Talbot County Creekwatchers

WATER QUALITY MONITORING REPORT

2001 – 2003

SUMMARY

Talbot County Creekwatchers is a citizen-based volunteer water quality monitoring organization based in Talbot County on Maryland's Eastern Shore. The mission of *Talbot County Creekwatchers* is to obtain objective, scientifically credible water quality data through the recruitment and mobilization of a grassroots volunteer force. The program engages over 60 volunteers who conduct annual monitoring of 65 sampling locations March through November. Data collection and sampling are on going.

Water quality data collected for Talbot County Rivers is historically sparse and fails to provide a comprehensive, reliable assessment of the health of local waterways. With full-scale sampling beginning in the summer of 1999, *Talbot County Creekwatchers* provides baseline data for identifying water quality conditions and trends over time. Talbot County tributaries for which data is collected include:

- *Broad Creek*
- *Choptank River (Denton to Frazier Pt.)*
- *Harris Creek*
- *Island Creek*
- *LaTrappe Creek*
- *Miles River*
- *Tred Avon River*
- *Wye River*

Data provided in this report can be used to identify river locations that show poor or deteriorating water quality. Long-term trends in river health can be correlated with changes in land use to facilitate decision-making consistent with the development and implementation of local pollution control strategies.

Talbot County Creekwatchers believes that the county's creeks and rivers are its most distinctive and valuable resource. They are of great natural beauty, loved by the community and provide tremendous economic and recreational benefits. Citizens of Talbot County including *Creekwatcher* volunteers are committed to facilitating action that ensures the highest level of water quality possible in these waterways. Data provided in this report is made available to help inform land-use decisions and to enhance water quality protection and restoration efforts.

This report summarizes data generated from on-site measurements and analysis of water samples collected in 2001, 2002 and 2003. It is the second report released by *Talbot County Creekwatchers* since its inception in 1999.

Key findings:

- Data analysis showed substantially poorer water quality in 2003 than in all previous years for which data has been collected.
- Water clarity was poor in all rivers in 2003.

- Acidity (pH) levels in 2003 fluctuated widely outside the healthy range.
- Bay grass populations, which had shown an increase in 2002, were found to be very sparse at best and usually non-existent.
- Oxygen deficiencies continue to persist.
- Areas that receive larger natural flow from the local watershed and have limited tidal flushing from the Bay had the poorest water quality. These include all of the Upper Choptank, headwaters of the Tred Avon River, Miles River, Island Creek, La Trappe Creek and some of the larger tributaries in these rivers, such as Peach Blossom Creek in the Tred Avon River.

METHODS

Talbot County Creekwatchers collects data on water quality conditions in 8 major local river systems: Broad Creek, Choptank River (Denton to Frazier Point), Harris Creek, Island Creek, LaTrappe Creek, Miles River, Tred Avon River and Wye River. More than 60 citizen volunteers monitor 65 sampling locations at two-week intervals, March through November each year.

In 1999, local Talbot County residents working together with scientists and water quality experts identified an equitable distribution of sampling locations based on local knowledge of the watershed. Efforts were made to select locations having water approximately four to eight feet in depth to conform to standard sampling protocol. A map indicating sampling site locations was generated (Appendix 3) and latitude/longitude coordinates were obtained for each site using GPS technology (Appendix 2).

Data collection procedures are standardized. Volunteers are organized into teams responsible for collecting data from the various rivers. Most sampling locations are accessed by boat, which volunteers provide for supporting the program.

Environmental measurements taken at each sampling location include descriptions of tide, weather, wind strength and direction, level of wave action, recent rainfall, and air temperature.

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

Estimates of the presence of underwater grass populations at each sampling location are made by visual observation and, at times, using a small leaf rake to scrape the bottom.

Volunteers also measure several key water quality parameters at each site: acidity (pH), chlorophyll a, dissolved oxygen, salinity, temperature, total nitrogen, and total phosphorus. Participants are trained in sampling protocol and methodology to obtain data that is scientifically verifiable.

Horiba monitoring equipment is used to acquire data on pH, dissolved

oxygen, salinity and temperature. Electronic data collection is replicated at each site for quality assurance.

Based on university guidelines, wet samples are collected, frozen, and delivered to the University of Maryland Center for Environmental Science at Horn Point where they are analyzed for concentrations of chlorophyll a, total nitrogen and total phosphorus.

Unlike the other parameters for which data is collected every other week during sampling season, wet samples are collected monthly, and only at a subset of the sampling locations due to financial limitations. Replicate samples for total nitrogen and phosphorus are analyzed for quality assurance on each of the eight monitored river systems.

RESULTS

Analysis conducted for this report was performed on data collected in 2001, 2002 and 2003. Data comparisons across years help provide perspective on how environmental conditions influence river health over time.

