FINAL

Water Quality Analysis of Eutrophication of the Savage River, Garrett County, Maryland

Final

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BOD	Biochemical Oxygen Demand
Chl_*a*	Active Chlorophyll
DO	Dissolved Oxygen

EXECUTIVE SUMMARY

Section 303(d) of the federal Clean Water Act (the Act) directs States 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. 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 provide justification for removal from the 303(d) list.

The Savage River was identified on the State's 1996 list of WQLSs as impaired by nutrients, among other substances. This report provides an analysis of recent monitoring data, which shows that the dissolved oxygen criterion and designated uses associated with nutrients are being met in the Savage River. 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 MDE proposes the revision of Maryland's 2002 303(d) list for public review. Although the waters of the Savage River do not display signs of eutrophication, the State reserves the right to require future controls in the Savage watershed if evidence suggests nutrients from the basin are contributing to downstream water quality problems.

1.0 INTRODUCTION

The Clean Water Act (CWA) Section 303(d) directs each State to develop a list of impaired waters, called the 303(d) list. The Savage River was first identified on the 1996 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE). Among other substances still under examination, the Savage River was listed as being impaired by nutrients. This report provides more recent information to be used in justifying the removal of the nutrients' listing for the Savage River.

In addition to the successful implementation of a TMDL, there are at least four scenarios by which a previously listed waterbody can be removed from the 303(d) list. Waters may be removed from the list based on 1) more recent data indicating that the impairment no longer exists; 2) more recent and updated water quality modeling demonstrates that the segment is now attaining standards; 3) refinements to water quality standards, or the interpretation of those standards, results in standards being met; or 4) correction to errors made in the initial listing. The first scenario most closely applies to the present case, with the qualification that the initial listing for nutrients was suspect due to the lack of data.

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

2.0 GENERAL SETTING

The Clean Water Act (CWA) Section 303(d) directs each State to develop a list of impaired waters, termed the 303(d) list. The Savage River was first identified on the 1996 303(d) list, submitted to EPA by the Maryland Department of the Environment (MDE). It was listed as being impaired by nutrients, suspended sediments, and low pH. The Savage River is designated as a Use III-P water according to the Code of Maryland Regulations 26.08.02. The dissolved oxygen standard for a Use III-P water is 5.0 mg/l. The pH may not be less than 6.5 or greater than 8.5. This document demonstrates that the Savage River was incorrectly listed on the 1996 303(d) list for nutrients. Recent monitoring data shows that this waterbody is not impaired, and should be taken off the 303(d) list.

The Savage River, a tributary of the Potomac River, is located in Garrett County Maryland (Figure 1). The River is approximately 26 miles in length from its headwaters near state route 48 to its confluence with the North Branch of the Potomac River. The Savage River Watershed has an area of approximately 116 mile^2 or 74,215 acres. The predominant landuse (Figures 2 and 3) in the watershed is forest (96.6 mile^2 or 83 %), with mixed agricultural (17.4 mile^2 or 15 %) and urban (2.0 mile^2 or 2 %).

The Savage River can be divided into four segments: (1) mouth of the river from the confluence with the North Branch of the Potomac River to the Savage River Reservoir, (2) Savage River Reservoir, (3) mainstem of the Savage River, and (4) the headwaters. Segment 1 is approximately four miles in length. The portion near the reservoir is designated State Forest. Steep topography and high stream velocities dominate this segment of the River. This segment of the river has a definite gradient with rapid currents over a rocky surface that generally causes continuous aeration of stream flow. Aaron Run is the only major stream flowing into the river within this segment.

The next segment, Savage River Reservoir, serves as a flood and water quality control reservoir as well as a drinking water supply. The reservoir spans across 310 acres and receives flow from five tributaries, including Crabtree Creek, Middle Fork, Big Run, Savage River mainstem, and

Pine Swamp Run. The reservoir is surrounded by State Forest with extreme slopes and dense growth of vegetation. The Savage River Reservoir is classified as oliogotrophic-mesotrophic.

The third segment, Savage River mainstem, is approximately 10 miles in length and receives flow from six tributaries including; Bear Pen Run, Poplar Lick Run, Elk Lick Run, Blacklick Run, Blue Lick Run, and Little Savage River. The Savage River proper flows almost exclusively through State Forest. The topography of this segment is steep slopes with dense vegetation.

The final segment, the headwaters, extend north about 20 km from the mainstem until it reaches State Route 48. It receives flow from only one major tributary, Mudlick Run. The watershed is a mountainous area with mild slopes.

