Maryland's CWA Section 303(d) Program:

Prioritizing Impairments for TMDL Development

2016 – 2022

I. Background

A. Overview of Clean Water Act § 303(d)

The goal of the federal Clean Water Act (CWA) is to "…restore and maintain the chemical, physical and biological integrity of the Nation's waters." Section 303(d) is the portion of the CWA involving state and tribal Total Maximum Daily Load (TMDL) programs. Per CWA § 303(d), states and tribes must conduct a biennial assessment of the state's water bodies to determine if the water quality standards (WQS) are being met, and identify those that are not meeting WQS. These waters are considered impaired and in the Integrated Report are designated as Category 5 (also referred to as the "303(d) list"). Lastly, the state must develop TMDLs to restore those water bodies designated as impaired and for which technology-based controls are not sufficient to meet WQS. A TMDL is a scientifically sound calculation of the amount of a pollutant a water body can receive while still safely meeting its WQS. In Maryland, state-level administration of CWA § 303(d) falls under the purview of the Maryland Department of the Environment (MDE).

B. Monitoring and Assessment

Section 305(b) of the Clean Water Act requires states and tribes to prepare and submit to EPA a water quality inventory of their jurisdictional waters. This requirement, coupled with the requirements under Section 303(d), creates the need for high quality monitoring data on a wide variety of spatial and temporal scales as well as for a variety of water body types and parameters. Maryland's water quality assessment process is therefore predominantly captured and summarized in the *Integrated Report of Surface Water Quality* ("Integrated Report" or "IR"), which combines the requirements from both Clean Water Act sections [303(d) and 305(b)]. The IR is published every two years using all available data that meet the State's data requirements.

The largest contributions of data to the IR are appropriately made by the Department of Natural Resources (DNR) and the Maryland Department of the Environment (MDE). These sister agencies collect different but complementary types of water quality data to support not only the goals of the Clean Water Act but also the respective mission of each agency. Specifically, DNR largely collects water quality data to support broad-scale and/or probabilistic assessments (e.g., Maryland Biological Stream Survey, Chesapeake Bay and Maryland Coastal Bays monitoring programs), long term trend assessments (e.g., CORE/TREND program), and resource-related assessments (e.g., fisheries, submerged aquatic vegetation). Conversely, MDE collects water quality data to support water quality criteria development, public health protection, site-specific impairment assessments, TMDL development, and antidegradation follow-up.

A comprehensive suite of nutrient and physical parameters are collected at stations maintained by DNR. There are twenty-two water quality stations in the main stem of the Chesapeake Bay, and fifty-five in its tidal tributaries. In the Maryland Coastal Bays, DNR maintains forty-five stations. These stations are monitored monthly or twice-monthly for various physical and chemical parameters. There are fifty-four CORE/TREND DNR stations in the non-tidal portions of the State's rivers, also collecting nutrient and

physical data. Figures 15 and 16 below show the locations of the tidal stations and the CORE/TREND stations, respectively.

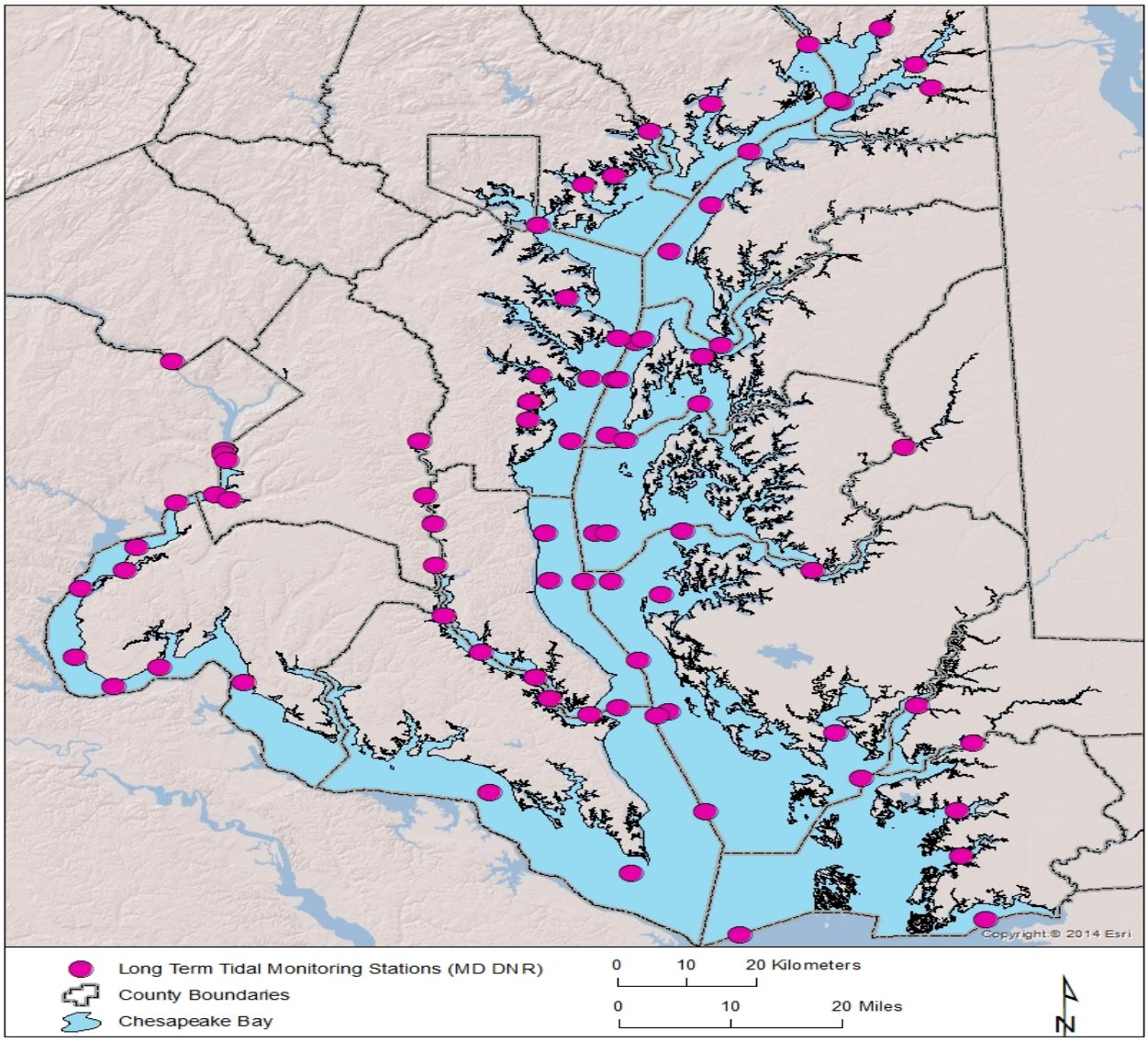

Figure 15: Location of Maryland DNR-maintained water quality stations in Maryland's tidal waters.

