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Water Quality Analysis of Eutrophication for the Gwynns Falls Watershed in Baltimore County and Baltimore City, Maryland

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Table of Contents

List of Figures..... i

List of Tables i

List of Abbreviations ii

EXECUTIVE SUMMARY iii

1.0 INTRODUCTION..... 1

2.0 GENERAL SETTING 2

3.0 WATER QUALITY CHARACTERIZATION..... 6

3.1 Dissolved Oxygen 8

3.2 Chlorophyll *a* 9

3.3 Nutrients 11

3.4 Biological Stressor Identification Analysis 13

4.0 CONCLUSION 14

REFERENCES..... 15

Appendix A – Tabular Water Quality Data..... A1

List of Figures

Figure 1: Location Map and Monitoring Stations of the Lower North Branch Patapsco River Watershed 4

Figure 2: Land Use of the Lower North Branch Patapsco River Watershed..... 5

Figure 3: Lower North Branch Patapsco River Dissolved Oxygen Data for Growing Season Periods May 1999 through October 2007 9

Figure 4: Lower North Branch Patapsco River Chlorophyll *a* Data for Growing Season Periods May 1999 through October 2007 11

Figure 5: Lower North Branch Patapsco River Total Nitrogen Data from May 1999 through October 2007..... 12

Figure 6: Lower North Branch Patapsco River Total Phosphorus Data from May 1999 through October 2007..... 13

List of Tables

Table 1: Water Quality Stations in Gwynns Falls Watershed Monitored During 1998-2007 7

Table A-1: MDE Water Quality Data..... A1

Table A-2: DNR Water Quality Data A9

Table A-3: MBSS Water Quality Data A12

List of Abbreviations

BOD	Biochemical Oxygen Demand
BSID	Biological Stressor Identification
CES	Coastal Environmental Services
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
mg/l	Milligrams Per Liter
mi ²	Square Miles
NPDES	National Pollution Discharge Elimination System
NRCS	National Resources Conservation Service
SCS	Soil Conservation Service
SSURGO	Soil Survey Geography
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSI	Trophic State Index
USGS	United States 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's (EPA) 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. For each WQLS listed on the *Integrated Report of Surface Water Quality in Maryland (Integrated Report)*, 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 (CFR 2007).

Gwynns Falls (assessment unit ID: MD-02130905) was identified on the State of Maryland's *Integrated Report* as impaired by nutrients, sediments (1996 listings), bacteria (fecal coliform), and impacts to biological communities (2002 listings). The designated uses for Gwynns Falls are as follows: Gwynns Falls and tributaries above Reisterstown Road, and Red Run and its tributaries – Use III (Nontidal Cold Water); Dead Run and tributaries – Use IV (Recreational Trout Waters); and all remaining waters – Use I (Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life). See [Code of Maryland Regulations \(COMAR\) 26.08.02.08K\(3\)\(e\) & \(5\)\(e\)](#). A TMDL was completed in 2006 to address the bacteria listing. The 1996 nutrients listing was refined in the 2008 *Integrated Report* and phosphorus was identified as the specific impairing substance. Consequently, for the purpose of this report the terms nutrients and phosphorus will be used interchangeably. A TMDL for sediment is scheduled to be submitted to the EPA in 2009, and the listing for impacts to biological communities will be addressed separately at a future date.

A data solicitation for information pertaining to pollutants, including nutrients, in the Gwynns Falls basin (as part of a data solicitation for the Patapsco River basin) was conducted by MDE in November 2007, and all readily available data from the past five years have been considered. Currently, there are no specific numeric criteria for nutrients in Maryland's water quality standards. Nutrients typically do not have a direct impact on aquatic life; rather, they mediate impacts through excessive algal growth leading to low dissolved oxygen. Therefore, the evaluation of potentially eutrophic conditions due to nutrient over-enrichment will be based on whether nutrient-related parameters (i.e., dissolved oxygen levels and chlorophyll *a* concentrations) are found to impair designated uses in the Gwynns Falls (in this case, protection of aquatic life and wildlife, fishing, and swimming).

Recently, MDE developed a biological stressor identification (BSID) methodology to identify the most probable cause(s) of the existing biological impairments in Maryland 8-digit watersheds based on the suite of available physical, chemical, and land use data (MDE 2009a). The BSID analysis for the Gwynns Falls indicates inorganic pollutants, ammonia toxicity, and flow/sediment stressors are associated with impacts to biological communities; these findings will be addressed separately. The BSID analysis did not identify any nutrient stressors present and/or nutrient stressors showing a significant association with degraded biological conditions (MDE 2009b). The results of the BSID study, combined with the analysis of recent water quality data presented in this report, indicate that the Gwynns Falls is not being impaired by nutrients.

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This WQA supports the conclusion that a TMDL for nutrients is not necessary to achieve water quality standards in the Gwynns Falls.

Although the waters of the Gwynns Falls do not display signs of eutrophication, the State reserves the right to require future controls if evidence suggests that nutrients from the basin are contributing to downstream water quality problems. In December 2007, EPA approved TMDLs of nitrogen and phosphorus for the Baltimore Harbor. The Gwynns Falls watershed is located upstream of the Baltimore Harbor and drains into the Harbor's tidal waters. Although the amount of nutrients entering the Gwynns Falls is not causing localized impairments, it is contributing to the eutrophication of the downstream tidal waters of the Harbor. Therefore, the TMDL for the Baltimore Harbor requires nutrient reductions in the Gwynns Falls necessary to meet water quality standards in the Harbor. On the same principle, additional reductions may also be required by the forthcoming Chesapeake Bay TMDL, currently under development and due to be established by EPA by the end of 2010.

Barring the receipt of contradictory data, this report will be used to support a revision of the phosphorus listing for the Gwynns Falls watershed, from Category 5 ("waterbody is impaired, does not attain the water quality standard, and a TMDL is required") to Category 2 ("waterbodies meeting some [in this case nutrients-related] water quality standards, but with insufficient data to assess all impairments") when MDE proposes the revision of the *Integrated Report*.

1.0 INTRODUCTION

Section 303(d) of the federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) 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. For each WQLS listed on the *Integrated Report of Surface Water Quality in Maryland (Integrated Report)*, 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 (CFR 2007).

A segment identified as a WQLS may not require the development and implementation of a TMDL if more recent information invalidates previous findings. The most common factual scenarios obviating the need for a TMDL are: 1) analysis of more recent data indicating that the impairment no longer exists (i.e., water quality standards are being met); 2) results of a more recent and updated water quality modeling which demonstrates that the segment is attaining standards; 3) refinements to water quality standards or to the interpretation of those standards accompanied by analysis demonstrating that the standards are being met; or 4) identification and correction of errors made in the initial listing.

Gwynns Falls (Assessment Unit ID: MD-02130905) was identified in the *Integrated Report* as impaired by nutrients, sediments (1996 listings), bacteria (fecal coliform), and impacts to biological communities (2002 listings) (MDE, 2008a). The designated uses for Gwynns Falls are as follows: Gwynns Falls and tributaries above Reisterstown Road, and Red Run and its tributaries – Use III (Nontidal Cold Water); Dead Run and tributaries – Use IV (Recreational Trout Waters); and all remaining waters – Use I (Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life). See [Code of Maryland Regulations \(COMAR\) 26.08.02.08K\(3\)\(e\) & \(5\)\(e\)](#). A TMDL was completed in 2006 to address the bacteria listing. The 1996 nutrients listing was refined in the 2008 *Integrated Report* and phosphorus was identified as the specific impairing substance. Consequently, for the purpose of this report the terms nutrients and phosphorus will be used interchangeably. A TMDL for sediment is scheduled to be submitted to the EPA in 2009, and the listing for impacts to biological communities will be addressed separately at a future date.

This report provides an analysis of recent data that supports the removal of the nutrients (phosphorus) listing for the Gwynns Falls watershed when MDE proposes the revision of the State's *Integrated Report*. The remainder of this report lays out the general setting of the Gwynns Falls watershed area and presents a discussion of the water quality characteristics in the basin in terms of the existing water quality standards relating to nutrients. This analysis supports the conclusion that the waters of the Gwynns Falls watershed do not display signs of eutrophication or nutrient over-enrichment.

2.0 GENERAL SETTING

Location

The Gwynns Falls watershed is located in the Patapsco River Basin within Maryland (see Figure 1). The watershed encompasses 41,710 acres (61 square miles) in Baltimore City and Baltimore County, Maryland. The headwaters of the Gwynns Falls begin in Glyndon, Maryland and flows southeast until its confluence with the Middle Branch of the Patapsco River near downtown Baltimore. Five major tributaries of the Gwynns Falls, listed north to south, include: Red Run, Horsehead Branch, Scotts Level Branch, Dead Run, and Maidens Choice Creek.

