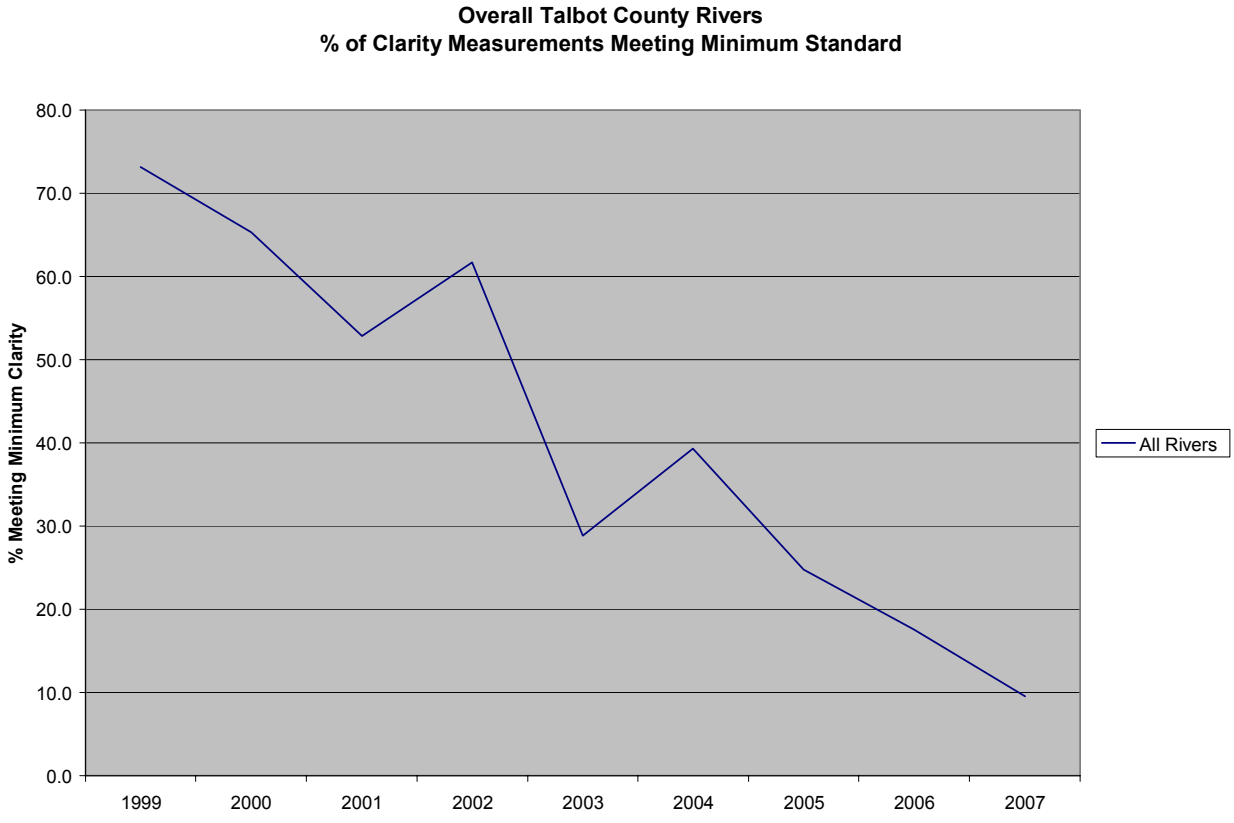
Talbot County
CREEKWATCHERS

Water Quality Monitoring Report

2007



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EXECUTIVE SUMMARY

BACKGROUND

Since 1999, the Talbot County Creekwatchers have monitored the tributaries of Talbot County for water quality. We are a volunteer organization more than 60 members collect water samples at 60 separate, distinct locations monthly from April through October. Each year, the members contribute in excess of 1,000 man hours. Talbot County Creekwatchers are trained to take accurate and reliable samples and data, and our state of the art instrumentation is calibrated and tested before every use. Wet samples for chemical determinations are analyzed by the laboratory at the University of Maryland's Center for Environmental Science at Horn Point, near Cambridge, MD.

Sample and data locations range from the headwaters to the mouths of the several tributaries. Although most monitoring sites are reached by boat, some are accessed from piers.

KEY FINDINGS

- Water Clarity: ***Very poor and continues to decline.***
  As shown with the chart on the cover page, water clarity – the most obvious and easily monitored indicator of overall water quality – shows dramatic and continued decline. When Talbot Creekwatchers started taking data in 1999, over 70percent of all measurements met the standard of greater than 3 feet clarity. This year, only 9.5 percent of measurements met that standard.

- Nitrogen Pollution: ***Increased for the 4th consecutive year to almost 5 times the standard.***

Talbot Creekwatcher Standard for Total Nitrogen <0.200 mg/l	
2007	0.916 mg/l
2006	0.913 mg/l
2005	0.870 mg/l
2004	0.807 mg/l

  Nitrogen levels in the Choptank River were extraordinarily high again this year, averaging averaged 3.115 mg/l in April and 3.420 mg/l in May. They are of particular concern for the fourth consecutive year.

- Phosphorus Pollution: ***Improved from 2006 but continues to be unsatisfactory at double the Talbot Creekwatcher standard.***

Talbot Creekwatcher Standard for Total Phosphorus < 0.0500 mg/l	
2007	0.109 mg/l
2006	0.131 mg/l
2005	0.084 mg/l
2004	0.136 mg/l

- **Oxygen Levels:** ***Substantial periods of inadequate oxygen were again common in most tributaries.*** Talbot Creekwatcher standard >5.0 mg/l
  Of the 740 individual measurements made over the 8 tributaries, only 84.9 percent achieved the minimum level of oxygen needed to support fin fish.

  Of particular note was a period from July 19 to August 16 in the Miles River when 31 samples were taken at 13 different sites on 6 different days and only 3 reached the Talbot Creekwatcher minimum of 5.0 mg/l. The average for the entire month long period was an unhealthy 3.1 mg/l.

  Periods of excessively high oxygen, implying high levels of algae, occurred in several tributaries.
  LaTrappe Creek had two episodes of elevated oxygen, as much as 90 percent above saturation, in early May and early July. In late August, Island Creek reached oxygen levels 35 to 70 percent above saturation. In early August, the Tred Avon had oxygen 30 to 50 percent above saturation.

- **Water Quality:** ***Poorer in the upper reaches of Talbot County waterways.***
  As we have observed every year since the program started, water quality measurements taken near the headwaters of Talbot County tributaries are worse than those collected at or near their mouths. *The data indicates local land uses are a main contributor to the poor water quality in the Talbot County tributaries.*

- **Submerged Aquatic Vegetation:** ***Declined again this year.***
  Only one observation of moderate to dense bay grass was made during the entire sampling season.

  Submerged aquatic vegetation is vital to the health of the Bay as it provides habitat for juvenile fish and crabs, reduces erosion along shorelines, is a source of nutrition for many aquatic creatures, and generates oxygen. Since this vegetation is sensitive to pollution and sediments, its presence is often considered the single best indication of overall water quality.

- **Chlorophyll a:** ***Average level of chlorophyll-a in all tributaries was similar to what has been seen in recent years.***
  Chlorophyll a is usually a good indicator of excessive algae. This year volunteers recorded periods of excessively high levels at several locations. The Wye River, again this year had the highest levels of this parameter. Island Creek, LaTrappe Creek, Miles River, and Tred Avon River also had very high readings. All of these observations occurred at each of the tributary's head waters.

- **pH Measurements:** ***Overall, pH levels in most tributaries were acceptable or excellent.***
  pH levels are directly related to the health of fish and aquatic plant populations. The most common causes of disruption are storm water runoff and air deposition of pollutants formed by emissions from industry, power plants, and automobiles. In Island Creek and LaTrappe Creek measurements were above the maximum of 8.5 in August and September.

RESULTS AND FINDINGS

DISCUSSION OF PARAMETERS

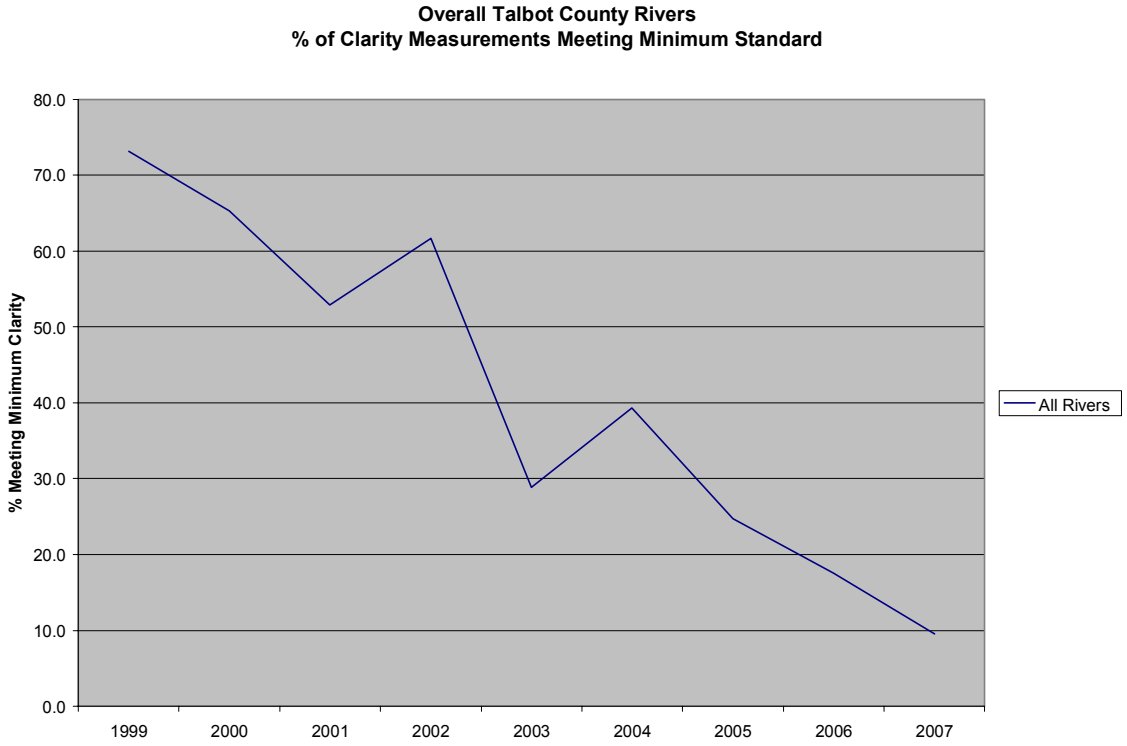
Analysis conducted for this report was performed on data collected between April and October, 2007. Previously collected data by Talbot Creekwatchers from 1999 through 2006 was used to provide perspective over time.

