Water Quality Analysis of Eutrophication for the Tidal Langford Creek, Kent County, Maryland

FINAL

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List of Abbreviations

BOD	Biochemical Oxygen Demand
COMAR	Code of Maryland Regulation
CWA	Clean Water Act
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
MDE	Maryland Department of the Environment
mg/l	Milligrams Per Liter
mi^2	Square miles
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
WQLS	Water Quality Limited Segment
*u*g/l	Micrograms Per Liter

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA)'s implementing regulations direct each State to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

Langford Creek (basin code 02-13-05-06) was identified on the State's 1996 list of water quality WQLSs as impaired by nutrients, sediments and fecal coliform. This document addresses the nutrient impairment in the tidal portion of Langford Creek; the sediment and fecal coliform impairments will be addressed at a future date. A separate action regarding St. Pauls Millpond is being considered for the future.

An analysis of recent monitoring data shows that the dissolved oxygen criterion and designated uses associated with nutrients are being met in Langford Creek. This analysis supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality standards in this case. Barring any contradictory future data, this report will be used as supporting material when Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review. Although the waters of Langford Creek do not display signs of eutrophication, the State reserves the right to require future controls in the Langford Creek watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and U.S. Environmental Protection Agency (EPA)'s implementing regulations direct each State to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. This list of impaired waters is commonly referred to as the "303(d) list". For each WQLS, the State is to either establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

In addition to the successful implementation of a TMDL, there are four other scenarios that may be used to address an impaired waterbody: 1) more recent data indicating that the impairment no longer exists (i.e., water quality standards are being met); 2) more recent and updated water quality modeling which demonstrates that the segment is now attaining standards; 3) refinements to water quality standards, or the interpretation of those standards, which result in standards being met; or 4) correction to errors made in the initial listing.

Langford Creek (basin code 02-13-05-06) was first identified on the 1996 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE), as being impaired by nutrients, sediments, and fecal coliform. This report provides more recent information that supports the removal of the nutrients listing for Langford Creek when the 303(d) list is revised; therefore, the aforementioned first scenario most closely applies, with the qualification that initial listing for nutrients was suspect due to the lack of data. The sediment and fecal coliform impairments will be addressed at a future date.

The remainder of this report lays out the general setting of the waterbody within the Langford Creek watershed, presents a discussion of the water quality characterization process, and provides conclusions with regard to the characterization. The data will establish that the Langford Creek is achieving water quality standards.

2.0 GENERAL SETTING

Langford Creek is located in Kent County, Maryland in the tidal portion of the Chester River watershed and flows south into the Chesapeake Bay. Langford Creek is approximately 14 miles in length, with a watershed area of approximately 43 mi^2 or 27,027 acres (Figure 1). The land uses in the watershed are mixed agricultural (27.1 mi^2 or 71% of the area), forest (9.57 mi^2 or 25% of the area), and urban (1.5 mi^2 or 4% of the area). Please refer to Figure 2 for a map of these land uses (Maryland Department of Planning, 2000).

Langford Creek originates from wetlands along the southern boundary of the Chester River watershed. Langford Creek is an active and producing fishing zone. A West Fork and an East Fork flow southward nearly parallel to each other and join mid-basin to form Langford Creek. Route 446, transecting the basin, roughly divides the West and East Fork drainage areas. The West Fork begins below Chestertown-Fairlee Road and flows to Sandy Bottom, where St. Pauls

Millpond is situated, before continuing downstream to Langford Creek. The East Fork begins as Fanels Branch at Stockton–Startt Road flowing into East Fork before entering into Langford Creek. The East Fork of Langford Creek is the larger stream of the two, and has few significant tributaries. The East Fork drainage area is predominantly mixed agriculture with forest surrounding the stream; the West Fork is predominantly mixed agriculture and forested (Figure 2).

The entire drainage basin of St. Pauls Millpond is located within a single farm dedicated predominantly to row crop agriculture, and without commercial animals such as beef cattle or poultry. The pond is fairly small and spillage ultimately flows to the headwaters of the West Fork of Langford Creek.

Langford Creek lies within the Mattapex-Othello soil series in the Atlantic Coastal Plain Province. These soils are nearly level to moderately sloping, and moderately to poorly drained soils formed in silty materials. These types of soils are associated as types C and D hydrological soils (USDA-SCS, 1982).

