Wicomico Creekwatchers

Water Quality Monitoring Report
2004 – 2005

This Water Quality Monitoring Report is the third annual release of data and analysis conducted by the citizen's group *Wicomico Creekwatchers*. *Wicomico Creekwatchers* is a community partnership between the Chesapeake Bay Foundation (CBF), the Salisbury Area Chamber of Commerce and Salisbury University. The mission of *Wicomico Creekwatchers* is to obtain objective, scientifically credible water quality data through the recruitment and mobilization of a grassroots volunteer force that monitors the waters of the Wicomico River and its tributaries on Maryland's Lower Eastern Shore. Creekwatcher volunteers monitor 25 sites throughout the Wicomico river system, generating water quality data that can be used to advance efforts of citizens, businesses and public officials to ensure that public policies and other management tools adequately protect and preserve the health of the Wicomico River. Data collection and sampling are on going.

Until the summer of 2002 when *Wicomico Creekwatchers* began regularly sampling the Wicomico River, water quality data collected for the Wicomico had been historically sparse and failed to provide a comprehensive, reliable assessment of river health. *Wicomico Creekwatchers* offers baseline data for identifying water quality conditions and trends over time. Wicomico tributaries and dammed water features for which data has been collected include Johnson's Pond, Parker Pond, Schumaker Pond, the East Prong, Mitchell Pond, Coulbourne Mill Pond, Tony Tank Lake, Allen Pond, Shiles Creek and Rockawalkin Creek.

Data provided in this report can be used to identify river locations where water quality may be deteriorating. Trends in water quality may also be correlated with changes in land use and/or implementation of pollution control strategies occurring within the watershed.

This report summarizes data generated from on-site measurements and laboratory analysis of water samples collected from four sections of the Wicomico River system (Johnson's Pond, Tony Tank Creek, Wicomico Creek and the Lower Wicomico) between September of 2004 and August of 2005. A preliminary trend analysis is also offered for evaluating changes in water quality over time since sampling began under the program in 2002. Following is a selection of key findings:

- **Nitrate** – None of the samples collected in 2004/2005 contained nitrate concentrations within the healthy range of 0.2 mg/l or less. The average nitrate concentration ranged from 0.38 mg/l (Site 1 in June, Johnson's Pond) to 10.24 mg/l (Site 19 in August, Lower Wicomico) with an average nitrate value for all samples of 4.7 mg/l. All tributaries showed higher levels of nitrate in 2004/2005.

- **Phosphate** – All values for phosphate were also outside the healthy range in 2004/2005, except in the Lower Wicomico where only 12.5 percent of samples had phosphate levels less than 0.05 mg/l. While Wicomico River tributaries experienced a decline in average phosphate values, the average phosphate concentration for all tributaries was 0.13 mg/l, over 6 times the limit for healthy water.

- **Water Clarity** – None of the visual turbidity readings conducted at sites on Tony Tank Creek and Wicomico Creek were in the healthy range of 36" or above in both sampling years. The average water clarity value increased slightly from last year in Johnson's Pond, Wicomico Creek, and the Lower Wicomico. The average water clarity value for all tributaries in 2004/2005 was 26.9".

PROGRAM OVERVIEW

Interest among citizens in the health of the Wicomico River and other Chesapeake Bay tributaries is growing. By federal law, six Mid-Atlantic states, including Maryland, are required to develop and implement strategies for improving water quality in the Chesapeake Bay or face severe restrictions in amounts of pollution that can be legally discharged into the estuary.

In 2000, state and federal officials formally committed to a comprehensive program for removing the Chesapeake Bay from the Environmental Protection Agency's dirty waters list by 2010. The plan, called the *Chesapeake 2000 Agreement (C2K)*, provides a roadmap for actions needed to reduce the amount of pollutants entering the Bay each year to a level sufficient to maintain the health of the estuary's living resources, including crabs, oysters and finfish.

Communities throughout the Chesapeake Bay watershed are responding to the call for action sounded in *C2K*. In Talbot County on Maryland's Eastern Shore, citizens working in partnership with CBF, Talbot River Protection Association and the Chesapeake Bay Maritime Museum launched a volunteer-based water quality monitoring program to identify trends in the health of the county's rivers. *Wicomico Creekwatchers* is modeled after that successful program, which is receiving statewide recognition for its effectiveness in providing water quality data useful for facilitating local watershed management efforts. Recent information on both the Talbot and Wicomico programs can be accessed at www.cbf.org.

Methods

In summer 2002, CBF, the Salisbury Area Chamber of Commerce and Salisbury University began working cooperatively with citizen volunteers to identify sampling locations along the Wicomico River. Twenty-eight sampling locations were selected that year for water quality monitoring (Appendix 2). Sampling sites were selected based on local knowledge of the tributary and equitable distribution throughout the river system. Site selection was also driven by the potential for long-term, regular access to ensure collection locations remain consistent in future years. In 2004/2005, three sampling locations were eliminated from the program when access to the sites became unavailable. Negotiations are underway to restore site access in 2005/2006.

Efforts were made to select locations having water approximately four feet in depth to conform to standard sampling protocol. A map (Appendix 3) indicating sampling site locations was generated and latitude/longitude coordinates were obtained for each site using GPS technology.

Volunteers were recruited for participation in *Wicomico Creekwatchers* in summer of 2002. Fifty-eight volunteers were trained in sampling techniques at an hour-long training session. Data collection procedures were demonstrated and sampling instructions were provided to all volunteers (Appendix 5).

A majority of volunteers recruited and trained in 2002 remain engaged in the program to date. Additional participants have joined the effort since the initial training program and received instruction in individualized sessions.

Environmental data were collected at regular two-week intervals in March through November. At each location, site conditions were recorded on a Water Quality Sampling Data Sheet (Appendix 4). Parameters measured included tide, weather, wind strength and direction, level of wave action, recent rainfall, and air and water temperature.

