Water Quality Analysis of Eutrophication for the Upper North Branch Potomac River, Garrett County, Maryland

FINAL

DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard, Suite 540
Baltimore MD 21230-1718

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Watershed Protection Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

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Table of Contents

List of Figures

List of Tables

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
MBSS	Maryland Biological Stream Survey
MDP	Maryland Department of Planning
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
USGS	U.S. Geological Survey
WQLS	Water Quality Limited Segment
μg/l	Micrograms Per Liter

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (CWA) and the 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.

Upper North Branch Potomac River (basin code 02141005), located in Garrett County, Maryland, was identified on the State's list of WQLSs as impaired by metals (1996 listing), sediments (1996 listing), nutrients (1996 listing), low pH (1996 listing), and impacts to biological communities (2002 & 2004 listing). Also in 2002, Spring Gap within this basin was listed as impaired by methylmercury in fish tissue. This document, upon EPA approval, addresses the nutrient impairment in Upper North Branch Potomac River; the mercury, pH, and impacts to biological communities impairments will be addressed at a future date. The metals and sediment listings will be addressed in 2006.

An analysis of recent monitoring data shows that the dissolved oxygen criterion and designated uses associated with nutrients are being met in Upper North Branch Potomac River. This analysis supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality standards in this case. Barring the receipt of contradictory data, this report will be used to support the nutrients listing change for the Upper North Branch Potomac River from Category 5 ("waterbodies impaired by one or more pollutants requiring a TMDL") to Category 2 ("Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards"), when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future. Although the waters of Upper North Branch Potomac River do not display signs of eutrophication, the State reserves the right to require future controls in the Upper North Branch Potomac River 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 the 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 development 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.

Upper North Branch Potomac River (basin code 02141005) was identified on the 1996, 1998, 2002 and 2004 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE), as impaired by metals, sediments, nutrients, low pH and impacts to biological communities (2002 & 2004 listing). Also in 2002, Spring Gap within this basin was listed as impaired by methylmercury in fish tissue. This report provides more recent information that supports the removal of the nutrients listing for Upper North Branch Potomac River when the 303(d) list is revised; therefore, the aforementioned first scenario most closely applies, with the qualification that initial listing for nutrients was suspected due to the lack of data. The mercury, pH, and impacts to biological communities impairments will be addressed at a future date. The metals and sediment listings will be addressed in 2006.

The remainder of this report lays out the general setting of the waterbody within the Upper North Branch Potomac River watershed, presents a discussion of the water quality characteristics in the basin, and provides conclusions with regard to the current water quality characteristics and the current standards. The data will demonstrate that the Upper North Branch Potomac River is achieving water quality standards.

2.0 GENERAL SETTING

Location

The North Branch of the Potomac River forms the border between Maryland and West Virginia from its origin at the Fairfax Stone downstream to its confluence with the South Branch of the Potomac. The Upper North Branch of the Potomac River is defined as the reach between its headwaters in West Virginia and its confluence with the Savage River (See Figure 1). The drainage area of Upper North Branch Potomac River watershed is 67,252 acres.

Geology/Soils

The Upper North Branch Potomac River watershed is situated within the Appalachian Plateaus Province in western Maryland. The surficial geology of the Appalachian Plateaus Province is characterized by gently folded shale, siltstone, and sandstone. Folding has produced elongated arches across the region, which expose Devonian rock at the surface. Coal bearing strata are preserved in the intervening synclinal basins of these folds. Consequently, this region has been a productive source for coal mining. The topography in the watershed is often steep and deeply carved by winding streams, with elevations ranging up to 3,200 feet.

The Upper North Branch Potomac River watershed lies primarily in the Dekalb soil series. The Dekalb soil series consists of moderately deep, well drained, loamy soils that developed in material weathered in place from sandstone and some conglomerate and shale bedrock. These nearly level to very steep soils are normally found in stony, mountainous regions. Dekalb soils have rapid permeability and internal drainage (Garrett County, Maryland Soil Conservation Service, 1977).

Land use

The land use in the Upper North Branch Potomac River watershed is predominantly forest. There are 49,762 acres (74.2%) of park and forest lands evenly dispersed throughout the watershed. The watershed contains 1,999 acres (3.2%) of residential land use and 4,711 acres (7.2%) of commercial land use. Crops and pasture land uses are dispersed through out the watershed, constituting 5,391 acres (8.0%) and 4,828 acres (7.4%), respectively. The land use distribution is based on 2002 Maryland Department of Planning (MDP) land use/land cover data. The Upper North Branch Potomac River land use coverage is displayed in Figure 2.

