Maryland's Final 2018 Integrated Report of Surface Water Quality

Submitted in Accordance with Sections 303(d), 305(b), and 314 of the Clean Water Act

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Last but not least, MDE would like to thank all non-state government groups and individuals who provided data for this report. As in past reports, this report used a variety of chemical, physical, and biological data provided by non-state partners. This information has been invaluable for improving both the spatial and temporal resolution of assessments of state waters. To view a full list of individuals and organizations that provided data during the data solicitation period please see Table 3.

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EXECUTIVE SUMMARY

Maryland's 2018 Integrated Report (IR) is submitted in compliance with sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA). This biennial report describes ongoing efforts to monitor, assess, track and restore the chemical, physical and biological integrity of Maryland waters. This report also presents the current status of water quality in Maryland by placing all waters of the State into one of five categories which are described in detail in the introductory section of this document. In addition, the report provides information about the progress on addressing impaired waters (Categories 4 & 5) by documenting:

- Completed Total Maximum Daily Loads (TMDLs), which re-categorize impairments from Category 5 (impaired and needs a TMDL: the "list of impaired waters") to Category 4a (TMDL completed, but still impaired).
- Analyses of new water quality data that shows areas previously identified as impaired that are attaining standards. This can result from remediation, changes in water quality standards, or improved monitoring and/or data analysis.
- Assessment methodologies and watershed segmentation that enhance the use of available data and provide consistency with management and implementation strategies.
- Statewide water quality statistics for Maryland's surface waters.
- Maryland's prioritization of impairments for TMDL development.

Similar to previous Integrated Reports, Maryland has made significant efforts to incorporate non-state government data in ways that increase the resolution of the state's water quality assessments. Datasets used included those collected by federal agencies, county governments, water utility agencies, and non-profit watershed organizations. The 2018 IR will also include a GIS submittal that provides coverages for streams, impoundments, and tidal waters which depict assessment information at appropriate scales. MDE continues to make Integrated Reporting data available to the public in several user-friendly formats. Accessible via the web, users can query MDE's searchable IR database to find individual assessments or groups of assessments that are of interest. The searchable IR database and companion clickable map application are available online at http://www.mde.maryland.gov/programs/water/tmdl/integrated303dreports/pages/303d.aspx.

New this year is a revamped online map which displays water quality assessment information overlaid on top of TMDL watersheds. This newly reformatted map is meant to highlight the spatial relationship between the specific water body impaired for a given pollutant and the TMDL that accounts for all sources of that pollutant in that water body's watershed. Users can select as few or as many pollutants to display as they like with this fully interactive map. This map therefore replaces the previously provided single-pollutant maps and provides users with a one-stop map for visualizing water quality assessment information. The newly created map can be found at: http://mdewin64.mde.state.md.us/WSA/IR-TMDL/index.html.[1]

Also new this year, Maryland will be submitting the Integrated Report to the EPA through the Assessment, Total maximum daily load Tracking and Implementation System (ATTAINS), an online

[1] Please note that both the searchable IR database and map applications will be updated with information from the 2018 IR once the IR has gone through public review and comment and has been approved by the Environmental Protection Agency.

system for accessing information about the condition of the Nation's surface waters. All Integrated Report information will be made available in ATTAINS through web reports and other query tools. More information on the new ATTAINS reporting system can be found online at https://www.epa.gov/waterdata/attains. The Maryland Department of the Environment will continue to maintain Maryland's Integrated Report information along with associated GIS mapping on the Department's webpage.

Maryland's Water Quality Highlights

This Integrated Report made use of the most comprehensive dataset ever assembled for the Lower Susquehanna River in Maryland, in both the portion upstream of the Conowingo Dam (also known as the Conowingo Reservoir) and immediately downstream of the Dam. Several imminent regulatory processes required for the Dam's continued operation generated significant new biological, habitat, and water quality information in this area. This recently collected data and information has helped to inform: a new Category 5 listing for the public water supply use related to total phosphorus in the Conowingo Reservoir; a Category 2 (meeting some water quality criteria) listing for the aquatic life use for total phosphorus in Conowingo Reservoir; a Category 3 (insufficient data for assessment) listing for debris in the Conowingo Reservoir; and Maryland's first ever impairment listing (Category 4c – impaired by pollution not caused by a pollutant) for flow alteration (changes in depth and flow velocity) for the portion of the Susquehanna River immediately downstream of the Dam and extending to the head of tide. These assessment records represent an important step forward for Maryland's water quality monitoring efforts as the state strives to address previously unassessed or under-assessed waters. This information also underscores the importance of managing dam operations in a way that supports not only the creation of carbon-free energy but also aquatic life and recreational uses of the Susquehanna River as well. The federal relicensing process and the water quality certification for the Conowingo Dam issued in April 2018 represent a critical opportunity to determine how best to deal with the water quality challenges presented by the dam.

Other persistent water quality challenges facing the State include the increasing trends of conductivity and water temperature in non-tidal streams throughout the State. Increasing conductivity levels appear to be strongly linked to the widespread use of road salt deicers. A component of road salt and contributor to stream conductivity, is the aquatic life toxicant, chloride. MDE has now documented 28 watersheds as impaired for chloride. Likewise, the State has also documented a number of temperature impairments in Class III (and Class III-P) coldwater streams. The exceedance of the temperature criterion in these streams threatens the persistence of coldwater obligate species and presents an additional challenge for restoration efforts aimed at providing biological uplift. However, as described further below, efforts are underway to get a handle on these pollutants moving forward.

The State can also tout several water quality successes in the past several years. In 2016, submerged aquatic vegetation coverage, a key indicator for the attainment of water clarity criteria, reached the highest level recorded in the Chesapeake Bay and tidal tributaries since aerial surveys began in 1984. In another example of a water quality success, the 2018 IR marks the third IR cycle in a row where specific restoration projects, undertaken by the State, have been directly linked to attainment of water quality criteria. In this instance, MDE's Bureau of Mines Division used Clean Water Act Section 319(h) funding to coordinate the construction of acid mine drainage treatment systems on three separate stream segments in the Casselman River watershed in Garrett County, MD. These 3 stream segments, Alexander Run, Tarkiln Run, and Spiker Run, were previously listed as impaired and had TMDLs established to address issues with low pH. The acid mine treatment systems, each installed more than 4 years ago, have demonstrated to be a reliable solution for increasing stream pH to levels within Maryland's pH criteria range (6.5 – 8.5). As a result, all three streams have been moved to Category 2 (meeting some water quality criteria) in recognition of meeting pH water quality criteria.

Maryland has made enormous progress in establishing TMDLs for the State's impaired water bodies. To date, Maryland has established 555 TMDLs out of a total of 839[2] water body-pollutant impairments. The water body size addressed by TMDLs for each major pollutant-type is shown in the figures below. As is evident from these figures, some pollutants have been almost completely addressed by TMDLs while others have not (e.g. chlorides, sulfates, stream temperature). For chlorides and stream temperature, the state is in the process of developing new water quality modeling methodologies for estimating loads and impacts.

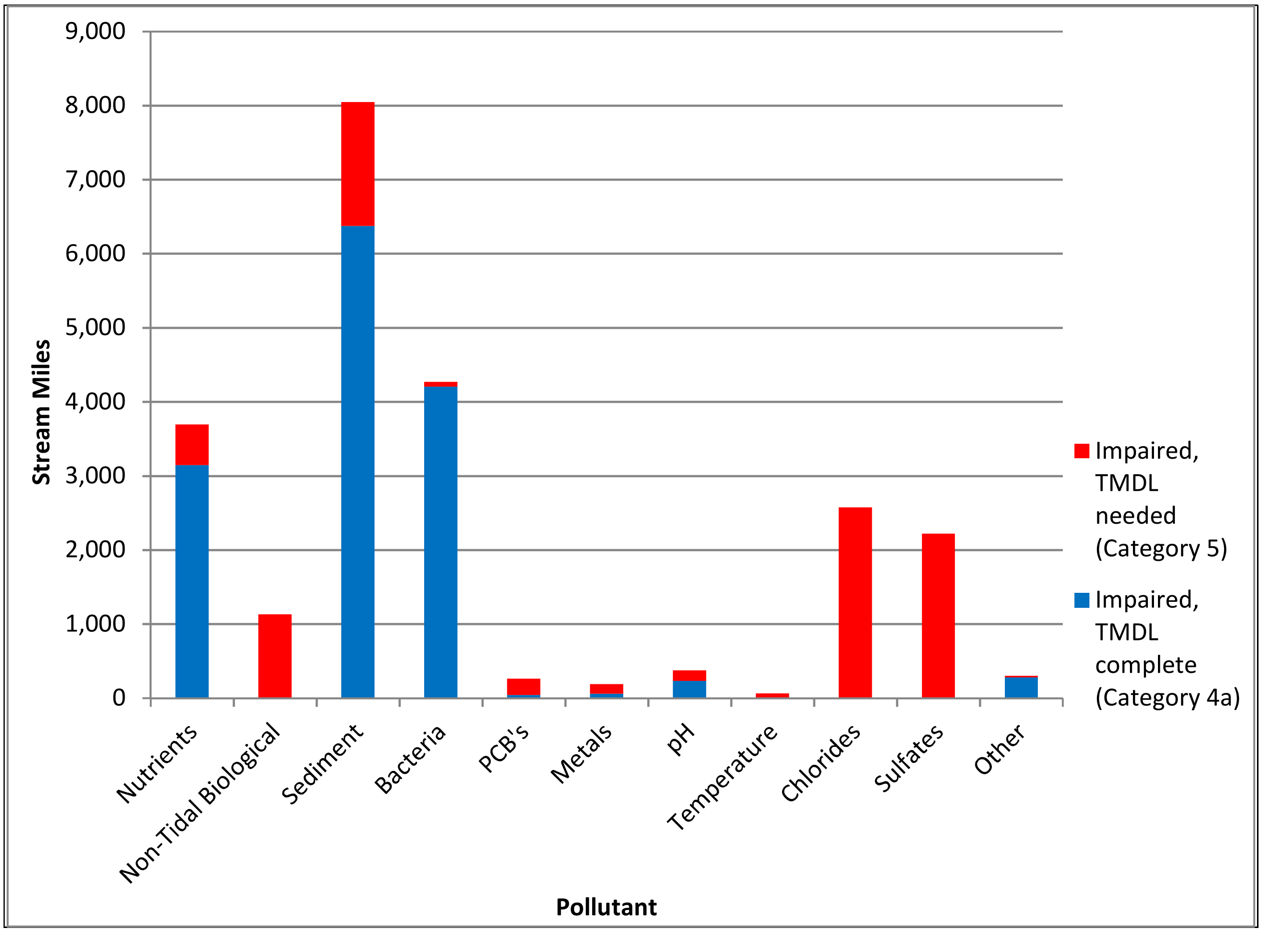

Figure 1: Stream miles impaired by various pollutants. Colors denote the stream miles currently addressed by TMDLs (blue) and those that still require TMDLs (red).

[2] These numbers can go up or down from IR cycle to IR cycle as impairments get added or delisted based on updated information and data.

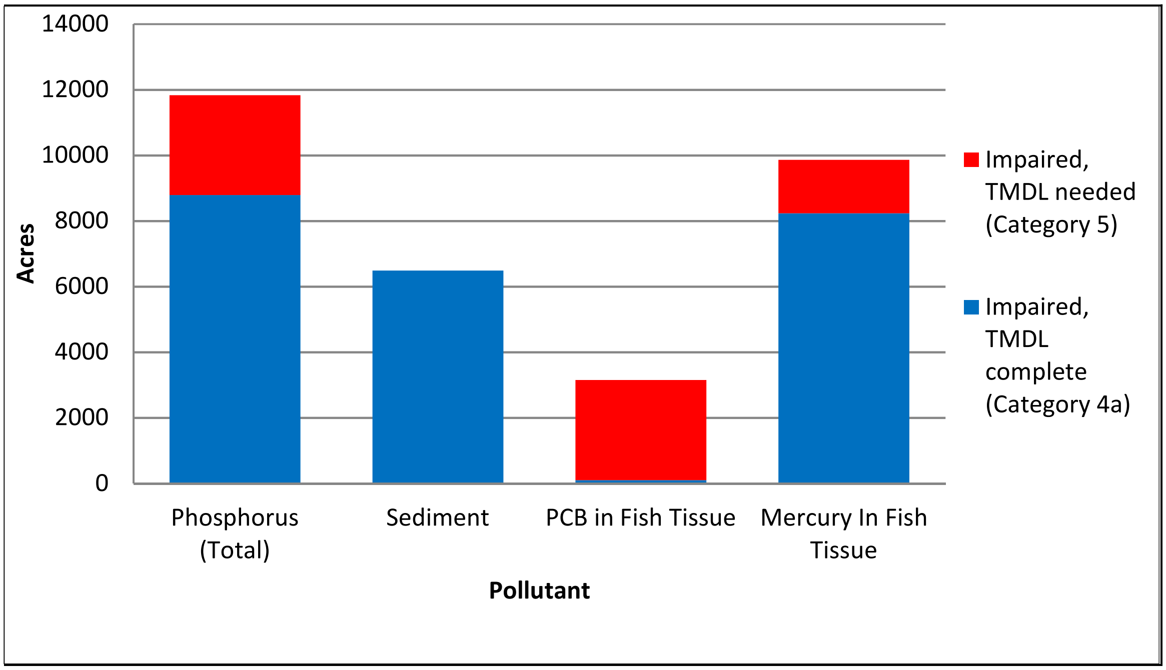

Figure 2: Impoundment size impaired by various pollutants. Colors denote the impoundment acres currently addressed by TMDLs (blue) and those that still require TMDLs (red).

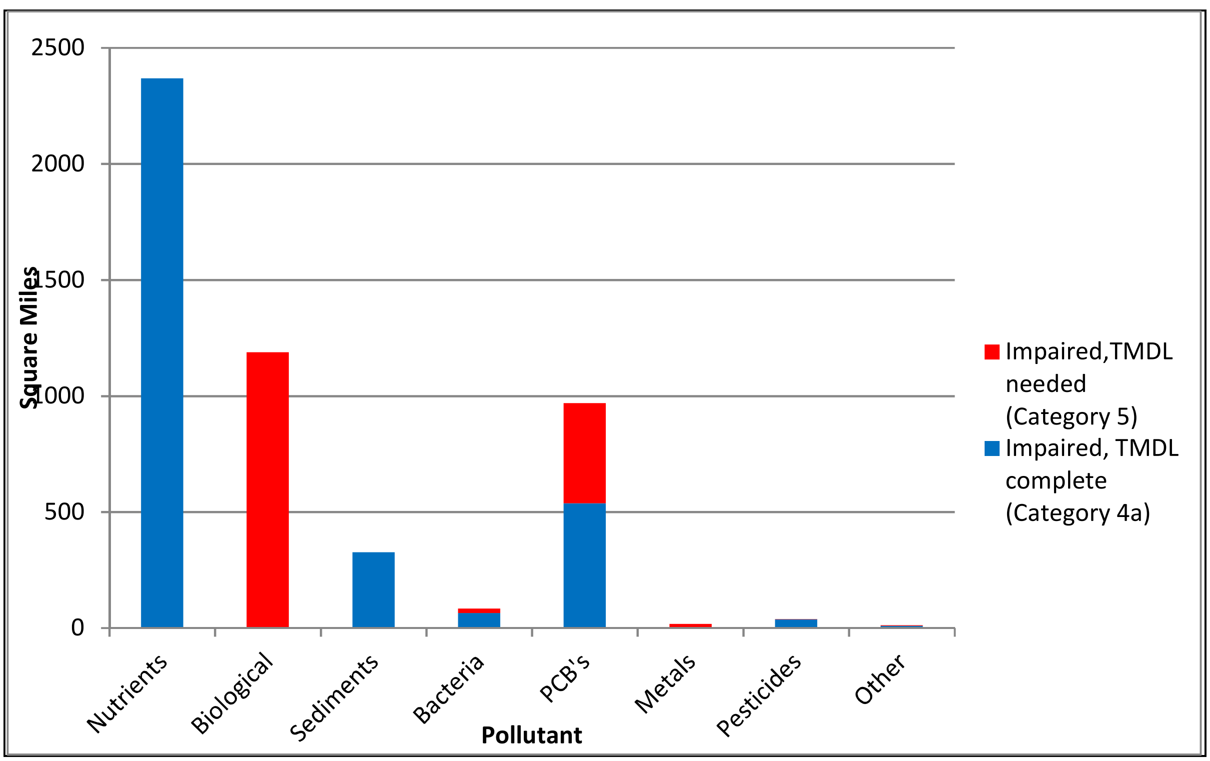

Figure 3: Size of estuarine waters impaired by various pollutants. Colors denote the square mileage of estuarine waters currently addressed by TMDLs (blue) and those that still require TMDLs (red).

Summary of Changes in the 2018 Integrated Report

There are a total of 42 additions to the list of Category 5 (impaired, TMDL needed) waters in 2018. Six of the new Category 5 waterbody-pollutant combinations (also referred to as listings or assessment records) resulted from MDE's Biological Stressor Identification Analyses (BSID). Of these 6 new 'biostressor' listings, three are for total suspended solids, two are for sulfates, and one is for chlorides. In addition, there are four new fecal coliform listings in shellfish harvesting waters, one new listing for PCBs in fish tissue, and one new listing for phosphorus. There are also 30 temperature listings that were moved from category 3 (insufficient information) to category 5 (impaired, TMDL needed) after the close of the public comment period. These 30 listings were changed based on a re-evaluation of these data using the policy of independent applicability which requires each individual data type (e.g. biological, water chemistry, etc) to be assessed independently and without weighting. Additional details about this re-evaluation are provided in Section C.3.1.1.

