

2007 STATE of the NANTICOKE RIVER WATERSHED

Nanticoke Creekwatchers: 2007 Water Quality Monitoring Report

SUMMARY

Nanticoke Creekwatchers is a community partnership between the Nanticoke Watershed Alliance (NWA) 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 recruiting and mobilizing a grassroots volunteer force that monitors the waters of the Nanticoke River and its tributaries in Maryland and Delaware. Data collection by volunteers is combined with analytical work by Envirocorp Labs and UMCES Horn Point Laboratory. Nanticoke Creekwatchers advances the efforts of NWA to protect and enhance Nanticoke River water quality. In 2007, Nanticoke Creekwatchers began to establish a set of baseline data for identifying water quality conditions and trends over time by monitoring 25 sites throughout the Nanticoke River system. Their data can be used to identify areas within the river system where water quality may be deteriorating.

This report summarizes data generated from on-site measurements and analysis of water samples collected within the Nanticoke River system from July through November 2007. (See methods section for an explanation of water quality parameters.) Key findings include:

- **Surface Dissolved Oxygen (DO)** – In 2007, there was only one instance of dissolved oxygen measurements that fell below the acceptable threshold of 5.0 milligrams/Liter (mg/L). These low levels occurred during one sampling period in early October in the small Delaware tributaries of the upper watershed. Similar trends were reflected in percent saturation of oxygen.
- **Water Clarity** – Water clarity for the Nanticoke River was very good for most regions of the river, using a conservative “healthy” standard of 0.5 meters. Water clarity diminishes from upriver to downriver as a result of the type of habitat found in this section of the river. Wave action, wind and tide play a significant role in the 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 some locations on the Marshyhope and Broad Creeks.
- **Total Nitrogen** – Nitrogen levels generally remained in the medium range (1-3 milligrams/Liter), with the exception of Broad Creek and Delaware tributaries. This could reflect human inputs such as sewage treatment plants and septic systems or agricultural runoff.
- **Total Phosphorus** – Phosphorus levels remained within the medium range (0.05-0.1 milligrams/Liter) for all functional groups over the sampling season, with the exception of a large spike in the small Maryland tributaries during one sampling period.
- **Fecal Bacteria** – Upper watershed areas experienced the highest spikes in fecal bacteria. High levels were also seen on the Broad Creek and on small Maryland tributaries.

PROGRAM HISTORY & OVERVIEW

In 2007 the Nanticoke Watershed Alliance (NWA), 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. Over the first season, Nanticoke Creekwatchers identified and began monitoring 25 sampling locations based on local river knowledge and reasonable distribution throughout the river system. Long-term, regular access to each site was considered in selection in order to ensure collection locations remain consistent in future years. The first group of Nanticoke Creekwatchers were provided hands-on training and water monitoring kits in July 2007. During the four-hour long training session, the program coordinator and partners provided sampling instructions to all volunteers, demonstrated data collection procedures, and reviewed sampling techniques. Newer participants continue to receive personal instruction in individualized sessions, and group review training has also been conducted.

METHODS

Nanticoke Creekwatchers collected water quality data at regular two-week intervals from July to November and recorded site conditions at each location. Subsequent years will comprise data collection from March-December. Samples are not collected in January or February, since biological activity and their effects on water quality are lower during the winter months. Environmental data includes weather, tide, wind strength, level of wave action and recent rainfall. Creekwatchers use a dissolved oxygen meter, pH meter, Secchi disk and refractometer to measure water temperature, surface dissolved oxygen content, pH, water clarity and surface salinity, respectively. Water samples are collected for subsequent nutrient, bacteria and chlorophyll analysis. The following water quality features are analyzed:

Dissolved Oxygen (DO): Dissolved oxygen below 5 mg/L is considered unhealthy for most aquatic species. Elevated DO at the surface can indicate healthy or unhealthy (eutrophic) conditions by signaling high photosynthetic activity among algae in the water. Dissolved oxygen can also be interpreted in percent saturation. Levels nearest 100% are ideal; large departures can indicate an unhealthy system.

Water Clarity: Light is critical for aquatic plant growth; 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 shallower depths along 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 type found in algae and cyanobacteria (blue-green algae), and its abundance is a good indicator of the amount of algae present in the water. Generally, lower levels of chlorophyll a represent healthier (lower nutrient) systems.

Total Nitrogen: Nitrogen is an essential nutrient for both plants and animals, but an overabundance of nutrients generates algal blooms and subsequent low dissolved oxygen levels.