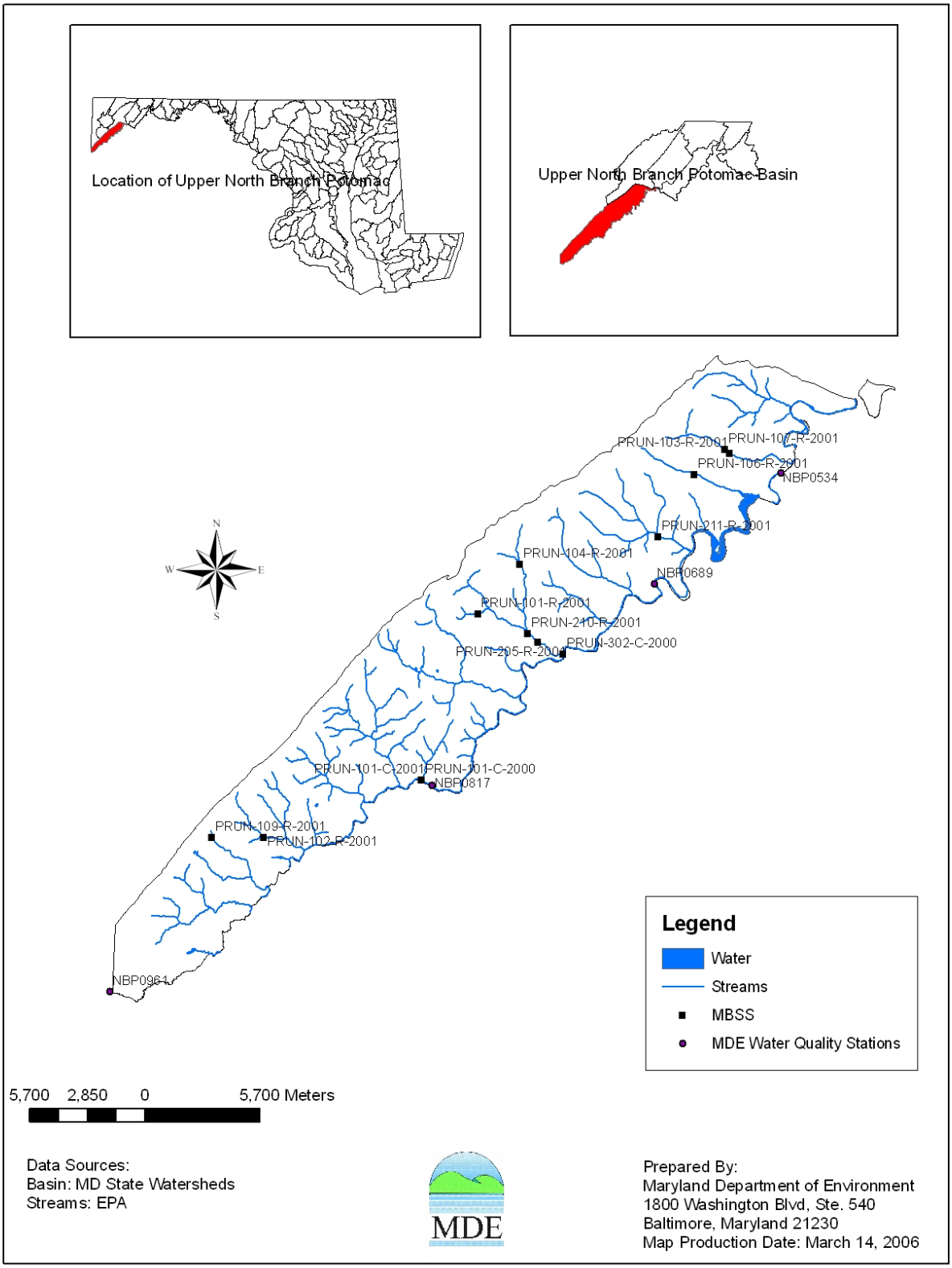

Figure 1: Upper North Branch Potomac River Location Map and Monitoring Stations

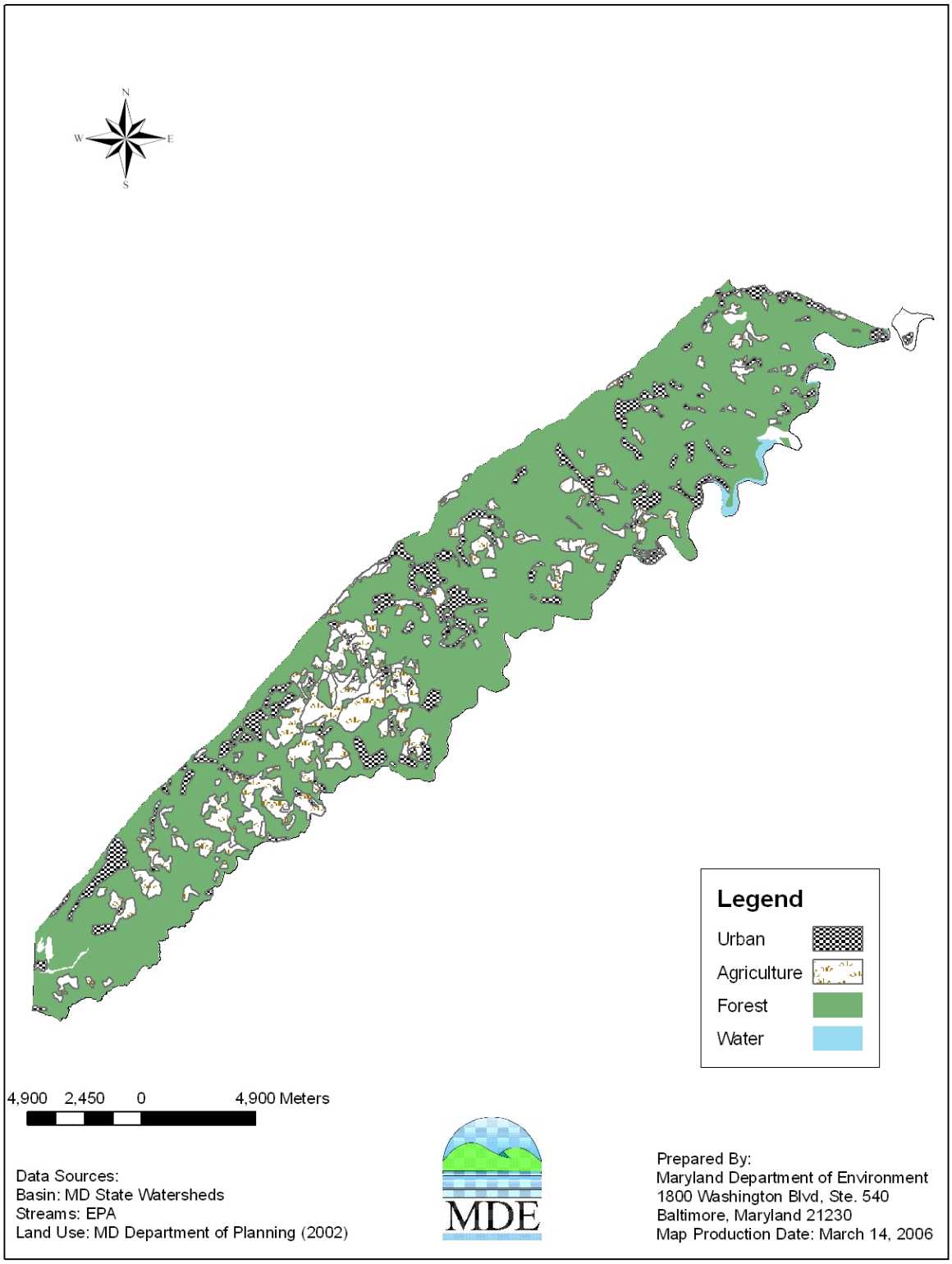

Figure 2: Land Use Map of the Upper North Branch Potomac River Watershed

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.

The Maryland Surface Water Use Designation for the Upper North Branch Potomac River (main stem) is Use I-P, water contact recreation, and protection of nontidal warm water aquatic life, and public water supply (Code of Maryland Regulations (COMAR) 26.08.02.08 (R)(1)(a)). All tributaries of the Upper North Branch Potomac River are designated Use III-P, nontidal cold water and public water supply (COMAR 26.08.02.08 (R)(4)). The DO criteria to protect Use I-P water may not be less than 5 mg/l at any time (COMAR 26.08.02.03-3B(1)). The DO criteria to protect Use III-P water may not be less than 5 mg/l at any time, with a minimum daily average of not less than 6 mg/l (COMAR 26.08.02.03-3E(2)). The water quality data presented in this section will show DO concentrations meet the appropriate criteria.