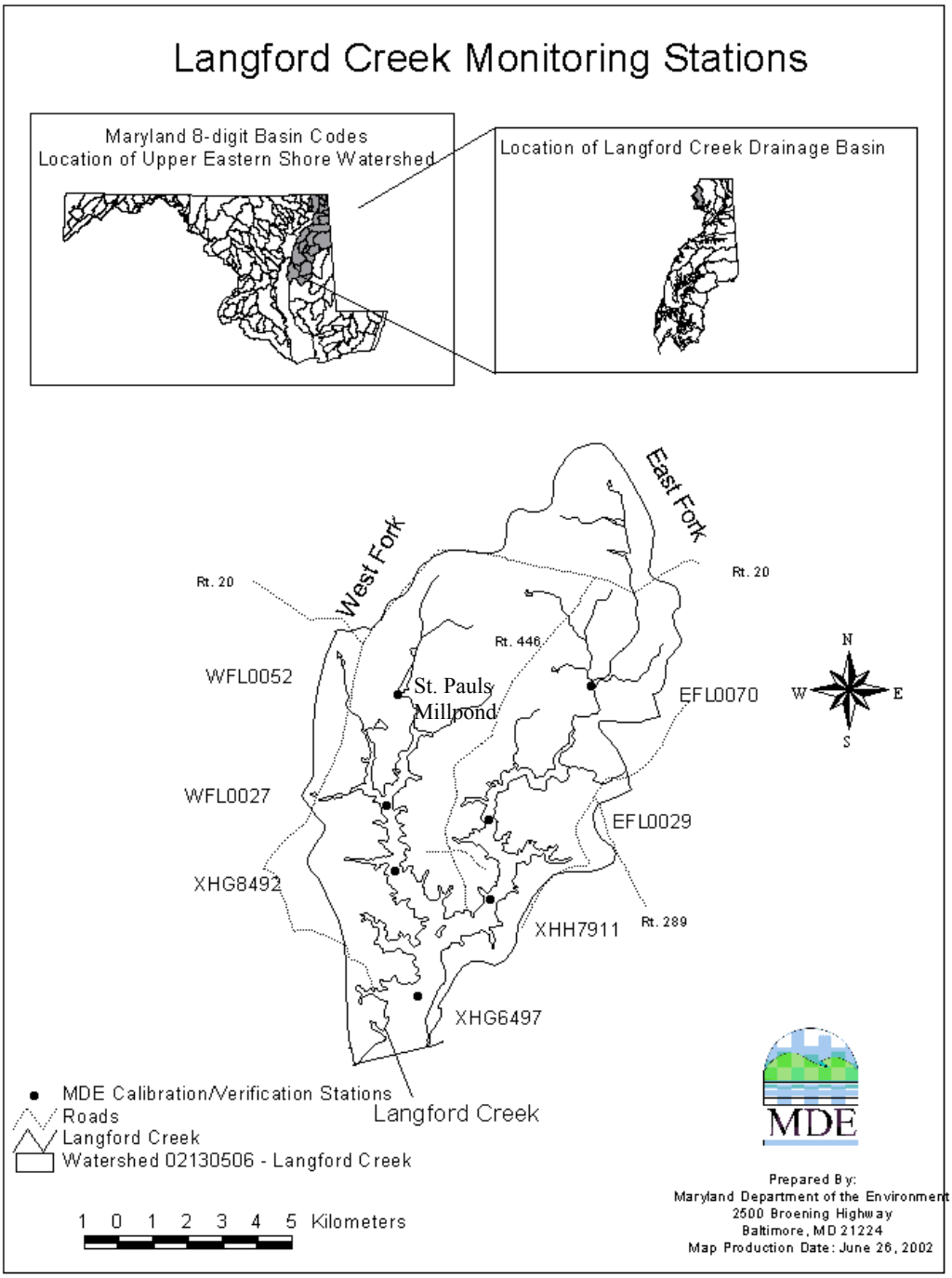


Figure 1: Langford Creek Location Map and Monitoring Stations

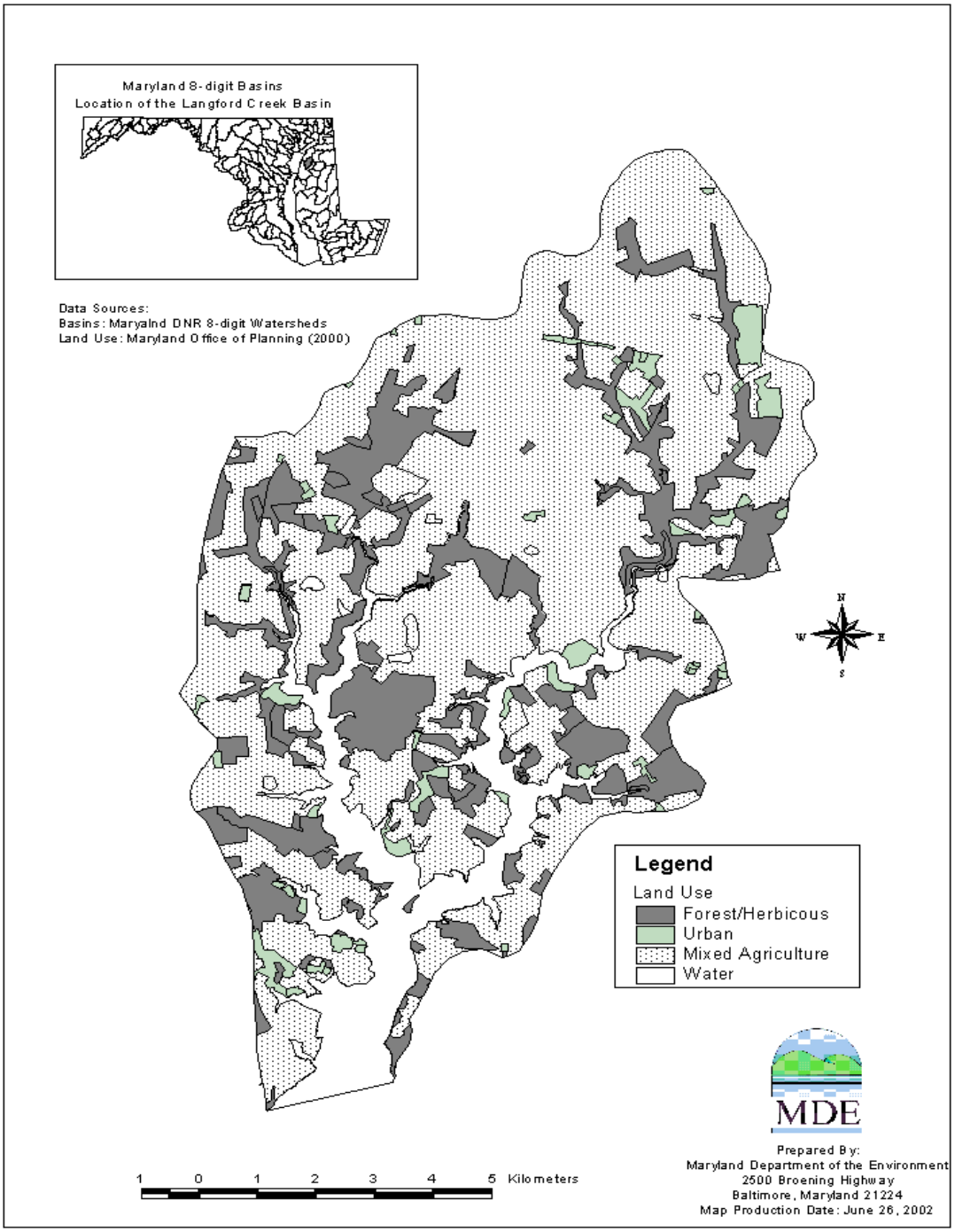


Figure 2: Land Use Map of the Langford Creek Watershed

3.0 WATER QUALITY CHARACTERIZATION

A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as swimming, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

Maryland's water quality standards presently do not impose a limit on the concentration of nutrients in the water column[1]. Rather, Maryland manages nutrients indirectly by limiting their effects expressed in terms of excess algal growth and low dissolved oxygen (DO). Because biochemical oxygen demand (BOD) also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed.

The Maryland Surface Water Use Designation (Code of Maryland Regulations (COMAR) 26.08.02.07) for the tidal portion of Langford Creek is Use II – w*ater used for shellfish harvesting*. According to Maryland's numeric criterion for DO, concentrations may not be less than 5.0 mg/l at any time (COMAR 26.08.02.03-3C(2)), unless resulting from natural conditions (COMAR 26.08.02.03.A(2)). The water quality data presented in this section will show the designated use of this water body is being met as it relates to nutrients.

Maryland's general water quality criteria prohibit pollution of waters of the State by any material in amounts sufficient to create nuisance or interfere with designated uses (COMAR 26.08.02.03B(2)). Excessive eutrophication, indicated by elevated levels of chlorophyll *a*, can produce nuisance levels of algae and interfere with designated uses such as fishing and swimming; therefore, a desired peak chlorophyll a level of 50 µg/l has been established for tidal waters. The chlorophyll *a* level is based on the designated use, guidelines set forth by Thomann and Mueller (1987) and by the EPA Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1 (1997).