Table 1: Changes to Category 5 Listings from 2016 to 2018

Integrated Report Year/Status	Category 5 Listings
2016 Total Category 5 Listings	**261**
2018 New Category 5 Listings	42*
2018 New Delistings (Category 5 to Category 2 or 3) *(See Table 2)*	-11*
Approved TMDLs (since the 2016 IR)	-8^*
2018 Grand Total Category 5 Listings	**284***

^The reader may note that this number is smaller than in previous cycles. The reason for this is that Maryland's 2016 Integrated Report (IR) was delayed and as a result was completed less than a year ago. Therefore, not much time has passed in which TMDLs could have been developed by MDE and then subsequently reviewed and approved by EPA (after which they are reflected in the IR).
*The reader may note that this number has changed since the draft report. Please refer to Part H: Assessments That Were Modified After the Start of the Public Comment Period for more information.

Eleven waterbody-pollutant combinations were removed from Category 5 (impaired, TMDL needed) in 2018. Four biological listings without a specified impairing substance have been replaced by specific pollutant listings enumerated by the Biological Stressor Identification analyses. Another three (of the 11) listings, originally listed as impaired for exceedances above the pH criteria (i.e. > 8.5 pH units), were removed from Category 5 because new data showed that water quality standards were being met. The last four listings removed from Category 5 included two for fecal coliform in shellfish harvesting areas, one for mercury in fish tissue, and one for PCBs in fish tissue. All of these four listings were moved to Category 2 on the basis of new data that demonstrated water quality that met the applicable criterion.

Some of these listings were originally based on limited data. In these cases, it is not possible to attribute these waters now meeting standards to a particular restoration action. It is possible that the extensive restoration practices that have been applied statewide might be playing a contributory role but it may also be true that these listings were made based upon insufficient data. Table 2 shows the general water body-pollutant combinations that have been delisted from Category 5.

Table 2: 2018 Delistings (water body-pollutant combinations removed from Category 5 (impaired, TMDL needed) and placed in Category 2 or 3 (non-impaired).

Type of Impairment Listing	Number of Listings Removed from Category 5
Generic Biological Listings – specific pollutant now specified (BSID process)	4
pH – water quality criteria now met	3*
Fecal Coliform – meeting water quality criteria for the shellfish harvesting use	2
Hg - fish tissue concentrations now meeting fishing designated use	1
PCBs - fish tissue concentrations now meeting fishing designated use	1
2018 Total Number of Delistings	**11**

* The reader may note that this number has changed since the draft report. Please refer to Part H: Assessments That Were Modified Since the Public Comment Period for more information.

In addition, there were other water quality listings removed from the impaired part of the IR but which were not counted in Table 2 because they were previously in Category 4a (impaired, TMDL approved). Four such delistings occurred in tidal tributaries to the Chesapeake Bay including the Chester River Oligohaline, Honga River Mesohaline, Middle River Oligohaline, and the Port Tobacco River Oligohaline segments. In this case, all four water body segments had recent assessment data that demonstrated attainment of the shallow water submerged aquatic vegetation (SAV) use and water clarity criteria (i.e. SAV coverage and water clarity). Other noteworthy assessments captured on the 2018 IR and which were not counted in Table 2, were the removal (from Category 4a) of the three low pH impairments in the Casselman River watershed that were mentioned above. For more details on the Category 4a delistings please see Section C.3.1.2.

Other notable actions taken by the State include:

- The passage of House Bill (HB) 1325 during Maryland's 2017 Legislative Session. This bill, signed by the Governor, banned the practice of hydraulic fracturing in the state. After much deliberation on the issue and comprehensive research by state agency staff, legislators and the Governor "concluded that the risks of hydraulic fracturing outweighed any potential benefits."
- Passage of the Clean Water Commerce Act (HB417/SB314) which expands the authorized uses of the Bay Restoration Fund to include funding urban stormwater retrofits to reduce nitrogen, phosphorus, and sediment going to the Chesapeake Bay.
- Issuing a notice of intent to award a contract to both remove the sediment built-up behind the Conowingo Dam and identify opportunities for innovative/beneficial reuse. EPA Chesapeake Bay Program modeling shows that, without addressing these sediments, Maryland will not be able to meet the requirements of the Chesapeake Bay TMDLs, thus making addressing the impacts of these accumulated sediments a high priority.
- Proposing road salt management strategies in the next round of Phase I Municipal Separate Storm Sewer System (MS4) permits thereby taking action to address the increasing chloride levels in Maryland's streams, groundwater, and drinking water reservoirs and subsequent water quality impairments identified in this report.

- The development of stream temperature modeling methods designed to address, through a TMDL or other mechanism, the 101 temperature impairments to Class III and III-P streams.

Maryland continues to work closely with EPA's Chesapeake Bay Program (CBP) and other state partners (VA, PA, D.C., NY, and DE) to refine and enhance the various tools used to monitor, assess, model, and restore this iconic estuary. This year, the Chesapeake Bay Midpoint Assessment was completed which provides a comprehensive review of mid-course progress towards meeting the Chesapeake Bay TMDLs. This assessment helps jurisdictions identify any necessary adjustments in strategies to ensure that the partnership can achieve its pollutant loading reductions by 2025 while accounting for future growth and a changing climate. As a result, the Midpoint Assessment will be used to inform the Phase III Watershed Implementation Plans (WIP) that will serve as the detailed road map for meeting nutrient and sediment reduction goals out to 2025. At the same time, the State also continues work in Maryland's Coastal Bays and Youghiogheny River watersheds to ensure that the unique challenges for these water bodies are properly assessed and managed to restore, protect, and maintain water quality.

PREFACE

Maryland's Integrated Report, when approved by the US Environmental Protection Agency, will satisfy Sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA). The following lists the requirements of these sections.

Clean Water Act §303(d) (Impaired waters) Requirements

- A list of water quality-limited (impaired) waters still requiring TMDL(s), pollutants causing the impairment and priority ranking for TMDL development (including waters targeted for TMDL development within the next two years).
- A description of the listing methodologies used to develop the list.
- A description of the data and information used to identify waters, including a description of the existing and readily available data and information used.
- A rationale for any decision to not use any existing and readily available data and information.
- Other reasonable information such as demonstrating good cause for not including waters on the list.

Clean Water Act §305(b) (Water quality inventory) Requirements

- A description of the quality of all waters in the state and the extent to which the quality of waters provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water.
- An estimate of the extent to which control programs have or will improve water quality, and recommendations for future actions necessary and identification of waters needing action.
- An estimate of the environmental, economic and social costs and benefits needed to achieve the objectives of the CWA and an estimate of the date of such achievement.
- A description of the nature and extent of nonpoint source pollution and recommendations of programs needed to control each category of nonpoint sources, including an estimate of implementation costs.
- An assessment of water quality of all publicly owned lakes as specified in §314(a)(1).

Clean Water Act §314 (Clean Lakes) Requirements

- An identification and classification according to eutrophic condition of all publicly owned lakes.
- A description of procedures, processes, and methods (including land use requirements), to control sources of pollution of such lakes.
- A description of methods and procedures, in conjunction with appropriate federal agencies, to restore the quality of such lakes.
- Methods and procedures to mitigate the harmful effects of high acidity, including innovative methods of neutralizing and restoring buffering capacity of lakes and methods of removing from lakes toxic metals and other toxic substances mobilized by high acidity.
- A list and description of those publicly owned lakes for which uses are known to be impaired and those in which water quality has deteriorated as a result of high acidity that may be due to acid deposition.
- An assessment of the status and trends of water quality in lakes, including but not limited to, the nature and extent of pollution loading from point and nonpoint sources and the extent to which the use of lakes is impaired as a result of such pollution, particularly with respect to toxic pollution.

PART A: INTRODUCTION

In Maryland, the Departments of Natural Resources (DNR) and the Environment (MDE) are the two principal agencies responsible for water resources monitoring, assessment and protection. DNR is the primary agency responsible for ambient water monitoring. MDE sets water quality standards, compiles and assesses water quality data, submits the Integrated Report, regulates discharges to Maryland waters through multiple permits, enforcement and compliance activities, and develops Total Maximum Daily Loads (TMDLs) for impaired waters. Historically, water quality monitoring results were submitted in two separate reports, the annual §305(b) reports and the biennial §303(d) List (list of impaired waters). Since 2002 and in compliance with Environmental Protection Agency guidance on 303(d) listing and 305(b) reporting, these formerly independent responsibilities have evolved into a combined reporting structure called the Integrated Report (IR).

The IR utilizes five reporting categories that not only include impaired waters requiring TMDLs, but also waters that are clean or need additional monitoring data to make an assessment. These categories are:

Category 1: water bodies that meet all water quality standards and no use is threatened;

Category 2: water bodies meeting some water quality standards but with insufficient data and information to determine if other water quality standards are being met;

Category 3: Insufficient data and information are available to determine if a water quality standard is being attained. This can be related to having an insufficient quantity of data and/or an insufficient quality of data to properly evaluate a water body's attainment status.

Category 4: one or more water quality standards are impaired or threatened but a TMDL is not required or has already been established. The following subcategories are included in Category 4:

- **Subcategory 4a**: TMDL already approved or established by EPA;
- **Subcategory 4b**: Other pollution control requirements (i.e., permits, consent decrees, etc.) are expected to attain water quality standards; and,
- **Subcategory 4c**: Water body impairment is not caused by a pollutant (e.g. habitat is limiting, dam prevents attainment of use, etc).

Category 5: Water body is impaired, does not attain the water quality standard, and a TMDL or other acceptable pollution abatement initiative is required. This is the part of the IR historically known as the 303(d) List.

Maryland uses these categories by placing each 'water body-pollutant' combination into one of the five categories. Doing this often causes a single water body to be included in multiple categories for different pollutants. For example, Loch Raven Reservoir is listed in Category 4a (impaired, TMDL completed) for sedimentation/siltation and also in Category 2 (meets water quality standards) for having levels of copper that meet water quality standards. This helps Maryland track the status of each pollutant for which a water body has been assessed.

A.1 Data Sources and Minimum Requirements

Section 130.7(B)(5) of the Clean Water Act requires that states "assemble and evaluate all existing and readily available water quality-related data and information" when compiling their Integrated Report. This includes but is not limited to the following:

(i) Waters identified by the state in its most recent Section 305(b) Report as "partially meeting" or "not meeting" designated uses;

(ii) Waters for which dilution calculations or predictive models indicate non-attainment of applicable water quality standards;

(iii) Waters for which water quality problems have been reported by local, state, or federal agencies; members of the public or academic institutions; and,

(iv) Waters identified by the state as impaired in a nonpoint source assessment submitted to EPA under Section 319 of the CWA or in any updates of the assessment.

With the integration of sections 305(b) and 303(d) of the Clean Water Act and the adoption of a multi-category reporting structure, Maryland has maintained a two-tiered approach to data quality. Tier 1 data are those used to determine impaired waters (e.g., Category 5 waters or the traditional 303(d) List) and are subject to the highest data quality standards. Maryland waters identified as impaired using Tier 1 data may require a TMDL or other regulatory actions. These data should be accompanied by a Quality Assurance Project Plan (QAPP) consistent with EPA data guidance specified in Guidance for Quality Assurance Project Plans (U.S. EPA 2002a). Tier 1 data analysis must also be consistent with Maryland's Assessment Methodologies (see Section C.2).

Tier 2 data are used to assess the general condition of surface waters in Maryland and may include land use data, visual observations of water quality condition, or data not consistent with Maryland's Assessment Methodologies. Such data may not have a QAPP or may have one that is not consistent with EPA guidance. Waters with this level of data may be placed in Categories 2 or 3 of the IR, denoting that water quality is generally good or that there are insufficient data to make an assessment, respectively. However, Tier 2 data alone are not used to make impairment decisions (i.e., Category 5 listings requiring a TMDL) because the data are of insufficient quantity and/or quality for regulatory decision-making. Table 3 below identifies the organizations and/or programs that submitted data to MDE for the 2018 IR.

Table 3: Organizations/Programs that submitted water quality data for consideration in the 2018 Integrated Report.

Data Provider	Data Description	Parameter(s) Measured	Data Tier	Notes
Audubon Naturalist Society	Non-tidal biological monitoring data from streams around Montgomery County.	Benthic Index of biological integrity	2	Data used for informational purposes - Benthic index of biotic integrity calculated using family level identification. Integration with state dataset not yet possible.
Blue Water Baltimore	Bacteria, nutrient, and physical parameters for the Gwynns Falls and Jones Falls watersheds as well as bacteria, nutrient, and physical parameters for the tidal Patapsco River.	water quality, bacteria	1	Data used to update bacteria and pH assessments. Tidal data has completed QAQC checks and will be integrated with the Chesapeake Bay Program assessments for future IR.
Choptank Riverkeeper and Midshore Riverkeeper Conservancy	Water quality assessments for the Choptank River, Miles River, Wye River, Eastern Bay, and their tributaries.	water quality, nutrients	2	Full vetting of data still needed (through the Chesapeake Monitoring Cooperative). Likely to be integrated with Chesapeake Bay Program assessments in future IR.
City of Cumberland	E. coli data collected from Potomac and Wills Creek.	E. Coli	2	Dataset needs station coordinate information and sampling protocols. Will need to ensure measurements in MPN can be translated in CFU for future IR.
Downstream Strategies for Deep Creek Lake	Nutrient and metals data collected for a number of coves in Deep Creek Lake	Turbidity, total dissolved solids, nitrite, total organic carbon, aluminum, arsenic, iron, lead, manganese, potassium, chloride, sulfate, nitrate, total phosphorus, pH, temperature, conductivity, TDS	2	Data used for informational purposes. Data needs to be accompanied by a QAPP or similar documentation. This data was collected as a "snapshot" of conditions in the area and therefore was not sampled with the temporal frequency to be assessed for the 2018 Integrated Report.
Garrett County Health Department	Bacteria data for Deep Creek Lake	fecal coliform, turbidity, phosphate, nitrate	1	Data used to assess non-beach recreational waters.

Data Provider	Data Description	Parameter(s) Measured	Data Tier	Notes
MD DNR and Chesapeake Bay Program	Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of CFD curves	1	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries
MD DNR Core Trends Program	In-situ water quality and nutrients	A comprehensive suite of nutrient species and in-situ physical parameters such as DO, pH, water temperature, etc	1	Data used to update non-tidal assessments and for conducting water quality trend analyses.
MD DNR Maryland Biological Stream Survey	Benthic macroinvertebrate and fish data used to assess current conditions and identify stressors	Benthic macroinvertebrate and fish biotic indices, other physical and chemical parameters	1	Data used to update non-tidal assessments for a variety of pollutants.
MDE - Abandoned Mine Land Division and Field Services Program	pH and metals data from restoration activities in streams in the Casselman River watershed affected by acid mine drainage	pH and metals	1	Data used to update pH assessments.
MDE - Biostressor Identification Program	Analysis that provides the pollutants impairing a watershed's biotic integrity	Biological Index Scores and the correlation to stressors	1	Data used to update biological assessments to reflect actual impairing substance.
MDE - Compliance Program's Sewage Overflow Database	Web-accessible Sewage Overflow Database provides data on location and volume of sewage overflows	gallons of untreated sewage discharged from leaky infrastructure	2	Data summarizes the areas with most frequent sewage overflows. No actual water quality data.
MDE- Beach Certification Program	Bacteria data collected at designated bathing beaches by County HDs.	Enterococcus levels	1	Data used to update beach assessments.

Data Provider	Data Description	Parameter(s) Measured	Data Tier	Notes
MDE- Integrated Water Planning and Field Services Programs	pH data for the Conococheague Creek watershed	pH	1	Data used to update the Conococheague Creek pH assessment.
MDE- Fish Tissue Monitoring Program	Fish Tissue data on Chlordane, PCBs and Hg content	Concentration of Chlordane, PCBs, and mercury in fish tissue	1	Data used to update fish consumption assessments for PCBs, mercury, and chlordane.
MDE – Field Services Program	Nutrient, Chlorophyll a, and in-situ data collected in the Conowingo Reservoir	Nutrient species, chlorophyll a, dissolved oxygen, pH, salinity, turbidity	1	Data used to assess the Conowingo Reservoir
MDE- Shellfish Certification Program	Bacteria data for stations in the Tidal areas of the Chesapeake Bay and Coastal Bays in MD	Fecal coliform	1	Data used to update bacteria assessments as they relate to the shellfish harvesting designated use.
Nanticoke Watershed Alliance	Physical water quality parameters, nutrients, chlorophyll a, and bacteria samples collected from both tidal and nontidal waters in the Nanticoke River watershed.	DO, salinity, Secchi depth, temperature, fecal coliform, enterococcus, chlorophyll a, nutrients	2	Data used to prioritize follow-up assessments. Additional data are needed for a conclusive assessment. Coordinates require greater precision and bacteria samples need to adhere to holding time requirements. After full vetting, tidal dissolved oxygen data will likely be integrated with the Chesapeake Bay Program assessments.
National Park Service Water Resources Division	Physical and chemical water quality data for fixed stations in Washington, Frederick, Montgomery and Prince George's Counties.	DO, pH, Temperature	2	Data used to prioritize follow-up assessments. However, additional data are needed for a conclusive assessment. Data needs to be accompanied by QAPP or similar documentation.