Geology/Soils

The Gwynns Falls watershed lies within the Piedmont and Atlantic Coastal Plain Provinces of Central Maryland. The Piedmont Province is characterized by gentle to steep rolling topography, low hills and ridges. The surface geology is characterized by metamorphic crystalline rocks consisting primarily of schist and gneiss. These formations are resistant to short-term erosion and often determine the limits of stream bank and streambed. These crystalline formations decrease in elevation from northwest to southeast and eventually extend beneath the younger sediments of the Coastal Plain. The fall line represents the transition between the Atlantic Coastal Plain Province and the Piedmont Province. The Atlantic Coastal Plain surface geology is characterized by thick, unconsolidated marine sediments deposited over the crystalline rock of the piedmont province. The deposits include clays, silts, sands and gravels. In the areas around the head of tide, the topography is flat, with elevations below 100 feet. The elevations steadily increase going north to approximately 600 feet in the headwaters. Streambeds throughout the basin are comprised of rock and rubble with gradually sloped stream banks.

The Gwynns Falls watershed lies predominantly in the Baile and Lehigh soil series. The Lehigh soil series consists of somewhat poorly drained to moderately well-drained, rather shallow soils. The Baile soil series consists of deep, poorly drained, nearly level to gently sloping, dominantly gray soils of the Piedmont Plateau. Baile soils have a high available moisture capacity and a water table that is seasonally at or near the surface (U.S. Department of Agriculture (USDA), 1995).

Land Use

The 2002 Maryland Department of Planning (MDP) land use/land cover data show that the Gwynns Falls watershed is primarily a residential and commercial region. The watershed contains 33,100 acres of residential land use and commercial land use. Forest lands account for 7,068 acres of the watershed, found primarily along the mainstem and tributaries of Gwynns Falls. A small portion of the watershed, 1,738 acres, consists of crops and pasture lands. The land use spatial distributions for each land use are presented in Figure 2.

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Point Sources

There are no municipal or industrial point source facilities with permits regulating their discharges in the Gwynns Falls watershed.

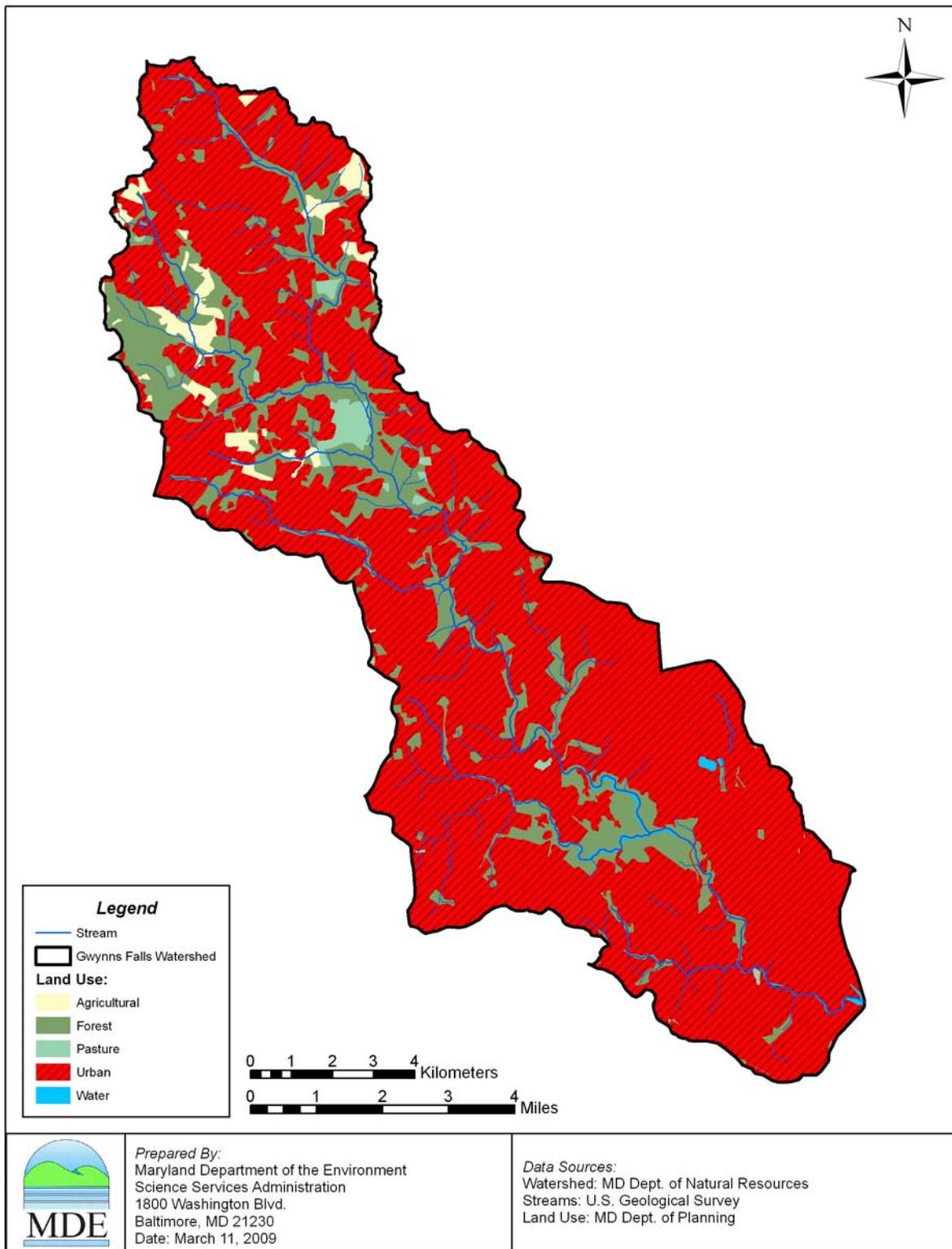


Figure 2: Land Use of the Gwynns Falls Watershed

3.0 WATER QUALITY CHARACTERIZATION

The Maryland Surface Water Use Designation for Gwynns Falls are as follows: Gwynns Falls and tributaries above Reisterstown Road, and Red Run and its tributaries – Use III (Non-tidal Cold Water); Dead Run and tributaries – Use IV (Recreational Trout Waters); and all remaining waters – Use I (Water Contact Recreation, and Protection of Nontidal Warmwater Aquatic Life) (COMAR 26.08.02.08K(3)(e) & (5)(e)). 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 support of aquatic life, primary or secondary contact recreation, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. The criteria developed to protect the designated use may differ and are dependent on the specific designated use(s) of a waterbody.

Currently, there are no specific numeric criteria for nutrients in Maryland's water quality standards. Therefore, the evaluation of potentially eutrophic conditions due to nutrient over-enrichment will be based on whether nutrient-related parameters (i.e., dissolved oxygen levels and chlorophyll *a* concentrations) are found to impair designated uses in the Gwynns Falls. The dissolved oxygen (DO) concentration to protect Use I and Use IV waters "may not be less than 5 milligrams per liter (mg/l) at any time" (COMAR 26.08.02.03-3A(2)). The DO concentration to protect Use III waters may not be less than 5 milligrams/liter at any time, with a minimum daily average of not less than 6 milligrams/liter" (COMAR 26.08.02.03-3D(2)). The water quality data presented in this section will show that DO concentrations in the Gwynns Falls and its tributaries meet these criteria, and that Maryland's narrative criteria for chlorophyll *a* are also met.

In addition to the DO and chlorophyll *a* data analysis, the results of a new biological stressor identification (BSID) analysis demonstrate that any biological impairment in the watershed is not caused by nutrient enrichment. Instead, the analysis suggests that the degradation to biological communities in the Gwynns Falls is strongly associated with the extensive urban nature of the watershed, which results in altered hydrology and elevated levels of ammonia¹, chlorides, and conductivity (a measure of the presence of dissolved substances) (MDE 2009b).

A data solicitation was conducted in 2007. All readily available water quality data from the past five years have been considered for this analysis. Water quality data from MDE surveys conducted along the Gwynns Falls from October 1999 through August 2000, October 2002 through December 2005, and January 2007 through December 2007, were used. Maryland Department of Natural Resources (DNR) data used in the analysis were from January 1998 through June 2007. Data from Maryland Biological Stream Survey (MBSS) sampling conducted in April 2000, and March 2004, were also used. Table 2 lists the water quality monitoring stations in the Gwynns Falls watershed with their geographical coordinates. Figures 3 through 6 provide graphical representation of the collected data for the parameters discussed below.

¹ Ammonia is a nitrogen nutrient species which, in excessive amounts has potential toxic effects on aquatic life. Maryland has numeric toxic substance criteria for ammonia for the protection of fresh water aquatic life (COMAR 26.08.02.03-2(H)).