All readily available water quality data for the last five years pertaining to the tidal portion of Langford Creek was considered for this analysis. Water quality data from surveys conducted at seven stations along Langford Creek during March through May 1999 (high-flow conditions) and during July through September 1999 (low-flow conditions) was used to perform this analysis. Table 1 shows the list of stations with their geographical coordinates and descriptive location in the Langford Creek watershed. Figure 3 through Figure 6 provide graphical representations of the collected data for the parameters discussed below. During sampling, no pollution sources is observed in the headwaters, or along the riparian banks of Langford Creek. Nothing out of the ordinary was observed during sampling.

1 Maryland does limit the ammonia form of nitrogen from the Waste Water Treatment Plants due to its toxic effects on some aquatic organisms.

Station Code	Lat/Long	Description
XHG6497 (MC-13,14)	39 06.400 76 10.300	Mid-channel off Long Cove. Depth ~ 29 ft.
XHH7911 (MC-15)	39 07.917 76 08.924	Off cove on western shore. Depth ~ 16 ft.
EFL0029 (MC-16)	39 09.149 76 08.937	Depth ~ 10 ft.
EFL0070 * (LC-27)	39 11.213 76 06.865	Bridge crossing at Langford-Pomona Rd. Sample free-flowing drainage from Mill Pond. – located west of Brices Mill Road.
XHG8492 (MC-17)	39 08.411 76 10.836	NE of Pastor Point. Off large blue boathouse. Depth ~ 13 ft.
WFL0027 (MC-18)	39 09.385 76 10.962	Below confluence of river fork. Depth 12 ft.
WFL0052 * (LC-28)	39 11.106 76 10.708	Spillage of St. Pauls Millpond at Langford Road.

* Free-flowing station (Non-tidal stations)

Table 1: Locations of Water Quality Samples Collected During 1999 in Langford Creek.

3.1 Nutrients

During the March through May 1999 sampling period, total phosphorus (TP) concentrations in the tidal waters ranged from 0.03 mg/l to 0.135 mg/l and total nitrogen (TN) concentrations ranged from 0.62 mg/l to 3.42 mg/l. During the July through September 1999 sampling period, TP concentrations ranged from 0.064 mg/l to 0.326 mg/l and TN concentrations ranged from 0.76 mg/l to 3.32 mg/l. Please refer to Figures 3 through 6 for graphical representations of this data; tabular data is presented in Appendix A.