Data Provider	Data Description	Parameter(s) Measured	Data Tier	Notes
South River Federation	Water quality and bacteria assessments for tidal and nontidal South River.	water quality, bacteria	2	Data used for informational purposes. Clarifications needed in QAPP documentation. Data may be used in the future but issues with metadata consistency prevented confident assessment. After full vetting, tidal dissolved oxygen data will likely be integrated with the Chesapeake Bay Program assessments.
Susquehanna River Basin Commission	Biological and water quality for the Maryland portion of the Susquehanna River Watershed	water quality, benthic macroinvertebrates, fish	2	Data used for informational purposes - Data had inadequate number of sampling events. Lacking weather related information needed for water quality impairment determinations.
The Elk and North East River Watershed Association (ENERWA)	Water quality data for the Elk and North East Rivers	water quality	2	Data not used due to the lack of QAPP documentation. pH sampling methods not comparable to methods for assessment.
Virginia Institute of Marine Science and Maryland Department of Natural Resources	Counts of areal submerged aquatic vegetation (SAV) coverage and measured water clarity for select tidal tributaries to the Chesapeake Bay.	SAV coverage (acres) and water clarity acres	1	Data used to update the SAV/sediment assessments for the Chesapeake Bay and its tidal tributaries.
Washington Suburban Sanitary Commission	Physical and chemical water quality data from the Patuxent Reservoirs	chlorophyll a, nutrients, turbidity, chlorides, DO	2	Data not used due to inconsistencies in metadata documentation.

Worth noting, in the coming years, MDE will be reevaluating the current data quality tier system (2 tier system) to determine if changes are necessary to establish consistency with the Chesapeake Monitoring Cooperative (CMC) and further refine the data evaluation process.

A.1.1 Quality Control of Water Quality Datasets

Data quality in Maryland's water monitoring programs is defined through implementation of the agency's quality control program (e.g., DNR's and MDE's Quality Management Plan), Quality Assurance Project Plans (QAPP) for each monitoring program, and field and laboratory Standard Operating Procedures (SOP). Water monitoring programs conducted under contract to the US Environmental Protection Agency (EPA) must have QAPPs approved by the EPA Regional or Chesapeake Bay Program Quality Assurance (QA) Officer prior to initiating monitoring activities.

Details in each program's QAPP define data quality indicators by establishing quality control and measurement performance criteria as part of the program's planning and development. Such measures help ensure there is a well-defined system in place to assess and ensure the quality of the data.

Water monitoring programs conducted by a local agency, educational institution, consultant or citizen group may not have a QAPP. Unless there are contractual requirements, water monitoring QAPPs for these groups are not reviewed or approved by the State. While it is recommended that a QAPP or equivalent planning document be developed, some water quality monitoring programs may have no QAPP or documentation on quality control. For state analysts to review these contributed data with any confidence the quantitative aspects of these data need to be defined.

Some of the data quality aspects that need to be considered include:

- **Precision** - How reproducible are the data? Are sample collection, handling and analytical work done consistently each time samples are collected and processed?
- **Accuracy/Bias** - How well do the measurements reflect what is actually in the sample? How far away are results from the "true" value, and are the measures consistently above or below this value?
- **Representativeness** - How well do the sample data characterize ambient environmental conditions?
- **Comparability** – How similar are results from other studies or from similar locations of the same study, or from different times of the year, etc.? Are similar sampling and analytical methods followed to ensure comparability? Do observations of field conditions support or explain poor comparability?
- **Completeness** – Is the quality and amount of data collected sufficient to assess water quality conditions or can these data be appended to other, existing data collected at the same site or nearby to provide enough information to make an assessment decision?
- **Sensitivity -** Are the field and/or laboratory methods sensitive enough to quantify parameters at or below the regulatory standards and at what threshold can an analytical measure maintain confidence in results?

QAPPs will likely not address all of these issues and there are often no quantitative tests or insufficient Quality Control (QC) data available to do so. In these instances, best professional judgment may be required as these aspects can be difficult to address, even if there is a monitoring QAPP. For some issues, there is no quantitative test and often little, if any, quality assurance data provided with contributed data. In most instances, an analyst's review of available monitoring program documentation and data are subjective. Once data quality is considered acceptable (or at least not objectionable), the dataset review process moves to a more quantitative review stage.

A.1.2 Water Quality Data Review

The designated uses defined in the Code of Maryland Regulations are assessed by relatively few field and analytical measures. Water temperature, dissolved oxygen, pH, turbidity, water clarity (Secchi depth or light extinction), acres of estuarine grasses, ammonia, biological integrity and certain bacteria levels define the principal data used to assess criteria attainment. Various measures of nitrogen and phosphorus (nutrients) have not been defined in terms of criteria, although exceedance of dissolved oxygen or chlorophyll a criteria or nuisance levels of algae are attributed to high levels of nutrients. Except for special studies or as a discharge permit requirement, metals, inorganic and organic parameters defined as criteria are not routinely measured due to the high cost of analysis and because few of these substances are found in ambient waters at levels exceeding criteria. Specific toxics known to be directly related to human health (i.e., mercury and PCBs) are assessed through MDE's fish and shellfish monitoring programs.

Water quality datasets reviewed for assessing use support are first examined in terms of a QAPP or other reports that define monitoring objectives and quality control. For selected parameters, the data are reviewed for sufficient sample size, data distribution (type and outliers/errors) and spatial and temporal distribution in the field. Censored data and field comments are examined for unusual events that may affect data quality (e.g., storm event). Data are examined for seasonality and known correlations (e.g., conductivity and salinity) are reviewed. Censored data are noted and may be excluded from the analysis.

Not all water quality criteria are assessed using this approach. Some assessments are conducted by other state programs using peer-reviewed or defined methods (e.g., Maryland's assessment methodologies) and are not re-evaluated using other approaches. Examples include; assessment of algal samples, the State's probabilistic non-tidal living resource survey (MD Biological Stream Survey), fish kill and bacterial assessments, bathing and shellfish harvesting restrictions, and toxic contaminants in fish tissue, shellstock and sediments.

Some criteria assessments are conducted externally. In these circumstances, the assessment methods are peer reviewed and results are provided to the State. Criteria assessed in this manner are not re-evaluated. Examples include, for Maryland's Chesapeake Bay and tidal tributaries, benthic community criteria (Versar, Inc. and Old Dominion University), aquatic grass coverage (VA Institute of Marine Science), water clarity (MD DNR), and dissolved oxygen (US Environmental Protection Agency's Chesapeake Bay Program).

MDE supports the use of computer models and other innovative approaches to water quality monitoring and assessment. Maryland and the Bay partners have also relied heavily on the Chesapeake Bay model to develop loading allocations, assess the effectiveness of best management practices, and guide implementation efforts. Several different modeling approaches have also been used in TMDL development. With the large number of biological impairments in Category 5 of the IR, Maryland has been relying more heavily on land use analyses, GIS modeling, data mining, and other innovative approaches to identify stressors, define ecological processes, and develop TMDLs.

PART B: BACKGROUND

B.1 Total Waters

Maryland is fortunate to have an incredible diversity of aquatic resources. The low-lying, coastal plain region in the eastern part of the State includes the oceanic zone as well as the estuarine waters of both the Coastal and Chesapeake Bays. Moving further west and up through the rolling hills of the Piedmont region, the tidal influences give way to flowing streams and the Liberty, Loch Raven and Prettyboy reservoir systems. Along the western borders of the State is the Highland region where the State's highest peaks are located, and which includes three distinct geological provinces (the Blue Ridge, the Ridge and Valley province, and the Appalachian Plateaus). Estimates of Maryland's total surface waters across these regions are given in Table 4.

Table 4: Scope of Maryland's Surface Waters.

		Value	Scale	Source
State population		5,773,552	N/A	U.S. Census Bureau, 2010
Surface Area	Total (square miles)	12,193	Unknown	MD DNR 2001
	Land (square miles)	9,844		
Rivers and streams (miles)		19,127	1:24,000 NHD Coverage	National Hydrography Dataset, 2012
Impoundments	All Lakes/Reservoirs (number/acres)	947 lakes / 77,965	1:100,000 (RF3)	US EPA, 1991
	Significant Publicly-owned (number/acres)	60 lakes / 21,876	1:24,000 NHD Coverage	USGS, MDE, 2012
Estuaries/Bays (square miles)		2,451	1:24,000	Chesapeake Bay Program, MDE, 2012
Ocean coast (square miles)		107	1:24,000	MDE, 2012
Wetlands	Freshwater (acres)	528,877	Unknown	Genuine Progress Indicator, 2013
	Tidal (acres)	237,042	Unknown	Genuine Progress Indicator, 2013

*Most of these numbers are based on the use of the 1:24,000 scale, USGS National Hydrography Dataset (NHD) coverage.

B.1.1 Water Quality Standards

A water body is considered "impaired" when it does not support a designated use [see Code of Maryland Regulations §26.08.02.02 at http://www.dsd.state.md.us/comar/comarhtml/26/26.08.02.02.htm]. Maryland's Water Quality Standards (WQS) assign use classes or groupings of specific designated uses to each body of water. The following is a generalized list of the four primary classes. Each of these may also be given a "-P" suffix which denotes that the water body also supports public water supply.

Class I waters: Water contact recreation, and protection of non-tidal warmwater aquatic life;
Class II waters: Support of estuarine and marine aquatic life and shellfish harvesting;
Class III waters: Non-tidal cold water; and,
Class IV waters: Non-tidal Recreational trout waters.

Each class then has an appropriate subset of specific designated uses. Water bodies assigned a use class are expected to support the entire subset of designated uses for that class. The only exception to this is for Class II waters which may or may not support shellfish harvesting (based on possible shellfish habitat) or other subcategory designated uses (e.g. denoted with an asterisk in the table below) specific to certain locales. Table 5 illustrates the specific designated uses that apply to each use class. This table shows all possible use classes in the column headings.

Table 5: Specific Designated Uses that apply to each Use Class.

	Use Classes							
Designated Uses	**I**	**I-P**	**II**	**II-P**	**III**	**III-P**	**IV**	**IV-P**
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Growth and Propagation of fish (other than trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use*			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use*			✓	✓				
Open-Water Fish and Shellfish Use*			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use*			✓	✓				
Seasonal Deep-Channel Refuge Use*			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

*These particular designated uses apply only to specific segments of the Chesapeake Bay and its tidal tributaries. They are discussed in more detail in Section B.1.1.1.

Each of the designated uses has associated water quality criteria that are then used to determine if the designated use is being supported. Such criteria can be narrative or numeric. Numeric Water Quality Criteria establish threshold values, usually based upon risk analyses or dose-response curves, for the protection of human health and aquatic life. These apply to pollutants that can be monitored and quantified to known levels of precision and accuracy, such as toxics concentrations, pH, and dissolved oxygen. Narrative criteria are less quantitative in nature but generally prohibit any undesirable water quality conditions that would preclude a water body from supporting a designated use.

The Federal Clean Water Act and its amendments require that states update their water quality standards every three years in what is referred to as the Triennial Review of Water Quality standards. This action includes a robust public comment process and is subject to review and approval by the US Environmental Protection Agency. Maryland's water quality standards are updated through changes to the regulatory language in the Code of Maryland Regulations (COMAR). For more information please visit: http://mde.maryland.gov/programs/water/TMDL/WaterQualityStandards/Pages/index.aspx.

B.1.1.1 Water Quality Standards for Chesapeake Bay and its Tidal Tributaries

Maryland has detailed water quality standards for Chesapeake Bay and its tidal tributaries to protect both aquatic resources and to provide for safe consumption of shellfish. The current aquatic resource protection standards are subcategories under Class II waters and establish five designated uses (see Figure 4) for Chesapeake Bay and its tidal tributaries, including:

Seasonal Migratory Fish Spawning and Nursery Designated Use - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced populations of ecologically, recreationally, and commercially important anadromous, semi-anadromous and tidal-fresh resident fish species inhabiting spawning and nursery grounds from February 1 through May 31.

Seasonal Shallow-Water Submerged Aquatic Vegetation Designated Use –includes tidal fresh, oligohaline and mesohaline waters of the Chesapeake Bay and its tributaries that have the potential for or are supporting the survival, growth, and propagation of rooted, underwater bay grasses in tidally influenced waters between April 1 and October 1.

Open-Water Fish and Shellfish Designated Use - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced, indigenous populations of ecologically, recreationally, and commercially important fish and shellfish species inhabiting open-water habitats. This subcategory applies to two distinct periods: summer (June 1 to September 30) and non-summer (October 1 through May 31). In summer, the open-water designated use in tidally influenced waters extends from shoreline to adjacent shoreline, and from the surface to the bottom or, if a pycnocline exists (preventing oxygen replenishment), to the upper measured boundary of the pycnocline. October 1 through May 31, the boundaries of this use include all tidally influenced waters from the shoreline to adjacent shoreline and down to the bottom, except when the migratory spawning and nursery designation (MSN) applies.
NOTE: If a pycnocline exists but other physical circulation patterns, such as the inflow of oxygen-rich oceanic bottom waters, provide oxygen replenishment to the deep waters, this use extends to the bottom. This is mostly prevalent in the Virginia portion of the Bay.

Seasonal Deep-Water Fish and Shellfish Designated Use - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival, growth, and propagation of balanced, indigenous populations of important fish and shellfish species inhabiting deep-water habitats from June 1 through September 30:
NOTE 1: In tidally influenced waters located between the measured depths of the upper and lower boundaries of the pycnocline, where a pycnocline is present and presents a barrier to oxygen replenishment; or
NOTE 2: From the upper boundary of the pycnocline down to the sediment/water interface at the bottom, where a lower boundary of the pycnocline cannot be calculated due to the depth of the water column.
NOTE 3: From October 1 to May 31, criteria for Open Water Fish and Shellfish Subcategory apply.

Seasonal Deep-Channel Refuge Designated Use - includes waters of the Chesapeake Bay and its tidal tributaries that have the potential for or are supporting the survival of balanced, indigenous populations of ecologically important benthic infaunal and epifaunal worms and clams, which provide food for bottom-feeding fish and crabs. This subcategory applies from June 1 through September 30 in tidally influenced waters where a measured pycnocline is present and presents a barrier to oxygen replenishment. Located below the measured lower boundary of the pycnocline to the bottom.
NOTE: From October 1 to May 31, criteria for Open Water Fish and Shellfish Subcategory apply.

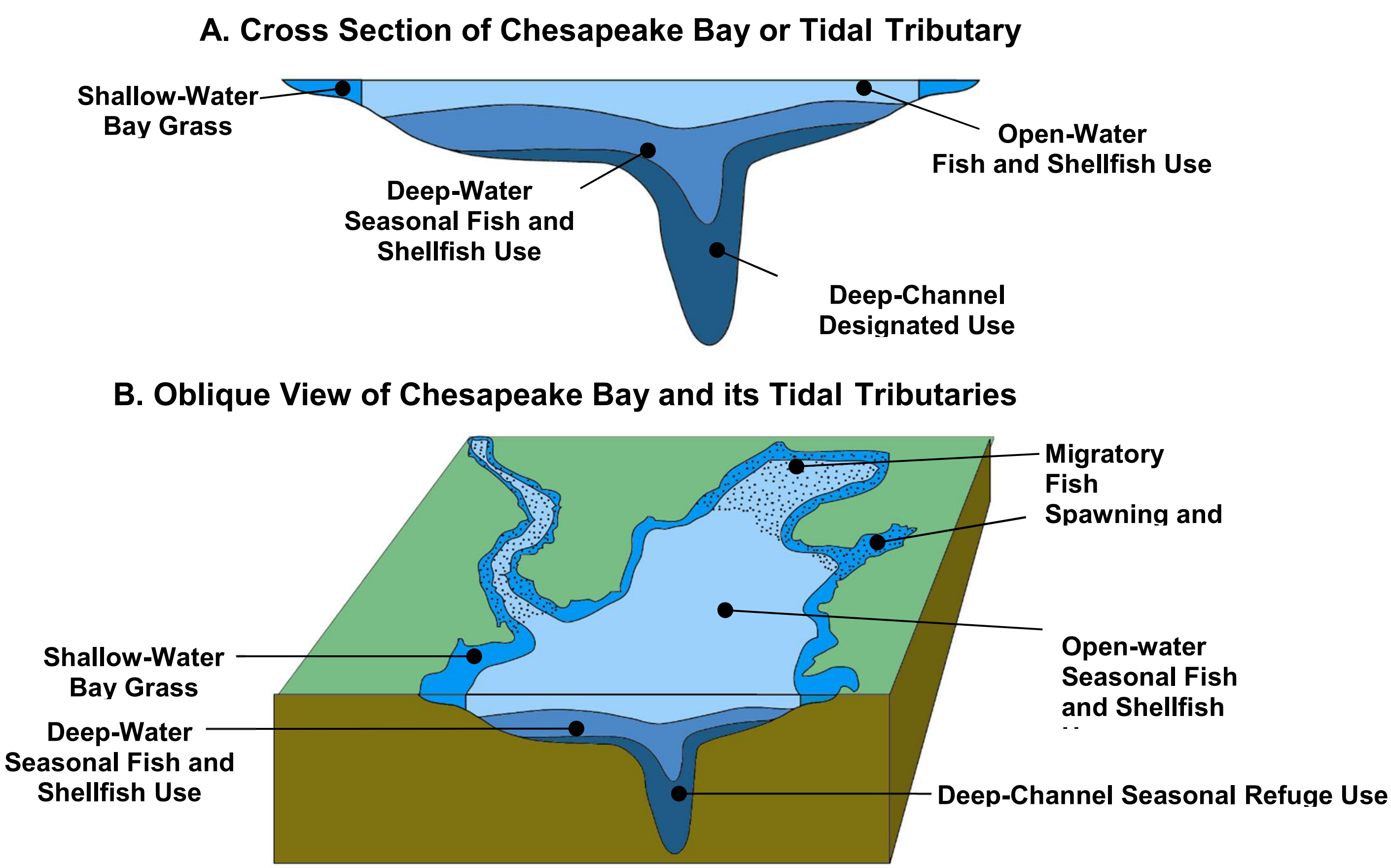

Figure 4: Illustration of the designated uses for Chesapeake Bay (Chesapeake Bay Program, 1998). Uses are both overlapping and three-dimensional.