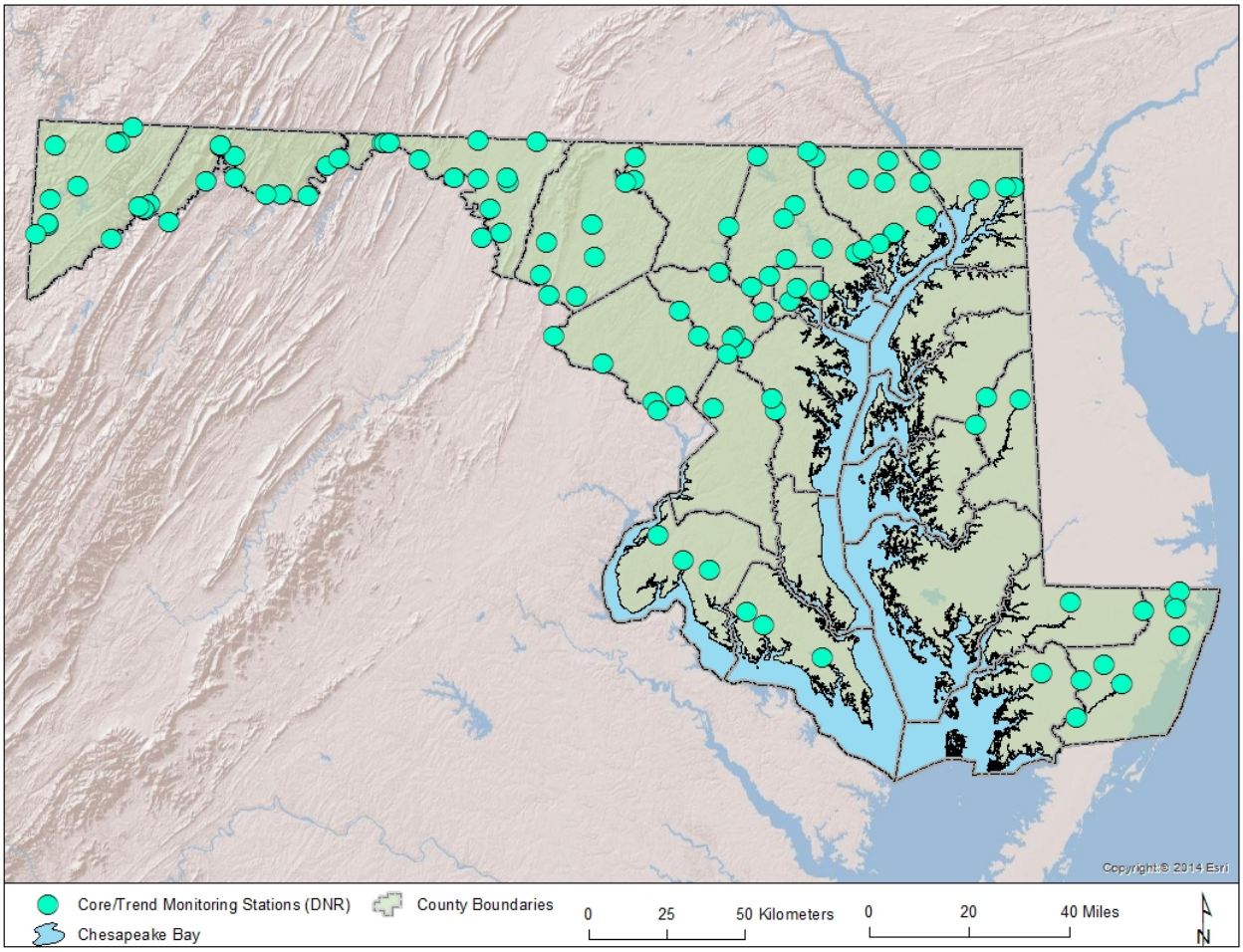

Figure 16: Location of Maryland DNR CORE/TREND stations in Maryland's non-tidal rivers.

To assess the health of lower (1^{st} – 4^{th}) order streams, there are over five thousand stations throughout the State, at which biological data are collected under DNR's Maryland Biological Stream Survey (MBSS) program. These data are used to develop indices of biotic integrity for the benthic macroinvertebrate and fish communities in these streams, and are used both to assess biological health and to identify potential stressors causing impairments to biological communities. Figure 17 below shows the wide distribution of MBSS stations throughout the State.

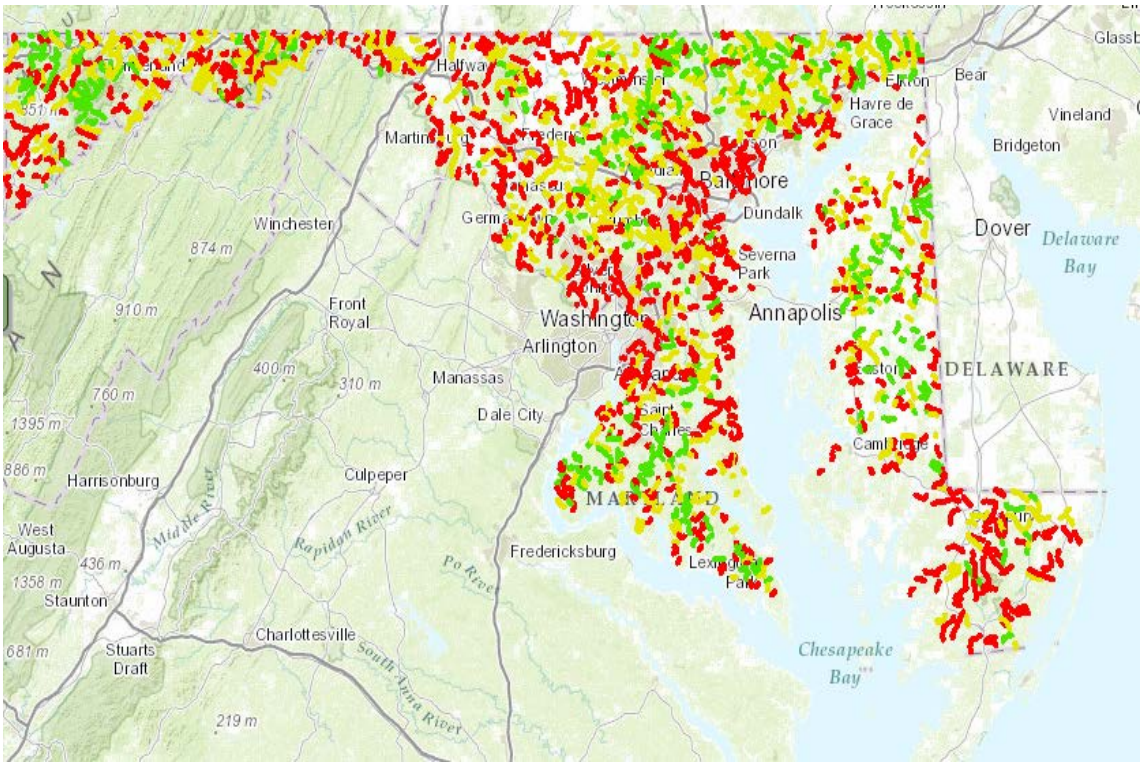

Figure 17: Location of Maryland Biological Stream Survey (MBSS) stations in Maryland (colors denote the three separate rounds of sampling completed to date).

Major public water supply reservoirs are monitored by municipalities and utilities. Data may be provided by non-profits such as the Chesapeake Bay Foundation and Blue Water Baltimore. Bathing beaches (185 stations throughout the State) and shellfish harvesting areas (762 stations) are routinely monitored for indicator bacteria to protect public health. MDE monitors fish tissue collected throughout the State for mercury, PCBs and other toxic contaminants, and issues Fish Consumption Advisories as warranted. Many other groups throughout Maryland also collect water quality data including local and federal government agencies, non-profits, and academia. Some of these data are also submitted and used in Maryland's Integrated Report (IR). Data from these groups provides a cost-effective way to enhance the spatial coverage and resolution of IR assessments. Maryland has increasingly engaged such groups to help fill known gaps in sampling. Collectively, these sources provide MDE with a robust dataset with which to assess the State's waters.

C. The New Vision for Section 303(d)

Beginning in 2012, EPA crafted and is in the process of establishing a "New Vision" for CWA § 303(d). The New Vision is in part a response to an analysis by the federal General Accounting Office (GAO), which concluded that the development of thousands of TMDLs nationwide had not resulted in commensurate improvements in water quality. A central goal of the New Vision is thus to increase quantifiable improvement in water quality restoration and protection. The New Vision consists of six elements, as outlined below (years by which they are to be adopted are in parentheses):

- Engagement (2014)
- Prioritization (2016)
- Protection (2016)
- Integration (2016)
- Alternatives (2018)
- Assessment (2020)

Since prioritization is an early and necessary step in the overall process, the main focus of this document is to describe the establishment of a method of prioritizing waters for TMDL development and other means of protecting, restoring and enhancing water quality. However, because of important linkages among all New Vision elements, others will be discussed in brief vis-à-vis Prioritization as appropriate.

There are a number of ways to categorize or prioritize impairments. Some states are prioritizing by pollutant (i.e., addressing all listings of one type of pollutant and moving on to another). Other states are prioritizing by watershed (e.g., addressing all impairments of whatever nature within a catchment). Prioritization can be aligned with monitoring cycling strategies, designated uses, source sector (e.g., prioritizing a watershed dominated by one or a few point sources) or any number of other means. This document describes Maryland's strategy of prioritizing water quality limited segments (WQLS) for development of Total Maximum Daily Loads (TMDLs), TMDL alternatives and other means for protecting and improving water quality within the State, under Section 303(d) of the federal Clean Water Act (CWA § 303(d)).