Total Phosphorus: Phosphorus is another key nutrient in aquatic systems, with the same overabundance problems as nitrogen. Phosphorus can often attach to particles of sediment.

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 feature. High degrees of departure from these levels indicate potential water quality problems. For purposes of this report, criteria and guidelines for nutrient 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 thresholds 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

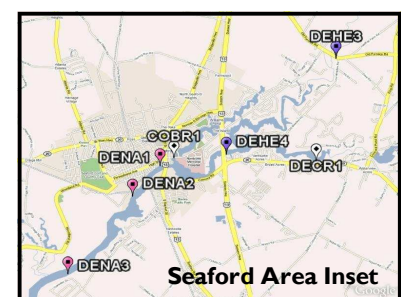
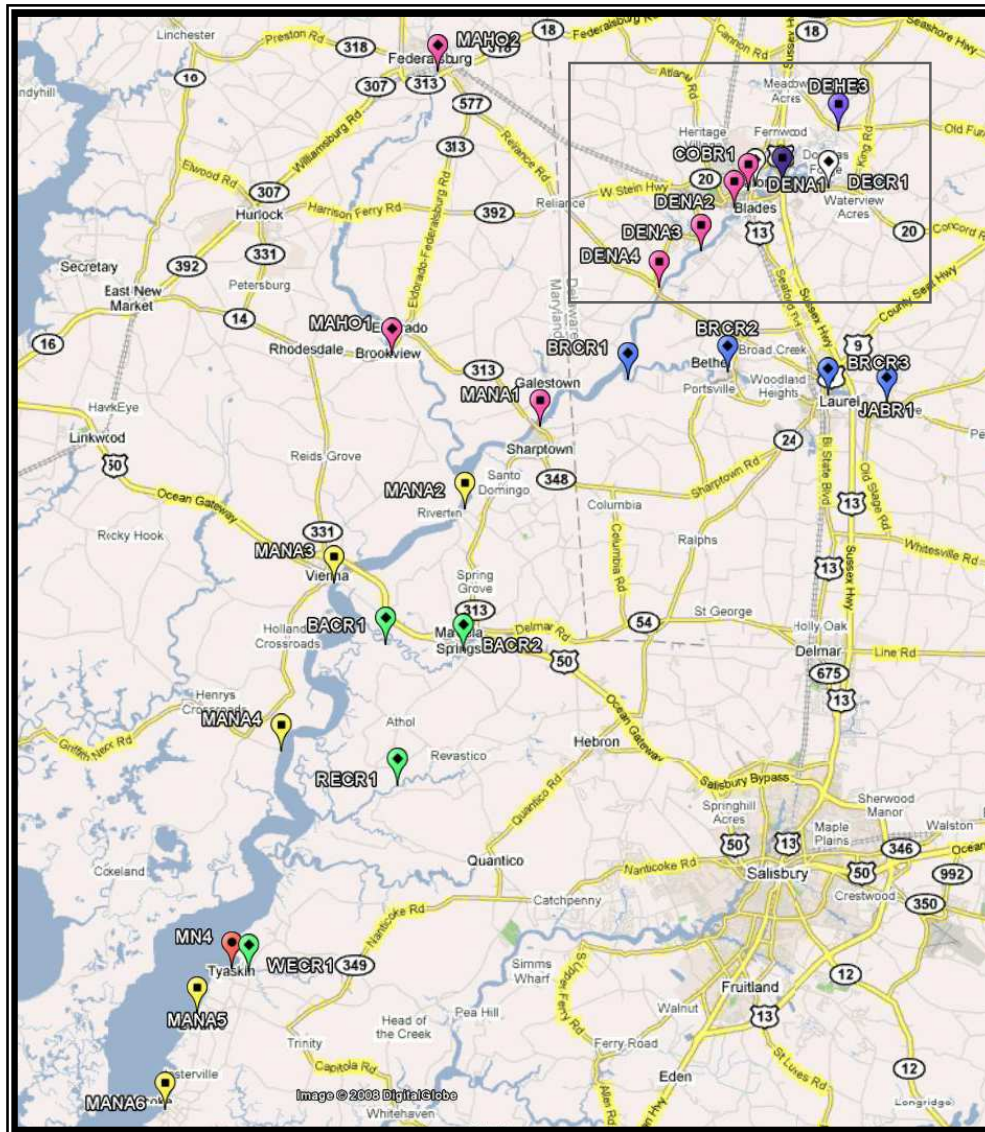
Table 1. DNREC criteria for healthy range of features measured in this study. Values in the low to moderate range represent healthier conditions than those in the higher range.

