UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

MAY 07 2014

Mr. D. Lee Currey, Director
Science Services Administration
Maryland Department of the Environment
1800 Washington Blvd., Suite 540
Baltimore, Maryland 21230-1718

Dear Mr. Currey:

The U.S. Environmental Protection Agency (EPA), Region III, is pleased to approve the report, *Total Maximum Daily Loads of Phosphorus and Sediments for Liberty Reservoir, Baltimore and Carroll Counties, Maryland.* The TMDL report was submitted by the Maryland Department of the Environment (MDE) to EPA for final review on September 28, 2012 and received on October 4, 2012. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act to address impairments of water quality as identified in Maryland's Section 303(d) List.

The Maryland Department of the Environment (MDE) has identified Liberty Reservoir (MD-02130907_Liberty_Reservoir) on the State's 2012 Integrated Report as impaired by sediments - sedimentation/siltation (1996), nutrients - phosphorus (1996), mercury in fish tissue (2002), and metals – chromium and lead (1996). The non-tidal portion of the Liberty Reservoir watershed has been identified by MDE on the State's 2012 Integrated Report as impaired by bacteria – fecal coliform (mainstem only; 2002) and impacts to biological communities (2004). A water quality analysis (WQA) for chromium and lead in Liberty Reservoir was approved by the EPA in 2003, and a fecal coliform TMDL for the nontidal portion of the watershed was approved by the EPA in 2009. In the final 2012 IR, the biological listing was addressed by the Biological Stressor Identification analysis which more specifically identified chloride as a stressor to biological communities within the 1$^{st}$- through 4$^{th}$-order streams of the Liberty Reservoir watershed. As a result, in the 2012 IR, the biological impairment listing was replaced with a category 5 chlorides listing. A mercury WQA is being approved by EPA concurrently with this TMDL. The TMDL established herein by MDE will address the 1996 nutrient and sediment listings for Liberty Reservoir.

In accordance with Federal regulations at 40 CFR §130.7, a TMDL must comply with the following requirements: (1) be designed to attain and maintain the applicable water quality standards; (2) include a total allowable loading and as appropriate, wasteload allocations for

point sources and load allocations for nonpoint sources; (3) consider the impacts of background pollutant contributions; (4) take critical stream conditions into account (the conditions when water quality is most likely to be violated); (5) consider seasonal variations; (6) include a margin of safety (which accounts for uncertainties in the relationship between pollutant loads and instream water quality); and (7) be subject to public participation. In addition, these TMDLs considered reasonable assurance that the TMDL allocations assigned to the nonpoint sources can be reasonably met. The enclosure to this letter describes how the Phosphorus and Sediment TMDLs for Liberty Reservoir satisfy each of these requirements.

As you know, any new or revised National Pollutant Discharge Elimination System permits must be consistent with the TMDL's wasteload allocation pursuant to 40 CFR §122.44(d)(1)(VII)(B). Please submit all such permits to EPA for review as per EPA's letter dated October 1, 1998.

If you have any questions or comments concerning this letter, please do not hesitate to contact Ms. Helene Drago, TMDL Program Manager at 215-814-5796.

Sincerely,

Signed

Jon M. Capacasa, Director
Water Protection Division

Enclosure

cc: Melissa Chatham, MDE-SSA
Jay Sakai, MDE-WMA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

# Decision Rationale
# Total Maximum Daily Load of Phosphorus and Sediments for Liberty Reservoir Baltimore and Carroll Counties, Maryland

Signed

Jon M. Capacasa, Director
Water Protection Division

Date: MAY 07 2014

**Decision Rationale**

**Total Maximum Daily Loads of Phosphorus and Sediments**
**for Liberty Reservoir Watershed**
**Baltimore and Carroll Counties, Maryland**

## I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those waterbodies identified as impaired by the State where technology based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a Margin of Safety (MOS), that may be discharged to a water quality limited waterbody.

This document sets forth the U.S. Environmental Protection Agency's (EPA) rationale for approving the TMDLs of Phosphorus and Sediments for Liberty Reservoir. The TMDL was established to address impairments of water quality, caused by phosphorus and sediments, as identified in Maryland's Section 303(d) List for water quality limited segments. The Maryland Department of the Environment (MDE) submitted the report, *Total Maximum Daily Loads of Phosphorus and Sediments for Liberty Reservoir, Baltimore and Carroll Counties, Maryland,* dated September 2012, to EPA for final review on September 28, 2012 and was received on October 4, 2012. The TMDLs in this report address the Phosphorus and Sediment impairments in the Liberty Reservoir as identified on Maryland's Section 303(d) List. The basin identification for the Liberty Reservoir watershed is MD-02130907.

EPA's rationale is based on the TMDL Report and information in the computer files provided to EPA by MDE. EPA's review determined that the TMDLs meet the following seven regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDL is designed to implement applicable water quality standards.
2. The TMDL includes a total allowable load as well as individual wasteload allocations (WLAs) and load allocations (LAs).
3. The TMDL considers the impacts of background pollutant contributions.
4. The TMDL considers critical environmental conditions.
5. The TMDL considers seasonal environmental variations.
6. The TMDL includes a MOS.
7. The TMDL has been subject to public participation.

In addition, these TMDLs considered reasonable assurance that the TMDLs allocations assigned to nonpoint sources can be reasonably met.

## II. Summary

The TMDLs specifically allocate the allowable Phosphorus and Sediment loadings to

Liberty Reservoir. There are thirty six permitted point sources and an allocation for Concentrated Feeding Operations (CAFOs) which are included in the WLA. The fact that the TMDL does not assign WLAs to any other sources in the watershed should not be construed as a determination by either EPA or MDE that there are no additional sources in the watershed that are subject to the National Pollutant Discharge Elimination System (NPDES) program. In addition, the fact that EPA is approving this TMDL does not mean that EPA has determined whether some of the sources discussed in the TMDL, under appropriate conditions, might be subject to the NPDES program. The Phosphorus TMDL is presented as an average annual load in pounds per year and for the Sediment TMDL in average annual load of tons per year because they were calculated so as to not cause any Phosphorus and Sediment related impacts to the designated uses. The maximum daily Phosphorus Load is presented in pounds per day and the maximum daily Sediment Load is presented as tons per year. The calculation of the maximum daily loads is explained in Appendix B of the TMDL report. The average annual Liberty Reservoir Phosphorus and Sediment TMDLs are summarized below in Table 1 and 3, respectively. The TMDL is the sum of the $LA_{LR}$, CAFO $WLA_{LR}$, NPDES Stormwater $WLA_{LR}$, Process Water $WLA_{LR}$, and MOS. The $LA_{LR}$ include nonpoint source loads generated within the Liberty Reservoir watershed. The maximum daily loads are presented in Tables 2 and 4. Individual annual average and maximum daily WLAs for permitted point sources are provided in Table 5 and 6.

