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**Water Quality Analysis of Total Phosphorus  
for the Conowingo Dam Susquehanna River Watershed,  
Cecil and Harford Counties, Maryland**



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

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

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## List of Abbreviations

BIBI	Benthic Index of Biological Integrity
BLM	Non-tidal Biological Listing Methodology
CFR	Code of Federal Regulations
COMAR	Code of Maryland Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources
DO	Dissolved Oxygen
EPA	United States Environmental Protection Agency
FIBI	Fish Index of Biological Integrity
IBI	Index of Biological Integrity
MAL	Minimal Allowable Limit
MBSS	Maryland Biological Stream Survey
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MGS	Maryland Geological Survey
mg/l	Milligrams Per Liter
NRCS	National Resources Conservation Service
PCB	Polychlorinated biphenyls
SCS	Soil Conservation Service
SRBC	Susquehanna River Basin Commission
STATSGO	State Soil Geographic Database
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment

## EXECUTIVE SUMMARY

This document, upon approval by the U.S. Environmental Protection Agency (EPA), presents a Water Quality Analysis (WQA) of phosphorus in the Maryland 8-Digit (MD 8-Digit) Conowingo Dam/Susquehanna River watershed (basin number 02120204) [2010 *Integrated Report of Surface Water Quality in Maryland* (Integrated Report) Assessment Unit ID: MD-02120204]. Section 303(d) of the federal Clean Water Act (CWA) and the 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. For each WQLS listed in the 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 via a WQA that water quality standards are being met (CFR 2010).

The MD 8-Digit Conowingo Dam/Susquehanna River watershed consists of:

1. The mainstem of the Conowingo Dam/Susquehanna River, which is fully occupied by the Conowingo Pool (the impoundment created behind the Conowingo Dam) for the entire length of the mainstem within Maryland, and
2. the nontidal tributaries within Maryland that drain to the pool.

The use of the term “nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed” throughout this report will refer solely to the nontidal tributaries within Maryland draining to the Conowingo Pool. The Maryland Department of the Environment (MDE) has identified the waters of the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed on the State's 2010 Integrated Report as impaired by nutrients (1996) and sediments (1996) (MDE 2010a). Because phosphorus is generally the limiting nutrient in freshwater aquatic systems, the 1996 nutrients listing was refined in the 2008 Integrated Report, and phosphorus (total) was identified as the specific impairing substance. Consequently, for the purpose of this report the terms “nutrients” and “phosphorus” will be used interchangeably. The Conowingo Pool is assessed separately, and therefore, is not included as part of the analysis presented herein. The designated use of the nontidal MD 8-Digit Conowingo Dam/Susquehanna River and all tributaries including Peddler Run and Conowingo Creek watershed is Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*) (COMAR 2010a,b).

The WQA presented herein by MDE will address the 2010 total phosphorus listing (1996 nutrients listing), for which a data solicitation was conducted, and all readily available data from the past ten years have been considered. An analysis for sediments to address the sediments listing is scheduled to be submitted to the EPA in 2011.

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The 2010 Integrated Report did not make a determination regarding impairment to aquatic life within the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed due to a limited amount of biological monitoring data (i.e., the watershed was placed on Category 3 of the Integrated Report - “insufficient data to determine if a waterbody is meeting standards for a particular stressor”). The watershed was reassessed in 2011, using the biological listing methodology (BLM) and additional biological monitoring data recently collected by the Susquehanna River Basin Commission (SRBC). This reassessment indicates that aquatic life is not impaired and the watershed is now fully supporting aquatic life (i.e., there are no stressors impairing biological communities, including phosphorus). Therefore, all impairment listings for this watershed related to the protection of aquatic life should be removed, and TMDLs for these listings are not required. The results of this reassessment will be published in the 2011 inter-annual update to the Integrated Report.

Maryland, has no numeric criteria that quantify the impact of nutrients (phosphorus) on the aquatic life of nontidal stream systems. However, excess phosphorus in aquatic systems can induce eutrophication, resulting in low levels of dissolved oxygen (DO) that can affect the biological communities of the stream. Under eutrophic conditions, excess growth of algae and aquatic plants can cause wide swings in diurnal DO concentrations, and the decay of algae and plants can deplete aquatic oxygen levels. Therefore, in addition to the biological listing reassessment, and because Maryland has numeric water quality criteria for DO, further analysis was performed using available DO data from the smaller-order streams in the Conowingo Dam/Susquehanna River watershed. The available DO data was compared to the DO criteria determined to protect Use I-P waters, which “may not be less than 5 milligrams per liter (mg/l) at any time (COMAR 2010d). The comparison analysis shows that all samples have DO concentrations above the Use I-P criteria of 5 mg/l.

The application of the BLM, with the additional data collected by SRBC, and the analysis of available DO data in the Conowingo Dam/Susquehanna River watershed demonstrates that the watershed meets the DO criterion for Use I-P waters and supports Aquatic Life. It is concluded that the Conowingo Dam/Susquehanna River watershed is not impaired by nutrients in general and phosphorus in particular.

Barring the receipt of contradictory data, this report will be used to support a revision of the 2010 Integrated Report phosphorus listing for the Conowingo Dam/Susquehanna River 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 phosphorus-related] water quality standards, but with insufficient data to assess all impairments”), when MDE proposes the revision of the 2012 Integrated Report.

Although the waters of the Conowingo Dam/Susquehanna River watershed 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. For instance, reductions will be required to meet allocations assigned to the Northern Chesapeake Bay Tidal Fresh Bay Water Quality Segment by the Chesapeake Bay TMDL, established by U.S. EPA on December 29, 2010.