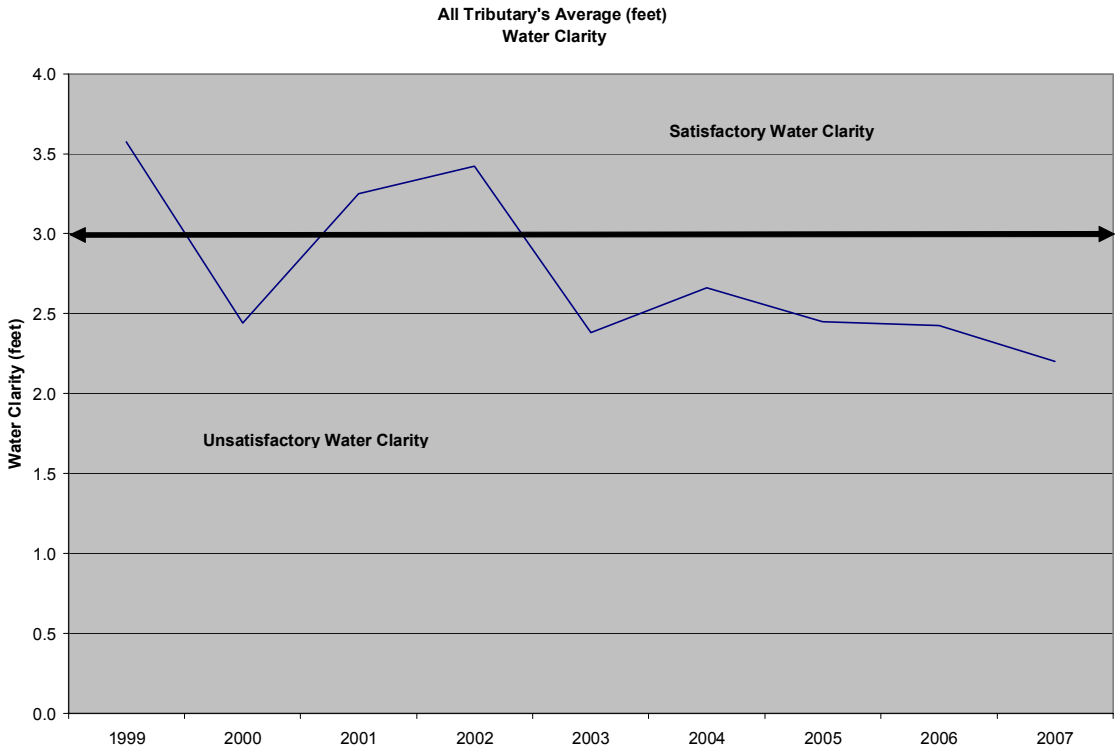
Each water quality parameter measured, and its corresponding scientifically accepted "healthy" range is described below. The summary of data inside the "healthy" range indicates the degree to which samples collected meet water quality benchmarks.

Clarity

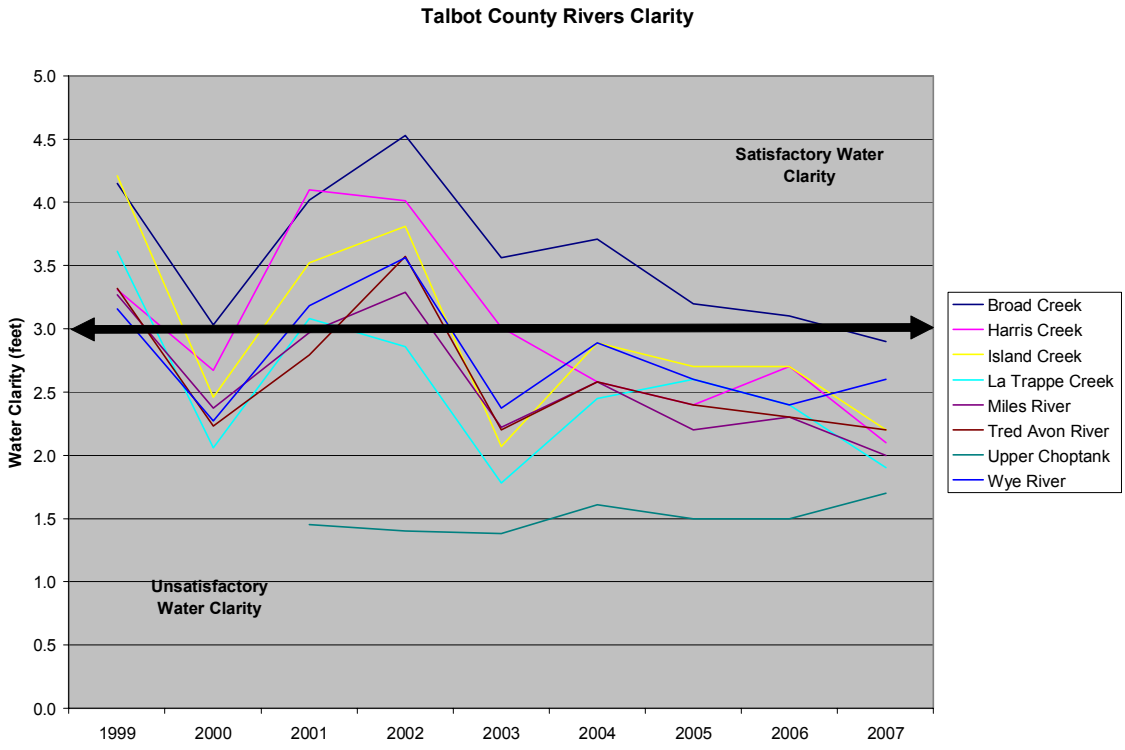
Water clarity, also known as turbidity, measures the ability of light to pass through water. Poor water clarity indicates that water is not clear enough for light to penetrate deeply enough to support the growth of underwater grass populations. The healthy range for water clarity is greater than 3 feet.

Water clarity in Talbot County's tributaries has declined dramatically since Talbot Creekwatchers started collecting data in 1999. At that time, over 70 percent of all measurements indicated healthy turbidity levels; eight years later, in 2007, only 9 percent of all measurements were in the healthy range. During this period, the overall average water clarity depth dropped from a healthy 3.7 feet in 1999 to a very unhealthy 2.2 feet in 2007.





Individual tributary performances are shown below:

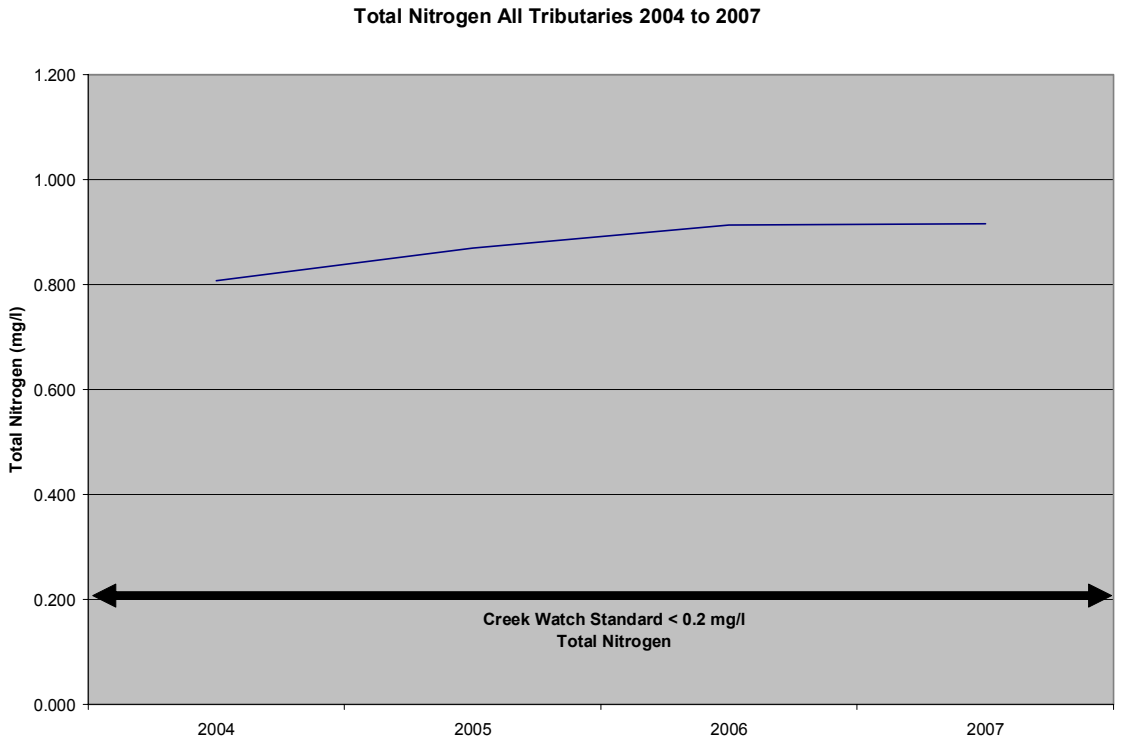


Total Nitrogen

Excess nitrogen promotes aggressive algae growth which in turn clouds water systems, reduces water clarity and inhibits the growth of underwater grasses. When the algae die, its decomposition consumes oxygen and contributes to low oxygen concentrations (also called anoxic conditions or "dead zones") – especially during summer months.