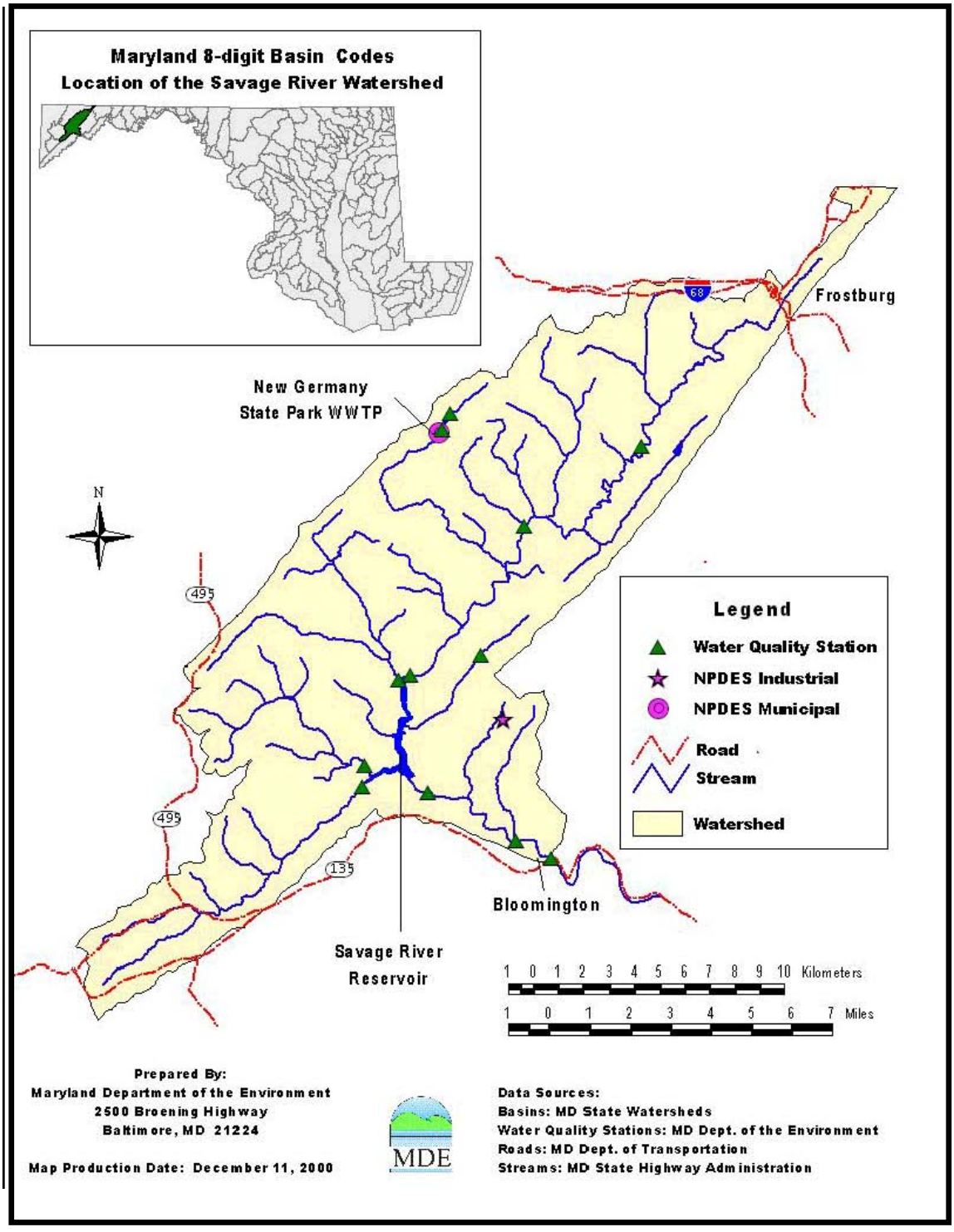

Figure 1: Watershed Map of the Savage River.

