN and TP levels. There were high nutrient loads, but no significant trends were observed over the years for TP or chlorophyll *a*. Although nutrients were high, DO showed a significant increasing trend and TN showed a significant decrease trend, which were good indicators for the improving health of the stream.

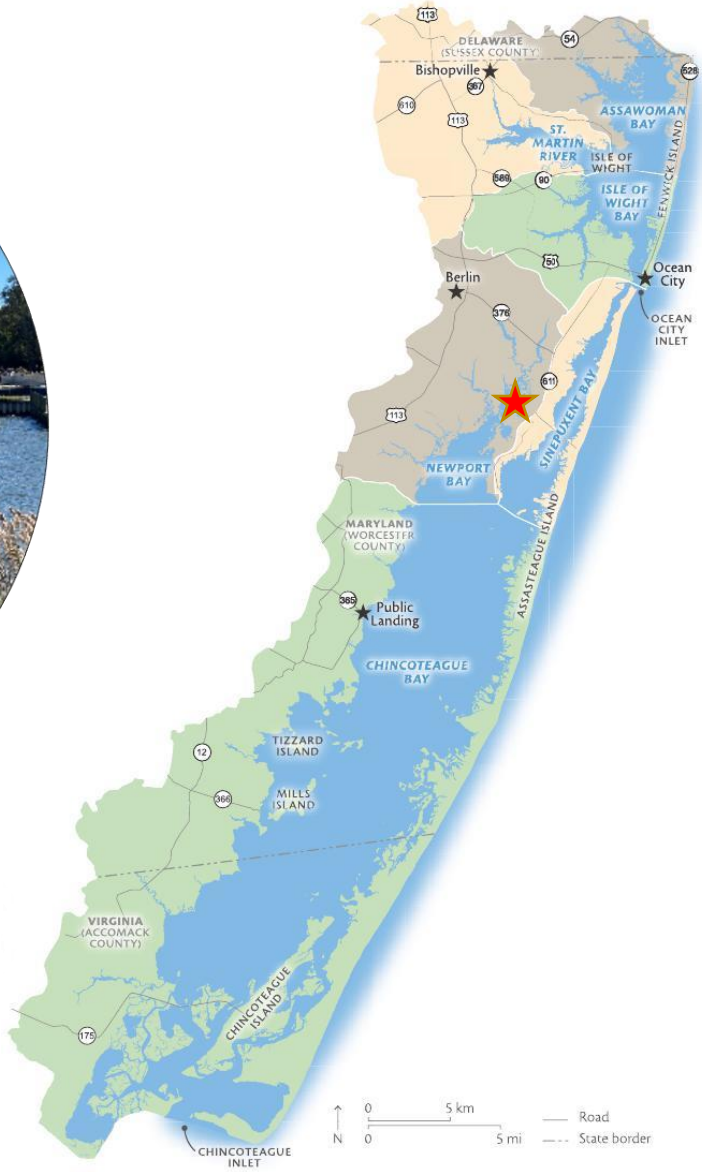
Data for Mason Landing (Site 12) from 2005 -2022 in blue. The black line shows the statistically significant trendline. The red line represents the threshold values that indicate pass or fail.





NEWPORT BAY GOLF COURSE – SITE 15

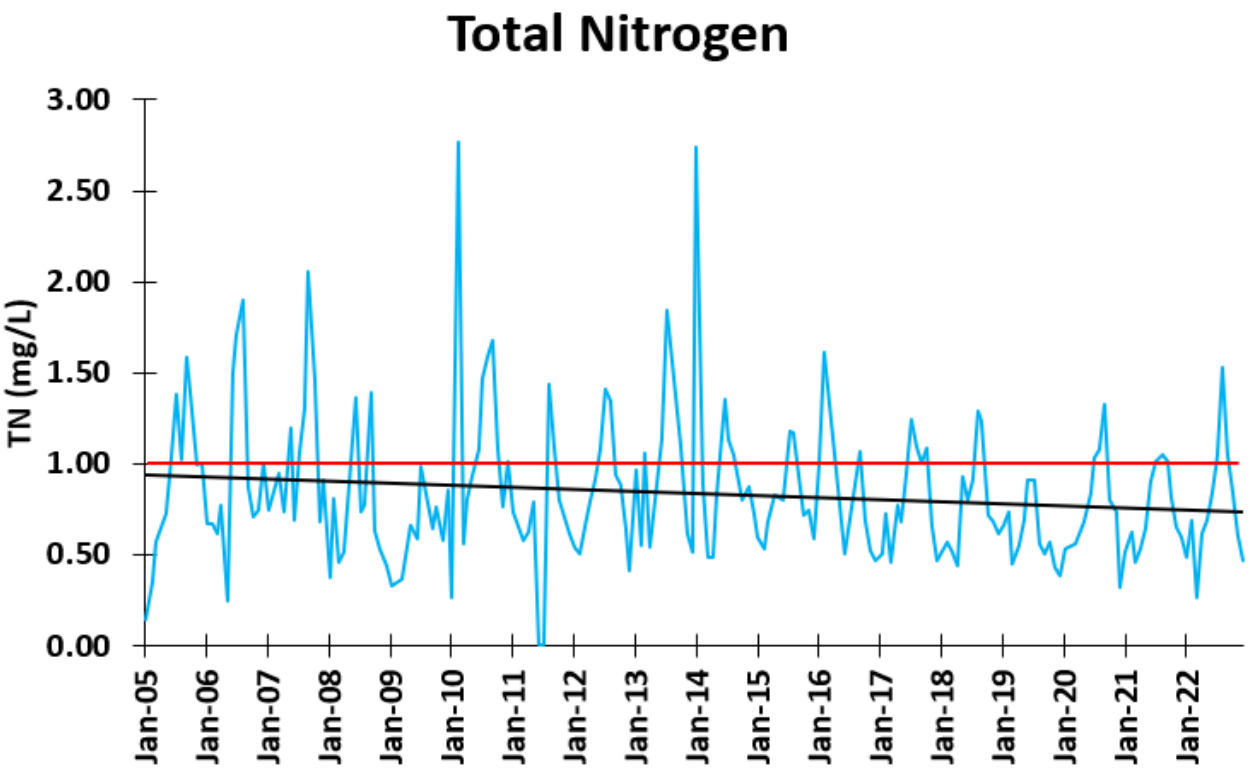
Newport Golf Course, site #15, is located at the Ocean City Golf Course off Country Club Dr., which drains into Newport Bay. Land use around this area is mostly the golf course and residential development. Special thanks to the Maryland Conservation Corps who assists MCBP in sampling this site from October – February.