3.2 Dissolved Oxygen

During the March through May 1999 sampling period, DO concentrations ranged from 7.4 mg/l to 12.7 mg/l. During the July through September 1999 sampling period, DO concentrations ranged from 5.3 mg/l to 8.2 mg/l. The data shows that none of the concentrations fell below 5 mg/l during either sampling period. Please refer to Figure 3 through Figure 6 for graphical representations of this data; data tables are presented in Appendix A.

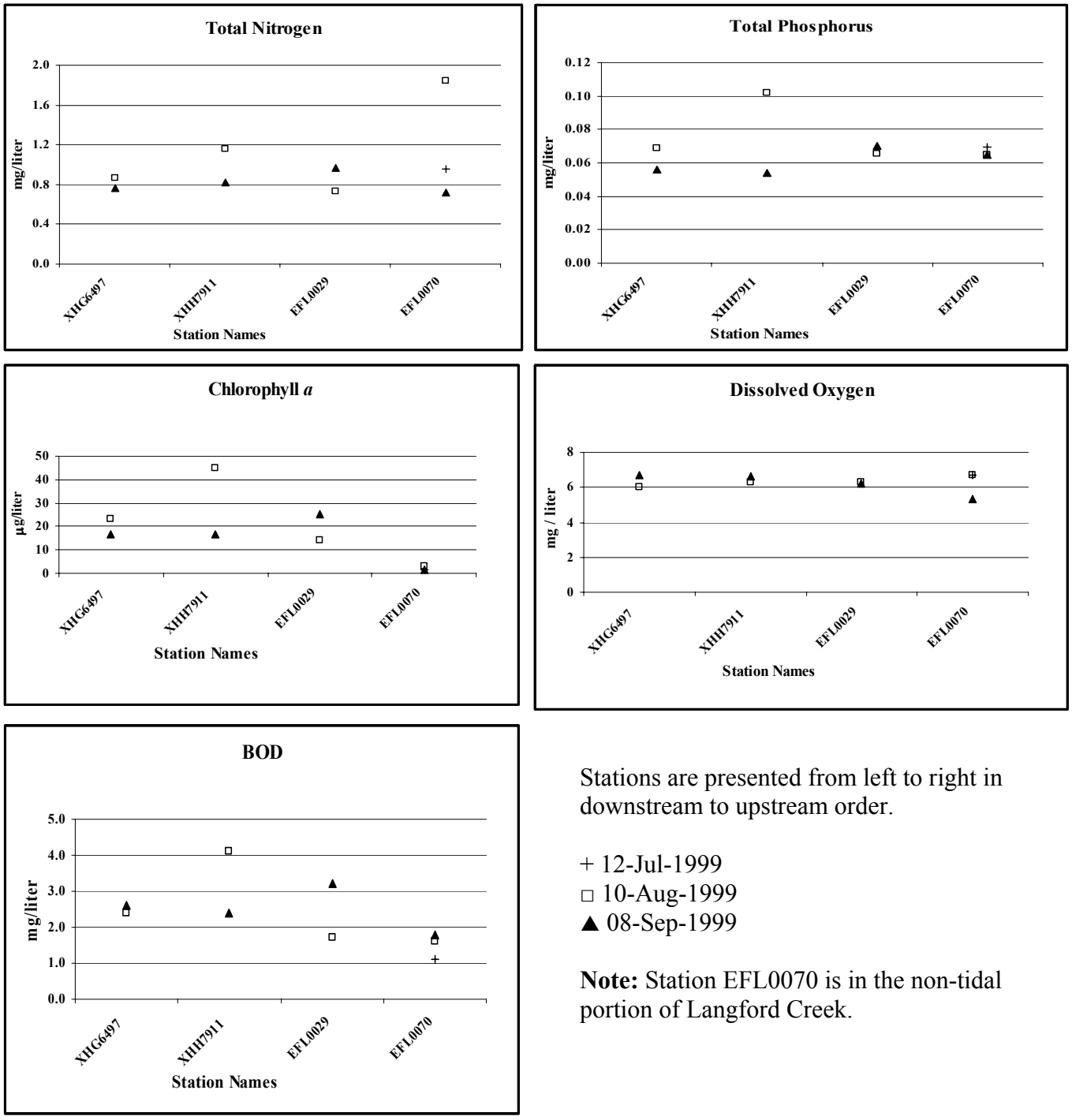
3.3 Chlorophyll *a*

Chlorophyll *a* data was collected during the algal growing season, March and August 1999 when concentrations are at their peak. Observed chlorophyll *a* concentrations are low and do not reach levels higher than 50 µg/l in the tidal portion of Langford Creek. Two measurements collected from non-tidal monitoring station WFL0052, located at the outlet of St. Pauls Millpond, have concentrations of 97.19 µg/l and 65.79 µg/l. These elevated chlorophyll *a* concentrations found in St. Pauls Millpond are not seen elsewhere in Langford Creek, even at the closest station downstream (WFL0027). As mentioned earlier, a separate action regarding St. Pauls Millpond is being considered for the future.

The low chlorophyll *a* concentrations found in Langford Creek suggests that chlorophyll *a* photosynthesis and respiration will have no significant effect on observed DO values. Nothing out of the ordinary was observed during sampling event. This data is summarized in Figure 3 through Figure 6. Tabular data is presented in Appendix A.