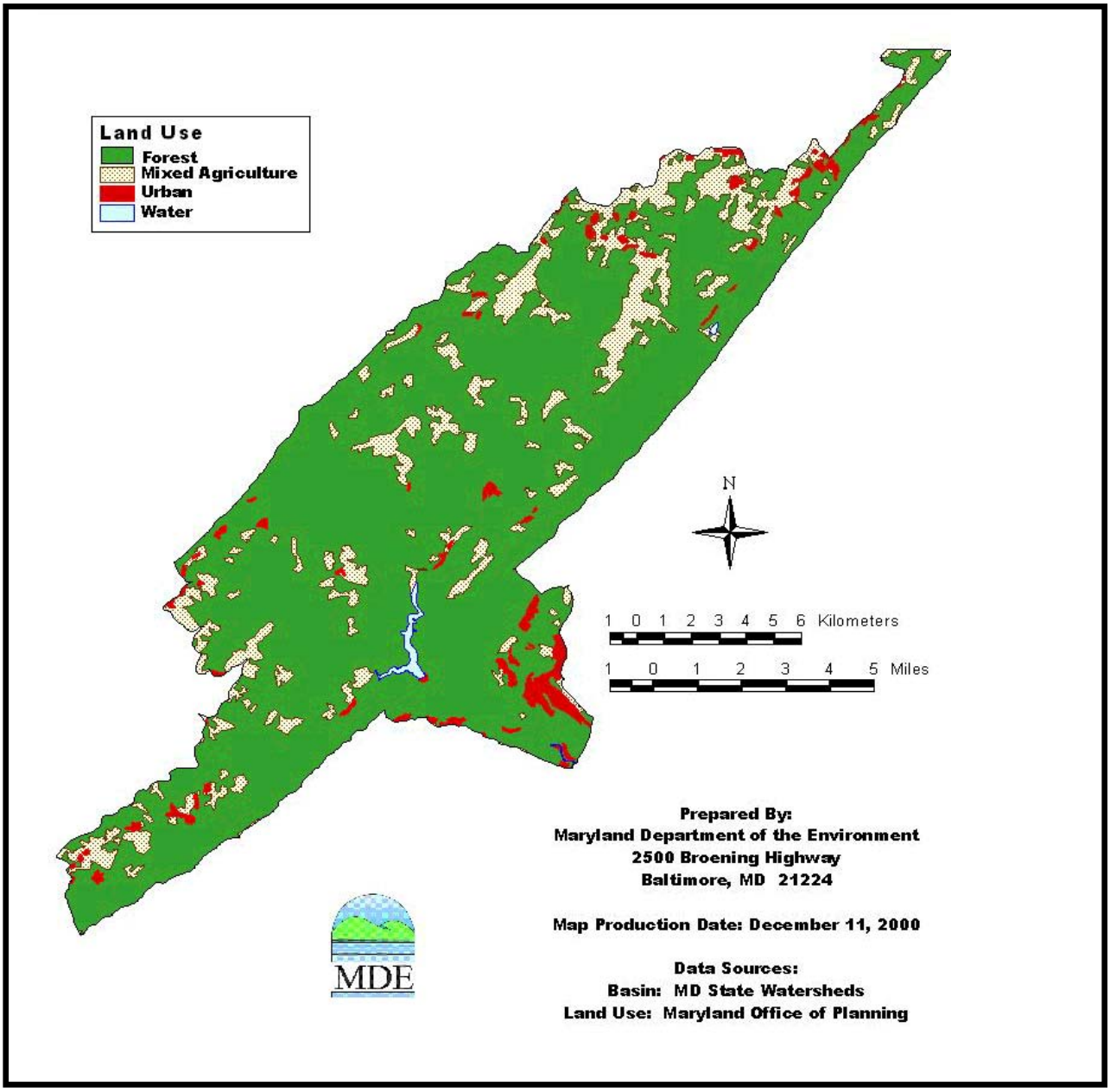

Figure 2: Landuse Map of Savage River, Maryland.

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 resultant 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 (COMAR 26.08.02.07) for the Savage River is Use III-P – *water contact recreation, fishing, protection of aquatic life and wildlife, natural trout waters, and public water supply*. According to the numeric criteria for DO for Use III-P waters, concentrations may not be less than 5.0 mg/l at any time, with a minimum daily average of not less than 6.0 mg/l (COMAR 26.08.02.03-3D(2)) unless resulting from natural conditions (COMAR 26.08.02.03.A (2)). The water quality data present in this section will show the designated use of this water body is being met.

All readily available water quality data for the last five years were considered for this analysis. Water quality surveys conducted at twelve (12) stations in the Savage River watershed from April until July 1997 were used to conduct the analysis. Table 1 shows the list of stations with their geographical coordinates and descriptive location in the Savage River.

1 Maryland does limit the ammonia form of nitrogen, from the WWTPs due its toxic affects on some aquatic organisms.

3.1 Nutrients

The total phosphorus (TP) concentrations range from 0.004 – 0.2 mg/l, while the total nitrogen (TN) concentrations range from 0.4 – 1.5 mg/l (Figures 3 and 4). Tabular data is presented in Appendix A.

3.2 Dissolved Oxygen

Figure 5 presents the dissolved oxygen concentrations sampled during the 1997 water quality surveys. The dissolved oxygen concentrations range from 1.2 mg/l to at times as high as 12 mg/l. From the total of 129 water quality samples collected within the sampling period, only four samples were below the 5.0 mg/l minimum DO threshold. Two of the four samples were taken from the bottom of the Savage Reservoir and the reliability of the samples are suspect. The other two values are 4.5 mg/l and 4.8 mg/l. Given the small number of excursions below the 5.0mg/l threshold, and their small deviation from that threshold (reservoir samples aside) the dissolved oxygen appears sufficient to support the Use III designation of this waterbody. The USEPA provides guidance for addressing situations in which a small fraction of a substantial number of samples exceed a numeric criterion (USEPA, 1995). This guideline, known as the "ten-percent rule", indicates that if 10% or fewer samples exceed the numeric criterion threshold, and there are no indications that the designated use is impacted due to the parameter of interest, then the water quality standard can be judged to be achieved. Consistent with EPA guidelines, MDE has applied the 10% rule in this case and concluded that the standard for DO is being achieved. Tabular data is presented in Appendix A.

3.3 Chlorophyll *a*

Limited chlorophyll *a* data was collected at representative sites April and May when the spring algal growth is expected to be at its peak. Observed concentrations are low and do not reach levels higher than 4.5 µg/l. This suggests that dissolved oxygen production from chlorophyll *a* photosynthesis will have no significant effect on observed DO values. These data are summarized in Figure 6. Tabular data is presented in Appendix A.