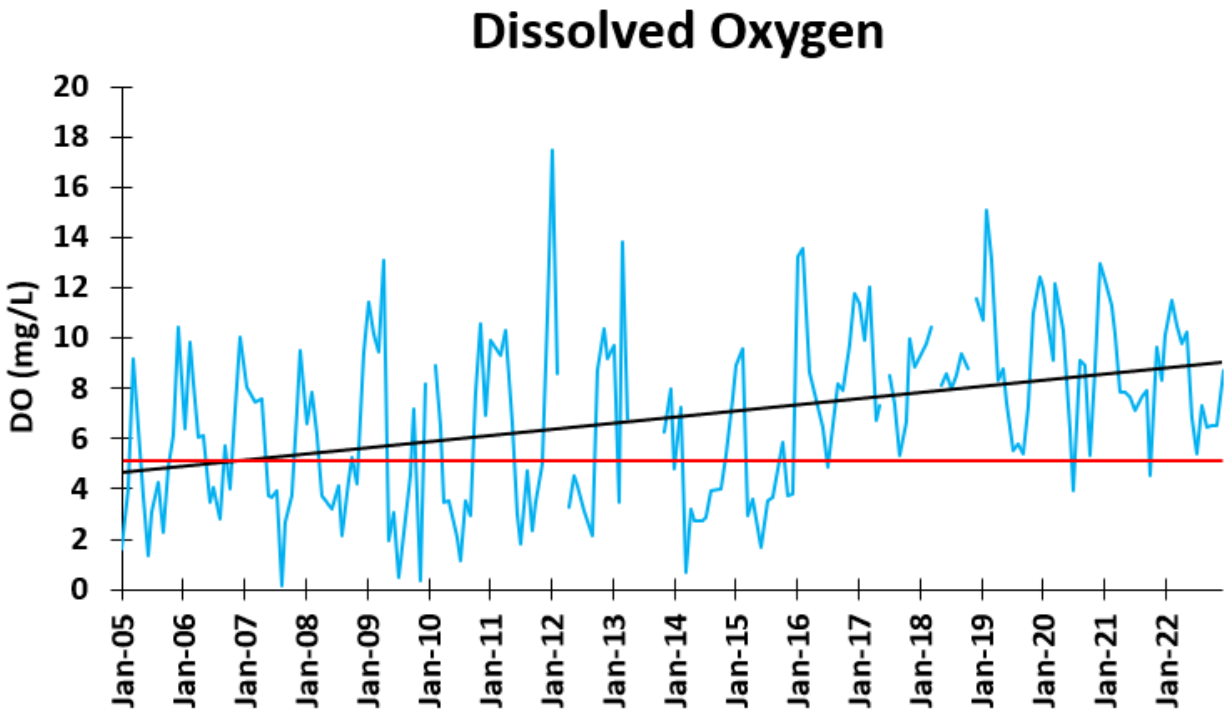


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	71%	29%
Total Phosphorus (TP) (mg/L)	> 0.044	37%	63%
Chlorophyll *a* (ug/L)	> 15.00	65%	35%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	63%	37%

This area shows high TP levels with no indication that it is decreasing. TN levels show a decreasing trend and DO shows significant improvement indicating a positive change in water quality. Chlorophyll *a* is relatively low and shows no significant change over the study period.

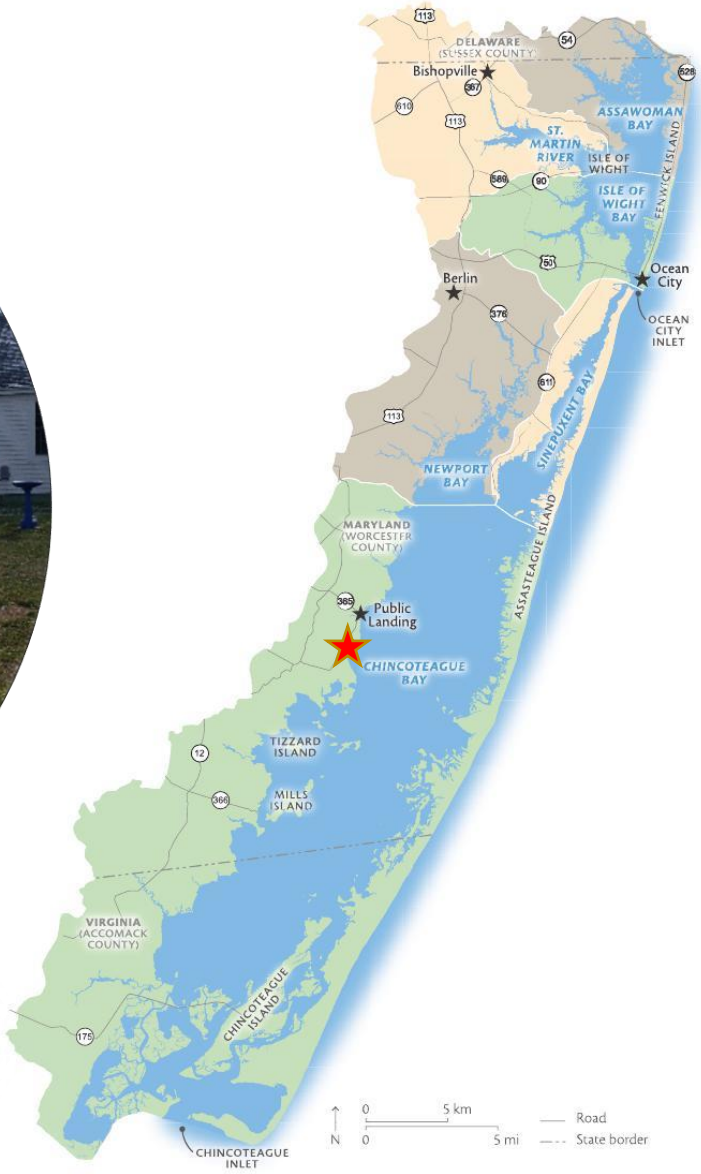
Data for the Newport Bay Golf Course (Site 15) from 2005 -2022 in blue. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.





FIGGS LANDING- SITE #18:

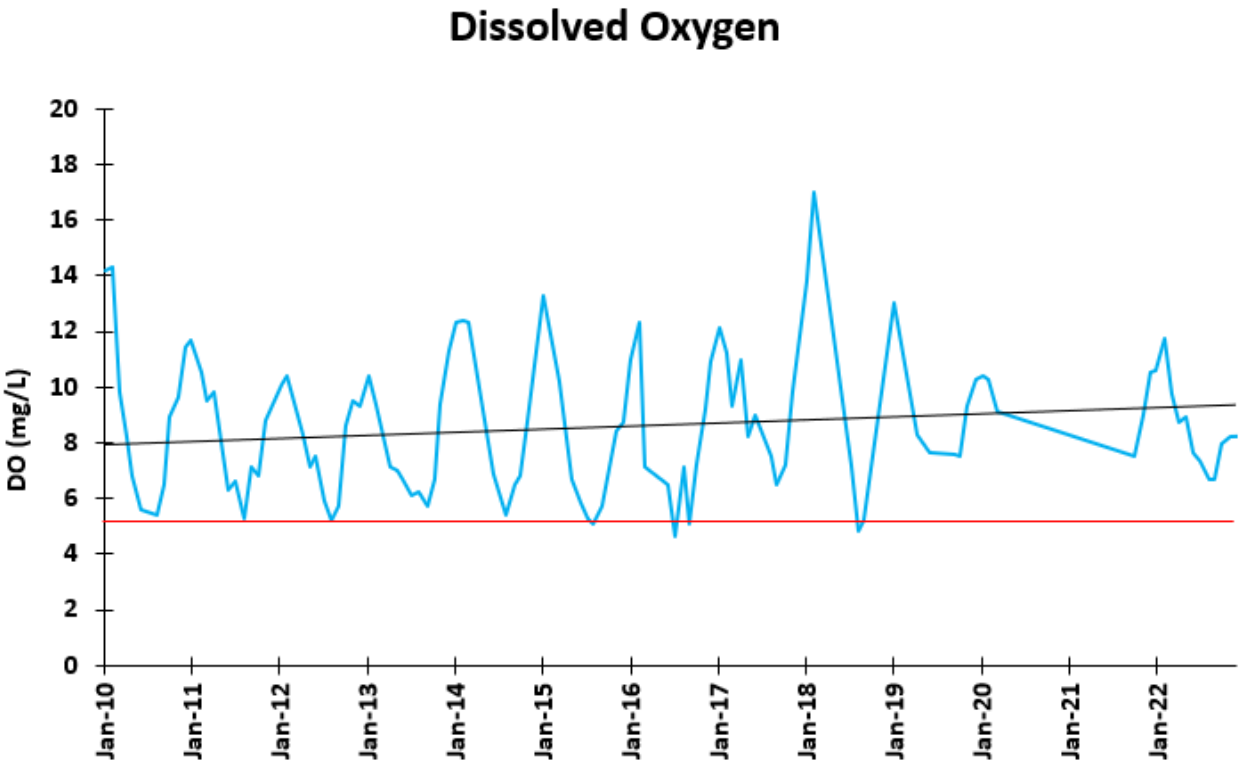
Figgs Landing is located off Figgs Landing Rd right on Chincoteague Bay. This site is mainly residential and agriculture. The shoreline consists of a small beach area that is reinforced by hardened shoreline structures. MCBP is so thankful to volunteer Alice Tweedy who dedicated the last 25 years of her life to monitoring this site and passed away in 2021.



Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	97%	3%
Total Phosphorus (TP) (mg/L)	> 0.044	54%	46%
Chlorophyll *a* (ug/L)	> 15.00	93%	7%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	98%	2%

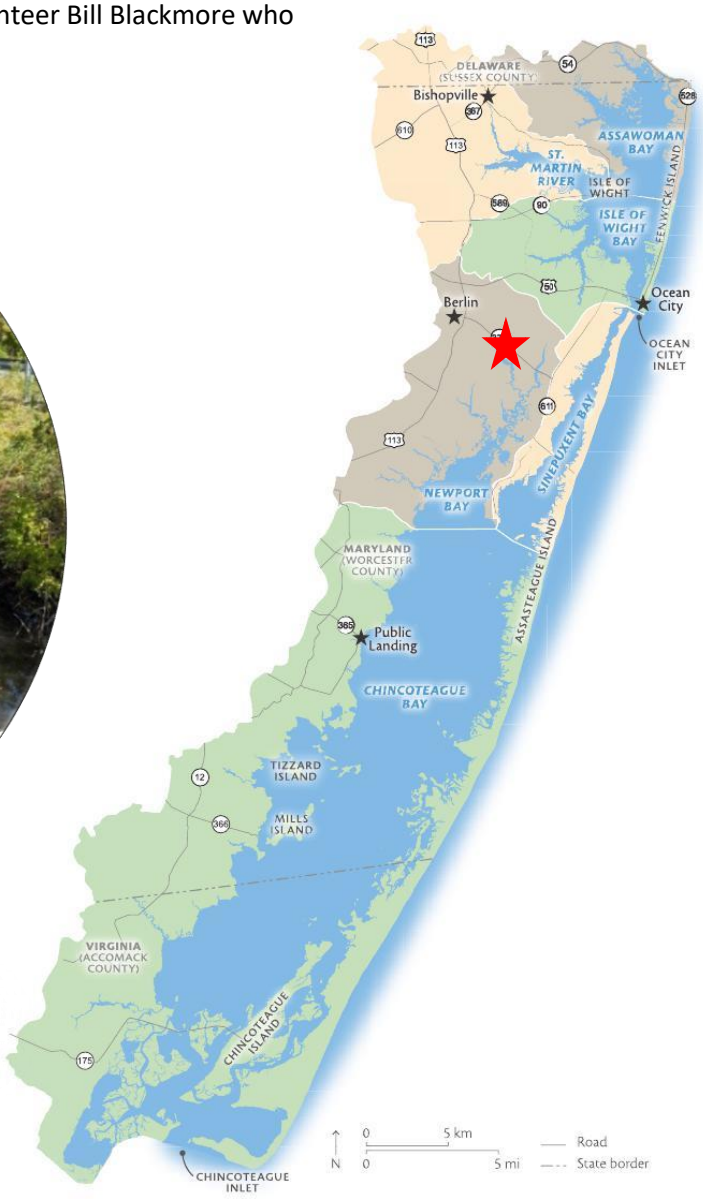
This area of the watershed is relatively healthy with all parameters passing most of the time. TP levels are of the most concern and failed almost one-half of the samples. The only significant trend that was detected is increasing DO which is a positive sign of better water quality.

Data for Figgs Landing (Site 18) from 2010 -2022 in blue. The black line shows the statistically significant trendline. The red line represents the threshold value that indicate pass or fail.



TRAPPE CREEK- SITE #23:

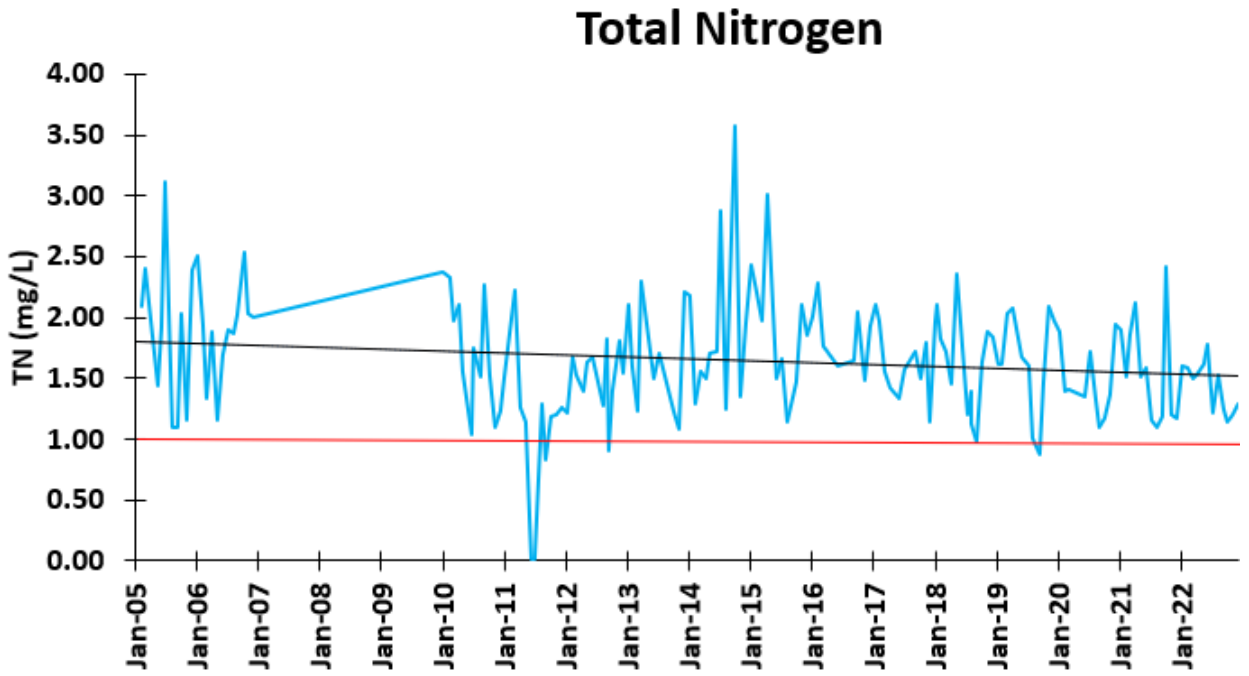
Trappe Creek is located off Assateague Road and is part of Newport Bay's watershed. This site is mainly residential and forest. MCBP thanks volunteer Bill Blackmore who took over monitoring this site in 2021.