3.4 Biochemical Oxygen Demand (BOD)

Because BOD also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed. During the March through May 1999 sampling period, BOD concentrations ranged from 0.4 mg/l to 7.7 mg/l. During the July through September 1999 sampling period, BOD concentrations ranged from 1.1 mg/l to 9.9 mg/l. Please refer to Figure 3 through Figure 6 for graphical representations of this data; data tables are presented in Appendix A. Because low DO is not indicated in Langford Creek, BOD does not enter into this analysis.

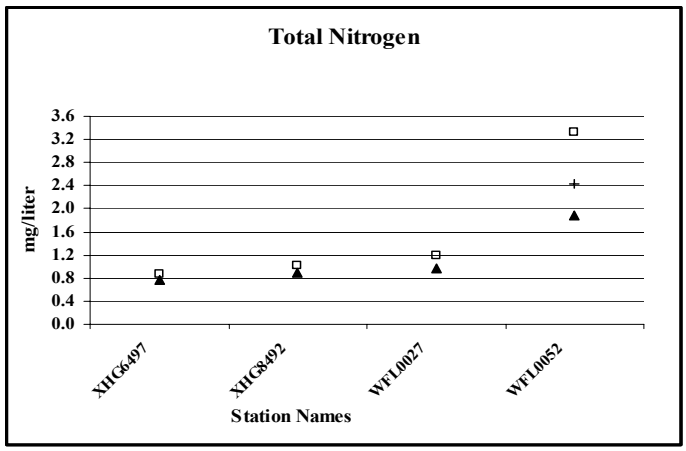


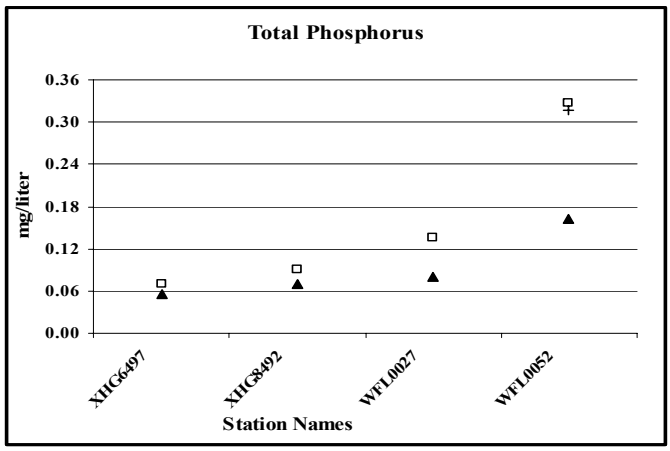
Stations are presented from left to right in downstream to upstream order.

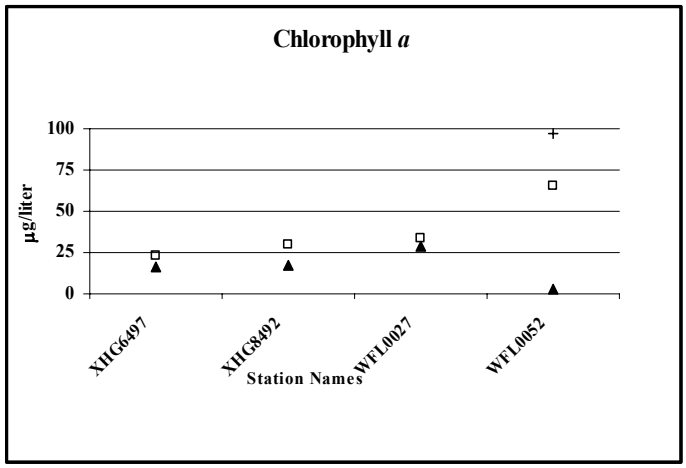
+ 12-Jul-1999
□ 10-Aug-1999
▲ 08-Sep-1999

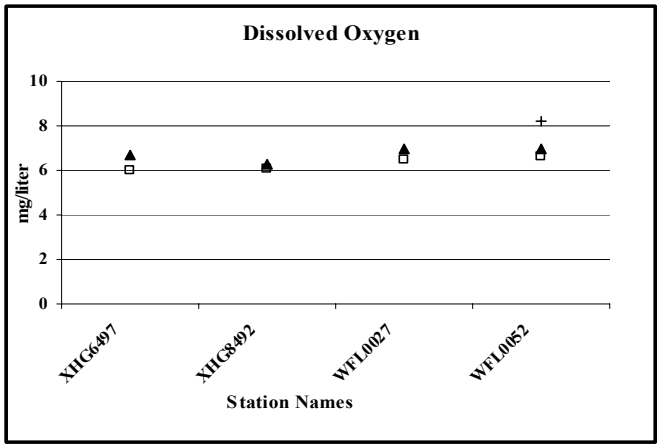
Note: Station EFL0070 is in the non-tidal portion of Langford Creek.