Nutrient	Low	Medium	High	Biological	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.

Creekwatcher sites were grouped to provide averages for **seven functionally distinct areas** that make up the Nanticoke River system. The data are presented graphically with average values representing means of 2-5 sites/group: **small Delaware tributaries** (two small tributary creeks beyond Seaford, DE); **Delaware headwaters** (two 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** (two sites along a major tributary in Maryland) and **small Maryland tributaries** (an aggregation of five sites along small tributary creeks in Maryland).

2007 Nanticoke Creekwatchers Sampling Sites

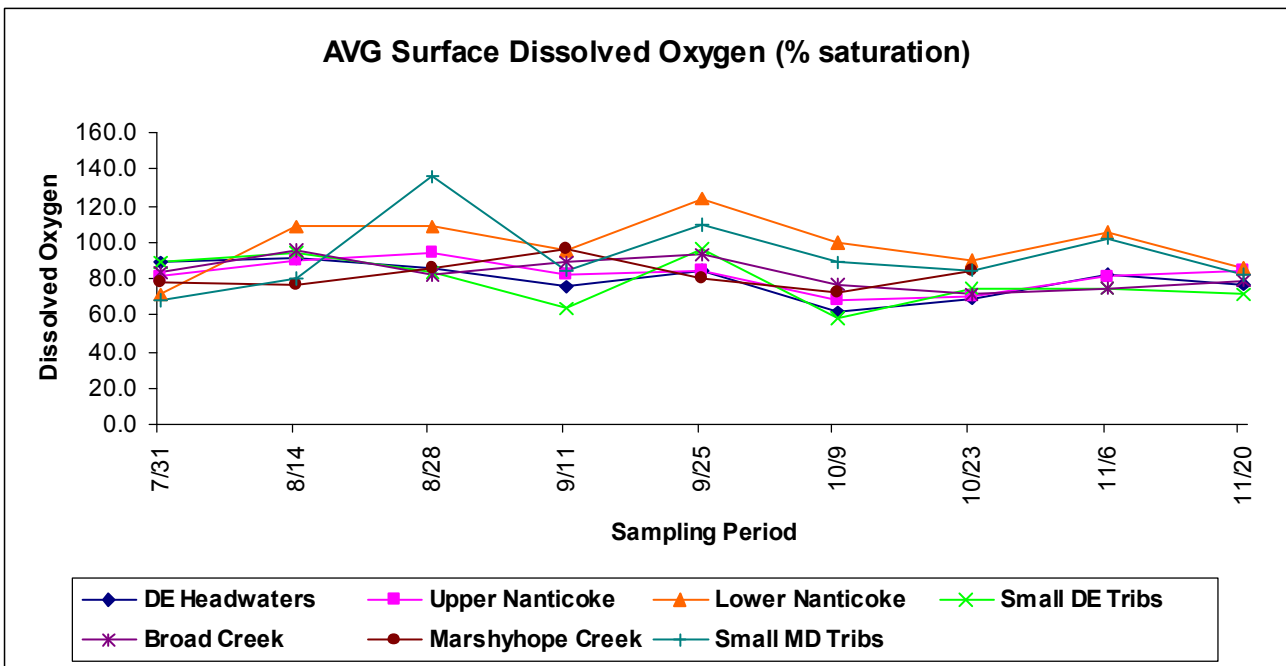
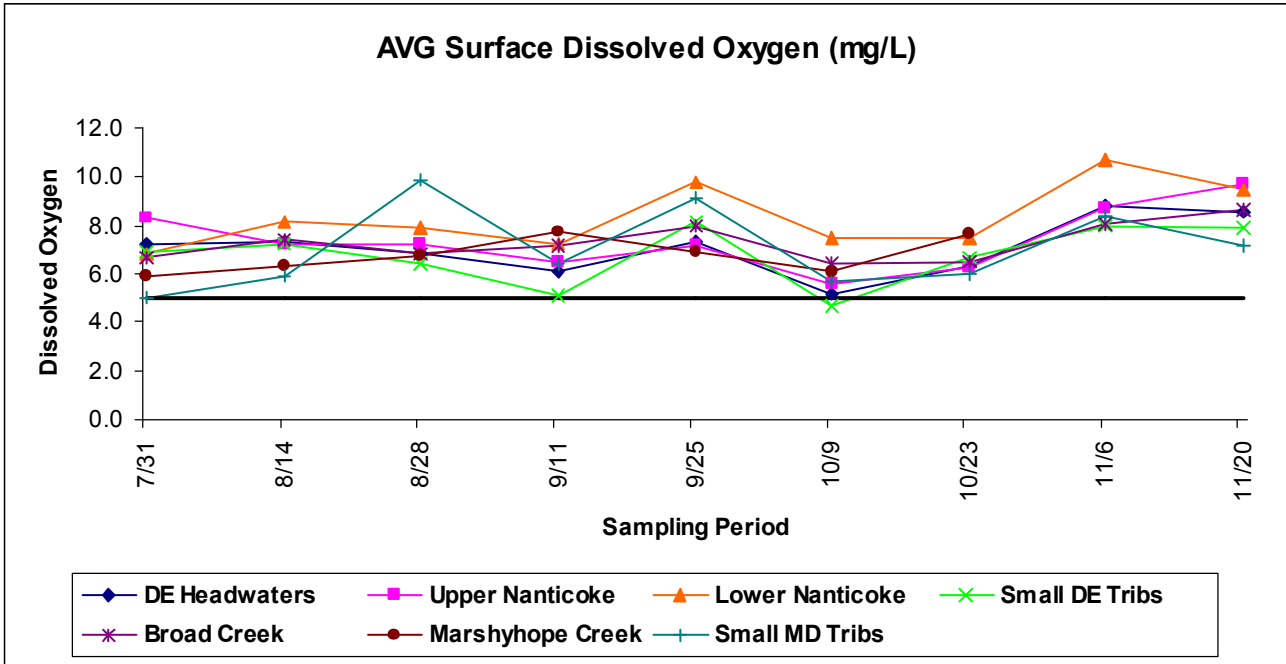