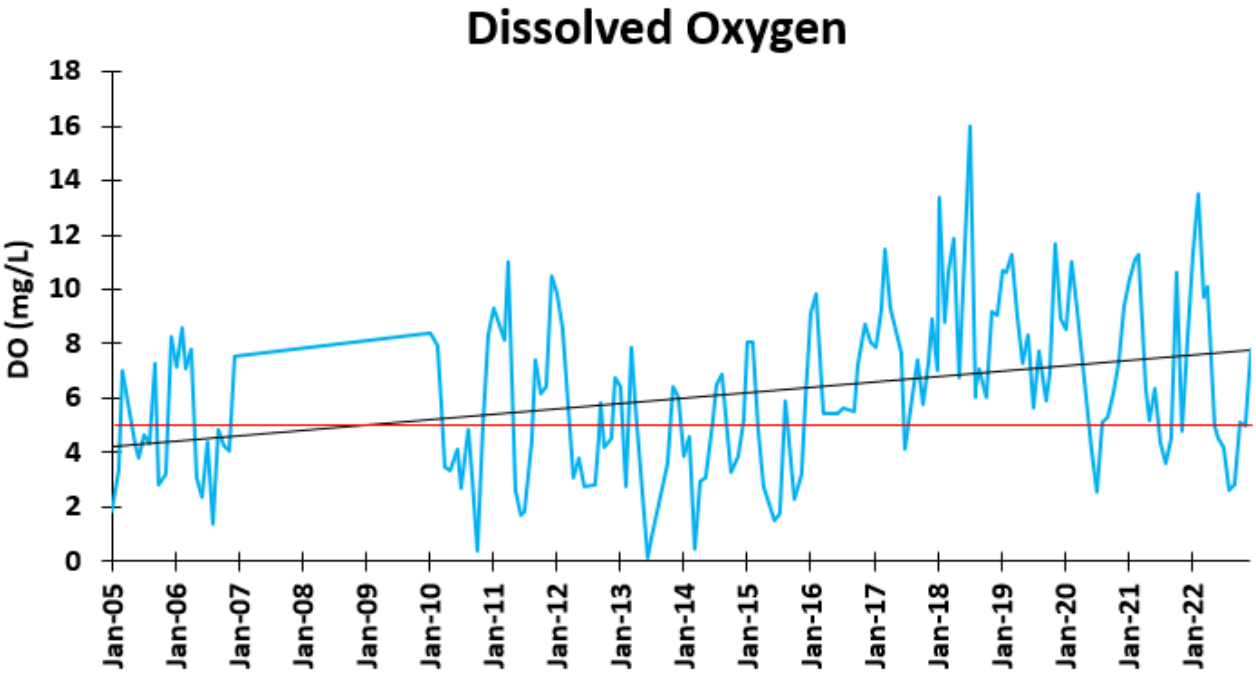


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	4%	96%
Total Phosphorus (TP) (mg/L)	> 0.044	33%	67%
Chlorophyll *a* (ug/L)	> 15.00	78%	22%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	62%	38%

This stream is impacted by high TN and TP levels, but has relatively low chlorophyll a levels most likely because trees along the banks block a good deal of sunlight that is needed for algae to thrive and produce high amounts of chlorophyll *a*. The decline in TN and improvement in DO is a good indicator that stream health is improving, although surprising given the high nutrient levels.

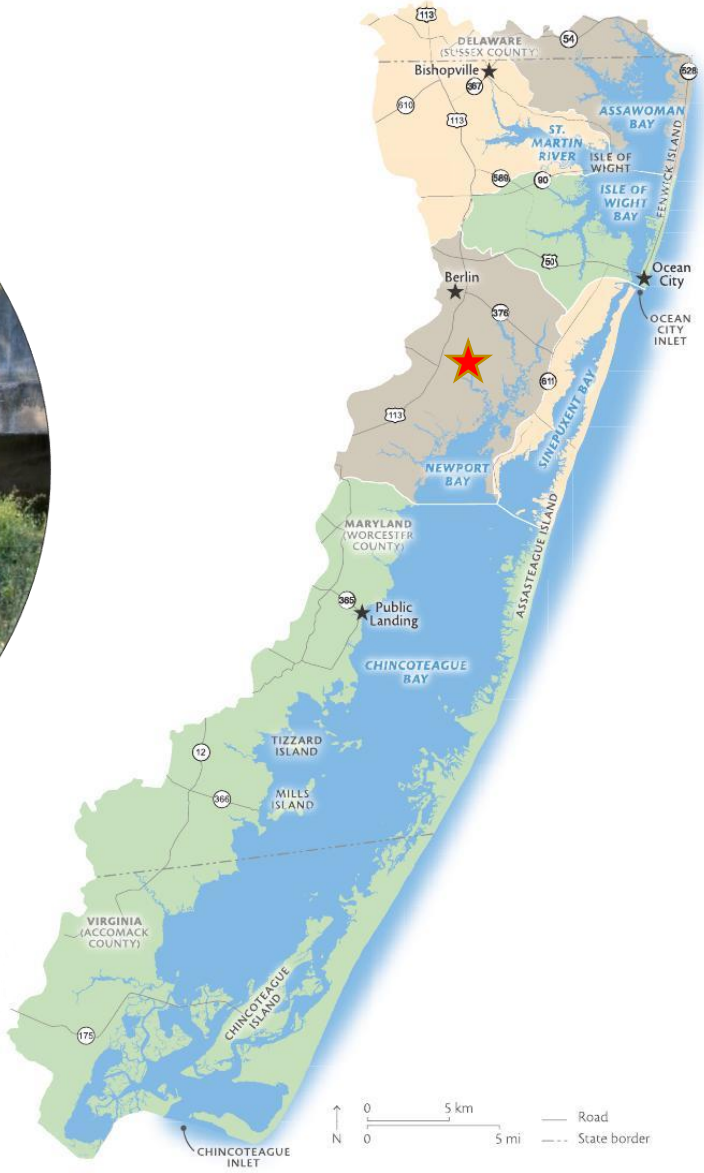
Data for Trappe Creek (Site 23) from 2005 -2022 in blue. The black line shows the statistically significant trendline. The red line represents the threshold values that indicate pass or fail.