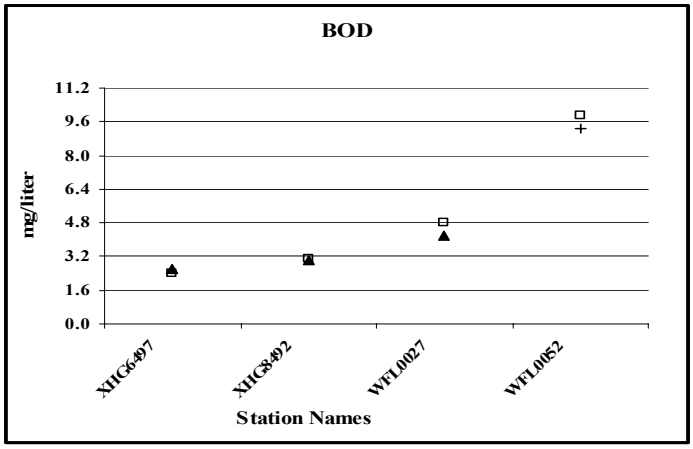
Figure 3: Langford Creek (East Fork) Low Flow Conditions (July – September)









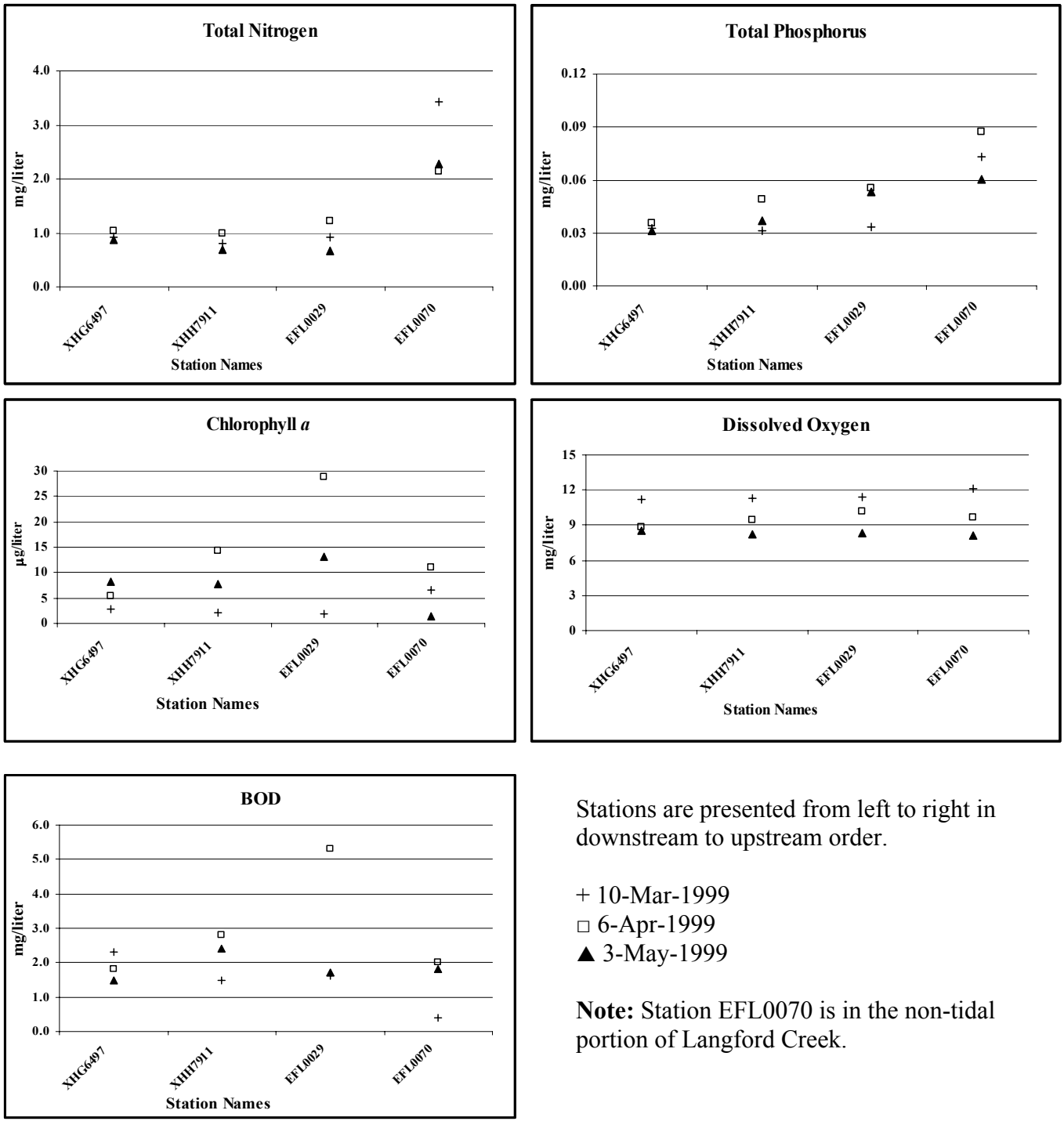


Stations are presented from left to right in downstream to upstream order.

+ 12-Jul-1999
□ 10-Aug-1999
▲ 08-Sep-1999

Note: Station WFL0052 is in the non-tidal portion of Langford Creek.