Creekwatcher Sites		
Site #	Name	Location
DEHE3	Middleford	Seaford, DE
DEHE4	Glen Sizemore Realty	Seaford, DE
DENA1	Riverwalk	Seaford, DE
DENA2	Seaford Boat Launch	Seaford, DE
DENA3	Holly Shores	Blades, DE
DENA4	Woodland Ferry	Woodland, DE
MANA1	Cherry Beach Park	Sharptown, MD
MANA2	Riverton Wharf	Riverton, MD
MANA3	Vienna Docks	Vienna, MD
MANA4	Lewis Wharf	Reids Grove, MD
MN4	Tyaskin Park	Tyaskin, MD
MANA5	Bivalve Wharf	Bivalve, MD
MANA6	Nanticoke Harbor	Nanticoke, MD
COBR1	Seaford Canoe Launch	Seaford, DE
DECR1	Concord Road	Seaford, DE
BRCR1	Phillips Landing	near Bethel, DE
BRCR2	Bethel Dock	Bethel, DE
BRCR3	Laurel Dock	Laurel, DE
JABR1	James Branch	Laurel, DE
MAHO1	Camp ESPA	Brookview, MD
MAHO2	Federalsburg Marina	Federalsburg, MD
BACR1	Taylor's Trail	Mardela Springs, MD
BACR2	Mardela Springs Boat Ramp	Mardela Springs, MD
RECR1	Rewastico Creek	Rewastico, MD
WECR1	Wetipquin Boat Ramp	Tyaskin, MD