## 1.0 INTRODUCTION

This document upon approval by the US EPA presents a Water Quality Analysis (WQA) for nutrients in the Conowingo Dam Susquehanna River watershed (basin code 02120204). Section 303(d) of the federal Clean Water Act (CWA) and the US 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. This list of impaired waters is commonly referred to as the 303(d) List. For each WQLS, the State is required 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 2010).

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 scenarios that would eliminate 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.

The Maryland Department of the Environment (MDE) has identified the waters of the Conowingo Dam Susquehanna River watershed on the State's 2010 Integrated Report as impaired by nutrients and sediments (1996) (2008) (MDE 2010). The 2010 IR also lists impact to biology as Category 3 (indeterminate). The 1996 suspended sediment listing was refined in the 2008 Integrated Report to a listing for total suspended solids. Similarly, the 1996 nutrients listing was refined in the 2008 Integrated Report, and phosphorus was identified as the specific impairing substance. Therefore, the listed impairment for phosphorus will henceforth be referred to in this report and the term "nutrients" should be read as interchangeably with "phosphorus" in this case. The Maryland Surface Water Use Designation in the Code of Maryland Regulations (COMAR) for the Conowingo Dam Susquehanna River and all tributaries including Peddler Run and Conowingo Creek is Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*) (COMAR 2010a,b,c).

The 2010 Integrated Report specifically identifies aquatic life as the designated use being impaired by phosphorus in the Susquehanna River Conowingo Dam nontidal MD 8-Digit watershed. However, when the watershed was originally identified on Maryland's 1996 303(d) List as impaired by phosphorus from nonpoint sources, with supporting evidence cited in Maryland's 1996 305(b) report, the specific designated use being impaired was not identified. The identification of aquatic life as the specific impaired designated use was done subsequent to the identification of the watershed as impaired for phosphorus. Furthermore, the 1996 305(b) report did not directly state that phosphorus was a concern; rather, best professional judgment, based on then available data, was the reason for the phosphorus listing (MDE 2004; DNR 1996).

The WQA presented herein by the MDE will address the 1996 nutrients listing, for which a data solicitation was conducted, and all readily available data from the past five years have been

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considered. A WQA to address the sediments listing is scheduled to be submitted to the EPA in 2011. In the 2012 Integrated Report, the listing for impacts to biological communities will be moved to Category 2 (meeting water quality).

The remainder of this report lays out the general setting of the Conowingo Dam Susquehanna River watershed and presents a discussion of the water quality characteristics in the basin in terms of the existing water quality standards relating to nutrients. Currently in Maryland, there are no specific numeric criteria that quantify the impact of nutrients on the aquatic life of nontidal stream systems. However, there is a methodology to determine if aquatic life is impacted. Therefore, the main analysis used for this report is the Biological Listing methodology (BLM) for non-tidal streams. In addition to the analysis of available biological monitoring data, the WQA also includes an analysis of dissolved oxygen (DO) monitoring data from the 1<sup>st</sup> through 4<sup>th</sup> order streams in the watershed. Since low levels of DO are sometimes associated with the decay of excess primary production and therefore nutrient over-enrichment, the WQA must demonstrate that either DO standards are met or that nutrients (phosphorus) are not the cause of any violation of DO standards.

## 2.0 GENERAL SETTING

### Location

The Conowingo Dam Susquehanna River watershed is located in the Lower Susquehanna sub-basin (02-12-02), which drains approximately 5,916 square miles starting at Sunbury, Pennsylvania and ends where the Susquehanna River empties into the Chesapeake Bay in Havre de Grace, Maryland. The watershed draining to the mainstem Susquehanna River between the Pennsylvania-Maryland border and the Conowingo Dam covers approximately 125 square miles, of which only 18 square miles are located in Maryland.

Although the Conowingo Dam Susquehanna River watershed encompasses areas both within Maryland and Pennsylvania, the assessment unit identified on the Maryland 303(d) list and consequently addressed by this WQA consists only of the Maryland portion of the watershed, otherwise referred to as the MD 8-digit Conowingo Dam Susquehanna River watershed. This watershed is located within Harford and Cecil Counties (see Figure 1). Approximately 21% of the watershed area is covered by water, primarily the mainstem Susquehanna River, but also other streams, ponds, and smaller waterbodies. The two largest tributaries in the watershed are Peddler Run in Harford County and Conowingo Creek in Cecil County.

### Geology/Soils

The Conowingo Dam Susquehanna River watershed lies within the Piedmont Upland Section of the Piedmont Plateau Province. The topography of the Piedmont Upland section ranges from gently rolling terrain with low relief to very hilly. Valleys can be broad-bottomed, but major streams are incised into narrow valleys with steep sideslopes and often have extensive cliffs. The surface geology is characterized by metamorphic rocks such as schist, gneiss, and gabbro and some igneous rocks likely of volcanic origin (MGS 2007, 2008a, 2008b).

The soils in the watershed are mostly fine loams and can be grouped into four soil series: the somewhat poorly to moderately well drained Neshaminy-Lehigh-Glenelg series (65%), the well drained Chrome-Conowingo-Neshaminy (15%) and Chester-Glenelg-Manor (7%) series, and the poorly drained Manor-Glenelg-Chester series (15%) (USDA 2006). The soils are generally moderately deep to deep.