**Table 1. Liberty Reservoir Average Annual TMDL of Phosphorus (lbs/yr)**

| TMDL (lbs/yr) | = | $LA_{LR}$ | + | CAFO $WLA_{LR}$ | + | NPDES Stormwater $WLA_{LR}$ | + | Process Water $WLA_{LR}$ | + | MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| 41,009 | = | 24,853 | + | 430 | + | 11,177 | + | 2,498 | + | 2,050 |

**Table 2. Liberty Reservoir Maximum Daily Load of Phosphorus (lbs/day)**

| MDL (lbs/day) | = | $LA_{LR}$ | + | CAFO $WLA_{LR}$ | + | NPDES Stormwater $WLA_{LR}$ | + | Process Water $WLA_{LR}$ | + | MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| 300.3 | = | 180.0 | + | 3.1 | + | 80.9 | + | 21.2 | + | 15.0 |

**Table 3. Liberty Reservoir Average Annual TMDL of Sediment (tons/yr)**

| TMDL (tons/yr) | = | $LA_{LR}$ | + | CAFO $WLA_{LR}$ | + | NPDES Stormwater $WLA_{LR}$ | + | Process Water $WLA_{LR}$ | + | MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| 15,988 | | 10,438 | | 5 | | 5,484 | | 61 | | Implicit |

**Table 4. Liberty Reservoir Maximum Daily Load of Sediment (tons/day)**

| MDL (tons/day) | = | $LA_{LR}$ | + | CAFO $WLA_{LR}$ | + | NPDES Stormwater $WLA_{LR}$ | + | Process Water $WLA_{LR}$ | + | MOS |
|---|---|---|---|---|---|---|---|---|---|---|
| 51.6 | | 33.5 | | 0.02 | | 17.6 | | 0.5 | | Implicit |

## Table 5. Wasteload Allocations of Phosphorus and Sediment for Point Sources in Liberty Reservoir

| Facility | NPDES ID Number | TP Annual Average WLA (lbs/yr) | TP MDL WLA (lbs/day) | Sediment Annual Average WLA (tons/yr) | Sediment MDL WLA (tons/day) |
|---|---|---|---|---|---|
| **Process Water Point Source**[1] | | | | | |
| Congoleum Corporation | MD0001384 | 160 | 1.36 | 4 | 0.03 |
| BTR Hampstead, LLC | MD0001881 | 2,338 | 19.88 | 57 | 0.48 |
| City of Westminster Koontz Well | MD0058556 | | | | |
| S & G Concrete – Finksburg Plant | MDG492472 | | | | |
| Carroll County Family YMCA | MDG766057 | | | | |
| The Boston Inn, Inc. | MDG766199 | | | | |
| Four Seasons Sports Complex | MDG766210 | | | | |
| Freedom Swim Club | MDG766371 | | | | |
| Green Valley Swim Club | MDG766379 | | | | |
| McDaniel College | MDG766048 | | | | |
| Glyndon Trace Condominiums | MDG766199 | | | | |
| **NPDES Regulated Stormwater Permits**[2] | | | | | |
| Baltimore County Phase I MS4 | MD0068314 | 524 | 3.8 | 294 | 0.9 |
| Carroll County Phase I MS4 | MD0068331 | 6,102 | 43.9 | 2,530 | 8.1 |
| SHA Phase I MS4 | MD0055501 | 677 | 4.9 | 275 | 0.9 |
| Municipal Phase II MS4s | MDR05550 | 893 | 6.4 | 350 | 1.1 |
| "Other NPDES Regulated Stormwater" | N/A | 2,981 | 21.5 | 2,035 | 6.5 |

1

- Two municipal Water Treatment Plants (WTPs) (Cranberry WTP, NPDES # MD0067644; and Freedom District WTP, NPDES# MD0067652) have been identified within the watershed, but are not included within the analysis, since they withdraw water from the watershed stream system. Therefore, any TP and TSS loads discharged from the plants are representative of a pass through condition.
- Two hydrostatic testing permits (Maryland Military Facility – Camp Fretterd, NPDES# MDG675043; and Pearlstone Family Camp, NPDES# MDG675029) have also been identified within the watershed but are not included within the analysis, since they both discharge to groundwater rather than surface water, and therefore there are no potential TP or TSS loadings from the permits.

2

See Table 6 below for a list of NPDES Regulated Stormwater Facilities.

## Table 6. NPDES Regulated Stormwater Permits in the Liberty Reservoir Watershed

| Permit Number | Facility | NPDES Group |
|---|---|---|
| N/A - 02SW1965 | Baltimore County Bureau of Highways - Shop 3 | Other NPDES Reg SW |
| N/A - 02SW1219 | BFI Waste Services, LLC - Finksburg | Other NPDES Reg SW |
| N/A - 02SW3001 | Bullock's Meats, Inc. | Other NPDES Reg SW |
| N/A - 02SW1824 | C and C Mulch Processing, LLC | Other NPDES Reg SW |
| N/A - 02SW1755 | Carroll County Regional Airport | Other NPDES Reg SW |
| N/A - 02SW1452 | Condon's Auto Parts, Inc. | Other NPDES Reg SW |
| N/A - 02SW2006 | General Dynamics Robotic Systems | Other NPDES Reg SW |
| N/A - 02SW0664 | Hodges Landfill | Other NPDES Reg SW |
| N/A - 02SW0954 | Jones Auto & Salvage | Other NPDES Reg SW |

| Permit Number | Facility | NPDES Group |
|---|---|---|
| N/A - 02SW1144 | M & M Truck & Equipment Co., Inc. | Other NPDES Reg SW |
| N/A - 02SW0660 | Northern Municipal Landfill | Other NPDES Reg SW |
| N/A - 02SW1345 | SHA – Westminster Shop | Other NPDES Reg SW |
| N/A - 02SW1908 | Smith Brothers Auto Parts | Other NPDES Reg SW |
| N/A - 02SW0078 | Thomas, Bennett & Hunter, Inc. – Shop Facility | Other NPDES Reg SW |
| N/A - 02SW0794 | Tobacco Technology, Inc. | Other NPDES Reg SW |
| N/A - 02SW0115 | CJ Miller, LLC | Other NPDES Reg SW |
| N/A - 02SW0719 | Maryland Paving - Finksburg | Other NPDES Reg SW |
| N/A - 02SW0029 | Maranda Industries | Other NPDES Reg SW |
| MDR05550 | City of Hampstead MS4 | Municipal Phase II MS4 |
| MDR05550 | City of Manchester MS4 | Municipal Phase II MS4 |
| MDR05550 | City of Westminster MS4 | Municipal Phase II MS4 |
| MD0068314 | Baltimore County MS4 | Baltimore County Phase I MS4 |
| MD0068331 | Carroll County MS4 | Carroll County Phase I MS4 |
| MD0055501 | State Highway Administration MS4 (Phase I) | SHA Phase I MS4 |
| N/A | MDE General Permit to Construct | Other NPDES Reg SW |

The TMDL is a written plan established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically based strategy that considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a MOS value. The option is always available to refine the TMDL for resubmittal to EPA for approval if environmental conditions, new data, or the understanding of the natural processes change more than what was anticipated by the MOS.

## III. Background

The Liberty Reservoir watershed is located within the Patapsco River sub-basin of the Chesapeake Bay watershed, within Maryland. The reservoir's watershed drains 104,800 acres of western Baltimore County and eastern Carroll County (majority of watershed is located in Carroll County). A dam was constructed on the North Branch Patapsco River in 1953, creating the Liberty Reservoir, which is owned by the Baltimore City Department of Public Works (BCDPW). Water supply intakes in the reservoir feed the BCDPW's Ashburton Water Filtration Plant, which provides drinking water to Baltimore City, Carroll County, and Baltimore County. The reservoir is primarily fed by the North Branch Patapsco River; other tributaries include Beaver Run, Keyer's Run, Prugh Run, Morgan Run, Middle Run, Locust Run, and Cooks Branch. There are several "high quality," or Tier II, stream segments (Benthic Index of Biotic Integrity (BIBI) and Fish Index of Biotic Integrity (FIBI) aquatic life assessment scores > 4 (scale 1-5)) located within the watershed requiring the implementation of Maryland's anti-degradation policy (COMAR 2012e). These include Keyser Run, Cooks Branch, an unnamed tributary to Morgan Run, an unnamed tributary to Little Morgan Run, and portions of Morgan Run, Joe Branch, Little Morgan Run, Middle Run, Beaver Run, the North Branch Patapsco River mainstem, and an unnamed tributary to the North Branch Patapsco River mainstem (MDE 2011). Approximately 1.9% percent of the watershed area is covered by water (i.e., streams, ponds, etc).