II. Introduction

Maryland's first "303(d) list" was compiled in 1996 – 1998. In the late 1990s, a round of lawsuits based on the pace of TMDL development resulted in the establishment of either consent decrees or memoranda of understanding (MOU) for virtually every state. Maryland and the U.S. Environmental Protection Agency (EPA) entered into a Memorandum of Understanding (MOU) in 1998. The need to quantify TMDL development, pursuant to the requirements of the MOU, largely dictated the work of Maryland's TMDL Program through 2011. These mandates were mostly met in the prescribed eight to thirteen-year timeframe. Maryland and EPA entered into another MOU in 2013.

By all accounts, Maryland has done a good job of addressing Category 5 listings pursuant to these MOUs. Since the original listings in 1996, Maryland has identified over 900 impairments and has developed TMDLs or otherwise addressed over 700 of them. Although new listings are identified with each Integrated Report, Maryland is gradually 'closing the gap' between impairments identified and TMDLs developed (see Figure 18).

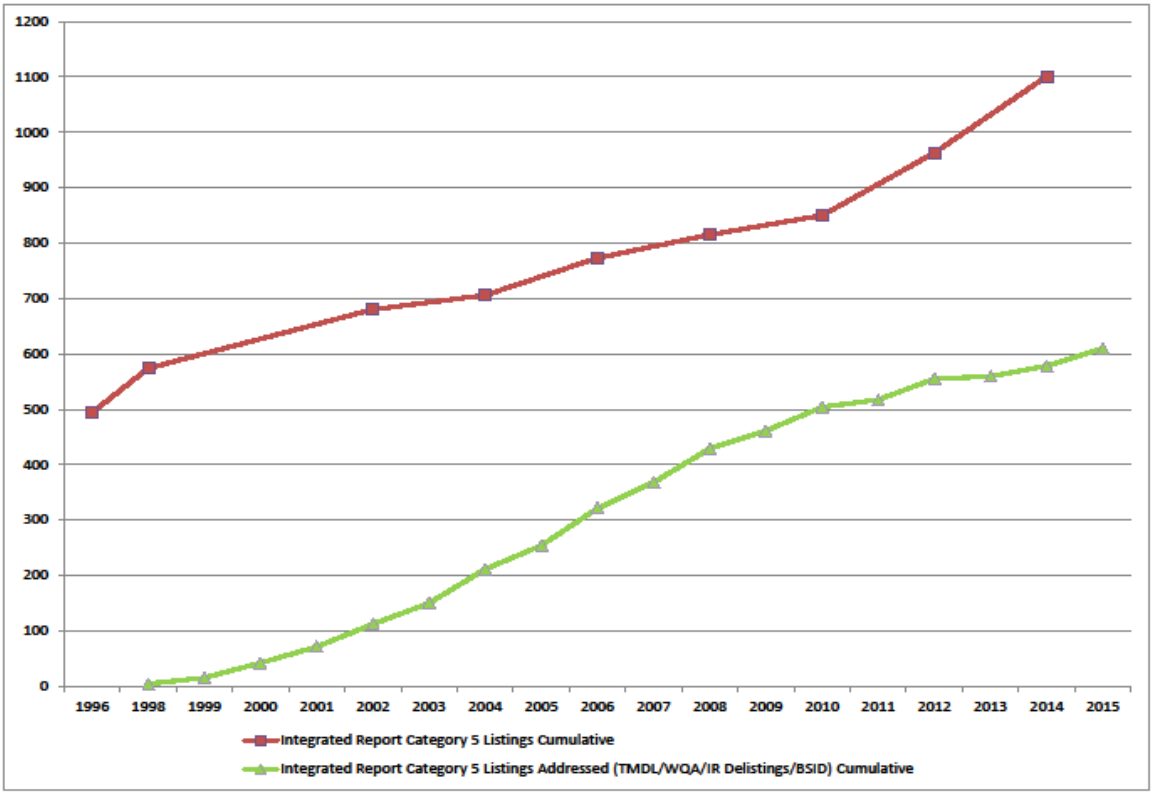

Figure 18: Cumulative Category 5 listings and TMDLs developed, 1996-2015.

Beginning with the first MOU in 1998, Maryland began addressing impairments with a systematic approach. A pollutant cycling strategy was established, dividing the State into five regions and monitoring them in a rotating manner to collect data to develop TMDLs for different types of pollutants (e.g., nutrients, sediments, bacteria, toxics, etc.). Since in many cases we needed to develop or refine water quality criteria, methodologies, monitoring plans and in-house expertise specific to different impairing substances, this approach allowed for efficiency in TMDL development. Methodologies and approaches are in place for most pollutant categories; however, refinements are ongoing to ensure accurate assessment results.

The original approach made sense in the context of the 1998 MOU, since the State was under a mandate to develop TMDLs. EPA's New Vision is intended to broaden efforts from TMDL development to include protection, TMDL alternatives, and a focus on implementation to facilitate water quality improvement. The New Vision stipulates that states develop a quantifiable scheme for prioritizing watersheds for addressing impairments under CWA § 303(d). Maryland is developing a multi-faceted approach that meshes with the core components of the mission of the Maryland Department of the Environment (MDE). Core mission

components salient to MDE's work in support of CWA § 303(d) include (in no particular order) the protection of public health; protection and restoration of the Chesapeake Bay, and protection and restoration of Maryland's other waterways.

In developing a prioritization approach to guide water quality protection and restoration efforts over the next few years, Maryland is taking a holistic approach. In addition to legal obligations under CWA § 303(d), the values and priorities of all Marylanders are being considered in matters ranging from the State's economic well-being to issues of public health, equity and environmental justice. The Chesapeake Bay, in addition to being central to the identity of many Marylanders, is a mainstay of the local and regional economy. Many of the State's citizens depend on MDE to ensure that fish and shellfish, from the tidal waters of the Bay and its tributaries to the cold, swift streams of the western mountains, are healthy and healthful to eat. These values and needs are reflected in this prioritization approach.

Like most states, Maryland has limited resources to address its impaired waters; hence the need for prioritization. To that end, MDE seeks to maximize the effectiveness of the use of its resources, be that in the rapid and efficient attainment of water quality standards (WQS) or by maximizing the improvement of water quality, even if WQS may not as easily be met. Focusing efforts in areas and under circumstances where implementation measures are likely to occur and to be successful is one strategy to further this goal.

III. Prioritizing TMDL Development and Other Programmatic Efforts in Support of MDE's Core Mission

The remainder of this document describes how Maryland's prioritization approach meshes key components of MDE's mission, as related to the TMDL Technical Development Program, with the goals and structure of EPA's New Vision for the 303(d) Program of the Clean Water Act. The Program will continue working in support of existing efforts to ensure the protection and restoration of the Chesapeake Bay. New TMDL development will focus on (1) the protection of public health, and (2) the protection of aquatic life in all of Maryland's waterways. It is important to note that the listings specified to be addressed during the 2016-2022 period represent MDE's good-faith intentions assuming that the Department is able to maintain its level of resources, budgetary and staffing, as of July 2015. Any reduction in funding, or loss of personnel, will necessarily result in an adjustment of the Department's ability to commit to the current projected level of effort. In accordance with guidance from EPA, the Department will review and may modify its level of commitment at the time of the development of the 2016, 2018 or 2020 Integrated Report of Surface Water Quality.