Water clarity was measured using a Secchi disk. The black and white disk was lowered into the water at the sampling location until it was no longer visible, at which point the distance from disk to water surface was recorded in feet.

Water samples were collected using a Winkler titration bottle. Empty bottles were submerged three inches below the water's surface at each sampling location until full. Care was taken to ensure no air bubbles were present when the stopper was inserted. Water samples were immediately put on ice and remained cool until they arrived at Salisbury University laboratories, where they were analyzed for pH, dissolved oxygen, nitrate and phosphate content and salinity levels.

RESULTS

Data compiled and analyzed in this report were derived from water clarity readings and samples collected at two-week intervals beginning on August 17, 2004 and ending on August 23, 2005. No data were collected in January, February and March this year, recognizing that biological activity and its effects on water quality is depressed during the winter months.

The data set builds on analysis conducted and reported on in two earlier *Wicomico Creekwatchers Water Quality Monitoring Reports,* released October 7, 2003 and September 17, 2004 (both currently accessible at www.cbf.org/publications). Comparisons between earlier and current data sets are made as part of a preliminary trend analysis for evaluating changes in water quality conditions over time.

As in the earlier reports, four regions were established that reflect geographic and hydrologic similarities to facilitate data analysis and interpretation. In 2004, slight modifications to the groupings of collection sites were made for building consistency with state-accepted watershed delineations (8-digit sub-watersheds) and related geographically based monitoring and natural resource management efforts. Names were also revised for the four sampling areas: Johnson's Pond, Tony Tank Creek, Wicomico Creek and the Lower Wicomico. This year, a total of 766 data points were generated.

Reference Site

In earlier years, spring-fed conditions at site 14 near Tony Tank Creek were expected to contribute significant levels of relatively fresh ground water to the receiving surface waters. Site 14 had therefore been established as a reference site for providing baseline comparisons among the parameters analyzed.

In 2005, data collected at site 14 showed some similarity to values obtained at other sites. This year's site 14 data was therefore added to the Tony Tank Creek data set and no reference site has been established.

Water Quality Parameters

The Environmental Protection Agency's Chesapeake Bay Program and other regional research institutions establish criteria to identify levels of water quality needed to support the Bay's living resources, such as crabs, oysters, finfish, underwater grasses and other aquatic organisms. Scientists evaluating the health of the Bay and its tributaries compare empirical water quality data with a standard "healthy" range of several key water quality indicators, including acidity (pH), chlorophyll a, coliforms, dissolved oxygen, nitrate, phosphate, and water clarity. In general, water quality parameters are often influenced by wastewater treatment plant and industrial discharges, air pollution, run-off from agricultural, landscaped and urban areas, septic system effluent, and other anthropogenic sources.

Table 1 describes each parameter used to determine Wicomico River water quality and suggests the range parameter measurements should fall within to qualify a tributary as “healthy.” Data outside the “healthy” range indicates poor water quality.

In the 2004/2005 sampling year, resource limitations prevented an analysis of chlorophyll a and coliform concentrations as had been evaluated in the first report released in 2003. Arrangements are currently being developed to re-include chlorophyll a data analysis in 2005/2006.

Table 1: Water Quality Parameters

Acidity (pH): pH levels are directly related to the health of fish and aquatic plant populations, and in a healthy system, should be between 6.5 and 8.5. The most common causes of variations include stormwater runoff and air deposition of nitric and sulfuric acids discharged by industries, power plants, and automobiles.

Dissolved Oxygen: Dissolved oxygen is essential to all aquatic life. Readings greater than 5 mg/l indicate sufficient levels of oxygen to support aquatic organisms. Common causes of low readings include an increase in algae production, which consumes oxygen as algae decompose. Seasonal changes in water salinity levels can also influence dissolved oxygen levels.

Nitrate (NO_3) and Phosphate (PO_4): Though essential to all bay life, nitrogen and phosphorus, in excessive levels, are the most damaging pollutants in the Chesapeake. Nitrogen and phosphorus are natural fertilizers that stimulate algae blooms. These blooms block sunlight from underwater grasses and, when the algae die, lead to low dissolved oxygen levels. Some naturally occurring algae may be toxic or have toxic stages in their life cycles. Nitrate (NO_3) and Phosphate (PO_4) are the primary chemical compounds that express critical levels of nitrogen and phosphorus. Nitrate levels should be less than 0.2 mg/liter and phosphate levels should be less than 0.05 mg/liter (see *Nutrient Criteria* below).

Water Clarity: Water clarity measures the ability of light to pass through water. Poor water clarity indicated by a low visual turbidity reading indicates that water is not clear enough for light to penetrate to a depth to support the growth of underwater grasses. The healthy range for visual turbidity includes readings greater than 36 inches.

Nutrient Criteria

Although anthropogenic sources of nitrogen and phosphorus fueling excessive algae production are the primary cause of most water quality problems in the Bay, the U.S. Environmental Protection Agency has not established criteria for safe levels of nitrogen and phosphorus in surface waters in the Chesapeake Bay and its tributaries. Instead, it deals with the effects of the anthropogenic nitrogen and phosphorus by establishing criteria for chlorophyll a, water clarity and dissolved oxygen. Exceeding these criteria indicates “impaired waters,” triggering a process to determine limits (also known as Total Maximum Daily Loads or TMDLs), for pollutants like nitrogen and phosphorus that a tributary can safely receive from point sources and the surrounding landscape. TMDLs are used to guide efforts to reduce levels of pollutants that threaten the health of aquatic life.

Despite the failure of EPA to establish water quality criteria for nitrogen and phosphorus in surface waters, there is substantial scientific literature supporting the establishment of such criteria in surface waters (Buchanan et al. sub.; Fisher et al. 1988, 1992, 2004; Ryding and Rast 1989; Staver et al. 1996; Stevenson et al. 1993).