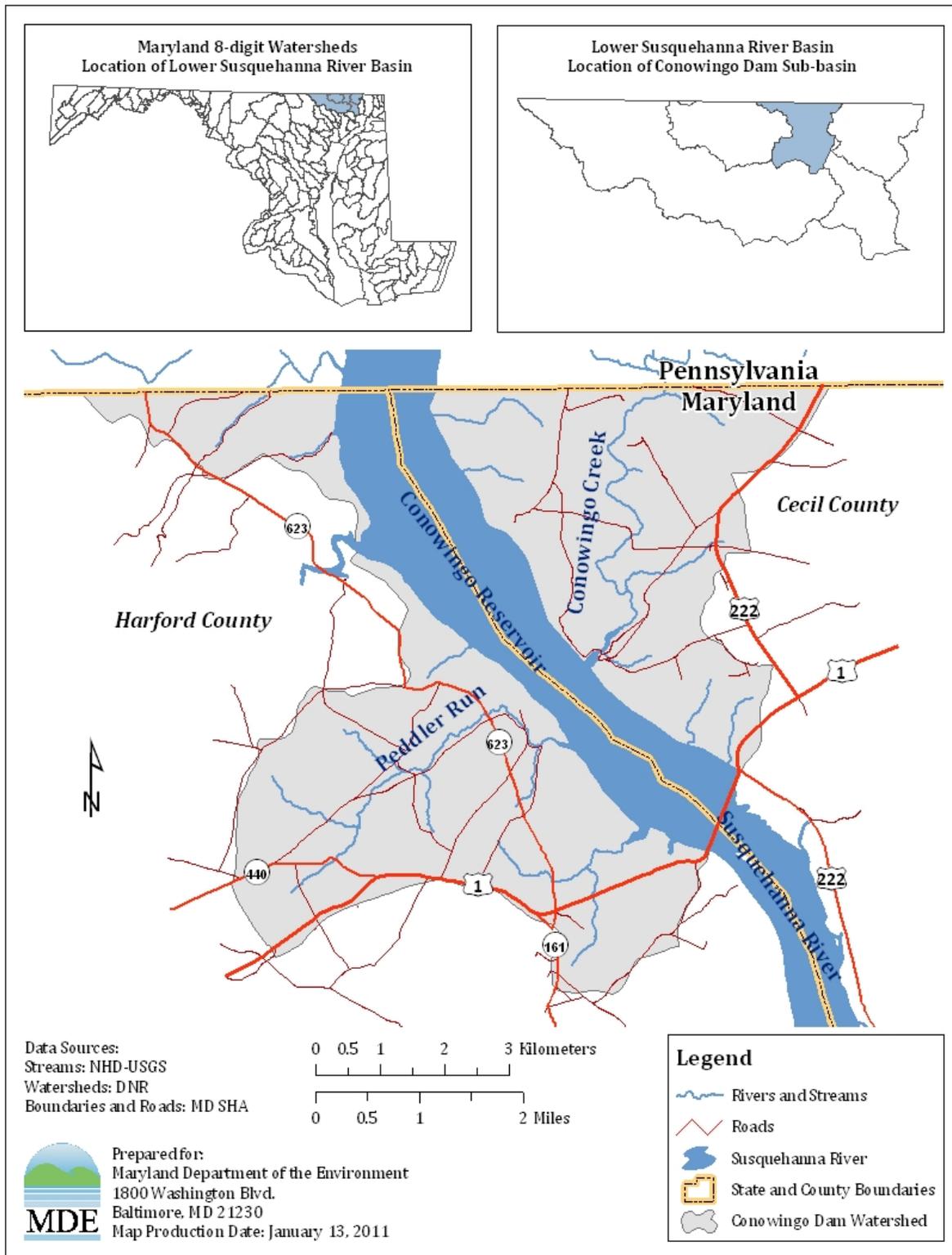
Soil types are also categorized by the United States Department of Agriculture (USDA) Soil Conservation Service (SCS) into four hydrologic soil groups: Group A soils have high infiltration rates and are typically deep well-drained to excessively drained sands or gravels; Group B soils have moderate infiltration rates and consist of moderately deep to deep and moderately well to well drained soils, with moderately fine to moderately coarse textures; Group C soils have slow infiltration rates and a layer that impedes downward water movement and consist of moderately fine to fine textured soils; Group D soils have very slow infiltration rates and consist of clay soils with a permanently high water table that are shallow and often over nearly impervious material. The Conowingo Dam Susquehanna River watershed is comprised of primarily C type soils (80%) with smaller amounts of and D (13%) and B soils (7%) (USDA 2006).