Maryland's water quality standards presently do not impose a limit on the concentration of nutrients in the water column. 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.

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. The analysis demonstrates no excessive algal growth as indicated by low chlorophyll *a* values in the data set.

A data solicitation was conducted in September 2005. All readily available water quality data were considered for this analysis. Water quality data from MDE surveys conducted along Upper North Branch Potomac River during October 2000 through September 2002 were used to perform this analysis. Water quality data from 13 Maryland Biological Stream Survey (MBSS) stations were also used during April 2000 through April 2001. Other available resources (Department of Natural Resources (DNR), U.S. Geological Survey (USGS), Chesapeake Bay Program data) were also investigated to determine if there were other available stations in the Upper North Branch Potomac River watershed. Table 1 shows the list of MDE stations with their geographical coordinates and descriptive location in the Upper North Branch Potomac River watershed. Figure 3 provides graphical representation of the collected data for the parameters discussed below.

Table 1: Locations of Water Quality Stations Monitored During 2000-2002 in Upper North Branch Potomac River

Station ID	Station Source	Latitude	Longitude
PRUN-205-R-2001	MBSS	39.36707	-79.2482
PRUN-101-R-2001	MBSS	39.37884	-79.2829
PRUN-211-R-2001	MBSS	39.41537	-79.1802
PRUN-210-R-2001	MBSS	39.37077	-79.2541
PRUN-102-R-2001	MBSS	39.27696	-79.4026
PRUN-109-R-2001	MBSS	39.27632	-79.4323
PRUN-103-R-2001	MBSS	39.45325	-79.1405
PRUN-107-R-2001	MBSS	39.45496	-79.1429
PRUN-106-R-2001	MBSS	39.44353	-79.1603
PRUN-101-C-2001	MBSS	39.30444	-79.3128
PRUN-104-R-2001	MBSS	39.40139	-79.2594
PRUN-101-C-2000	MBSS	39.30444	-79.3128
PRUN-302-C-2000	MBSS	39.36194	-79.2333
NBP0534	MDE	39.44513	-79.1108
NBP0689	MDE	39.39418	-79.1817
NBP0817	MDE	39.30187	-79.307
NBP0961	MDE	39.26945	-79.2625

3.1 Dissolved Oxygen

During the April 2000 through September 2002 sampling period, DO concentrations ranged from 7.0 mg/l to 17.8 mg/l. The data shows that none of the values fell below the 7 mg/l during the entire sampling period. This data is summarized in Figure 3. Tabular data is presented in Appendix A.

3.2 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 April 2000 through September 2002 sampling period, BOD concentrations ranged from 1 mg/l to 3 mg/l. Again, please refer to Figure 3 for graphical representations of this data. Data tables are presented in Appendix A. Please note that DO concentrations were always above 5 mg/l during the sampling period.

3.3 Chlorophyll *a*

Chlorophyll *a* data was collected during the entire period from April 2000 through September 2002 covering algal growing season, when concentrations are at their peak. Observed chlorophyll *a* concentrations are low and do not reach levels higher than 2.0 µg/l.

The low chlorophyll *a* concentrations found in Upper North Branch Potomac River 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. This data is summarized in Figure 3. Tabular data is presented in Appendix A.

3.4 Nutrients

During the April 2000 through September 2002 sampling period, total phosphorus (TP) concentrations ranged from 0.002 mg/l to 2 mg/l and total nitrogen (TN) concentrations ranged from 0.21 mg/l to 3.16 mg/l. Please refer to Figure 3 for graphical representations of this data. Data tables are presented in Appendix A.