A. Restoration of the Chesapeake Bay and its Tidal Tributaries

1. Background

The Chesapeake Bay and its tidal tributaries are widely recognized as a national treasure[22]. Human activities in the Bay's watershed have long contributed to the degradation of water quality. Attention began to be focused on the Bay's condition beginning in the 1960s, and serious efforts to clean the Bay up began in the early 1980s. For decades, these efforts were primarily voluntary and accompanied by limited success. As a requirement under the Clean Water Act and in response to consent decrees in Virginia and the District of Columbia from the late 1990s, TMDLs were developed and approved in 2010 for nutrients and sediments in the Chesapeake Bay and its tidal tributaries. Also in 2010, President Barack Obama signed an executive order to restore and protect the Bay. These TMDLs are as of yet unique in the nation in that they provide for true accountability in implementation throughout the watershed. Full implementation of management practices must be in place by 2025, with an interim target to have practices in place to achieve 60% of load reduction by 2017. There are two-year assessments with meaningful consequences throughout the process. In Maryland, various phases of Watershed Implementation Plans (WIPs) have been developed, and a robust framework for implementation is forming at the State and County levels throughout Maryland's portion of the watershed.

The Chesapeake Bay and its tidal tributaries have been and continue to be a priority in Maryland. With these TMDLs developed and in place, the focus of the TMDL Program's effort in this area has shifted from that of TMDL development to technical support for the WIPs and ongoing efforts towards refining the modeling tools for the Mid-Point Assessment (MPA). MDE, working closely with its sister agencies, the State departments of Natural Resources (DNR), Agriculture (MDA), and Planning (MDP), is dedicating significant resources to the Bay restoration efforts, with the Science Services Administration (SSA) taking the lead. Working toward the full implementation of the TMDLs for Chesapeake Bay and its tidal tributaries will ensure a good return on the long-term investments of the Maryland taxpayer. With the federal oversight, meaningful milestones and consequences, and coordinated efforts of other states in the watershed, this effort has a high probability of success. This is important economically for Maryland, as a healthy Bay is essential for the well-being of the State. While there is uncertainty surrounding the exact costs and valuations of Bay restoration, the Chesapeake Bay Foundation has estimated the annual, watershed-wide restoration costs to be in the vicinity of $5 billion, with the annual value-added benefits around $22 billion throughout the watershed. Clearly, this is an investment worth sustaining.

[22] Throughout this document, references may be made simply to 'the Chesapeake' or 'the Bay;' these references are intended also to apply to the tidal tributaries of the Chesapeake Bay. Similarly, references to the Bay's TMDLs also apply to the associated TMDLs for the Bay's tidal tributaries.

2. Maryland's Role in the Chesapeake Bay Partnership

Maryland's TMDL Program plays an active role in the Chesapeake Bay Partnership (CBP). The Partnership is organized into committees, goal implementation teams, workgroups, and action teams with a focus on collaborative, shared decision-making with a consensus-based approach. There are six "Goal Implementation Teams," including the Water Quality Goal Implementation Team (WQGIT), which is responsible for the evaluation and implementation of practices, policies and programs that will restore water quality in the Chesapeake Bay and its tidal tributaries. While the State is involved in all six Goal Implementation Teams, MDE (and specifically the TMDL Program) is an active member of this Team and the workgroups and task groups under it. Details on the WQGIT scope and purpose, and members, workgroups and task groups can be found at: http://www.chesapeakebay.net/groups/group/water_quality_goal_implementation_team.

Maryland also plays a lead role in the Partnership's Modeling Workgroup. The Modeling Workgroup is responsible for model development and refinements; soliciting feedback from the partnership; and making any necessary revisions to the decision-support tools based on the latest science and water quality data. Maryland and West Virginia are the two jurisdictions leading the Phase 6 modeling development process. The director of the Maryland Department of the Environment Science Services Administration (MDE/SSA) co-chairs the Modeling Workgroup. In addition, MDE/SSA TMDL Program and MDA are represented on the Modeling Workgroup. At Maryland's request and with the State's financial support, the Interstate Commission on the Potomac River Basin (ICPRB) is providing technical assistance to the Modeling Workgroup. More information on the Modeling Workgroup may be found at http://www.chesapeakebay.net/%20groups/group/modeling_team. Detailed information on the overall structure, organization and decision making process of the Partnership is available at http://www.chesapeakebay.net/about/organized.

In addition to its involvement in the Chesapeake Bay Partnership, Maryland has established a number of state-level forums used to coordinate the Chesapeake Bay and Tidal Tributaries (CBTT) TMDLs implementation. These groups work on Maryland-specific policy decisions and program actions related to the Mid-Point Assessment and the TMDLs Implementation. These groups include:

- *MDE SSA WIP Technical Workgroup*: A collaborative monthly meeting of staff from the TMDL Development and Implementation Programs to discuss scientific, policy and feasibility issues related to achieving Maryland environmental progress goals. Technical analysis, evaluation and identifying data gaps are central parts of each meeting. Findings are reported to management to inform decision-making.
- *MDE SSA WIP Coordination Group*: A weekly management meeting within SSA to assess progress, set priorities and identify next steps related to the implementation and communication of watershed implementation plan activities.
- *MDE Bay Policy Group*: MDE internal group composed of MDE's Water Management Administration and Science Services Administration managers and staff. The group is responsible for policy coordination and integration of Bay-related programs within MDE Administrations.

- *Maryland's Chesapeake Bay Workgroup and Bay Cabinet*: The Bay Workgroup is composed of State agency senior managers and staff. This body coordinates among State agencies and reports to the Bay Cabinet, which is composed of key State agency secretaries.

3. The Mid-Point Assessment of the Chesapeake Bay and Tidal Tributary TMDLs

The Bay TMDLs call for a Mid-Point Assessment (MPA) in 2017 to review the progress toward meeting the nutrient and sediment pollutant load reductions identified in the 2010 Bay TMDLs. Since the establishment of the CBTT TMDLs in 2010, Maryland's TMDL Technical Development Program has allocated a significant portion of its staff time and financial resources to the MPA. This level of effort is expected to continue after the MPA and throughout the period of the New Vision phase-in.

The MPA will evaluate the effectiveness of the Phase I and Phase II WIPs and the two-year milestones used to track implementation to date. The MPA is critical to achieving the water quality restoration goals of the CBTT TMDLs. Through this process, all Bay jurisdictions will optimize the implementation of their water quality commitments. The MPA provides the Chesapeake Bay Partnership with the mechanism to ascertain the effectiveness and efficiency of implementation efforts, and to identify opportunities for improvement. The MPA also affords the Partnership an excellent opportunity to further engage its local partners. MPA activities facilitate and strengthen local engagement by ensuring that stakeholders have the tools and the data to fulfill their critical role in Bay restoration efforts, as well as to understand the immediate benefits to the quality of nearby waterways as well as that of the Chesapeake Bay. Such engagement is critical to achieving success in attaining our collective goals. Engagement is discussed in more detail below. Comprehensive information on the midpoint assessment, including priorities, schedule, and supporting documentation, is available at http://www.chesapeakebay.net/%20about/programs/tmdl/mpa.

4. Refinements to the Phase 6 Watershed Model and Other Decision-Support Tools

In 2012, the Partnership identified fourteen primary priorities to be addressed over the next several years, capturing a range of strategic and programmatic issues. The highest priorities identified are related to refinements to the modeling tools, such as improving the transparency and the decision-support capabilities of the models. Phase I and Phase II WIPs were developed in 2010 and 2012, respectively, using the most recent Phase 5 versions of the modeling tools. The Phase III WIPs, the planning tools to be used in identifying pollution reduction measures necessary to fully implement the CBTT TMDLs by 2025, will be informed by Phase 6 of the modeling system. Phase 6 represents a significant refinement and improvement over Phase 5. Beginning in 2015 and to continue through 2018, Maryland's TMDL Program is working in collaboration with the Partnership to revise and improve the modeling tools to be used in the development of the Phase III WIPs as well as to inform Partnership decisions.

Refinements to the modeling tools include lengthening the modeling tools simulation period; incorporating more recent data and data from additional monitoring stations; updating BMP efficiencies; representation of phosphorus-saturation in soils; incorporation of the latest science to facilitate representation of the effects of sedimentation behind the Conowingo Dam; and accounting for the effects of climate change. Refinements will improve transparency as well as the accuracy and performance of the model and will foster greater acceptance among local partners who have the responsibility for planning and implementing the pollution control measures required to meet the nutrient and sediment allocations under the TMDLs.
The release of the Phase 6 models version, in the spring of 2017, is only the most recent in a long and continuing history of improvements to the modeling tools used to simulate the Chesapeake Bay Watershed. For a more detailed description of the modeling tools and the history of improvements to these tools, see Chapter 1 of the USEPA's Phase 5.3 Watershed Model documentation (USEPA 2010a-1) and Linker et al. (2002).