Table 3.1: Water Quality Stations in Gwynns Falls Watershed Monitored During 1998-2007

Station ID	Agency/Program	Latitude (Decimal-Degrees)	Longitude (Decimal-Degrees)
GWN0015	MDE	39.271	-76.648
GWN0215	MDE	39.443	-76.783
DDR0001	MDE	39.305	-76.686
GWN0024	MDE	39.269	-76.662
GWN0026	MDE	39.277	-76.662
GWN0050	MDE	39.306	-76.679
GWN0080	MDE	39.325	-76.715
GWN0125	MDE	39.360	-76.745
GWN0160	MDE	39.392	-76.765
GWN0179	MDE	39.411	-76.779
GWN0186	MDE	39.421	-76.782
MCR0001	MDE	39.276	-76.662
RDR0001	MDE	39.405	-76.779
RDR0008	MDE	39.402	-76.786
UHX0001	MDE	39.360	-76.746
GWN0115	DNR/MDE	39.343	-76.726
GWYN-102-R-2004	DNR/MBSS	39.400	-76.820
GWYN-104-R-2004	DNR/MBSS	39.380	-76.800
GWYN-105-R-2004	DNR/MBSS	39.380	-76.770
GWYN-107-R-2004	DNR/MBSS	39.450	-76.800
GWYN-112-R-2004	DNR/MBSS	39.390	-76.810
GWYN-210-R-2004	DNR/MBSS	39.300	-76.690
GWYN-211-R-2004	DNR/MBSS	39.300	-76.700
GWYN-301-R-2004	DNR/MBSS	39.280	-76.660
GWYN-301-X-2000	DNR/MBSS	39.340	-76.730
GWYN-302-X-2000	DNR/MBSS	39.440	-76.780
GWYN-303-R-2004	DNR/MBSS	39.390	-76.760
GWYN-306-R-2004	DNR/MBSS	39.270	-76.650

Antidegradation Policy and Tier II Waters

Antidegradation is one of three key components required by the Clean Water Act. These three components are: designated uses, water quality criteria, and antidegradation policy. The Clean Water Act's (CWA) Tier II antidegradation policy is found in section 303(d) and its goals are to 1) ensure that no activity will lower water quality to support existing uses, and 2) maintain and protect high quality waters.

Waters of the Gwynns Falls watershed designated as Tier II are listed in Table 2.1.

*Gwynns Falls WQA - Eutrophication
Document version: September 1, 2009*

Table 2.1: High Quality (Tier II) Waters in the Loch Raven Reservoir Watershed

Tier II Segment	County	Segment Length (miles)
Red Run 1	Baltimore	1.63

3.1 Dissolved Oxygen

DNR samples were taken in the Gwynns Falls from January 1998 through June 2007. MDE samples were taken from October 1999 through August 2000, October 2002 through December 2005, and January 2007 through December 2007, and MBSS samples were taken in April 2000, and March 2004. Samples taken during the growing season (May through October) show DO concentrations ranging from 5.4 to 11.8 mg/l, all above the DO criterion for Use I waters of 5 mg/l. There is one monitoring station located in Dead Run (DDR0001), a tributary of the Gwynns Falls designated as Use IV. All four samples at this station have DO concentrations above the Use IV criterion of 5 mg/l, with a lowest value of 5.4 mg/l. Gwynns Falls and its tributaries above Reisterstown Road are designated as Use III. Monitoring Stations located above Reisterstown Road are: GWN0179, GWN0186, GWN0215, GWYN107-X and GWYN302-R. In addition, Red Run and its tributaries are designated as Use III. Stations located in Red Run are: RDR0001 and RDR0008. All samples at these seven monitoring stations have DO concentrations above the Use III daily average criterion of 6 mg/l. DO concentrations at these stations located above Reisterstown Road are between 6.6 and 10.9 mg/l. DO data are presented graphically in Figure 3 and in tabular form in Appendix A. The water quality standard for DO is being met in the Gwynns Falls watershed.

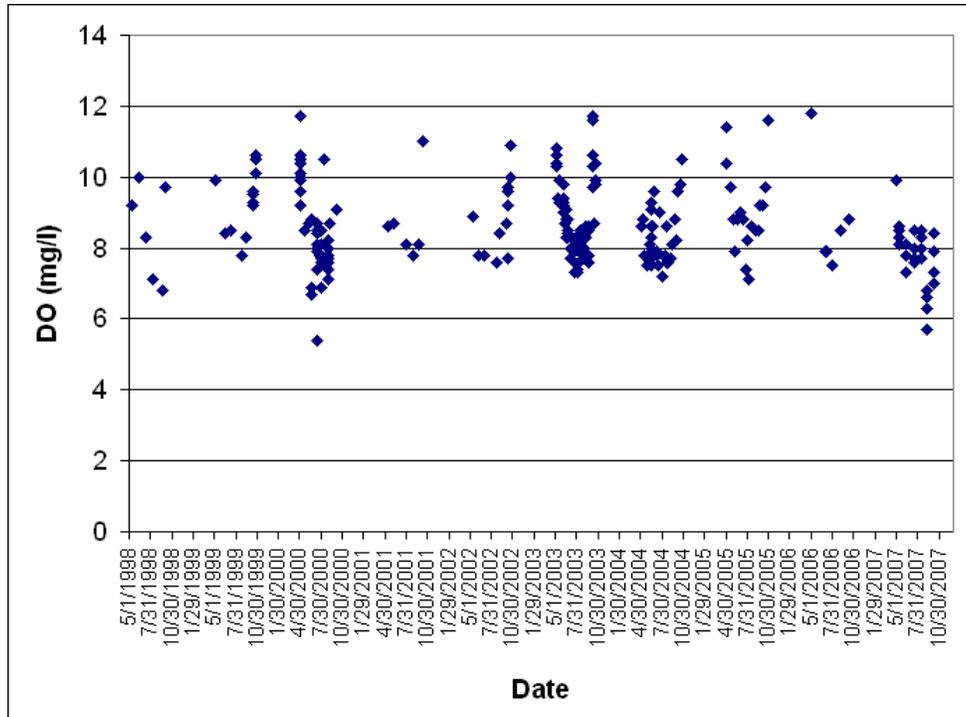


Figure 3: Gwynns Falls Dissolved Oxygen Data for Growing Season Periods May 1999 through October 2007

3.2 Chlorophyll *a*

Currently, Maryland water quality standards do not specify numeric criteria for chlorophyll *a*. However, pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere with designated uses is prohibited (COMAR 26.08.02.03B(2)). Elevated chlorophyll *a* concentrations, a measure of algal growth, may indicate poor water quality that cannot support a waterbody's designated uses and may constitute a nuisance condition. Nuisance levels of algae can interfere with uses related to recreational activities such as fishing, boating, and aesthetic appreciation. High chlorophyll *a* levels can also present taste, odor, and treatment problems in water supply systems.

Narrative water quality criteria are an important component of the State's water quality standards, but are difficult to incorporate into quantitative water quality or TMDL analyses. In the case of free-flowing non-tidal waters, there is an insufficient understanding of the relationship between chlorophyll *a* concentrations and the waterbody's designated use impairment. However, COMAR includes narrative criteria for acceptable chlorophyll *a* levels in tidal waters. Maryland's numeric interpretation of these criteria for application in estuarine waters, adapted from previously approved nutrient TMDLs, is as follows:

The chlorophyll *a* concentration goal used by the State in estuarine TMDL analyses is based on 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). The chlorophyll *a* narrative criterion (COMAR 26.08.02.03-3C(10)) states: “Chlorophyll *a* - Concentrations of chlorophyll *a* in free-floating microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences that would render tidal waters unsuitable for designated uses.” The Thomann and Mueller guidelines acknowledge that “Undesirable levels of phytoplankton [chlorophyll *a*] vary considerably depending on water body.” MDE has determined, per Thomann and Mueller, that it is acceptable to maintain chlorophyll *a* concentrations below a maximum of 100 µg/L, and to target, with some flexibility depending on waterbody characteristics, a 30-day rolling average of approximately 50 µg/L (with some flexibility depending on waterbody characteristics). (MDE 2006)

Maryland has also developed guidelines for application of the narrative criteria in drinking water reservoirs. The guidelines, adapted from previously approved TMDLs, are as follows:

The chlorophyll *a* endpoints selected for public water supply reservoirs are (a) a ninetieth-percentile instantaneous concentration not to exceed 30 µg/l in the surface layers, and (b) a 30-day moving average concentration not to exceed 10 µg/l in the surface layers. The concentration of 10 µg/l corresponds to a score of approximately 53 on the Carlson’s Trophic State Index (TSI). This is at the boundary of mesotrophic and eutrophic conditions, which is an appropriate trophic state at which to manage these reservoirs. Mean chlorophyll *a* concentrations exceeding 10 µg/l are associated with peaks exceeding 30 µg/l, which in turn are associated with a shift to blue-green assemblages, which present taste, odor and treatment problems (Walker 1984). Achieving these chlorophyll *a* endpoints should thus safeguard such reservoirs from nuisance algal blooms. (MDE 2008b)

Using the chlorophyll *a* targets for tidal waters and public water supply reservoirs described above as screening values for non-tidal waters, the following data analysis reflects an absence of excessive algal growth in the Gwynns Falls, as indicated by low chlorophyll *a* concentrations in comparison with those values.

