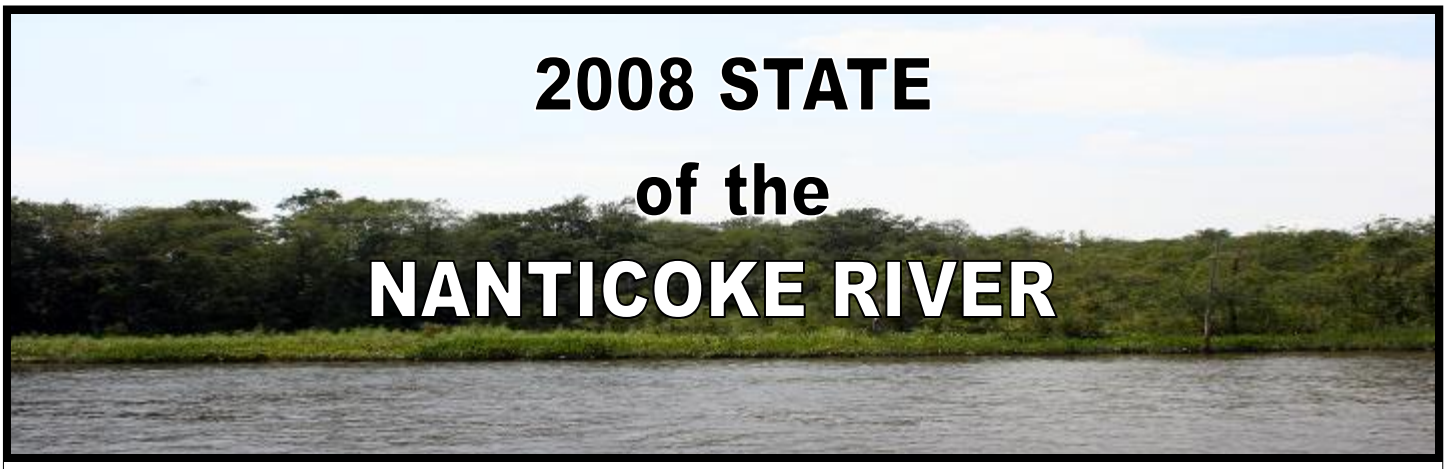


Nanticoke Creekwatchers: 2008 Water Quality Monitoring Report

SUMMARY

Nanticoke Creekwatchers is a community partnership between the Nanticoke Watershed Alliance and the Chesapeake Bay Trust, Delaware Department of Natural Resources and Environmental Control, Envirocorp Labs, University of Maryland Center for Environmental Science (UMCES) and Johns Hopkins University. Its mission is to collect and develop objective, scientifically-credible water quality data by using volunteers to monitor the waters of the Nanticoke River and its tributaries in Maryland and Delaware. Data collection is combined with analytical work by Envirocorp Labs and UMCES Horn Point Laboratory. Nanticoke Creekwatchers advances the efforts of the Alliance to protect and enhance Nanticoke River water quality. In 2008, Nanticoke Creekwatchers continued to establish a set of baseline data for identifying water quality conditions and trends over time by monitoring 43 sites throughout the Nanticoke River system. Their data can be used to identify areas within the river system where water quality may be changing.

This report summarizes data generated from on-site measurements and analysis of water samples collected within the Nanticoke River system from April through December 2008. (See methods section for an explanation of water quality parameters.) Key findings include:

- **Surface Dissolved Oxygen (DO)** – In 2008, there was only one sampling period where average dissolved oxygen measurements in certain regions of the river fell below Delaware's marine water quality standard of 5.0 milligrams/Liter (mg/L). These sub-standard levels occurred in early September in Marshyhope Creek and the small Maryland tributaries of the lower watershed. Similar trends were reflected in percent saturation of oxygen.
- **Water Clarity** – Water clarity for the Nanticoke River continues to be typical of a coastal plain tidal river, using a conservative standard of 0.5 meters. Tributaries in both Maryland and Delaware experienced periods of low water clarity in August. In general, water clarity diminishes from upriver to downriver as a result of natural conditions. Wave action, wind and tide play a large role in the mixing of open water of the lower Nanticoke River and may stir up sediment to reduce water clarity.
- **Chlorophyll *a*** – Chlorophyll *a* levels ranged from low to medium (10-50 micrograms/Liter), with highest levels found in tributary areas in Maryland and Delaware, as well as in Broad Creek.
- **Total Nitrogen** – Nitrogen levels were mostly in the medium range (1-3 milligrams/Liter), with the exception of Broad Creek and Delaware headwaters, which were high throughout the season. Small Maryland tributaries and the lower portion of the Nanticoke River experienced increases in the fall. High levels of nitrogen strongly suggest human activity.
- **Total Phosphorus** – Phosphorus levels were mostly within the medium range (0.05-0.1 milligrams/Liter) over the sampling season, with the exception of the Maryland tributaries that were high from July to early September. Occasional high levels were seen in the upper and lower portions of the Nanticoke, as well as in the tributary areas of Delaware.
- **Fecal Bacteria** – Fecal Enterococcus levels were generally high throughout the Nanticoke and its tributaries. Fecal Coliform levels tended to be higher in the upper watershed areas: Small Delaware Tributaries, Delaware Headwaters, Upper Nanticoke and Broad Creek. Small Maryland Tributaries also experienced high levels of Fecal Coliform for portions of the sampling season.

PROGRAM HISTORY & OVERVIEW

In 2007 the Nanticoke Watershed Alliance, Chesapeake Bay Trust, and Delaware Department of Natural Resources and Environmental Control began working cooperatively with citizen volunteers to monitor water quality along the Nanticoke River. Two additional partners also joined our efforts: Envirocorp Labs in Harrington, Delaware donated all nutrient and bacteria analysis and a team of faculty, staff and students at Johns Hopkins University assisted in data management and analysis. This program continues to be a collaborative effort of volunteers, scientists, local businesses, universities, state agencies and more. The Nanticoke Watershed Alliance could not support such a high level program on its own—to all volunteers, program partners, funders, and other supporters, we sincerely thank you for your contributions. We are proud to have such a passionate and dedicated crew to help us protect the health of the Nanticoke River.

PARAMETERS

The following water quality parameters are analyzed:

Dissolved Oxygen (DO): Oxygen must be present in the water for aquatic animals to survive. Dissolved oxygen below 5 mg/L is considered unhealthy for many aquatic species. Where phytoplankton are abundant, photosynthesis during the day can produce very high DO concentrations in surface waters. DO can also be interpreted in percent saturation. Levels nearest 100% are ideal; large departures in either direction can indicate an unhealthy system.