After the Mid-Point Assessment, the Partnership will transition to the improved Phase 6 decision-support tools to continue to evaluate and measure progress of implementation efforts, and will continue to make refinements and improvements to the modeling tools as needed.

5. Incorporating Local Land Use and Land Cover Data in the Phase 6 Watershed Model

Improving the resolution of land use and land cover data in the Partnership decision-support tools is also one of the highest priorities identified for the MPA. Incorporation of more refined land use data into these tools is a critical piece in the refinement of the Chesapeake Bay Watershed Model, to facilitate an improved accounting of actions being implemented on the ground at the local level. One of the key concerns expressed by local jurisdictions during the Phase II WIP process was that the land-use data in the model did not match their higher resolution information. In an effort to address this concern, the CBP partnership has led an effort over the past several years to collect land use data from the local jurisdictions throughout the watershed, as well as acquire high resolution (1 meter) land cover data for the entire watershed. The partnership is subsequently using this data to build a more accurate land-use dataset for the Phase 6 model, which will inform the Phase III WIPs. Maryland, in conjunction with USGS-CBP, has been processing both locally derived land-cover data products as well as high-resolution land-cover developed by the Chesapeake Conservancy to build the Phase 6 model land-use dataset. This has involved combining and supplementing a large combination of different datasets that are considered to be the most accurate data available for particular model land-use classifications. More detailed information, including documentation, recorded webinars and original datasets, on the refinements of Maryland's land use data for the Phase 6 WSM may be found at
http://www.mde.state.md.us/programs/Water/TMDL/DataCenter/Pages/phase6_development.aspx.

6. Local Engagement

The Midpoint Assessment gives Bay Jurisdictions an unparalleled opportunity to engage their local partners and to help them understand their contribution to the WIP goals. Ensuring robust stakeholder engagement at the local level is essential to successfully achieving our shared water quality goals.

Maryland is ultimately responsible for engaging its local partners for WIP development and implementation, and for that reason is currently developing a local engagement strategy that will lay out the framework within which local partners can play a meaningful role in developing and implementing the Phase III WIP. The MDE/SSA Water Quality Restoration and Accountability Program is the Program leading the development of the Phase III WIPs and engaging Maryland's stakeholders in the process. Key expected products from this engagement will be estimates of what can reasonably be accomplished by 2025, an evaluation of expected sector shortfalls and surpluses, and an estimated pace of implementation beyond 2025. Specific types of engagement will be customized according to local needs and capacities. In general, the goal of Phase III WIP local engagement will be to obtain realistic and achievable local pollutant load reduction estimates. Engagement will primarily target partner groups most directly involved in implementation, including soil conservation districts, local governments, and state agencies. Discussion of implementation funding will also be an important component of engagement activities. State and local jurisdictions will need to consider funding strategies for achieving the Bay restoration goals and to continue making reductions after 2025. Engagement on funding will vary depending on local partners' circumstances, for example, whether or not they are MS4 jurisdictions.

Additionally, EPA, in coordination with the seven Bay watershed jurisdictions and working through the partnership's Communications Workgroup, is developing a communications and outreach strategy on the Midpoint Assessment and Phase III WIP process. This communications and outreach strategy will be designed to inform local governments, sector stakeholders and citizens, and federal agencies of opportunities for participation, what needs to happen and why, what resources are available, and the implications of success and failure.

In conclusion, the protection and restoration of the Chesapeake Bay and its Tidal Tributaries has long been, and will continue to be, of the highest priority for the State of Maryland. The description herein of the TMDL Program's contribution is but an overview of the level of effort and resources the Program devotes to Bay restoration. Maryland has for decades been committed to stewardship of the Chesapeake. With the establishment of the CBTT TMDLs, a robust, collaborative effort is well underway. As this process continues to unfold, Maryland's contributions and commitments will be ever more significant.

B. State-Level TMDL Development to Support the Protection of Public Health

Since early in the history of the TMDL Technical Development Program, addressing water quality impairments with the potential to affect public health has been a high priority. In some cases, these impairments also have the potential to impact aquatic life as well as non-

aquatic wildlife. These impairments generally fall into two categories—pathogens and toxic substances. The impairments to be addressed during the 2016-2022 period include bacteriological listings (especially in shellfish harvesting areas), methylmercury in fish tissue, polychlorinated biphenyls (PCBs) in fish tissue, heptachlor epoxide, lead and zinc (specifically in the Baltimore Harbor), and chlorides. While primarily an issue affecting aquatic life, chlorides are also a matter of increasing concern regarding public water supply sustainability, and thus also have public health ramifications.

1. *Bacteriological Impairments*

Maryland has numerous listings for impairments caused by bacteria. Generally, an indicator (fecal coliform, *Enterococcus* spp. or *E. coli*) is used as a surrogate for potential presence of human waste; the assumption is made that, in the presence of the indicator, human pathogens may also be present. Prior TMDL development using antibiotic resistance analysis (ARA) bacterial source tracking (BST) techniques has resulted in our ability to differentiate sources of indicator bacteria into the following categories: human, livestock, pet and wildlife sources. While all sources are important, that of human origin is the greatest concern, since a human source represents the highest risk to human health.

Since molluscan shellfish are often consumed raw or partially cooked, impairments to shellfish harvesting waters pose the most direct risk to public health and are thus the highest priority of the bacteriological listings. Additionally, work conducted during the TMDL development process—for example, shoreline surveys and source assessments—is directly useful during the implementation phase, thus enhancing the effectiveness of MDE's resources. In an effort to re-establish and increase oyster numbers in the Chesapeake Bay, Maryland has been promoting shellfish aquaculture; thus, there are also economic benefits to addressing these impairments.

The majority of current bacteria listings already have TMDLs established under the past MOU. Also, in many cases, newer impairments are shown to be transient in nature, with the areas not always showing confirmed impairment in subsequent Integrated Reports. These areas tend to come off the list without additional mitigation. For this reason, MDE will first address those impairments that have been listed since 2012 or earlier. Since these impairments are associated with public health protection, it is important to note that Maryland has a rigorous shellfish monitoring and management program with which the TMDL program works closely. Shellfish harvesting areas are routinely inspected in compliance with FDA's National Shellfish Sanitation Program. Under this program, all of Maryland's shellfish harvesting waters undergo routine shoreline survey and monthly monitoring. In all cases, if a problem associated with bacteria sources impacting shellfish harvesting waters is observed or identified through monitoring and it falls under Maryland regulation, immediate action is taken to mitigate the problem. Mitigation includes working with MDE's compliance program and local environmental health departments. These problems are primarily from a human source and sometimes from farms and associated with manure management. Addressing these actual and potential bacteria sources, which in some cases lead to shellfish impairments, in collaboration with shellfish program staff represents an opportunity to quickly and efficiently improve water quality and reduce the risk to public health on an ongoing basis. Integration of this program with the TMDL process is an efficient use of MDE's resources.

As of this writing, there are nine bacteria listings associated with shellfish harvesting waters that MDE intends to address between 2016 and 2022, via the TMDL process in conjunction with MDE's shellfish management program. Subsequent monitoring and the publication of future Integrated Reports may result in modifications. The shellfish harvesting areas are enumerated below:

1. Choptank Mesohaline Mainstem
2. Patuxent Mesohaline Battle Creek 2
3. Patuxent Mesohaline Battle Creek 3
4. Buzzard Island Creek
5. Patuxent Mesohaline Hog Neck Creek
6. Patuxent Mesohaline Wells Cove
7. Potomac Mesohaline Neale Sound
8. Wicomico Mesohaline Ellis Bay
9. Wicomico Mesohaline Mainstem

Although Maryland does not currently have any bathing beaches listed as impaired for bacteriological contamination, such listings would be the second highest priority within this grouping. Impairments to waters with recreational designated uses are lower in priority, since the risk is less direct than in the case of shellfish harvesting areas or designated bathing beaches. Currently, there are listings associated with recreational uses in two areas (the Port Tobacco River and Baltimore Harbor) that will be addressed during the 2016-2022 period.