Talbot Creekwatchers have been measuring total nitrogen (dissolved organic nitrogen + dissolved inorganic nitrogen + particulate nitrogen) since 2004. According to researchers, including scientists at the University of Maryland, total nitrogen should be less than 0.2 mg/l in a healthy system.

Talbot County tributaries exhibited four times the healthy level of nitrogen and are getting worse.



Individual tributary data:

Average Nitrogen Level Concentrations in mg/l

Tributary	Total Nitrogen				Dissolved Nitrogen		
	2007	2006	2005	2004	2003	2002	2001
Broad Creek	0.64	0.58	0.62	0.59	0.37	0.34	0.44
Harris Creek	0.69	0.67	0.72	0.78	0.45	0.31	0.37
Island Creek	0.79	0.65	0.65	0.74	0.46	0.48	0.45
LaTrappe Creek	0.90	0.89	0.73	0.76	0.62	0.50	0.44
Miles River	0.93	0.82	0.92	0.77	0.55	0.46	0.39
Tred Avon River	0.77	0.80	0.73	0.84	0.52	0.35	0.37
Upper Choptank	1.65	2.05	1.88	1.29	2.01	0.95	1.79
Wye River	0.86	0.82	0.83	0.98	0.51	0.48	0.41

Results at least 2 fold above standard
Results above standard
Results at standard or better < 0.2 mg/l

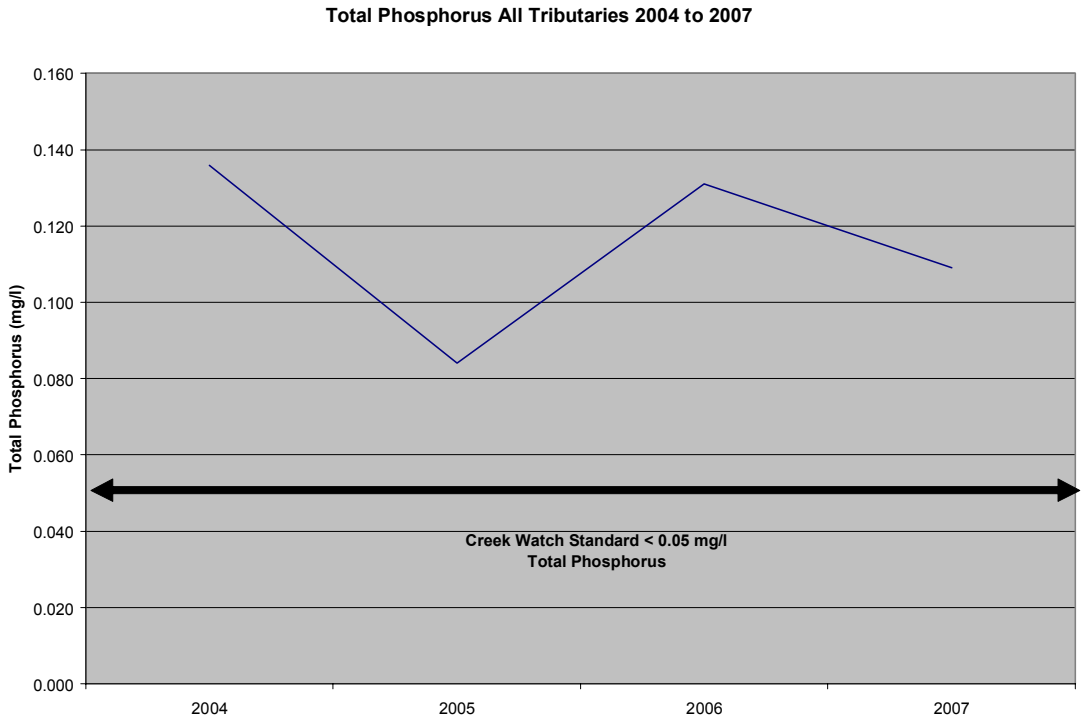
Data for 2001 to 2003 adjusted for total nitrogen

Total Phosphorus

Talbot Creekwatchers has measured total phosphorus (dissolved organic phosphorus + dissolved inorganic phosphorus + particulate phosphorus) since 2004. According to researchers, including scientists at the University of Maryland, total phosphorus should be less than 0.05 mg/l in a healthy system.

As with nitrogen, elevated phosphorus levels can have dramatic effects on life in Chesapeake Bay tributaries. Unlike nitrogen, which tends to be predominately in dissolved form, phosphorus is often bound to sediment particles, causing nutrient enrichment and impacting water quality when high levels of sediment enter waterways.

While well above the healthy level, there is no discernable pattern of increasing phosphorus.



Average Phosphorus Level Concentrations in mg/l

Tributary	Total Phosphorus				Dissolved Phosphorus		
	2007	2006	2005	2004	2003	2002	2001
Broad Creek	0.078	0.165	0.057	0.150	0.026	0.012	0.013
Harris Creek	0.062	0.111	0.062	0.200	0.019	0.014	0.013
Island Creek	0.098	0.069	0.066	0.098	0.041	0.017	0.012
LaTrappe Creek	0.134	0.168	0.076	0.100	0.026	0.016	0.014
Miles River	0.164	0.101	0.126	0.070	0.071	0.023	0.029
Tred Avon River	0.124	0.095	0.071	0.110	0.043	0.021	0.018
Upper Choptank	0.102	0.115	0.120	0.260	0.062	0.047	0.045
Wye River	0.117	0.189	0.102	0.118	0.063	0.015	0.024

Results at least twice the standard
Results above standard
Results at standard or better < 0.05 mg/l

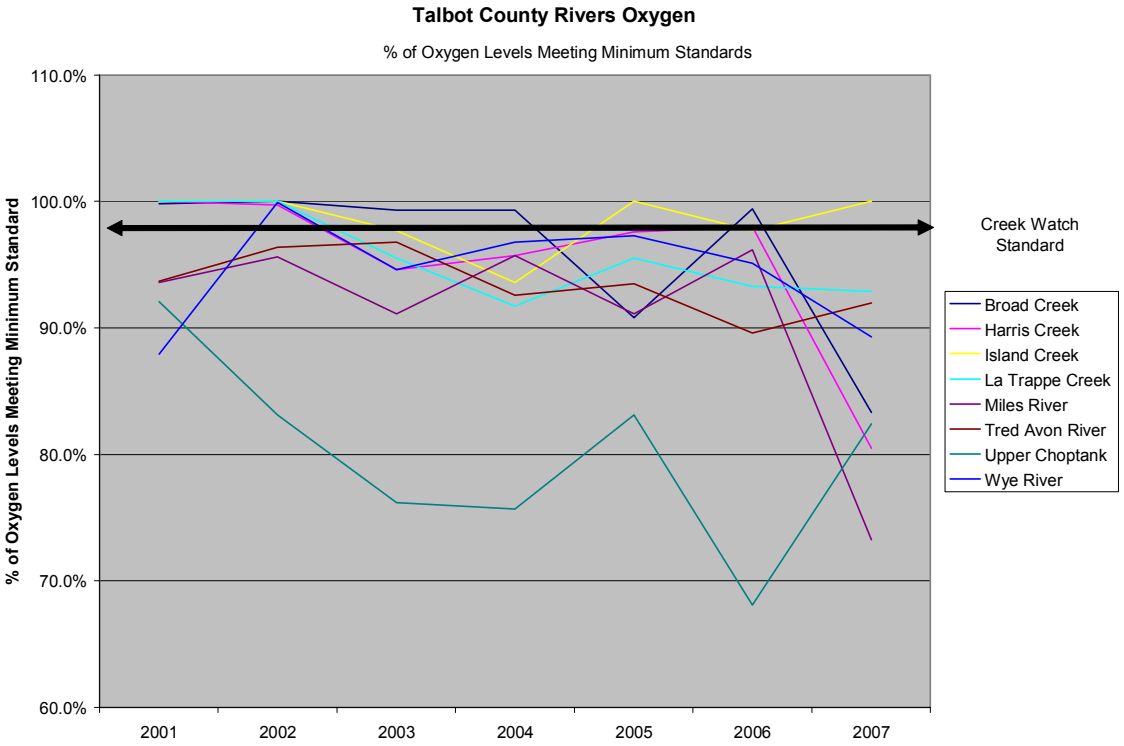
Data for 2001 to 2003 adjusted for total phosphorus

Dissolved Oxygen

Dissolved oxygen is essential to all aquatic life. Excessive algae production, however, can strip water of adequate oxygen levels: algae die off and sink to the river bottom, the bacterial decomposition process consumes large amounts of dissolved oxygen, often resulting in anoxic conditions. Seasonal changes in water salinity and temperature also influence dissolved oxygen levels.