Based on the scientific literature and the recommendation of Dr. Thomas R. Fisher at the University of Maryland Center for Environmental Science, *Wicomico Creekwatchers* establishes a conservative benchmark for healthy levels of nitrate at 0.2 mg/l and phosphate at 0.05 mg/l in the 2004/2005 sampling year. These figures replace the 1.0 mg/l (nitrate) and 0.1 mg/l (phosphate) benchmarks used by *Wicomico Creekwatchers* in previous years. Analysis of data collected in earlier years and reported on in this paper were adjusted to reflect this recommendation.

Wicomico River Water Quality

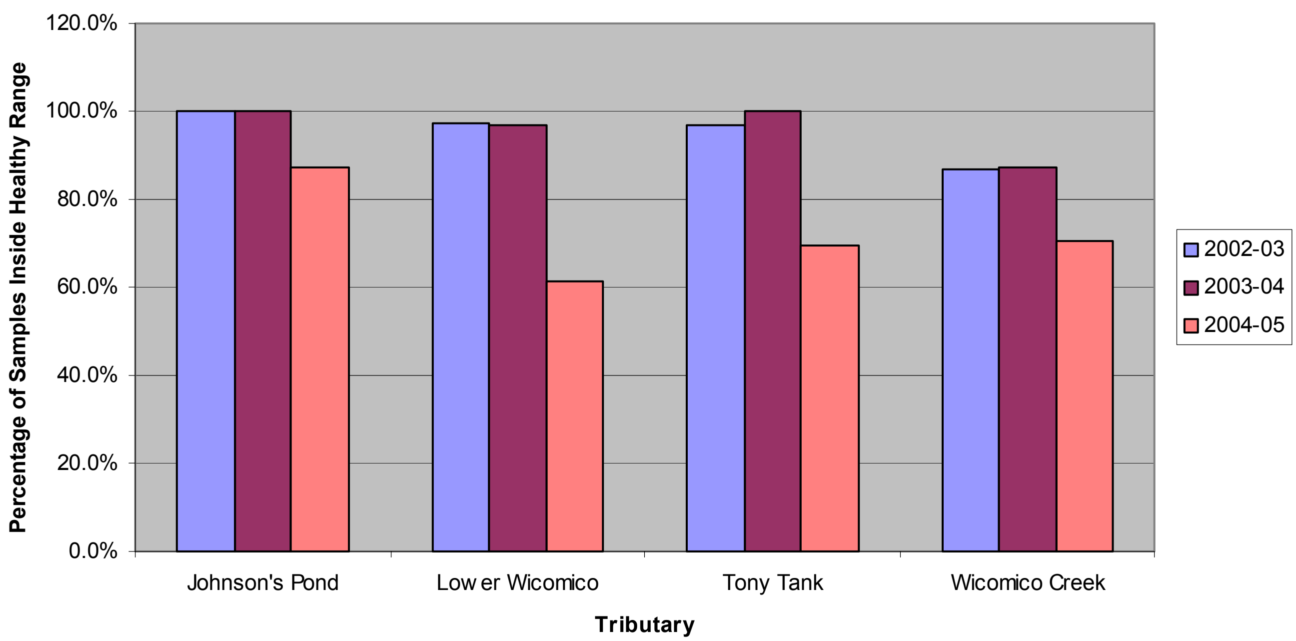
Using the criteria identified for healthy water, data collected were analyzed to determine the percentage of data points that fall outside the healthy range for each parameter measured. High percentages by parameter indicate potential water quality problems. Potential trends in water quality are indicated by health range percentages offered in the three sampling years.

Acidity (pH):

The percentage of samples within the healthy range for pH declined in each tributary in 2004/2005. The Lower Wicomico showed the largest decrease, with 61.3 % of samples showing pH levels within the healthy range, compared to 96.9 % of samples last year. Tony Tank Creek had a similar decline, with 30.4 % less healthy measurements for pH than the previous year.

The healthy range for pH is 6.5 – 8.5. Thirty-four percent of all samples had pH values lower than 6.5. Eighty-three percent of samples had pH values lower than 6.5 in August. No samples had pH values higher than 8.5.

Graph 1: Percentage of pH Samples by Tributary Inside Healthy Range (6.5 to 8.5)



Dissolved Oxygen

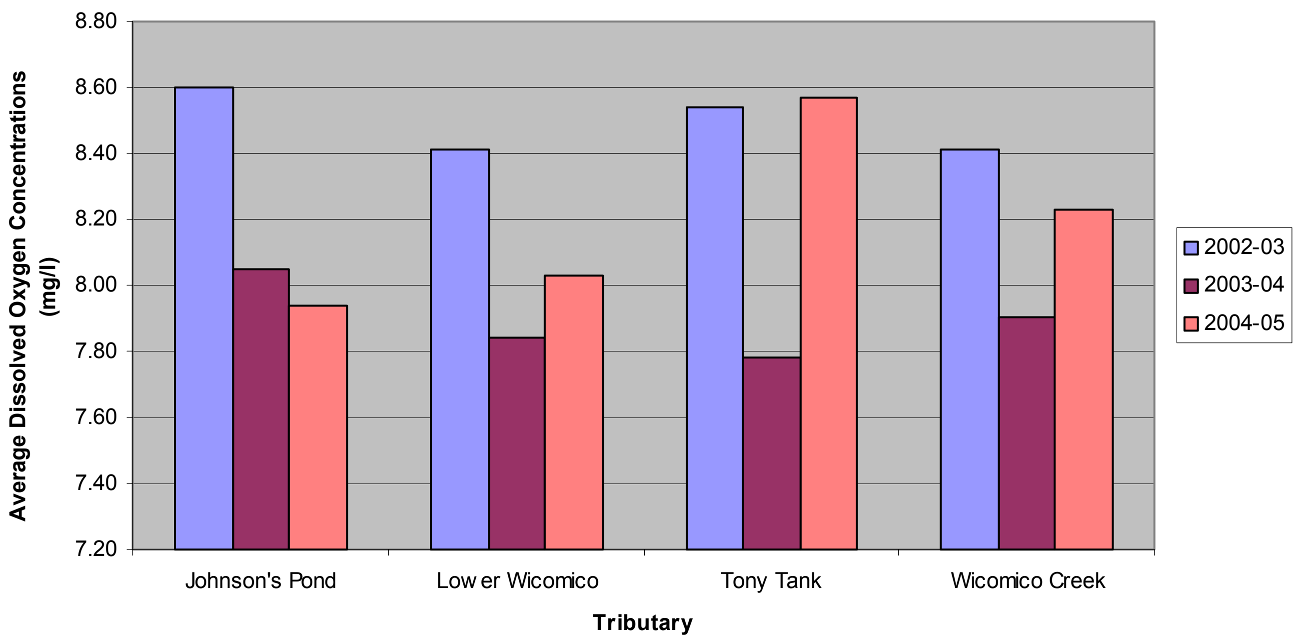
Dissolved oxygen values, measured just below the water's surface in this study, remained relatively unchanged in 2004/2005. The percentage of samples containing dissolved oxygen concentrations less than 5.0 mg/l (the healthy range) at Johnson's Pond declined from 100 % to 94.7 %. Tony Tank Creek and the Lower Wicomico showed modest increases in the percentage of samples found to be within the healthy range. As in previous years, all Wicomico Creek samples indicated healthy dissolved oxygen levels.