2. *Polychlorinated Biphenyls (PCBs)*

Impairments caused by PCBs pose a direct threat to human health via the consumption of contaminated fish tissue. PCBs are a human carcinogen, and can cause neurobehavioral and developmental deficits in newborns and older children (U.S. Department of Health and Human Services, 2014). Prior to being banned in 1979, PCBs were widely used in industrial applications such as cooling and insulating oils in electrical transformers. Although their production was discontinued in 1979, their use in some applications continued, and their persistence and stability have resulted in widespread and lasting environmental effects.

Upon its renewal in 2014, the Chesapeake Bay Watershed Agreement included a "Toxic Contaminants Goals and Outcomes" element. The goal of this element is to "…ensure that the Bay and its rivers are free of effects of toxic contaminants on living resources and human health." One of the objectives of the toxic contaminant outcomes to achieve this goal is to "build on existing programs to reduce the amount and effects of PCBs in the Bay and watershed." Thus, prioritizing the development and implementation of TMDLs to address PCB impairments will also address the objectives of the new Chesapeake Bay Watershed Agreement. This provides an opportunity for potentially greater, regional benefits, since monitoring and analyses conducted during the TMDL development process help to identify the sources of PCBs, which facilitates implementation as well as supporting the Toxic Contaminants Goals.

Among the PCB impairments, Maryland will prioritize those that are within the jurisdictions covered by Municipal Separate Storm Sewer System (MS4) permits. These nine counties, and Baltimore City, are the most densely populated jurisdictions in the State; the greater population translates to greater potential for exposure, so prioritizing these listings will result in the greatest public health benefit. Additionally, in some of these areas, there may be larger numbers of economically disadvantaged individuals who may rely on subsistence fishing and thus be more likely to exceed the number of meals recommended in Maryland's fish consumption advisories. The following PCBs listings will be addressed during the 2016 – 2022 period:

1. Bush River
2. Middle River
3. Lower Patuxent River
4. Lower Susquehanna River
5. Conowingo Pool
6. Stansbury Pond
7. Mattawoman Creek
8. Piscataway Creek
9. Potomac River (reaches in Montgomery and Frederick Counties)
10. Double Pipe Creek

3. *Methylmercury in Fish Tissue*

Methylmercury is a potent neurotoxin that, like PCBs, primarily affects public health via the consumption of contaminated fish tissue. Once ingested, methylmercury easily penetrates the blood-brain barrier and causes damage to the central nervous system, particularly in fetuses (Diez 2009). The primary source sector for mercury is atmospheric deposition, with coal-fired electrical generation units and waste incinerators being among the most significant emission sources. Upon deposition or transport into aquatic environments, bacterially-mediated processes can transform it into methylated mercury, the most toxic form. Methylmercury readily binds with proteins and thus bioaccumulates and biomagnifies, with increasing concentrations found at higher trophic levels.

In addition to the public health issue, there are a number of reasons why Maryland is prioritizing mercury impairments. TMDL development activities serve as a useful public education tool, complementing the State's fish consumption advisories. As is true of PCBs, mercury TMDLs will support the Toxic Contaminant Goals of the new Bay Agreement. While all active listings are for non-tidal waters, implementation activities arising out of these TMDLs help maintain acceptable levels of the contaminant in rockfish, which is the basis of an estimated $500 million fishery in Maryland (www.cbf.org). A new, national (and global) mercury emissions data inventory is due out soon, replacing the outdated 2002 data inventory. There is increasing interest regionally and nationally in mercury research and modeling, with efforts currently underway at the National Oceanic and Atmospheric Agency (NOAA) providing a good opportunity for Maryland and other states. Although there is an indirect linkage between TMDL

development and implementation efforts for mercury, TMDLs in the aggregate have provided impetus for source-based programmatic efforts to reduce emissions. Finally, because of the cross-media nature of mercury impairments, addressing them meshes with the Integration component of the New Vision, whereby the resources of other environmental legislation (in this case the Clean Air Act) may be brought to bear.

Maryland intends to address all mercury impairments on Category 5 of the 2014 Integrated Report during the period of 2016-2022. A combined monitoring, modeling and documentation effort will address all these impairments simultaneously. They are enumerated below:

1. Upper North Branch Potomac—Jennings Randolph Reservoir
2. Youghiogheny River Lake
3. Potomac River Washington County—Dam #3 to Dam #4
4. Potomac River Washington County—Dam #4 to Dam #5
5. Conococheague Creek
6. Lower North Branch Potomac
7. Potomac River Frederick County

4. *Other Toxic Contaminants*

In addition to PCBs and mercury, there are a few other current impairments caused by toxic contaminants in Maryland. In the Anacostia River, two listings for heptachlor epoxide, a pesticide that affects public health via fish consumption, will be addressed. EPA is currently coordinating a collaborative effort between the District of Columbia and Maryland to develop an inter-jurisdictional TMDL to address these listings. In Baltimore Harbor there are listings for lead and zinc; these are impairing the aquatic life designated use, and the Department will continue efforts to address these impairments, since they are outstanding listings from the original 1998 MOU. MDE has funded several studies by the University of Maryland Center for Environmental Sciences (UMCES) and Wye Research and Education Center to conduct sediment contaminant surveys to determine if Zn and Pb contamination in Harbor sediments are responsible for the aquatic life impairment. MDE completed a sediment metals contaminant and toxicity survey in the Baltimore Harbor in March 2015. MDE plans to conduct additional studies in 2016 to provide additional water quality data to complete the assessment. There is also one outstanding listing for "toxics" at the federal Aberdeen Proving Ground (APG) facility. EPA contracted Tetra Tech to conduct chemical contaminant surveys for sediment and the water column in two of the tidal water bodies within APG. MDE evaluated the water quality data and determined that the water column is not impaired by specific chemical contaminants; however, additional sediment quality data is required to determine if the sediment is also not impaired. EPA has provided MDE with additional funds through a CBRAP grant to continue monitoring at APG. The remaining tidal waters will be monitored in Summer/Fall 2017 and additional sediment quality data will be collected in the tidal waters that were previously monitored by Tetra Tech. This information will be evaluated to determine if the remaining tidal waters are impaired by specific chemical contaminants.

C. TMDL Development to Support the Protection of Aquatic Life

1. *Chlorides*

The State has listed a number of water bodies as impaired by chlorides based on the results of Biological Stressor Identification (BSID) analyses.[23] Since 2010 twenty-seven watersheds have been listed as impaired for chlorides. The designated use listed as impaired is the aquatic life use; however, chlorides (and associated sodium) also have public health ramifications, as they are a growing source of concern for water supply managers.

When reviewed at the Statewide level, the BSID clearly shows a strong association between identification of chlorides as a stressor and the degree of urbanization within watersheds (see figure 19).