Figure 4: Langford Creek (West Fork) Low Flow Conditions (July – September)

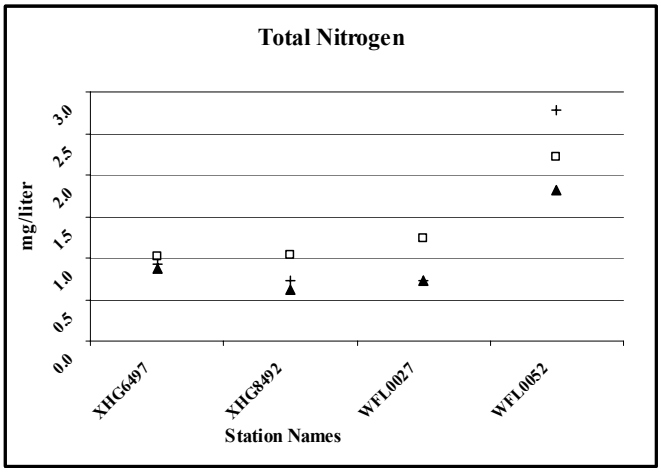


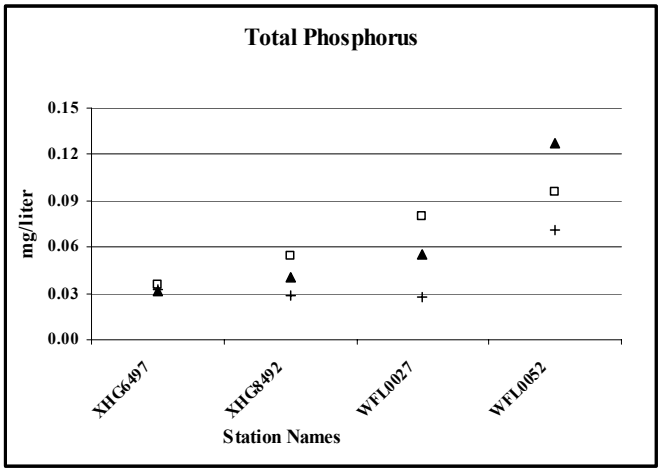
Stations are presented from left to right in downstream to upstream order.

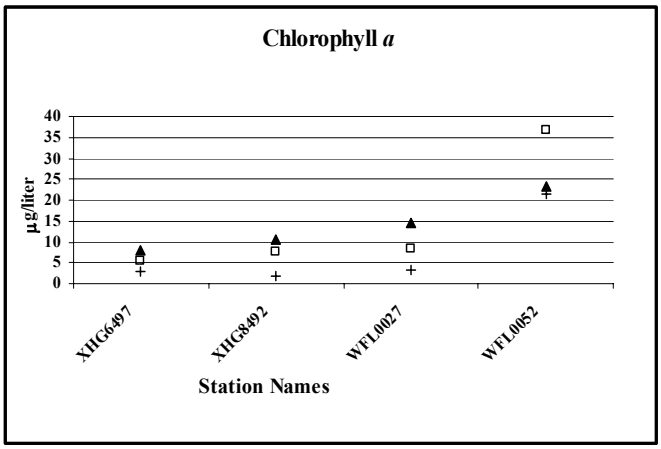
+ 10-Mar-1999
□ 6-Apr-1999
▲ 3-May-1999

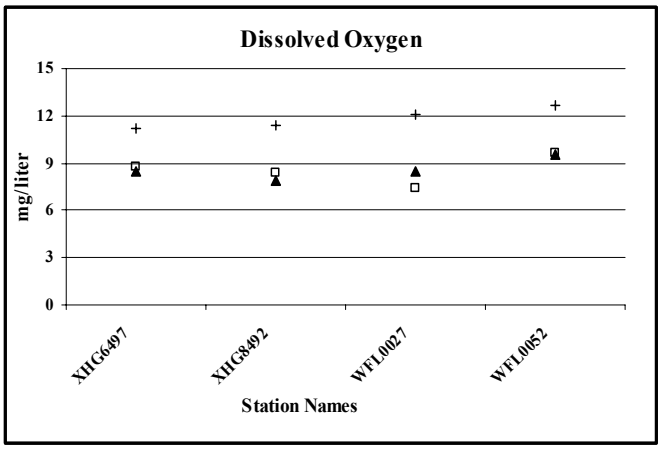
Note: Station EFL0070 is in the non-tidal portion of Langford Creek.

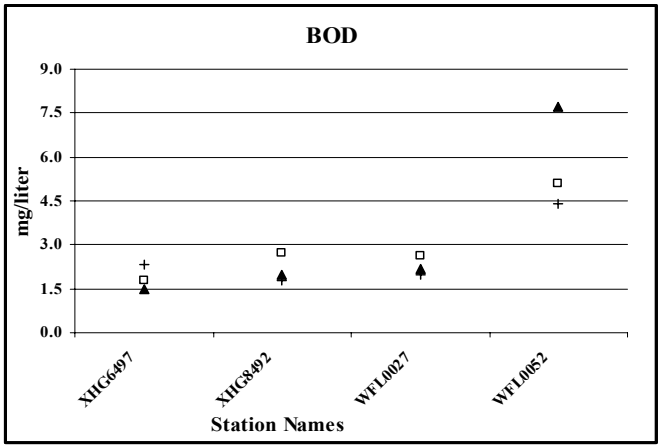
Figure 5: Langford Creek (East Fork) High Flow Conditions (March – May)











Stations are presented from left to right in downstream to upstream order.

+ 10-Mar-1999
□ 6-Apr-1999
▲ 3-May-1999

Note: Station WFL0052 is in the non-tidal portion of Langford Creek.