DNR and MDE monitoring data in the Gwynns Falls show growing season (May through October) averages, by station, between 1.03 and 2.88 µg/l. These samples show observed chlorophyll *a* concentrations ranging from 0.21 and 14.95 µg/l, with only 2 samples (out of 182) above 10 µg/l. These monitoring data values suggest that chlorophyll *a* concentrations any nuisance issues due to nutrients in the Gwynns Falls or interfering with its designated uses.

The chlorophyll *a* data are presented graphically in Figure 4 and in tabular form in Appendix A.

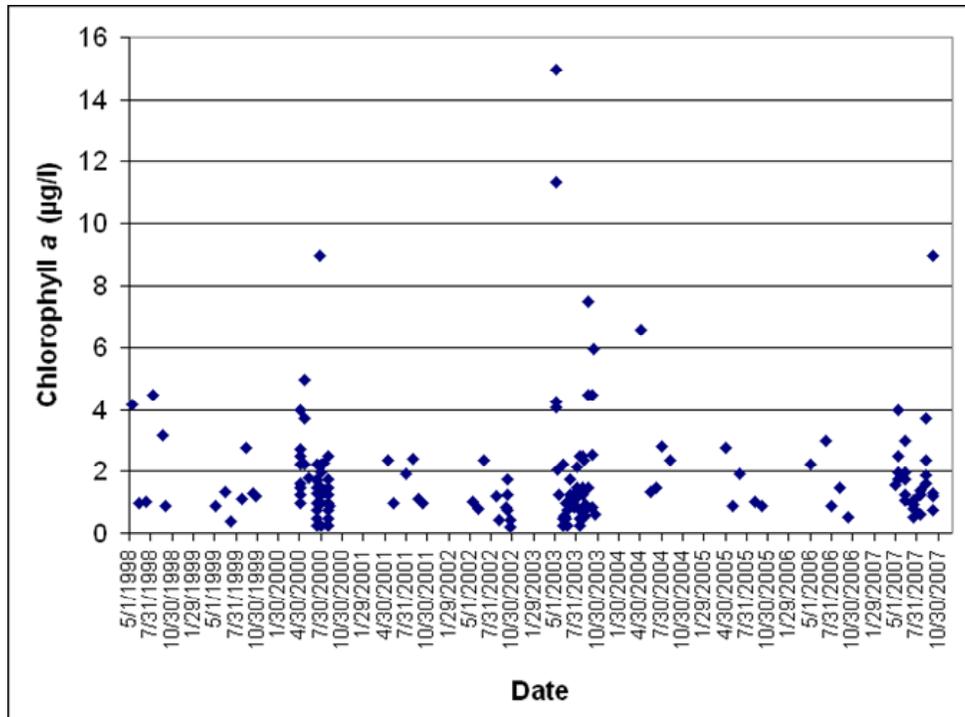


Figure 4: Gwynns Falls Chlorophyll *a* Data for Growing Season Periods May 1999 through October 2007

3.3 Nutrients

In the absence of State water quality standards with specific numeric limits for nutrients, evaluation of potentially eutrophic conditions is based on whether nutrient-related parameters (i.e., dissolved oxygen levels and chlorophyll *a* concentrations) are found to impair the designated uses in the Gwynns Falls (in this case protection of aquatic life and wildlife, fishing, and swimming). Consequently, the nutrients data presented in this section are for informational purposes only.

Total nitrogen (TN) and total phosphorus (TP) data for the Gwynns Falls have been collected as part of this study and the results are presented here for informational purposes, graphically in Figures 5 and 6, and in tabular form in Appendix A. In general, DNR, MDE, and MBSS data show TN concentrations during the growing season (May through October) ranging from 0.89 to 4.39 mg/l and TP concentrations ranging from 0.006 to 0.36 mg/l.

In the absence of specific numeric criteria to assess the TP and TN monitoring data results, MDE evaluated these results using its BSID methodology, which compared Gwynns Falls parameters to the results from similar control sites (i.e., watersheds with no biological impairments) and concluded that nutrients are not likely stressors associated with the degraded biological conditions (MDE 2009b). Current DO conditions in the Gwynns Falls further support this conclusion.

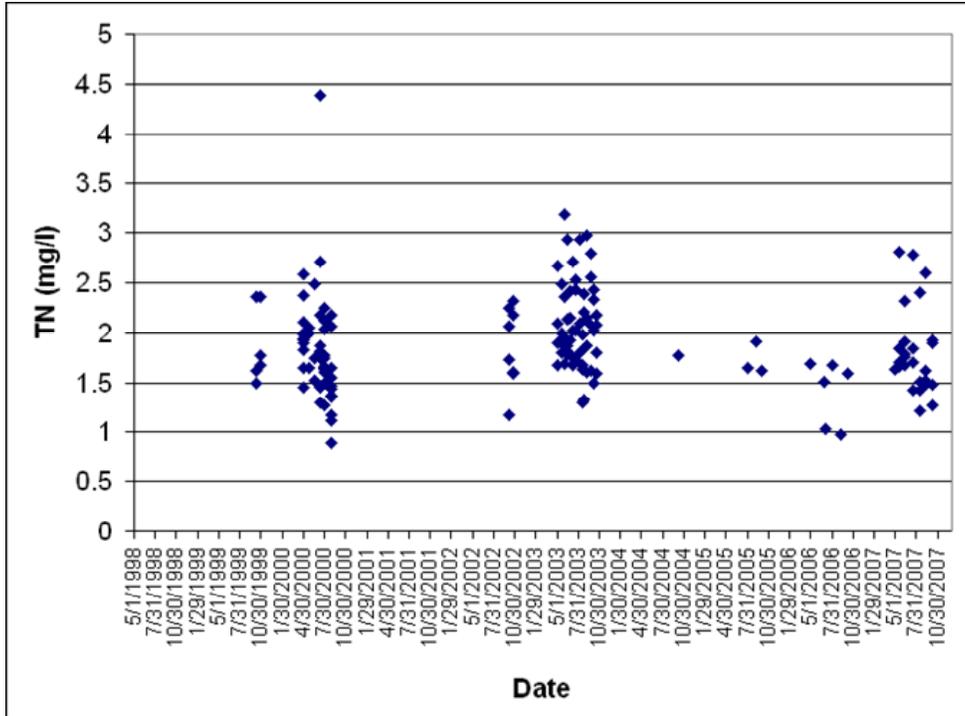


Figure 5: Gwynns Falls Total Nitrogen Data from May 1999 through October 2007

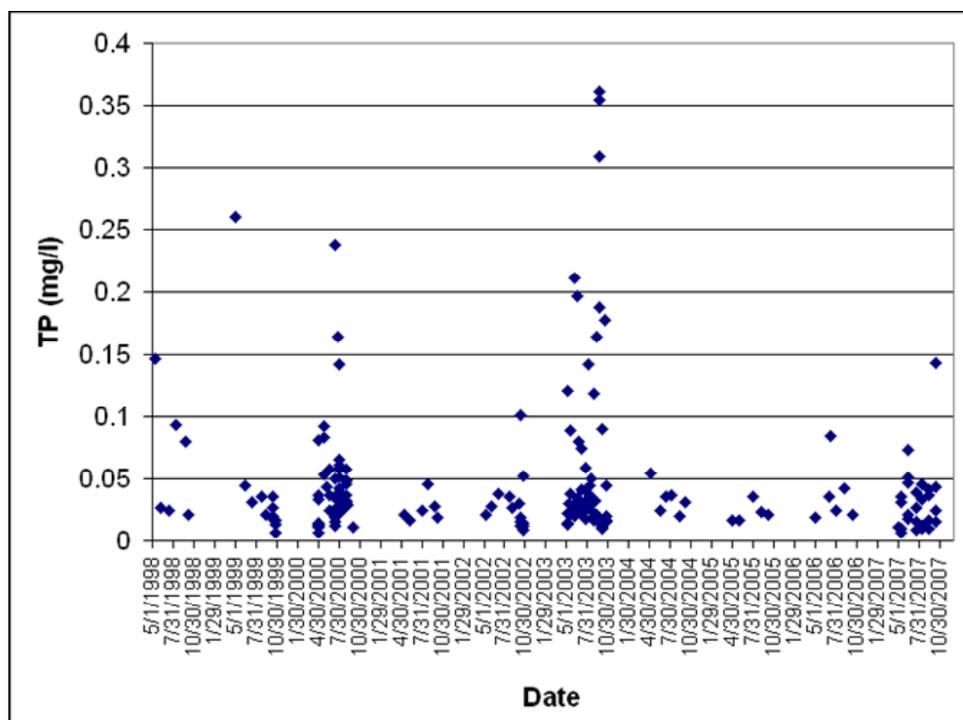


Figure 6: Gwynns Falls Total Phosphorus Data from May 1999 through October 2007

3.4 Biological Stressor Identification Analysis

In the process of evaluating the existing biological impairments, MDE developed a BSID methodology (MDE 2009a). The BSID methodology uses data available from the statewide DNR MBSS. These data are presented in Appendix A. The current MDE biological assessment methodology is a three-step process: (1) a data quality review, (2) a systematic vetting of the dataset, and (3) a watershed assessment that presents the results of this assignment in terms of currently used *Integrated Report* listing categories.