3.4 Biochemical Oxygen Demand (BOD)

Because biochemical oxygen demand (BOD) also consumes DO, this potentially confounding factor must be considered in the analysis if low DO is observed. However, because low DO is not indicated in the Casselman River, BOD does not enter into this analysis.

Table 1: Water Quality Analysis Stations for Savage River, Maryland.

#	Station I.D.	GPS coordinates	Station Description
1	SAV0000	39°28.825’ 79°04.006’	Savage River at mouth
2	AAR0000	39°29.195’ 79°05.011’	Aarons Run at mouth
3	SAV0040	39°30.177’ 79°07.477’	Savage River at bridge below dam
4	CRT0013	39°30.267’ 79°09.297’	Crabtree Run at S. River Rd
5	MDF0004	39°30.735’ 79°09.248’	Middlefork Run at S. River Rd
6	BRU0003	39°32.577’ 79°08.370’	Big Run at S. River Rd
7	SAV0078	39°32.688’ 79°08.052’	Savage River above reservoir
8	PYS0024	39°33.127’ 79°06.099’	Pine Swamp Run at S.F. boundary
9*	SAV0132	39°35.948’ 79°04.965’	Savage River at Weternport Rd
10	POP0065	39°37.966’ 79°07.332’	Poplar Lick below N.G. lake
11	POP0071	39°38.328’ 79°07.087’	Poplar Lick above N.G. lake
12	SAV0189	39°37.702’ 79°01.770’	Savage River at Avilton Rd