B.2 Water Pollution Control Programs

Maryland implements a host of water pollution control programs to ensure that water quality standards are attained, many of which are funded by federal dollars under the Clean Water Act. Some programs are administered by different state agencies within Maryland or by local jurisdictions. Some of the programs administered by MDE are briefly cited below and web links are provided for access to more detailed information.

B.2.1 Permits

MDE is responsible for administering several permit programs to reduce the impacts of surface water and groundwater discharges to state waters. More detailed information on the State's water permits is available at: http://mde.maryland.gov/programs/Permits/WaterManagementPermits/Pages/index.aspx.

B.2.2 Tier II Waters and Antidegradation

Maryland continues to implement antidegradation regulations to better protect state waters where data indicate that water quality is significantly better than that required to support the applicable designated uses (COMAR 26.08.02.04). MDE has recently updated its web resources to clarify how these regulations are implemented. In addition, the Department has created a webpage specifically designed to assist applicants for Wetlands and Waterways permits to understand what is expected during an Tier II review of their project. The antidegradation program aims to protect high quality waters by requiring more rigorous permit application reviews. The reviews identify practices that avoid, minimize, and/or mitigate the amount of buffering capacity (i.e., assimilative capacity) used by a permitted discharge. More information on Tier II can be found at http://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx.

B.2.3 Grant Programs

A number of financial assistance programs are offered and/or facilitated by the Maryland Department of the Environment. Funding may be in the form of grants, low interest loans, or direct payments for specific projects. More detailed information on the range of programs administered by the Department can be found at: http://mde.maryland.gov/programs/Water/WQFA/Pages/index.aspx.

B.2.4 Total Maximum Daily Loads (TMDLs)

Waters listed on Category 5 of this Integrated Report may require a Total Maximum Daily Load (TMDL). A TMDL is an estimate of the amount or load of a particular pollutant that a water body can assimilate and still meet water quality standards. After a total load has been developed, upstream discharges will be further regulated to ensure the prescribed loading amounts are attained. More information on Maryland's TMDL program can be found at: http://mde.maryland.gov/programs/Water/TMDL/Pages/index.aspx. Changes to assessments in this Integrated Report that are based on newly approved TMDLs (TMDLs approved by EPA within the last two years) are described in this document in Section C.3. Worth noting, MDE has created the Maryland "TMDL Data Center" on the Department website to make it easier for the public to search for applicable

TMDLs and waste load allocations, and to see the geographic extent of waters addressed by TMDLs. This webpage also has links to the Stormwater Toolkit, other stormwater documents, and information about the Chesapeake Bay and tidal tributary Phase 6 model development process, all to assist stakeholders engaged in implementing TMDLs and restoring their waters. Maryland's TMDL Data Center is accessible at: http://mde.maryland.gov/programs/Water/TMDL/DataCenter/Pages/index.aspx.

B.2.5 Functional Stream Assessment for Stream Restoration Projects in Maryland

Due to increases in proposals to restore or enhance streams and wetlands to meet watershed restoration objectives in the Chesapeake and Coastal Bays, MDE had a need to improve assessment methodologies for assessing both adverse impacts and benefits of restoration projects when the projects are proposed in regulated resources.

To meet this need, MDE's Wetlands and Waterways Program entered into an interagency agreement with the U.S. Fish and Wildlife Service to adapt its functional pyramid approach to stream restoration specifically for Maryland. Detailed and rapid assessments and a restoration process were developed, as well as specific checklists for different types of stream restoration practices. These practices include natural channel design, valley restoration, regenerative stormwater conveyance, and analytical design approaches. The project was field tested, revised and completed in 2016. The final guidance documents may be found at: http://www.fws.gov/chesapeakebay/stream/protocols.html.

B.2.6 Drinking Water Source Protection

MDE Water Supply Program (WSP) is responsible for the implementation of the Safe Drinking Water Act (SDWA). In Maryland, the CWA and the SDWA are aligned very closely under the one water concept promoting a holistic approach toward protection, usage and management of the State water resources. Ensuring safe drinking water supplies for Maryland's citizens is one of the primary responsibilities of the WSP. This Program oversees numerous activities to make sure public water systems that serve about 84% of Marylanders provide safe and adequate supply of drinking water. Having safe and reliable drinking water sources, whether it is from a surface water or groundwater, is of paramount importance. Therefore protecting the drinking water sources in concert with the CWA activities is an integral function of this Administration. In addition, to protect the sustainability of the State water resources for present and future generations, the Program administers the Water Withdrawal Appropriation and Use Permitting Program.

MDE Water Supply Program promotes and encourages local governments and water suppliers to utilize tools at their disposal to protect the watershed areas contributing to their surface water supplies and wellhead protection areas providing recharge to their groundwater suppliers. Local governments have adopted ordinances to enact performance standards to protect water resources, and have adopted development review procedures and restricted development through special overlay zoning ordinances in sensitive watershed and wellhead protection areas. Completed source water assessments for Maryland's public water systems document the most significant risks and vulnerabilities of water supply sources to different sources and classes of contaminants. For more information on MDE's Source Protection efforts please see: http://mde.maryland.gov/programs/Water/water_supply/Source_Water_Assessment_Program/Pages/index.aspx.

The Water Supply Programs Water Appropriation and Use Permitting Program ensures the sustainability of the State's water resources for current and future Marylanders. Maryland law requires that water users do not unreasonably impact the State's water resources or other users of the resources. The Water Supply Program implements testing and evaluation procedures to ensure that the potential impacts from a proposed use is well understood, and that an appropriate permit decision can be made. Permits include conditions to protect the States water resources and may include special conditions for protecting other users or downstream aquatic life. Such conditions include requirements for withdrawals to cease when low flows are reached in a water body, release minimum flows behind impoundments or design screen intakes to minimize adverse impacts on aquatic life. Groundwater permits may contain conditions for a permittee to monitor water levels, or be financially responsible for replacing or upgrading nearby water supplies that are or are likely to be adversely impacted by a withdrawal. More information on Water Appropriation and Use Permits may be found at http://mde.maryland.gov/programs/Water/water_supply/Pages/WaterAppropriationsOrUsePermits.aspx.

The Water Supply Program is actively involved in the activities of the Susquehanna River Basin Commission (SRBC) and the Interstate Commission for the Potomac River Basin (ICPRB). As a Commission member the MDE works to ensure that these valuable water resources are managed and protected for the best interests of Maryland's citizens. Both Commissions are actively involved in facilitating the protection of drinking water sources in the basins and carry out planning functions to ensure that the cumulative impact of water uses throughout the basins are properly accounted for and managed. These partnerships have fostered interstate cooperation for the improvement of water quality and managing water supply sources.

More information on Maryland's Water Supply Programs can be found at http://mde.maryland.gov/programs/water/water_supply/Pages/index.aspx.

B.2.7 Corsica River Targeted Watershed

The Corsica River Watershed Project is a long-standing dedicated program designed to demonstrate that a tidal tributary of Chesapeake Bay can be successfully restored with a highly focused watershed restoration effort. This project was initiated in 2005 after both a TMDL (2000) and Watershed Restoration Action Strategy had been developed for the watershed. Using a variety of funding mechanisms and restoration practices, great strides have been made in reducing the estimated loads of nitrogen, phosphorus, and sediments coming from both point and nonpoint sources in the watershed. Partners to the Corsica River Targeted Program include the Maryland Department of Natural Resources, Maryland Department of the Environment, Queen Anne's County Soil Conservation District, the Town of Centreville, Queen Anne's County, and the Corsica River Conservancy.

Even with expected lag times between restoration practice installation and water quality effects, the State has documented decreasing trends of in-stream nitrogen and phosphorus concentrations in the nontidal tributaries of the Three Bridges Branch and Gravel Run subwatersheds. In addition, groundwater monitoring conducted on crop fields also appear to indicate that cover crop planting may be reducing nutrient loadings. Monitoring and analysis will be ongoing as restoration efforts continue to be targeted to this watershed with the end goal of demonstrating water quality standards support. More detailed progress information on this project can be found in the 2005-2011 Progress report at:

http://mde.maryland.gov/programs/Water/319NonPointSource/Documents/Corsica_report.pdf and the Section 319 Success Story brief: http://mde.maryland.gov/programs/Water/319NonPointSource/Documents/Success%20Stories/md_corsica_success_story.pdf. For other information related to the restoration of the Corsica River please visit: http://www.corsicariverconservancy.org/.

B.2.8 Program Coordination

State agency staff participate in many work groups, committees, task forces, and other forums to coordinate and communicate state efforts with interested stakeholders. Coordination with the Chesapeake Bay Program and participation by state staff in the associated subcommittees and goal implementation teams continues to be a nexus for Maryland's water quality restoration activities. MDE staff also communicate regularly with other state agencies and stakeholders on topics including water quality standards development, water quality monitoring and assessment, TMDL development, and permitting. State staff also participate in groups such as the Maryland Water Monitoring Council, to ensure program coordination with local and federal government agencies, as well as the private sector, academia, non-governmental organizations, and Maryland's citizens.

B.3 Cost/Benefit Assessment

One specific reporting requirement of the Clean Water Act under §305(b), is a cost-benefit analysis of water pollution control efforts to ensure that the benefits of these programs are worth the costs. Economists have defined various ways to measure water quality benefits (e.g., Smith and Desvousges, 1986) and a number of agencies have produced estimates of water quality values based on uses (e.g., flood control value of wetlands – Leschine et al., 1997) or specific activities (e.g., recreational fishing - US Fish and Wildlife Service, 1998). Data for these efforts are often difficult to obtain, the results are complex or often address only a single use, and comparability between states or regions can be impossible. There are increasing efforts, lead primarily by the academic community, to establish ecosystem service values for a variety of attributes provided by natural areas and waters. However, it is difficult at this time to apply values broadly across a range of regional and jurisdictional boundaries.

B.3.1 Program Costs

A substantial level of federal funding for water pollution control efforts comes from some agencies (US Environmental Protection Agency) while funding for aquatic resource protection and restoration may be substantially provided by other federal agencies (e.g., US Fish and Wildlife Service). Funds usually are transferred to states through a variety of appropriations – for example, certain provisions of the federal Water Pollution Control Act and its amendments provide for grants to states, including Sections 104(b) (NPDES), 106 (surface and ground water monitoring and permitting), 117 (Chesapeake Bay Program), 319 (nonpoint source pollution control), and 604(b) (water quality planning). These funds often provide seed money or low-interest loans that must be matched by state or local funds or documented in-kind efforts used on the project. A summary of federal water quality/aquatic resource-related grants to state agencies is shown in Figure 5.

While some new water programs are occasionally initiated, over the last 13 years, there has been a general decline of federal funding available to states for various water quality-related programs. That being said, more recently, small increases in Section 106, 319 and Public Water Supply funding sources have led to an increase in water program funding since 2013. The figure below shows a summary of EPA budget data from traditional water grants (Clean Water Act §106, §319, §104b planning, wetlands, targeted watersheds, public water supply, and beach monitoring).

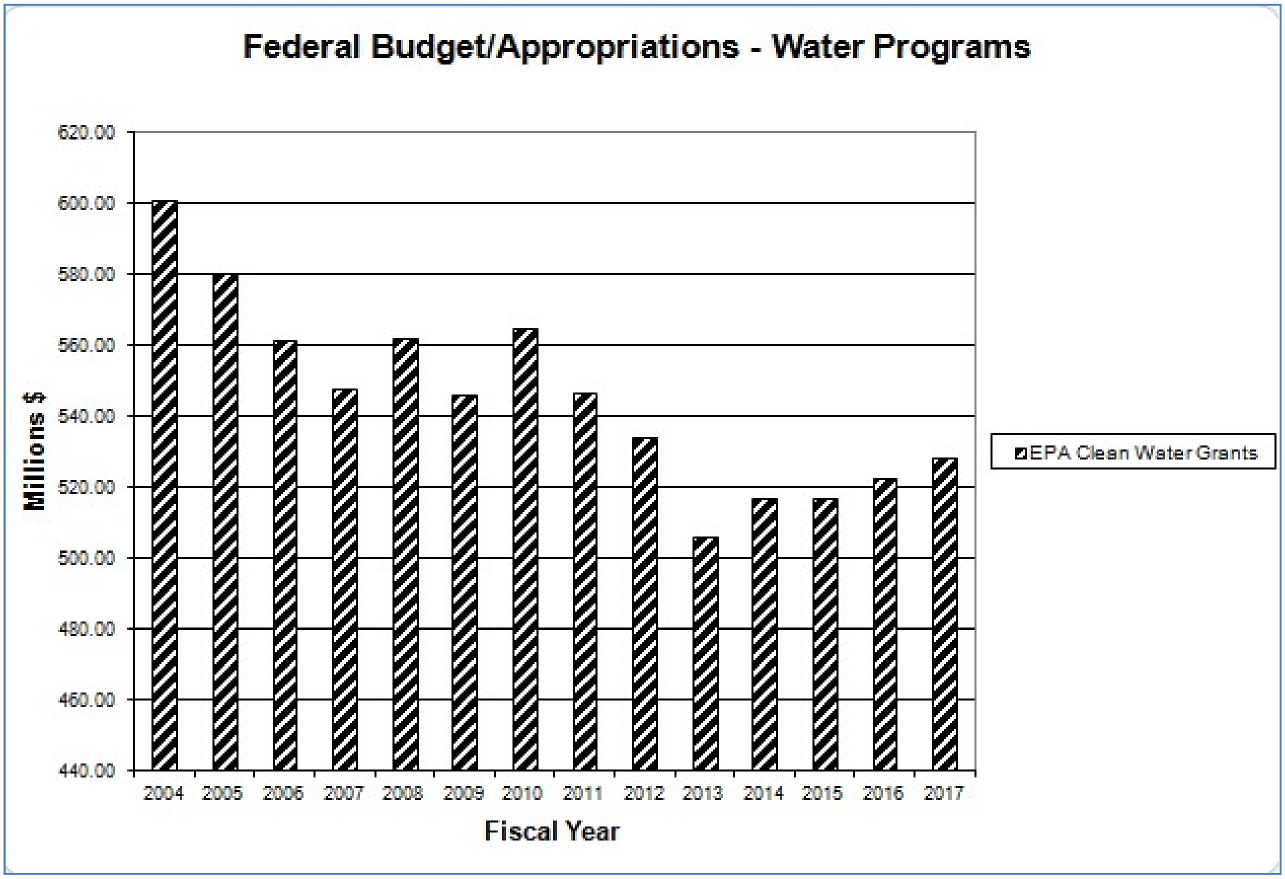

Figure 5: Federal Budget Appropriations to Water Programs (2004-2017). (Source: Association of Clean Water Administrators (ACWA) President's FY2018 Budget Request Funding Chart, Updated 5-23-17)

Although the changes may appear gradual, the loss for state programs is increased when programs that require matching funds are reduced. An example of the impact of national funding variance in §319 funding appropriation and what Maryland received is shown in Figure 6.

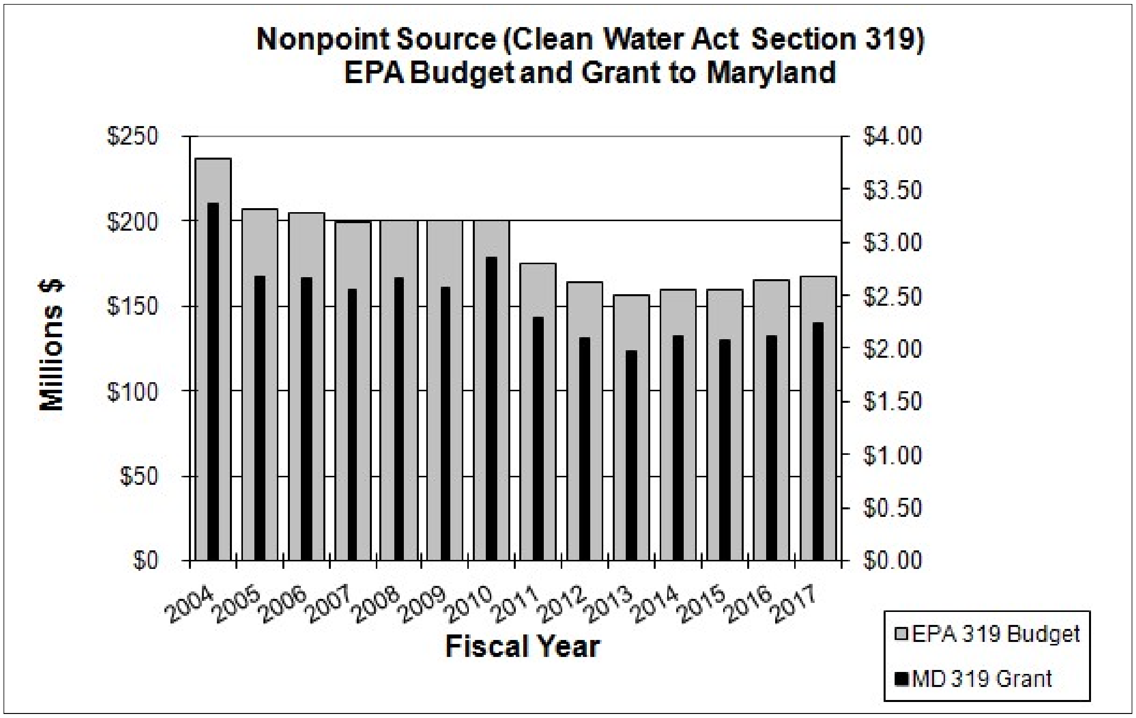

Figure 6: Federal nonpoint source total budget allocation including the Maryland totals. (Sources: Association of Clean Water Administrators FY2017 Report and MDE's 319 Annual Report)

As the federal funding for water programs vary and program costs increase annually, maintenance of nearly every water program activity requires either an increased share from state/local budgets or reductions in program function.