Water Clarity: Light is a limiting factor for aquatic plant growth and is measured by a Secchi disk; water clarity indicates the ability of light to penetrate through water. Poor water clarity indicates water is not clear enough for light to penetrate to a depth that supports the growth of underwater grasses. Secchi depth of 0.5 meters or greater is considered healthy for the Nanticoke River.

Chlorophyll *a*: Chlorophyll is the pigment that allows plants—including algae—to use sunlight to make organic compounds in the process of photosynthesis. Chlorophyll *a* is the predominant pigment found in algae and cyanobacteria (blue-green algae), and its concentration is a good indicator of the amount of algae present in the water. Generally, lower levels of chlorophyll a represent healthier systems.

Total Nitrogen: Nitrogen is an essential nutrient for both plants and animals, but an overload of nitrogen from human sources can cause algal blooms of undesirable abundance and/or species. This can lead to low dissolved oxygen and food chain disruption. an overabundance of nutrients generates algal blooms and subsequent low dissolved oxygen levels.

Total Phosphorus: Phosphorus is another essential nutrient in aquatic systems, with the same overabundance problems as nitrogen. Phosphorus can often attach to particles of sediment, which can lead to high levels during periods of soil erosion.

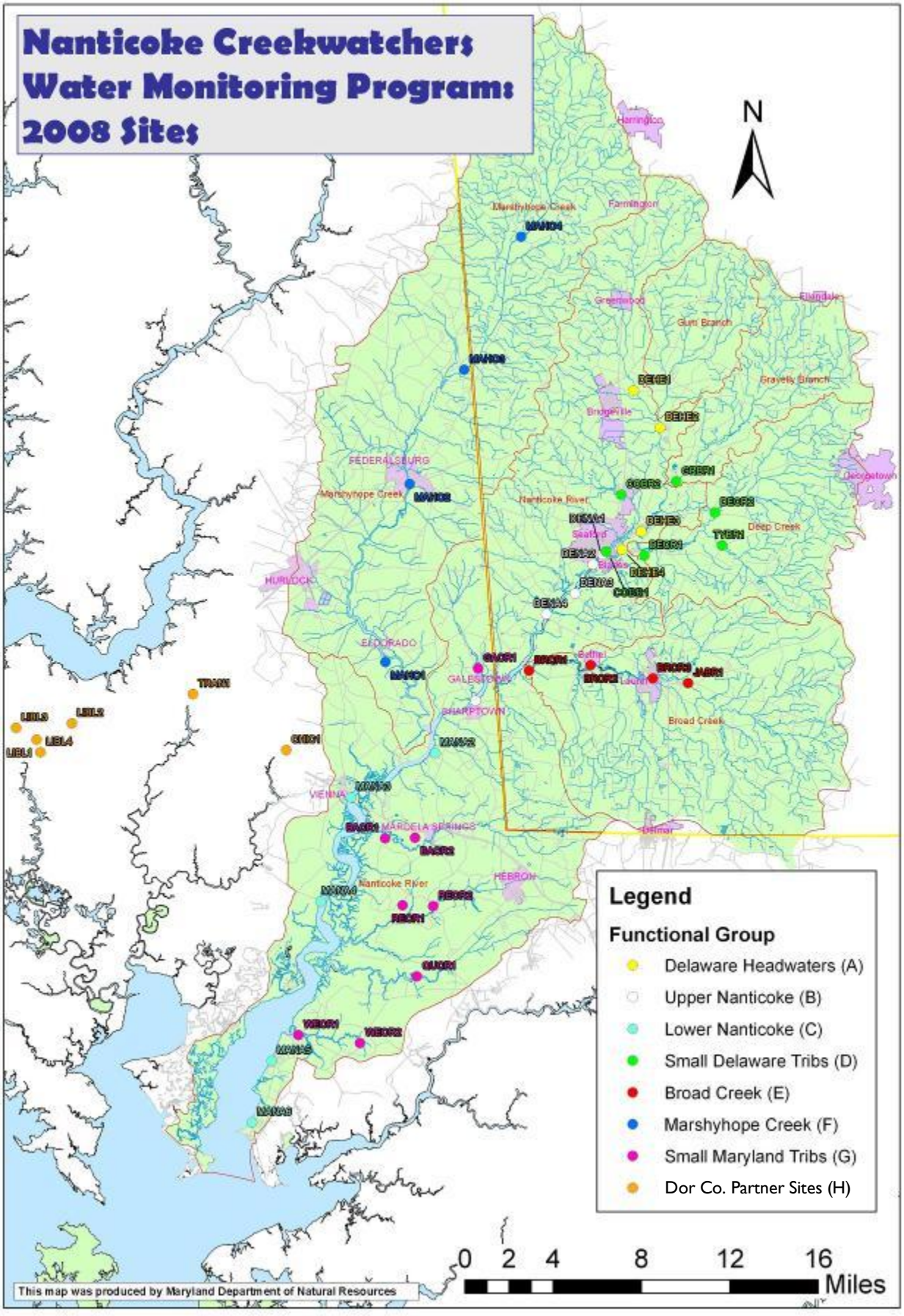
Fecal Bacteria: Fecal bacteria in the water may come from natural and human sources. It is used as an indicator of potential health risks to individuals exposed to this water because high levels of fecal bacteria can occur as the result of an overflow of sewage systems or nonpoint sources of human and animal waste. Fecal Coliform (FC) and Fecal Enterococcus (FE) were analyzed in a selected portion of water samples.

Using the identified healthy water criteria, data were analyzed to determine which measurements fell outside the healthy range for each water quality parameter. High degrees of departure from these levels can indicate water quality problems. For purposes of this report, criteria and guidelines for nutrients and bacteria that have been developed and used in Delaware waters were used for comparison with data from the Nanticoke Creekwatchers samples. The Delaware Department of Natural Resources and Environmental Control (DNREC) uses the guidelines shown in Table 1 below to indicate high, moderate, and low ranges for total nitrogen (TN), total phosphorus (TP) and chlorophyll *a* (Chl *a*) in estuarine waters.[1]

Table 1. DNREC guidelines and criteria for parameters measured in this study. For nutrients, values in the low to moderate range are thought to represent healthier conditions than those in the higher range.