2007 Results

DISSOLVED OXYGEN

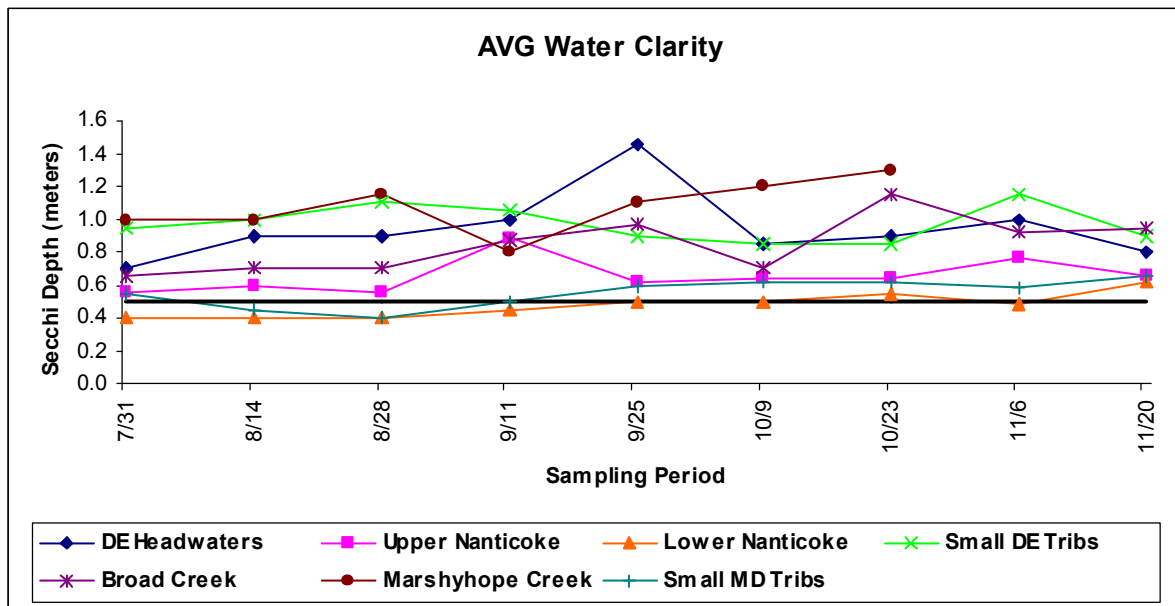
Surface DO levels were generally high suggesting a well-mixed system, the shallow depth of sampling, and an abundance of phytoplankton performing photosynthesis within these waters. Oxygen fell below acceptable levels within the “Small Maryland Tributaries” during one sampling period in the fall (October 9-10). Lower levels are to be expected in small tributaries in where tides may have little to no role. Levels were higher in the lower Nanticoke where wave action and tide play a more significant 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 samples dates are connected by lines for ease of discerning potential trends and are not meant to reflect continuous data.

WATER CLARITY

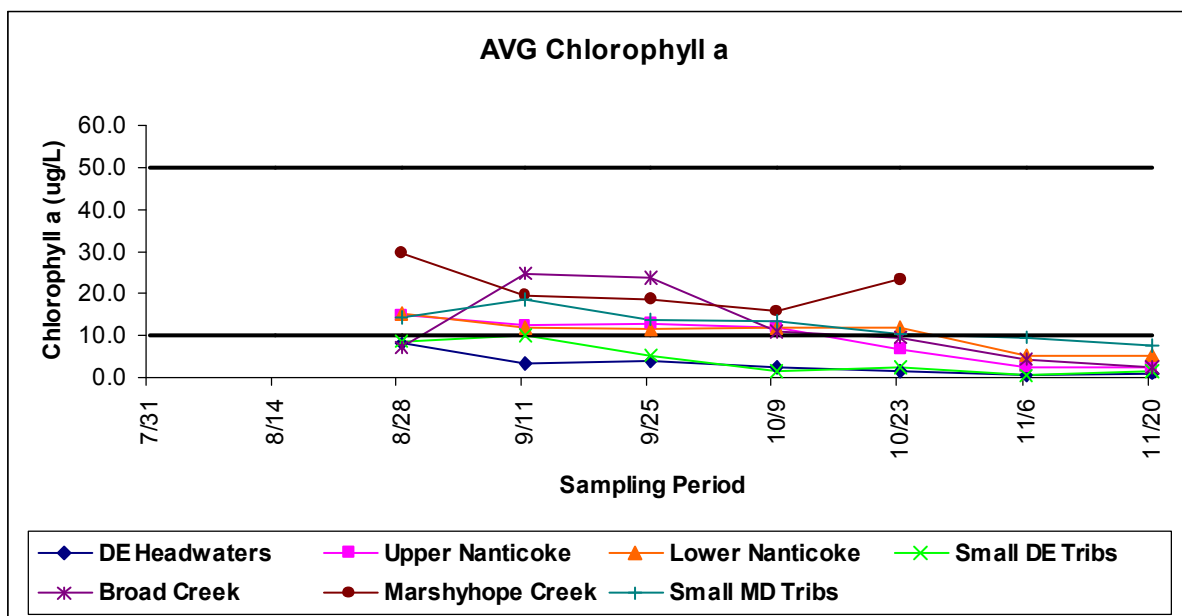
Water clarity can reflect both phytoplankton (algae) growth and suspended sediment. Water clarity was lowest in the “Lower Nanticoke,” which may be a result of the open water habitat found in this section of the river. Wave action, winds and tides may stir up sediment and lower water clarity levels. Highest levels were measured along the Marshyhope Creek, Delaware Headwaters, and Delaware Tributaries. This could indicate a well-vegetated and properly functioning ecosystem in these areas. Low levels were also found in Small Maryland Tributaries and could suggest 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. One site (DENA3) “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 this location.