Table 2: Percent of Dissolved Oxygen Samples Within Healthy Range

	2002/2003	2003/2004	2004/2005
Johnson's Pond	100.0%	100.0%	94.7%
Tony Tank Creek	100.0%	94.1%	95.5%
Wicomico Creek	100.0%	100.0%	100.0%
Lower Wicomico	100.0%	96.9%	97.1%

Average dissolved oxygen values increased in all tributaries this year except in Johnson's Pond. The average dissolved oxygen value for all tributaries in 2004/2005 was 8.1 mg/l.

Graph 2: Average Dissolved Oxygen Concentrations by Tributary and Year



* Dissolved Oxygen Healthy Range: > 5.0 mg/l

Nitrate and Phosphate

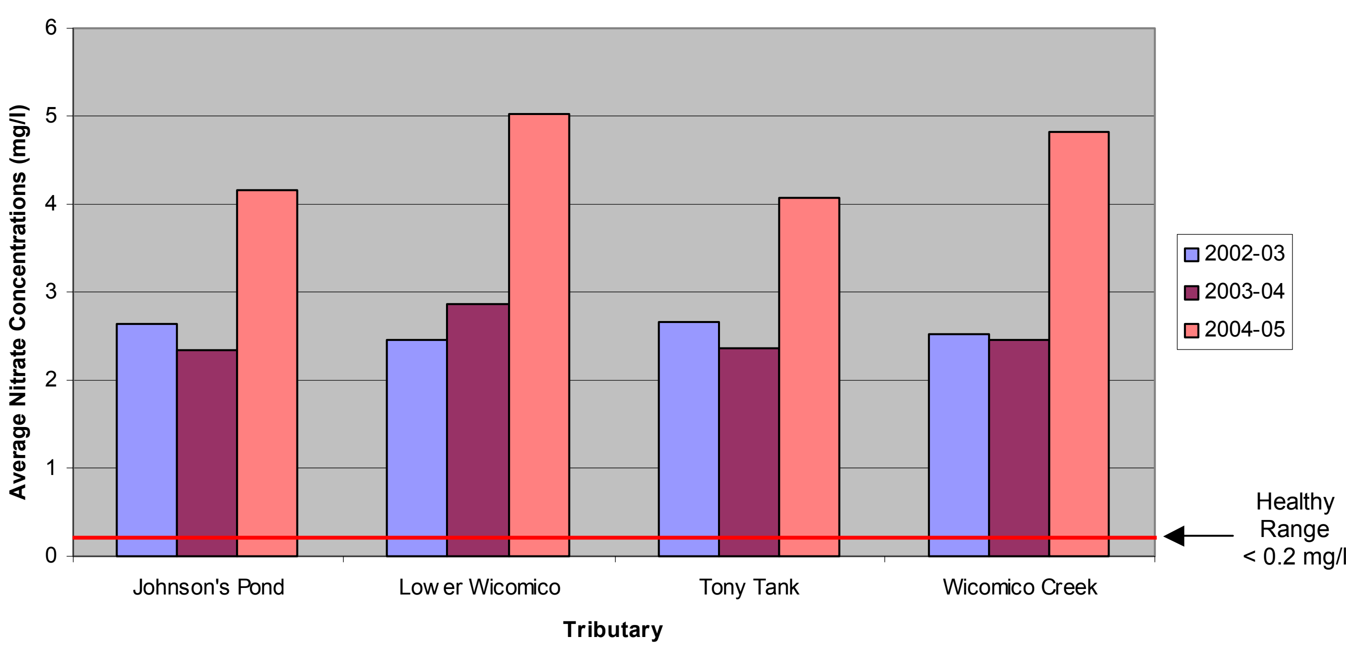
Consistent with University of Maryland recommendations, the healthy ranges for nitrate and phosphate were revised to reflect the latest thinking among scientists who study nutrient dynamics in the Chesapeake Bay and its rivers and streams (see *Nutrient Criteria*, page 4). The 2004/2005 healthy range for nitrate is < 0.2 mg/l, and the healthy range for phosphate is 0.05 mg/l. Data collected in earlier years was analyzed using the new healthy range criteria.

Table 3: Percent of Nitrate Samples Within Healthy Range

	2002/2003	2003/2004	2004/2005
Johnson's Pond	0.0%	0.0%	0.0%
Tony Tank Creek	0.0%	0.0%	0.0%
Wicomico Creek	0.0%	0.0%	0.0%
Lower Wicomico	0.0%	0.0%	0.0%

None of the samples collected in 2004/2005 contained nitrate concentrations within the healthy range of 0.2 mg/l or less. The average nitrate concentration ranged from 0.38 mg/l (Site 1, Johnson's Pond in June) to 10.24 mg/l (Site 19, Lower Wicomico in August) with an average nitrate value for all samples of 4.7 mg/l. All tributaries showed higher average levels of nitrate in 2004/2005.