Parameter	Low	Medium	High	Bacteria	Accepted
TN (mg/L)	<1.0	1.0 – 3.0	>3.0	FE (#/100mL)	<70
TP (mg/L)	<0.05	0.05 – 0.1	>0.1	FC** (#/100mL)	<104
Chl *a* (ug/L)	<10	10 – 50	>50	FC** (#/100mL)	<185

These benchmarks reflect the most current thinking among scientists who are refining criteria for evaluating surface water health based on nitrogen, phosphorus, chlorophyll and fecal bacteria concentrations. **Accepted Fecal Coliform level for primary contact recreation is <104 for fresh waters, <185 for marine waters.


Nanticoke Creekwatchers
Water Monitoring Program:
2008 Sites
N
Legend
Functional Group
Delaware Headwaters (A)
Upper Nanticoke (B)
Lower Nanticoke (C)
Small Delaware Tribs (D)
Broad Creek (E)
Marshyhope Creek (F)
Small Maryland Tribs (G)
Dor Co. Partner Sites (H)
0 2 4 8 12 16
Miles
This map was produced by Maryland Department of Natural Resources
FEDERALSBURG
HURLOCK
EDDORADO
GALESTOWN
SHARPTOWN
VIENNA
MARDELA SPRINGS
HEBRON
Nanticoke River
Marshyhope Creek
Broad Creek
Deep Creek
Gum Branch
Gravelly Branch
Seaford
Blades
Bethel
Laurel
Farmington
Greenwood
Bridgeville
Ellendale
Georgetown

CREEKWATCHERS WATER MONITORING SITES AND GROUPINGS

Creekwatcher sites were grouped to provide averages for **eight functionally distinct areas** that make up the Nanticoke River system. The data are presented graphically with each value representing an average of 4-9 sites/group: **small Delaware tributaries** (six small tributary creeks beyond Seaford, DE); **Delaware headwaters** (four sites in Nanticoke River headwaters beyond Seaford, DE); the **"Upper" Nanticoke** (five sites within the region north of the mouth of Marshyhope Creek), the **"Lower" Nanticoke** (five sites within the region south of the mouth of Marshyhope Creek), **Broad Creek** (four sites along a major tributary in Delaware), **Marshyhope Creek** (four sites along a major tributary in Maryland), **small Maryland tributaries** (an aggregation of nine sites along small tributary creeks in Maryland), and **Dorchester County partner sites**** (four sites along the Chicamicomico, Transquaking and Little Blackwater Rivers, waterways that flow into Fishing Bay near the mouth of the Nanticoke River.)

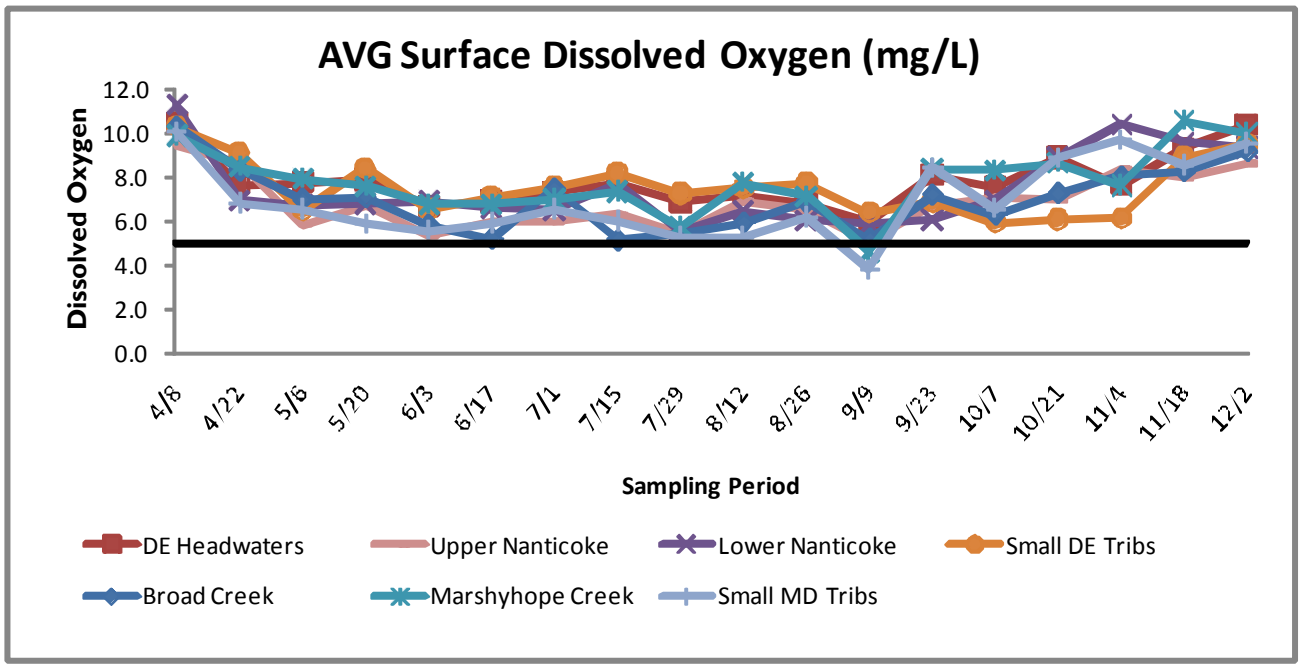
**For the purpose of this report on the State of the Nanticoke, the Dorchester Partner Sites (in orange) were not depicted on graphs.