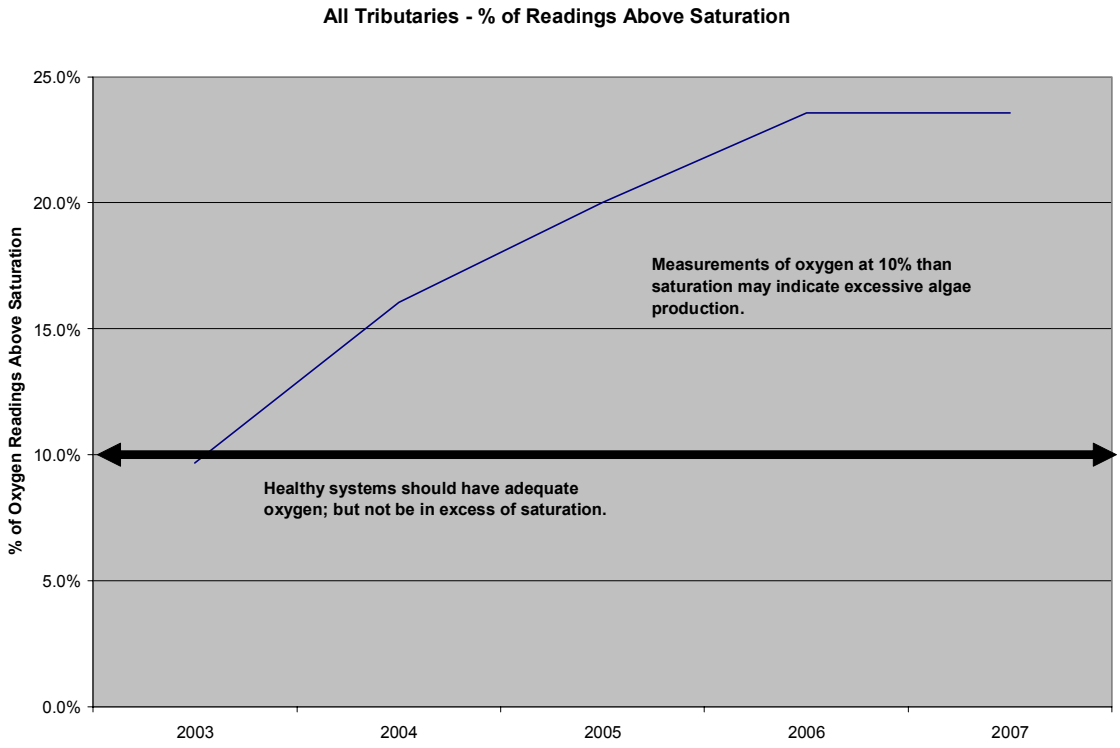
Readings greater than 5 mg/l indicate that sufficient levels of oxygen are present to support aquatic life. Talbot County Creekwatchers measures dissolved oxygen concentrations at a depth of one foot below the water's surface. At greater depths, concentrations of dissolved oxygen often decline. Any measurement below 5 mg/l indicates serious water quality problems and may be dangerous to fish and other aquatic organisms.

As shown below, there has been a general decline in the oxygen content of tributary waters. If less than 98 percent of observations meet the 5 mg/l minimum of oxygen, levels are critically low and Talbot Creekwatchers considers the tributary unhealthy.



Oxygen Levels Above Saturation

Under certain conditions, photosynthesis conducted by the algae population results in higher than normal levels of dissolved oxygen, since algae respiration creates oxygen beyond the point of saturation in surface waters. These conditions were not unusual, occurring in 23 percent of all samples – the same percentage as in 2006. Excess dissolved oxygen levels, beyond the saturation point, may indicate excessive algae production (perhaps an algae bloom) at locations where those samples were collected.



Chlorophyll a

Chlorophyll, the naturally occurring pigment found in leaves and plants, is essential to the production of carbohydrates by photosynthesis. "Chlorophyll a" refers to a specific type of pigment known to be associated with algae and other organisms and, in water bodies, can indicate the level of algae that is present. A healthy range for Chlorophyll a is 15 ug/l or less. Very high levels are indicative of excessive algae.

Chlorophyll a Levels (ug/l)

Tributary	2007	2006	2005	2004		Average
Broad Creek	12.2	12.8	13.9	9.0		12.0
Harris Creek	12.9	14.7	11.7	8.7		12.0
Island Creek	28.2	29.7	23.1	20.8		25.5
LaTrappe Creek	33.4	30.3	29.9	13.2		26.7
Miles River	22.2	24.2	17.8	9.3		18.4
Tred Avon River	21.8	29.7	18.1	48.7		29.6
Upper Choptank	10	9.7	11.4	14.9		11.5
Wye River	39.4	39.1	34.5	57.5		42.6
overall average	23.5	23.8	20.1	22.8		22.3
Results more than twice the standard						
Results above standard						
Results at standard or better						
Chlorophyll a Levels by River - Talbot Creekwatcher Standard - < 15 ug/l						

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 are storm water runoff and air deposition of pollutants formed by emissions from industry, 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.

Both Island Creek and LaTrappe Creek had higher than healthy pH measurements in August and September. The specific source of run off within their watersheds is unknown.

	Percent (%) of pH measurements within standards							
Tributary	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**	**2001**	**Average**
Broad Creek	93.8	96.8	93.9	100.0	92.4	99.3	98.2	96.3
Harris Creek	100.0	100.0	100.0	93.5	94.6	99.3	100.0	98.2
Island Creek	80.5	100.0	94.5	100.0	95.5	100.0	100.0	95.8
LaTrappe Creek	80.5	100.0	93.2	95.8	95.5	100.0	100.0	95.0
Miles River	95.8	94.0	97.9	100.0	91.1	95.4	93.6	95.4
Tred Avon River	100.0	92.0	91.9	100.0	96.8	96.6	93.7	95.9
Upper Choptank	100.0	98.6	98.7	95.5	76.2	83.1	92.1	92.0
Wye River	90.1	91.1	93.3	100.0	94.6	90.0	87.9	92.4

Less than 90% healthy
Less than 95% healthy
Over 95% healthy

Acidity Standard is a pH between 6.5 and 8.5

Underwater or Submerged Grasses

The abundant presence of underwater grass is a good indicator of a healthy tributary. Talbot Creekwatchers observe the presence or absence of grasses by looking into the water at sample locations and collecting grasses from the bottom. Observations are characterized as "none," "very sparse," "sparse," "moderate," or "heavy." Any observation of moderate or better is considered a positive. Since all measurements are made in 4 to 8 feet of water, we would expect that grasses could be present. At the volunteer's discretion, observations may be made in nearby shallows where conditions may be better.

As shown below, the underwater or submerged grasses continue to be minimal in several waterways.

Submerged Bay Grass Observations

	Percent (%) positive observations			
Tributary	**2007**	**2006**	**2005**	**2004**
Broad Creek	0.0	10.5	28.1	3.7
Harris Creek	0.0	7.9	0.0	0.0
Island Creek	no data	no data	0*	no data
LaTrappe Creek	no data	no data	0*	no data
Miles River	0.0	0.0	6.7*	1.9
Tred Avon River	0.0	0.0	0.0	0.0
Upper Choptank	0.0	0.0	0.0	0.0
Wye River	8.3	4.5	2.9	0.0
Average	0.8	3.6	7.2	1.0

*a very low number of observations

Upstream vs. Downstream

In every previous report, as in this one, Talbot Creekwatchers determined that water quality at the headwaters was poorer than at the mouths of the tributary. This is due to the apparent poor quality of land-based runoff in the watershed.

The impact of runoff is most apparent in the clarity observations, nitrogen levels, phosphorus levels and Chlorophyll a measurements, where both the depth of clear water and the percentage of healthy measurements are markedly better at downstream locations.

Those tributaries with the largest watersheds have the worst water quality at their headwaters. These are the Choptank River, Tred Avon River and Miles River. The Upper Choptank has, by far, the largest watershed and natural flow. It consistently has the poorest water quality as can be seen in the chart below.

2007 Upstream versus Downstream

	Average Dissolved Oxygen (mg/l)	Healthy Dissolved Oxygen (%)	Clarity (Feet)	Healthy Clarity (%)	Total Nitrogen (mg/l)	Total Phosphorus (Mg/l)	Chlorophyll A (ug/l)
Healthy =	**> 5.0 mg/l**		**>3.0 feet**		**<0.2 mg/l**	**<0.05 mg/l**	**<15 ug/l**
Broad Creek							
Upstream (sites1-4, 15)	7.0	75.7	2.8	25.6	0.627	0.091	12.2
Downstream (site13)	7.3	85.7	3.6	57.1	0.606	0.050	
Harris Creek							
Upstream (sites 1, 2 & 14)	6.7	85.7	2.1	14.3	0.709	0.071	12.9
Downstream (sites9&10)	7.3	100.0	2.2	0.0	0.661	0.058	
Island Creek							
Upstream (site 1)	8.3	100.0	1.8	0.0	0.951	0.143	28.2
Downstream (site 4a)	9.0	100.0	2.8	25.0	0.628	0.055	
LaTrappe Creek							
Upstream (site 6)	8.5	83.3	1.7	0.0	1.271	0.165	33.4
Downstream (site 8)	9.3	100.0	2.2	0.0	0.721	0.067	
Miles River							
Upstream (sites 1&2)	7.0	75.0	1.3	0.0	1.086	0.185	19.0
Downstream(sites10,11,12)	6.2	65.4	2.7	23.1	0.715	0.084	25.2
Tred Avon River							
Upstream (sites 1&2)	7.5	85.7	1.8	5.7	0.866	0.131	25.4
Downstream (sites 12 & 14)	8.0	94.1	2.8	29.3	0.682	0.109	14.5
Wye River							
Upstream (sites 1&2)	8.1	88.0	1.8	0.0	1.096	0.193	55.2
Downstream (site 8)	7.3	84.6	3.4	46.2	0.761	0.080	25.9
Upper Choptank	6.3	82.4	1.9	2.9	1.683	0.103	10.0

RiVER GRADES

GRADING SYSTEM

Most of the parameters — water clarity, dissolved oxygen, total nitrogen, total phosphorus, pH and Chlorophyll a — are so elemental to good water quality that Talbot Creekwatchers considers anything below a 90% healthy level to be unsatisfactory. These are the parameters that residents of Talbot County control, with our action or inaction within the watershed.

River Summary Grading System	
Range of Data % Inside Healthy Range	**Grade**
95 - 100%	Excellent
90.0 - 94.9%	Acceptable
Less than 90%	Unsatisfactory

GRADES BY RIVER

Broad Creek Grade: Poor

This creek is Talbot County's widest and most open tributary. It has a relatively small watershed with little natural flow. It typically has better water quality than other Talbot County rivers and creeks. However, in 2007, the water quality did not achieve minimal acceptability. Last year Broad Creek had adequate levels of oxygen. This year, only 83.3% of the measurements indicate there was enough dissolved oxygen for fin fish.

Broad Creek 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**25.7**	**Unsatisfactory**
Total Nitrogen	**2.4**	**Unsatisfactory**
Total Phosphorus	**37.5**	**Unsatisfactory**
Dissolved Oxygen	**83.3**	**Unsatisfactory**
Dissolved Oxygen Saturation	**81.9**	**Unsatisfactory**
Acidity (pH)	**93.8**	**Acceptable**
Chlorophyll a	**71.4**	**Unsatisfactory**
Underwater Grasses	**0.0**	**Unsatisfactory**

Harris Creek Grade: Poor

This tributary is longer and narrower than neighboring Broad Creek and has a relatively small watershed with little natural flow.