Graph 3: Average Nitrate Concentrations by Tributary and Year



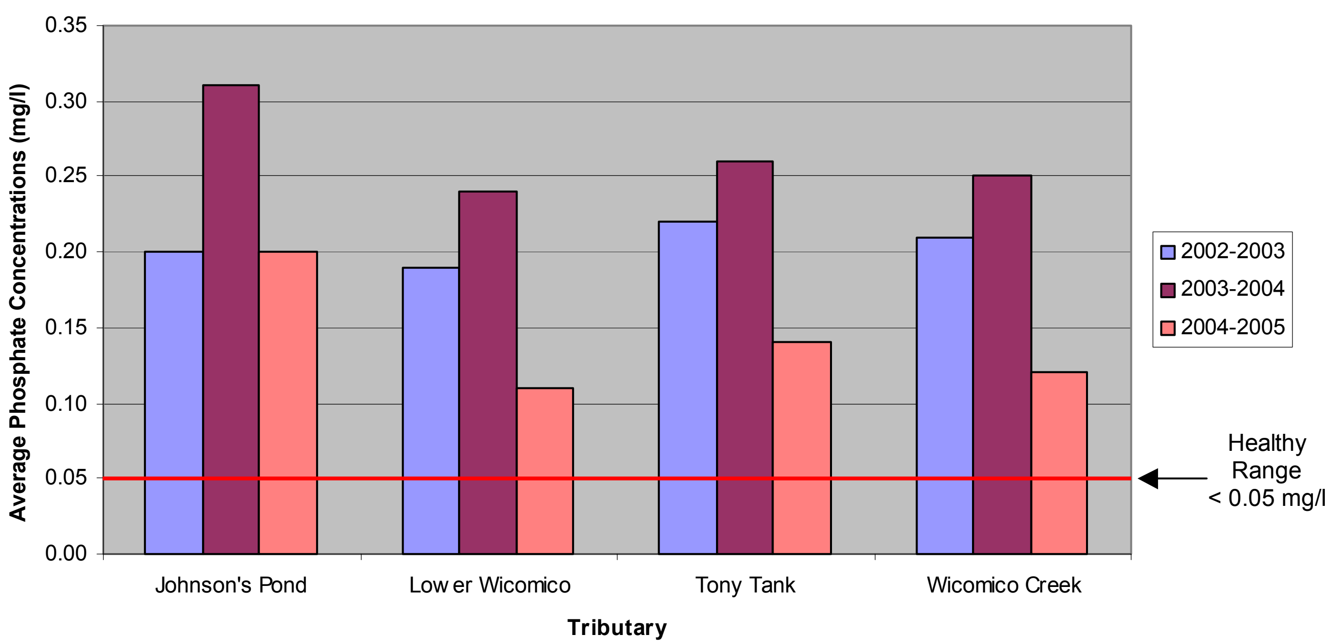
All values for phosphate were also outside the healthy range in 2004/2005, except in the Lower Wicomico where 12.5 % of samples had phosphate levels less than 0.05 mg/l.

Table 4: Percent of Phosphate Samples Within Healthy Range

	2002/2003	2003/2004	2004/2005
Johnson's Pond	0.0%	0.0%	0.0%
Tony Tank Creek	0.0%	0.0%	0.0%
Wicomico Creek	0.0%	0.0%	0.0%
Lower Wicomico	0.0%	0.0%	12.3%

In contrast to nitrate, phosphate values declined from the previous year in all tributaries. Average phosphate concentrations were less than half the values recorded in 2003/2004 in the Lower Wicomico, Tony Tank Creek and Wicomico Creek. The average phosphate concentration for all tributaries was 0.13 mg/l, over 6 times the limit for healthy water.

Graph 4: Average Phosphate Concentrations by Tributary and Year



Water Clarity

As in previous years, none of the visual turbidity readings conducted at sites on Tony Tank Creek and Wicomico Creek were in the healthy range of 36" or greater. Healthy water clarity readings were recorded more frequently in Johnson's Pond in 2003/2004 with 18.7 % of samples less than 36", compared with 9.5 % the previous year. Only 24.8 % of Lower Wicomico water clarity samples were greater than 36", a less than 1 % change from last year.

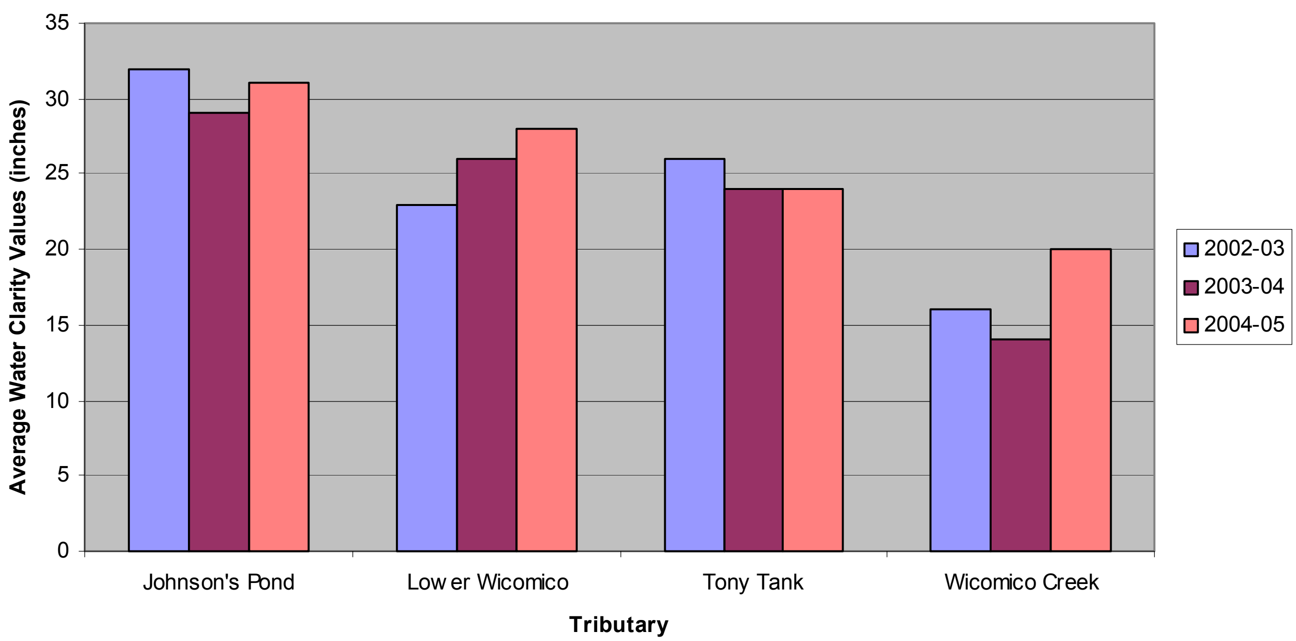
Table 5: Percent of Water Clarity Samples Within Healthy Range