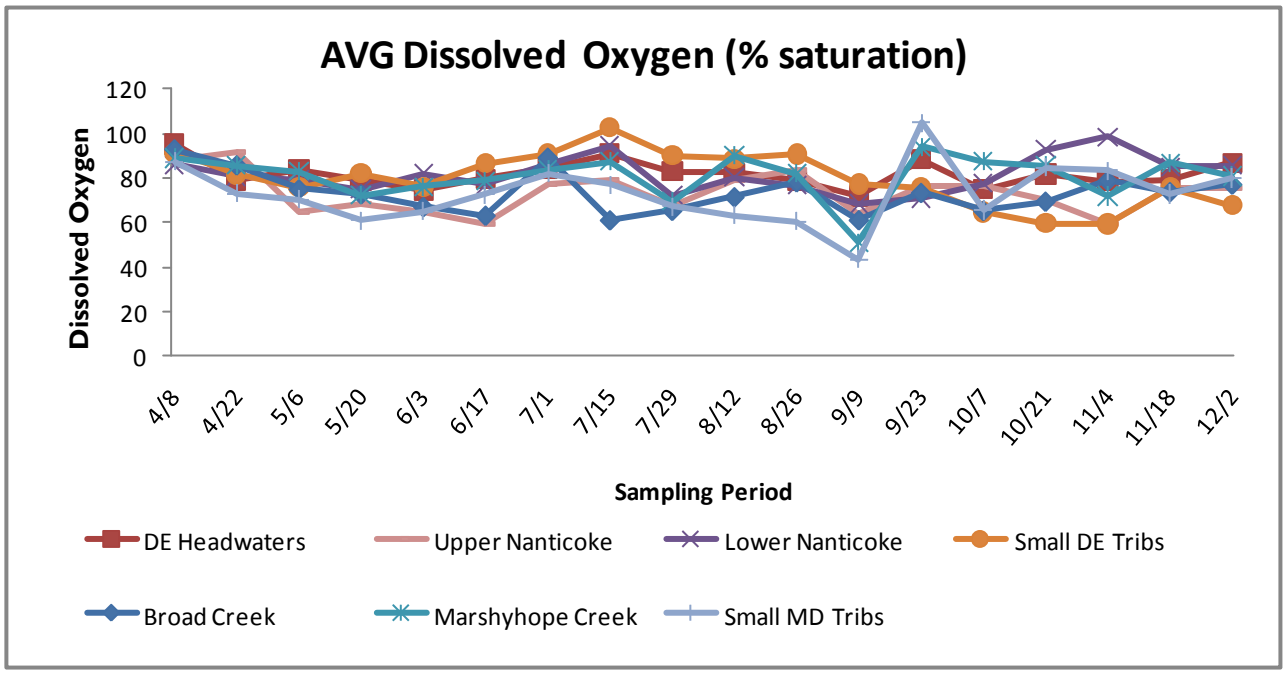
Site Code	Site Name	Functional Group
DEHE1	Redden Road	Delaware Headwaters
DEHE2	Rifle Range Road	Delaware Headwaters
DEHE3	Middleford	Delaware Headwaters
DEHE4	Glen Sizemore Realty	Delaware Headwaters
DENA1	Riverwalk	Upper Nanticoke
DENA2	Seaford Boat Launch	Upper Nanticoke
DENA3	Holly Shores	Upper Nanticoke
DENA4	Woodland Ferry	Upper Nanticoke
MANA1	Cherry Beach Park	Upper Nanticoke
MANA2	Riverton Wharf	Lower Nanticoke
MANA3	Vienna Docks	Lower Nanticoke
MANA4	Lewis Wharf	Lower Nanticoke
MANA5	Bivalve Wharf	Lower Nanticoke
MANA6	Nanticoke Harbor	Lower Nanticoke
COBR1	Seaford Canoe Launch	Small Delaware Tribs
COBR2	Bridgeville Hwy	Small Delaware Tribs
DECR1	Concord Road	Small Delaware Tribs
DECR2	Old Furnace Rd	Small Delaware Tribs
GRBR1	Coverdale Rd	Small Delaware Tribs
TYBR1	Fleetwood Pond	Small Delaware Tribs
BRCR1	Phillips Landing	Broad Creek
BRCR2	Bethel Dock	Broad Creek
BRCR3	Laurel Dock	Broad Creek
JABR1	James Branch	Broad Creek
MAHO1	Camp ESPA	Marshyhope Creek
MAHO2	Federalsburg Marina	Marshyhope Creek
MAHO3	Noble Road	Marshyhope Creek
MAHO4	Fishers Bridge Road	Marshyhope Creek
GACR1	Gales Creek	Small Maryland Tribs
BACR1	Taylors Trail	Small Maryland Tribs
BACR2	Mardela Springs Boat Ramp	Small Maryland Tribs
RECR1	Rewastico Creek	Small Maryland Tribs
RECR2c	Rewastico Pond	Small Maryland Tribs
RECR2p	Rewastico Pond	Small Maryland Tribs
QUCR1	Quantico Creek	Small Maryland Tribs
WECR1	Wetipquin Boat Ramp	Small Maryland Tribs
WECR2	Nanticoke Rd, Wetipquin HW	Small Maryland Tribs
CHIC1	Chicamicomico HW	Dorchester Co. Partner Sites
TRAN1	Transquaking HW	Dorchester Co. Partner Sites
LIBL1	Little BW HW	Dorchester Co. Partner Sites
LIBL2	Little BW Trib2	Dorchester Co. Partner Sites
**LIBL3	Little BW Trib3 (dropped due to lack of water)	Dorchester Co. Partner Sites
LIBL4	Little BW Trib4	Dorchester Co. Partner Sites

2008 Results

DISSOLVED OXYGEN

Surface DO levels were generally high suggesting a well-mixed system and an abundance of phytoplankton performing photosynthesis within these waters. The DO fell below acceptable levels within the "Small Maryland Tributaries" and Marshyhope Creek during one sampling period in the fall (September 9-10). Lower levels may be expected in small tributaries where tides may have little to no role. Levels were higher in the lower Nanticoke where wave action and tide play a larger role in mixing.