Water Quality Parameters

The Environmental Protection Agency's Chesapeake 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 pH, chlorophyll a, 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. Following is a description of each parameter and its corresponding scientifically accepted "healthy" range. The summary of data outside the "healthy" range indicates the degree to which samples do not meet water quality standards.

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 disruption include stormwater runoff and air deposition of nitric and sulfuric acids discharged by industries, power plants, and automobiles. Since pH is a logarithmic scale, a change of a single unit is actually a 10-fold increase in concentration of unhealthy ions.

	Percent of Samples with pH Outside 6.5 – 8.5
2001	5.1
2002	1.0
2003	13.2

In 2001, unhealthy pH readings occurred most often in spring in the upper reaches of the Miles and Wye Rivers and in Island and La Trappe Creeks. Island Creek, LaTrappe Creek and Broad Creek showed poor pH levels in June of 2002.

The percentage of acidity levels outside the healthy range increased substantially in 2003 to 13.2% of all measurements. Of particular concern was La Trappe Creek where 32% of all readings were above 8.5 and Island Creek where 18% of the readings were high and a maximum of 9.6 was seen. While most unhealthy readings throughout the tributaries occurred above the healthy range, low or acidic conditions were observed in the Choptank River during summer 2003. PH readings as low as 5.5 were recorded and 19.7% of all readings were below 6.5 that year.

Chlorophyll a: Chlorophyll, a naturally occurring pigment found in leaves and plants, is essential to the production of carbohydrates by photosynthesis. In water bodies, chlorophyll can indicate the level of algae that is present. “Chlorophyll a” refers to a specific type of coloring known to be associated with algae and other organisms. A healthy range for chlorophyll a is 30 ug/l or less. *Talbot County Creekwatchers* began sampling for chlorophyll a in 2002.

	Percent of Samples with Chlorophyll a > 30 ug/l
2001	no data
2002	12.9
2003	22.0

Dissolved Oxygen: Dissolved oxygen is essential to all aquatic life. Readings greater than 5 mg/l indicate that sufficient levels of oxygen are present to support aquatic organisms. A common cause of inadequate oxygen is excessive algae production, which consumes oxygen when algae populations die and decompose. Seasonal changes in water salinity and temperature also influence dissolved oxygen levels.

	Percent of Samples with Dissolved Oxygen < 5 mg/l
2001	5.5
2002	3.4
2003	15.8

The Miles River, Tred Avon River, Wye River, and the Upper Choptank were most frequently deficient in healthy dissolved oxygen concentrations in 2001. In 2002, measurements taken in the upper reaches of the Tred Avon River, Miles River and in the Upper Choptank again typically showed low concentrations of dissolved oxygen. In 2003, the percentage of measurements below the healthy limit was 7.2%.

In some instances, impossibly high levels of oxygen were measured (more that 40% above saturation). These occurred when water was observed to be extremely cloudy and appeared to contain excessive amounts of algae. University of Maryland scientists suspect a disruptive interaction between the measuring instrument and the presence of algae populations, causing the false readings. The real oxygen level was actually very low - below the healthy level on 8.6% of measurements. As a result, the data can be interpreted to show a total of 15.8% of samples containing dissolved oxygen levels outside the healthy range in 2003.

Nitrogen and Phosphorus: 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. "Total" nitrogen and phosphorus levels include all values for the various chemical forms of these nutrients (like nitrate and ammonia in the case of nitrogen), accounting for the cumulative effect of nitrogen-based compounds in waterways. Total nitrogen levels should be less than 1.0 mg/l and total phosphorus levels should be less than 0.1 mg/l.

	Percent of Samples with Total Nitrogen > 1.0 mg/l
2001	5.8
2002	3.3
2003	8.5

	Percent of Samples with Total Phosphorus > 0.1 mg/l
2001	2.2
2002	1.5
2003	10.8

Water Clarity: Water clarity measures the ability of light to pass through water. Poor water clarity 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 water clarity includes readings greater than 36 inches.

	Percent of Samples with Water Clarity < 36"
2001	49.0
2002	39.7
2003	67.4

Water clarity was below the healthy standard in nearly half of all measurements in 2001. 100% of samples collected in the Upper Choptank had unhealthy water clarity levels, while Broad Creek and Harris Creek showed the best levels that year.

In 2002, water clarity improved somewhat from previous years but was still unhealthy in over one-third of all measurements. In 2003, water clarity was particularly unhealthy. 67.4% of all measurements did not meet healthy standards. Even Broad Creek, the Talbot tributary most influenced by the Bay's flushing effect, had less than half of its measurements meet the healthy standard. For the second year in a row, no measurements met the healthy standard in the Upper Choptank.

RIVER SUMMARIES

Broad Creek

This tributary is Talbot County's widest and most open. It has a relatively small watershed with little natural flow. It typically has the best water quality.