**Land Use**

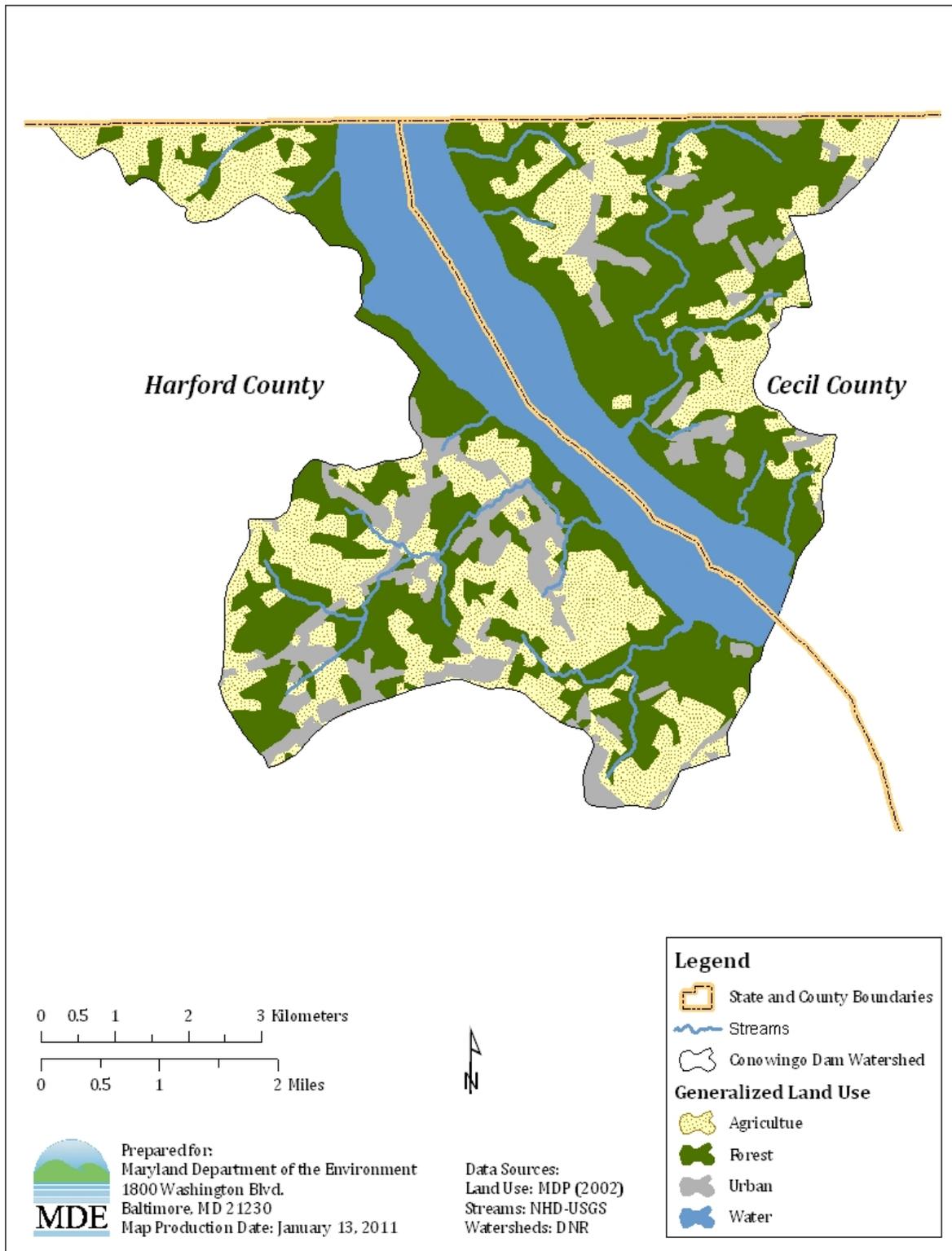
The MD 8-Digit Conowingo Dam/Susquehanna River watershed land use distribution consists primarily of forest (66.3%). There are also smaller amounts of pasture (3.7%), crop land (17.6%), and urban land (12.4%), as per the Chesapeake Bay Program Phase 5.2 (CBP P5.2) watershed model (US EPA 2008). A detailed summary of the watershed land use areas is presented in Table 1, and a land use map is provided in Figure 2

**Table 1: Land Use Percentage Distribution for the MD 8-Digit Conowingo Dam Susquehanna River Watershed**

<b>General Land Use</b>	<b>Detailed Land Use</b>	<b>Area (Acres)</b>	<b>Percent</b>	<b>Grouped Percent of Total</b>
Crop	Animal Feeding Operations	4.5	0.0	17.6
	Hay	473.7	4.1	
	High Till	666.5	5.7	
	Low Till	909.5	7.8	
	Nursery	0.3	0.0	
Extractive	Extractive	0.0	0.0	0.0
Forest	Forest	7662.9	65.6	66.3
	Harvested Forest	77.4	0.7	
Pasture	Pasture	437.6	3.7	3.7
	Trampled Pasture	0.0	0.0	
Urban	Urban: Barren	3.9	0.0	12.4
	Urban: Impervious	110.1	0.9	
	Urban: Pervious	1332.8	11.4	
Total		11,679.3	100.0	100.0



**Figure 1: Location Map of the Conowingo Dam Susquehanna River Watershed**



**Figure 2: Land Use Map of the Conowingo Dam Susquehanna River Watershed**

### 3.0 WATER QUALITY CHARACTERIZATION

The Maryland water quality standards Surface Water Use Designation for the Conowingo Dam Susquehanna River and all tributaries have been designated as Use I-P – *water contact recreation, protection of aquatic life, and public water supply* (COMAR 2010a,b,c). 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.

The Conowingo Dam Susquehanna River watershed was originally listed on Maryland's 1996 303(d) List as impaired by nutrients from nonpoint sources, with supporting evidence cited in Maryland's 1996 305(b) report. The 1996 305(b) report did not directly state that elevated nutrients were a concern, and it has been determined that the nutrient listing was based on best professional judgment (MDE 2004; DNR 1996).

The 2010 Integrated Report specified that the designated use that is impaired by nutrients is the Aquatic Life Use. Maryland bases its assessment of Aquatic Life use on biological criteria (biocriteria), which are measurements of biological community structure used to assess the ability of waterbodies to support aquatic life. These biocriteria are calculated from the results of fish and benthic macroinvertebrate monitoring performed by the Maryland Biological Stream Survey (MBSS). In 2008, MDE's biological assessment of the Conowingo Dam/Susquehanna River watershed used the combined results of MBSS round one (1995-1997) and round two (2000-2004) data, which only included 5 stations. The 2010 Integrated Report assessment for the watershed was also based on this limited biological data. Due to the limited sample size, a statistically reliable assessment of whether or not the BIBI and/or FIBI scores for the watershed are significantly lower than 3.0 (on a scale of 1 to 5) and therefore different from the MBSS reference sites can not be made (MDE 2008). Additional biological data was collected in 2008 by the Susquehanna River Basin Commission (SRBC), under contract with MDE, and that data was incorporated in the current biological assessment and used in conjunction with the MBSS data to determine if the Conowingo Dam Susquehanna River watershed is supporting Aquatic Life.