BASSETT CREEK – SITE 28

Bassett Creek, Site 28 is right off 113N on Goody Hill Rd., which drains into Bassett Creek that connects to Newport Bay. Land use around this area is mostly forest with some residential development and agriculture. Special thanks to the Maryland Conservation Corps who assists MCBP in sampling from October – February.

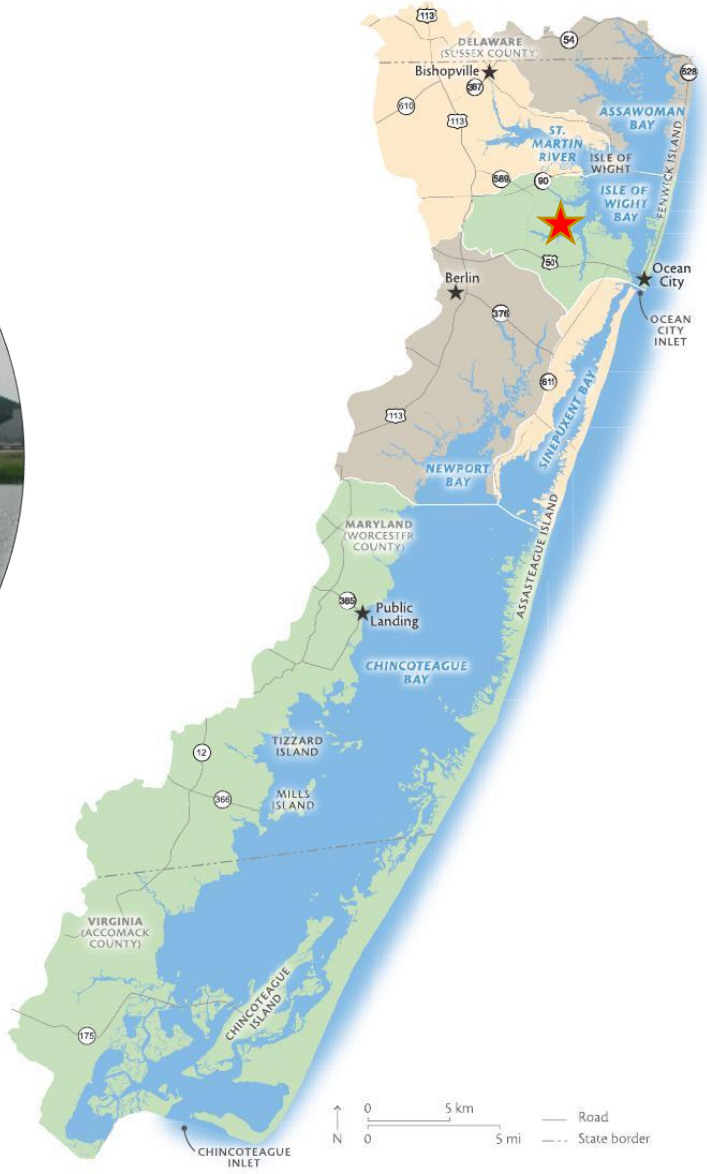


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	2%	98%
Total Phosphorus (TP) (mg/L)	> 0.044	52%	48%
Chlorophyll *a* (ug/L)	> 15.00	98%	2%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	84%	16%

This stream is impacted by high TN levels that consistently exceed the threshold. Chlorophyll *a* is relatively low most likely because trees along the banks block a good deal of sunlight that is needed to produce high amounts of chlorophyll *a* for algae to thrive. There are no parameters showing any significant trends meaning it is too inconsistent to draw any conclusions.

TURVILLE CREEK - SITE #30:

Site #30 is located at the public boat ramp off Gum Point Road at the head of Turville Creek, which drains into Isle of Wight Bay. Across the creek is the Ocean Downs Casino, and land use in the area is mostly residential. MCBP thanks volunteer Chris McGillen who samples this site.

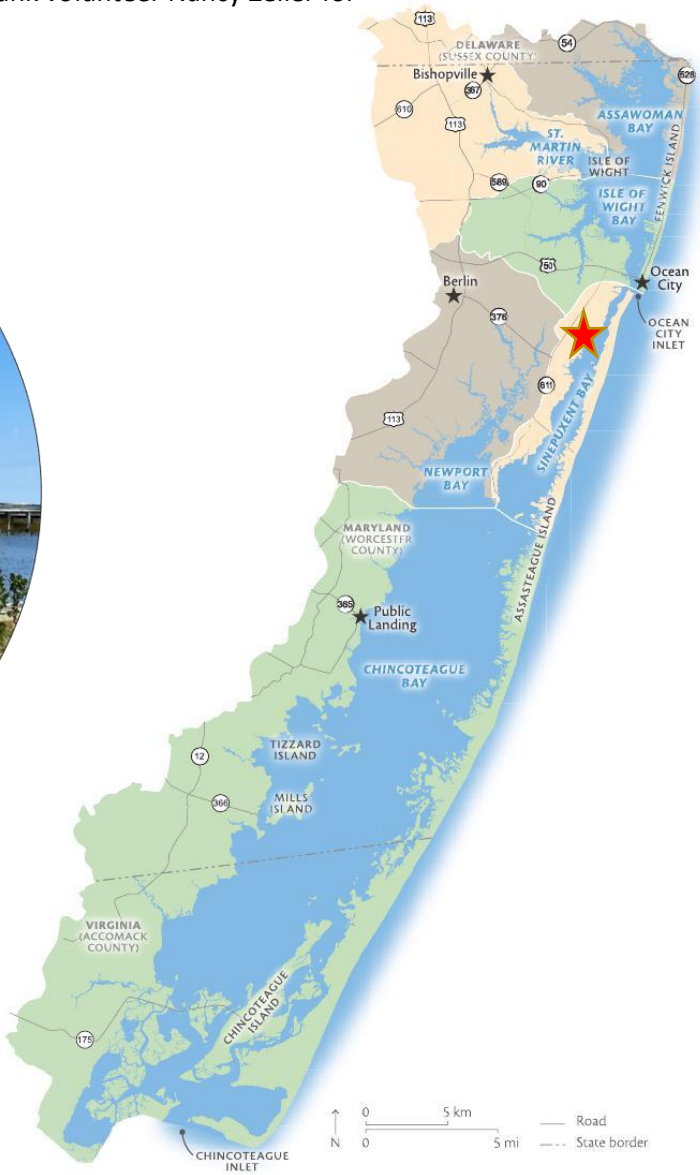


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	33%	67%
Total Phosphorus (TP) (mg/L)	> 0.044	15%	85%
Chlorophyll *a* (ug/L)	> 15.00	50%	50%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	77%	23%

This stream is impacted by high TN and TP levels that exceed the threshold often. Turville Creek is relatively wide at this point, so much of the creek is open to sunlight. The high nutrient levels and exposure to sunlight are responsible for the high chlorophyll *a* levels exhibited at this location. Although DO usually passes at this site, there are no parameters showing any significant trends in data meaning it is too variable to draw any conclusions.