	2002/2003	2003/2004	2004/2005
Johnson's Pond	42.9%	9.5%	18.7%
Tony Tank Creek	0.0%	0.0%	0.0%
Wicomico Creek	0.0%	0.0%	0.0%
Lower Wicomico	8.7%	25.6%	24.8%

The average water clarity value increased slightly in Johnson's Pond, Wicomico Creek, and the Lower Wicomico. The average water clarity value for all tributaries in 2004/2005 was 26.9".

Samples from sites where the water was too shallow to obtain a reliable reading were removed from the data set during statistical analysis. While effort is made to establish sampling sites in water approximately four feet in depth, some sampling locations contain a shallower water depth that prevents accurate water clarity measurement.

Graph 5: Average Water Clarity by Tribuatary and Year



* Water Clarity Healthy Range: > 36 inches

CONCLUSIONS

In its third year of data collection and analysis, *Wicomico Creekwatchers* continues to reveal water quality problems in the Wicomico River and its tributaries.

Nutrient concentrations in the Wicomico River measured in this year's study are at very high levels. Average nitrate concentrations in 2004/2005 were higher than those measured in either of the two previous years. Average phosphate concentrations decreased in all four tributaries, but were still recorded at 6 times the levels found in healthy waterways.

The incidence of excess nitrate and phosphate in surface waters is known to adversely impact aquatic species like crabs, oysters and finfish as nutrient-rich waters fuel algae growth that clouds waterways and reduces wildlife habitat. Measured visual turbidity levels confirmed poor water clarity conditions in most of the Wicomico system's headwater tributaries and in portions of the river's mainstem.

Average nitrate concentrations measured in 2004/2005 were often more than 2 times higher than values measured in previous years, which showed a more incremental increase. Given the large increase in values obtained this year, program methodology is being reviewed in 2005/2006 and sample analysis is being verified using an independent laboratory to verify results. Additional analysis of the data is also being conducted to compare values across months and between sampling sites for a more detailed look at water quality data.

In addition to clouding waterways, algae growth and decay can reduce availability of oxygen, often times below threshold levels required by aquatic species for survival. As in previous years, most samples were found to contain dissolved oxygen levels within the healthy range.

Wave action and boat traffic can help explain higher dissolved oxygen levels near the surface of waterways as waves increase the surface area of water an enable oxygen from the air to more easily diffuse into water. In addition, photosynthesis in algae and other aquatic plants often increases oxygen levels near the surface of waterways during daylight hours. Deeper water that experiences lower light levels due to the presence of fewer aquatic plants populations is expected to contain lower dissolved oxygen concentrations as decomposition of algae outpaces the ability of the system to replenish oxygen. In 2005/2006, a mechanism to measure dissolved oxygen concentrations in deeper water is being developed. Also, chlorophyll a measurements are being taken in 2005/2006 to further evaluate the level and extent of activity by aquatic plants.

Now in its third year, preliminary trend analysis conducted by *Wicomico Creekwatchers* is indicating deteriorating water quality. The findings of this report suggest that the health of the Wicomico and its tributaries is declining, and that pollution sources impacting water quality remain inadequately controlled.

EPA's Chesapeake Bay Program, the *Chesapeake 2000 Agreement* and other regional initiatives establish a framework for addressing pollution problems in Chesapeake Bay tributaries and can be leveraged to provide guidance in establishing strategies for improving management of pollution sources. Local governments, businesses and citizens who are responsible for land use decisions that impact water quality continue to be in the best position to take action and restore the health of the Wicomico River.

ACKNOWLEDGEMENTS

Wicomico Creek watchers is indebted to the following organizations for their financial, technical and administrative support:

Chesapeake Bay Foundation
Salisbury Area Chamber of Commerce
Salisbury University - Bioenvirons Club
Salisbury University - Biology Department
Salisbury University - Eastern Regional GIS Cooperative
University of Maryland Center for Environmental Science at Horn Point
Wicomico Environmental Trust

Wicomico Creekwatchers would not be possible without the dedication and commitment of Wicomico County residents who have volunteered thousands of hours collecting water samples for the benefit of local water quality and all who are responsible for protecting it. Citizens who participated in the program in 2004/2005 include:

Richard Anderson
Brad Bellacicco
Jan Bellistri
Julia Bozick
Peter Bozick
Clint & Ramona Bradway
Kenny Bruce
Bob Burnett-Kurie
John Cawley
Sharon Clark
Robert Cool
Kathy Cordrey
Richelle Crockett
Anita Crowley
Brenda Dawson
Joe Derbyshire
David Eccleston
Myra Gattis
Earl Johanson
Stacey King
Catherine Laperle
Liz LaPosta
Mike & Cassy Lewis
Charlotte & Tom Lilly
Susanne Lischer
Tom & Nancy Mace
Joan Maloof
Stacy McSherry
George Miller
Terry Monteith
Calvin & Susan Peacock
Lynne & Mac Peverley
Mary Phillips
David Pogge
Christopher Potvin
Tom & Becky Ratliff
Dave Rossi
Tom Seiler
Emily Seldomridge
Dave Sigrist
Mary Stadlebacher
Jenny Starkey
Tina Taylor
Mat Tilghman
Debra Truitt
Christine Walker
Sandra & Clayton Wetzel
Susan Wheatley
Stuart Wikander
Tom Wilkes
Frank & Carol Wills
Chuck Wojciechowski
Pam Workman
William & Judy Wyatt