B.3.2 Program Benefits

Clean water offers many valuable uses to individuals and communities as direct and indirect economic benefits. Beautiful beaches, whitewater rivers, and calm, cool lakes add to aesthetic appeal and contribute to a recreation and tourism industry. A plentiful supply and good quality drinking water encourages economic growth and development, increased property values, and water-based recreational opportunities and commerce. But while environmental quality ranks high in the public's perception of livable communities, an economic valuation of each of these benefits is difficult to develop.

Most often, economic benefits are determined for single uses (e.g., fishing). For example, approximately 347,000 Maryland residents are anglers (about one in 17) and residents comprise more than 81 percent of the State's anglers. In 2011, these anglers spent $535 million in the State on fishing expenses - an average of $1,212 per angler per year. Most of these expenses (62 percent) were equipment-related which included things like fishing equipment, clothing, boats, tents, etc. Trip-related costs (food, lodging, transportation, equipment rental) accounted for another large portion (37 percent) and other items (membership dues, magazines, permits, stamps and leases) amounted to $7 million (1%) (US Fish and Wildlife Service, 2013).

B.3.3 Summary

Water pollution control efforts are very costly. Much of the federal funds provided to the State and cost-shared with additional state and local funds are used to implement local pollution control and/or restoration programs. On an annual basis, the funds available are but a fraction of the estimated cost.

EPA needs to clearly define meaningful and comparable cost/benefit information that would enable states to assess the value of implementing directives of the Clean Water Act. A pilot state or regional program or a national study with recognized economists and federal and state participation could help simplify the complexities of this economic analysis.

B.4 Special State Concerns and Recommendations

The Chesapeake Bay continues to be a major focal point for water quality planning and restoration efforts across the State. Since the Chesapeake Bay TMDL was finalized in December 2010, states have completed Phase I and Phase II Watershed Implementation Plans (WIP) which allocate the nutrient and sediment reductions necessary to support the water quality goals for the Chesapeake Bay and tidal tributaries. States are currently developing Phase III WIPs in light of the recently released Midpoint Assessment which provides information on states' progress in meeting their sector-specific nutrient and sediment targets by 2017. Maryland continues to measure progress in achieving the two-year milestones that serve as interim goals to help track Maryland's progress in restoring the Bay. EPA's most recent evaluation of Maryland's milestone progress states that Maryland met its 2017 targets for phosphorus and sediment load reductions but did not meet its 2017 milestone for nitrogen reduction. According to source sector, all sectors with the exception of urban/suburban stormwater met phosphorus and sediment targets. On the other hand, the agriculture, urban/suburban stormwater, and septic sectors did not meet their respective nitrogen targets for 2017. Maryland will need to continue to leverage important funding vehicles such as the Bay Restoration Fund, the Chesapeake Bay and Atlantic Coastal Bays Trust Fund, and others to make future progress and ensure that the state keeps pace with increasing pressures from development. Additionally, the state will need to kickstart nutrient trading if it hopes to expedite nutrient reduction efforts from non-regulated sectors and offset new loads from development.

Another one of Maryland's major water quality concerns centers around the Conowingo Dam on the Susquehanna River. The Dam, owned and operated by Exelon Corporation as a hydroelectric facility, impounds roughly 3,039 acres of water in Maryland's portion of the Susquehanna River. In so doing, the dam alters the transport and dynamics of pollutants and drastically modifies the flow regime of the river. For years, the Dam has functioned as a sediment trap for sediments and associated nutrients coming down the Susquehanna River. However, after years of accumulation upstream of the dam, the level of sediments has reached a state of dynamic equilibrium and during major storm events, these sediments and nutrients are no longer reliably trapped. Recent Chesapeake Bay modeling efforts have also shown that this build-up of sediments poses a major threat to Chesapeake Bay restoration efforts and that without addressing the additional load due to the lack of trapping, the Bay partnership will not be able to meet its water quality standards for the long term. In addition, recent data collected by the Department has demonstrated exceedances of the chlorophyll a criteria in the Conowingo Reservoir, indicating that excess total phosphorus levels have accumulated in the Reservoir along with the sediment. Anecdotal reports from local citizens, recreational users, and other state agency staff have also indicated potential issues with excessive debris collecting upstream of the Dam and being distributed downstream in the upper Chesapeake Bay during high flow events. And finally, a variety of information has recently come to light which details the biological impacts of the current flow regime as it is managed by Exelon. The current Federal Energy Regulatory Commission (FERC) and MDE's Clean Water Act Section 401 Water Quality Certification[3] processes provide a critical juncture at which these issues should be addressed.

Ongoing concerns related to climate change and the increasing utility of continuous water temperature loggers has led to greater consideration of the thermal impacts on Maryland's coldwater resources. As such, there has been a renewed emphasis to identify streams with coldwater obligate species and to

[3] The Department issued a Section 401 Water Quality Certification for Conowingo Dam Hydroelectric Project on April 27, 2018.

protect these unique resources and the water quality that supports them. Additionally, on the 2014 Integrated Report, Maryland first assessed and listed Class III (coldwater) streams as thermally impaired (Category 5 – impaired, TMDL needed) recognizing the widespread presence of sources of thermal pollution. Since that time, the Department has been actively developing temperature modeling methods for use in future TMDL development. The Department has also been working with stakeholders during this time to take a closer look at the existing thermal water quality protections and ideas for improving these protections. Together, these modeling efforts and the regulatory research will need to be a high priority to ensure that Maryland's remaining cold and cool water resources can be maintained and protected well into the future.

The salinization of state fresh waters due to road salt application continues to be a major challenge facing the State. Spikes in stream conductivity and declining aquatic biological communities have been strongly linked to increasing chloride levels throughout the State. Maryland now has 28 non-tidal watersheds listed as impaired for chlorides. In addition, data collected from tributaries to drinking water reservoirs also show upward trends for chloride levels, creating concern for the health of consumers and concerns regarding the longevity of drinking water infrastructure (due to increased corrosivity). Other impacts from excessive road salt use have been reports of corroding bridge infrastructure, adding additional considerations to questions surrounding public health. In response to some of these concerns, MDE has analyzed the toxicity of chlorides to aquatic life and conducted an intensive water quality study of chloride levels in several watersheds in Maryland. In addition, the Department has also been working with the State's largest jurisdictions, including State Highway Administration, in developing road salt management strategies as part of the next round of Municipal Separate Storm Sewer System (MS4) permits. This issue will require ongoing study and adaptation as the State determines the most effective ways to reduce the side effects of road salt usage.

For several years, the prospect of allowing hydraulic fracturing in the Marcellus Shale formation in Western Maryland loomed over legislators and state regulators. After much deliberation and study, the Maryland General Assembly and Governor Hogan decided that the risks to human health and the environment outweighed the potential economic benefits that might occur from allowing hydraulic fracturing in the State. Therefore, the General Assembly and Governor Hogan signed House Bill 1325 into law, effectively banning the practice within Maryland. This forward-thinking legislation undoubtedly prevented a number of environmental impacts associated with the process of hydraulic fracturing.

Maryland continues to meet its commitments to EPA and other stakeholders in developing Total Maximum Daily Loads for restoring impaired waters. However, Maryland will also have to look for innovative ways, such as straight-to-implementation approaches and water quality trading, in order to ramp up restoration efforts. Funding constraints and unsustainable growth patterns continue to be the limiting factors for making restoration progress. The State's adoption of environmental site design practices and the focus on cost-efficiencies will help to address these limiting factors. Meanwhile, more sustainable development patterns, consistent with Smart Growth, will be needed if the State expects to reduce losses of open space and preserve water quality for future generations. To protect water quality, the State must continue to implement its antidegradation policy for both Tier I and Tier II (high quality) waters as well as develop clarifying guidance consistent with both water quality goals and the State's Smart Growth Initiative. To do this effectively, Maryland will have to continue to coordinate closely with local jurisdictions and the public and be willing to face any associated legal challenges.

PART C: SURFACE WATER MONITORING AND ASSESSMENT

C.1 Monitoring Program

In December 2009, Maryland completed the last update of its comprehensive water monitoring strategy http://mde.maryland.gov/programs/Water/TMDL/MD-AWQMS/Documents/Maryland_Monitoring_Strategy2009.pdf. Maryland's water quality monitoring programs are designed to support State Water Quality Standards (Code of Maryland Regulations Title 26, Subtitle 08) for the protection of both human health and aquatic life. This strategy identifies the programs, processes and procedures that have been institutionalized to ensure state monitoring activities continue to meet defined programmatic goals and objectives. The strategy also discusses data management and quality assurance/quality control procedures implemented across the State to preserve data integrity and guarantee that data are of sufficient quality and quantity to meet the intended use. Finally, this document serves as a road map for assigning monitoring priorities and addressing gaps in current monitoring programs. It has proven to be especially useful as declining monitoring budgets have increased the need for greater monitoring efficiency.

C.2 Assessment Methodologies Overview

Starting in 2002, Maryland developed and solicited public review of the assessment methodologies used to document the State's assessment of its water quality standards (WQS) and which establish objective and statistically based approaches for determining water body impairment. These methodologies are designed to provide consistency and transparency in Integrated Reporting so that the public and other interested stakeholders understand how assessment decisions are made and can independently verify listing decisions. The assessment methodologies are living documents that can be revised as new statistical approaches, technologies, or other improved methods are identified. For the 2018 reporting cycle, no changes were made to any of Maryland's assessment methodologies. All of Maryland's current assessment methodologies are available on MDE's website at: http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/ir_listing_methodologies.aspx. The public is invited to review and comment on any of these methodologies during the public review period for the Integrated Report. Comments should be submitted in writing to Becky Monahan at becky.monahan@maryland.gov.

C.3 Assessment Results

Maryland assesses state waters using data generated by both long-term ongoing monitoring programs as well as short-term targeted monitoring efforts. These monitoring programs predominantly sample three water body types (flowing waters, impoundments, and estuarine waters) found throughout Maryland and collect water quality samples for both conventional and toxic pollutants. Although many assessments are still based on data collected by state agencies, the Department continues to make greater use of data collected by Federal agencies, County governments, utility managers, and nongovernmental organizations (NGO). Using datasets from such organizations can help to fill data gaps and create valuable partnerships for meeting clean water goals. The following sections provide assessment summaries for the whole state as well as for particular water body types found throughout Maryland.

C.3.1 Assessment Summary

The following table summarizes the water quality status of all of Maryland's waters. It should be noted that it represents a conservative estimate for the size of waters assigned to each Category, defaulting to the Categories that symbolize impairment (4a, 4b, 4c, or 5) when a single water body has been assessed for multiple pollutants and is impaired for at least one. The reader is cautioned against using these numbers to track statewide water quality progress with reports published prior to 2012. Beginning with the 2012 IR, Maryland used the 1:24,000 scale National Hydrography Dataset (NHD) to calculate water body sizes.[4] In contrast, the water body sizes used for the 2008 and 2010 IR cycles were calculated using the 1:100,000 scale NHD coverage. This, by itself, causes discrepancies in the total stream miles, estuarine square mileage, and impoundment acreage represented. In addition, in some cases, the water body size reported in Category 1 or 2 (unimpaired status) can increase or decrease cycle to cycle simply because assessments were corrected or made with better data and instrumentation. Other useful water quality tracking information can be found at the Department's webpage describing Maryland's Two Year Milestones for Chesapeake Bay restoration (http://mde.maryland.gov/programs/Water/TMDL/TMDLImplementation/Pages/milestones.aspx) which describes the State's progress towards meeting the Chesapeake Bay TMDLs.

Table 6: Size of Surface Waters Assigned to Reporting Categories.

Waterbody Type	Category							Total in State	Total Assessed
	1	2	3	4a	4b	4c	5		
River/stream miles	0	6523.33	2274.29	4611.04	0	0	5726.65	19,185.29	16,861.02
Lake/pond acres	0	1201.83	729.39	13408.17	0	0	4684.43	21,876.08	19,294.43
Estuarine square miles	0	0	47.69	894.85	0	0	1508.60	2,451.18	2,403.49
Ocean square miles	0	0	107.39	0	0	0	0	107.39	0.00
Freshwater wetland	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tidal wetland acres	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

*Maryland utilizes a multi-category report structure for the IR which can potentially report a single water body in multiple listing categories. For the purposes of this table, water body sizes were not double-counted. If a water body was listed in Category 5 for one pollutant and Category 2 for another, the water body size was assigned to Category 5 to represent a worst-

[4] Although converting to the 1:24,000 scale NHD made it harder to track progress between IR cycles, the benefits of a higher resolution stream scale enable greater mapping capabilities and increased geographic precision.

case scenario. In the case where a water body was listed in Categories 4a, 4b, and 4c for different pollutants, the water body size defaulted to Category 4a.

C.3.1.1 New Impairment Listings

There are 42 additions to the list of Category 5 (impaired, TMDL needed) waters in 2018. Six of the new Category 5 listings resulted from MDE's Biological Stressor Identification Analyses. The purpose of these analyses, as discussed in the Biological Assessment Methodology for Non-tidal Streams, is to identify the probable pollutants that are responsible for impairing watershed biological integrity. Of these six new 'biostressor' listings, three are for total suspended solids, two are for sulfates, and one is for chlorides. In addition, there are thirty new temperature listings, four new fecal coliform listings in shellfish harvesting waters, one new listing for PCBs in fish tissue, and one new listing for phosphorus. The table below provides more detailed information regarding these new listings.

Table 7: New Category 5 (impaired, may need a TMDL) Listings on the 2018 Integrated Report.

Assessment Unit ID	Basin Name	Water Type Detail	Designated Use	Pollutant
MD-021202030344-Basin_Run2	Octoraro Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-02120204-Conowingo_Reservoir	Conowingo Dam Susquehanna River	Impoundments	Public Water Supply	Phosphorus, Total
MD-021202050340-Deep_Run	Broad Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021308050302-Baisman_Run	Loch Raven Reservoir	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021308050309-Little_Falls	Loch Raven Reservoir	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309041036-DippingPond_Run	Jones Falls	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309041036-NBranchJones_Falls	Jones Falls	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309071050-Joe_Branch	Liberty Reservoir	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309071057-Beaver_Run	Liberty Reservoir	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081025-Gillis_Falls1	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081025-SBranchPatapsco_River1	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081028-SBranchPatapsco_River2	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081029-Middle_Run	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081030-Gillis_Falls2	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021309081031-Gillis_Falls3	South Branch Patapsco River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-02131107	Rocky Gorge Dam	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)
MD-02140201	Potomac River Upper tidal	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)

MD-02140201	Potomac River Upper tidal	1st thru 4th order streams	Aquatic Life and Wildlife	Sulfate
MD-02140201	Potomac River Upper tidal	1st thru 4th order streams	Aquatic Life and Wildlife	Chloride
MD-02140301-Wadeable_Streams	Potomac River Frederick County	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)
MD-02140301-Wadeable_Streams	Potomac River Frederick County	1st thru 4th order streams	Aquatic Life and Wildlife	Sulfate
MD-021403030244-Buzzard_Branch	Upper Monocacy River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021403030251-BigHunting_Creek1	Upper Monocacy River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021403030251-BigHunting_Creek2	Upper Monocacy River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021403030251-High_Run	Upper Monocacy River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021405020201-UTLittleAntietam_Creek	Antietam Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021405120129-UTTown_Creek	Town Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021405120132-Murley_Branch	Town Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021410010055-Mill_Run	Lower North Branch Potomac River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021410020104-UTEvitts_Creek2	Evitts Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021410030098-UTJennings_Run1	Wills Creek	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021410060077-Dry_Run	Savage River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-021410060081-Savage_River1	Savage River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-050202010013-Ginseng_Run	Youghiogheny River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-050202010016-Bear_Creek3	Youghiogheny River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-050202030028-MeadowMountain_Run	Deep Creek Lake	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-050202040036-Red_Run	Casselman River	Non-tidal Segment(s)	Aquatic Life and Wildlife	Temperature
MD-BIGMH-BigAnnemessex_River	BIGMH - Big Annemessex River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-CHOMH1-Cummings_Creek-2	Lower Choptank River	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-CHSOH-02130509	Middle Chester River	Tidal subsegment	Fishing	PCBs in Fish Tissue
MD-POTMH-Breton_Bay	POTMH - Lower Potomac River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform
MD-POTMH-Herring_Creek	POTMH - Lower Potomac River Mesohaline	Tidal Shellfish Area	Shellfishing	Fecal Coliform

It should be noted that the thirty temperature listings were moved from category 3 (insufficient information) to category 5 (impaired, TMDL needed) after the public comment period. These temperature listings were originally placed in category 3 (insufficient information) because although the segments exceeded Class III (or III-P) water temperature criteria, coldwater obligate taxa were documented at these same locations. The rationale, at the time, was that the presence of coldwater obligate biota potentially demonstrated that coldwater refugia still existed in these segments and that more data was needed to either confirm temperature impairment or confirm that stream temperatures were met. However, based on comments submitted during the public review and re-examination by the Department, it was determined that the policy of independent applicability should be applied. In this case, assessing the temperature and biological data (i.e., data on the presence of coldwater obligate taxa) independently required the Department to list these stream segments as impaired in Category 5.