Broad Creek had a period of high pH levels in March through April of 2003 when 30% of all measurements were above the 8.5 standard. Water clarity in Broad Creek is usually the best of all tributaries and it was again in 2003, but nevertheless, over 38% of all readings were unsatisfactory that year.

Harris Creek

This tributary is longer and narrower than Broad Creek, has a relatively

small watershed with little natural flow, and flushes well to the Bay.

Conditions in Harris Creek are usually better than in other tributaries. Unsatisfactory water clarity in 2001 and 2002 occurred in about 25% of measurements. This percentage increased to 54% in 2003.

Island Creek

Island Creek is long and narrow and has a narrow mouth. The watershed is small and relatively undeveloped.

Levels of pH outside the healthy range were measured in 2001 (5.8% unhealthy), 2002 (7.8% unhealthy) and 2003 (18.2% unhealthy). Water clarity is often poor in this tributary and was unsatisfactory in 2003 with 54% of all measurements showing Secchi disk readings less than 36 inches. There were also high levels of phosphorus and frequent dissolved oxygen levels well above saturation during periods of algae blooms in 2003.

La Trappe Creek

Similar to Island Creek, this tributary is long, narrow, has a narrow outlet and the watershed is small and relatively undeveloped.

Dissolved oxygen levels in La Trappe Creek and in Island Creek were 100% above minimum levels in 2001 and 2002. However, in 2003, La Trappe Creek was found to have unhealthy dissolved oxygen levels in 4.5 % of samples. Also, dissolved oxygen levels indicative of algae blooms and inadequate to support finfish were observed 23.8% of the time. There were also high levels of phosphorus and Chlorophyll a. Water clarity, which had been unhealthy about 50% of the time in 2001 and 2002 jumped to 90% in 2003.

Miles River

The lower reaches of the Miles River are long and broad. The upper reaches are narrow. The Miles has a large watershed with some natural fresh flow. The watershed includes St. Michaels and the discharge from its sewage treatment plant.

In 2001 and 2002, water conditions were generally poor. Low dissolved oxygen concentrations were observed 5% of the time, clarity was unsatisfactory 35 – 49% of the time, and there were several samples showing high nitrogen, high phosphorus and high chlorophyll a levels.

The conditions in 2003 were significantly worse. Dissolved oxygen was inadequate 8.9% of the time and above saturation an additional 7.9% of the time. Also unsatisfactory was clarity (67% unhealthy), nitrogen (7.1% unhealthy), phosphorus (23.6% unhealthy) and chlorophyll a (57.1% unhealthy).

Tred Avon River

The Tred Avon River is long, wide and receives water from several large minor tributaries. Included in the watershed are the towns of Easton and Oxford and the Oxford sewage treatment plant. The watershed is large and some fresh water flows into the headwaters at Easton and into Peach Blossom Creek, one of the Tred Avon's larger tributaries.

In 2001 and 2002, no unhealthy measurements were observed for pH, nitrogen, or phosphorus. There were, however, consistent dissolved oxygen deficiencies and poor water clarity at the headwaters near Easton and Peach Blossom Creek.

A general deterioration was observed in 2003: unhealthy conditions were measured for pH (13.5% unhealthy), phosphorus (10.0% unhealthy), and clarity (73% unhealthy up from 50% in 2002). Algae blooms were common and dissolved oxygen levels well above saturation were measured 19% of the time.

Upper Choptank River

Of the rivers monitored by *Talbot County Creekwatchers*, this is the largest river, with the largest watershed and the most fresh water flow. *Creekwatcher* volunteers take measurements between Denton and Frazier Point (about 16 miles of river). This part of the watershed is largely agricultural. It includes the discharge of the Easton sewage treatment plant. Treated sewage also enters the river from upstream plants at Denton, Ridgley, and Greensboro. Secretary/NewMarket and Cambridge treatment plants are downstream of the monitored area. Salinities in this region are typically 5 to 10 times less than those measured in other Talbot County rivers.

This tributary consistently has the poorest water quality. The results from 2003 were particularly disappointing. Failure rates were as follows: clarity (100% unhealthy), dissolved oxygen (23.8% unhealthy), and nitrogen (78.3% unhealthy). Nitrogen levels averaged greater than twice the standard for this parameter. Surprisingly, however, phosphorus and chlorophyll a were satisfactory.

Since monitoring began on the Choptank in 2001, *Creekwatchers* have made 324 separate measurements for water clarity. Among these, only once has the minimum water clarity of 36 inches ever been observed. The failure rate for clarity for the Upper Choptank is 99.7%.

Acidic conditions were present between June and September, 2003. Over 40% of the measurements during this period were below the healthy standard with pH levels as low as 5.5.

Wye River

The Wye River is a deep and sprawling tributary with a large agricultural watershed and some regular fresh water flow.