In 2006, like Broad Creek, this tributary was graded as Fair/Poor. Conditions deteriorated from last year with significant reductions in water clarity, oxygen solubility and nitrogen concentrations. In fact, the only clarity measurements that met Talbot Creekwatcher standards were seen in April. On the positive side, Chlorophyll a measurements were the best of all the tributaries.

Harris Creek 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**4.8**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**32.0**	**Unsatisfactory**
Dissolved Oxygen	**80.5**	**Unsatisfactory**
Dissolved Oxygen Saturation	**80.0**	**Unsatisfactory**
Acidity (pH)	**100.0**	**Excellent**
Chlorophyll a	**85.7**	**Unsatisfactory**
Underwater Grasses	**0.0**	**Unsatisfactory**

Miles River Grade: Poor

The lower reaches of the Miles River are long and broad. The upper reaches are narrow. This river has a large watershed that includes the town of St. Michaels. It has some natural fresh flow and is the receiving water body for the discharge from its sewage treatment plant.

The Miles River is graded as poor this year – the same grade as in 2006. Unfortunately for aquatic organisms, this year's oxygen levels are substantially lower than in 2006 with only 73.3 percent of measurements meeting minimum concentrations, down from 96.2 percent last year. This includes very low oxygen seen from mid June to mid July. Excessive Chlorophyll a was observed in April and May.

Miles River 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**6.7**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**5.5**	**Unsatisfactory**
Dissolved Oxygen	**73.2**	**Unsatisfactory**
Dissolved Oxygen Saturation	**82.1**	**Unsatisfactory**
Acidity (pH)	**95.8**	**Excellent**
Chlorophyll a	**21.4**	**Unsatisfactory**
Underwater Grasses	**0.0**	**Unsatisfactory**

Tred Avon River Grade: Poor

The Tred Avon River watershed includes the town of Easton and the growing Cook's Hope community on the Peachblossum River tributary. The discharge from the Easton and Oxford wastewater treatment plants flow into this river.

Conditions in this tributary are poor, similar to what Talbot Creekwatchers observed in 2006. High levels of Chlorophyll a were seen from April through August at the headwaters near Easton Point.

Tred Avon River 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**10.5**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**8.8**	**Unsatisfactory**
Dissolved Oxygen	**92.0**	**Acceptable**
Dissolved Oxygen Saturation	**74.4**	**Unsatisfactory**
Acidity (pH)	**100.0**	**Excellent**
Chlorophyll a	**38.5**	**Unsatisfactory**
Underwater Grasses	**0.0**	**Unsatisfactory**

Wye River Grade: Poor

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

Conditions in the Wye River are poor and similar to what was observed in 2006. From April to September, very high levels of Chlorophyll a – up to 116.3 ug/l – were seen at the sampling site near Wye Landing.

Wye River 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**19.0**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**3.6**	**Unsatisfactory**
Dissolved Oxygen	**89.3**	**Unsatisfactory**
Dissolved Oxygen Saturation	**78.5**	**Unsatisfactory**
Acidity (pH)	**90.1**	**Acceptable**
Chlorophyll A	**50.0**	**Unsatisfactory**
Underwater Grasses	**15.3**	**Unsatisfactory**

Island Creek Grade: Poor

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

Island Creek has the positive distinction of meeting minimum oxygen concentrations for every measurement. However, excessively high pH levels in August and September, periods of high oxygen (well above saturation), high Chlorophyll a readings, and very poor water clarity mean that this tributary is rated as poor – as it was last year.

Island Creek 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**9.5**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**25.0**	**Unsatisfactory**
Dissolved Oxygen	**100.0**	**Excellent**
Dissolved Oxygen Saturation	**59.5**	**Unsatisfactory**
Acidity (pH)	**80.5**	**Unsatisfactory**
Chlorophyll a	**33.3**	**Unsatisfactory**
Underwater Grasses	**Insufficient Sampling**	

LaTrappe Creek Grade: Poor

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

LaTrappe Creek experienced very high levels of oxygen, above saturation, during April, May and June, indicative of excessive algae. At the same time, as might be expected, the Chlorophyll a levels were also above Talbot Creekwatcher standards. The tributary also had high pH measurements in August and September.

LaTrappe Creek 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**0.0**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**5.6**	**Unsatisfactory**
Dissolved Oxygen	**92.9**	**Acceptable**
Dissolved Oxygen Saturation	**54.8**	**Unsatisfactory**
Acidity (pH)	**80.5**	**Unsatisfactory**
Chlorophyll a	**16.7**	**Unsatisfactory**
Underwater Grasses	**Insufficient Sampling**	

Upper Choptank River Grade: Very Poor

The Upper Choptank has a large, predominantly agricultural watershed and substantial freshwater flow. It receives the discharge of the Easton sewage treatment plant as well as from the upstream plants at Denton, Ridgley, and Greensboro, and the downstream plants of Secretary, East New Market, and Cambridge.

Because of the substantial fresh water flow, salinities in this region are typically 5 to 10 times less than those measured in other Talbot County rivers. The upper reaches, while tidal, are not flushed nearly as well as the other Talbot County tributaries with much less natural flow.

While still very unsatisfactory, there seems to be a modest improvement in water quality in 2007. Total nitrogen, in 2007, averaged 1.653 mg/l. This is over eight times higher than the Talbot Creekwatcher standard; but is below the 2.051 mg/l from 2006.

Not a single measurement recorded water clarity greater than 3 feet; but the average of all observations was 1.7 feet – better than recent year's measurements of 1.2 - 1.5 feet.

Upper Choptank River 2007		
Parameter	**% Inside Healthy Range**	**Grade**
Water Clarity	**0.0**	**Unsatisfactory**
Total Nitrogen	**0.0**	**Unsatisfactory**
Total Phosphorus	**0.0**	**Unsatisfactory**
Dissolved Oxygen	**82.4**	**Unsatisfactory**
Dissolved Oxygen Saturation	**100.0**	**Excellent**
Acidity (pH)	**100.0**	**Excellent**
Chlorophyll a	**83.3**	**Unsatisfactory**
Underwater Grasses	**0.0**	**Unsatisfactory**

METHODS

Prior to 1999, water quality data collected for Talbot County Rivers was historically sparse and failed to provide a comprehensive, reliable assessment of the health of local waterways. In 1999, full scale sampling began allowing Talbot County Creekwatchers to provide baseline data for identifying water quality conditions and trends over time.

Talbot County Creekwatchers trains volunteers in sampling protocol and methodology those results in scientifically verifiable data. Sampling volunteers use Horiba monitoring equipment to measure several key water quality parameters at each site: acidity (pH), Chlorophyll a, dissolved oxygen, salinity, temperature, total nitrogen, total phosphorus, presence of underwater grasses, and water clarity. All instruments are tested and calibrated before each use.

Based on university guidelines, wet samples are collected and delivered to the University of Maryland Center for Environmental Science, Horn Point Laboratory 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 at a subset of the sampling locations.

Because the amount of Chlorophyll a present in a sample can change – the phytoplankton can continue to live and grow inside the sample bottle unless the sample is kept very cold - a special team was established in 2004 to collect all Chlorophyll a samples, county-wide, keep them very cold, and then deliver them immediately to Horn Point Laboratory where they could be frozen and analyzed.

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 by using a long handle leaf rake to scrape the bottom. Observations about the presence of underwater grasses are recorded as heavy, moderate, sparse, very sparse, or none.

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

WATER QUALITY PARAMETERS

The U.S. 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 pH, Chlorophyll-a, dissolved oxygen, total nitrogen, total phosphorus, and water clarity. In general, water quality parameters are often influenced by wastewater treatment and industrial discharges, air pollution, run-off from agricultural activities, urban storm water, and other human-based sources.

NUTRIENT CRITERIA

Though essential to all Bay life, nitrogen and phosphorus in excessive levels are the most damaging pollutants in the Chesapeake. Both 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 during the decomposition process. Some naturally occurring algae may be toxic or have toxic stages in their life cycles.

Human-based sources of nitrogen and phosphorus are the primary cause of most water quality problems in the Bay. However, 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 nitrogen and phosphorus by establishing criteria for high chlorophyll levels from algal blooms, low water clarity due to excess algae or erosion, and low dissolved oxygen due to decay of excess algae in bottom waters. EPA uses these criteria (chlorophyll, water clarity, dissolved oxygen) to indicate "impaired waters," which supports a process to determine limits (also known as Total Maximum Daily Loads or TMDLs), for pollutants like nitrogen and phosphorus. TMDLs define the amount of specific pollutants 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 the 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 University of Maryland Center for Environmental Science, Talbot County Creekwatchers establishes a conservative benchmark for healthy levels of total nitrogen at 0.2 mg/l and total phosphorus at 0.05 mg/l in the 2004 sampling year. These figures replace the 1.0 mg/l (total dissolved inorganic nitrogen) and 0.1 mg/l (total dissolved inorganic phosphorus) benchmarks used by Talbot County Creekwatchers in previous years. Analysis of data collected in earlier years was adjusted to reflect this recommendation.

CONCLUSIONS

As has been continually observed since 1999, the headwaters of Talbot County creeks and rivers exhibit significantly poorer water quality than the mouths. Persistently poor upstream water quality conditions suggest that sources of pollution are local, underscoring a need to evaluate the connection of urban and rural land-use activity to the declining health of local waterways. Interpretation of Talbot Creekwatcher data indicates that sources of pollution are within the watersheds of each of the rivers studied, and in most cases are controllable by the citizens and leaders who live and work in Talbot County.

Nitrogen and Phosphorus pollution in Chesapeake Bay tributaries is widely regarded as the leading cause of habitat decline in the Chesapeake Bay. Nutrients including nitrogen and phosphorus are well documented to cause algae blooms and the related declines in dissolved oxygen and water clarity conditions that aquatic organisms depend on for survival.