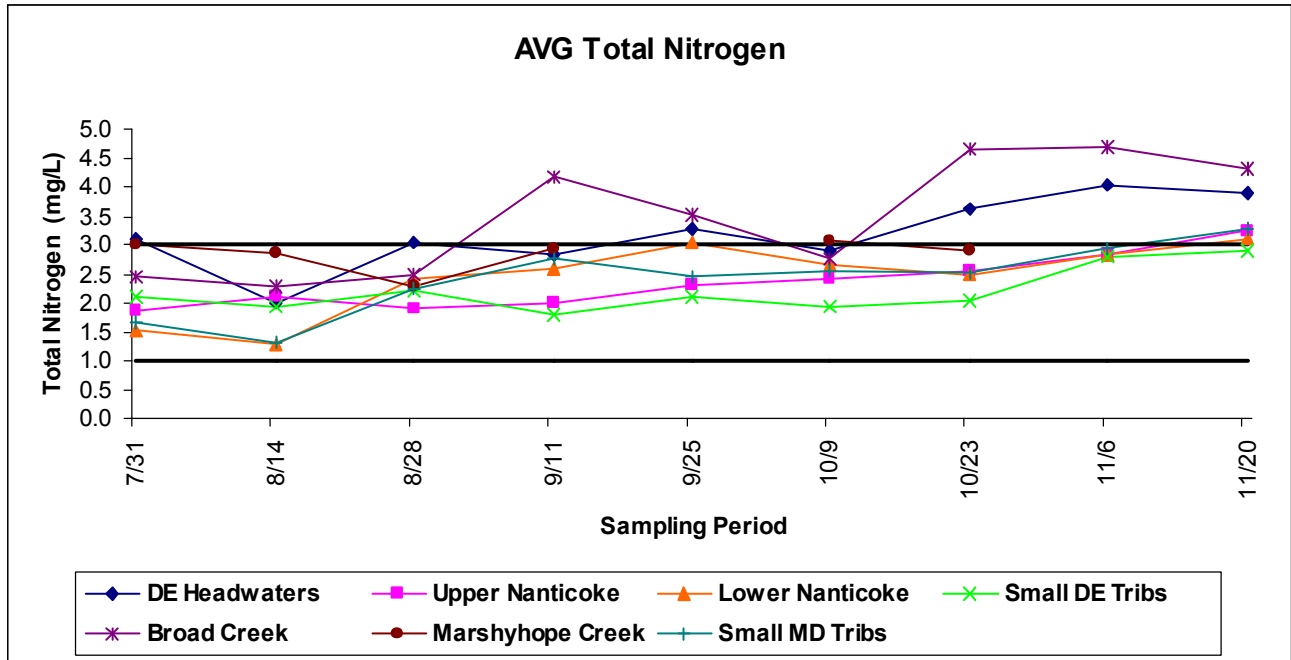
CHLOROPHYLL A

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, possibly due to shorter day lengths (less opportunity for photosynthesis). Highest levels were found along the Marshyhope and Broad Creeks. Within the Marshyhope Creek system, the lower site (MAHO1) consistently had much greater measurements than at the upstream location (MAHO2).