The BSID analysis for the Gwynns Falls watershed did not identify nutrients (as indicated by DO, total nitrogen, total phosphorus, etc.) as potential stressors or indicate any significant association between current nutrient levels and the degraded biological conditions (MDE 2009b). According to this report, nutrients are not causing any impairment to aquatic life or biological communities in the Gwynns Falls.

The BSID analysis results suggest rather that the degradation of biological communities in the Gwynns Falls watershed is strongly associated with the urban nature of the watershed, which has resulted in altered hydrology and elevated levels of ammonia, chlorides, and conductivity (a measure of the presence of dissolved substances). As explained in the BSID report, the urbanization of landscapes creates broad and interrelated forms of degradation (i.e., hydrological, morphological, and water chemistry) that can affect stream ecology and biological composition. Peer-reviewed scientific literature establishes a link between highly urbanized landscapes and degradation in the aquatic health of non-tidal stream ecosystems.

4.0 CONCLUSION

Based on the analysis of data presented in the preceding section of this report, indicating that DO and chlorophyll *a* concentrations are meeting water quality criteria, and on the results of the Gwynns Falls BSID analysis, MDE concludes that currently the Gwynns Falls watershed is not being impaired by nutrients. (The BSID analysis indicates inorganic pollutants, ammonia toxicity, and flow/sediment stressors are associated with impacts to biological communities; these findings will be addressed separately.) Barring the receipt of contradictory data, this report will be used to support a revision of the phosphorus listing for the Gwynns Falls watershed, from Category 5 (“waterbody is impaired, does not attain the water quality standard, and a TMDL is required”) to Category 2 (“waterbodies meeting some [in this case nutrients-related] water quality standards, but with insufficient data to assess all impairments”), when MDE proposes the revision of Maryland’s *Integrated Report*.

Although the waters of the Gwynns Falls do not display signs of eutrophication, the State reserves the right to require future controls if evidence suggests that nutrients from the basin are contributing to downstream water quality problems. In December 2007, EPA approved TMDLs of nitrogen and phosphorus for the Baltimore Harbor. The Gwynns Falls watershed is located upstream of the Baltimore Harbor and drains into the Harbor’s tidal waters. Although the amount of nutrients entering the Gwynns Falls is not causing localized impairments, it is contributing to the eutrophication of the downstream tidal waters of the Harbor. Therefore, the TMDL for the Baltimore Harbor requires nutrient reductions in the Gwynns Falls necessary to meet water quality standards in the Harbor. On the same principle, additional reductions may also be required by the forthcoming Chesapeake Bay TMDL, currently under development and due to be established by EPA by the end of 2010.

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Appendix A – Tabular Water Quality Data

Table A-1: MDE Water Quality Data

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
DDR0001	7/12/2000	5.40	1.50	4.387	0.2379
DDR0001	8/2/2000	6.90	1.28	2.249	0.1424
DDR0001	4/4/2000	9.00	12.46	1.226	0.0615
DDR0001	5/3/2000	10.10	2.49	2.380	0.0807
DDR0001	3/8/2000	12.30	5.98	2.546	0.1381
DDR0001	8/31/2000		0.75	1.168	0.0478
GWN0015	9/12/2007	6.30	3.74	1.617	0.0410
GWN0015	6/20/2000	6.70		1.750	0.0574
GWN0015	7/22/2003	7.30	0.85	2.530	0.0587
GWN0015	8/5/2003	7.30	1.50	2.931	0.1421
GWN0015	6/13/2007	7.30	2.99	1.791	0.0737
GWN0015	8/2/2000	7.60	1.00	1.665	0.0654
GWN0015	7/18/2007	7.60	1.09	1.701	0.0386
GWN0015	10/8/2002	7.70	1.25	2.251	0.1008
GWN0015	7/8/2003	7.70	1.74	2.711	0.0740
GWN0015	8/15/2007	7.70	1.37	1.514	0.0460
GWN0015	10/11/2007	7.90	8.97	1.899	0.1429
GWN0015	5/16/2007	8.10	2.49	1.850	0.0309
GWN0015	6/17/2003	8.30	1.00	2.931	0.1968
GWN0015	11/15/2007	8.30	5.48	2.001	0.2281
GWN0015	6/24/2003	8.40	0.75	2.422	0.0801
GWN0015	8/19/2003	8.40	0.25	1.631	0.0498
GWN0015	9/9/2003	8.40	0.75	2.973	0.1642
GWN0015	5/24/2000	8.50	3.74	1.653	0.0837
GWN0015	8/26/2003	8.50	2.49	2.389	0.1194
GWN0015	9/23/2003	8.60	7.48	2.800	0.3613
GWN0015	4/4/2000	8.70	8.97	1.905	0.0854
GWN0015	7/12/2000	8.70	1.71	1.782	0.0498
GWN0015	6/3/2003	9.00	2.24	3.179	0.2106
GWN0015	10/13/1999	9.30		1.625	0.0268
GWN0015	5/20/2003	9.30	1.25	2.490	0.0887
GWN0015	4/25/2007	9.40	2.99	1.424	0.0089
GWN0015	10/21/2003	9.80		2.084	0.0446
GWN0015	10/22/2002	10.00		1.608	0.0521
GWN0015	10/26/1999	10.10	1.22	1.674	0.0171
GWN0015	11/13/2002	10.10	1.50	1.330	0.0750
GWN0015	5/6/2003	10.30	14.95	2.669	0.1208
GWN0015	4/22/2003	10.60	14.20	2.461	0.0761
GWN0015	12/12/2007	10.80		1.686	0.0324
GWN0015	11/25/2002	10.90	0.25	3.229	0.1324
GWN0015	2/29/2000	11.40	3.99	1.788	0.0435

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0015	1/11/2000	11.50	3.49	1.875	0.0545
GWN0015	12/14/1999	11.60	14.95	2.108	0.2640
GWN0015	3/8/2000	11.60	2.74	1.870	0.0314
GWN0015	5/3/2000	11.70	3.99	1.935	0.0367
GWN0015	10/7/2003	11.70	4.49	2.432	0.0902
GWN0015	3/14/2007	11.90	2.74	1.852	0.0148
GWN0015	12/17/2002	12.10		2.157	0.0969
GWN0015	2/4/2003	12.10	29.90	4.100	0.6093
GWN0015	3/18/2003	12.10	4.49	2.419	0.0963
GWN0015	11/30/1999	12.20	0.75	1.641	0.0335
GWN0015	12/3/2002	12.20	0.25	3.091	0.1404
GWN0015	1/7/2003	12.20	0.43	2.932	0.1135
GWN0015	11/16/1999	12.30	2.35	1.515	0.0164
GWN0015	2/23/2000	12.50	1.64	1.881	0.0183
GWN0015	3/4/2003	12.50		3.018	0.1141
GWN0015	1/22/2003	13.10	0.75	4.214	0.2701
GWN0015	1/24/2000	13.30		2.406	0.0236
GWN0015	1/18/2007	13.60	1.00	1.921	0.0174
GWN0015	2/26/2007	13.70	6.48	2.086	0.0442
GWN0015	8/31/2000		1.50	1.171	0.0484
GWN0024	4/4/2000	8.80	5.98	1.737	0.0631
GWN0024	3/8/2000	11.90	3.74	1.789	0.0229
GWN0026	7/22/2003	7.90	1.28	1.717	0.0295
GWN0026	8/5/2003	8.10	1.28	1.693	0.0374
GWN0026	7/8/2003	8.30	1.25	1.671	0.0412
GWN0026	8/26/2003	8.30	1.50	1.323	0.0176
GWN0026	8/19/2003	8.50	0.75	1.303	0.0352
GWN0026	9/23/2003	8.50	4.49	2.550	0.3540
GWN0026	9/9/2003	8.60	0.75	1.602	0.0216
GWN0026	6/24/2003	8.80	1.00	1.782	0.0330
GWN0026	6/17/2003	9.10	0.50	1.770	0.0341
GWN0026	6/3/2003	9.80	0.50	1.696	0.0301
GWN0026	5/20/2003	9.90	1.25	1.892	0.0381
GWN0026	10/21/2003	10.40	0.64	1.586	0.0204
GWN0026	4/22/2003	10.80	14.45	1.487	0.0185
GWN0026	5/6/2003	10.80	11.32	1.671	0.0221
GWN0026	10/7/2003	11.60	2.56	1.501	0.0101
GWN0026	2/4/2003	12.30	37.38	4.330	0.6595
GWN0026	11/25/2002	12.40		1.665	0.0212
GWN0026	3/18/2003	12.60	3.74	1.646	0.0219
GWN0026	12/17/2002	12.90		1.736	0.0248
GWN0026	3/4/2003	13.00		2.183	0.0506
GWN0026	1/7/2003	13.20	0.21	2.050	0.0285
GWN0026	12/3/2002	13.30		1.625	0.0176
GWN0026	1/22/2003	14.00		2.226	0.0144
GWN0050	9/12/2007	5.70	2.39	1.521	0.0365
GWN0050	8/2/2000	8.10	1.99	1.490	0.0508