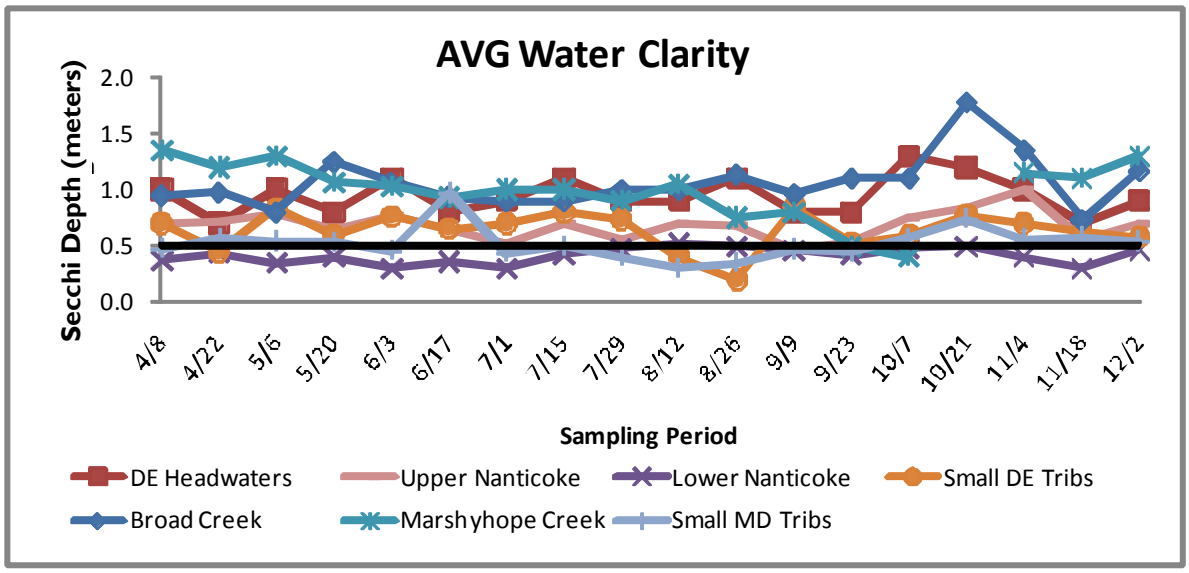
Note: For all graphs, each 2-day sampling period is indicated with one date for purposes of remaining concise. In addition, discrete sample dates are connected by lines for ease of discerning potential trends and are not meant to reflect continuous data.

WATER CLARITY

Water clarity can reflect both phytoplankton (algae) abundance and suspended sediment. Inputs of nitrogen and phosphorus from various human and natural sources can create algal blooms, which result in the "green" water seen in many river systems. The amount of available sunlight can promote or inhibit algae growth.

Sedimentation is caused by erosion due to natural causes, various human land disturbances and the barge traffic that is common on the Nanticoke as far north as Seaford, DE. Wind, wave action and tides can also stir up sediment in areas of open water.

Water clarity was lowest in the "Lower Nanticoke," which may be a combined result of relatively abundant phytoplankton and sediment churned up by the open water habitat in this section of the river. Highest levels were measured along the Marshyhope Creek, Delaware Headwaters, and Broad Creek. Forested, freshwater tidal areas often exhibit higher water clarity than more open, higher salinity sections located downstream. Forest cover results in less sunlight reaching the water, meaning less light is available for algae growth. Levels dropped below 0.5 meters in August in the Small Maryland Tributaries and Small Delaware Tributaries, which may indicate sediment or nutrient inputs in these areas.



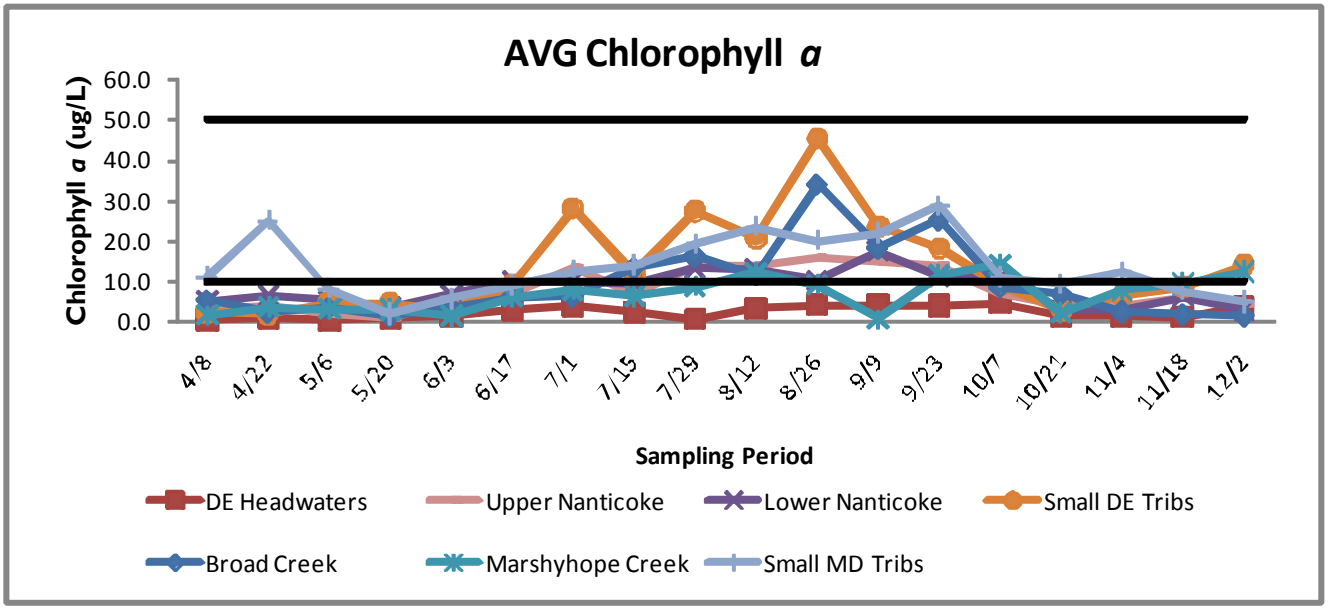
Note: Measurements where the Secchi disk touched the bottom before a reading could be taken were not included. Three sites (DEHE1, DEHE2, RECR2C) "bottomed out" for each sampling period and was therefore excluded from analysis. It should be noted that this indicates a high degree of water clarity at these locations.

Erosion on the bank of the Nanticoke River in Delaware. July 2008. Photo by Don Allen.

Example of a forested area in the headwaters of the Nanticoke. Fall 2008. Photo by Don Allen.