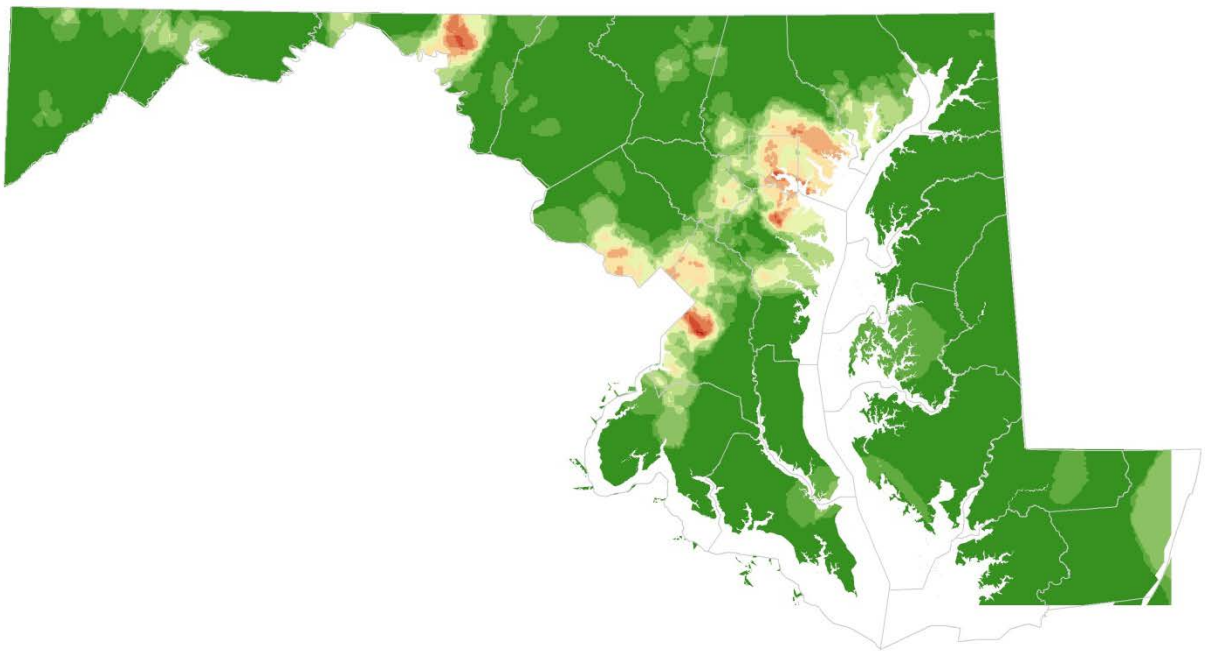

Figure 19: Results of Statewide BSID analysis, indicating areas of increased likelihood of the occurrence of elevated chloride levels (≥50mg/L).

As can be seen, the I-95 corridor, the Baltimore metro area, the metro D.C. area and an area around Hagerstown are the sites of the greatest attributable risk of chlorides to biological impacts. With the exception of Washington County, all these areas are within MS4 jurisdictions.

[23] Please visit the following link for more information about the BSID analyses: http://www.mde.state.md.us/programs/Water/TMDL/Pages/Programs/WaterPrograms/tmdl/bsid_studies.aspx.

Accordingly, the chloride impairments selected for attention during the 2016-2022 period are chosen based on the following attributes:

- Occurrence in an MS4 jurisdiction
- Identification in BSID analyses of a risk attributable to chlorides of 75% or greater
- Watershed size of 75 mi^2 or smaller

The MS4 jurisdictions, in addition to having a permitting mechanism to facilitate implementation, constitute the most urbanized areas, thus typically being the most affected by chlorides. The greater the attributable risk, the more confidence we have that implementation will result in improved biological communities. Smaller watershed size may facilitate greater feasibility of implementation, as well as a potentially more rapid response to implementation activities.

Within this set of listings, any watersheds having Tier II-high quality streams may be addressed earlier, if feasible. The occurrence of Tier II streams will also be discussed in the Assurance of Implementation section of the TMDL documentation, with recommendations that consideration be given to targeting some of the implementation efforts toward preventing the degradation of high quality waters. The specific chlorides impairments Maryland plans to address from 2016 to 2022 are listed below:

1. Jones Falls
2. Gwynns Falls
3. Back River
4. Cabin John Creek
5. Patapsco Lower North Branch

2. *Sediments*

Along with nutrients, sediments are the most widespread cause of impairment to aquatic life designated uses in Maryland. Figure 20 shows the results of a statewide BSID analysis to assess the likelihood of sediment as a stressor to aquatic life in 1st- through 4th-order streams. As can be seen, sediments have potential impacts across the state, especially in heavily urbanized or agricultural areas.

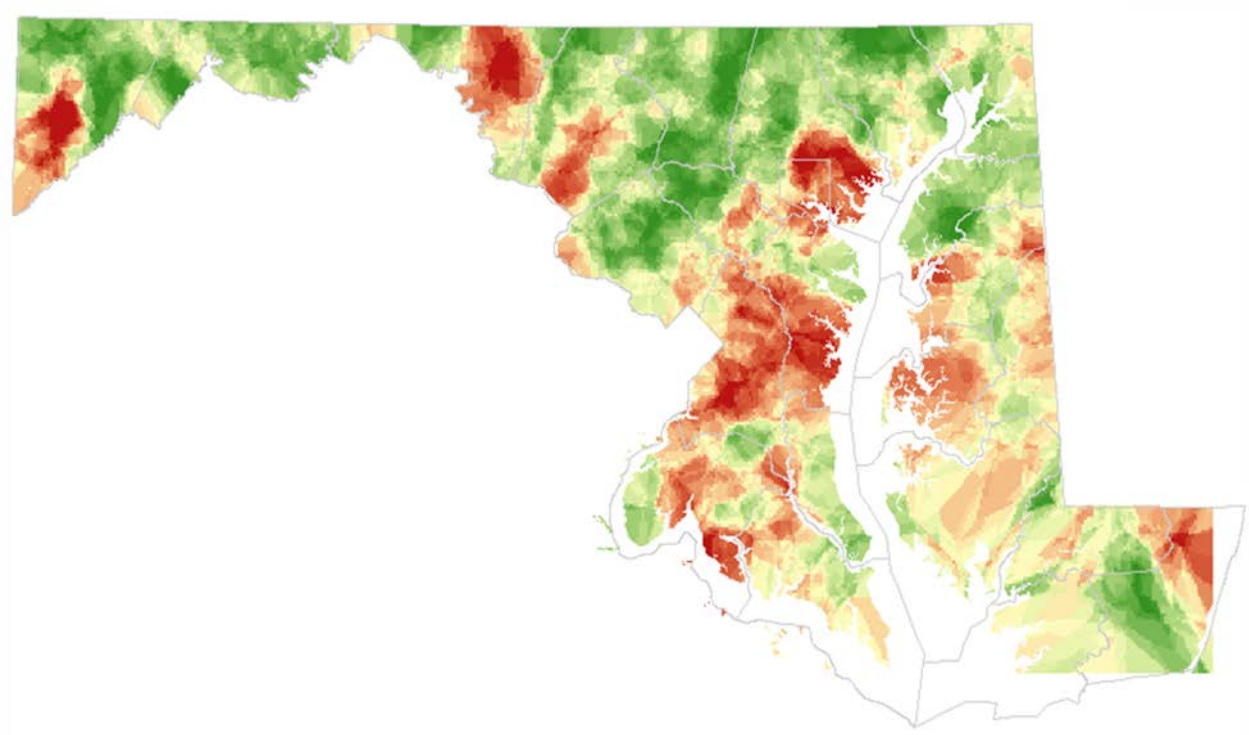

Figure 20: Results of statewide BSID analysis, indicating areas of increased likelihood sediment as a stressor to aquatic communities.

The majority of the State is covered by sediment allocations from the Chesapeake Bay TMDL, in order to meet water quality standards in the Bay and its tidal tributaries. However, allocations to meet the Bay TMDL are not intended to address impairments in low (e.g., 1st-4th) order streams. Not all low-order streams are impaired by sediment; hence, to identify these streams and ensure the protection of aquatic life in them, the BSID process was used to identify sediment impacts to biological communities. BSID analyses have indeed demonstrated high likelihoods of sediment as a stressor to some low-order streams with degraded biology. The BSID process links impacts to biological communities with several sediment-related stressors: extensive bar formation, embeddedness (of larger-sized gravel within silts), and degraded epifaunal substrate.

In addition to the ubiquity of the pollutant and its impact on aquatic life, there are good reasons to prioritize sediment impairments. First, in MS4 jurisdictions, there is a permitting mechanism in place to facilitate expedited implementation; because of the existing work associated with the Bay TMDL, there is 'infrastructure' in the form of local government staffing and technical expertise already in place. Secondly, implementation activities to mitigate the effects of sediments typically have ancillary benefits; many other pollutants (especially phosphorus) bind with or are associated with sediments, and vegetation establishment enhances habitat for aquatic and even terrestrial wildlife. Finally, there is an established, cost-effective methodology (a reference watershed-based approach) for the development of this type of sediment TMDL. From 2016 through 2022, MDE intends to develop TMDLs for all new sediment listings resulting from the BSID analysis for which the aforementioned methodology is appropriate. The watersheds will be overlain with Tier II coverages using geographic information system (GIS) technology; if Tier II stream segments are identified within the 8-digit watersheds, they will be handled as

described in the Chlorides section above. The non-tidal sediment listings identified by the BSID are enumerated below:

1. Baltimore Harbor
2. Back River
3. Lower Patuxent
4. Middle Patuxent
5. Other West Chesapeake
6. South River
7. Marshyhope Creek
8. Upper Chester River
9. Upper Choptank
10. Lower Choptank
11. Deep Creek Lake

Again, these impairments are based on impacts to biological communities (fish and benthic macroinvertebrates), identified through the BSID process, in 1st through 4th order streams, and thus differ in key ways from the Bay TMDL. However, it is important to take into consideration both the Bay TMDL sediment allocations and any allocations resulting from the low-order stream TMDLs described in this section. In instances of overlap of allocations between the Bay TMDL and a local TMDL, the more stringent of the two should take precedence. In such an instance, because of the existing WIPs (and especially in MS4 jurisdictions), there should be some economy in implementation.