* Duplicate samples collected

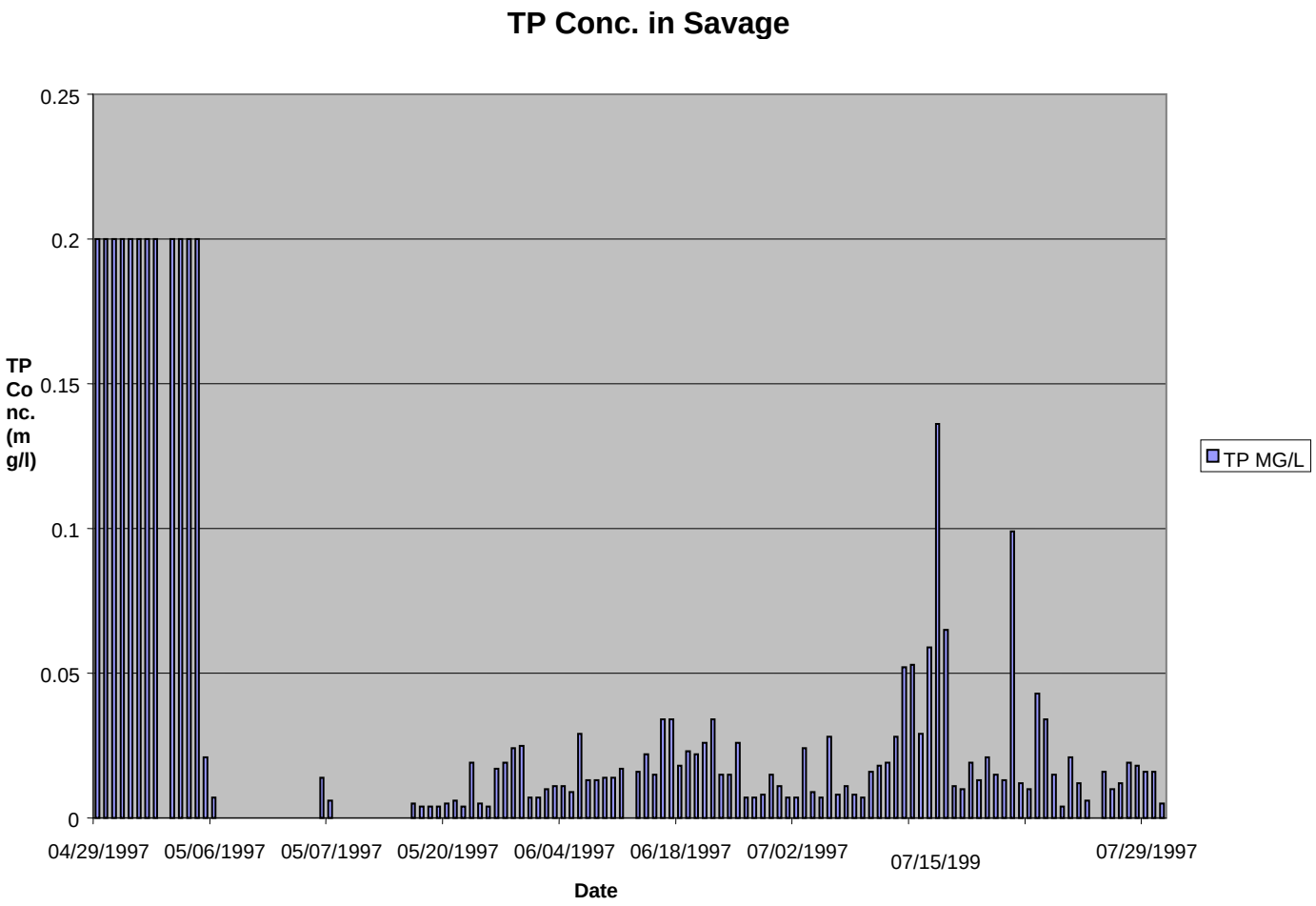

Figure 3: Total Phosphorus Concentration in Savage River, Maryland

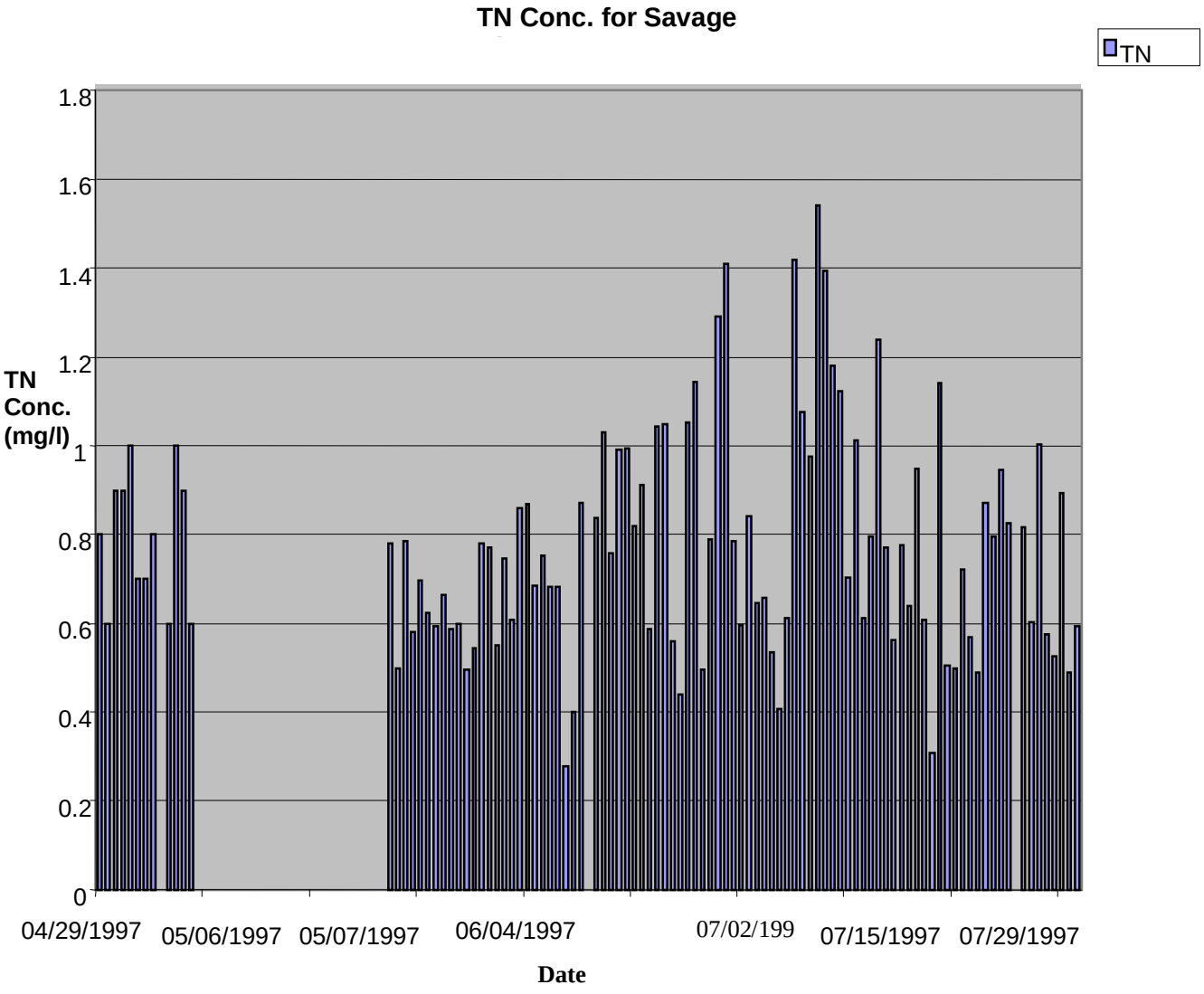

Figure 4: Total Nitrogen Concentration in Savage River, Maryland.