The land-use distribution in the Liberty Reservoir watershed consists primarily of forest (36.0%), crop land (27.2%), and urban land (31.6%). There are also smaller amounts of pasture (5.0%), animal feeding operations (AFOs) (0.1%), and nurseries (0.1%). The total population in the MD 8-digit Liberty Reservoir watershed is approximately 115,288 (US Census Bureau

The Maryland 8-Digit (MD 8-Digit) Liberty Reservoir watershed consists of the actual impoundment created behind the Liberty Dam, and the nontidal tributaries within the watershed that drain to the impoundment. The use of the term "Liberty Reservoir" throughout this document will refer to solely the impoundment created behind Liberty dam. Use of the term "non-tidal portion of the Liberty Reservoir watershed" will refer to the non-tidal tributaries within the watershed draining to the Reservoir.

The Maryland Department of the Environment (MDE) has identified Liberty Reservoir on the State's 2012 Integrated Report as impaired by sediments - sedimentation/siltation (1996), nutrients - phosphorus (1996), mercury in fish tissue (2002), and metals – chromium and lead (1996). The non-tidal portion of the Liberty Reservoir watershed has been identified by MDE on the State's 2012 Integrated Report as impaired by bacteria – fecal coliform (mainstem only; 2002) and impacts to biological communities (2004) (MDE 2010a). A water quality analysis (WQA) for chromium and lead in Liberty Reservoir was approved by the EPA in 2003, and a fecal coliform TMDL for the nontidal portion of the watershed was approved by the EPA in 2009. In the final 2012 IR, the biological listing was addressed by the Biological Stressor Identification analysis which more specifically identified chloride as a stressor to biological communities within the 1$^{st}$- through 4$^{th}$-order streams of the Liberty Reservoir watershed. As a result, in the 2012 IR, the biological impairment listing was replaced with a category 5 chlorides listing. A mercury WQA is being approved by EPA concurrently with this TMDL. The TMDL established herein by MDE will address the 1996 nutrient and sediment listings for Liberty Reservoir.

The Maryland water quality standards surface water use designation in the Code of Maryland Regulations (COMAR) for Liberty Reservoir is Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*) (COMAR 2012d). Maryland's general water quality criteria prohibit the pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere directly or indirectly with designated uses (COMAR 2012b).

CWA Section 303(d) and its implementing regulations require that TMDLs be developed for waterbodies identified as impaired by the State where technology based and other required controls do not provide for attainment of water quality standards. The water quality goal of the phosphorus TMDL is to decrease phosphorus inputs to the reservoir to levels that will 1) reduce high chlorophyll *a* (Chla) concentrations associated with excessive algal blooms, and 2) increase dissolved oxygen (DO) concentrations to levels that are supportive of the designated use for the reservoir. The water quality goal of the sediment TMDL for Liberty Reservoir is to increase the useful life of the reservoir for water supply purposes by preserving storage capacity. Additionally, reducing sediment influx will directly reduce phosphorus loads, thus ensuring the maintenance of healthy levels of dissolved oxygen and algal biomass, both of which are direct measures of impairment to the aquatic life.

The BCDPW is currently the only entity that monitors water quality in the reservoir. Table 7, below, summarizes the characteristics of the monitoring programs. BCDPW samples four monitoring stations in the reservoir. Water column samples are analyzed for temperature, DO, TP, ammonia ($NH_3$), nitrate ($NO_3$), turbidity, and Secchi depth, among other constituents.

Samples are not analyzed for phosphorus species and organic or total nitrogen. Starting at the surface, samples are taken every five feet until reaching sixty feet in depth; samples are taken at ten-foot intervals thereafter. Not every sample is analyzed for the entire suite of parameters. Generally, only field measurements like temperature and DO are measured at every depth sampled. Lab analysis is performed for Chla for each sample collected at the surface and at ten-foot depth intervals down to 50 feet. Chemical analysis is performed on samples collected at the surface and at ten–foot depth intervals down to sixty feet.

**Table 7. Summary of BCDPW Liberty Reservoir Monitoring Program**

| Water Quality Monitoring Characteristic | Details |
|---|---|
| Collection Period | 3/98-11/04 |
| Number of Monitoring Stations | 4 |
| Temperature and DO measurements/Monitoring Station | Samples taken at approximately 5-10 ft. intervals from surface to bottom |
| Water quality Samples/Monitoring Station | Samples taken at approximately 10 ft. intervals from surface to bottom |
| Water Quality Analysis Parameters | $NH_3$, $NO_3$, $NO_{23}$, TP, DS, Chla, Turbidity, Secchi depth[1] |

**Note:** [1] $NO_{23}$: Nitrite plus Nitrate; DS: Dissolved Solids.

Liberty Reservoir regularly exhibits temperature stratification starting in April or May and lasting until November. Stratification sometimes occurs in winter but it does not have a significant effect on water quality at this time. Under stratified conditions during the summer and early fall, bottom waters in the reservoir can become hypoxic, or oxygen deficient, because stable density differences inhibit the turbulent mixing that usually transports oxygen from the surface. Under such conditions, the reservoirs can be divided vertically into a well-mixed surface layer, or epilimnion; a relatively homogeneous bottom layer or hypolimnion; and a transitional zone between them, the metalimnion, characterized by a sharp density gradient.

Low dissolved oxygen occurs in the Liberty Reservoir hypolimnion regularly. Generally, the low DO concentrations in the hypolimnion are due to two related causes. First is temperature stratification, as explained above ; second is the entrainment of low DO waters into the epilimnion. Entrainment refers to the process by which turbulent layers spread into a non-turbulent region (Ford and Johnson 1986). The onset of cool weather causes the epilimnion to increase in depth by entraining water from the metalimnion. This water can be low in oxygen and thereby reduce the DO concentrations in the epilimnion. This can occur any time under stratified conditions when the well-mixed surface layer deepens, often well before the fall overturn, when the surface and bottom layers displace one another, which is typical of many lakes and reservoirs (including Liberty). In a typical reservoir system, there is also another factor that can influence entrainment, which is drawdown. Withdrawals from a reservoir can induce currents that enhance mixing. In 2002 (a drought year), withdrawals from Liberty Reservoir dropped the surface elevation by about ten feet. These drawdowns are more than likely contributing to the low DO concentrations in the well-mixed surface layer of the reservoir.

Nitrogen and phosphorus are essential nutrients for algal growth. If one nutrient is available in great abundance relative to the other, then the nutrient that is less available limits the amount of plant matter that can be produced, and it is said to be the "limiting nutrient". Based

on the available monitoring data and high N:P ratios, it is clearly evident that Liberty Reservoir is phosphorus limited.

Maximum Chla concentrations in the surface layer at the four Liberty Reservoir BCDPW monitoring stations show that Chla concentrations tend to be higher in the upstream portion of the reservoir. The maximum Chla concentrations by month and year from 2000 through 2008 reveal that Chla concentrations above 10 micrograms per liter (µg/l) occur regularly, and concentrations above 30 µg/l occur frequently. Concentrations above 10 µg/l occur in every season, but concentrations above 30 µg/l tend to occur more frequently in the summer months.

An algal bloom occurred in the winter of 2004 following the extremely wet conditions in 2003. Peak Chla concentrations reached 225 µg/l in the upper reaches of the reservoir. An analysis of algal taxa performed at the Ashburn WTP showed that there was a significant blue-green algal component in the algal assemblage during the bloom, which is unusual for winter months. The bloom was localized to the upper reaches in the reservoir, as Chla concentrations observed during the bloom at a station just upstream of the dam, were below10 µg/l. The magnitude of the bloom in the winter of 2004, the largest observed in the reservoir in the last twenty years, seems unique to the extreme hydrological conditions preceding the event, and it is not considered representative of long-term average conditions in the reservoir.