Creekwatcher data shows that 2002 produced reasonably good water quality, with the exception of poor water clarity.

In 2001 and 2003, high levels of pH were found in the spring, dissolved oxygen levels were frequently inadequate (up to 12% in 2001), and water clarity was consistently unhealthy reaching 58% in 2003.

CONCLUSIONS

Talbot County Creekwatchers provides the most comprehensive water quality data set known to exist for the Talbot County tributaries on

Maryland's Eastern Shore. In its fifth year of data collection and analysis, the program reveals certain water quality conditions that do not meet accepted standards required for supporting habitat needs of a variety of aquatic organisms.

Poor water clarity is a serious problem of increasing magnitude in Talbot Rivers. High percentages of unhealthy water clarity measurements, particularly in 2003 (67.4%) correlate with the low incidence of underwater grasses as confirmed by *Creekwatcher* observations. The absence of the grasses mean reduced habitat for crabs and finfish. Low water clarity levels are also indicative of high algae concentrations and excessive amounts of suspended sediments. Increasing concentrations of chlorophyll a, a corollary for algae populations, are documented in 2003 at 27.8% unhealthy.

Many of the water quality parameters measured and analyzed in this study showed a substantial increase in unhealthy measurements in 2003 as compared to 2001 and 2002 in particular. Shown in the table below, rainfall in 2003 was significantly higher than normal and almost twice that received in 2002, a particularly dry year.

Through Oct 1	Precipitation (Inches)	Normal (Inches)
2002	24.55	32.38
2003	47.27	32.38

Through Dec 31	Precipitation (Inches)	Normal (Inches)
2002	39.30	41.94
2003	62.66	41.94

The difference in precipitation for the two years is also reflected in water salinity, but not water temperature. (Note: ocean salinity runs between 3.0 and 3.5 %)

	Avg. Salinity (Percent)	Avg. Temp (Celsius)
2001	1.21	21.5
2002	1.28	21.3
2003	0.84	21.3

Water quality conditions are well understood to be influenced by rainfall amounts, as rainwater that reaches the earth's surface flows down hill to the nearest tributary, carrying with it pollutants like sediments that cloud waterways and nitrogen and phosphorus compounds that fuel algae growth in rivers and streams. Nitrogen and phosphorus from agricultural activity, wastewater treatment, urban storm water runoff and other sources are now believed to be the leading cause of the decline in health of the Chesapeake Bay and its tributaries, causing massive algae blooms and habitat loss for a variety of aquatic organisms.

With a relatively dry year in 2002 followed by the wettest on record in 2003, pollution entering rivers and streams is thought to be at record levels, helping explain the increase in unhealthy measurements observed by *Talbot County Creekwatchers*. While it may be easy to blame the weather for declines in river health, consideration must be given to human-caused changes in the ability of the regional landscape to absorb and filter runoff, particularly in years of high rainfall amounts.

As has been continually observed over 5 years of data collection, the headwaters of Talbot County creeks and rivers express significantly poorer water quality than the mouths. Persistently poor upstream water quality conditions suggests that sources of pollution are local, underscoring a need to evaluate the contribution of urban and rural land use activity in the county to the declining health of local waterways. Interpretation of *Creekwacther* data indicates that sources of pollution are within the watersheds of the rivers studied, and in most cases are controllable by citizens and their representatives who live and work in Talbot County.

APPENDIX 1: Distribution List

Bay Hundred Foundation
Chester River Association
Coastal and Watershed Resources Advisory Committee
Delmarva Poultry Industry
Eastern Shore Land Conservancy
Easton Planning & Zoning Department
Easton Public Works Department
Easton Recreation & Parks Department
Easton Town Council
Easton Utilities Commission
JEDSAS Audubon Sanctuary
Maryland Department of the Environment
Maryland House of Delegates
Maryland House of Delegates
Maryland State Senate
Maryland Tributary Strategies Program
Mayor of Easton
Mid-Shore Regional Council
Oxford Town Commissioners
Pickering Creek Audubon Center
St. Michaels Commissioners
Talbot County Council
Talbot County Farm Bureau
Talbot County Free Library
Talbot County Free Library St. Michaels Branch
Talbot County Health Department
Talbot County Office of Economic Development
Talbot County Parks & Recreation
Talbot County Planning and Zoning
Talbot County Public Works
Talbot Preservation Alliance
Talbot River Protection Association
Talbot Soil Conservation District
Trappe Landing Farm and Native Sanctuary
Trappe Town Council
United States House of Representatives
United States Senate
United States Senate
University of Maryland Center for Environmental Science
University of Maryland Cooperative Extension Talbot County