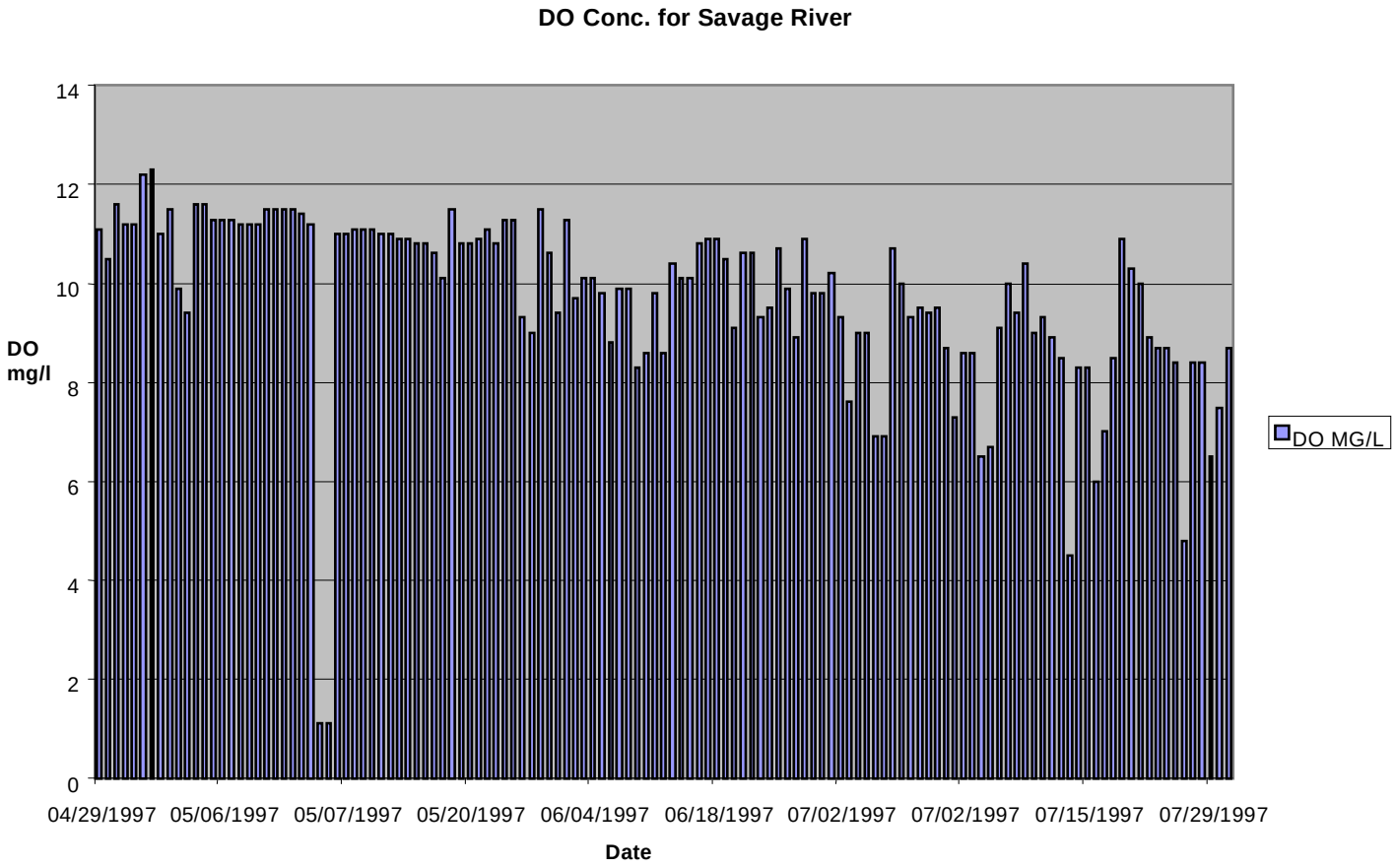

Figure 5: Dissolved Oxygen Concentration in Savage River, Maryland.