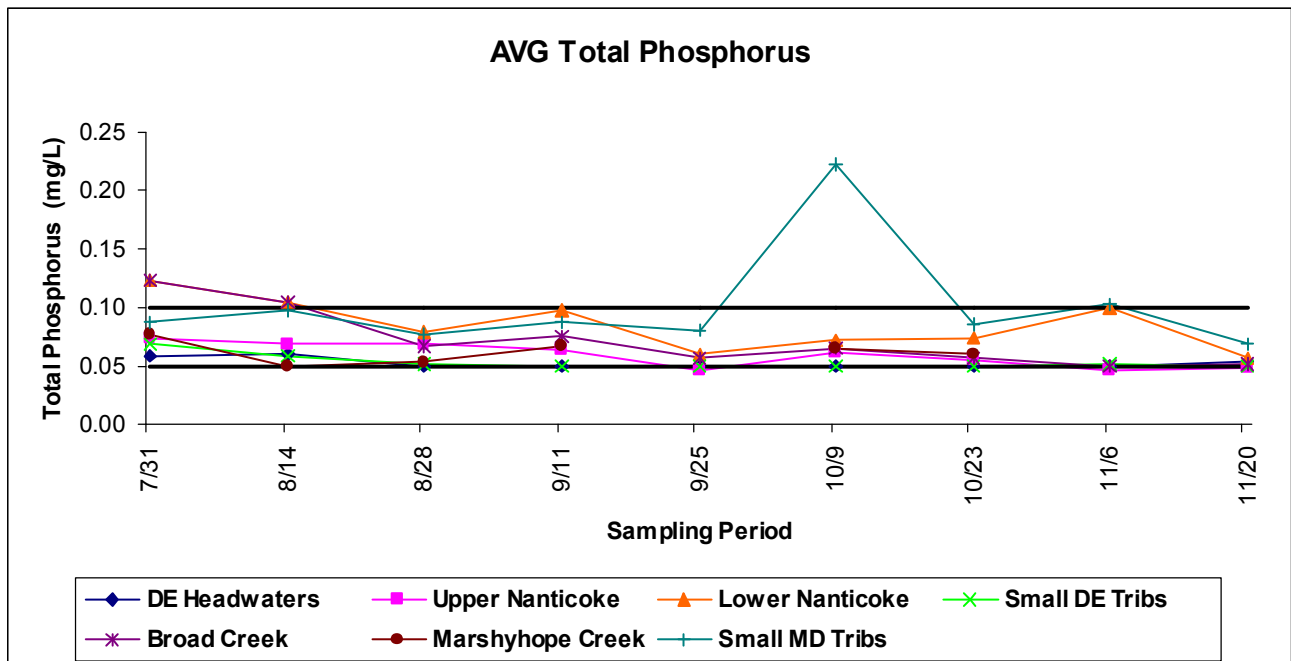
NITROGEN

Total Nitrogen (TN) remained within the medium range with the exception of Broad Creek and Delaware headwaters, where values were at or above the maximum healthy level on several sampling dates. Higher nitrogen levels can indicate inputs from sewage treatment plants, septic systems or agricultural runoff.



PHOSPHORUS

Unlike Total Nitrogen, phosphorus only exceeded the maximum healthy level on a few occasions. A spike in phosphorus occurred in early October within the small Maryland tributaries.