Appendix 1: Distribution List

City of Salisbury Building, Housing and Zoning Department
City of Salisbury City Council
City of Salisbury Office of the Mayor
City of Salisbury Public Works Department
Congressman Wayne Gilchrest
Delegate Bennett Bozman
Delegate D. Page Elmore
Delegate Norman H. Conway
Delmarva Poultry Industry
Delmarva Water Transport Committee
Friend of the Nanticoke
Great Salisbury Committee
Lower Eastern Shore Tributary Team
Lower Shore Land Trust
Maryland Department of Agriculture
Maryland Department of the Environment
Maryland Department of Natural Resources
Maryland Department of Planning
Nanticoke Watershed Alliance
Nanticoke Watershed Preservation Group
Pemberton Historical Park
Salisbury Area Chamber of Commerce
Salisbury University Biology Department
Salisbury-Wicomico Economic Development, Inc.
Salisbury Zoo
Senator J. Lowell Stoltzfus
Somerset Board of County Commissioners
Somerset County Department of Solid Waste and Drainage
Somerset County Division of Planning and Zoning
Somerset County Economic Development Commission
Somerset County Health Department, Environmental Health
Somerset County Planning Commission
Somerset County Public Library
Somerset County Department of Tourism
The Nature Conservancy Nanticoke Field Office
Tri-County League of Women Voters
Ward Wildfowl Museum of Art
Wicomico County Council
Wicomico County Department of Planning, Zoning and Community Development
Wicomico County Department of Public Works
Wicomico County Department of Parks, Recreation and Tourism
Wicomico County Farm Bureau
Wicomico County Free Library
Wicomico County Health Department, Environmental Health Division
Wicomico County Planning Commission
Wicomico Environmental Trust
University of Maryland Center for Environmental Science
University of Maryland Cooperative Extension Wicomico County
Urban Salisbury

Appendix 2: Sampling Site Description

Site Number	Site Name	Site Location (Lat./Long.)
Johnson's Pond		
1	North Johnson	N38^0 23. 18.7' W75^0 35. 32.1'
2	TV Station	N38^0 23.025' W75^0 34.935'
3	South Johnson	N38^0 22.772' W75^0 35.856'
Lower Wicomico		
4	Port Exchange	N38^0 21. 874' W75^0 36. 382'
5	Parker Pond	N38^0 20. 750' W75^0 32. 832'
6	Schumaker Pond East	N38^0 20. 946' W75^0 33. 795'
7	Schumaker Pond	N38^0 21.106' W75^0 34.207'
8	East Branch Downtown	N38^0 21. 741' W75^0 35. 067'
9	Mitchell Pond West	N38^0 21. 53.4' W75^0 36. 46.9'
10	Mitchell Pond (discontinued 2005)	N38^0 22. 218' W75^0 37. 171'
11	Landfill (discontinued 2005)	N38^0 23. 101' W75^0 38.039'
19	City East Side	N38^0 21. 015' W75^0 37. 133'
20	Shad Point	N38^0 20. 285' W75^0 37.481'
21	Nithsdale	N38^0 20. 480' W75^0 40. 470'
22	Green Hill	N38^0 19. 835' W75^0 44. 166'
23	Geipe	N38^0 18. 02.4' W75^0 45. 31.5'
24	Mount Vernon (discontinued 2005)	N38^0 14. 945' W75^0 49. 886'
25	Shiles Creek	N38^0 16. 286' W75^0 48. 788'
26	Rockawalkin	N38^0 20. 520'

		W75^{0} 40. 811'
27	River Wharf	N38^{0} 21. 540' W75^{0} 36. 150'
28	Whitehaven	N38^{0} 16. 095' W75^{0} 47. 411'