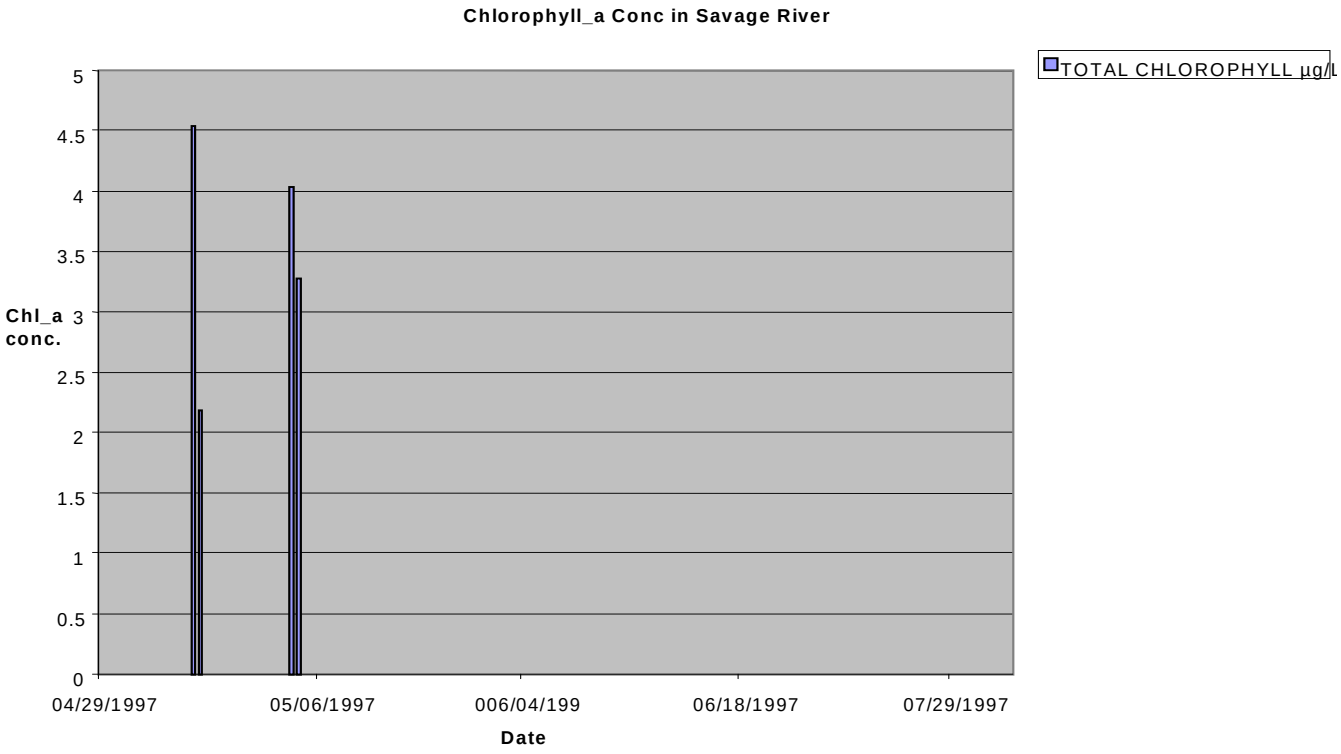

Figure 6: Chlorophyll *a* Concentration in Savage River, Maryland.

4.0 CONCLUSION

The data presented above suggest that there is no excessive algal growth in the Savage River, as indicated by low chlorophyll *a*. Similarly, dissolved oxygen concentrations meet standards. Based on the synoptic survey conducted during 1997, water quality data indicate the Savage River has no eutrophication water quality problems. 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 the Savage River.

5.0 REFERENCES

U.S. Environmental Protection Agency. Guidelines for preparation of the 1996 state water quality assessments (305(b) reports). Office of Water, Washington, DC. EPA 841-B-95-001, 1995.

Appendix A: Tabular Water Quality Data

Appendix A: Water Quality Data for Savage River, Maryland

DATE	Sampling Stations	SAMPLE DEPTH FROM SURFACE METERS	DO MG/L	TN MG/L	TP MG/L	Chl a Conc. µg/L
04/29/1997	SAV0000	0	11.1	0.80	0.20	
04/29/1997	AAR0000	0	10.5	0.60	0.20	
04/29/1997	SAV0040	0	11.6	0.90	0.20	
04/29/1997	CRT0013	0	11.2	0.90	0.20	
04/29/1997	MDF0004	0	11.2	1.00	0.20	
04/29/1997	BRU0003	0	12.2	0.70	0.20	
04/29/1997	SAV0078	0	12.3	0.70	0.20	
04/29/1997	PYS0024	0	11	0.80	0.20	
04/29/1997	SAV0132	0	11.5			
04/29/1997	POP0065	0	9.9	0.60	0.20	
04/29/1997	POP0071	0	9.4	1.00	0.20	
04/29/1997	SAV0189	0	11.6	0.90	0.20	
04/29/1997	SAV0189	0	11.6	0.60	0.20	4.53
05/06/1997	SAV0046	0.3	11.3		0.02	2.18
05/06/1997	SAV0046	0.3	11.3		0.01	
05/06/1997	SAV0046	1	11.3			
05/06/1997	SAV0046	3	11.2			
05/06/1997	SAV0046	6	11.2			
05/06/1997	SAV0046	9	11.2			
05/06/1997	SAV0046	12	11.5			
05/06/1997	SAV0046	15	11.5			
05/06/1997	SAV0046	18	11.5			
05/06/1997	SAV0046	21	11.5			
05/06/1997	SAV0046	24	11.4			
05/06/1997	SAV0046	27	11.2			
05/06/1997	SAV0046	33	1.12			
05/06/1997	SAV0046	33	1.12			
05/06/1997	SAV0061	0.3	11		0.01	4.03
05/06/1997	SAV0061	0.3	11		0.01	3.26
05/06/1997	SAV0061	1	11.1			
05/06/1997	SAV0061	3	11.1			
05/06/1997	SAV0061	5	11.1			
05/06/1997	SAV0061	7	11			
05/06/1997	SAV0061	9	11			
05/06/1997	SAV0061	11	10.9			
05/06/1997	SAV0061	13	10.9			
05/06/1997	SAV0061	15	10.8			
05/06/1997	SAV0061	16	10.8			
05/07/1997	SAV0000	0	10.6	0.78	0.01	