Currently in Maryland, there are no numeric criteria for nutrients (phosphorus), however, there is water quality criteria for DO. In addition to the biological reassessment using MBSS and SRBC data, potentially eutrophic conditions due to phosphorus over-enrichment can be evaluated by determining if levels of dissolved oxygen in the stream are not protective of the designated uses in the Conowingo Dam/Susquehanna River. Low levels of DO are often associated with eutrophication (excess algal growth) and nutrient over-enrichment. The dissolved oxygen (DO) concentration to protect Use I-P waters "may not be less than 5 milligrams per liter (mg/l) at any time" (COMAR 2010d).

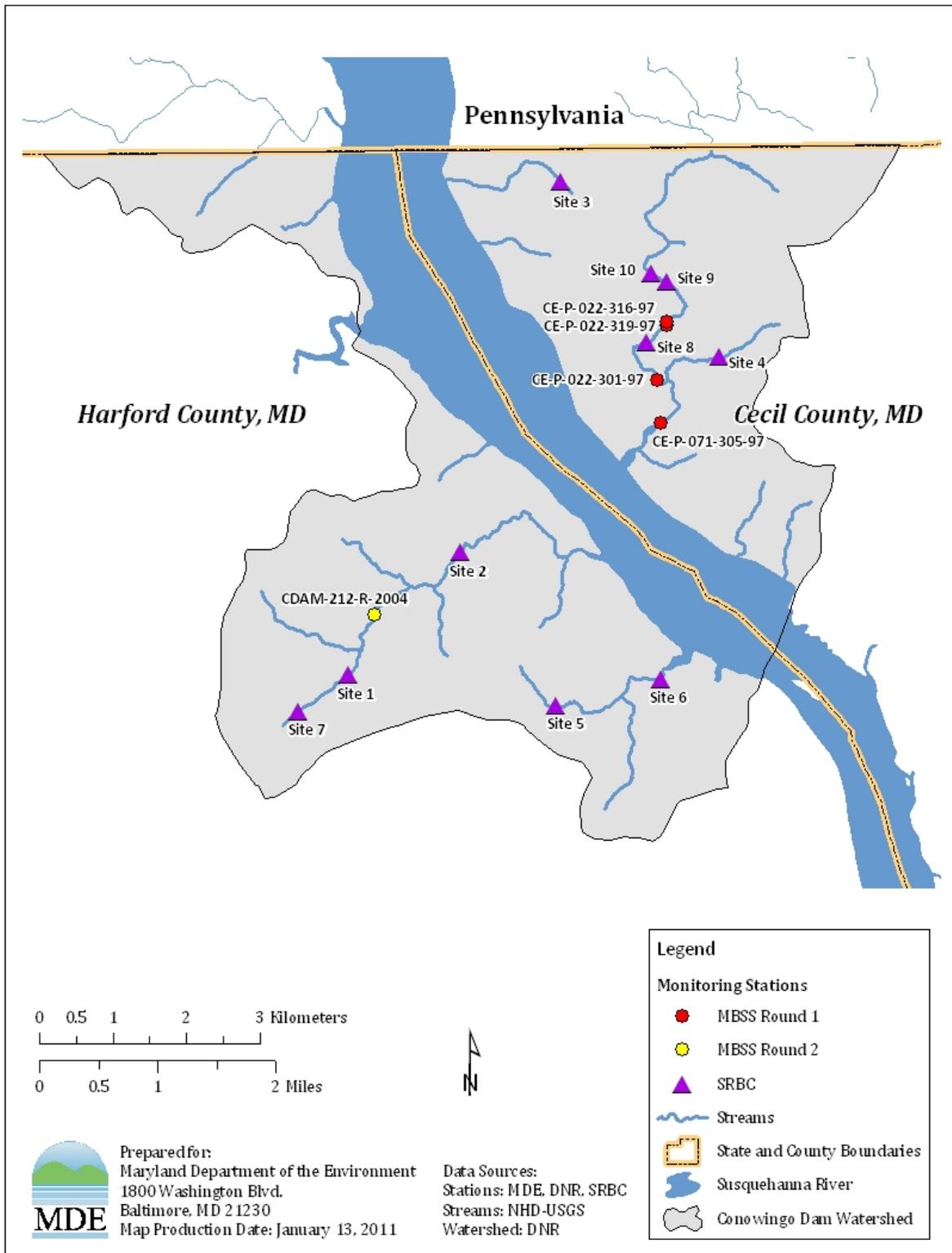
A data solicitation was conducted by MDE and all readily available data from the time period of 1997 through 2008 were considered for this analysis.

### 3.1 Conowingo Dam Susquehanna River Watershed Monitoring Stations

A total of 15 water quality monitoring stations were used to characterize the CDSR nontidal 8-digit watershed in Maryland's 2011 inter-annual update to the 2010 Integrated Report. Five stations were biological/physical habitat monitoring stations from the MBSS program round one and two data collection. Ten stations were biological/physical habitat monitoring stations from SRBC's data collection efforts in 2008. All stations are presented in Figure 3 and listed in Table 1.

The MBSS is a robust statewide probability-based sampling survey for assessing the biological conditions of 1<sup>st</sup> through 4<sup>th</sup> order, non-tidal streams (Klauda et al. 1998; Roth et al. 2005). It uses a fixed length (75 meter (m)) randomly selected stream segment for collecting site level information within a primary sampling unit (PSU), also defined as a watershed. The randomly selected stream segments, from which field data are collected, are selected using either stratified random sampling with proportional allocation, or simple random sampling (Cochran 1977). The random sample design allows for unbiased estimates of overall watershed conditions. Thus, the dataset facilitated case-control analyses because: 1) in-stream biological data are paired with chemical, physical, and land use data variables that could be identified as possible stressors; and 2) it uses a probabilistic statewide monitoring design.