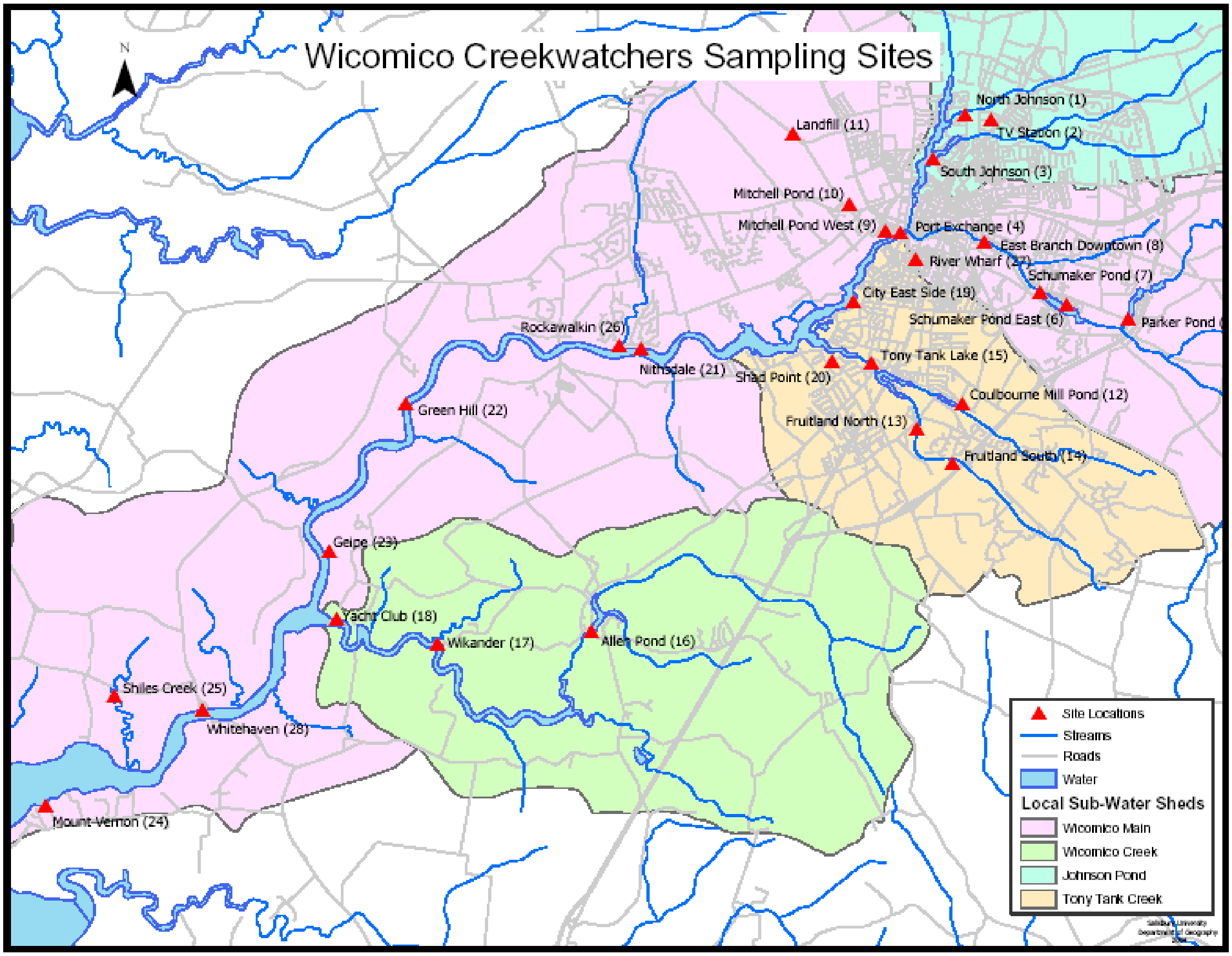
Tonytank Creek

12	Coulbourne Mill Pond	N38^{0} 19. 44.8' W75^{0} 35. 32.8'
13	Fruitland North	N38^{0} 19. 570’ W75^{0} 36. 148’
14	Fruitland South	N38^{0} 19. 00.0' W75^{0} 35. 59.2'
15	Tony Tank Lake	N38^{0} 20. 265' W75^{0} 36. 869'

Wicomico Creek

16	Allen Pond	N38^{0} 17. 00.0' W75^{0} 41. 28.2'
17	Wikander’s	N38^{0} 16. 87' W75^{0} 43. 719'
18	Wicomico Yacht Club	N38^{0} 17.112’ W75^{0} 45.178

<u>Appendix 3</u>: Site Location Map



Appendix 4: Data Sheet

Wicomico Creekwatchers
Water Quality Sampling Data Sheet

Site Number ______ Date: ______ Time: ______

Observers ____

Tide

1	High
2	Middle Falling
3	Low
4	Middle Flooding

Weather

1	Clear
2	Partly Cloudy
3	Overcast
4	Light Rain
5	Rain
6	Heavy Rain
7	Fog
8	Snow

Wind

1	Still
2	Light Wind
3	Medium Wind
4	Heavy Wind

Wind Direction

1	N
2	NE
3	E
4	SE
5	S
6	SW
7	W
8	NW

Water Surface

1	Calm
2	Ripples
3	Choppy
4	Heavy Chop

Rainfall in Previous 48 Hours

1	None
2	Trace
3	Light
4	Moderate
5	Heavy
6	Monsoon

Air Temperature ________

Water Temperature ____________

Secchi Disk Depth _______

Bottomed Out

1	No
2	Yes

Water Sample Bottle Number __________

Observations: ______________________

____

____

____

Appendix 5: Sampling Instructions

Wicomico Creekwatchers
Sampling Instructions

1. **At your sampling site, use the Water Quality Sampling Data Sheet to record the following:**

   - ✓ **Site Number**
   - ✓ **Date**
   - ✓ **Time**
   - ✓ **Observers**
   - ✓ **Tide Conditions**
   - ✓ **Weather Conditions**
   - ✓ **Wind Conditions**
   - ✓ **Wind Direction**
   - ✓ **Water Surface Conditions**
   - ✓ **Rainfall in Previous 48 Hours**

2. **Air Temperature: Use the thermometer to measure the air temperature and record it on the data sheet.**

3. **Water Temperature: Use the thermometer to measure the water temperature and record it on the data sheet. Insert the thermometer just under the water's surface, wait one minute before removing and record the measurement.**

4. **Secchi Disk Depth: Use the secchi disc to measure water clarity. Lower the disc into the water until you can no longer see it. Look away for a moment, then slowly raise the disc to the point where it just becomes visible. Note the mark on the rope closest to the water's surface. Marks are at 3-inch intervals. Record the secchi disk depth in feet and inches on the data sheet.**

   If the disc hits river bottom during lowering and you can still see it, record the secchi disc depth and circle "2 Yes" under "Bottomed Out" on the data sheet. Otherwise circle "1 No."

5. **Water Samples: On the data sheet, record the number located on the water sample bottle. Submerge the bottle 3 inches below the water's surface, top end up, until it fills. Remove the bottle from the river and insert the stopper. IF ANY AIR BUBBLES ARE PRESENT AFTER INSERTING THE STOPPER, EMPTY THE BOTTLE AND REPEAT THE PROCEDURE.**

   After collecting the water sample, bring it and the completed data sheet to CBF's Salisbury Office as soon as possible. Use a cooler or refrigerator to keep water samples cool during transport or short-term storage. When you arrive at CBF, exchange your water sample bottle and data sheet with new ones.

6. **Observations: Note anything you think might be of interest to those compiling and analyzing the data you have collected.**