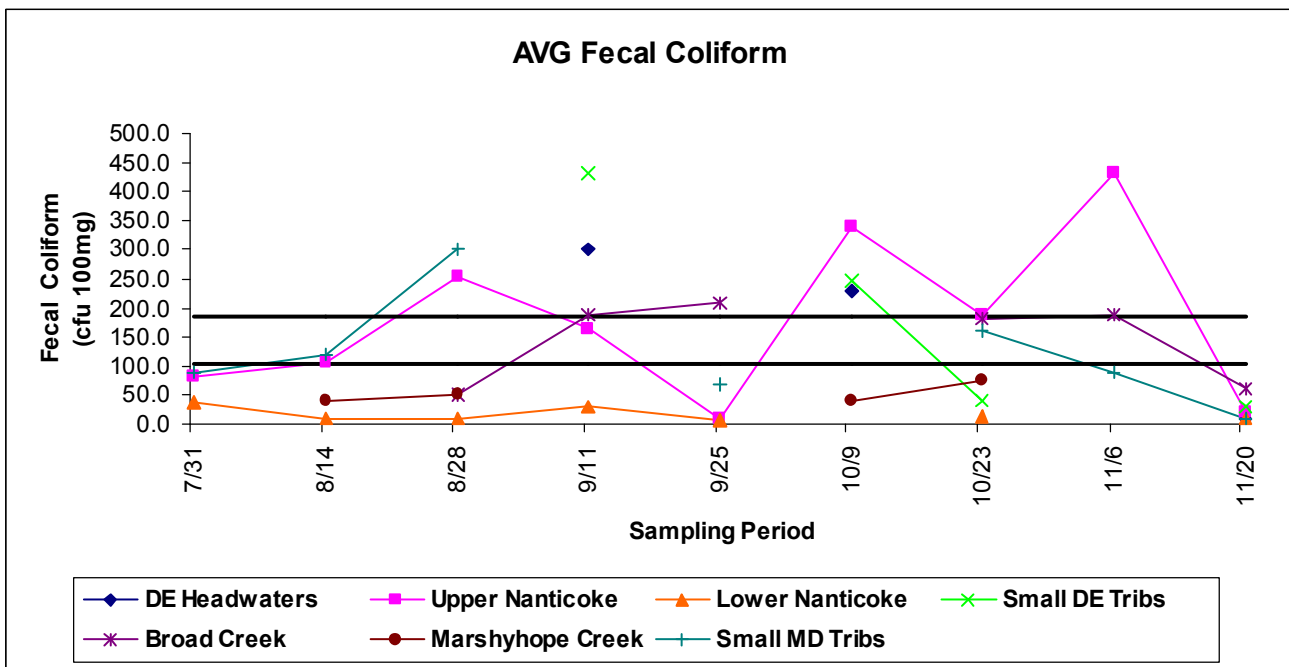
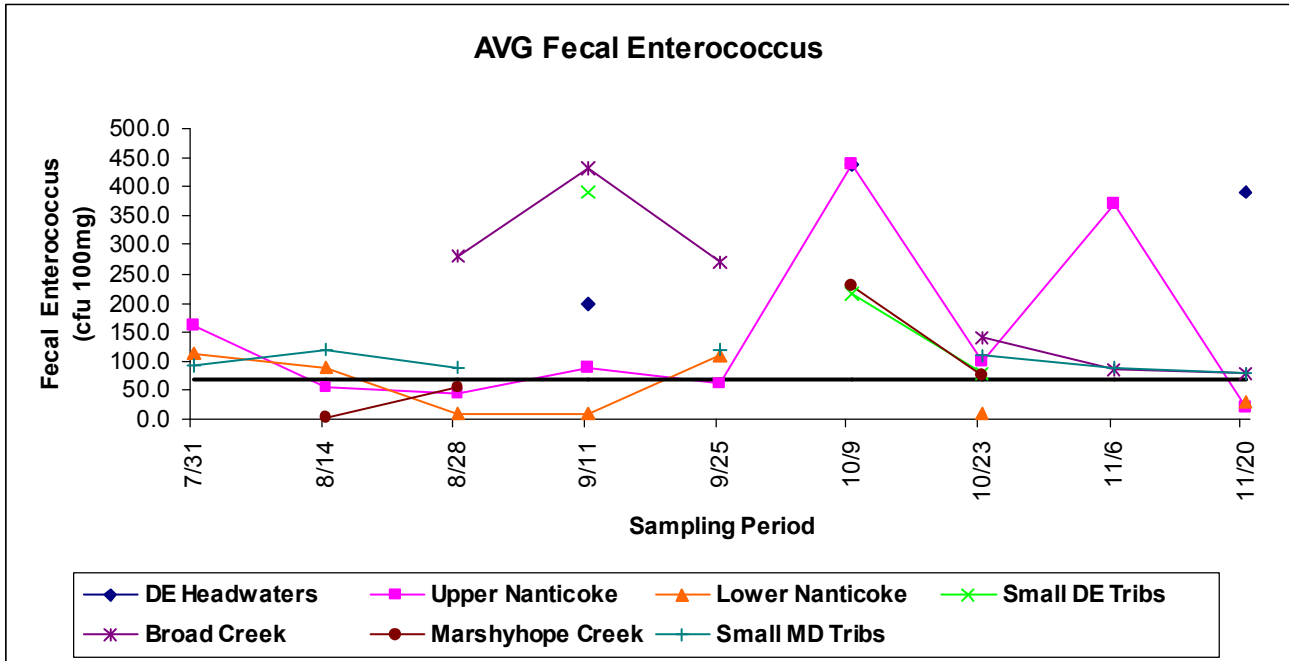


**Note: Phosphorus levels that were below laboratory detection limits of 0.05 mg/L were given a value of 0.05 mg/L for analytical purposes.

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.

Only samples that complied with EPA collection standards were included in analysis. In general, fecal bacteria spiked to highest levels in the upper watershed areas: Delaware headwaters, small Delaware tributaries and the upper Nanticoke. High levels were also seen on Broad Creek. In the small Maryland tributaries, levels for both remained in the medium to high range.





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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 2007 Creekwatchers water monitoring season was an effort to begin collecting "baseline" information on the current health Nanticoke River and the various streams that feed into it. This first season provides an initial assessment of how the Nanticoke River "measures up," though further sampling seasons will be necessary to gain a more thorough understanding of river health and trends that may emerge over time.

Nanticoke Creekwatchers' data begin to depict the state of the Nanticoke Watershed. In general, there is an improving gradient of water quality from upstream to downstream. This could be a result of differences in land use or population density — 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 will be published annually so interested 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 greater 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!