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0050	6/13/2007	8.10	1.99	1.674	0.0466
GWN0050	5/16/2007	8.30	3.99	1.658	0.0358
GWN0050	8/15/2007	8.30	1.25	1.217	0.0330
GWN0050	10/11/2007	8.40	1.28	1.477	0.0435
GWN0050	7/12/2000	8.50	1.28	1.459	0.0347
GWN0050	7/18/2007	8.50	0.95	1.421	0.0265
GWN0050	4/4/2000	9.00	14.45	1.530	0.0440
GWN0050	11/15/2007	10.00	4.49	1.360	0.0264
GWN0050	4/25/2007	10.50	3.49	1.185	0.0097
GWN0050	5/3/2000	10.60	2.24	1.827	0.0337
GWN0050	12/12/2007	11.70	1.50	1.416	0.0167
GWN0050	3/14/2007	12.40	4.24	1.628	0.0085
GWN0050	2/26/2007	12.90	6.23	1.966	0.0428
GWN0050	1/18/2007	13.90	1.50	1.775	0.0076
GWN0050	3/8/2000	14.20	5.23	1.574	0.0175
GWN0050	8/31/2000		1.50	0.890	0.0367
GWN0080	7/12/2000	7.40	2.24	1.781	0.0360
GWN0080	8/2/2000	8.50	2.24	1.495	0.0615
GWN0080	4/4/2000	8.90	3.49	1.614	0.0451
GWN0080	5/3/2000	9.90	2.74	1.900	0.0337
GWN0080	3/8/2000	12.10	2.24	1.812	0.0205
GWN0080	8/31/2000		0.50	1.434	0.0574
GWN0115	6/20/2000	6.90		1.526	0.0365
GWN0115	8/4/2005	7.10			
GWN0115	8/5/2003	7.40	0.85	1.803	0.0318
GWN0115	7/26/2005	7.40			
GWN0115	5/27/2004	7.50			
GWN0115	7/14/2004	7.50			
GWN0115	8/2/2000	7.60	1.25	1.640	0.0360
GWN0115	8/2/2000	7.60	1.25	1.603	0.0371
GWN0115	7/22/2003	7.60	1.07	2.031	0.0181
GWN0115	7/22/2003	7.60			
GWN0115	9/23/2003	7.60	1.50	2.081	0.3093
GWN0115	9/23/2003	7.60			
GWN0115	9/23/2003	7.60			
GWN0115	8/26/2004	7.60			
GWN0115	8/31/2000	7.80	1.50	1.369	0.0320
GWN0115	8/31/2000	7.80	1.00	1.357	0.0312
GWN0115	5/19/2004	7.80			
GWN0115	7/9/2004	7.80			
GWN0115	8/12/2004	7.80			
GWN0115	8/26/2003	7.90	0.50	1.841	0.0199
GWN0115	6/8/2005	7.90			
GWN0115	7/8/2003	8.00	1.00	1.679	0.0231
GWN0115	7/8/2003	8.00			
GWN0115	8/19/2003	8.00	0.50	1.673	0.0292
GWN0115	8/19/2003	8.00			

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	6/10/2004	8.10			
GWN0115	9/10/2004	8.10			
GWN0115	9/29/2004	8.20			
GWN0115	8/5/2003	8.30			
GWN0115	7/12/2000	8.40	1.00	1.746	0.0154
GWN0115	7/12/2000	8.40	1.74	1.749	0.0161
GWN0115	9/9/2003	8.40	0.56	1.876	0.0189
GWN0115	4/4/2000	8.50	6.48	1.688	0.0470
GWN0115	4/4/2000	8.50	5.73	1.702	0.0495
GWN0115	5/24/2000	8.50	4.98	2.059	0.0926
GWN0115	6/24/2003	8.50	0.25	1.930	0.0255
GWN0115	9/9/2003	8.50			
GWN0115	9/15/2005	8.50			
GWN0115	4/22/2004	8.60			
GWN0115	6/24/2004	8.60			
GWN0115	8/17/2004	8.60			
GWN0115	8/18/2005	8.60			
GWN0115	6/17/2003	8.80	0.50	1.874	0.0237
GWN0115	6/17/2003	8.80			
GWN0115	5/13/2004	8.80			
GWN0115	9/23/2004	8.80			
GWN0115	6/23/2005	8.80			
GWN0115	7/13/2005	8.80			
GWN0115	11/6/2003	8.90			
GWN0115	7/22/2004	9.00			
GWN0115	5/3/2000	9.20	1.00	1.994	0.0119
GWN0115	5/3/2000	9.20	1.25	1.984	0.0122
GWN0115	6/3/2003	9.20	0.25	1.955	0.0213
GWN0115	9/22/2005	9.20			
GWN0115	6/3/2003	9.30			
GWN0115	11/13/2002	9.40	0.50	0.981	0.0343
GWN0115	10/13/1999	9.50		1.494	0.0202
GWN0115	6/28/2004	9.60			
GWN0115	10/7/2004	9.60			
GWN0115	10/8/2002	9.70	0.75	1.179	0.0193
GWN0115	10/7/2003	9.70			
GWN0115	11/13/2003	9.70			
GWN0115	5/19/2005	9.70			
GWN0115	10/18/2005	9.70			
GWN0115	10/21/2003	9.80			
GWN0115	10/21/2004	9.80			
GWN0115	4/22/2003	9.90	2.99	1.632	0.0112
GWN0115	4/22/2003	9.90			
GWN0115	5/20/2003	9.90	1.25	1.804	0.0230
GWN0115	5/20/2003	9.90			
GWN0115	10/21/2003	9.90		1.799	0.0158
GWN0115	11/20/2003	9.90			

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	5/6/2003	10.40	4.27	1.904	0.0142
GWN0115	5/6/2003	10.40			
GWN0115	10/26/2004	10.50			
GWN0115	10/26/1999	10.60		1.773	0.0132
GWN0115	10/7/2003	10.60		2.025	0.0109
GWN0115	10/22/2002	10.90		1.595	0.0147
GWN0115	1/5/2005	10.90			
GWN0115	3/18/2003	11.10	2.49	1.600	0.0151
GWN0115	4/13/2004	11.10			
GWN0115	4/13/2004	11.10			
GWN0115	11/10/2004	11.10			
GWN0115	12/8/2004	11.10			
GWN0115	12/1/2005	11.10			
GWN0115	12/14/1999	11.20	3.99	1.264	0.1183
GWN0115	4/8/2004	11.20			
GWN0115	1/11/2000	11.30	1.99	1.364	0.0388
GWN0115	11/2/2005	11.30			
GWN0115	3/8/2004	11.40			
GWN0115	5/5/2005	11.40			
GWN0115	11/16/1999	11.50	0.43	1.510	0.0105
GWN0115	12/11/2003	11.50			
GWN0115	12/11/2003	11.50			
GWN0115	11/22/2004	11.50			
GWN0115	2/29/2000	11.60	2.49	1.577	0.0249
GWN0115	10/28/2005	11.60			
GWN0115	3/4/2004	11.80			
GWN0115	11/18/2005	11.80			
GWN0115	11/25/2002	12.20		1.896	0.0154
GWN0115	3/18/2003	12.30			
GWN0115	1/13/2005	12.30			
GWN0115	4/14/2005	12.30			
GWN0115	11/30/1999	12.50	1.00	1.355	0.0191
GWN0115	3/8/2000	12.50	1.74	1.976	0.0103
GWN0115	3/8/2000	12.50	1.74	1.966	0.0099
GWN0115	2/4/2003	12.50	11.96	2.442	0.1502
GWN0115	2/4/2003	12.50			
GWN0115	12/18/2003	12.60			
GWN0115	2/10/2004	12.60			
GWN0115	2/14/2005	12.60			
GWN0115	12/17/2002	12.70		1.691	0.0141
GWN0115	2/23/2000	12.80	0.75	1.966	0.0092
GWN0115	3/4/2003	13.00			
GWN0115	2/22/2005	13.00			
GWN0115	3/4/2003	13.10		1.884	0.0177
GWN0115	2/25/2004	13.10			
GWN0115	3/16/2005	13.10			
GWN0115	12/3/2002	13.20		1.856	0.0075