SNUG HARBOR - SITE #31:

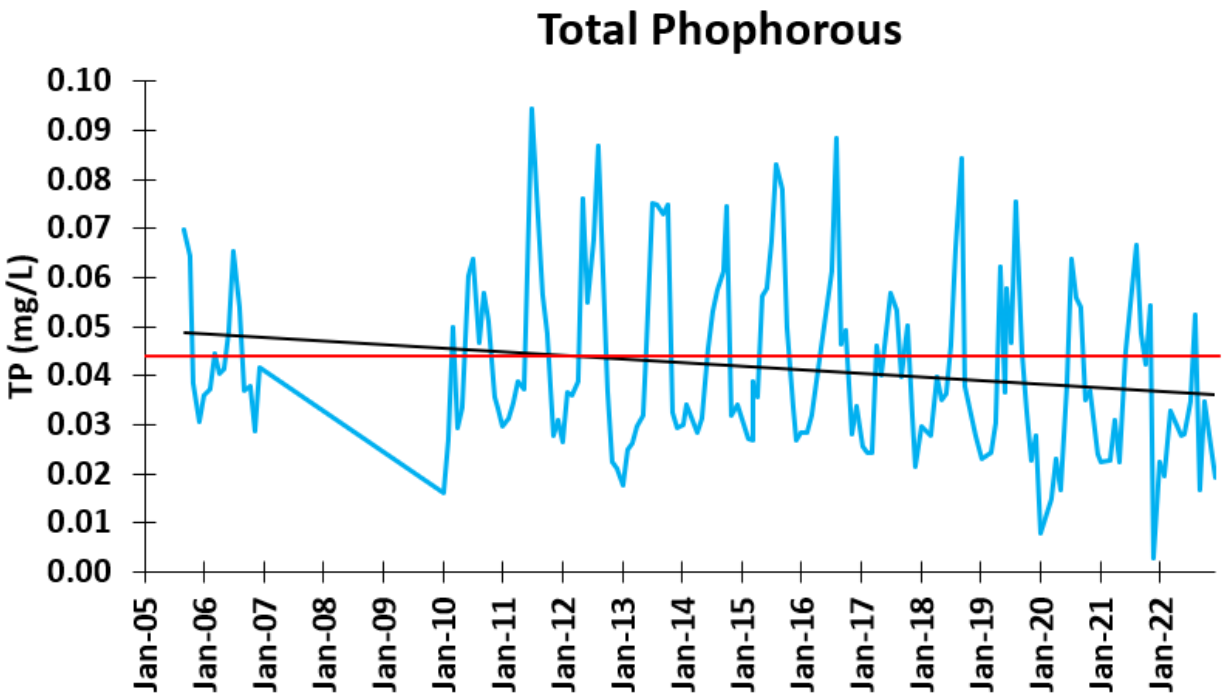
Snug Harbor, site #31, is located on the most bay side location of Snug Harbor Rd within the Sinepuxent Bay watershed. This site is within a canal where the shoreline is entirely bulkheaded on one side and wetlands on the other. MCBP would like to thank volunteer Nancy Zeller for sampling this water quality site.



Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	100%	0%
Total Phosphorus (TP) (mg/L)	> 0.044	60%	40%
Chlorophyll *a* (ug/L)	> 15.00	98%	2%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	91%	9%

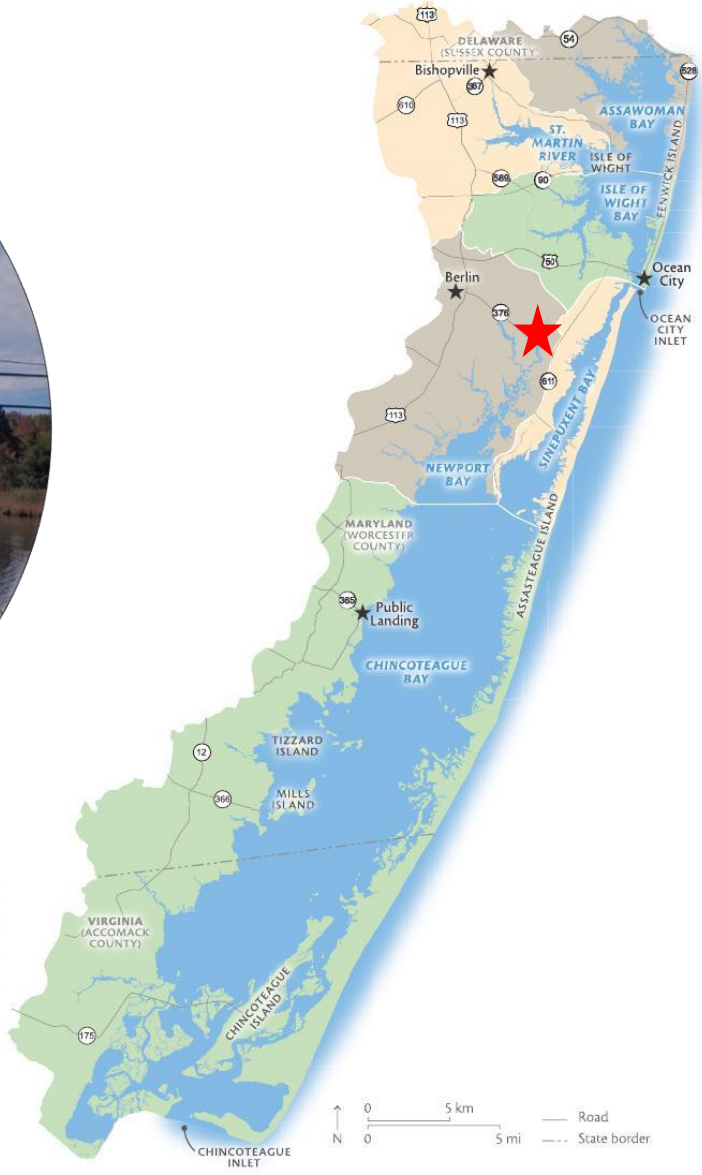
This site has no nitrogen pollution as the TN levels pass the threshold 100% of the time. The high passing rates for DO and chlorophyll *a* are most likely due to the high flushing rate of the canal. There's a relatively high failure rate for TP levels, but the significant decrease in levels indicate that the site is improving in water quality.

Data for the Snug Harbor (Site 31) from 2005 -2022 in blue. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.