MDE contracted with SRBC in 2006 for work in the Lower Susquehanna River Basin. Tasks identified by the scope of work included the following: to propose sampling sites, to develop biological sampling protocols, and to determine appropriate water chemistry and habitat parameters for macroinvertebrate sampling in the basin. Within the contract negotiations, it was decided that MBSS protocols would be used for the SRBC monitoring, so that they could be used in MDE's biological assessment. Sample locations were determined per agreement with MDE and SRBC. Due to time limitations, however, only benthic samples were collected.



**Figure:3. Monitoring Stations in the Conowingo Dam Susquehanna River Watershed**

**Table 2: Monitoring Stations in Conowingo Dam Susquehanna River Watershed Monitored During 1998-2008**

Station Number	Sponsor	Location	Latitude (Decimal Degree)	Longitude (Decimal Degree)
CDAM-212-R-2004	MBSS	Peddler Run	39.66494	-76.23661
CE-P-022-301-97	MBSS	Conowingo Creek	39.6930	76.1920
CE-P-022-316-97	MBSS	Conowingo Creek	39.7050	76.1930
CE-P-022-319-97	MBSS	Conowingo Creek	39.7050	76.1920
CE-P-071-305-97	MBSS	Conowingo Creek	39.6870	76.1930
Site 1	SRBC	Peddler Run	39.657281	-76.240699
Site 2	SRBC	Peddler Run	39.671750	-76.222806
Site 7	SRBC	Peddler Run	39.652778	-76.248806
Site 3	SRBC	UT2 to Susquehanna River	39.717380	-76.206550
Site 4	SRBC	UT to Conowingo Creek	39.695778	-76.181667
Site 5	SRBC	UT1 to Susquehanna River	39.653220	-76.208013
Site 6	SRBC	UT1 to Susquehanna River	39.656361	-76.191444
Site 8	SRBC	Conowingo Creek	39.697570	-76.193160
Site 9	SRBC	Conowingo Creek	39.704920	-76.189980
Site 10	SRBC	Conowingo Creek	39.706040	-76.192380

### 3.2 Biological Assessment

Since the 2010 Integrated Report did not make a determination regarding impairment to aquatic life within the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed due to a limited amount of biological monitoring data (i.e., the watershed was placed on Category 3 of the Integrated Report), the watershed has been reassessed in 2011 using the biological listing methodology and new biological monitoring data collected by SRBC. Maryland's biological listing methodology makes assessments at the 8-digit watershed scale only. This is consistent with both the probabilistic design of the MBSS, which forms the basis of the listing methodology, and the scale of listings for other pollutant impairments. The methodology takes into account both spatial and temporal uncertainty, and it also provides an estimate of biologically impaired stream miles, which is a reporting requirement of the Clean Water Act (US EPA 2005).

The primary metrics used in the biological listing methodology consist of two indices of biological integrity (IBI), one for fish (FIBI scores) and one for benthic macroinvertebrates (BIBI scores), which are both derived from MBSS biological monitoring data (Roth et al. 2000; Stribling et al. 1998). For each sampling site, IBIs are calculated from individual component metrics, whose scores are determined based on a comparison of site conditions to those at reference/non-degraded sites (i.e., sites with minimal human impacts). For a complete list of metrics and criteria for reference sites see Southerland et al. (2005). To calculate the individual component metrics of the IBI, a site receives a score of 1.0 if its metric score is less than the 10<sup>th</sup> percentile of reference site scores; a 3.0 if its score is between the 10<sup>th</sup> and 50<sup>th</sup> percentile of reference site scores; and a 5.0 if its score is greater than the 50<sup>th</sup> percentile of reference site scores. The overall site IBI is then calculated as the average of the individual metric scores.

An overall IBI greater than or equal to 3.0 generally means that the biological community at a site is comparable to reference sites. Given the variability of IBI scores over time, however, even reference sites can have poor IBI scores (Southerland et al. 2005). Year-to-year variability in IBI scores is taken into account by calculating a minimum allowable limit (MAL), based on a comparison of reference site scores with the variation in scores observed at MBSS sentinel sites, which are sampled annually. The 2010 Integrated Report identifies the MAL for the FIBI as 2.5 and the MAL for the BIBI as 2.65. Any site with an IBI score below these thresholds is considered impaired.

A MD 8-digit watershed is considered to be supportive of aquatic life if less than 10% of its stream miles are impaired (i.e., less than 10% of MBSS sampling sites are impaired). If there are a sufficient number of sampling sites within an 8-digit watershed, a confidence interval is constructed around the calculation of the percent of stream miles degraded using the IBI scores for the watershed sampling sites. If the lower bound of the confidence interval is greater than 10%, aquatic life within the watershed is considered to be impaired, and the watershed is placed in Category 5 of the Integrated Report (“waterbody is impaired, does not attain the water quality standard, and a TMDL is required”). If the lower bound of the confidence interval is less than or equal to 10%, and the precision of the estimate is less than 25%, the watershed is considered to be supportive of aquatic life, and it is placed on Category 2 of the Integrated Report (“waterbody is meeting some water quality standards, but with insufficient data to assess all impairments”). If there is an insufficient number of samples, or if the lower bound of the confidence interval is less than or equal to 10% but the precision is greater than 25%, the watershed assessment is considered to be inconclusive, and the watershed is placed in Category 3 of the Integrated Report.

The MBSS program collected biological/physical habitat monitoring data at four sites in the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed during round one of the program’s data collection efforts and at one site during round two of the program’s data collection efforts. The BIBI and FIBI scores for these five sites are shown in Table 3; however, based on the biological listing methodology, five sampling sites is not considered to be a sufficient amount of data to determine whether the watershed is supporting aquatic life.