The Maryland Geological Survey (MGS) developed new bathymetry for Liberty Reservoir in 2001 (Ortt and Wells 2001). Table 8 summarizes capacity loss and the average sediment accumulation rate for the reservoir.

**Table 8. Liberty Reservoir Sedimentation Rates[1]**

| | |
|---|---|
| Capacity Prior to 1953 Construction (acre-ft)[2] | 118,148 |
| 2001 Capacity (acre-ft) | 115,617 |
| Capacity Loss (acre-ft) | 2,531 |
| Average Annual Capacity Loss (acre-ft/yr)[3] | 54 |
| Sediment Accumulation Rate (in/yr)[4] | 0.21 |

**Note:** [1]Source: Ortt and Wells 2001.
[2]acre-ft: acres by feet.
[3]acre-ft/yr: acre by feet per year.
[4]in/yr: inches per year.

The computer modeling framework used to develop the Liberty Reservoir TMDLs has two elements: (1) a refined version of the Chesapeake Bay Program's Phase (CBP P5.3.2) watershed model was used to determine the rate and timing of phosphorus and sediment loads to Liberty Reservoir; and (2) a CE-QUAL-W2 (W2) model of the Liberty Reservoir itself, to simulate the impact of those loads on water quality. W2 is a laterally averaged, two-dimensional computer simulation model, capable in its most recent formulations of representing the hydrodynamics and water quality of rivers, lakes, and estuaries. It is particularly well-suited for representing the temperature stratification that occurs in reservoirs such as Liberty. The W2 reservoir model was used to simulate not only hydrodynamics and temperature but also eutrophic dynamics as well. TMDL development consisted of the following four scenarios: baseline

scenario, calibration scenario, TMDL scenario and the All-Forested Scenario.

The baseline scenario models the current phosphorus and sediment loads in the Liberty Reservoir watershed. The phosphorus and sediment loads from the CBP P5.3.2 Watershed Model 2009 Progress Scenario were applied as the baseline for the TMDLs. The 2009 Progress Scenario represents current land-use, loading rates, and Best Management Practice (BMP) implementation within the Chesapeake Bay watershed, simulated using precipitation and other meteorological inputs from the time period of 1991-2000, in order to represent variable hydrological conditions. The 1991-2000 simulation period is used in all Chesapeake Bay TMDL scenarios to represent the impact of variable hydrology and meteorology. The 2009 Progress Scenario is applied as the baseline loading scenario for the Chesapeake Bay TMDLs and is considered to be the best available representation of current conditions. Forest and Harvested Forest EOS phosphorus loads were revised to make them more compatible with the assumptions used in previous phosphorus TMDLs for the Gunpowder Reservoirs (MDE 2007; ICPRB 2006) and Patuxent Reservoirs (MDE 2008, ICPRB 2008).

The Calibration Scenario represents the actual phosphorus and sediment loads over the model simulation period of 2000 to 2005. The phosphorus and sediment loads in this scenario were used to calibrate the Liberty Reservoir W2 model. Loads from WWTPs and other point source discharges are based on reported flows and concentrations for the model simulation period. Loads from NPDES regulated urban land, as well as nonpoint source loads from forest and agricultural land, were estimated based on the calibration of the refined CBP P5.3.2 Liberty Reservoir watershed model.

The Liberty Reservoir W2 model was used to calculate the maximum total phosphorus load the reservoir can assimilate and still meet water quality standards. Simulated phosphorus and sediment loads were reduced until two conditions were met: (1) the ninetieth percentile of simulated Chla concentrations in any W2 model cell did not exceed 30 µg/l, and (2) the 30-day moving average Chla concentration of each W2 model cell within approximately 50 feet of the surface was not greater than 10 µg/l. The TMDL Scenario was also used to evaluate whether the reservoir would meet the DO criteria for Use I-P waters at the scenario's calculated phosphorus and sediment loadings. To more accurately screen for potential violations, the position of the well-mixed surface layer was estimated on a daily basis, thereby providing for a more precise evaluation (daily comparison) in the surface layer of DO concentrations versus the Use I-P DO criterion. Instantaneous DO concentrations were output from all cells in the surface layer at half-day intervals. In the TMDL scenario, there is no cell in the surface layer of the reservoir with an instantaneous DO concentration less than 5.0 mg/l except during periods such as the fall overturn, when the surface layer deepens and entrains water with low DO concentrations from the metalimnion.

Even in the TMDL Scenario, seasonal hypoxia persists in the hypolimnion of Liberty Reservoir. Average bottom DO concentrations at the downstream BCDPW monitoring stations in the reservoir indicate that although the average DO concentration in the bottom layer increases in the TMDL Scenario, the reservoir still does not maintain a DO concentration greater than 5.0 mg/l in the hypolimnion throughout the simulation period.

The purpose of the All-Forest Scenario is to aid in assessing whether hypoxic conditions in the bottom layers of Liberty Reservoir are primarily due to the stratification of the reservoir caused by its morphology, or current nutrient inputs from the reservoir watershed. If hypoxia occurs even under all-forested watershed conditions and associated nutrient loadings, then reservoir stratification is the primary cause of hypoxia in the hypolimnion. Consequently, the reservoir would be meeting the applicable water quality standards for DO in Use I-P waters, as interpreted for reservoirs and impoundment. The All-Forest Scenario demonstrates that current phosphorus and sediment loads, and the loads simulated in the TMDL Scenario, do not result in hypoxic conditions that significantly exceed those associated with the natural conditions in the watershed. To an extent, low DO concentrations in the bottom layer of the reservoir are a naturally occurring condition, as described by the interpretation of Maryland's water quality standards for DO in Use I-P waters for reservoirs and impoundments. The TMDL Scenario thus meets water quality standards for DO as per this interpretation.

The Liberty Reservoir Average Annual TMDL of Phosphorus is 41,009 lbs/yr. The average annual TMDL is further subdivided into point and nonpoint source allocations and is comprised of a Load Allocation ($LA_{LR}$) of 24,853 lbs/yr, a CAFO Wasteload Allocation (CAFO $WLA_{LR}$) of 430 lbs/yr, an NPDES Stormwater Wasteload Allocation (NPDES Stormwater $WLA_{LR}$) of 11,177 lbs/yr, and a Process Water Wasteload Allocation (Process Water $WLA_{LR}$) of 2,498 lbs/yr. The MOS for the Phosphorus TMDL is 2,050 lbs/yr (5% of the total TMDL). The Liberty Reservoir Average Annual TMDL of Sediment is 15,988 tons/yr, and is comprised of a Load Allocation ($LA_{LR}$) of 10,438 tons/yr, a CAFO Wasteload Allocation (CAFO $WLA_{LR}$) of 5 tons/yr, an NPDES Stormwater Wasteload Allocation (NPDES Stormwater $WLA_{LR}$) of 5,484 tons/yr, and a Process Water Wasteload Allocation (Process Water $WLA_{LR}$) of 61 tons/yr (see Tables 1 and 3). The MOS for the Sediment TMDL is implicit.

## IV. Discussion of Regulatory Conditions

EPA finds that MDE has provided sufficient information to meet all seven of the basic requirements for establishing a Phosphorus and Sediment TMDLs for Liberty Reservoir. EPA, therefore, approves these Phosphorus and Sediment TMDLs for the Liberty Reservoir. This approval is outlined below according to the seven regulatory requirements.