APPENDIX 2: Sampling Sites

Site Code	General Location	Site Latitude	Site Longitude	Site Description
	Broad Creek			
bc01	Broad Creek	N38 48.214	W076 14.662	Farthest North
bc02	Broad Creek	N38 47.779	W076 14.970	2nd point south of BC01
bc03	Broad Creek	N38 46.781	W076 15.313	Just downstream of Mt. Pleasant
bc04	San Domingo Ck	N38 46.734	W076 13.706	Near St. Michaels where creek turns south
bc05	San Domingo Ck	discontinued		Red #6
bc06	San Domingo Ck	N38 46.035	W076 13.620	Where branch goes east
bc07	Grace Creek	N38 45.589	W076 15.800	Green #5
bc08	Leadenham Creek	N38 44.588	W076 16.442	Upstream at mouth of Caulk Cove on right
bc09	Edge Creek	N38 43.970	W076 11.890	Upstream intersection w/mouth of Solitude Creek
bc10	Edge Creek	N38 44.090	W076 13.042	Mouth of Elberts Cove
bc11	Balls Creek	N38 43.669	W076 16.749	Upstream 1st cove on right
bc12	Irish Creek	N38 42.500	W076 12.700	Red #4
bc13	Mulberry Point	N38 44.909	W076 14.475	
bc14	Broad Creek			Replicate of BC02
	Harris Creek			
hc01	Northeast Branch	N38 48.600	W076 17.300	Upstream 2nd cove on left; Sans Souci pier
hc02	Northwest Branch	N38 38.000	W076 16.700	Upstream 1st cove on left; Stewart dock
hc03	Harris Creek	N38 46.300	W076 16.600	Cove near Bozman; private dock
hc04	Cummings Creek	N38 47.500	W076 17.900	Launch ramp
hc05	Harris Creek	N38 46.800	W076 17.300	Off Seawell Point - private pier
hc06	Rabbit Point	discontinued		Opposite Bozman; Somerville dock
hc07	Water Hole Cove	N38 45.500	W076 18.800	Sherwood town dock
hc08	Dun Cove	N38 44.200	W076 19.500	Dederbeck dock - 2nd cove on right
hc09	Knapps Narrows	N38 42.500	W076 19.800	Tilghman-on-Chesapeake dock - red #6
hc10	Change Point	N38 42.800	W076 18.400	Flashing #2
hc11	Blackwalnut Cove	N38 41.000	W076 20.000	Inside Harbor; town dock
hc12	Blackwalnut Cove	discontinued		Entrance to Cove; flashing green
hc13	Northeast Branch			Replicate of HC01
	Island Creek and LaTrappe Creeks			
li01	Island Creek	N38 40.655	W076 06.447	Upstream where creek forks -Private Dock
li02	Island Creek	discontinued		Opposite 3rd cove on right;Private dock
li03	Island Creek	N38 40.143	W076 08.001	East shore between 2nd & 3rd coves -Private dock
li04a	Island Creek	N38 39.694	W076 08.862	Inside 1st point on east shore - Private dock
li05	Boone Creek	discontinued		Mouth, west shore; Private dock
li06	Trappe Creek	N38 39.099	W076 05.639	Upstream at mouth of cove past Connolly Cove
li07	Trappe Creek	N38 38.655	W076 06.651	Entrance to Sawmill Cove
li08	Trappe Creek	N38 38.187	W076 06.524	300' west of duck blind (south shore) off 1st cove east
li09	Island Creek			Replicate of LI01
	Miles River			
mr01	Glebe Creek	N38 47.607	W076 06.886	Upstream 2nd cove on right
mr02	Goldsborough Ck	N38 48.571	W076 06.455	Upstream 2nd cove on left
mr03	Miles River	N38 49.310	W076 07.427	Upstream from Gully Cove at Black Duck Cove on right
mr04	Miles River	N38 47.679	W076 07.694	Near drawbridge on left
mr05	Red #8	N38 46.831	W076 08.781	
mr06	MEBA Cove	N38 46.372	W076 08.972	Mouth
mr07	Oak Creek	N38 45.265	W076 10.403	Near bridge on right
mr08	Hunting Creek	N38 47.289	W076 10.542	Upstream from Long Point, Cove on right where creek turns right
mr09	Spencer Creek			Upstream inside mouth on right
mr10	St. Michaels	N38 47.123	W076 12.581	Parrott Point Waste Water Outflow
mr11	St. Michaels	N38 47.023	W076 13.142	End of Chew St.
mr12	St. Michaels	N38 47.302	W076 13.183	CBMM
mr13	Long Haul Creek	N38 48.313	W076 13.357	Upstream off 1st cove on right
mr14	Leeds Creek			Downstream Tunis Mills Bridge
mr15	Leeds Creek	N38 48.357	W076 11.714	Fairview Point
mr16	Hambleton Cove	N38 49.176	W076 13.876	
mr17	Goldsborough Ck			Replicate of MR02
	Tred Avon River			
ta01	North Fork	N38 46.302	W076 05.581	North Fork at Rt.33 culvert
ta02	Papermill Pd	N38 45.985	W076 05.644	South Fork at Rt.333 culvert
ta03	Dixson Creek	N38 45.888	W076 06.837	Upstream to Large Creek on right
ta04	Tred Avon River	N38 45.519	W076 07.109	Mouth of Dixson and Shiphead Creeks
ta05	Peachblossom Ck	N38 44.064	W076 05.415	Upstream of Rt.333 bridge