Ayers Creek- Site #33:

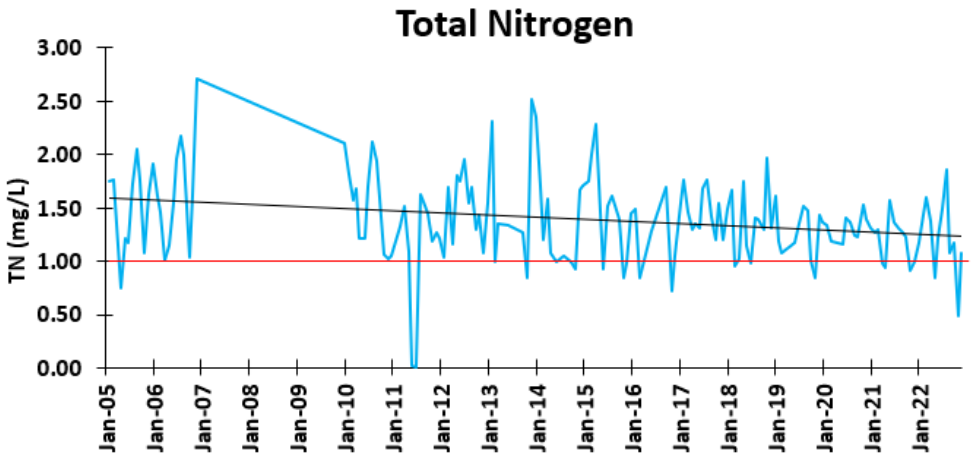
Ayers Creek, Site #33 is located on Assateague Road and is part of Newport Bay's watershed. This site is mainly residential and wetland. MCBP would like to thank volunteer Bill Blackmore who took over monitoring this site in 2021.

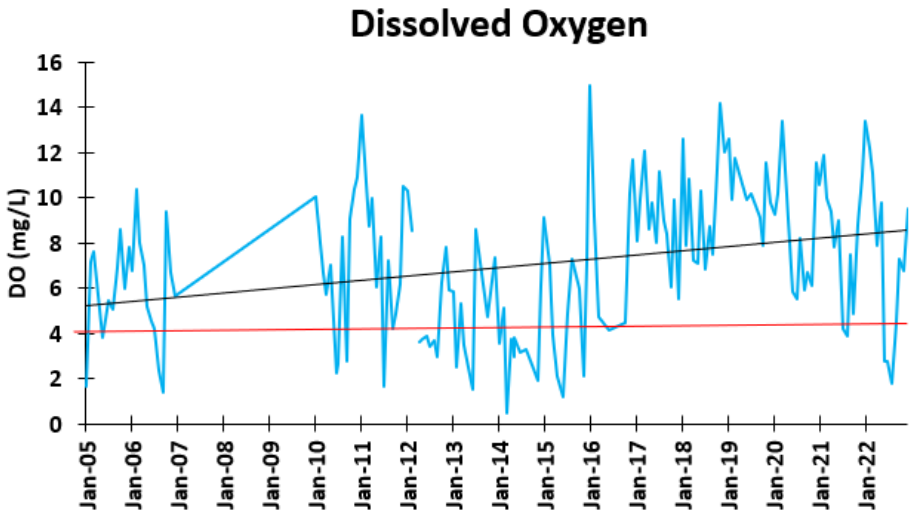


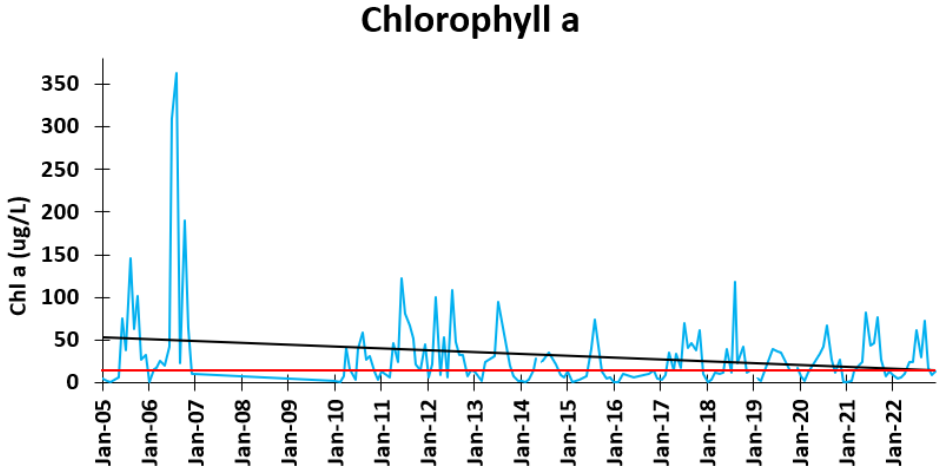
Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	13%	87%
Total Phosphorus (TP) (mg/L)	> 0.044	6%	94%
Chlorophyll *a* (ug/L)	> 15.00	45%	55%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	71%	29%

This creek is most negatively affected by TN and TP levels that fail to meet the threshold over 85% of the time. This site shows a significant decline in TN, but no trend was observed for TP. DO and chlorophyll *a* both show significant positive trends indicating that water quality is improving even with high TP levels.

Data for Ayers Creek (Site 33) from 2005 -2022. The black lines show the statistically significant trendlines. The red lines represent the threshold values that indicate pass or fail.

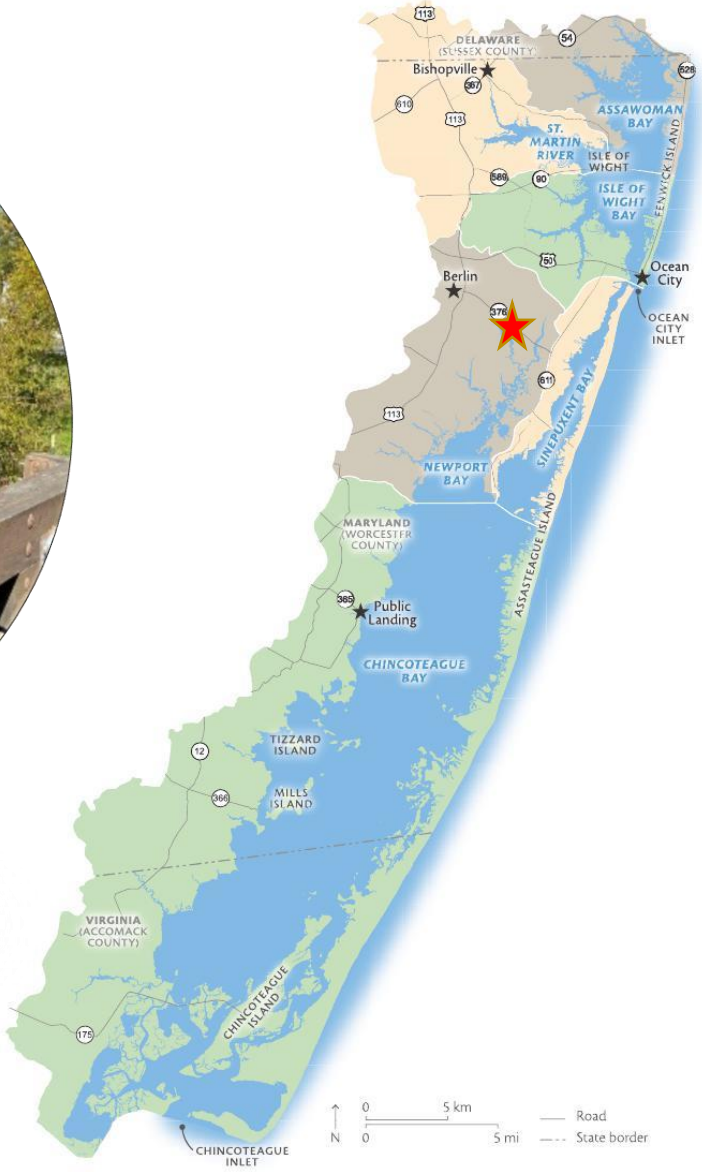






BOTTLE BRANCH- SITE #35:

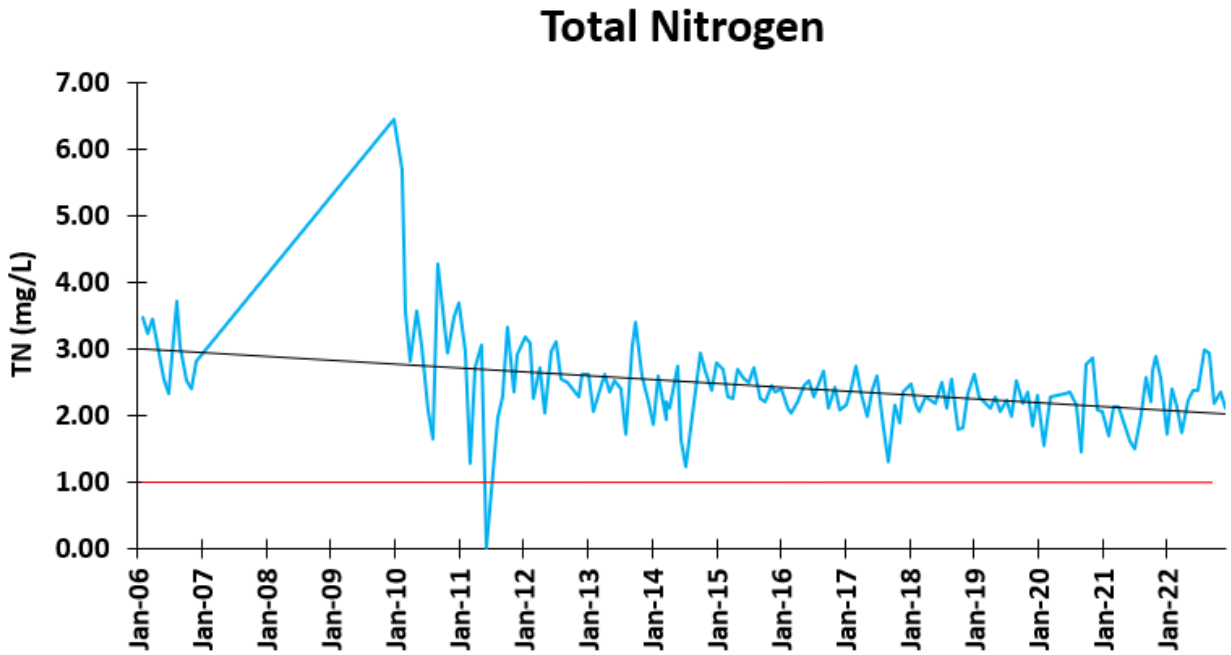
Bottle Branch, site #35, is located at the bridge on Harrison Rd. This site is located on Bottle Branch, tributary to Newport Bay. This site is mostly developed with some areas forested. MCBP would like to thank volunteer Sue Latour for sampling this water quality site.

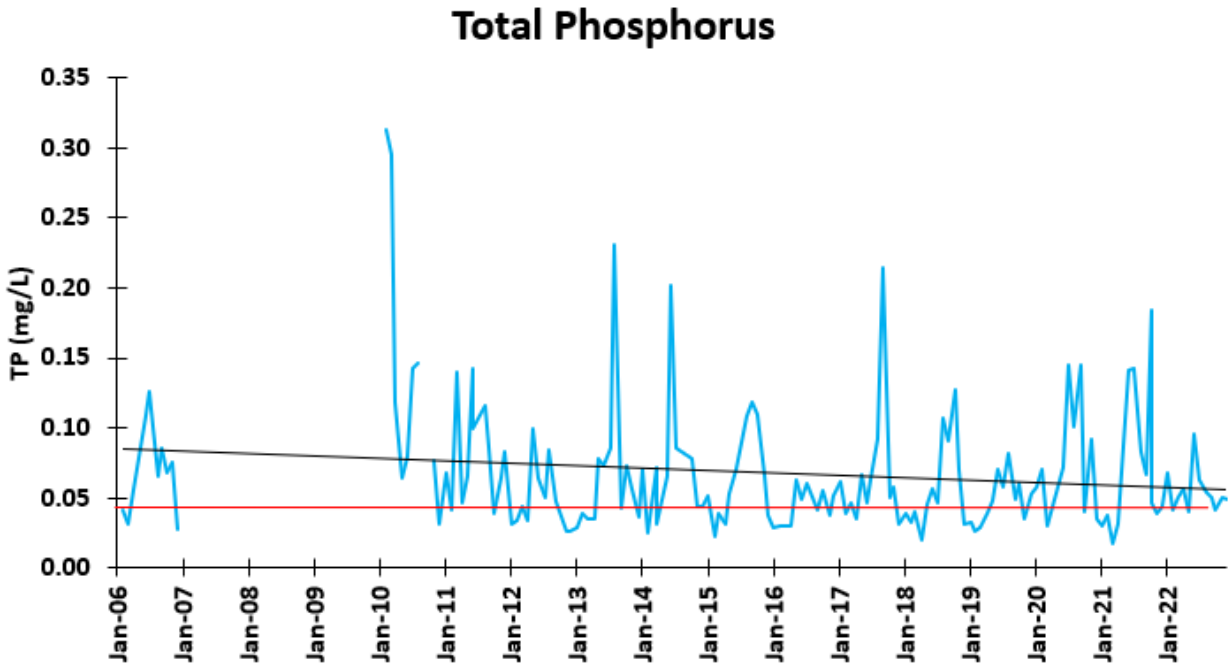


Parameter	Threshold	Pass	Fail
Total Nitrogen (TN) (mg/L)	> 1.00	1%	99%
Total Phosphorus (TP) (mg/L)	> 0.044	17%	83%
Chlorophyll *a* (ug/L)	> 15.00	84%	16%
Dissolved Oxygen (DO) (mg/L)	≥ 5.00	87%	13%

This stream is most negatively affected by high TN and TP levels. Although TN and TP values remain above the threshold consistently, there is a significant decline in the trends overall. There are no significant trends found for the other parameters. However, chlorophyll *a* and DO levels tend to stay within the thresholds indicating that the site does not experience algal blooms often and water quality is improving.

Data for Bottle Branch (Site 35) from 2005 -2022 is shown in blue. The black line shows the statistically significant trendline. The red line represents the threshold values that indicate pass or fail.





Works Cited

Juuti, P., Katko, T. S., & Vuorinen, H. S. (2016). *Environmental history of water: Global Views on Community Water Supply and sanitation*. IWA Publishing.

Pitarch, J. (2020). A review of Secchi's contribution to Marine Optics and the foundation of Secchi Disk Science. *Oceanography*, *33*(3). https://doi.org/10.5670/oceanog.2020.301

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