### *1) The TMDLs are designed to implement applicable water quality standards.*

Water Quality Standards consist of three components: designated and existing uses; narrative and/or numerical water quality criteria necessary to support those uses; and an anti-degradation Statement. The Maryland water quality standards surface water use designation in the Code of Maryland Regulations (COMAR) for Liberty Reservoir is Use I-P (*Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply*) (COMAR 2012d). Maryland's general water quality criteria prohibit the pollution of waters of the State by any material in amounts sufficient to create a nuisance or interfere directly or indirectly with designated uses (COMAR 2012b). Excessive eutrophication, as indicated by elevated Chla concentrations, can produce nuisance levels of algae and interfere with designated uses such as fishing and swimming. These algal blooms eventually die off and decompose, and as a result consume oxygen. Excessive eutrophication in Liberty Reservoir is caused by nutrient over enrichment.

An analysis of the available water quality data has demonstrated that phosphorus is the limiting nutrient. In conjunction with excess nutrient inputs, sediment loadings in the watershed are also elevated, which has decreased the projected lifespan of the reservoir. The shortened lifespan of the reservoir violates Maryland's general water quality criteria that prohibit interference with a designated use, specifically, for Liberty Reservoir, the public water supply use.

As per Maryland's water quality criteria for specific water use designations, in Use I-P waters, DO is not allowed to fall below 5.0 mg/l at any time, unless natural conditions result in lower DO concentrations (COMAR 2012a). New DO standards for tidal waters of the Chesapeake Bay and its tributaries take into account stratification and its impact on deeper waters. MDE recognizes that stratified reservoirs and impoundments (there are no natural lakes in Maryland) have conditions similar to stratified tidal waters. Therefore, an interpretation of the existing use I-P standard, to allow for the impact of stratification on DO concentrations, is being applied within this analysis. This interpretation recognizes that low dissolved oxygen in the hypolimnion is due to natural conditions resultant from the morphology of the reservoir, the resulting degree of stratification, and the naturally occurring sources of organic material in the watershed. Therefore, the interpretation of the Use I-P DO standard for non-tidal waters, as applied to reservoirs, is as follows:

- A minimum DO concentration of 5.0 mg/l will be maintained throughout the water column during periods of complete and stable mixing;
- A minimum DO concentration of 5.0 mg/l will be maintained in the mixed surface layer at all times, even during stratified conditions, except during periods of overturn or other naturally-occurring disruptions to the stratification; and
- Hypolimnetic hypoxia will be addressed on a case-by-case basis, taking into account morphology, the degree of stratification, sources of diagenic organic material in reservoir sediments, and other such factors.

Hypoxia occurs when DO concentrations are below levels necessary to support aquatic life. DO concentrations below 2-3 mg/l are considered hypoxic (Committee on Environment and Natural Resources 2010). For the application of the DO standard to Liberty Reservoir, the hypolimnion will be considered hypoxic when DO concentrations are below 2 mg/l.

Analysis of the water quality data presented indicates that all observed DO concentrations below 5.0 mg/l in the surface layer of Liberty Reservoir are associated with stratification or the mixing of stratified waters into the surface layer during periods of reservoir overturn or drawdown. However, seasonal hypoxia occurs regularly in the hypolimnion of the reservoir.

The Chla endpoints selected for the reservoir are (1) a ninetieth percentile instantaneous chlorophyll concentration not to exceed 30 µg/l in the surface layer, and (2) a 30-day moving average concentration not to exceed 10 µg/l in the surface layer. A concentration of 10 µg/l corresponds to a score of approximately 53 on the Carlson Trophic State Index (TSI) (Carlson 1977). This is the approximate boundary between mesotrophic and eutrophic conditions, which is an appropriate trophic state at which to manage the reservoir. Mean Chla concentrations exceeding 10 µg/l are associated with Chla peaks exceeding 30 µg/l. These peaks are associated with a shift in algal composition to blue-green assemblages, which present taste, odor, and

treatment problems (Walker 1984). Thus, the Chla endpoints should be reflective of conditions void of nuisance algal blooms. The decrease in phosphorus loads is expected to reduce excessive algal growth and therefore prevent violations of the narrative criteria associated with nuisances, such as taste and odor problems.

Also, Maryland's water quality standards establish that turbidity levels: (a) may not exceed levels detrimental to aquatic life, and (b) turbidity in the surface water resulting from any discharge may not exceed 150 Nephelometer Turbidity Units (NTU). Turbidity data collected from January 1994 to June 2008 was evaluated and it showed no exceedances of either the maximum or permissible average. Only five samples (of 2,650) exceeded 50 NTU; none occurred within a month of the others. Therefore, this demonstrates that the observed turbidity in Liberty Reservoir does not negatively impact the aquatic life designated use.

In summary, the TMDLs for phosphorus and sediment are intended to:

1. Resolve violations of the general, narrative water quality criteria, as it relates to excessive algal growth causing a nuisance, within the Liberty Reservoir, which is associated with the phosphorus enrichment of the reservoir;
2. Resolve violations of the general, narrative water quality criteria, as it relates to the preservation of a reservoir's life-span and the public water supply designated use, associated with excess sedimentation in Liberty Reservoir; and
3. Assure that DO levels in Liberty Reservoir are in attainment of the non-tidal Use I-P DO criteria, as appropriately modified for the reservoir.

EPA believes these are reasonable and appropriate water quality goals.

***2) The TMDLs include a total allowable load as well as individual wasteload allocations and load allocations.***

**Total Allowable Load**

EPA regulations at 40 CFR §130.2(i) state that *the total allowable load shall be the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background concentrations.* The TMDLs for Phosphorus and Sediment for the Liberty Reservoir is consistent with 40 CFR §130.2(i) because the total loads provided by MDE equal the sum of the individual WLAs for point sources and the land based LAs for nonpoint sources.

The TMDL for Phosphorus was established based on the modeled phosphorus loadings within the TMDL Scenario, as described above, and the resulting water quality response in the reservoir for the simulated years of 2000 to 2005, which demonstrated achievement of the applicable Chla and DO water quality standards for Use I-P waters. This model simulation time period was used to estimate the TMDL because it is suitable for calculating long-term average loading rates. It includes a dry year as well as very wet years and therefore takes into account a variety of hydrological conditions. Chla concentrations indicative of eutrophic conditions can occur at any time of year, and the model simulation time period encompasses the complete spectrum of observed, seasonal concentrations. Low DO concentrations in the hypolimnion that

occur seasonally each year are also captured in the model.

In order to attain the phosphorus TMDL loading cap calculated for the reservoir, reductions will be applied to the controllable sources in the watershed. The controllable sources include: (1) NPDES regulated urban land; (2) high till crops, low till crops, hay, and pasture; (3) harvested forest; (4) unregulated AFOs and regulated CAFOS; and (5) industrial process water discharges. If the TMDL loading cap cannot be achieved by applying reductions to solely the controllable sources, additional sources might need to be identified and controlled in order to ensure that the water quality standards are attained.

The Liberty Reservoir Total Phosphorus Baseline Load, TMDL, and reduction percentage are presented in Table 9. An overall phosphorus reduction of 46% from current estimated loads will be required to meet the TMDL and attain Maryland's applicable water quality standards for Use I-P waters.

**Table 9. Liberty Reservoir Phosphorus TMDL**

| **Baseline Load** (lbs/yr) | **TMDL** (lbs/yr) | **Reduction** (%) |
|---|---|---|
| 75,977 | 41,009 | 46 |

Excess sedimentation reduces a reservoir's storage capacity and therefore negatively impacts its ability to function as a water supply reservoir. No single, critical time period can be defined relative to the impact that sedimentation has on water quality in the reservoir. An excessive sedimentation rate negatively impacts a reservoir, regardless of when it occurs. Therefore, efforts to reduce sediment loadings to the reservoir should focus on achieving effective, long-term sediment control. Since measures to control phosphorus can also effectively reduce sedimentation, the expected sediment reduction can be estimated based on the degree of phosphorus control needed to achieve water quality standards in the reservoir.