Site Code	General Location	Site Latitude	Site Longitude	Site Description
ta06	Peachblossom Ck	N38 44.062	W076 07.135	Mouth
ta07	Maximore Creek	N38 44.299	W076 08.297	Upstream from Long Point on left
ta08	Trippe Creek	N38 42.662	W076 06.285	End of creek, northern branch, by Canterbury
ta09	reserved for future			Upstream 3rd large cove on right
ta10	Pirates Cove	N38 42.458	W076 07.463	Entrance
ta11	Plaindealing Creek	N38 42.662	W076 06.285	Mouth
ta12	Town Creek	N38 41.849	W076 10.046	Mouth near Oxford
ta13	Goldsborough Ck	N38 41.828	W076 08.669	Outside 1st cove on right
ta14	Tred Avon Creek	N38 42.546	W076 08.405	Entrance to Trippe Creek - green #1
ta15	Bellevue	N38 42.566	W076 10.554	Entrance to Tarr Creek - first cove above ferry slip
ta16	Town Creek	N38 41.158	W076 10.148	Headwaters - right of green #13
ta17	Tred Avon River			Replicate of TA02
	Choptank River			
uc01	Denton Water Park	N38 53.329	W075 50.252	Right of boat ramp
uc02	Tuckahoe Ramp	N38 43.896	W075 54.056	boat ramp beside rte 328highway bridge
uc03	Ganey's Wharf	discontinued		End of long wharf
uc04	Private dock	N38 47.757	W075 56.035	High Banks
uc05	Kings Creek Bridge	N38 47.537	W075 58.528	Middle of Bridge over Kings Creek
uc06	Dover Bridge	N38 45.457	W075 59.876	Cement Abutement at Dover Rd
uc07	Choptank Marina	discontinued		End of Wharf
uc08	Frazier Point	N38 42.553	W076 59.571	Private dock at end of Frazier Point Lane
uc09	Private dock			Replicate of UC04
uc15	Bolingbroke Creek	N38 37.400	W076 01.400	Head of crrek at Moneymake Rd bridge
uc16	Bolingbroke Creek	N38 35.800	W076 01.900	Private Dock at mid creek
uc17	Miles Creek	N38 40.900	W076 00.200	Bruceville Rd bridge over Creek
	Wye River			
wr01	Wye Mills	N38 53.310	W076 05.430	Mouth of Mill Creek
wr02	Wye Landing	N38 53.460	W076 06.230	Downstream from Launching Ramp
wr03	Wye River	N38 52.060	W076 06.580	Second Point Upstream from Pickering Creek on Right
wr04	Pickering Creek	N38 52.460	W076 07.400	Mouth
wr05	Quarter Cove	N38 52.670	W076 09.220	Entrance
wr06	Gross Creek	N38 51.690	W076 09.600	Mouth
wr07	Lloyd Creek	N38 51.330	W076 09.750	Upstream near 2nd point on right
wr08	Shaw Bay	N38 51.250	W076 11.290	Near Bruff Island Isthmus
wr09	Woodland Creek	N38 50.091	W076 11.490	Inside mouth at Narrows
wr10	Porter Creek	N38 48.938	W076 14.292	End of channel on left before marsh
wr11	Claiborne Creek	N38 49.709	W076 15.524	Upstream past 2nd cove on left
wr12	Tilghman Creek	N38 50.153	W076 16.071	Upstream past second cove on left
wr13	Tilghman Point	N38 51.313	W076 14.961	Off outer tip of Rich Neck into Miles River
wr14	Wye Landing			Replicate of wr02


WR12
WR11
WR13
WR5
WR4
WR6
WR7
WR8
WR13
WR12
WR9
WR11
MR14
MR3
MR16
WR10
MR2
HC1
HC2
BC1
MR13
MR15
MR1
BC2
MR8
HC4
MR11
MR10
MR12
MR16
MR5
SOUNDINGS IN FEE
HC5
BC3
BC4
HC6
HC3
BC5
BC6
MR9
TA1
MR6
TA3
TA2
HC7
BC7
TA4
MR7
BC8
BC13
HC8
TA7
TA6
TA5
BC10
BC9
BC11
HC10
HC9
TA11
TA8
BC12
TA15
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L16
L17
L18