The absence of clearly defined nutrient criteria reduces the ability of citizens and their representatives in government to make clear connections between nutrient pollution in tributaries and human-based sources of nitrogen and phosphorus pollution in local watersheds.

Now with over nine years of data on Talbot County tributary nutrient levels and other water quality indicators, Talbot County Creekwatchers help the land use decision-making process by reporting on current water quality conditions and trends over time. Data and analysis published in this report can be used to help build accountability when land use decisions, known to generate nutrient pollution and have local water quality impacts, are anticipated.

ACKNOWLEDGEMENTS

Talbot County Creekwatchers is in gratitude to the following organizations for their financial and technical support:

Chesapeake Bay Foundation
Chesapeake Bay Maritime Museum
Talbot River Protection Association
University of Maryland Center for Environmental Science - Horn Point Laboratory

All labor to collect and deliver samples, manage data, operate boats, and repair and calibrate instruments is provided by citizen volunteers, most of who live in Talbot County. In 2007, volunteers visited our 60+ sampling locations on over 700 occasions.

Financial support for laboratory analysis and equipment maintenance and repair is provided by the Chesapeake Bay Foundation, Talbot River Protection Association, and Talbot County Council (through the Talbot Rivers Protection Association).

Talbot County
CREEKWATCHERS

Talbot County
CREEKWATCHERS

Program Oversight

Chairman: Brice Gamber
Vice-Chair: Lois Lindsley
Equipment Manager: Lois Lindsley
Communications: Bernard Burns
Data Manager: Ian Donaldson
Data Interpretation: Jerry Land

Advisory Committee
John Ford - *Chesapeake Bay Maritime Museum*
Margaret Enloe-Vivian - *Chesapeake Bay Foundation*
Pat Bettlejewski - *Talbot River Protection Association*
Roger Baldwin - *Past Chair, Talbot County Creekwatchers*

Data Collection Teams

Broad Creek

Brice Gamber, *Team Leader*
Bud Keiser ~ Bob Mason ~ Bob Porter ~ John Stumpf ~ Anne & Charles Worthington

Harris Creek

Bob & Judy Amdur, *Team Leader*
Jack & Maria Fischer ~ Albert & Mary Jo Kubelis ~ John & Marge Richardson

Island Creek and La Trappe Creek

Don & Carol Silliman, *Team Leader*
Mr. & Mrs. Jay Harford ~ Mel & Marlies Mraz ~ Cyrus & Debbie Smith

Miles River

Annabel Lesher, *Team Leader*
Betty Brunetti ~ Doug & Andrea Gray ~ Lois Lindsley
Jack & Marcia Moore ~ Don Parks ~ Carmen Perry ~ Karen & Bud Wood

Tred Avon River

Bernard Burns, *Team Leader*
Roger Baldwin ~ Bill Bonsteel ~ Jim Britt ~ Jim Cooney ~ Richard Crowley
Jerry Jana ~ Jerry Land ~ Dorette & Larry Murray ~ Buck Waller

Upper Choptank

Gerri & Frank Newton, *Team Leader*
Mike Lindemann ~ George Tulloch ~ Richard M. Tettelbaum

Wye River

Roger Bollman, *Team Leader*
Ian Donaldson ~ Barry Gillman ~ Brian O'Hare ~ George Strother ~ Mike Tappan ~ Bev & Bob Wolffe

Chlorophyll- a Team

Team 8
Roger Baldwin ~ Dorette & Larry Murray

Team 9
Bud and Anne Keiser

Alternates
Dick Bemis ~ Roger Bollman

APPENDIX 1: Distribution List

Alliance for the Chesapeake Bay
Bay Hundred Foundation
Chester River Association
Chesapeake Bay Foundation
Chesapeake Bay Maritime Museum
Chesapeake Bay Program
Coastal Conservation Association
Coastal & Watershed Resources Advisory Committee
Delmarva Poultry Industry
Dorchester County Council
Eastern Shore Land Conservancy
Easton Planning Commission
Easton Planning & Zoning Department
Easton Public Works Department
Easton Recreation & Parks Department
Easton Town Council
Easton Utilities
Easton Utilities Commission
Garden Club of the Eastern Shore
Garden Club of Talbot County
JEDSAS Audubon Sanctuary
Grayce B. Kerr Foundation
League of Conservation Voters
Maryland Critical Area Commission
Maryland Department of the Environment
Maryland Department of Planning
Maryland House of Delegates
Maryland Ornithological Society
Maryland Sportfisheries Association
Maryland State Senate
Maryland Tributary Strategies Program
Maryland Waterman's Association
Mayor of Easton
Mid-Shore Board of Realtors
Mid-Shore Regional Council
Oxford Town Commissioners
Pickering Creek Audubon Center
Talbot County Chamber of Commerce
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 County Tourism office
Talbot Preservation Alliance
Talbot River Protection Association
Talbot Soil Conservation District
Town of Denton
Town of Secretary
Town of East New Market
Town of St. Michaels
City of Cambridge
Town Creek Foundation
Trappe Landing Farm and Native Sanctuary
Trappe Town Council
United States House of Representatives
United States Senate
University of Maryland Center for Environmental Science
University of Maryland Cooperative Extension, Talbot County

APPENDIX 2: Sampling Sites Table

	Site Code	General Location	Site Latitude	Site Longitude	Site Description
BROAD	bc01	Broad Creek	N38 48.214	W076 14.662	Farthest North
CREEK	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
	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 Elbert's 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	
	bc15	Upper Broad Creek	N38 48.25	W076 14.65	Private dock, 8619 Bozman Neavitt Rd.
HARRIS	hc01	Northeast Branch	N38 48.600	W076 16.00	Upstream 2nd cove on left; Sans Souci pier
CREEK	hc04	Cummings Creek	N38 45.70	W076 19.0	Launch ramp
	hc07	Water Hole Cove	N38 45.700	W076 18.800	Sherwood pier
	hc08	Dun Cove	N38 45.500	W076 19.500	Dederbeck dock - 2nd cove on right
	hc09	Knapps Narrows	N38 42.500	W076 19.800	Tilghman-on-Chesapeake dock - red #6
	hc11	Blackwalnut Cove	N38 41.00	W076 20.00	Inside Harbor; village dock
	hc14	Upper Harris Creek	N38 48.35	W076 15.90	Private dock, 8622 Bozman Neavitt Rd.
ISLAND	li01	Island Creek	N38 40.655	W076 06.447	Upstream where creek forks -Private Dock
CREEK & LA	li03	Island Creek	N38 40.143	W076 08.001	East shore between 2nd & 3rd coves -Private dock
TRAPPE	li04a	Island Creek	N38 39.694	W076 08.862	Inside 1st point on east shore - Private dock
CREEK	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
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
	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	N38 49.22	W076 10.10	Downstream Tunis Mills Bridge
	mr15	Leeds Creek	N38 48.357	W076 11.714	Fairview Point
	mr16	Hambleton Cove	N38 49.176	W076 13.876	Private dock

TRED AVON	ta01	North Fork	N38 46.302	W076 05.581	North Fork beyond Easton Point
RIVER	ta02	Papermill Pd	N38 45.985	W076 05.644	South Fork beyond Easton Point
	ta04	Tred Avon River	N38 45.519	W076 07.109	Mouth of Dixon and Shipshead Creeks
	ta05	Peachblossom Ck	N38 44.064	W076 05.415	Downstream of Rt.333 bridge
	ta08	Trippe Creek	N38 42.662	W076 06.285	Northern branch, by Canterbury
	ta12	Town Creek	N38 41.849	W076 10.046	Mouth near Oxford
	ta14	Trippe Creek	N38 42.546	W076 08.405	Entrance to Trippe Creek - green #1
	ta16	Town Creek	N38 41.158	W076 10.148	Headwaters - right of green #13
CHOPTANK	uc01	Denton Water Park	N38 53.329	W075 50.252	Right of boat ramp
RIVER	uc02	Tuckahoe Ramp	N38 43.896	W075 54.056	Boat ramp beside rte 328highway bridge
	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 abutment at Dover Rd
	uc10	Frazier Neck	N38 41.09	W075 59.09	Private dock off Dover Landing Rd
	uc15	Bolingbroke Creek	N38 37.400	W076 01.400	Head of creek at Moneymaker 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