Figure 6: Langford Creek (West Fork) High Flow Conditions (March – May)

4.0 CONCLUSION

The data presented above clearly demonstrates that excessive algal growth does not exist in the tidal portion of Langford Creek, as indicated by low chlorophyll *a*. Similarly, DO concentrations are well within standards. Based on the synoptic survey conducted during 1999, the water quality data indicates that Langford Creek has no eutrophication-related water quality problems. No pollution sources in the headwaters, or along the riparian banks of Langford Creek was observed during sampling. Nothing notable was observed during field sampling. Barring any contradictory future data, this information provides sufficient justification to revise Maryland's 303(d) list to remove nutrients as an impairing substance in relation to Langford Creek.

REFERENCES

Code of Maryland Regulations, 26.08.02.07, 26.08.02.03-3C(2), 26.08.02.03A(2), 26.08.02.03(2)

Maryland Department of Planning. Digital Land Use/Land Cover Data for Maryland. 2000.

Thomann, Robert V., John A. Mueller "Principles of Surface Water Quality Modeling and Control, " HarperCollins Publisher Inc., New York, 1987.

U.S. Department of Agriculture, Soil Conservation Service, "Soil Survey of Kent County, Maryland", 1982, pp. 67-68.

U.S. Environmental Protection Agency, "Technical Guidance Manual for Developing Total Maximum Daily Loads, Book2: Streams and Rivers, Part 1: Biochemical Oxygen Demand/ Dissolved Oxygen and Nutrients/ Eutrophication," Office of Water, Washington D.C., March 1997.

Appendix A: Tabular Water Quality Data

SAMPLING STATION IDENTIFIER	DATE START SAMPLING	DISSOLVED OXYGEN FIELD VALUE MG/L	BIOCHEMICAL OXYGEN DEMAND 5-DAY MG/L	TOTAL NITROGEN MG/L	TOTAL PHOSPHORUS MG/L	ACTIVE CHLOROPHYLL A µG/L
EFL0070	03/09/1999	12.1	0.4	3.42	0.072	6.48
WFL0052	03/09/1999	12.7	4.4	2.79	0.07	21.43
XHG6497	03/10/1999	11.2	2.3	0.88	0.034	2.84
XHG6497	03/10/1999	11.2		0.97	0.029	2.99
XHH7911	03/10/1999	11.3	1.5	0.81	0.03	2.09
EFL0029	03/10/1999	11.4	1.6	0.92	0.032	1.79
XHG8492	03/10/1999	11.4	1.8	0.73	0.028	1.79
WFL0027	03/10/1999	12.1	2	0.73	0.028	3.44
EFL0070	04/05/1999	9.7	2	2.14	0.086	10.96
WFL0052	04/05/1999	9.6	5.1	2.22	0.095	36.78
XHG6497	04/06/1999	8.8	1.8	1.02	0.033	5.23
XHG6497	04/06/1999	8.8		1.03	0.036	5.73
XHH7911	04/06/1999	9.5	2.8	0.98	0.048	14.31
EFL0029	04/06/1999	10.2	5.3	1.21	0.055	28.91
XHG8492	04/06/1999	8.4	2.7	1.03	0.054	7.48
WFL0027	04/06/1999	7.4	2.6	1.24	0.079	8.22
XHG6497	05/03/1999	8.5	1.5	0.87	0.03	7.23
XHG6497	05/03/1999	8.5		0.87	0.031	8.97
XHH7911	05/03/1999	8.2	2.4	0.69	0.036	7.73
EFL0029	05/03/1999	8.1	1.7	0.66	0.052	13.08
XHG8492	05/03/1999	8.3	2	0.62	0.04	10.72
WFL0027	05/03/1999	8.5	2.2	0.72	0.054	14.70
EFL0070	05/04/1999	7.9	1.8	2.28	0.059	1.50
WFL0052	05/04/1999	9.5	7.7	1.82	0.127	23.42
EFL0070	07/12/1999	6.7	1.1	0.96	0.068	1.74
WFL0052	07/12/1999	8.2	9.3	2.43	0.317	97.19
EFL0070	08/09/1999	6.7	1.6	1.84	0.064	3.24
WFL0052	08/09/1999	6.6	9.9	3.32	0.326	65.79
XHG6497	08/10/1999	6	2.4	0.87	0.068	23.92
XHG6497	08/10/1999	6		0.86	0.068	22.68
XHH7911	08/10/1999	6.3	4.1	1.15	0.1	45.11
EFL0029	08/10/1999	6.3	1.7	0.73	0.064	14.20
XHG8492	08/10/1999	6.1	3.1	1.03	0.089	29.90
WFL0027	08/10/1999	6.5	4.8	1.20	0.135	33.89
EFL0070	09/07/1999	5.3	1.8	0.72	0.064	1.50
WFL0052	09/07/1999	7		1.90	0.162	3.14
XHG6497	09/08/1999	6.7	2.6	0.77	0.054	16.20
XHG6497	09/08/1999	6.7		0.76	0.056	16.70
XHH7911	09/08/1999	6.6	2.4	0.82	0.054	16.45
EFL0029	09/08/1999	6.2	3.2	0.97	0.07	25.17
XHG8492	09/08/1999	6.3	3	0.90	0.07	17.30
WFL0027	09/08/1999	7	4.2	0.97	0.079	29.16