It should also be noted that the new Category 5 listing for fecal coliform in Cummings Creek is one that was created by the splitting of the Cummings Creek assessment unit (MD-CHOMH1-Cummings_Creek) found in the 2016 IR. New data, available for the 2018 IR, demonstrated that a portion of Cummings Creek now exceeds bacterial water quality criteria for shellfish harvesting waters. As a result, the assessment record for the original water body-pollutant combination was split so as to characterize the change in impairment status at the appropriate spatial extent. The table below describes the listing Category changes and assessment record split that occurred in the case of Cummings Creek.

Table 8: Crosswalk table showing how the original assessment unit for Cummings Creek was split to reflect the latest assessment information.

Former (2016) Assessment Unit ID	Basin Code	Designated Use	Pollutant	2016 Category	New (2018) Split Assessment Unit ID	2018 Category	Rationale
MD-CHOMH1-Cummings_Creek	02130403	Shellfish	Fecal Coliform	2	MD-CHOMH1-Cummings_Creek-1	2	This portion of Cummings Creek is meeting the shellfish harvesting criteria. Cummings_Creek-2 (station 0808050) was separated because this station was failing to meet the shellfish harvesting criteria.
					MD-CHOMH1-Cummings_Creek-2	5	This portion of the previous fecal coliform listing for Cummings_Creek was separated because this station is failing to meet the shellfish harvesting criteria. The other portion of Cummings Creek is meeting the shellfish harvesting criteria.

There are also 3 assessment records which were placed directly in Category 4c (impaired, TMDL not needed as impairment is not caused by a pollutant) in the 2018 IR without first being listed as impaired in Category 5 (impaired, TMDL needed). Two of these assessment records resulted from separate Biological Stressor Identification analyses that identified channelization of streams and the lack of a riparian buffer as major stressors impacting biological communities in the Potomac River Upper (basin code: 02140201) and Potomac River Frederick County (basin code: 02140301) watersheds, respectively. The third assessment record placed directly in Category 4c was the assessment of the Lower Susquehanna River (the portion immediately below the Conowingo Dam down to head of tide) for an impairment due to flow alteration that causes drastic changes in water depth and flow velocity with concomitant impacts to aquatic-dependent life downstream. This unique assessment and listing is described in more detail in Part G.2 of this report.

Table 9: Listings that were put directly in a Category 4 impairment status without being previously listed in Category 5.

Assessment Unit ID	Basin Name	Basin Code	Water Type	Designated Use	Listing Category	Pollution	Notes
MD-02140201	Potomac River Upper	02140201	RIVER	Aquatic Life and Wildlife	4c	Channelization	The Biostressor analysis indicated that stream channelization due to urban development is a major stressor affecting biological integrity in this watershed. This listing replaces the biological listing.
MD-02140301-Wadeable_Streams	Potomac River Frederick County	02140301	RIVER	Aquatic Life and Wildlife	4c	Lack of Riparian Buffer	The Biostressor analysis indicates that the lack of an adequate riparian buffer is a major stressor affecting biological integrity in this watershed. This listing, along with others, replaces the biological listing.
MD-02120201-Lower_Susquehanna_Mainstem	Lower Susquehanna River	02120201	RIVER	Aquatic Life and Wildlife	4c	Flow Alteration - Changes in Depth and Flow Velocity	Assessment of flow regime and biological impacts demonstrate that Conowingo Dam operations cause impairment of the aquatic life and wildlife designated use.

C.3.1.2 Impairment Listings Reassessed as Not-impaired

There were a total of eleven waterbody-pollutant combinations removed[5] from Category 5 in 2018 (Table 10). Four of these were generic biological listings (cause unknown) that did not specify a particular pollutant or stressor as the cause of impairment. These listings have now been replaced by specific pollutant/stressor listings enumerated by the Biological Stressor Identification analyses (Table 25). Another three (of the 11) listings, originally listed as impaired for exceedances above the pH criteria (i.e. > 8.5 pH units), were removed from Category 5 because new data showed that water quality standards were being met. The last four listings removed from Category 5 included two for fecal coliform in shellfish harvesting areas, one for mercury in fish tissue, and one for PCBs in fish tissue. All of these four listings were moved to Category 2 on the basis of more recent data that demonstrated water quality that met the applicable criterion or threshold.

[5] The number eleven does not include partial delistings (Table 13), listings that were addressed by a TMDL (moved to Category 4a, Table 29), or listings that were in Categories 4a, 4b, or 4c but which are now meeting standards (Table 12).

Table 10: New Delistings for 2018 (removed from Category 5). Please note that this table does not include waterbody-pollutant combinations for which a TMDL was established, i.e., listings that changed from Category 5 to Category 4a.

ID	Assessment Unit ID	Basin Name	Basin Code	Water Type	Designated Use	Pollutant	Summary Rationale
2301	MD-02140202-Mainstem_segment	Potomac River Montgomery County	02140202	RIVER	Aquatic Life and Wildlife	pH, High	1
765	MD-02140501-Dam3-4	Potomac River Washington County	02140501	RIVER	Fishing	Mercury in Fish Tissue	1
2300	MD-02140501-Mainstem_segment	Potomac River Washington County	02140501	RIVER	Aquatic Life and Wildlife	pH, High	1
2338	MD-02140508-Mainstem2	Potomac River Allegany County	02140508	RIVER	Aquatic Life and Wildlife	pH, High	1
2025	MD-POTMH-02140104	Breton Bay	02140104	ESTUARY	Fishing	PCB in Fish Tissue	1
2583	MD-TANMH-Big_Thorofare	TANMH - Tangier Sound Mesohaline	02139998	ESTUARY	Shellfishing	Fecal Coliform	1
2069	MD-WICMH-Wicomico_River-2**	WICMH - Wicomico River Mesohaline	02130301	ESTUARY	Shellfishing	Fecal Coliform	1
169	MD-02140301-Wadeable_Streams	Potomac River Frederick County	02140301	RIVER	Aquatic Life and Wildlife	Cause Unknown	5
419	MD-02141004*	Georges Creek	02141004	RIVER	Aquatic Life and Wildlife	Cause Unknown	5
1446	MD-02140201	Potomac River Upper tidal	02140201	RIVER	Aquatic Life and Wildlife	Cause Unknown	5
1607	MD-02131107	Rocky Gorge Dam	02131107	RIVER	Aquatic Life and Wildlife	Cause Unknown	5

*This assessment record should have been removed from Category 5 in a prior Integrated Report (2014) when it was replaced by specific pollutant listings. Its removal on this IR corrects this oversight.

**A TMDL revision was approved during the 2018 IR cycle to extend the TMDL coverage to include this additional impaired portion, but the listing was simultaneously moved to category 2 (from category 5 in 2016) since it is now meeting water quality standards.

Table 11: Key for the last column in Table 10.

Summary Rationale for Delisting of Segment/Pollutant Combinations	Explanation
1	State determines water quality standard is being met
2	Flaws in original listing
3	Other point source or nonpoint source controls are expected to meet water quality standards
4	Impairment due to non-pollutant
5	Original listing was based on a bioassessment, specific pollutants are now identified in place of biological listing

Another subset of assessment records that are now no longer considered impaired include seven that were previously (2016) in Category 4a (impaired, TMDL completed) but have since been moved to Category 2 (meeting some standards). Four of these assessment records were tidal tributaries to the Chesapeake Bay that now meet the submerged aquatic vegetation (SAV)/water clarity criteria. The other three assessment records all relate to streams in the Casselman River watershed (Garrett County) where the Department recently (2013) implemented acid mine remediation projects. In all three cases, at Alexander, Spiker, and Tarkiln Run, the Department measured stream pH after the remediation project for a minimum of 3 years and found these streams to be consistently meeting Maryland's pH criteria range of 6.5 – 8.5. Management of these streams will be ongoing to ensure that they continue to meet pH criteria moving forward.

Table 12: Whole Listings that moved from Category 4a (impaired, TMDL complete) to Category 2 (meeting some standards).

Assessment Unit ID	Basin Name	Basin Code	Water Type	Designated Use	Pollutant	Notes
MD-050202040032-Alexander_Run	Casselman River	05020204	RIVER	Aquatic Life and Wildlife	pH, Low	Restoration activities implemented by MDE have brought this segment back into attainment with pH water quality criteria.
MD-050202040032-Tarkiln_Run	Casselman River	05020204	RIVER	Aquatic Life and Wildlife	pH, Low	Restoration activities implemented by MDE have brought this segment back into attainment with pH water quality criteria.
MD-050202040034-Spiker_Run	Casselman River	05020204	RIVER	Aquatic Life and Wildlife	pH, Low	Restoration activities implemented by MDE brought this segment back into attainment with pH water quality criteria.

Assessment Unit ID	Basin Name	Basin Code	Water Type	Designated Use	Pollutant	Notes
MD-CHSOH-SWSAV	CHSOH - Middle Chester River Oligohaline	02130505, 02130508, 02130509	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	This segment meets the SAV restoration goal and was thus moved to Category 2.
MD-HNGMH-SWSAV	HNGMH - Honga River Mesohaline	02130401	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	This segment meets the SAV restoration goal and was thus moved to Category 2.
MD-MIDOH-SWSAV	MIDOH - Middle River Oligohaline	02130801, 02130807	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	This segment meets the SAV restoration goal and was thus moved to Category 2.
MD-POTOH2-SWSAV	POTOH2 - Port Tobacco River Oligohaline	02140109	ESTUARY	Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory	Total Suspended Solids (TSS)	This segment meets the SAV restoration goal and was thus moved to Category 2.

There were also three partial removals of Category 4a impairment (TMDL completed) listings on the 2018 IR. A partial Category 4a removal can occur in cases where an assessment unit that was previously entirely listed as impaired (with a TMDL established) had new data collected that demonstrated use support in some smaller geographic portion. In order to reflect this new information and the fact that a portion of the original water segment now meets standards, MDE may split the original assessment unit into two assessment units, one which is still impaired and another that is not. Table 13 below shows the three instances in 2018 where this occurred. All of these partial removals resulted from shellfish harvesting areas that were previously assessed as impaired (and had a TMDL completed) and which subsequently had new data which demonstrated that a portion of the water body was now meeting water quality criteria. These partial Category 4a delistings were not counted as part of the 11 total Category 5 delistings since they did not have any effect on the total number of Category 5 listings. However, the impact of these partial Category 4a removals is reflected in the summary numbers (e.g. Tables 14, 22, etc) that describe the size of waters impaired for various pollutants

Table 13: Crosswalk table showing the Partial Category 4a Removals of in 2018 (Category 4a to Category 2)

Former (2016) Assessment Unit ID	Basin Code	Designated Use	Pollutant	Category	New (2018) Split Assessment Unit ID	2018 Category	Rationale
MD-WICMH-Wicomico_River	02130301	Shellfishing	Fecal Coliform	4a	MD-WICMH-Wicomico_River	4a	This area of the Wicomico River is still exceeding the shellfish harvesting area criteria.
					MD-WICMH-Wicomico_River-4	2	Recent data shows that the shellfish harvesting criteria are being met in the middle portion of the Wicomico River.
MD-EASMH-WYE_RIVER-2	02130503	Shellfishing	Fecal Coliform	4a	MD-EASMH-WYE_RIVER-2	4a	This shellfish harvesting area was split in the 2016 IR because three stations are now meeting the shellfish harvesting criteria. This listing record still captures the remaining impaired portion of the Nanticoke River.
					MD-EASMH-WYE_RIVER-3	2	This portion of the previous fecal coliform listing for the Wye River was separated because three stations (0802014, 0802019, and 0802023) are now meeting the criteria. This listing captures the area represented by those three stations.
MD-SOUMH-SELBY_BAY	02131003	Shellfishing	Fecal Coliform	4a	MD-SOUMH-SELBY_BAY-1	4a	This area, assessed by station 0306801, does not meet shellfish harvesting standards. MD-SOUMH-SELBY_BAY-2 was split from this listing since stations 036115 and 0306015 were currently meeting the shellfish harvesting bacteria criteria.
					MD-SOUMH-SELBY_BAY-2	2	This area assessed by stations (0306115 and 0306015) was split out from MD-SOUMH-SELBY_BAY-1 in the 2018 IR since it now supports the shellfish harvesting bacteria standard.

C.3.2 Estuarine Assessments

This section provides assessment results and water quality summaries for Maryland's estuarine systems that include both the Chesapeake and Coastal Bays. The Chesapeake Bay assessments continue to evolve as new criteria and assessment methodologies are implemented and as Maryland utilizes the newer salinity-based segmentation. Comparatively, the Coastal Bays fall behind the Chesapeake in terms of public awareness and resource allocation for monitoring and assessment activities. However, the completion and approval of TMDLs for all of Maryland's Coastal Bays does represent significant progress towards improving water quality. For additional details on Chesapeake Bay assessments, please see https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/2008%20Ambient%20Water%20Criteria.pdf. For additional information on Maryland's Coastal Bays, please visit http://www.mdcoastalbays.org/.

Tables 14 and 15 show the size of estuarine waters assigned to each category for each pollutant. For the 2018 cycle, these numbers were calculated in the same fashion as they were for the 2016 cycle. For nutrient listings, the entire size of a Chesapeake Bay segment was assigned to one category, defaulting to the least desirable category (in this order, 5, 4a, 3, 2, 1). In other words, regardless of the magnitude of impairment for that segment, a segment's whole size will be reported in Category 5 for nutrients (TP or TN) if any percentage of the segment fails to meet the applicable water quality criterion.

Table 14: Square mileage of estuarine waters assigned to categories according to the pollutant assessed.

Size of Estuarine Area (sq. miles) per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
Arsenic		35.43					
BOD, Biochemical oxygen demand				34.26			
Cadmium		85.68					
Chlordane		0.085		36.99			
Chlorpyrifos		48.73					
Chromium		79.00					
Copper		94.83					
Copper* (Point Source)		*3			*1		
Cyanide* (Point Source)					*3		
Debris/Floatables/Trash				0.09			
Estuarine Bioassessments		938.50	213.52				1188.69
Enteroccoccus				0.69			4.27
Fecal coliform		133.21		63.69			14.31
Heptachlor Epoxide							0.09
Lead		87.59					1.30
Mercury in Fish Tissue		324.91	83.12				
Nickel		38.79					
Nickel* (Point Source)		*5					
Nitrogen (Total)			82.30	2368.92			
Oil spill - PAHs		0.30			1.03		

Size of Estuarine Area (sq. miles) per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
PCBs		66.91	83.12	537.89			430.51
Phosphorus (Total)			82.30	2368.90			
Selenium		34.50					
Silver		35.43					
Total Suspended Solids (TSS)**		262.38	94.00	326.58			
Toxics							2.00
Zinc		47.89					16.87

Point* - These listings are remnants of the 304(L) list and were originally listed due to the presence of point sources. Thus these listings have no associated sizes and the values are the number of point sources.
**The total size of areas assessed for TSS do not total the area assessed for the Shallow Water designated use (DU) due to TSS listings for the aquatic life designated uses.

Table 15: Size of Estuarine Waters in Linear Distance per Category According to Pollutant.

Size of Estuarine Linear Distance (shoreline distance in miles) per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
Debris/Floatables/Trash				9.50			
Enterococcus		1.27	0.41	0.22			
Escherichia coli		0.15					
Fecal coliform		0.01					

The table below depicts the status of estuarine waters with respect to different designated uses. Similar to Table 5, the numbers provided for the open water, deep water, and deep channel designated uses are calculated using a binary method. Instead of calculating the percent-area-impaired using data supplied with the dissolved oxygen assessments, Maryland used the 'impaired or not' approach to determine the column in which a water-segment's size should be placed. This approach simplifies the calculations and improves general understanding of the geographic scope of impairment.

Table 16: Designated Use Support Summary for Maryland's Estuarine Waters.

Designated Use		Size of Estuarine Waters (square miles)				
		State Total	Total Assessed	Supporting - Attaining WQ Standards	Not Supporting - Not Attaining WQ Standards	Insufficient Data and Information
Aquatic Life and Wildlife		2,451.2	2,260.3	912.8	1,347.5	190.9
Fishing		2,451.2	986.6	66.9	919.7	1,464.6
Water Contact Recreation	General Recreational Waters	2,451.2	6.4	1.4	5.0	2,444.8
Water Contact Recreation	Public Beaches*	143	143	143	0	0
Shellfish Harvesting		2,136.2	2,136.2	2,056.7	79.5	0
Migratory Spawning and Nursery**		1,338.8	1,256.5	0	1,256.5	82.3
Shallow Water SAV**		667.6	569.1	250.0	319.1	98.5
Open Water**		2,342.3	2,260.0	0	2,260.0	82.3
Deep Water**		1,402.1	1,402.1	0	1,402.1	0
Deep Channel**		1,329.7	1,329.7	0	1,329.7	0

*Public Beach results are reported as the number of beaches, not as surface area or linear extent of water affected.
**Chesapeake Bay specific uses. Note: Areas are based on total segment surface area. Surface area sizes for each specific designated use have not been defined.