APPENDIX 4: Percent of Parameters Outside the Healthy Range

	pH 6.5 - 8.5	Low Oxygen < 5 mg/l	High Oxygen >40% of saturation	Clarity < 36 inches	Total Nitrogen > 1.0 mg/l	Total Phosphorus >0.1 mg/l	Chlorophyll A >30 mg/l
Broad Creek							
2001	1.8%	1.2%	not available	22.5%	0.0%	0.0%	no samples
2002	0.7%	0.0%	not available	9.7%	0.0%	0.0%	0.0%
2003	7.6%	0.7%	3.5%	38.2%	0.0%	7.9%	0.0%
Harris Creek							
2001	2.5%	0.0%	not available	27.3%	0.0%	0.0%	no samples
2002	2.5%	0.7%	not available	24.6%	0.0%	2.3%	12.5%
2003	3.6%	5.4%	0.0%	51.8%	0.0%	4.2%	0.0%
Island Creek							
2001	5.2%	0.0%	not available	42.1%	4.3%	0.0%	no samples
2002	7.8%	0.0%	not available	29.4%	4.3%	0.0%	20.0%
2003	18.2%	2.3%	13.6%	54.5%	0.0%	12.5%	0%
LaTrappe Creek							
2001	7.8%	0.0%	not available	48.0%	0.0%	0.0%	no samples
2002	2.0%	0.0%	not available	50.0%	8.3%	0.0%	0.0%
2003	31.8%	4.5%	23.8%	90.1%	3.8%	8.0%	40.0%
Miles River							
2001	5.4%	6.4%	not available	49.0%	3.8%	5.8%	no samples
2002	0.0%	4.6%	not available	35.2%	0.0%	2.4%	16.7%
2003	5.8%	8.9%	7.9%	67.5%	7.1%	23.6%	57.1%
Tred Avon River							
2001	0.0%	6.3%	not available	54.4%	0.0%	3.8%	no samples
2002	0.0%	3.4%	not available	44.8%	0.0%	0.0%	0.0%
2003	13.5%	3.2%	19.0%	73.8%	1.7%	10.0%	37.5%
Upper Choptank							
2001	5.3%	7.9%	not available	98.7%	73.3%	0.0%	no samples
2002	0.8%	16.9%	not available	100.0%	25.0%	12.5%	44.4%
2003	19.7%	23.8%	0.8%	100.0%	78.3%	4.8%	0.0%
Wye River							
2001	5.3%	12.1%	not available	44.9%	0.0%	3.7%	no samples
2002	0.0%	0.1%	not available	36.6%	4.1%	0.0%	0.0%
2003	15.5%	5.4%	8.8%	58.1%	0.0%	3.3%	28.6%

APPENDIX 5: Percentage of Samples Failing Standards 1999 - 2003

PH

% of Samples < 6.5 and >8.5

	Broad Creek	Harris Creek	Island/La Trappe	Miles River	Tred Avon	Wye River	Upper Choptank	All Tribs
1999	0.0%	0.0%	0.0%	0.0%	0.7%	16.3%	not sampled	1.3%
2000	3.4%	2.4%	20.5%	3.8%	11.3%	32.9%	not sampled	11.7%
2001	1.8%	0.7%	5.9%	5.4%	0.0%	5.3%	5.3%	5.1%
2002	0.7%	2.5%	4.9%	4.6%	0.0%	0.0%	0.8%	1.0%
2003	7.6%	3.6%	25.6%	5.8%	13.5%	15.5%	19.7%	13.2%

Dissolved Oxygen

% of samples < 5 mg/l

	Broad Creek	Harris Creek	Island/La Trappe	Miles River	Tred Avon	Wye River	Upper Choptank	All Tribs
1999	0.0%	0.0%	0.0%	5.1%	2.0%	2.0%	not sampled	1.7%
2000	1.1%	2.4%	1.4%	3.8%	1.8%	5.3%	not sampled	2.7%
2001	1.2%	0.7%	0.0%	6.4%	6.3%	12.1%	7.9%	5.5%
2002	0.0%	0.0%	0.0%	4.6%	3.4%	0.0%	0.8%	3.4%
2003	0.7%	5.4%	1.2%	8.9%	3.2%	5.4%	23.8%	7.2%

Water Clarity

% of samples < 3 feet

	Broad Creek	Harris Creek	Island/La Trappe	Miles River	Tred Avon	Wye River	Upper Choptank	All Tribs
1999	16.2%	20.3%	27.8%	44.7%	32.7%	20.5%	not sampled	26.5%
2000	62.9%	55.4%	63.5%	69.8%	68.4%	73.7%	not sampled	65.9%
2001	22.5%	27.3%	40.5%	49.0%	54.4%	44.9%	98.7%	49.0%
2002	9.7%	24.6%	35.3%	35.2%	44.8%	36.6%	100.0%	39.7%
2003	38.2%	51.8%	87.8%	67.5%	73.8%	58.1%	100.0%	67.4%