APPENDIX 3: Sampling Sites Graphics

APPENDIX 4: Rivers Summaries Graphic

APPENDIX 5: All Tributaries Average Data

	Month	Air Temp. (F)	# Samples	pH	Conductivity (mS/cM)	Dissolved Oxygen	Oxygen Saturation (%)	Water Temp.		Salinity (%)	Secchi (Feet)	# N & P samples	Total N (mg/l)	Total P (mg/l)	Chl a (ug/l)
								C	F						
Healthy criteria				**6.5 to 8.5**		**>5.0**	**<110%**				**> 3 feet**		**< 0.2 mg/l**	**<0.05 mg/l**	**<15 ug/l**
Broad Creek															
	April	60	13	8.1	17	9.6	102.8	17	63	1.0	4.0	2	0.545	0.031	11.8
	May	77	24	8.1	16	7.5	90.4	23	73	0.9	2.8	7	0.628	0.047	9.8
	June	81	17	7.9	18	6.4	83.4	27	81	1.1	3.1	7	0.551	0.169	9.0
	July	87	28	8.1	20	6.3	86.2	28	82	1.2	2.9	7	0.671	0.059	16.5
	August	86	25	8.0	20	8.1	110.2	29	84	1.2	2.6	7	0.778	0.081	19.2
	September	76	17	8.0	23	7.9	100.6	24	75	1.4	2.6	6	0.583	0.068	12.5
	October	65	21	7.7	25	5.6	64.6	19	66	1.5	2.6	5	0.622	0.050	6.7
	Yearly Average			8.0	20	7.2	90.8	24	76	1.2	2.9		0.636	0.078	12.2
Harris Creek															
	April	60	2	8.3	22	10.1	106.3	15	59	1.3	3.8	2	0.511	0.044	11.8
	May	62	6	8.1	17	8.8	97.9	19	66	1.0	2.6	0			12.5
	June	76	7	7.3	19	6.2	78.6	25	77	1.2	2.3	5	0.627	0.040	9.4
	July	90	6	7.7	20	6.7	95.0	32	90	1.2	2.2	4	0.617	0.057	14.9
	August	87	6	7.5	23	5.9	93.9	33	91	1.4	1.5	4	0.808	0.086	22.0
	September	84	8	8.2	25	7.1	83.1	29	84	1.6	1.8	6	0.762	0.074	9.7
	October	73	7	7.8	24	6.4	79.4	23	73	1.5	2.0	5	0.689	0.062	10.2
	Yearly Average			7.8	22	7.0	88.2	26	79	1.3	2.1		0.687	0.062	12.9
Island Creek															
	April	64	7	7.6	15	10.9	108.8	13	55	0.9	2.5	2	1.037	0.079	8.9
	May	76	6	7.9	17	9.8	120.2	23	73	1.0	2.6	1	0.643	0.042	
	June	80	7	8.1	19	7.6	99.0	26	79	1.1	1.7	2	0.678	0.078	14.7
	July	80	7	8.4	20	7.5	104.2	29	84	1.2	2.0	2	0.747	0.099	43.2
	August	85	7	8.5	23	9.0	124.2	29	84	1.4	1.8	2	0.825	0.144	49.2
	September	70	4	8.6	24	7.4	91.3	23	73	1.4	2.5	1	0.846	0.116	36.2
	October	67	4	7.8	26	8.7	103.6	21	70	1.6	2.8	2	0.705	0.110	16.8
	Yearly Average			8.1	20	8.8	108.4	24	75	1.2	2.2		0.789	0.098	28.2

	Month	Air Temp. (F)	# Samples	pH	Conductivity (mS/cM)	Dissolved Oxygen	Oxygen Saturation (%)	Water Temp.		Salinity (%)	Secchi (Feet)	# N & P samples	Total N (mg/l)	Total P (mg/l)	Chl a (ug/l)
								C	F						
Healthy criteria				**6.5 to 8.5**		**>5.0**	**<110%**				**> 3 feet**		**< 0.2 mg/l**	**<0.05 mg/l**	**<15 ug/l**
LaTrappe Creek															
	April	64	7	7.6	14	11.8	120.8	14	57	0.8	2.2	3	1.123	0.194	16.7
	May	77	6	8.0	17	10.8	131.4	23	73	1.0	1.8	2	0.829	0.076	
	June	81	6	8.2	17	8.6	113.2	27	81	1.1	1.9	3	1.131	0.103	57.1
	July	79	7	8.2	20	6.8	94.7	29	84	1.2	1.9	3	0.787	0.115	69.3
	August	84	7	8.4	23	8.6	116.7	28	82	1.4	1.6	3	0.799	0.126	29.0
	September	70	4	8.6	23	6.6	81.1	23	73	1.4	2.0	1	0.875	0.115	12.7
	October	66	4	7.7	25	8.8	103.9	20	68	1.6	2.4	3	0.712	0.176	15.4
	Yearly Average			8.1	19	9.0	110.6	24	75	1.2	1.9		0.899	0.134	33.4
Miles River															
	April	51	12	7.7	15	8.7	85.6	11	52	0.9	2.2	7	1.125	0.196	31.4
	May	74	26	8.1	16	8.5	99.6	22	72	0.9	2.6	8	0.823	0.086	31.0
	June	78	25	7.8	17	6.6	86.0	26	79	1.0	1.7	9	0.853	0.187	21.9
	July	84	29	7.9	21	5.3	71.2	27	81	1.3	1.7	8	0.905	0.134	21.5
	August	84	25	7.8	22	3.0	40.4	28	82	1.3	1.7	9	1.013	0.173	19.6
	September	82	23	8.1	24	7.2	95.7	26	79	1.4	2.0	9	0.996	0.223	18.4
	October	78	25	7.9	24	7.1	89.0	23	73	1.5	2.1	8	0.827	0.142	11.3
	Yearly Average			7.9	20	6.4	80.4	24	76	1.2	2.0		0.932	0.164	22.2
Tred Avon River															
	April	62	26	7.8	15	9.7	90.7	16	61	0.9	2.7	8	0.789	0.155	23.0
	May	77	9	8.3	15	11.3	134.9	22	72	0.9	2.1	7	0.780	0.122	40.5
	June	79	18	7.7	16	6.5	83.7	27	81	0.9	1.8	8	0.714	0.078	19.9
	July	84	18	7.5	20	7.5	104.5	30	86	1.1	1.7	9	0.811	0.114	20.8
	August	89	18	8.0	20	8.3	114.2	29	84	1.2	1.8	9	0.728	0.111	23.4
	September	70	18	7.7	20	6.1	77.2	24	75	1.2	2.2	8	0.849	0.203	16.0
	October	63	18	7.9	24	8.3	95.0	18	64	1.4	2.8	8	0.719	0.086	9.1
	Yearly Average			7.8	19	8.1	96.9	23	74	1.1	2.2		0.770	0.124	22.5

	Month	Air Temp. (F)	# Samples	pH	Conductivity (mS/cM)	Dissolved Oxygen	Oxygen Saturation (%)	Water Temp.		Salinity (%)	Secchi (Feet)	# N & P samples	Total N (mg/l)	Total P (mg/l)	Chl a (ug/l)
								C	F						
Healthy criteria				**6.5 to 8.5**		**>5.0**	**<110%**				**> 3 feet**		**< 0.2 mg/l**	**<0.05 mg/l**	**<15 ug/l**
Upper Choptank River															
	April	62	10	7.3	1	8.1	77.1	14	57	0.0	1.6	4	3.115	0.121	4.6
	May	80	9	7.4	1	8.0	89.5	22	72	0.0	1.7	3	3.420	0.101	
	June	76	10	7.5	3	5.1	62.6	26	79	0.1	1.7	4	1.722	0.102	5.6
	July	88	11	7.3	5	6.6	84.1	28	82	0.3	1.9	4	1.164	0.105	14.7
	August	83	11	7.6	8	5.5	70.5	27	81	0.5	1.4	4	0.773	0.114	15.8
	September	68	12	7.2	7	5.3	63.1	24	75	0.3	1.7	4	0.824	0.084	10.9
	October	68	6	7.9	9	5.7	64.4	21	70	0.5	2.0	4	0.998	0.087	8.5
	Yearly Average			7.4	5	6.3	73.1	23	74	0.2	1.7		1.653	0.102	10.0
Wye River															
	April	55	20	7.9	14	11.0	104.7	11	52	0.8	3.2	4	1.333	0.097	29.0
	May	68	19	7.8	14	8.1	89.6	19	66	0.8	2.8	4	0.743	0.055	43.2
	June	72	15	7.6	17	5.8	73.0	25	77	1.0	1.8	4	0.854	0.112	44.0
	July	78	18	8.3	21	8.2	108.1	27	81	1.2	2.4	2	0.948	0.188	68.2
	August	85	20	8.3	23	6.3	85.5	28	82	1.4	2.2	4	0.871	0.163	50.3
	September	74	19	8.2	21	6.7	88.0	26	79	1.3	2.6	6	0.765	0.129	29.2
	October	74	10	8.1	23	6.8	84.6	23	73	1.4	2.9	4	0.775	0.106	13.9
	Yearly Average			8.0	19	7.7	91.4	23	73	1.1	2.6		0.885	0.117	39.4
Total # samples			750									267			
All Tributary Aver.				7.9	18	7.6	92.8	24	74	1.1	2.2		0.916	0.109	23.5

APPENDIX 6: Healthy Percentages by Tributary

	pH		Oxygen		Oxygen Saturation		Clarity		Total Nitrogen		Total Phosphorus		Chlorophyll a	
	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy
Healthy Criteria	6.5 to 8.5		> 5 mg/l		<111%		>3 feet		<0.2 mg/l		<0.05 mg/l		<15 ug/l	
Broad Creek														
April	8.1	100.0	9.6	100.0	102.8	69.2	4.0	69.2	0.545	0.0	0.031	100.0	11.8	100.0
May	8.1	87.5	7.5	100.0	90.4	87.5	2.8	8.3	0.628	0.0	0.047	71.4	9.8	100.0
June	7.9	76.5	6.4	76.5	83.4	94.1	3.1	29.4	0.551	0.0	0.169	57.1	9.0	100.0
July	8.1	100.0	6.3	64.3	86.2	85.7	2.9	35.7	0.671	0.0	0.159	0.0	16.5	0.0
August	8.0	88.0	8.1	100.0	110.6	56.0	2.6	20.0	0.778	0.0	0.081	0.0	19.2	0.0
September	8.0	100.0	7.9	94.1	100.6	82.4	2.6	11.8	0.583	16.7	0.068	0.0	12.5	100.0
October	7.7	100.0	5.6	52.4	64.6	95.2	2.6	19.0	0.622	0.0	0.050	80.0	6.7	100.0
Total	8.0	93.8	7.2	83.3	90.8	81.9	2.9	25.7	0.636	2.4	0.078	37.5	12.2	71.4
# of Measurements	144		144		144		144		41		40		7	
Upper Choptank River														
April	7.3	100.0	8.1	90.0	77.1	100.0	1.6	0.0	3.115	0.0	0.121	0.0	4.6	100.0
May	7.4	100.0	8.0	100.0	89.5	100.0	1.7	0.0	3.420	0.0	0.101	0.0		
June	7.5	100.0	5.1	60.0	62.6	100.0	1.7	0.0	1.722	0.0	0.102	0.0	5.6	100.0
July	7.3	100.0	6.6	100.0	84.1	100.0	1.9	0.0	1.164	0.0	0.105	0.0	14.7	100.0
August	7.6	100.0	5.5	90.9	70.5	100.0	1.4	0.0	0.773	0.0	0.114	0.0	15.8	0.0
September	7.2	100.0	5.3	58.3	63.1	100.0	1.7	0.0	0.824	0.0	0.084	0.0	10.9	100.0
October	7.9	100.0	5.7	83.3	64.4	100.0	2.0	0.0	0.998	0.0	0.087	0.0	8.5	100.0
Total	7.4	100.0	6.3	82.4	73.0	100.0	1.7	0.0	1.653	0.0	0.102	0.0	10.0	83.3
# of Measurements	68		68		68		68		27		27		6	