Table 17: Size of Estuarine Waters Impaired by Various Sources.

Waterbody Type - Estuary	
Sources	Water Size in Square Miles
Agriculture	471.03
Channel Erosion/Incision from Upstream Hydromodifications	0.09
Contaminated Sediments	318.28
Contribution from Downstream Waters due to Tidal Action	16.06
Discharges from Municipal Separate Storm Sewer Systems (MS4)	30.83
Inappropriate Waste Disposal	9.59
Industrial Point Source Discharge *	*3
Livestock (Grazing or Feeding Operations)	15.74
Manure Runoff	16.82
Municipal Point Source Discharges	42.45
Non-regulated watershed runoff	15.36
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	2.92
Pipeline Breaks	1.03
Source Unknown	2,251.15
Upstream Source	439.59
Upstream/Downstream Source	12.84
Urban Runoff/Storm Sewers	37.11
Wastes from Pets	12.19
Wildlife Other than Waterfowl	0.43

*These listings are remnants of the 304(L) list and were originally listed due to the presence of point sources. Thus these listings have no associated sizes and the values are the number of point sources.

The summary table provided below is submitted for consistency with EPA guidance and to allow for statewide biological condition estimates. Please note that this table is identical to that provided in Maryland's 2014 and 2016 Integrated Reports (IR) as new assessments have not been available since the 2014 IR.

Table 18: Attainment Results for the Chesapeake Bay Calculated Using a Probabilistic Monitoring Design.

Project Name	**Chesapeake Bay Benthic Assessment**
Owner of Data	**Chesapeake Bay Program and Versar Inc.**
Target Population	**Tidal waters of the Chesapeake Bay (reporting only the MD portion)**
Type of Waterbody	**Chesapeake Bay Estuary**
Size of Target Population	**2342.3 (only the MD portion)**
Units of Measurement	**Square Miles**
Designated use	**Aquatic Life**
Percent Attaining	**40.1%**
Percent Not-Attaining	**50.8%**
Percent Nonresponse	**9.1%**
Indicator	**Biology - Estuarine Benthic macroinvertebrate IBI**
Assessment Date	**4/1/2014**
Precision	**unknown**

C.3.2.1 The Coastal Bays

Maryland's Coastal Bays, the shallow lagoons nestled behind Ocean City and Assateague Island, comprise a complex ecosystem. Like many estuaries, Maryland's Coastal Bays display differences in water quality ranging from generally degraded conditions near tributaries to better conditions in the more open, well-flushed bay regions. Showing the strain of nutrient enrichment, the Coastal Bays exhibit high nitrate levels in the freshwater reaches of streams, excess algae, chronic brown tide blooms, macroalgae blooms, and incidents of low dissolved oxygen.

Like water quality, the status of Coastal Bays living resources is mixed. While the Bays still support diverse and abundant populations of fish and shellfish, human activities are affecting their numbers. Forage fish, the major prey item for gamefish, have been in steady decline since the 1980s and reports of fish kills, usually the result of low oxygen levels, are increasing. Hard clam densities are lower than historic levels but have been generally stable over the past 10 years. Blue crab populations are fluctuating but do not appear to be in decline, despite a relatively new parasite causing summer mortality in some areas. Oysters, which were historically abundant in the Coastal Bays, remain only as small, relict populations. Bay scallops have recently returned after being absent for many decades and are now found throughout the Bays, although numbers are low. Seagrass coverage has decreased in recent years after large increases were seen in the 1980s and 1990s.

In terms of overall water quality, living resources, and habitat conditions, the Bays were given the following ranking from best to worst: Sinepuxent Bay, Chincoteague Bay, Assawoman Bay, Isle of Wight Bay, Newport Bay, and St. Martin River. For more information, please refer to the 2015 Coastal Bays Report Card (http://ian.umces.edu/pdfs/ian_report_card_536.pdf). In addition, once published, the "Ecosystem Health Assessment of the Maryland Coastal Bays: 2007-2013" will provide additional detail

on the status of both the water quality and living resources of the Coastal Bays. The Maryland Department of the Environment completed and submitted nutrient TMDLs for all of the Coastal Bays in April 2014. EPA subsequently approved these TMDLs in August of 2014. To read the full text of these TMDLs please visit:
http://mde.maryland.gov/programs/Water/TMDL/ApprovedFinalTMDLs/Pages/TMDL_final_MD_Coastal_Bays_nutrients.aspx.

C.3.2.2 2007 National Estuary Program Coastal Condition Report

In spring of 2007, the US Environmental Protection Agency (EPA) released its third in a series of coastal environmental assessments which focused on conditions in the 28 National Estuary Program (NEP) estuaries (online at: http://water.epa.gov/type/oceb/nep/index.cfm). In this Coastal Condition Report (CCR), four estuarine condition indicators were rated for individual estuaries:

- water quality (e.g., dissolved inorganic nitrogen, dissolved inorganic phosphorus, chlorophyll a, water clarity, and dissolved oxygen);
- sediment quality (e.g., sediment toxicity, sediment contaminants, and sediment total organic carbon);
- benthic index and;
- fish tissue contaminants index

For each of these four key indicators, a score of good, fair, or poor was assigned to each estuary which were then averaged to create overall regional and national scores. Based on these calculations, the overall condition of the nation's NEP estuaries was generally fair. Specifically for the estuaries in the Northeast Coast region where Maryland's two NEP estuaries are located (Coastal Bays; Chesapeake Bay), the water quality index was rated as fair; sediment quality, benthic, and fish tissue contaminants indices were poor and the overall condition was rated as poor. However, considered altogether, the NEP estuaries showed the same or better estuarine condition than US coastal waters overall.

The report describes a number of major environmental concerns that affect some or all of the nation's 28 NEP estuaries. The goal of this report is to provide a benchmark for analyzing the progress and changing conditions of the NEPs over time. The top three issues, which also affect Maryland's estuaries include:

- Habitat loss and alteration (including dredging and dredge-disposal activities; construction of groins, seawalls, and other hardened structures; and hydrologic modifications);
- Declines in fish and wildlife populations (associated with habitat loss, fragmentation or alteration, water pollution from toxic chemicals and nutrients, overexploitation of natural resources, and introduction of invasive species); and
- Excessive nutrients (nitrogen and phosphorus runoff from agriculturally and residentially applied fertilizers and animal wastes, discharges from wastewater treatment plants, leaching from malfunctioning septic systems, and discharges of sanitary wastes from recreational boats).

C.3.2.3 The National Coastal Condition Assessment (NCCA)

The National Coastal Condition Assessment is a statistical survey of the condition of the Nation's marine and Great Lakes Coasts.[6] This EPA-funded assessment program is implemented in cooperation with the States. The NCCA is designed to report on the water quality, ecological, and recreational health of the nation's waters. Another key goal is to use this survey to determine the key stressors that impact these uses. Field data collection for the NCCA, in its current form, occurred in 2010 and again in 2015. The sites are surveyed one time during the index period with a couple of sites being resampled. In both years, Maryland's Department of Natural Resources participated in collecting and submitting data. This information is not generally used for IR assessment purposes; however it does help to inform regional comparisons in coastal conditions. For more information about this survey and to view available reports please visit: https://www.epa.gov/national-aquatic-resource-surveys/ncca.

[6] Much of this text was borrowed from EPA web pages on this survey https://www.epa.gov/national-aquatic-resource-surveys/what-national-coastal-condition-assessment .

C.3.3 Lakes Assessment- Clean Water Act §314 (Clean Lakes) Report

In the federal Clean Water Act (CWA), §314 addresses the Clean Lakes program, which was designed to identify publicly owned lakes, assess their water quality condition, implement in-lake and watershed restoration activities and develop programs to protect restored conditions. This section also required regular reporting of State efforts and results.

In Maryland, all significant (> 5 acres surface area), publicly-owned lakes are man-made impoundments. A number of specific assessment, planning and restoration activities in Maryland were funded by §314 as early as 1980 until Congress rescinded Clean Lakes funding in 1994. Section 314 has since been reauthorized (2000) under the Estuaries and Clean Water Act of 2000 but no funds have yet been appropriated to states. The US Environmental Protection Agency currently encourages states to use funds in the §319 (Nonpoint Source Program) to address Clean Lakes priorities; however, no Clean Lake projects have been funded in Maryland through this program because of limited funding.

C.3.3.1 Trophic status

One measure of lake water quality is through classification by overall level of productivity ("trophic condition"). This measure often is based on relative nutrient levels which can affect not only biological community structure, but also certain physical characteristics of lakes:

- **oligotrophic lakes** - usually deep, with low levels of nutrients, plankton and low production rates - often serve well as drinking water sources or as lakes for boating or swimming, but having limited gamefish populations.
- **eutrophic lakes** - generally shallow, with high plankton levels and production rates - often supporting sportfishing for some species, but oxygen may be depleted below the thermocline and during periods of ice cover and may result in fish kills. Diurnal oxygen and pH levels may vary widely. Sportfishing for some fish species may be excellent, but water clarity will be reduced.
- **mesotrophic lakes** - have moderate productivity levels between the above two classifications and serve well as recreational lakes for fishing, boating and swimming activities.

Two other lake trophic classes not found in Maryland include: dystrophic or "bog" lakes characterized as having low nutrient levels, but very high color from humic materials and often acidified, and hypereutrophic lakes characterized by extremely high nutrient/productivity levels.

The most recent Statewide trophic survey of Maryland's significant, publicly-owned lakes was conducted in 1991 and 1993. For this survey, 58 lakes were identified as meeting the definition of significant, publicly-owned lakes. Since then, two other lakes have been added to this list:

1. Piney Reservoir (Allegany Co.; Casselman River segment) - 110 ac. Frostburg water supply reservoir that was being rebuilt during this survey when public access was restricted, and
2. Lake Artemesia (Prince George's Co.; Anacostia River segment) - a recreational lake created from Metro construction.

The table below provides the 8-digit basin code, surface area size, owner, and trophic status (based on the statewide survey conducted in 1991 and 1993) for each of the State's 60 significant, publicly-owned lakes. Table 20 provides an overall summary of the trophic status for Maryland's publicly-owned lakes.

Table 19: Trophic status of Maryland's significant, publicly-owned lakes.

BASIN	LAKE NAME	SIZE (acres)	OWNER/MANAGER	TROPHIC ASSESSMENT
02120204	Conowingo Reservoir	2,936.0	Exelon Generation Co.	Meso/Eutrophic
02130103	Bishopville Pond	5.7	Worcester Co.	Eutrophic
02130106	Big Mill Pond	60.2	Worcester Co.	Eutrophic
02130203	Adkins Pond	17.2	MD State Hwy/Wicomico Co.	Eutrophic
02130301	Coulbourn Pond	8.6	Wicomico Co.	Meso/Eutrophic
02130301	Mitchell Pond #2	8.6	City of Salisbury	Eutrophic
02130301	Mitchell Pond #3	5.8	City of Salisbury	Eutrophic
02130301	Schumaker Pond	48.6	City of Salisbury	Meso/Eutrophic
02130301	TonyTank Lake	42.0	Wicomico Co.	Eutrophic
02130301	TonyTank Pond	41.3	MD State Hwy Admin.	Eutrophic
02130303	Allen Pond	35.8	Somerset/Wicomico Co.	Meso/Eutrophic
02130304	Johnson Pond	104.0	City of Salisbury	Eutrophic
02130304	Leonards Mill Pond	45.9	Wicomico Co.	Eutrophic
02130306	Chambers Lake	9.4	Town of Federalsburg	Meso/Eutrophic
02130306	Smithville Lake	40.0	MD DNR	Meso/Eutrophic
02130405	Tuckahoe Lake	86.0	MD DNR	Eutrophic
02130503	Wye Mills Community Lake	61.5	MD DNR	Eutrophic
02130509	Urieville Community Lake	35.0	MD DNR	Meso/Eutrophic
02130510	Unicorn Mill Pond	48.0	MD DNR	Meso/Eutrophic
02130805	Loch Raven Reservoir	2,400.0	Baltimore City	Mesotrophic
02130806	Prettyboy Reservoir	1,500.0	Baltimore City	Mesotrophic
02130904	Lake Roland	100.0	Baltimore City	Eutrophic
02130907	Liberty Reservoir	3,106.0	Baltimore City	Mesotrophic
02130908	Piney Run Reservoir	298.0	Carroll Co.	Meso/Eutrophic
02131001	Lake Waterford	12.0	Anne Arundel Co.	Meso/Eutrophic
02131103	Allen Pond	9.5	City of Bowie	Eutrophic
02131104	Laurel Lake	12.0	City of Laurel	Meso/Eutrophic
02131105	Centennial Lake	50.0	Howard Co.	Eutrophic
02131105	Lake Elkhorn	49.0	Columbia Assn.	Eutrophic
02131105	Lake Kittamaqundi	31.0	Columbia Assn.	Eutrophic
02131105	Wilde Lake	23.0	Columbia Assn.	Eutrophic
02131107	Duckett Reservoir	773.0	Wash. Suburban Sanitary Comm.	Meso/Eutrophic
02131108	Triadelphia Reservoir	800.0	Wash. Suburban Sanitary Comm.	Mesotrophic
02140103	St. Mary's Lake	250.0	MD DNR	Meso/Eutrophic
02140107	Wheatley Lake	59.0	Charles Co.	Mesotrophic
02140111	Myrtle Grove Lake	23.0	MD DNR	Eutrophic
02140203	Cosca Lake	11.0	MD-NCPPC	Eutrophic
02140205	Greenbelt Lake	21.5	City of Greenbelt	Eutrophic
02140205	Pine Lake	5.0	MD-NCPPC	Meso/Eutrophic
02140205	Lake Artemesia	38.0	MD-NCPPC	Unknown
02140206	Lake Bernard Frank	56.0	MD-NCPPC	Eutrophic
02140206	Lake Needwood	74.0	MD-NCPPC	Eutrophic
02140208	Little Seneca Lake	505.0	Wash. Suburban Sanitary Comm.	Mesotrophic
02140208	Clopper Lake	90.0	MD DNR	Mesotrophic
02140303	Hunting Creek Lake	46.0	MD DNR	Mesotrophic
02140501	Big Pool (C&O Canal)	92.4	National Park Service	Meso/Eutrophic
02140502	City Park Lake	5.2	City of Hagerstown	Mesotrophic
02140502	Greenbrier Lake	27.0	MD DNR	Oligo/Mesotrophic
02140508	Blairs Valley Lake	26.4	MD DNR	Meso/Eutrophic
02141002	Lake Habeeb	208.5	MD DNR	Oligo/Mesotrophic
02141005	Wm. Jennings Randolph Reservoir	952.0	Army Corps of Engineers	Oligo/Mesotrophic
02141006	Savage River Reservoir	360.0	Upper Potomac River Assn.	Oligo/Mesotrophic
02141006	New Germany Lake	13.0	MD DNR	Meso/Eutrophic
05020201	Youghiogheny River Lake	593.0	Army Corps of Engineers	Meso/Eutrophic
05020201	Herrington Lake	41.5	MD DNR	Mesotrophic
05020202	Broadford Lake	138.0	Town of Oakland	Meso/Eutrophic
05020203	Deep Creek Lake	4,500.0	MD DNR	Oligo/Mesotrophic
05020204	Cunningham Lake	20.0	Univ. Maryland	Mesotrophic
05020204	Piney Reservoir	110.0	City of Frostburg	Unknown

Source: MD Department of the Environment, 1993; 1995

Table 20: Trophic Status Summary of Maryland's significant, publicly-owned lakes.

	Number of lakes	Lake size (acres)
Total lakes	60	21,167.6
Lakes assessed	58	21,009.6
Dystrophic	0	0.0
Oligotrophic	0	0.0
Oligotrophic-Mesotrophic	5	6,047.5
Mesotrophic	11	8,572.7
Mesotrophic-Eutrophic	19	5,380.0
Eutrophic	23	1,009.4
Hypereutrophic	0	0.0
Unknown	2	158.0

Source: MD Department of the Environment, 1993; 1995

Since the trophic status surveys completed in 1991 and 1993, MDE and DNR have conducted several other sampling efforts that have provided more up-to-date lake productivity information. TMDL studies, an intensive study on Deep Creek Lake, and the National Lake Assessment surveys have all provided more recent information which will be incorporated into the next Integrated Report. These more recent lake sampling efforts have, in some cases, collected data for some of the State's privately-owned impoundments helping to further improve spatial coverage of water quality assessments.

C.3.3.1.1 Cyanobacteria Blooms

Inland waters across the US are at risk for increased outbreaks of toxic cyanobacteria blooms resulting from elevated water temperatures, extreme hydrologic events, and excess nutrient loading. Blooms of cyanobacteria, also known as bluegreen algae, can produce toxins that are harmful to wildlife and humans. In addition, these toxins have the potential to accumulate in estuarine organisms (fish, crabs, otters). Cyanobacteria have been evaluated in 43 Maryland lakes, ponds and reservoirs with potentially harmful species being found in 25 lakes. Several Maryland lakes have had "no–contact" advisories issued due to toxic cyanobacteria blooms. Most recently, monitoring data related to cyanobacteria blooms has come from: three national lake surveys, two special studies in 2015 (MDE eutrophication) and 2016 (DNR invasive species), special harmful algae studies, bloom response monitoring and satellite detection. For more information about harmful algal blooms please see Section C.6.5.