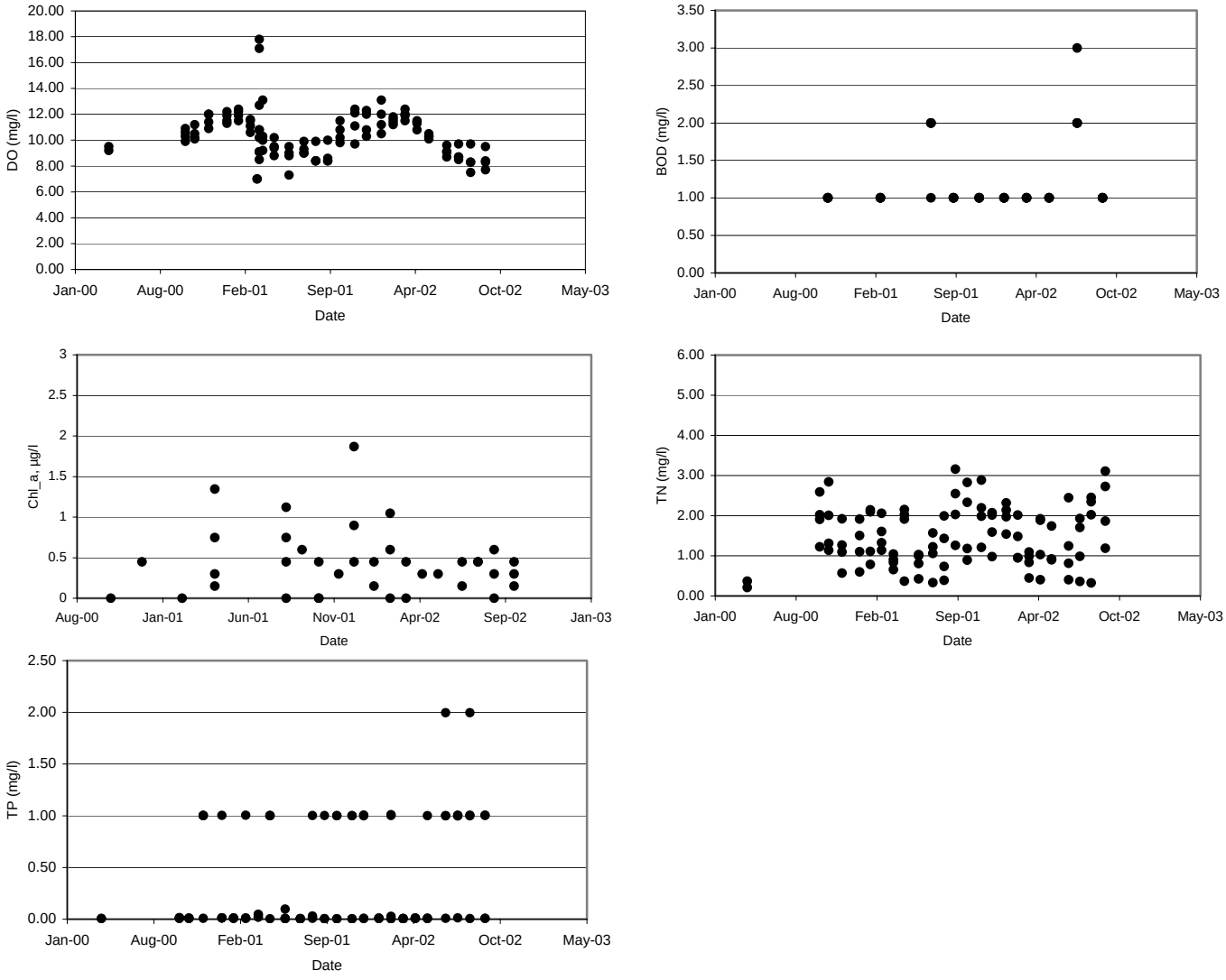

Figure 3: Upper North Branch Potomac River Water Quality Data from April 2000 through September 2002

4.0 CONCLUSION

The data presented above clearly demonstrates that excessive algal growth does not exist in the Upper North Branch Potomac River, as indicated by the chlorophyll *a* levels. Similarly, DO concentrations are well above the criterion of 5.0 mg/l. Based on the synoptic surveys conducted during 2000-2002, the water quality data indicates that Upper North Branch Potomac River has no eutrophication-related water quality impairments. Barring the receipt of contradictory data, this report will be used to support a nutrients listing change for the Upper North Branch Potomac River from Category 5 "waterbodies impaired by one or more pollutants requiring a TMDL" to Category 2 "Surface waters that are meeting some standards and have insufficient information to determine attainment of other standards", when the Maryland Department of the Environment (MDE) proposes the revision of Maryland's 303(d) list for public review in the future.

Although the waters of Upper North Branch Potomac River do not display signs of eutrophication, the State reserves the right to require future controls in the Upper North Branch Potomac River watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

REFERENCES

Code of Maryland Regulations, 26.08.02.07, 26.08.02.08, 26.08.02.03-3B(1), 26.08.02.03-3E(2), 26.08.02.03A(2), 26.08.02.03B(2)

Maryland Department of the Environment, 2004 FINAL List of Impaired Surface Waters [303(d) List] and Integrated Assessment of Water Quality in Maryland.