**Table 3: IBI Scores for MBSS Stations in the Nontidal MD 8-Digit Conowingo Dam/Susquehanna River Watershed**

Site Number	BIBI	FIBI
CE-P-022-301-1997	2.67	4.00
CE-P-022-316-1997	2.00	4.33
CE-P-022-319-1997	3.00	4.00
CE-P-071-305-1997	3.33	4.00
CDAM-212-R-2004	4.00	3.33

The biological listing methodology allows for the incorporation of biological data collected outside of the MBSS program as long as it was collected and analyzed using comparable sampling protocols, such that it can be integrated with MBSS data. In 2008, SRBC conducted benthic macroinvertebrate sampling at ten sites in the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed. The study was funded by MDE and meets the biological

listing methodology criteria. The sampling results are shown in Table 4. Eight of the ten sites had passing BIBI scores.

With the incorporation of the SRBC monitoring data, the total number of sampling sites in the nontidal MD 8-Digit Conowingo Dam/Susquehanna River watershed is 15. Only three of the sites had BIBI scores less than the 2010 Integrated Report MAL for the BIBI (2.65), and none of the sites had a FIBI score less than the MAL for the FIBI (2.5). According to the biological listing methodology, if there are a total of 15 sampling sites within a MD 8-Digit watershed, and there are no more than three sites with BIBI or FIBI scores significantly less than the MAL, the watershed is considered to be similar to the population of reference sites and therefore supportive of aquatic life. Therefore, the aquatic life designated use is fully supported in the nontidal 1<sup>st</sup> through 4<sup>th</sup> order streams in the MD 8-Digit Conowingo Dam/Susquehanna River watershed, indicating that the watershed should be placed on the Category 2 of the Integrated Report. Since the watershed is now identified as supporting aquatic life, there are no stressors impairing biological communities, including phosphorus. Therefore, the Integrated Report listing that previously identified phosphorus as impairing aquatic life in the nontidal MD 8-Digit watershed is no longer applicable, and a TMDL for phosphorus is not required..

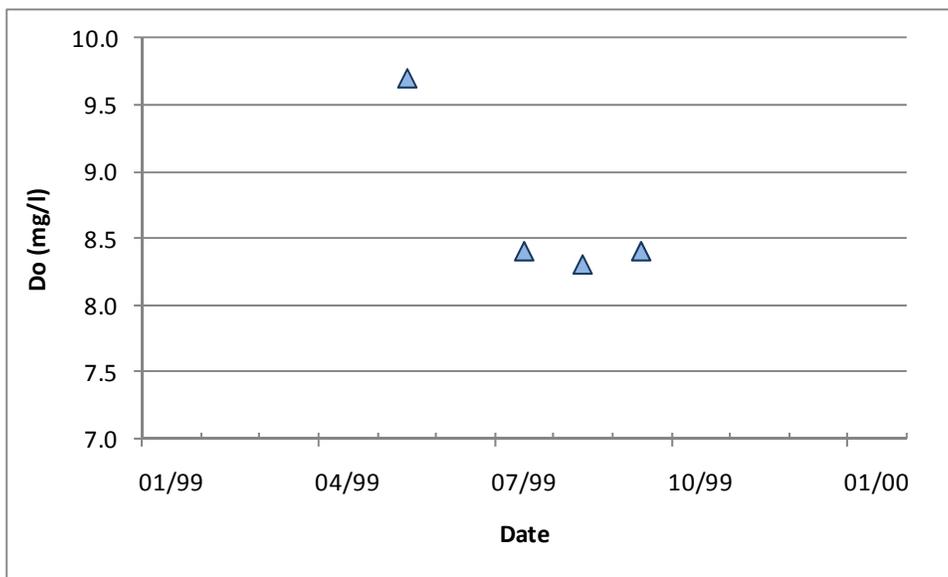
**Table 4: BIBI Scores for SRBC Stations in the Nontidal MD 8-Digit Conowingo Dam/Susquehanna River Watershed**

<b>Site Number</b>	<b>BIBI</b>
Site 1	4.00
Site 2	4.33
Site 7	2.33
Site 3	4.67
Site 4	4.00
Site 5	4.00
Site 6	3.67
Site 8	3.67
Site 9	1.00
Site 10	3.67