	pH		Oxygen		Oxygen Saturation		Clarity		Total Nitrogen		Total Phosphorus		Chlorophyll a	
	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy
Healthy Criteria	6.5 to 8.5		> 5 mg/l		<111%		>3 feet		<0.2 mg/l		<0.05 mg/l		<15 ug/l	
Harris Creek														
April	8.3	100.0	10.1	100.0	106.3	50.0	3.8	100.0	0.511	0.0	0.044	100.0	11.8	100.0
May	8.1	100.0	8.8	100.0	97.9	100.0	2.6	0.0					12.5	100.0
June	7.3	100.0	6.2	100.0	78.6	100.0	2.3	0.0	0.627	0.0	0.040	100.0	9.4	100.0
July	7.7	100.0	6.7	100.0	95.0	80.0	2.2	0.0	0.617	0.0	0.057	25.0	14.9	100.0
August	7.5	100.0	5.9	50.0	93.9	100.0	1.5	0.0	0.808	0.0	0.086	0.0	22.0	0.0
September	8.2	100.0	7.1	100.0	83.1	85.7	1.8	0.0	0.762	0.0	0.074	0.0	9.7	100.0
October	7.8	100.0	6.4	85.7	79.4	100.0	2.0	0.0	0.689	0.0	0.062	0.0	10.2	100.0
Total	7.8	100.0	7.0	80.5	87.3	80.0	2.1	4.8	0.690	0.0	0.062	32.0	12.9	85.7
# of Measurements	42		41		35		42		25		25		7	

Island Creek														
April	7.6	100.0	10.9	100.0	108.8	57.1	2.5	28.6	1.037	0.0	0.079	50.0	8.9	100.0
May	7.9	100.0	9.8	100.0	120.2	50.0	2.6	16.7	0.643	0.0	0.042	100.0		
June	8.1	100.0	7.6	100.0	99.0	85.7	1.7	0.0	0.678	0.0	0.078	50.0	14.7	100.0
July	8.4	83.3	7.5	100.0	104.4	57.1	2.0	0.0	0.747	0.0	0.099	0.0	43.2	0.0
August	8.5	42.9	9.0	100.0	124.2	28.6	1.8	0.0	0.825	0.0	0.144	0.0	49.2	0.0
September	8.6	25.0	7.4	100.0	91.3	100.0	2.5	0.0	0.846	0.0	0.116	0.0	36.2	0.0
October	7.8	100.0	8.7	100.0	103.6	50.0	2.8	25.0	0.705	0.0	0.110	0.0	16.8	0.0
Total	8.1	80.5	8.8	100.0	108.5	59.5	2.2	9.5	0.789	0.0	0.098	25.0	28.2	33.3
# of Measurements	41		42		42		42		12		12		6	

	pH		Oxygen		Oxygen Saturation		Clarity		Total Nitrogen		Total Phosphorus		Chlorophyll a	
	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy
Healthy Criteria	6.5 to 8.5		> 5 mg/l		<111%		>3 feet		<0.2 mg/l		<0.05 mg/l		<15 ug/l	
La Trappe Creek														
April	7.6	85.7	11.8	100.0	120.8	57.1	2.2	0.0	1.123	0.0	0.194	33.3	16.7	0.0
May	8.0	66.7	10.8	100.0	131.2	50.0	1.8	0.0	0.829	0.0	0.076	0.0		
June	8.2	100.0	8.6	85.7	113.2	14.3	1.9	0.0	1.131	0.0	0.103	0.0	57.1	0.0
July	8.2	100.0	6.8	85.7	94.7	57.1	1.9	0.0	0.787	0.0	0.115	0.0	69.3	0.0
August	8.4	71.4	8.6	85.7	116.7	42.9	1.6	0.0	0.799	0.0	0.126	0.0	29.0	0.0
September	8.6	25.0	6.6	100.0	81.1	100.0	2.0	0.0	0.875	0.0	0.115	0.0	12.7	100.0
October	7.7	100.0	8.8	100.0	103.9	75.0	2.4	0.0	0.724	0.0	0.176	0.0	15.4	0.0
Total	8.1	80.5	9.0	92.9	110.6	54.8	1.9	0.0	0.902	0.0	0.134	5.6	33.4	16.7
# of Measurements	41		42		42		42		18		18			
Miles River														
April	7.7	100.0	8.7	91.7	85.6	90.9	2.2	8.3	1.125	0.0	0.196	0.0	31.4	50.0
May	8.1	69.2	8.5	100.0	99.6	73.1	2.6	32.0	0.823	0.0	0.086	37.5	31.0	0.0
June	7.8	72.0	6.6	80.0	86.0	84.0	1.7	0.0	0.853	0.0	0.187	0.0	21.9	0.0
July	7.9	100.0	5.3	44.8	71.2	79.3	1.7	0.0	0.905	0.0	0.135	0.0	21.5	0.0
August	7.8	72.0	3.0	11.8	40.4	100.0	1.7	4.0	1.013	0.0	0.173	0.0	19.6	0.0
September	8.1	100.0	7.2	87.0	95.7	69.6	2.0	0.0	0.996	0.0	0.223	0.0	18.4	0.0
October	7.9	72.0	7.1	92.0	89.0	88.0	2.1	4.0	0.827	0.0	0.142	0.0	11.3	100.0
Total	7.9	82.4	6.6	73.2	82.5	82.1	2.0	6.7	0.932	0.0	0.164	5.5	22.2	21.4
# of Measurements	165		157		156		164		58		55		14	

	pH		Oxygen		Oxygen Saturation		Clarity		Total Nitrogen		Total Phosphorus		Chlorophyll a	
	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy	Avg	% Healthy
Healthy Criteria	6.5 to 8.5		> 5 mg/l		<111%		>3 feet		<0.2 mg/l		<0.05 mg/l		<15 ug/l	
Tred Avon River														
April	7.8	100.0	8.7	96.2	90.7	80.8	2.7	19.2	0.789	0.0	0.155	50.0	23.0	50.0
May	8.3	100.0	11.3	100.0	134.9	11.1	2.1	11.1	0.780	0.0	0.122	0.0	40.5	0.0
June	7.7	100.0	6.5	72.2	83.7	88.9	1.8	0.0	0.714	0.0	0.078	12.5	19.9	0.0
July	7.5	100.0	7.5	100.0	104.5	83.3	1.7	0.0	0.811	0.0	0.114	0.0	20.8	0.0
August	8.0	100.0	8.3	100.0	114.2	94.4	1.8	0.0	0.728	0.0	0.111	0.0	23.4	50.0
September	7.8	100.0	6.1	83.3	77.2	100.0	2.2	11.1	0.849	0.0	0.203	0.0	16.0	50.0
October	7.9	100.0	8.3	100.0	95.0	94.4	2.8	29.4	0.719	0.0	0.086	0.0	9.1	100.0
Total	7.8	100.0	7.9	92.0	96.9	74.4	2.2	10.5	0.770	0.0	0.124	8.8	21.8	38.5
# of Measurements	125		125		125		124		57		57		13	
Wye River														
April	7.9	95.0	11.0	100.0	104.4	65.0	3.2	55.0	1.333	0.0	0.097	0.0	29.0	50.0
May	8.1	100.0	8.1	94.7	89.6	84.2	2.8	15.8	0.743	0.0	0.055	25.0	43.2	0.0
June	7.6	100.0	5.8	73.3	73.0	93.3	1.8	0.0	0.854	0.0	0.112	0.0	44.0	0.0
July	8.3	55.6	8.2	94.4	108.1	55.6	2.4	11.1	0.948	0.0	0.188	0.0	68.2	0.0
August	8.3	85.0	6.3	70.0	85.5	80.0	2.2	5.0	0.871	0.0	0.163	0.0	50.3	0.0
September	8.2	100.0	6.7	94.7	88.0	84.2	2.6	15.8	0.765	0.0	0.129	0.0	29.2	0.0
October	8.1	100.0	6.8	100.0	84.6	100.0	2.9	30.0	0.775	0.0	0.106	0.0	13.9	50.0
Total	8.1	90.1	7.7	89.3	91.4	78.5	2.6	19.0	0.885	0.0	0.117	3.6	39.4	15.3
# of Measurements	121		121		121		121		28		28		14	

APPENDIX 7: Submerged Aquatic Vegetation (SAV) Observations 2007

	April				May				June				July				August				September				October				
	# of observations				# of observations				# of observations				# of observations				# of observations				# of observations				# of observations				Positive observations
	N	Sp	M	D	N	Sp	M	D	N	Sp	M	D	N	Sp	M	D	N	Sp	M	D	N	Sp	M	D	N	Sp	M	D	
Broad Creek	2				1	1							3	1			1				1				1				0.0
Harris Creek					5	1			2	2			1	2				2			1				4	1			0.0
Island Creek																													insufficient data
LaTrappe Creek																													insufficient data
Miles River	2				1				2								2				2				2				0.0
Tred Avon River	9				8				9				1				1				10				1				0.0
Upper Choptank	5				5				5				5				5				6				7				0.0
Wye River					4	1	1		1								1				1				1				10.0
Totals	18	0	0	0	24	3	1	0	19	2	0	0	10	3	0	0	10	2	0	0	21	0	0	0	16	1	0	0	0.8

N = No SAV observed

Sp =Very sparse to sparse SAV

M = Moderate SAV

D = Dense SAV

Total number of No SAV observations ----------	118
Total number of Very Sparse or Sparse observations ------	11
Total number of Moderate SAV observations ----------	1
Total number of Dense SAV observations ----------	0

Positive observation is moderate or dense

Talbot County CREEKWATCHERS