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	1/7/2003	13.30		1.962	0.0143
GWN0115	1/7/2003	13.30			
GWN0115	1/24/2000	13.40		2.445	0.0061
GWN0115	2/20/2004	13.40			
GWN0115	12/20/2004	13.40			
GWN0115	3/18/2004	13.60			
GWN0115	12/4/2003	13.70			
GWN0115	1/29/2004	13.70			
GWN0115	12/15/2004	13.70			
GWN0115	1/20/2005	13.80			
GWN0115	12/15/2005	13.90			
GWN0115	1/8/2004	14.00			
GWN0115	2/2/2005	14.00			
GWN0115	1/22/2003	14.20	0.25	2.296	0.0076
GWN0115	1/22/2003	14.20			
GWN0115	1/23/2004	14.80			
GWN0125	8/31/2000	7.10	1.25	1.468	0.0362
GWN0125	8/2/2000	7.70	1.99	1.650	0.0387
GWN0125	7/12/2000	8.10	1.00	1.821	0.0204
GWN0125	4/4/2000	8.80	5.48	1.762	0.0416
GWN0125	5/3/2000	9.60	1.00	1.924	0.0128
GWN0125	3/8/2000	11.70	1.28	2.082	0.0094
GWN0160	8/5/2003	7.40	2.14	2.101	0.0284
GWN0160	8/2/2000	7.60	1.00	1.742	0.0345
GWN0160	7/22/2003	7.60		2.433	0.0182
GWN0160	8/31/2000	7.70	2.49	1.654	0.0325
GWN0160	7/8/2003	7.70	1.00	2.022	0.0226
GWN0160	8/26/2003	7.80	1.25	2.203	0.0165
GWN0160	9/23/2003	7.80		1.622	0.1879
GWN0160	7/12/2000	8.10	0.75	2.175	0.0184
GWN0160	8/19/2003	8.10	2.49	1.986	0.0247
GWN0160	6/24/2003	8.30		2.153	0.0316
GWN0160	9/9/2003	8.30	0.93	2.157	0.0162
GWN0160	6/17/2003	8.80		2.139	0.0292
GWN0160	4/4/2000	9.10	6.98	1.805	0.0502
GWN0160	6/3/2003	9.40	0.25	2.363	0.0199
GWN0160	10/21/2003	9.80	0.64	2.179	0.0170
GWN0160	5/20/2003	9.90		1.990	0.0219
GWN0160	5/3/2000	10.00	1.50	2.105	0.0120
GWN0160	10/7/2003	10.30	0.85	2.338	0.0135
GWN0160	5/6/2003	10.60	4.06	2.097	0.0137
GWN0160	4/22/2003	11.00	2.99	1.963	0.0135
GWN0160	3/18/2003	11.80	2.49	1.911	0.0163
GWN0160	3/8/2000	12.10	2.06	2.339	0.0100
GWN0160	12/17/2002	12.50		1.983	0.0125
GWN0160	11/25/2002	12.60		2.326	0.0104
GWN0160	12/3/2002	13.20		2.136	0.0068

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0160	3/4/2003	13.20		2.303	0.0241
GWN0160	2/4/2003	13.30	3.63	2.399	0.0204
GWN0160	1/7/2003	14.50		2.195	0.0126
GWN0160	1/22/2003	15.30	1.50	2.676	0.0071
GWN0179	9/12/2007	6.60	1.89	2.604	0.0172
GWN0179	10/11/2007	7.00	0.75	1.928	0.0249
GWN0179	6/13/2007	7.80	1.74	2.317	0.0510
GWN0179	7/18/2007	8.00	0.82	2.777	0.0160
GWN0179	5/16/2007	8.50	1.99	2.812	0.0103
GWN0179	8/15/2007	8.50	0.62	2.404	0.0119
GWN0179	11/15/2007	9.00	1.25	1.730	0.0325
GWN0179	4/25/2007	10.50	1.99	2.399	0.0061
GWN0179	12/12/2007	10.90		2.017	0.0084
GWN0179	3/14/2007	12.30	2.24	2.772	0.0076
GWN0179	2/26/2007	12.90	2.49	2.252	0.0414
GWN0179	1/18/2007	13.70		2.895	0.0063
GWN0186	8/2/2000	7.80	1.50	2.119	0.0417
GWN0186	8/31/2000	8.20	1.25	2.064	0.0366
GWN0186	7/12/2000	8.50	0.75	2.706	0.0198
GWN0186	10/8/2002	9.20	1.25	1.730	0.0159
GWN0186	4/4/2000	9.40	4.98	1.774	0.0367
GWN0186	11/13/2002	9.80	0.50	0.976	0.0258
GWN0186	5/3/2000	10.00	1.25	2.579	0.0120
GWN0186	10/22/2002	10.90	0.21	2.174	0.0117
GWN0186	3/8/2000	11.50	1.31	2.697	0.0084
GWN0215	8/31/2000	8.00	0.25	2.176	0.0299
GWN0215	5/24/2000	8.50	2.24	1.999	0.0532
GWN0215	7/12/2000	8.50	0.50	2.704	0.0197
GWN0215	8/2/2000	8.50	1.50	2.043	0.0575
GWN0215	6/20/2000	8.80		2.480	0.0248
GWN0215	4/4/2000	9.20	3.99	1.508	0.0310
GWN0215	10/13/1999	9.60		2.356	0.0174
GWN0215	5/3/2000	10.00	1.25	2.578	0.0117
GWN0215	10/26/1999	10.50		2.357	0.0065
GWN0215	11/16/1999	11.00	1.28	2.182	0.0136
GWN0215	1/11/2000	11.10		1.834	0.0230
GWN0215	12/14/1999	11.20	2.99	1.297	0.1328
GWN0215	3/8/2000	11.20	0.93	2.701	0.0086
GWN0215	2/29/2000	11.70	1.74	2.148	0.0225
GWN0215	11/30/1999	12.20	0.25	2.334	0.0134
GWN0215	2/23/2000	12.40	1.05	2.613	0.0072
GWN0215	1/24/2000	13.20		2.820	0.0057
MCR0001	4/4/2000	8.90	3.49	1.793	0.0706
MCR0001	3/8/2000	11.20	6.48	1.520	0.0475
RDR0001	8/2/2000	7.60	1.00	1.772	0.0325
RDR0001	8/31/2000	7.60	1.74	1.545	0.0321
RDR0001	7/12/2000	8.10	1.00	1.865	0.0124

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
RDR0001	4/4/2000	9.20	3.49	1.305	0.0332
RDR0001	10/8/2002	9.60	1.74	2.062	0.0122
RDR0001	11/13/2002	9.70	1.25	1.179	0.0269
RDR0001	5/3/2000	10.50	1.00	1.644	0.0071
RDR0001	10/22/2002	10.90	0.43	2.312	0.0093
RDR0001	3/8/2000	11.90	1.68	1.975	0.0120
RDR0008	9/12/2007	6.80	1.59	1.483	0.0101
RDR0008	10/11/2007	7.30	1.20	1.266	0.0154
RDR0008	7/18/2007	7.70	0.54	1.848	0.0087
RDR0008	8/15/2007	8.00	0.62	1.419	0.0105
RDR0008	6/13/2007	8.10	1.25	1.916	0.0209
RDR0008	5/16/2007	8.60	1.74	1.703	0.0063
RDR0008	11/15/2007	8.60	1.25	1.227	0.0273
RDR0008	4/25/2007	10.70	1.74	1.338	0.0053
RDR0008	12/12/2007	10.80		1.524	0.0063
RDR0008	3/14/2007	12.00	1.00	1.733	0.0065
RDR0008	2/26/2007	13.10	2.99	1.974	0.0241
RDR0008	1/18/2007	13.80	0.75	1.859	0.0060
UHX0001	8/31/2000	7.40	1.50	1.118	0.0451
UHX0001	8/2/2000	7.50	0.25	1.267	0.0313
UHX0001	7/12/2000	7.90	0.25	1.305	0.0261
UHX0001	4/4/2000	9.20	8.22	1.481	0.0536
UHX0001	5/3/2000	10.40	2.74	1.453	0.0108
UHX0001	3/8/2000	11.30	1.50	1.444	0.0103