APPENDIX 6: Total Nitrogen & Phosphorus, Chlorophyll a, Temperature and Salinity by River and Year

	Total Nitrogen				Total Phosphorus				Chlorophyll A				Temp	Salin
	# of Samp.	Samp. >1.0 mg/l	% >1.0 mg/l	Avg. mg/l	# of Samp.	>0.1 mg/l	>0.1 mg/l	Avg. mg/l	# of Samp.	Samp. >30 ug/l	% >30 ug/l	Avg. mg/l	Avg. C	Avg. %
2001														
Broad Creek	31	0	0.0	0.438	29	0	0.0%	0.013					22.1	1.36
Harris Creek	53	0	0.0	0.369	53	0	0.0%	0.013					20.1	1.39
Island Creek	23	1	4.3	0.448	23	0	0.0%	0.012					19.9	1.32
LaTrappe Creek	23	0	0.0	0.442	23	0	0.0%	0.014					21.3	1.32
Miles River	52	2	3.8	0.387	51	3	5.9%	0.029					21.3	1.32
Tred Avon River	53	0	0.0	0.369	52	2	3.8%	0.018					20.7	1.19
Upper Choptank	16	13	81.3	1.793	16	0	0.0%	0.045					20.4	0.09
Wye River	27	0	0.0	0.406	27	1	3.7%	0.024					24.6	1.24
Sample Average	278	16	5.8	0.478	274	6	2.2%	0.020					21.5	1.21
2002														
Broad Creek	24	0	0.0	0.337	24	0	0.0%	0.012	7	0	0.0%	8.6	20.7	1.58
Harris Creek	43	0	0.0	0.306	43	1	2.3%	0.014	8	1	12.5%	14.4	20.1	1.56
Island Creek	23	1	4.3	0.482	24	0	0.0%	0.017	5	1	20.0%	13.5	21.2	1.54
LaTrappe Creek	24	2	8.3	0.495	24	0	0.0%	0.016	3	0	0.0%	11.3	21.2	1.5
Miles River	44	0	0.0	0.386	42	1	2.4%	0.023	6	1	16.7%	23.9	22.7	1.49
Tred Avon River	47	0	0.0	0.351	43	0	0.0%	0.021	9	0	0.0%	9.2	20.5	1.54
Upper Choptank	16	4	25.0	0.950	16	2	12.5%	0.047	9	0	0.0%	11.9	19.8	0.36
Wye River	49	2	4.1	0.484	45	0	0.0%	0.015	8	4	50.0%	41.6	21.4	1.44
Sample Average	270	9	3.3	0.432	261	4	1.5%	0.019	55	7	12.7%	17.7	21.3	1.28
2003														
Broad Creek	38	0	0.0	0.373	38	3	7.9%	0.026	10	0	0.0%	17.7	21.1	1.04
Harris Creek	24	0	0.0	0.446	24	1	4.2%	0.019	2	0	0.0%	3.6	22.4	0.98
Island Creek	24	0	0.0	0.462	24	3	12.5%	0.041	2	0	0.0%	17.4	21.9	0.92
LaTrappe Creek	26	1	3.8	0.624	25	2	8.0%	0.026	5	2	40.0%	149.2	21.7	0.87
Miles River	56	4	7.1	0.552	55	13	23.6%	0.071	7	4	57.1%	69.4	21.1	0.98
Tred Avon River	60	1	1.7	0.519	60	6	10.0%	0.043	8	3	37.5%	38.0	22.1	0.85
Upper Choptank	23	18	78.3	2.005	21	1	4.8%	0.062	9	0	0.0%	11.6	19.5	0.09
Wye River	30	0	0.0	0.505	30	1	3.3%	0.063	7	2	28.6%	74.9	21.7	0.97
Sample Average	281	24	8.5	0.625	277	30	10.8%	0.046	50	11	22.0%	47.7	21.3	0.84

APPENDIX 7: Average Secchi Disk Depth

	2001	2002	2003	% change 2001 to 2002	% change 2002 to 2003
Broad Creek	4.02	4.53	3.56	11.3%	-21.4%
Harris Creek	4.10	4.01	3.01	-2.2%	-24.9%
Island Creek	3.52	3.81	2.07	7.6%	-45.7%
LaTrappe Creek	3.08	2.86	1.78	-7.7%	-37.8%
Miles River	2.97	3.29	2.22	9.7%	-32.5%
Tred Avon River	2.79	3.57	2.20	21.8%	-38.4%
Upper Choptank	1.45	1.40	1.38	-3.6%	-1.4%
Wye River	3.18	3.56	2.37	10.7%	-33.4%
Overall	3.25	3.42	2.38	5.0%	-30.4%

Creekwatchers Standard > 3 feet