To quantify the sediment reduction associated with the total required phosphorus reduction for the reservoir, modeling assumptions applied within the CBP P5.3.2 watershed model were applied. For agricultural Best Management Practices (BMPs) that control both phosphorus and sediments, EPA's CBP estimates a 1:1 reduction in sediments, as a result of controlling phosphorus (US EPA 1998). This ratio, however, does not account for phosphorus controls that do not remove sediments.

To estimate the applicable ratio between phosphorus and sediment reductions, it is necessary to estimate the proportion of the phosphorus reduction controls that remove sediments versus those that do not. In general, soil conservation and water quality plans (SCWQPs) remove sediments as well as phosphorus, while nutrient management plans (NMPs) do not. It is assumed that 50% of the phosphorus reduction in the Liberty Reservoir watershed will come from SCWQPs and 50% will come from NMPs. This results in a 0.5:1 ratio of sediment reduction to phosphorus reduction. The net sediment reduction associated with a 46% phosphorus reduction from nonpoint sources is about 23% (0.46 * 0.5 = 0.23).

It is assumed that a reduced sediment loading rate would result in a similar reduction in

the sediment accumulation rate in the reservoir. The sediment accumulation rate estimated to result from this reduced loading rate would allow for the retention of 99% of the reservoir's overall, original volume after 40 years.

MDE contends that this volumetric retention will support the Use I-P designated use of Liberty Reservoir: water contact recreation, protection of aquatic life, and public water supply. This estimate is reasonably consistent with technical guidance provided by EPA Region III, which estimates a 0.7:1.0 reduction in sediment relative to phosphorus reductions (US EPA 1998). This rule-of-thumb would yield a 32 % estimated reduction in sediment [100*(0.46 * 0.70) = 32%].

The Liberty Reservoir Sediment TMDL assumes that a 46% reduction in total phosphorus load results in a 23% reduction in sediment load. The Liberty Reservoir Total Sediment Baseline Load, TMDL, and reduction percentage are presented in Table 10.

**Table 10. Liberty Reservoir Sediment TMDL**

| **Baseline Load** (tons/yr) | **TMDL** (tons/yr) | **Reduction** (%) |
|---|---|---|
| 20,767 | 15,988 | 23% |

In order to attain the sediment TMDL loading cap calculated for the reservoir, reductions will be applied to the controllable sources in the watershed. The controllable sources include: (1) NPDES regulated urban land; (2) high till crops, low till crops, hay, and pasture; (3) harvested forest; (4) unregulated AFOS and regulated CAFOS; and (5) industrial process water discharges. If the TMDL loading cap cannot be achieved by applying reductions to solely the controllable sources, additional sources might need to be identified and controlled in order to ensure that the water quality standards are attained.

The Phosphorus TMDL and allocations are presented as mass loading rates of pounds per year for the average annual load and pounds per day for the maximum daily load. Similarly, the Sediment TMDL and allocations are presented as mass loading rates of tons/yr for the average annual load and in tons per day for maximum daily load. Expressing TMDLs as annual average and maximum daily mass loading rates is consistent with Federal regulations at 40 CFR §130.2(i), which states that *TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure.* The annual average and maximum daily Phosphorus and Sediment loads are presented in Tables 1 through 3 above.

**Load Allocations**

According to Federal regulations at 40 CFR §130.2(g), LAs are best estimates of the loading, which may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loadings should be distinguished. The TMDLs summary in Table 1 and 3 contains the LAs for Phosphorus and Sediment for the Liberty Reservoir, respectively.

In the Liberty Reservoir watershed, crops, pasture, nurseries, NPDES regulated urban

land, Animal Feeding Operations (AFOs), CAFOs, and industrial process water facilities were identified as the predominant controllable sources. Forest is the primary non-controllable source, as it represents the most natural condition in the watershed. Direct atmospheric deposition on water is a minor source that primarily originates outside of the watershed. Atmospheric deposition will be reduced by existing state and federal programs and therefore is not addressed in this TMDL. There are no Combined Sewer Overflows (CSOs) in the Liberty Reservoir watershed, and phosphorus and sediment loads from septic systems are considered insignificant. Although loads from urban land are a major controllable source, within the Liberty Reservoir watershed the entirety of the phosphorus and sediment loads from urban land are considered to be regulated under NPDES Phase I and II stormwater permits.

The baseline nonpoint source phosphorus and sediment loads were estimated using the CBP P5.3.2 watershed model 2009 Progress Scenario. The Liberty Reservoir TMDLs require a 52% reduction in phosphorus loads and a 18% reduction in sediment loads from nonpoint sources, primarily agricultural land-uses. Equal percent reductions were applied to the current controllable loads from nonpoint sources. Current controllable loads were determined as the difference between the CBP P5.3.2 2009 Progress Scenario and the "E3" Scenario, where the E3 Scenario represents the application of all possible BMPs and control technologies to current land-uses and point sources.

Table 11 provides one possible scenario for the distribution of the annual nonpoint source phosphorus loads amongst the different nonpoint source sectors in the Liberty Reservoir watershed. Table 12 provides one possible scenario for the distribution of the annual nonpoint source sediment loads amongst the different nonpoint source sectors in the Liberty Reservoir watershed. The source categories in Tables 11 and 12 represent aggregates of multiple sources (e.g., crop is an aggregate of high till, low till, and hay).

**Table 11. Liberty Reservoir Phosphorus TMDL Nonpoint Source Sector LAs**

| General Nonpoint Source Sector | Detailed Nonpoint Source Sector | Baseline Load (lbs/yr) | LA (lbs/yr) | Reduction (%) |
|---|---|---|---|---|
| Forest | Forest | 6,885 | 6,885 | 0 |
| | Harvested Forest | 258 | 13 | 95 |
| AFOs | Animal Feeding Operations | 831 | 42 | 95 |
| Pasture | Pasture | 4,216 | 518 | 88 |
| Crop | Crop | 27,853 | 8,689 | 69 |
| Nursery | Nursery | 10,149 | 7,477 | 26 |
| Atmospheric Deposition | Atmospheric Deposition | 1,230 | 1,230 | 0 |
| Total | | 51,421 | 24,853 | 52 |

**Table 12. Liberty Reservoir Sediment TMDL Nonpoint Source Sector LAs**

| General Nonpoint Source Sector | Detailed Nonpoint Source Sector | Baseline Load (tons/yr) | LA (tons/yr) | Reduction (%) |
|---|---|---|---|---|
| Forest | Forest | 3,019 | 3,019 | 0 |
| | Harvested Forest | 208 | 133 | 36 |
| AFOs | Animal Feeding Operations | 45 | 43 | 5 |
| Pasture | Pasture | 423 | 307 | 27 |
| Crop | Crop | 8,842 | 6,774 | 23 |
| Nursery | Nursery | 182 | 161 | 12 |

| General Nonpoint Source Sector | Detailed Nonpoint Source Sector | Baseline Load (tons/yr) | LA (tons/yr) | Reduction (%) |
|---|---|---|---|---|
| Atmospheric Deposition | Atmospheric Deposition | 0 | 0 | 0 |
| Total | | 12,720 | 10,438 | 18 |

**Wasteload Allocations**

There are thirty six permitted point sources in this watershed. The permits can be grouped into two categories, process water and stormwater. Allocations are provided for those point sources included within the NPDES process WLA and the regulated stormwater WLA. Also, an allocation for CAFOs is included in the WLA.