05/07/1997 AAR0000	0	10.1	0.50	0.00
05/07/1997 SAV0040	0	11.5	0.79	0.00
05/07/1997 CRT0013	0	10.8	0.58	0.00
05/07/1997 MDF0004	0	10.8	0.70	0.01
05/07/1997 BRU0003	0	10.9	0.62	0.01
05/07/1997 SAV0078	0	11.1	0.59	0.00
05/07/1997 PYS0024	0	10.8	0.66	0.02
05/07/1997 SAV0132	0	11.3	0.59	0.01
05/07/1997 SAV0132	0	11.3	0.60	0.00
05/07/1997 POP0065	0	9.3	0.49	0.02
05/07/1997 POP0071	0	9	0.54	0.02
05/07/1997 SAV0189	0	11.5	0.78	0.02
05/20/1997 SAV0000	0	10.6	0.77	0.03
05/20/1997 AAR0000	0	9.4	0.55	0.01
05/20/1997 SAV0040	0	11.3	0.75	0.01
05/20/1997 CRT0013	0	9.7	0.61	0.01
05/20/1997 MDF0004	0	10.1	0.86	0.01
05/20/1997 BRU0003	0	10.1	0.87	0.01
05/20/1997 SAV0078	0	9.8	0.68	0.01
05/20/1997 PYS0024	0	8.8	0.75	0.03
05/20/1997 SAV0132	0	9.9	0.68	0.01
05/20/1997 SAV0132	0	9.9	0.68	0.01
05/20/1997 POP0065	0	8.3	0.28	0.01
05/20/1997 POP0071	0	8.6	0.40	0.01
05/20/1997 SAV0189	0	9.8	0.87	0.02
05/20/1997 POP0066	0.3	8.6		
06/04/1997 SAV0000	0	10.4	0.84	0.02
06/04/1997 AAR0000	0	10.1	1.03	0.02
06/04/1997 SAV0040	0	10.1	0.76	0.02
06/04/1997 CRT0013	0	10.8	0.99	0.03
06/04/1997 MDF0004	0	10.9	0.99	0.03
06/04/1997 BRU0003	0	10.9	0.82	0.02
06/04/1997 SAV0078	0	10.5	0.91	0.02
06/04/1997 PYS0024	0	9.1	0.59	0.02
06/04/1997 SAV0132	0	10.6	1.04	0.03
06/04/1997 SAV0132	0	10.6	1.05	0.03
06/04/1997 POP0065	0	9.3	0.56	0.02
06/04/1997 POP0071	0	9.5	0.44	0.02
06/04/1997 SAV0189	0	10.7	1.05	0.03
06/18/1997 SAV0000	0	9.9	1.15	0.01
06/18/1997 AAR0000	0	8.9	0.50	0.01
06/18/1997 SAV0040	0	10.9	0.79	0.01
06/18/1997 CRT0013	0	9.8	1.29	0.02
06/18/1997 MDF0004	0	9.8	1.41	0.01
06/18/1997 BRU0003	0	10.2	0.79	0.01
06/18/1997 SAV0078	0	9.3	0.60	0.01
06/18/1997 PYS0024	0	7.6	0.84	0.02

06/18/1997 SAV0132	0	9	0.64	0.01
06/18/1997 SAV0132	0	9	0.66	0.01
06/18/1997 POP0065	0	6.9	0.53	0.03
06/18/1997 POP0071	0	6.9	0.41	0.01
06/18/1997 SAV0189	0	10.7	0.61	0.01
07/02/1997 SAV0000	0	10	1.42	0.01
07/02/1997 AAR0000	0	9.3	1.08	0.01
07/02/1997 CRT0013	0	9.5	0.98	0.02
07/02/1997 MDF0004	0	9.4	1.54	0.02
07/02/1997 BRU0003	0	9.5	1.40	0.02
07/02/1997 SAV0078	0	8.7	1.18	0.03
07/02/1997 PYS0024	0	7.3	1.12	0.05
07/02/1997 SAV0132	0	8.6	0.70	0.05
07/02/1997 SAV0132	0	8.6	1.01	0.03
07/02/1997 POP0065	0	6.5	0.61	0.06
07/02/1997 POP0071	0	6.7	0.80	0.14
07/02/1997 SAV0189	0	9.1	1.24	0.07
07/15/1997 SAV0000	0	10	0.77	0.01
07/15/1997 AAR0000	0	9.4	0.56	0.01
07/15/1997 SAV0040	0	10.4	0.78	0.02
07/15/1997 CRT0013	0	9	0.64	0.01
07/15/1997 MDF0004	0	9.3	0.95	0.02
07/15/1997 BRU0003	0	8.9	0.61	0.02
07/15/1997 SAV0078	0	8.5	0.31	0.01
07/15/1997 PYS0024	0	4.5	1.14	0.10
07/15/1997 SAV0132	0	8.3	0.50	0.01
07/15/1997 SAV0132	0	8.3	0.50	0.01
07/15/1997 POP0065	0	6	0.72	0.04
07/15/1997 POP0071	0	7	0.57	0.03
07/15/1997 SAV0189	0	8.5	0.49	0.02
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07/29/1997 BRU0003	0	8.7	0.82	0.02
07/29/1997 SAV0078	0	8.4	0.60	0.01
07/29/1997 PYS0024	0	4.8	1.00	0.01
07/29/1997 SAV0132	0	8.4	0.58	0.02
07/29/1997 SAV0132	0	8.4	0.53	0.02
07/29/1997 POP0065	0	6.5	0.89	0.02
07/29/1997 POP0071	0	7.5	0.49	0.02
07/29/1997 SAV0189	0	8.7	0.59	0.01