D. Revisions to Existing TMDLs

While Maryland has no plans to systematically revisit older TMDLs, there are a few that require revisions to facilitate compatibility with the Chesapeake Bay TMDL and associated implementation efforts, including the potential for nutrient trading. These TMDLs, developed for small, recreational impoundments, are among the earliest that the State developed, and date as far back as the late 1990s. The TMDLs, addressing total phosphorus and in most cases sedimentation, were developed using empirical and statistical tools such as Carlson's Trophic State Index and the Vollenweider Relationship. The methods were appropriate at the time, but better science and methodologies exist presently. Some TMDL endpoints have changed, and more recent land use data are available. Additionally, baseline loadings were simulated using Phase 4.3 of the Chesapeake Bay watershed model; the assumptions and methods used in that version of the model may be outdated and incompatible with newer iterations. The EPA drafted a memo, dated March 22, 2012, acknowledging the potential need to revise TMDLs, and outlining some situations under which that is appropriate. The memo specifically states that significant changes in modeling assumptions, data, and watershed characteristics may be grounds for such revisions; all of these situations apply in the case of these impoundment TMDLs.

Maryland is currently collecting data for these lakes, and is in the process of exploring technical options and refining TMDL endpoints. There are seven lakes currently prioritized for TMDL revision (more may be added within the 2016-2022 timeframe):

1. Tony Tank Lake
2. Adkins Pond
3. Lake Linganore
4. Clopper Lake
5. Centennial Lake
6. Lake Habeeb
7. Urieville Lake
8. Broadford Lake
9. Bigmill Pond
10. Johnson Pond

E. Other Nutrient Listings

With the approval of nutrient TMDLs for the Chesapeake Bay and its tidal tributaries, as well as for the Maryland Coastal Bays, all tidal nutrient listings in Maryland have been addressed. As a result, beginning with Maryland's 2014 Integrated Report, there are no remaining tidal Category 5 listings for nutrients. There are several non-tidal listings for total phosphorus (TP), but none for nitrogen or any of its species. The state of the science, specifically with regard to load-response relationships for nutrients in flowing waters, is expected to progress during this period, and there will be refinements to the Chesapeake Bay watershed model. As a result, Maryland plans to address these nutrient listings subsequent to the 2016-2022 period of implementing the New Vision. As stated above, nutrient impacts in Maryland's waters have been and continue to be a priority for the State. The Department will thus continue to concentrate efforts on the refinement of the modeling tools for the mid-point assessment of the Chesapeake Bay TMDL approaching in 2017. However, MDE will be revisiting certain early TMDLs developed for TP, and in some cases sedimentation, in small impoundments; this is described more fully below.

F. Linkage of Prioritization with other New Vision elements

A. *Engagement*

Maryland has had a robust outreach component to its TMDL program since inception. The Engagement element of the New Vision does not replace or change Maryland's current TMDL outreach process. As part of the engagement process, MDE has actively sought involvement from stakeholders during the prioritization process. In 2014, TMDL staff presented its preliminary prioritization approach at the Maryland Water Monitoring Council (MWMC) annual conference. It was also presented in refined form at the MWMC annual conference in 2015, and Maryland will use this venue for future engagement as appropriate. MDE also presented its prioritization approach and list of priority waters at three representative locations

throughout the State (Frederick, Baltimore and Easton) in Fall of 2015, engaging stakeholders and soliciting feedback.

B. *Protection*

The linkage between Prioritization and the Protection element has been described above as it relates to Chlorides and Sediments. In these instances, any Tier II stream segments within the larger, 8-digit watershed will be identified, and recommendations made that implementation efforts take into consideration the protection of high-quality stream segments as well as mitigating the impacts to impaired areas. MDE is developing a threat-analysis model to assess vulnerability of watersheds to anthropogenic impacts; this should be a useful tool to target watersheds for protection, whether under the auspices of CWA § 303(d) or via other mechanisms. Maryland's approach to the protection element will be expanded upon as the state develops and refines its plans, and as more guidance becomes available from EPA.

C. *Alternatives*

The Alternatives element is included to allow a mechanism by which water quality may be improved more expeditiously than is often the case with a traditional TMDL. This will likely consist of a 'straight-to-implementation' (STI) or similar approach. Although specific plans are not in place, Maryland is considering the possibility of a TMDL alternative to address the Deep Creek Lake watershed sediment impairment to biological communities in 1st- through 4th-order streams. This area is an economic engine for Western Maryland and a major tourist attraction. There is an engaged watershed association (Friends of Deep Creek Lake) as well as strong interest in mitigating sediment impacts to the lake itself on behalf of the real estate community and property owners along the lake. The Maryland DNR and Department of General Services conducted a study of lake sedimentation and recommends watershed-based mitigation rather than dredging to address the in-lake sediment impacts. In October 2014, a Watershed Management Plan was finalized. These qualities lend themselves to the development of an alternative such as an STI approach, with the prospect of a TMDL to be used as a backstop.

Alternative approaches may prove effective and efficient in addressing bacteriological impairments to shellfish harvesting areas. Maryland has a rigorous shellfish monitoring and management program with which the TMDL program works closely. Shellfish harvesting areas are routinely inspected in compliance with FDA's National Shellfish Sanitation Program. If a problem associated with bacteria sources impacting shellfish harvesting waters is observed or identified through monitoring and it falls under Maryland regulation, immediate action is taken to mitigate the problem. This represents an opportunity to quickly and efficiently improve water quality and reduce the risk to public health on an ongoing basis.

D. *Integration*

The Integration element refers to linking and integrating CWA § 303(d) with other sections of the Clean Water Act and with other environmental statutes or initiatives, such as the Clean Air Act. Maryland sees this as an excellent opportunity to bring additional resources to bear in our efforts to protect and restore the State's waters. In the past, credible assurances of implementation for mercury TMDLs have been hamstrung by the lack of authority under the CWA, although in the aggregate these TMDLs have been helpful in shaping policy to reduce air emissions of mercury (by far the largest source sector) at the state level (e.g., Maryland's Healthy Air Act). Establishing direct communications between CWA § 303(d) and appropriate portions of the Clean Air Act would be very helpful in this area. In the development of TMDLs to address PCB impairments, the TMDL program works with MDE's Land Restoration Program (Superfund Division) to acquire data for estimating loads from contaminated sites.

In the development of TMDLs or other mechanisms to address bacteriological impairments to shellfish harvesting areas, the TMDL program works closely with MDE's shellfish management program. Many of the shellfish program's activities fall under the oversight of the Food and Drug Administration (FDA). Coordinating work conducted by the two programs offers an opportunity to leverage the resources and expertise of both groups at MDE, as well as to ensure rigorous compliance with public health standards in addition to meeting water quality standards as prescribed under the CWA.

MDE is also considering soliciting a review of Category 5 listings and/or TMDL documentation by DNR's Natural Heritage program, for the purposes of potential mutual benefits to efforts under both CWA § 303(d) and the Endangered Species Act.

E. *Assessment*

Lastly, the Assessment element most specifically refers to a review of overall progress toward the end of the first "cycle" of impairments addressed under the New Vision. However, Maryland's robust monitoring and assessment initiatives by design and necessity inform the Prioritization process; these efforts are discussed in detail in the "Monitoring and Assessment" section toward the beginning of this document. As the full implementation of the New Vision unfolds, MDE will look for additional opportunities to quantify and maximize the utility, efficiency and effectiveness of these efforts.

IV. References Specific to the Prioritization

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