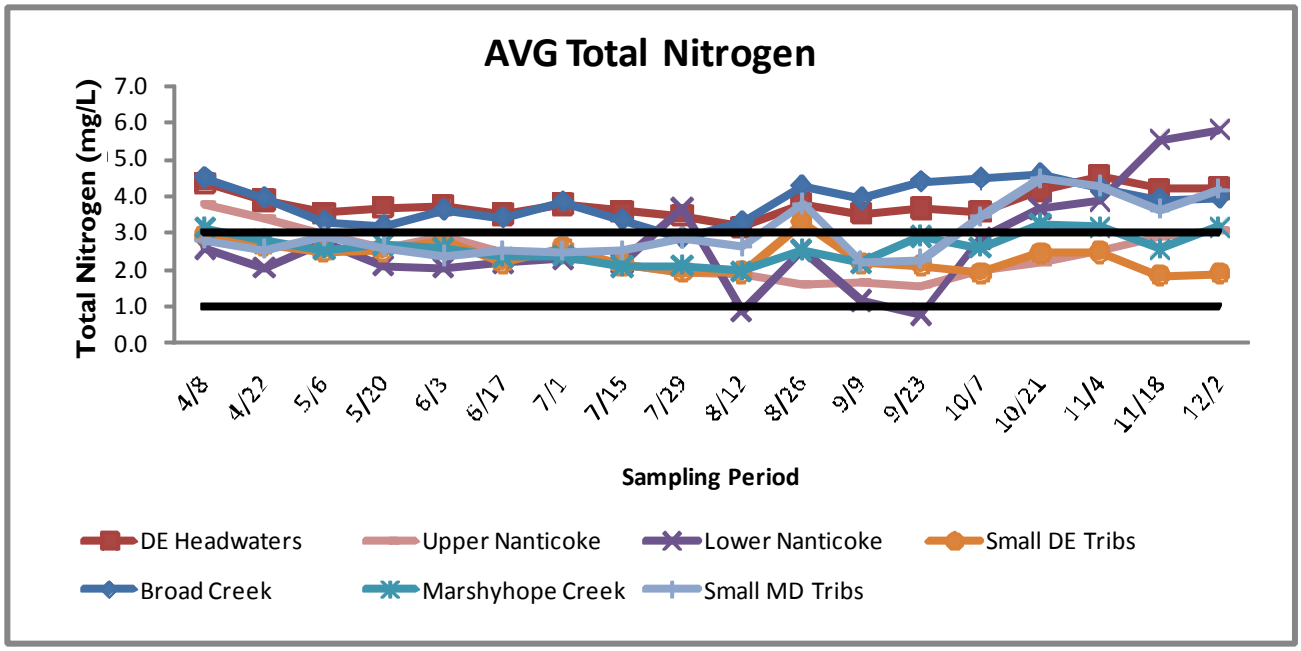
CHLOROPHYLL *A*

Chlorophyll *a* is a measure of the abundance of phytoplankton, or algae, in an aquatic habitat. In general, values were higher in the summer and decreased in the fall due to shorter day lengths (less opportunity for photosynthesis). The amount of forest cover also affected algae growth—forested areas have less sunlight, therefore less opportunity for algal photosynthesis. Highest levels were found along the Small Delaware Tributaries, Small Maryland Tributaries and Broad Creek.



NITROGEN

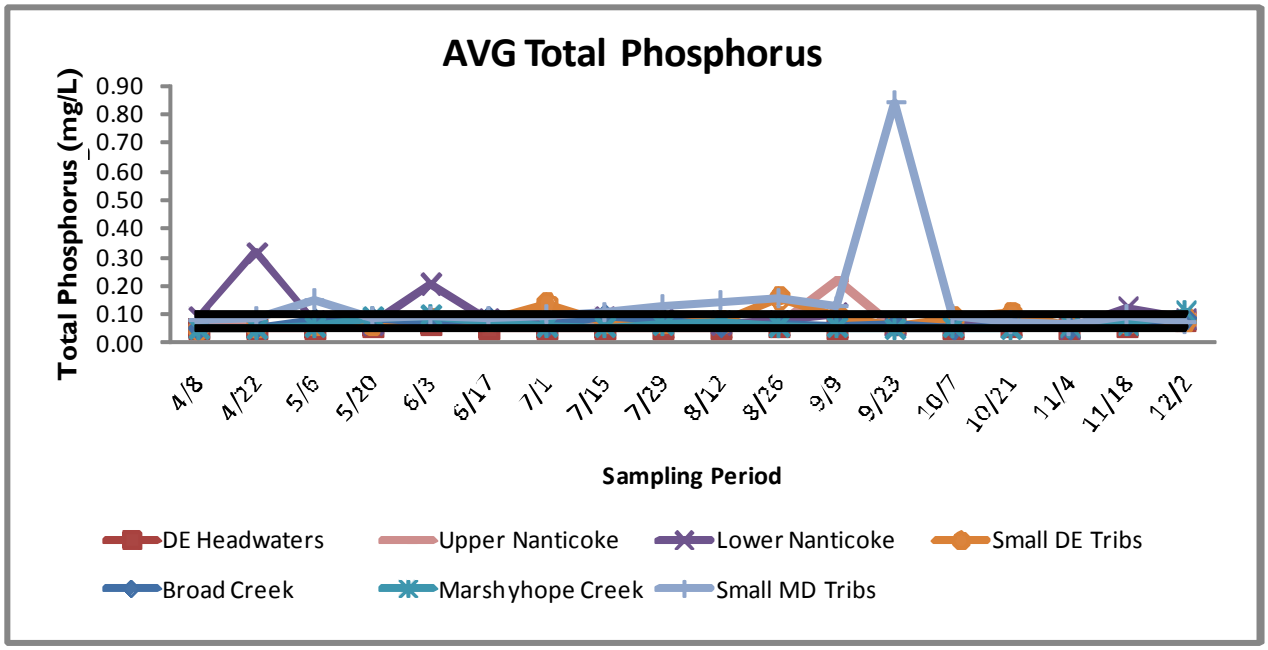
Total nitrogen (TN) was mostly within the medium range with the exception of Broad Creek and Delaware headwaters, where values were high throughout the season. The Lower Nanticoke and Small Maryland Tributaries also experienced nitrogen increases during the fall sampling periods. Higher nitrogen levels can indicate various types of human activity.