The process water category includes the following sources: municipal WWTPs, industrial process water permits, and mineral mines. There are no municipal WWTPs or mineral mines located in the watershed. There are eleven industrial process water permits in the Liberty Reservoir watershed that are capable of discharging phosphorus and/or sediments. The Liberty Reservoir phosphorus and sediment WLAs for the process water point sources are based on the WLAs assigned to the same facilities within the Chesapeake Bay TMDL (US EPA 2010) and Maryland's Phase I and Phase II Watershed Implementation Plans (WIPs) (MDE 2010, 2012). These WLAs are loading caps that are designed to meet the Phase II 2025 final implementation goals for the Chesapeake Bay TMDL and accommodate future growth after full implementation of the TMDL in 2025. Within the Chesapeake Bay TMDL, industrial facilities capable of discharging phosphorus and sediments in their process water were assigned a WLA based on the results of monitoring data collected as part of their permit requirements or best professional judgment. These WLAs were adopted for the Liberty Reservoir Phosphorus and Sediment TMDLs.

The stormwater category includes all NPDES regulated stormwater discharges. There are 25 NPDES Phase I and Phase II stormwater permits identified within the Liberty Reservoir watershed. These include both individual and general NPDES Phase I and II stormwater permits. The permits are regulated based on BMPs and do not include TP or TSS limits. In the absence of TP and TSS limits, the baseline loads for these NPDES regulated stormwater discharges are calculated using the CBP P.3.2 2009 Progress Scenario nonpoint source loads from the urban land use within the watershed.

Individual WLAs have been calculated for each of the Phase I county MS4 permits in the watershed and the SHA Phase I MS4 permit. An aggregate WLA has been calculated for the general municipal Phase II MS4 permits for the towns of Hampstead, Manchester, and Westminster. Finally, an aggregate WLA was also calculated for all other NPDES regulated stormwater permits, collectively termed "Other NPDES Regulated Stormwater", which include general state and federal Phase II MS4 permits, all industrial facilities permitted for stormwater discharges, and general construction permits.

In order to calculate the individual and aggregate NPDES stormwater WLAs, MDE further refined the CBP P5.3.2 urban land-use. The refined CBP P5.3.2 land-use contains the specific level of detail needed to determine individual and aggregate WLAs for the Baltimore and Carroll counties Phase I jurisdictional MS4s, the SHA Phase I MS4, the Phase II

jurisdictional MS4s, and "Other NPDES regulated stormwater,". The methods used by MDE to refine the CBP P5.3.2 urban land-use are described within MDE's documentation, *CBP P5.3.2 Land-Use and MDE Urban Source Sector Delineation - Development Methodology* (MDE 2011).

The WLAs for each regulated stormwater source sector were calculated based on applying an equal percent reduction to the controllable loads for each regulated stormwater source sector, along with other land-uses. Reductions for all NPDES regulated stormwater source sectors were not allowed to exceed 75% of the controllable load, which MDE has defined as the maximum feasible reduction. Tables13 and 14 provide one possible scenario for the distribution of the average annual phosphorus and sediment WLAs to the NPDES regulated stormwater source sectors in the Liberty Reservoir watershed, respectively

**Table 13. Liberty Reservoir Phosphorus TMDL NPDES Regulated Stormwater WLAs**

| NPDES Regulated Stormwater Sector | NPDES # | Baseline Load (lbs/yr) | WLA (lbs/year) | Reduction (%) |
|---|---|---|---|---|
| Baltimore County Phase I MS4 | MD0068314 | 1,037 | 524 | 49 |
| Carroll County Phase I MS4 | MD0068331 | 12,300 | 6,102 | 50 |
| SHA Phase I MS4 | MD0055501 | 1,231 | 677 | 45 |
| Municipal Phase II MS4s | MDR05550 | 1,672 | 893 | 47 |
| "Other NPDES Regulated Stormwater" | N/A | 3,848 | 2,981 | 23 |
| Total | | 20,088 | 11,177 | 44 |

**Table 14. Liberty Reservoir Sediment TMDL NPDES Regulated Stormwater WLAs**

| NPDES Regulated Stormwater Sector | NPDES # | Baseline Load (tons/yr) | WLA (tons/yr) | Reduction (%) |
|---|---|---|---|---|
| Baltimore County Phase I MS4 | MD0068314 | 475 | 294 | 38 |
| Carroll County Phase I MS4 | MD0068331 | 4,033 | 2,530 | 37 |
| SHA Phase I MS4 | MD0055501 | 500 | 275 | 45 |
| Municipal Phase II MS4s | MDR05550 | 611 | 350 | 43 |
| "Other NPDES Regulated Stormwater" | N/A | 2,402 | 2,035 | 15 |
| Total | | 8,021 | 5,484 | 32 |

As per the Clean Water Act (CWA) all CAFOs are required to obtain NPDES permits for their discharges or potential discharges (CFR 2012b). In January, 2009, Maryland implemented new regulations governing CAFOs (COMAR 2012a,b), which were approved by the EPA in January, 2010. Under these regulations, CAFOs are required to fulfill the conditions of a general permit. These conditions include instituting a Comprehensive Nutrient Management Plan (CNMP) that meets the Nine Minimum Standards to Protect Water Quality. The general permit also prohibits the discharge of pollutants, including nutrients, from CAFO production areas except as the result of an event greater than the 25-year, 24-hour storm. Based on the TMDL methodology approach of applying an equal percent reduction to all controllable loads, subject to a maximum reduction for permitted sources of 75%, a 59% reduction in phosphorus loads and 50% reduction on sediment loads is required from CAFOs in the Liberty Reservoir TMDLs. Table 15 and 16 provide the baseline load and WLA for CAFOs for Phosphorus and Sediment, respectively.

**Table 15. Liberty Reservoir Phosphorus TMDL NPDES Regulated CAFO WLA**

| Baseline Load (lbs/yr) | WLA (lbs/year) | Reduction (%) |
|---|---|---|
| 1,060 | 430 | 59 |

**Table 16. Liberty Reservoir Sediment TMDL NPDES Regulated CAFO WLA**

| Baseline Load (tons/yr) | WLA (tons/year) | Reduction (%) |
|---|---|---|
| 11 | 5 | 50 |

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require that, for an NPDES permit for an individual point source, the effluent limitations must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. There is no express or implied statutory requirement that effluent limitations in NPDES permits necessarily be expressed in daily terms. The CWA definition of "effluent limitation" is quite broad (effluent limitation is "any restriction on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources ... )." See CWA 502(11). Unlike the CWA's definition of TMDL, the CWA definition of "effluent limitation" does not contain a "daily" temporal restriction. NPDES permit regulations do not require that effluent limits in permits be expressed as maximum daily limits or even as numeric limitations in all circumstances, and such discretion exists regardless of the time increment chosen to express the TMDL. For further guidance, refer to Benjamin H. Grumbles memo (November 15, 2006) titled *Establishing TMDL Daily Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015 (April 25, 2006) and implications for NPDES Permits.*

EPA has authority to object to the issuance of an NPDES permit that is inconsistent with WLAs established for that point source. It is expected that MDE will require periodic monitoring of the point source(s), through the NPDES permit process, in order to monitor and determine compliance with the TMDL's WLAs. Based on the foregoing, EPA has determined that the TMDLs are consistent with the regulations and requirements of 40 CFR Part 130.

***3) The TMDLs consider the impacts of background pollutant contributions.***

The TMDLs consider the impact of background pollutants by considering the Phosphorus load from natural sources such as forested land. The CBP P5.3.2 model also considers background pollutant contributions by incorporating all land uses.

***4) The TMDLs consider critical environmental conditions.***

EPA regulations at 40 CFR §130.7(c)(1) require TMDLs to account for critical conditions for stream flow, loading, and water quality parameters. The intent of the regulations is to ensure that: (1) the TMDLs are protective of human health, and (2) the water quality of the waterbodies is protected during the times when they are most vulnerable. Critical conditions are important because they describe the factors that combine to cause a violation of water quality

standards and will help in identifying the actions that may have to be undertaken to meet water quality standards[1]. Critical conditions are a combination of environmental factors (e.g., flow, temperature, etc.), which have an acceptably low frequency of occurrence. In specifying critical conditions in the waterbody, an attempt is made to use a reasonable worst-case scenario condition.