Table A-2: DNR Water Quality Data

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	9/22/1998	6.80	3.18		0.0800
GWN0115	8/11/1998	7.10	4.49		0.0930
GWN0115	8/3/2004	7.20	2.84		0.0370
GWN0115	8/2/2006	7.50	0.90	1.670	0.0240
GWN0115	8/21/2002	7.60	1.20		0.0350
GWN0115	8/11/2003	7.60	1.20		0.0450
GWN0115	9/8/2004	7.70	2.39		0.0200
GWN0115	8/25/1999	7.80	1.12		0.0360
GWN0115	7/26/2000	7.80	8.97		0.1650
GWN0115	8/28/2001	7.80	2.43		0.0460
GWN0115	6/5/2002	7.80	0.82		0.0280
GWN0115	7/1/2002	7.80	2.39		0.0380
GWN0115	7/12/2004	7.90	1.50		0.0350
GWN0115	6/29/2006	7.90		1.504	0.0350
GWN0115	7/6/2006	7.90	2.99	1.038	0.0850
GWN0115	9/3/2003	8.00	2.39		0.0320
GWN0115	8/14/2000	8.10	2.29		0.0240
GWN0115	7/31/2001	8.10	1.94		0.0250
GWN0115	9/24/2001	8.10	1.12		0.0280
GWN0115	6/12/2007	8.10	1.07	1.754	0.0180
GWN0115	7/15/2003	8.20	1.05		0.0310
GWN0115	8/1/2005	8.20		1.654	0.0350
GWN0115	7/14/1998	8.30	1.05		0.0250
GWN0115	9/15/1999	8.30	2.79		0.0210
GWN0115	6/14/2004	8.30	1.33		0.0240
GWN0115	6/16/1999	8.40	1.35		0.0440
GWN0115	9/3/2002	8.40	0.45		0.0270
GWN0115	7/12/1999	8.50	0.40		0.0310
GWN0115	9/8/2005	8.50	1.05	1.909	0.0230
GWN0115	9/6/2006	8.50	1.50	0.972	0.0420
GWN0115	5/15/2001	8.60	2.39		0.0210
GWN0115	5/3/2004	8.60	6.58		0.0540
GWN0115	6/7/2000	8.70	1.79		0.0430
GWN0115	9/6/2000	8.70	0.90		0.0290
GWN0115	6/6/2001	8.70	1.00		0.0170
GWN0115	10/1/2002	8.70	0.87		0.0300
GWN0115	6/10/2003	8.70	0.60		0.0290
GWN0115	10/15/2003	8.70	5.98		0.1780
GWN0115	6/1/2005	8.80	0.90		0.0170
GWN0115	10/11/2006	8.80	0.53	1.596	0.0210
GWN0115	5/13/2002	8.90	1.05		0.0210

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	7/5/2005	9.00	1.94		
GWN0115	10/4/2000	9.10			0.0110
GWN0115	11/2/2006	9.10	2.14	1.507	0.0510
GWN0115	5/12/1998	9.20	4.19		0.1470
GWN0115	10/12/1999	9.20	1.30		0.0350
GWN0115	10/3/2005	9.20	0.90	1.623	0.0210
GWN0115	5/13/2003	9.40	2.08		0.0300
GWN0115	11/3/2003	9.50	0.60		0.0200
GWN0115	5/3/2000	9.60	1.60		0.0140
GWN0115	10/5/2004	9.60		1.769	0.0310
GWN0115	10/6/1998	9.70	0.90		0.0210
GWN0115	12/1/1998	9.90	0.40		0.0180
GWN0115	5/5/1999	9.90	0.91		0.2600
GWN0115	11/4/2004	9.90	1.31		0.0180
GWN0115	5/3/2007	9.90	1.59	1.633	0.0110
GWN0115	6/9/1998	10.00	0.97		0.0270
GWN0115	11/6/2002	10.20	2.39		0.1800
GWN0115	11/6/2001	10.30	0.60		0.0140
GWN0115	5/2/2005	10.40	2.77		0.0170
GWN0115	4/5/2000	10.60	2.39		0.0230
GWN0115	11/4/1998	10.80	0.45		0.0120
GWN0115	11/1/2005	10.80	0.75	1.887	0.0210
GWN0115	4/6/1999	11.00	2.89		0.0160
GWN0115	11/1/2000	11.00	0.84		0.0230
GWN0115	10/9/2001	11.00	1.00		0.0190
GWN0115	12/14/1999	11.10	3.74		0.1260
GWN0115	4/30/2001	11.10	2.62		0.0270
GWN0115	11/16/1999	11.20	0.90		0.0170
GWN0115	1/11/2000	11.20	2.39		0.0480
GWN0115	1/3/2006	11.20	10.96	1.309	0.0790
GWN0115	4/3/2007	11.30	2.80	1.759	0.0085
GWN0115	2/23/1998	11.40	1.40		0.0410
GWN0115	4/4/2005	11.40	0.90		0.0420
GWN0115	1/6/2004	11.50	1.64		0.0340
GWN0115	4/14/1998	11.60	3.09		0.0100
GWN0115	5/1/2006	11.80	2.24	1.692	0.0190
GWN0115	2/2/1999	11.90	3.89		0.0730
GWN0115	12/4/2001	11.90	0.60		0.0100
GWN0115	3/6/2000	12.10	1.65		0.0100
GWN0115	4/2/2002	12.10	1.89		0.0100
GWN0115	3/9/2004	12.10	2.24		0.0160
GWN0115	3/26/2001	12.30	1.33		0.0160
GWN0115	4/1/2003	12.30	2.54		0.0170
GWN0115	4/6/2004	12.30			0.0160
GWN0115	4/11/2006	12.30	2.24	1.496	0.0150
GWN0115	2/10/2004	12.40	0.70		0.0200
GWN0115	1/7/2003	12.50		1.672	0.0100

STATION	DATE	DO (mg/l)	Chlorophyll <i>a</i> (ug/l)	TN (mg/l)	TP (mg/l)
GWN0115	2/2/2006	12.50	1.79	1.556	0.0160
GWN0115	3/5/2007	12.50	1.20	1.863	0.0200
GWN0115	1/13/1998	12.60	1.64		0.0210
GWN0115	1/4/2007	12.60	1.92	1.692	0.0130
GWN0115	3/16/1998	12.70	0.45		0.0260
GWN0115	1/14/2002	12.70	0.75		0.0100
GWN0115	2/7/2005	12.80	0.55		0.0170
GWN0115	12/2/2002	12.90	0.30		0.0130
GWN0115	3/7/2005	12.90	3.74		0.0220
GWN0115	12/2/2004	13.00	1.50		0.0360
GWN0115	1/19/2005	13.00	0.12		0.0480
GWN0115	3/9/1999	13.10	1.12		0.0250
GWN0115	2/8/2000	13.10	0.37		0.0170
GWN0115	2/3/2003	13.10	1.40	1.862	0.0150
GWN0115	12/8/2003	13.10			0.0190
GWN0115	3/5/2002	13.20	1.40		0.0260
GWN0115	3/3/2003	13.20	1.20		0.0360
GWN0115	12/5/2000	13.30	0.60		0.0100
GWN0115	2/20/2001	13.30	2.06		0.0180
GWN0115	12/5/2006	13.30	0.75	1.794	0.0130
GWN0115	2/5/2002	13.40	1.35		0.0100
GWN0115	12/6/2005	13.40	0.75	1.698	0.0200
GWN0115	3/1/2006	13.50	1.92	2.124	0.0110
GWN0115	1/23/2001	14.00			0.0190
GWN0115	2/6/2007	14.30	1.35	2.526	0.0105

Table A-3: MBSS Water Quality Data

Station ID	Stream Name	DO (mg/l)	TN (mg/l)	TP (mg/l)
GWYN-104-R-2004	Scotts Level Branch	7.5	1.015	0.059
GWYN-306-R-2004	Gwynns Falls	7.6	1.868	0.024
GWYN-301-R-2004	Gwynns Falls	7.7	1.977	0.033
GWYN-303-R-2004	Gwynns Falls	7.7	1.84	0.016
GWYN-112-R-2004	Red Run UT1	7.9	0.511	0.014
GWYN-107-R-2004	Gwynns Falls	8	2.629	0.024
GWYN-302-X-2000	Gwynns Falls	8	2.143	0.012
GWYN-105-R-2004	Horsehead Branch	8.6	1.306	0.017
GWYN-210-R-2004	Dead Run	8.6	1.601	0.026
GWYN-211-R-2004	Dead Run	9.1	1.404	0.033
GWYN-102-R-2004	Red Run UT2	9.3	1.063	0.013
GWYN-301-X-2000	Gwynns Falls	10.5	1.392	0.015