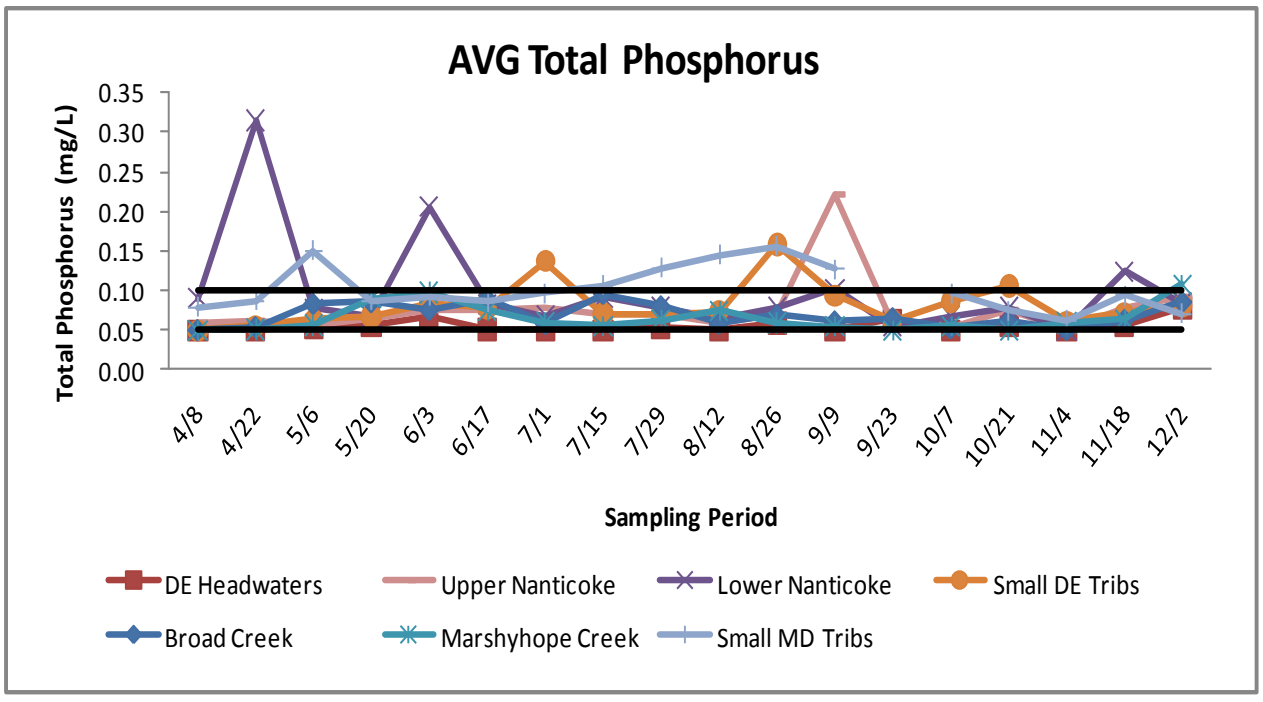


PHOSPHORUS

Unlike total nitrogen, phosphorus was high on only a few occasions. One exception to this is in the Small Maryland Tributaries, where total phosphorus was high on several occasions, including a large spike in late September. Portions of the Upper Nanticoke, Lower Nanticoke and Small Delaware Tributaries also experienced occasional spikes during the season. Phosphorus attaches itself to soil particles, and spikes may indicate a heavy rainfall event and/or poor methods for erosion prevention.

Two graphs of total phosphorus have been provided here—the first includes all phosphorus measures. The second graph removed the large spike in Small Maryland Tributaries in late September, so that the lesser variations of other river regions could be more easily observed.





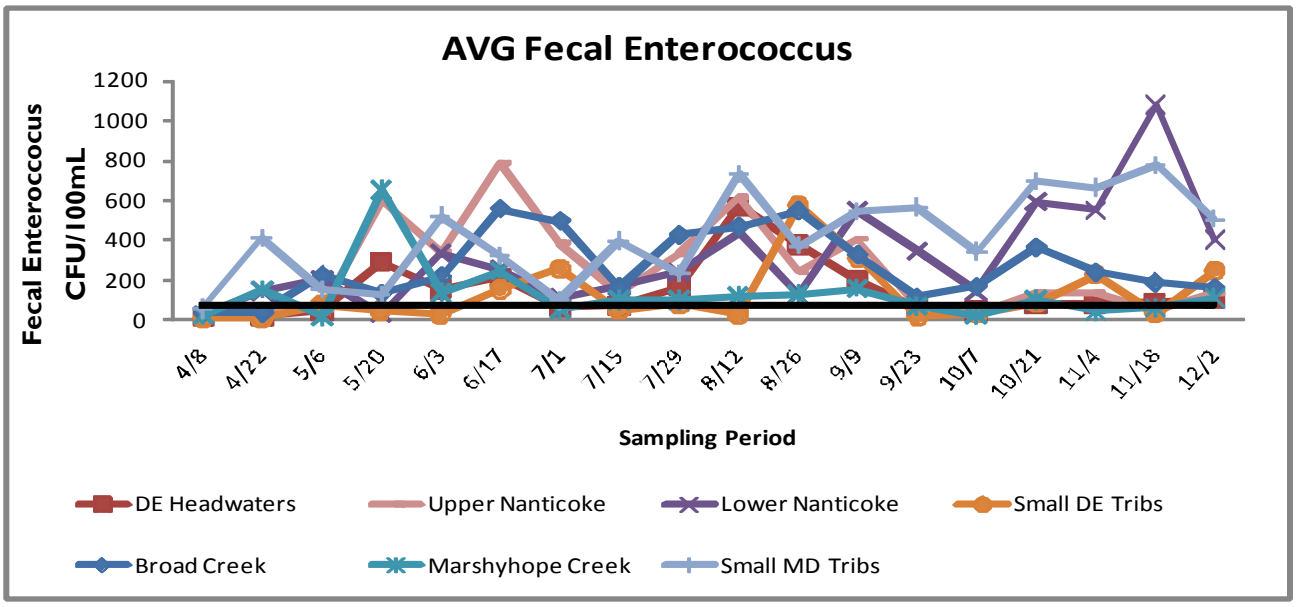
**Note: Phosphorus levels that were below laboratory detection limits of 0.05 mg/L were given a va.lue of 0.05 mg/L for analytical purposes.