The phosphorus and sediment loading rates applied within the analysis are reflective of long term average annual loads, and the water quality response in the reservoir to various nutrient inputs was modeled using a continuous simulation model with a six year simulation period from 2000-2005. The six year simulation period encompasses seasonal variations and a range of hydrological and meteorological conditions, including a very dry year (2002) and very wet years (2003 and 2004). Thus, critical conditions are implicitly addressed in the analysis.

***5) The TMDLs consider seasonal environmental variations.***

As for critical conditions, the phosphorus and sediment loading rates applied within the analysis are reflective of long term average annual loads, and the water quality response in the reservoir to various nutrient inputs was modeled using a continuous simulation model with a six year simulation period from 2000-2005. The six year simulation period encompasses seasonal variations and a range of hydrological and meteorological conditions, including a very dry year (2002) and very wet years (2003 and 2004). Thus, seasonal conditions are implicitly addressed in the analysis.

***6) The TMDLs include a Margin of Safety.***

The requirement for a MOS is intended to add a level of conservatism to the modeling process in order to account for uncertainty. Based on EPA guidance, the MOS can be achieved through two approaches. One approach is to reserve a portion of the loading capacity as a separate term, and the other approach is to incorporate the MOS as part of the design conditions. MDE has adopted has adopted a MOS for Phosphorus TMDLs using an explicit MOS. The reserved load allocated to the MOS was computed as 5% of the total phosphorus load. The explicit phosphorus MOS for Liberty Reservoir is 2,050 lbs/yr.

In establishing a MOS for sediments, Maryland has adopted an implicit approach by incorporating conservative assumptions. First, because phosphorus binds to sediments, sediment loads will be controlled as a result of controlling phosphorus loads. This estimate of sediment reduction is based on the phosphorus LAs and WLAs, rather than the entire phosphorus TMDL including the MOS. Thus, the explicit 5% MOS for phosphorus will result in an implicit MOS for sediments. This conservative assumption results in a difference of about 280 tons/yr (see Section 4.5 of the TMDL report for a discussion of the relationship between the reductions in phosphorus and sediments). Secondly, MDE conservatively assumes a sediment-to-phosphorus

[1] EPA memorandum regarding EPA Actions to Support High Quality TMDLs from Robert H. Wayland III, Director, Office of Wetlands, Oceans, and Watersheds to the Regional Management Division Directors, August 9, 1999.

reduction ratio of 0.5:1, rather than 0.7:1 estimated in the technical guidance provided by EPA Region III.

*7) The TMDLs have been subject to public participation.*

MDE provided an opportunity for public review and comment on the Phosphorus and Sediment TMDLs for the Liberty Reservoir. The public review and comment period was open from August 15, 2012 through September 13, 2012. MDE received three sets of written comments. The comments were considered and addressed appropriately.

A letter was sent to the U.S. Fish and Wildlife Service pursuant to Section 7(c) of the Endangered Species Act, requesting the Service's concurrence with EPA's findings that approval of this TMDL does not adversely affect any listed endangered and threatened species, and their critical habitats. US FWS's response to EPA's letter stated that except for occasional transient individuals, no federally proposed or listed endangered or threatened species are known to exist within the project impact area and therefore, no biological assessment or further Section 7 consultation with US FWS was required.

## V. Discussion of Reasonable Assurance

EPA requires that there be a reasonable assurance that the TMDLs can be implemented. WLAs will be implemented through the NPDES permit process. According to 40 CFR §122.44(d)(1)(vii)(B), the effluent limitations for an NPDES permit must be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the State and approved by EPA. Furthermore, EPA has the authority to object to issuance of an NPDES permit that is inconsistent with WLAs established for that point source.

Since 1979, Baltimore City, Baltimore County, and Carroll County have had in place a formal agreement to manage the Liberty Reservoir watershed, and since 1984, these agreements have been accompanied by an action strategy with specific commitments from the signatories. A revised Reservoir Watershed Management Agreement was signed in 2005, accompanied by a revised Action Strategy. Table 17, below, lists the parties to the 2005 agreement and some of their major commitments made in the Action Strategy.

**Table 17. Signatories to the 2005 Reservoir Management Agreement and the Major Commitments of the 2005 Action Strategy[1]**

| | |
|---|---|
| Maryland Department of the Environment | 1. Use NPDES program to discourage significant phosphorus discharges in reservoir watersheds from package plants and new industrial dischargers. |
| Maryland Department of Agriculture | 1. Enforce the provisions of Maryland Water Quality Improvement Act of 1998.<br>2. Offer assistance through the Maryland Agriculture Cost-Share Program.<br>3. Target assistance to farm operations having problems with the potential to cause water pollution. |
| Baltimore City | 1. Continue water quality monitoring of reservoirs. |
| Baltimore County | 1. Continued water quality monitoring of tributaries.<br>2. Maintain Resource Conservation zoning in the reservoir watersheds and maintain insofar as possible the Urban-Rural Demarcation Line.<br>3. Conduct programs of street-sweeping, storm drain-inlet cleaning, and storm pipe cleaning in urban areas. |
| Carroll County | 1. Require enhanced stormwater management practices for all new development in reservoir watersheds.<br>2. Use master land-use plans to support Reservoir Management Agreement.<br>3. Limit insofar as possible additional urban development zoning with the reservoir watersheds. |
| Baltimore County Soil Conservation District<br><br>Carroll County Soil Conservation District | 1. Encourage farmers to participate in federal and state assistance programs that promote soil conservation and the protection of water quality.<br>2. Prepare Soil Conservation and Water Quality Plans for each farm in the reservoir watersheds, update plans where necessary, and assist operators in implementing them.<br>3. Encourage and assist operators to comply with nutrient management plans mandated under the Maryland Water Quality Improvement Act. |
| Baltimore Metropolitan Council | 1. Provide staff for coordination and administration of the Reservoir Technical Program through the financial support of its member jurisdictions. |

**Note**: [1]Source: (RTG 2005)

Maryland recently enacted significant new legislation that requires Phase I MS4 jurisdictions to establish, by July 1, 2013, an annual stormwater remediation fee and a local watershed protection and restoration fund to support implementation of local stormwater management plans. Maryland has made a commitment to include provisions in Phase I and II MS4 permits to reduce nutrient and sediment loads from urban stormwater sources.

Additional potential funding sources for implementation include Maryland's Agricultural Cost Share Program (MACS), which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production.

Although the Liberty Reservoir watershed does not deliver significant phosphorus and sediment loads to the Chesapeake Bay, implementation of the Liberty Reservoir TMDLs is expected to benefit from the programs Maryland has put in place to implement the nitrogen and phosphorus load reductions that will be required to meet the Chesapeake Bay TMDL recently established by EPA (US EPA 2010a), as well as Maryland's Phase I and II Watershed Implementation Plans (WIPs), which were developed to provide implementation strategies to achieve the Chesapeake Bay TMDL required nutrient and sediment reductions (MDE 2010b, 2012a). Accounting, tracking, and reporting are an important part of the overall WIP strategy, and progress will be closely monitored by tracking both implementation and water quality. This

framework of accounting, tracking, and reporting also applies to the Liberty Reservoir phosphorus and sediment TMDLs. This approach provides further assurance that the implementation of the Liberty Reservoir phosphorus TMDL will be achieved through increased accountability and verification of water quality improvements over time.

For more details about other Maryland actions and funding programs to support TMDL Implementation refer to Section 5.0 of the TMDL report.