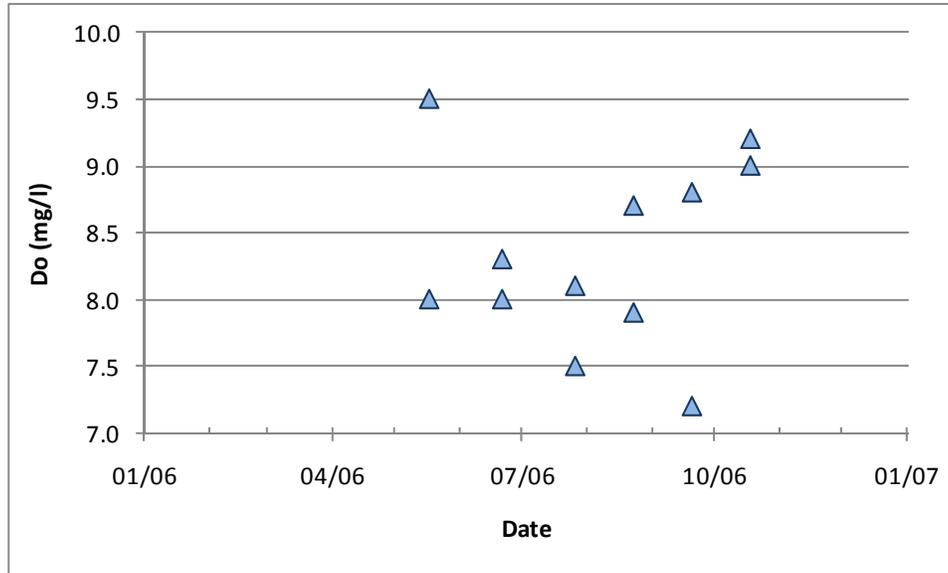
### 3.3 Dissolved Oxygen

The potential impact of eutrophication on DO concentrations is best measured during the growing season, May through October. MDE collected ten DO samples during the growing season in 1999 and 2006 from two stations on smaller-order tributaries to the Conowingo Dam Susquehanna River. Observed values ranged from 7.2 to 9.7 mg/l with an average concentration of 8.4 mg/l. Given that none of the observed DO concentrations were below 5 mg/l, MDE considers that the water quality standard for DO is being met in the 1<sup>st</sup> through 4<sup>th</sup> order streams in the Conowingo Dam Susquehanna River watershed.

The DO data are presented graphically in Figures 4 and 5 and in tabular form in Appendix A.



**Figure 4: Conowingo Dam Susquehanna River Dissolved Oxygen Data for Growing Season Periods May 1998 through October 2000**



**Figure 5: Conowingo Dam Susquehanna River Dissolved Oxygen Data for Growing Season Periods May 2006 through October 2008**

#### 4.0 CONCLUSION

The reassessment of the Conowingo Dam/Susquehanna River watershed, with the application of the BLM using additional and more recent biological monitoring data, demonstrates that the watershed is fully supporting its Aquatic Life Use in 1<sup>st</sup> through 4<sup>th</sup> order streams. An analysis of available DO data from the smaller-order streams in Conowingo Dam Susquehanna River watershed shows that all samples have DO concentrations above 5 mg/l. Therefore, DO criterion for Use I-P waters is being met. Based on the analysis presented in this report, the Conowingo Dam/Susquehanna River watershed supports its Aquatic Life Use, and it is not impaired by nutrients in general and phosphorus in particular,

Barring the receipt of contradictory data, this report will be used to support a revision of the 2010 Integrated Report phosphorus listing for the Conowingo Dam Susquehanna River 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 phosphorus-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 Conowingo Dam Susquehanna River 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. For instance, reductions will be required to meet allocations assigned to the Northern Chesapeake Bay Tidal Fresh Bay Water Quality Segment by the Chesapeake Bay TMDL, established by EPA on December 29, 2010.

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## Appendix A – Tabular Water Quality Data

### Table A-1: MDE Dissolved Oxygen Data

Station	Stream	Date	DO (mg/l)
COW0020	Conowingo Creek	03/17/99	13.5
COW0020	Conowingo Creek	04/14/99	12.4
COW0020	Conowingo Creek	05/12/99	9.7
COW0020	Conowingo Creek	07/21/99	8.4
COW0020	Conowingo Creek	08/18/99	8.3
COW0020	Conowingo Creek	09/15/99	8.4
COW0020	Conowingo Creek	12/12/05	14.5
COW0020	Conowingo Creek	01/25/06	11.3
COW0020	Conowingo Creek	02/23/06	12.7
COW0020	Conowingo Creek	03/22/06	10.1
COW0020	Conowingo Creek	04/19/06	13.1
COW0020	Conowingo Creek	05/17/06	9.5
COW0020	Conowingo Creek	06/21/06	8.3
COW0020	Conowingo Creek	07/26/06	8.1
COW0020	Conowingo Creek	08/23/06	8.7
COW0020	Conowingo Creek	09/20/06	7.2
COW0020	Conowingo Creek	10/18/06	9.0
COW0020	Conowingo Creek	11/15/06	9.7
PDD0006	Peddler Run	12/12/05	14.5
PDD0006	Peddler Run	01/25/06	12.3
PDD0006	Peddler Run	02/23/06	13.7
PDD0006	Peddler Run	03/22/06	11.0
PDD0006	Peddler Run	04/19/06	9.1
PDD0006	Peddler Run	05/17/06	8.0
PDD0006	Peddler Run	06/21/06	8.0
PDD0006	Peddler Run	07/26/06	7.5
PDD0006	Peddler Run	08/23/06	7.9
PDD0006	Peddler Run	09/20/06	8.8
PDD0006	Peddler Run	10/18/06	9.2
PDD0006	Peddler Run	11/15/06	9.8

**Table A-2: MBSS and SRBC Dissolved Oxygen Data**

<b>Sponsor</b>	<b>Station</b>	<b>Stream</b>	<b>Date</b>	<b>DO (mg/l)</b>
MBSS	CE-P-022-301-97	Conowingo Creek	03/05/97	10.0
MBSS	CE-P-022-316-97	Conowingo Creek	03/05/97	8.5
MBSS	CE-P-022-319-97	Conowingo Creek	03/11/97	8.5
MBSS	CE-P-071-305-97	Conowingo Creek	03/05/97	8.8
MBSS	CDAM-212-R-2004	Peddler Run	03/29/04	7.1
SRBC	Site 2	Peddler Run	04/21/08	10.8
SRBC	Site 3	UT2 to Susquehanna River	04/23/08	11.0
SRBC	Site 4	UT to Conowingo Creek	04/22/08	10.8
SRBC	Site 5	UT1 to Susquehanna River	04/23/08	11.0
SRBC	Site 6	UT1 to Susquehanna River	04/21/08	10.4
SRBC	Site 8	Conowingo Creek	04/22/08	11.5
SRBC	Site 9	Conowingo Creek	04/22/08	11.0
SRBC	Site 10	Conowingo Creek	04/22/08	11.2