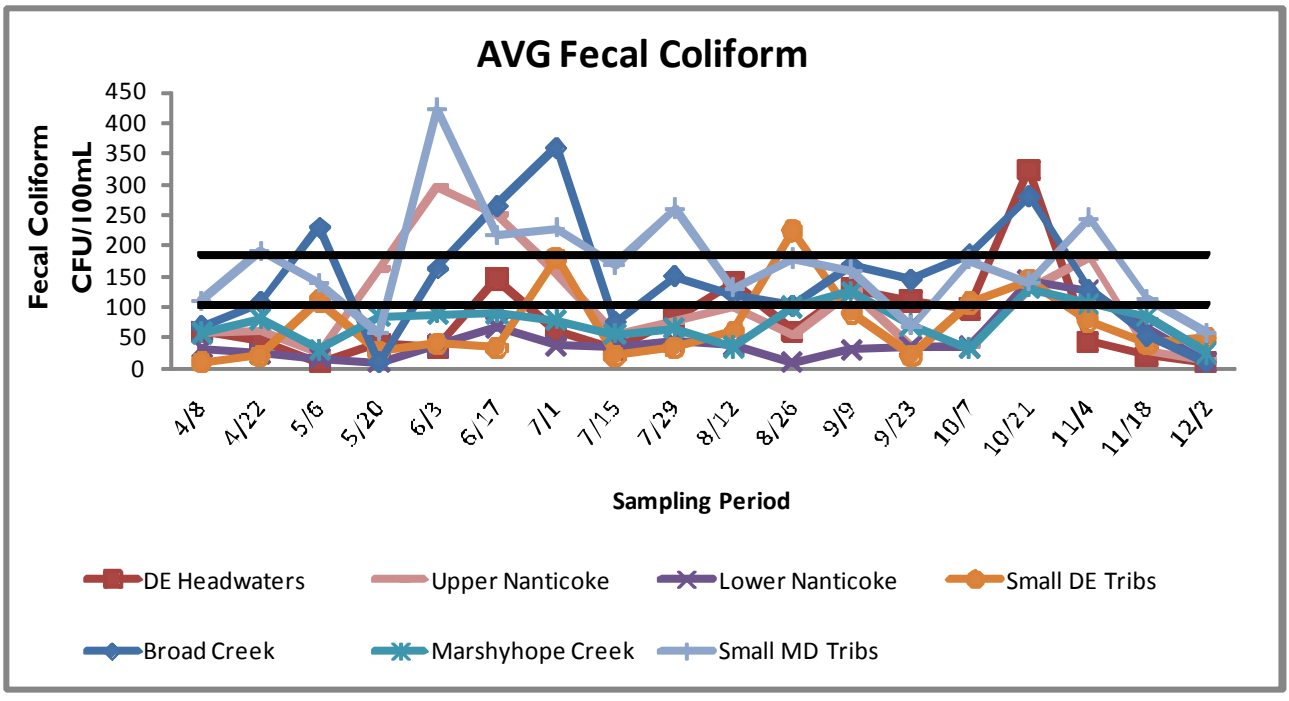
FECAL BACTERIA

Fecal Enterococcus (FE) and Fecal Coliform (FC) are both used as indicators of potentially harmful pathogens in the water. Wastewater treatment plants or septic system overflows as well as nonpoint sources of livestock and domestic animal waste can cause fecal bacteria to exceed natural levels. Enterococcus is a good indicator of water quality for primary and secondary contact recreation activities (such as swimming, boating and fishing) and Coliform is used to assess harvestable shellfish waters.

In general, fecal Enterococcus levels were high throughout the Nanticoke and its tributaries. Fecal Coliform levels were generally high in the upper watershed areas: Small Delaware Tributaries, Delaware Headwaters, Upper Nanticoke and Broad Creek. Small Maryland Tributaries also experienced large spikes during the spring and fall.

Note: All data collected by Creekwatcher citizen monitors were used in the production of this graph. Some of the data points fall outside of the EPA-approved 6-hour "holding time," or the amount of permissible time lapse between sample collection and its analysis at the laboratory. Information regarding the holding time for each sample is reflected in our Excel spreadsheets, which we make available to state and federal agencies.





Nanticoke Watershed Alliance

PO Box 111
115 Old Ocean Gateway
Vienna, MD 21869

...Dialogue, partnership and progress in conserving the Nanticoke River watershed.

We're on the web!
www.nanticokeriver.org

In June of 1992, Maryland and Delaware conservation organizations reached across state lines in a formal bi-state agreement to create the Nanticoke Watershed Alliance. The product of this agreement was the creation of a dedicated, broad spectrum effort to conserve the Nanticoke River, one of the most pristine of the major Chesapeake Bay tributaries. In 1995, the NWA established itself as a nonprofit organization and become a consortium, i.e. an organization of organizations. Since its inception its mission and goals have remained clear and concise, its strategy of engaging a broad spectrum of stakeholders has proved effective for organization growth and mission advancement. The efforts of the NWA include using restoration projects like the oyster reef at the mouth of the Nanticoke River and river clean-ups, public outreach through sponsorship of candidate forums, speakers, film festivals, and events like the annual shad fest, and broad initiatives based on land conservation and a comprehensive volunteer water monitoring program. Through these efforts the Nanticoke Watershed Alliance has brought many organizations to the table and been able to focus the combined resources of the partnership on the protection of the Nanticoke and the Bay. Today, over forty organizations belong to the NWA. Our members are made up of foresters, industry, small business owners, government agencies, main stream environmental groups, land trusts, realtors, academicians, fishermen, restoration groups, farmers, and citizen groups.

Discussion

The 2008 Creekwatchers water monitoring season is the second year of an ongoing effort to collect important information on the health of the Nanticoke River and the various streams that feed into it. The information collected during our first full nine-month season (2008) has allowed us to "paint" a more thorough picture of the current state of the Nanticoke. Future sampling seasons will be used to gain a better understanding of changes in river health and trends that may emerge over time.

The information in this report creates an overall impression that the river is healthy. Key indicators such as dissolved oxygen, water clarity, chlorophyll a and nutrients are within the low to medium range most of the time. Certain areas in the upper watershed of Delaware, as well as Broad Creek and Maryland tributaries, show higher nutrient levels—a possible indicator of nutrient loading from various human sources. Bacteria levels in some areas could be a concern.

It is also important to note that the variations among the geographic regions, or "functional groups," also reflect the differences in vegetation and habitat types within this large geographic area. Forested areas versus open, marshy areas will have different "expected" levels of our key parameters as an indication of a healthy, functioning ecosystem. Taking these different habitats into consideration, the data is often in agreement with these expectations.

The upper watershed in Sussex County, Delaware is more heavily populated than portions of the lower watershed. As a result, there are more inputs of sewage treatment plants and more septic systems in this area. The lower watershed, in contrast, has a more agricultural influence and lower population density. It is also buffered by extensive wetlands.

As the Nanticoke River watershed changes in land use and population density, our Creekwatchers Water Monitoring Program will allow us to identify potential restoration, education and outreach projects. The Nanticoke Watershed Alliance strives to conserve the tremendous resources of our lands and waters. A "State of the Nanticoke" report is published annually so citizens can keep up with our efforts. Thanks for your support!

The Nanticoke River watershed comprises 725,000 acres and is among the most pristine rivers within the Chesapeake Bay watershed. It is home to large tracts of unspoiled marsh, beautiful vistas and a large biodiversity of plants and animals.

Let's keep it clean!