Maryland Department of Planning, 2002 Land Use, Land Cover Map Series. 2002.

Soil Conservation Service (SCS). *Soil Survey of Garrett County, MD*, 1977.

Appendix A: Tabular Water Quality Data

Station	Date	DO mg/l	TN mg/l	TP mg/l	Chlorophyll_a µg/l	BOD mg/l
NBP0534	10/10/2000	9.90	1.91	0.0072		
NBP0534	11/1/2000	10.10	2.00	0.0078		1.00
NBP0534	12/4/2000	10.90	1.92	1.0035	0.449	
NBP0534	1/16/2001	12.20	1.91	1.0041		
NBP0534	2/12/2001	12.40	2.14	0.0124		
NBP0534	3/12/2001	11.60	2.06	0.0079		1.00
NBP0534	4/10/2001	13.10	1.04	0.0206	0.150	
NBP0534	5/7/2001	10.20	2.02	1.0014		
NBP0534	6/11/2001	9.50	1.00	0.0972		
NBP0534	7/16/2001	9.90	1.06	0.0037		2.00
NBP0534	8/13/2001	9.90	1.99	1.0027	0.449	
NBP0534	9/10/2001	10.00	2.03	0.0036		1.00
NBP0534	10/9/2001	9.80	0.89	0.0023	0.000	
NBP0534	11/13/2001	9.70	1.99	0.0032	0.299	1.00
NBP0534	12/10/2001	10.30	2.01	0.9990	0.449	
NBP0534	1/14/2002	10.50	1.97	0.0071	0.449	1.00
NBP0534	2/11/2002	11.40	2.02	0.0034		
NBP0534	3/11/2002	11.50	0.98	0.0043	0.449	1.00
NBP0534	4/8/2002	11.40	1.03	0.0111	0.299	
NBP0534	5/6/2002	10.50	0.92	0.0098		1.00
NBP0534	6/17/2002	9.60	0.81	0.9990	0.150	
NBP0534	7/15/2002	9.70	1.93	0.9985		3.00
NBP0534	8/12/2002	9.70	2.02	0.0060	0.299	
NBP0534	9/16/2002	9.50	1.87	1.0045	0.150	1.00
NBP0689	10/10/2000	10.90	2.02	0.0137	0.000	
NBP0689	11/1/2000	11.20	1.14	0.0076		1.00
NBP0689	12/4/2000	12.00	1.10	1.0009		
NBP0689	1/16/2001	11.90	1.10	0.0121		
NBP0689	2/12/2001	12.20	1.11	0.0089		
NBP0689	3/12/2001	11.50	1.14	0.0114		1.00
NBP0689	4/10/2001	10.00	0.90	0.0475	1.346	
NBP0689	5/7/2001	9.50	2.15	1.0007		
NBP0689	6/11/2001	8.80	0.81	0.0048		
NBP0689	7/16/2001	9.00	1.22	0.0034		1.00
NBP0689	8/13/2001	8.40	1.43	0.0310	1.121	
NBP0689	9/10/2001	8.60	2.55	1.0022		1.00
NBP0689	10/9/2001	11.50	2.83	1.0007		
NBP0689	11/13/2001	12.40	2.20	1.0009		1.00
NBP0689	12/10/2001	12.30	0.98	1.0064	1.869	
NBP0689	1/14/2002	13.10	2.13	0.0085		1.00
NBP0689	2/11/2002	11.80	0.95	1.0106	1.047	
NBP0689	3/11/2002	12.40	0.84	0.0054	0.000	1.00
NBP0689	4/8/2002	11.50	1.88	0.0093		
NBP0689	5/6/2002	10.30	1.74	0.0060		1.00

Station	Date	DO mg/l	TN mg/l	TP mg/l	Chlorophyll_a µg/l	BOD mg/l
NBP0689	7/15/2002	8.70	1.70	0.0121		2.00
NBP0689	8/12/2002	8.30	2.35	1.9967	0.449	
NBP0689	9/16/2002	8.40	2.73	1.0039	0.000	1.00
NBP0817	10/10/2000	10.60	2.59	0.0091		
NBP0817	11/1/2000	10.50	2.84	0.0080		1.00
NBP0817	12/4/2000	11.40	1.26	0.0077		
NBP0817	1/16/2001	11.30	1.50	0.0124		
NBP0817	2/12/2001	11.90	2.09	0.0094		
NBP0817	3/12/2001	11.10	1.32	0.0099		1.00
NBP0817	4/10/2001	10.30	0.84	0.0416		
NBP0817	5/7/2001	9.40	1.91	1.0017	0.748	
NBP0817	6/11/2001	9.00	1.03	0.0083		
NBP0817	7/16/2001	9.30	1.57	0.0058		2.00
NBP0817	8/13/2001	8.40	0.73	0.0181		
NBP0817	9/10/2001	8.40	3.16	0.0037	0.748	1.00
NBP0817	10/9/2001	10.80	2.33	0.0041	0.598	
NBP0817	11/13/2001	12.10	2.88	0.0039	0.449	1.00
NBP0817	12/10/2001	12.00	2.07	0.0081		
NBP0817	1/14/2002	12.00	2.31	0.0114	0.897	1.00
NBP0817	2/11/2002	11.20	0.95	0.0282	0.150	
NBP0817	3/11/2002	12.00	1.10	0.0068	0.598	1.00
NBP0817	4/8/2002	11.30	1.92	0.0096		
NBP0817	5/6/2002	10.30	0.90	1.0006		1.00
NBP0817	6/17/2002	9.10	2.44	0.0082	0.299	
NBP0817	7/15/2002	8.50	0.99	1.0050	0.449	2.00
NBP0817	8/12/2002	8.30	2.45	0.9989	0.449	
NBP0817	9/16/2002	8.30	3.11	0.0071		1.00
NBP0961	10/10/2000	10.30	1.22	0.0142	0.449	
NBP0961	11/1/2000	10.20	1.31	0.0116		1.00
NBP0961	12/4/2000	12.00	0.57	1.0021		
NBP0961	1/16/2001	11.50	0.60	0.0107		
NBP0961	2/12/2001	11.50	0.78	0.0077		
NBP0961	3/12/2001	10.60	1.61	1.0051	0.000	1.00
NBP0961	4/10/2001	9.20	0.65	0.0196		
NBP0961	5/7/2001	8.80	0.37	0.0046	0.299	
NBP0961	6/11/2001	7.30	0.43	0.0057		
NBP0961	7/16/2001	9.00	0.33	0.0046		2.00
NBP0961	8/13/2001	8.40	0.39	0.0077		
NBP0961	9/10/2001	8.40	1.26	0.0047	0.000	1.00
NBP0961	10/9/2001	10.20	1.18	1.0007		
NBP0961	11/13/2001	11.10	1.21	1.0003	0.000	1.00
NBP0961	12/10/2001	10.80	1.59	0.0057		
NBP0961	1/14/2002	11.20	1.54	0.0073		1.00
NBP0961	2/11/2002	11.60	1.48	1.0019		
NBP0961	3/11/2002	11.90	0.44	0.0047	0.000	1.00
NBP0961	4/8/2002	10.80	0.41	0.0061		

FINAL

Station	Date	DO mg/l	TN mg/l	TP mg/l	Chlorophyll_a µg/l	BOD mg/l
NBP0961	5/6/2002	10.10		0.0068		1.00
NBP0961	6/17/2002	8.70	0.40	1.0009		
NBP0961	7/15/2002	8.70	0.36	1.0019		2.00
NBP0961	8/12/2002	7.50	0.32	1.0053	0.598	
NBP0961	9/16/2002	7.70	1.19	0.0086	0.299	1.00
PRUN-101-C-2000	4/13/2000	9.2	0.37	0.0072		
PRUN-101-C-2001	4/2/2001	8.5				
PRUN-101-R-2001	4/2/2001	10.8				
PRUN-102-R-2001	4/2/2001	17.1				
PRUN-103-R-2001	3/28/2001	7				
PRUN-104-R-2001	4/2/2001	9.1				
PRUN-106-R-2001	3/28/2001	8.4				
PRUN-107-R-2001	3/28/2001	7				
PRUN-109-R-2001	4/2/2001	17.8				
PRUN-205-R-2001	4/2/2001	10.2				
PRUN-210-R-2001	4/2/2001	12.7				
PRUN-211-R-2001	4/2/2001	10.8				
PRUN-302-C-2000	4/13/2000	9.5	0.21	0.0056		