C.3.3.2 Pollution control programs

Various existing point and nonpoint source management programs described in this report can be effective in managing pollutant inputs directly to lakes and to lake watersheds. Unlike other water types, lakes have features that complicate the water management process, but also provide more options than other water body types. Some of these factors include: "residence time" - the time it takes water to pass through a lake, seasonal stratification, and the ability, at some lakes, to control water levels by selectively bypassing certain layers.

Unless the impoundment is a run-of-the-river system, lakes (and estuaries) have a longer residence time than free-flowing streams, allowing organic and inorganic substances more time to interact with the biota (primary producers) and sediments. If the lakes are large enough to develop seasonal stratification, new water masses develop, in-lake residence time is modified, and water movements altered. The ability to manage water levels and withdrawals provides management options, but adds to the complexity of managing lake waters for the best possible uses.

Most lakes in Maryland do not have a comprehensive lake or watershed management plan that addresses both point and nonpoint source pollution, land cover, or appropriate management options. In most instances, pollutant sources do not directly discharge to a lake but instead discharge to the lake's upstream watershed. While large water supply systems invest in lake management plans, often their effectiveness in addressing pollution sources varies since lake watershed areas often are not controlled by the lake owners. Effective lake management plans require a cooperative relationship with upstream land managers (public agencies and private land owners) in order to develop agreements which address land use, pollution control and funding priorities so as to protect lake resources.

C.3.3.3 Lake Restoration Programs

One aspect of the now un-funded §314 Clean Lakes Program was to provide grants for lake restoration activities. After the Clean Lakes Program was de-authorized in 1994, restoration funding for lakes was added to the list of fundable activities for the §319 Nonpoint Source Program. Grant requirements, priorities and limited funding in this program, however, do not allow for much needed in-lake reclamation activities (e.g., removal/dredging of excess sediments and nutrients, aquatic vegetation control, aquatic and wildlife habitat enhancement, and shoreline stabilization).

Without a directed management program and financial support, current lake restoration activities are generally initiated by lake managers (often the owners). With few lake management plans in place, there is often little planning activity or actual effort to address lake water issues until they become severe (and more difficult and costly to address). Lake managers can take advantage of expert resources available from various State agencies (DNR, MDA, MDE), federal agencies (EPA, US Dept. Agriculture) and non-governmental organizations (e.g., North American Lake Management Society; regional lake management organizations in PA and VA) to assist in developing lake management plans and finding available funding sources.

C.3.3.4 Acidification of lakes

Poorly buffered lakes or lakes in mining areas are subject to acidification due to atmospheric deposition or through acid mine drainage. Although several of Maryland's significant, publicly-owned lakes receive acid mine drainage or naturally acidic drainage from free-flowing tributaries (Deep Creek Lake, Jennings Randolph Reservoir), dilution and natural buffering prevent these lakes from becoming acidified.

With support from the US Department of Interior's Office of Surface Mining Reclamation and Enforcement, the MD Bureau of Mines has completed several projects in Cherry Creek (tributary to Deep Creek Lake in Garrett Co.) to remediate high acidity due to acid mine drainage (AMD). Completion of these AMD projects has measurably reduced mineral acidity, though natural organic acidity from the wetlands remain. It is worth noting however, that even prior to installing the acid remediation projects; the acidic inflow to Deep Creek Lake was quickly buffered by a natural limestone layer. Because of this, even in an acidic state, the water quality of Cherry Creek is not a threat to water quality of Deep Creek Lake.

Wm. Jennings Randolph Reservoir (Garrett Co.; Upper North Branch Potomac River segment) receives acid mine drainage from numerous tributaries that drain directly to the lake and also from tributaries well upstream of the lake (in both Maryland and West Virginia). Constructed primarily to manage flows for downstream water quality and quantity, the lake volume varies considerably. Although the lake was designed to manage an expected acidic layer, data show that acidic stratification did not occur. The lowest pH levels in the lake are rarely acidic and water quality below the dam is good enough to support a trout hatchery in the tailwaters of the dam. As AMD is managed upstream of the lake, pH levels should only improve, helping to increase productivity and support a robust sport fishery.

Information about acidification in small lakes and privately-owned lakes is not widely known, but water quality impacts can be significant and restoration can be successful. Lake Louise (Garrett Co.; Casselman River segment), a privately-owned, 30-acre lake, had a renowned trout fishery. In the 1970s, sulphide-bearing fill material was used in the construction of Interstate 68 through the upper lake watershed. Acidic leachate from this material entered tributaries to the lake, and within two years, caused severe ecosystem degradation and loss of the sport fishery. In the 1990s, the State Highway Administration installed a passive treatment system in the upper lake watershed in an effort to reduce the acidic runoff. In 1999, following restoration of water quality in the lake, an aquatic resource restoration program was implemented to re-establish the aquatic community and sport fishery. More information on this restoration project can be found at: http://www.hpl.umces.edu/ERI/lakes.html

C.3.3.5 Lake Status and Trends

Maryland agencies do not include lakes in their ambient monitoring programs, although contaminants in selected fish species are tested in some reservoirs on a cyclical basis (MDE). Infrequent sampling is done to address fish kills and algal bloom complaints (DNR, MDE) and some water sampling is done to provide input for pollutant loading models (Total Maximum Daily Loads, MDE). Some water supply reservoirs have routine water monitoring programs in their lakes (e.g., Baltimore City, Washington Suburban Sanitary Commission reservoirs) and, in a few cases, local agencies and citizen groups will monitor particular lakes. Based on available data, a summary of the status of Maryland lakes and reservoirs is given in the table below.

Table 21: Designated use support summary for Maryland's lakes and reservoirs (acres), 2018.

Designated Use		Size of Impoundments (acres)				
		Total Impoundment Acres	**Total Assessed**	**Supporting - Attaining WQ Standards**	**Not Supporting - Not Attaining WQ Standards**	**Insufficient Data and Information**
Aquatic Life and Wildlife		21,876	16,805	4,973	11,831	5,072
Fishing		21,876	18,976	5,967	13,009	2,900
Water Contact Recreation	**General Recreational Waters**	21,876	0	0	0	21,876
Water Contact Recreation	**Public Beaches***	27	27	27	0	0
Public Water Supply		16,108	16,108	4,690	11,418	0

*Public beaches were reported as the number of beaches in each category rather than providing a size.

C.3.3.5.1 Causes and sources of impairment

Since the water quality of lakes is largely dependent on the upstream watershed, there are numerous pollutants that can potentially impact a lake (Table 22). Overall, one of the principal lake problems is due to the accelerated eutrophication process that characterizes most reservoir systems. Upstream watershed sources, both natural and anthropogenic, supply nutrients and sediments to lakes on a continual basis which can lead to nuisance algal blooms, decreased dissolved oxygen levels (harmful to aquatic organisms), and loss of drinking water storage capacity. Currently, there are 16 lakes impaired for excess total phosphorus and 11 lakes impaired for excess sediment.

Table 22: Impoundment acreage assigned to Categories according to the pollutant assessed.

Size of Impoundments (acres) per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
Arsenic		3,708					
Cadmium		3,708					
Chlordane		98					
Chromium (total)		5,113					
Chromium, hexavalent		1,508					
Copper		3,708					
Debris/Floatables/Trash			3,039				
Fecal Coliform		3,039					
Lead		6,621					
Mercury in Fish Tissue		9,271		8,226			1,635
Nickel		3,708					
Nitrogen (Total)		27					
PCB in Fish Tissue		12,785	198	98			3,049
Phosphorus (Total)		4,973	168	8,792			3,039
Sedimentation/Siltation		281	33	6,485			
Selenium		3,708					
Zinc		1,508					

The Department has also found elevated concentrations of mercury (12 lakes) and PCBs (3 lakes) in fish tissue at a number of publicly and privately-owned lakes throughout Maryland. To protect public health, the Department publishes fish-consumption advisories that provide recommended meal limits for certain fish found to have high levels of these contaminants. For more information on fish consumption advisories please visit: http://mde.maryland.gov/programs/water/FishandShellfish/Pages/index.aspx. Table 23 shows the predominant sources of pollutants to impaired lakes.

Table 23: The total size of impoundments impaired by various sources, 2018.

Waterbody Type - Impoundment	
Sources	**Water Size in Acres**
Agriculture	4,336.8
Atmospheric Deposition - Toxics	9,861.8
Contaminated Sediments	3,039.4
Crop Production (Crop Land or Dry Land)	4,362.0
Municipal Point Source Discharges	170.9
Source Unknown	3,049.0
Urban Runoff/Storm Sewers	2,331.0
Upstream Source	98.0

The Baltimore City water supply reservoirs (Loch Raven, Prettyboy, Liberty Reservoirs), are still in various states of eutrophication and need both improvement and continued protection. Sedimentation is monitored periodically to assess the practical storage capacity of these systems - last reported as: Loch Raven Reservoir losing about 11 percent of its original volume followed by Prettyboy Reservoir (losing 7.5 percent), and Liberty Reservoir (losing 3.3 percent) (Baltimore Metropolitan Council 2004). Finally, of increasing concern are the rising levels of chlorides and conductivity found at lake tributary stations and in the treated water at the Ashburton (Liberty) and Montebello (Loch Raven) treatment plants. It is believed that road salt is the largest contributor to this trend.

C.3.3.5.2 National Lake Survey

As part of a national effort to assess the quality of the nation's waters in a statistically-valid manner, every five years EPA randomly selects lakes in each state to be sampled using a nationally-consistent set of protocols (stratified by state, EPA Region and ecological region). So far, this lake survey has been completed in 2007, 2012, and 2017. See the table below for the names of the lakes sampled each year. In preparation for these sampling events, DNR biologists were trained by EPA to collect data on field water quality, biological community, habitat, and sediment conditions. Lakes were intensively sampled a single time during the late summer with one additional lake being sampled as a replicate for quality control purposes. Water, sediment and biological samples were sent to national labs for analysis and field data were submitted to EPA. Most recently, during the 2017 summer sampling season, 8 lakes were sampled in Maryland. More information on the national survey can be found at http://water.epa.gov/type/lakes/lakessurvey_index.cfm.

Table 24: Lakes Surveyed by the National Lake Survey

2007 National Lake Survey	2012 National Lake Survey	2017 National Lake Survey
Lake Habeeb	Lake Habeeb	Lake Habeeb
Lake Kittamaqundi	Lake Kittamaqundi	Lake Needwood
Johnson Pond	Johnsons Pond	Whetstone
Piney Run Reservoir	Lake Louise	Lake Louise
Savage River Reservoir	Unnamed Montgomery County Pond	Piney Run
	Lake Vista	Little Brown
	Leonard Pond	Lake Vista
	Unicorn Mill Pond	Stormwater pond Talbot CC

C.3.3.5.3 Total Maximum Daily Loads for Lakes

MDE has completed thirty seven (37) TMDLs for various lake-pollutant combinations in Maryland through January 2018. These TMDLs addressed substances including: methylmercury, phosphorus, chlordane, PCBs, and sediments (Section F.4). Another four (4) lake-pollutant combinations are currently identified as impaired and need TMDLs for the pollutants mercury and PCBs.

C.3.4 Non-tidal Rivers and Streams Assessment

The State of Maryland has two major monitoring programs for assessing non-tidal flowing waters. One is the probabilistic Maryland Biological Stream Survey (MBSS) and the other is the CORE/TREND program for assessing water quality trends at fixed locations (both conducted by MD DNR). The MBSS program uses fish and aquatic insects as indicators of aquatic health while the CORE/TREND program focuses on conventional water quality parameters (temperature, pH, etc.) and nutrient species. In addition to these two monitoring programs, Maryland also makes use of other ad-hoc stream monitoring data as well as data submitted by non-state organizations to assess state waters. Since the 2014 Integrated Report (IR), Maryland has now also integrated biological stream data from specific counties (Baltimore and Frederick) to provide better sampling resolution for stream bioassessments. The summary tables below therefore reflect the data supplied from this variety of sources.

The table below provides the most recent results from a statewide probabilistic biological assessment in first through fourth order streams. The reader will notice that this table has not changed since the 2014 IR. The Department generally conducts statewide biological assessments as resources permit as these assessments are extremely time intensive due to the level of quality control needed. The results shown below incorporate biological monitoring performed by the Maryland Biological Stream Survey (DNR), Baltimore County, and Frederick County.

Table 25: Statewide results for probabilistic biological sampling. This data assesses support of the aquatic life designated use.

Project Name	Maryland Biological Stream Survey and County Biological Data
Owner of Data	MD Dept. of Natural Resources (MANTA), Baltimore Co. Frederick Co.
Target Population	All 1st through 4th order non-tidal wadeable streams in MD
Type of Waterbody	1st through 4th Order Wadeable Streams
Size of Target Population	19,127.0
Units of Measurement	Miles
Designated use	Aquatic Life
Percent Attaining	56.55%
Percent Not-Attaining	42.99%
Percent Nonresponse	0.50%
Indicator	Biology - freshwater fish and benthic macroinvertebrate IBIs
Assessment Date	4/1/2014

Table 26 shows 8-digit watersheds which were previously listed as impaired (Category 5) based on a biological assessment but which now have a completed stressor identification analysis. Provided in this table is the attributable risk percentage for each identified stressor. For more information about this Biological Stressor Identification (BSID) process and how the attributable risk is calculated please visit the BSID website at: http://mde.maryland.gov/programs/Water/TMDL/Pages/bsid_studies.aspx.

Table 26: Watersheds previously listed as biologically impaired that have undergone BSID analysis. As a result of this analysis, the biological listings have been replaced by listings for the specific pollutants/stressors identified below.

8-digit watersheds that were previously in Category 5 based on impaired biological communities (cause unknown)	Stressors Identified through BSID Analysis	IR Category	Attributable Risk
Potomac River Frederick County	Sediments	5	75%
	Sulfates	5	47%
	No Riparian Buffer	4c	25%
Potomac River Upper Tidal	Chlorides	5	55%
	Sulfates	5	28%
	Sediments	5	52%
	Channelization	4c	45%
Rocky Gorge Dam	Sediments	5	63%

*The biological listing for Georges Creek was also removed on this IR but had actually been addressed through BSID analysis on the 2014 IR. Its removal on this IR (2018) corrects this oversight.

The following tables present statewide assessment summaries on the wide range of pollutants and sources of pollutants to non-tidal flowing waters. Much of the data used for these assessments is from state-led monitoring efforts but increasingly more data from federal agencies, counties, non-profits, and academia are also being used. These other data sources have helped to supplement the state-led programs and increase the overall spatial resolution at which certain parameters are measured. Tables 27-29 provide statewide assessment data for non-tidal rivers and streams.

Table 27: Extent of River/Stream Miles assigned to each category according to the pollutant assessed.

Number of River Miles per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	**Cat. 1**	**Cat. 2**	**Cat. 3**	**Cat. 4a**	**Cat. 4b**	**Cat. 4c**	**Cat. 5**
Aluminum		160.1		26.2			
Ammonia		317.4					
Arsenic		663.7					
BOD, Biochemical oxygen demand		132.2		277.5			
BOD, carbonaceous		447.1		72.1			
BOD, nitrogenous		447.1		72.1			
Cadmium		1235.5					
Cause Unknown/Combination Benthic and Fish Bioassessments		4466.7	1867.1				1132.1

Number of River Miles per Category according to Pollutant Type							
	Category on the Integrated List						
Cause	Cat. 1	Cat. 2	Cat. 3	Cat. 4a	Cat. 4b	Cat. 4c	Cat. 5
Channelization						1973.9	
Chlordane		48.0					
Chlorides							2573.0
Chromium (total)		292.4					
Chromium, hexavalent		266.0					
Chromium, trivalent		105.3					
Copper		684.6					
Cyanide		98.4					
Debris/Floatables/Trash				277.5			
Enterococcus		6.8		383.9			67.3
Escherichia coli		491.2	613.3	3450.5			
Fecal coliform		563.2	569.1	368.2			
Flow alteration						4.3	
Heptachlor Epoxide							21.5
Iron		126.1		58.5			
Lack of Riparian Buffer						1658.3	
Lead		764.3					
Manganese		186.3					
Mercury		477.4					
Mercury in Fish Tissue		343.3	19.4				129.4
Nickel		663.7					
Nitrogen (Total)		1545.7	243.3	277.5			
PCB in Fish Tissue		171.4	107.5				223.6
PCBs - water				39.5			
pH, High		20.4	21.1				127.5
pH, Low		1204.9		231.1	1.1		142.2
Phosphorus (Total)		4034.9	246.1	3071.0			551.9
Selenium		22.0					
Silver		186.3					
Sulfates							2218.5
Temperature, Water		45.9	1.3				106.5
Total Suspended Solids (TSS)		851.7		6371.8			1674.9
Zinc		910.1					

Table 28: Designated Use Support Summary for Non-tidal Rivers and Streams.

Designated Use		Size of River/Stream Miles				
		Total River miles	Total Assessed	Supporting - Attaining WQ Standards	Not Supporting - Not Attaining WQ Standards	Insufficient Data and Information
Aquatic Life and Wildlife		19,127.0	17,001.2	7,274.7	9,726.6	2,125.8
Fishing		19,127.0	515.5	216.46	299.04	18,611.5
Water Contact Recreation	General Recreation Waters	19,127.0	5,331.2	1,061.2	4,270.0	13,795.8
	Public Beaches*	1	1	1	0	0
Agricultural Water Use		19,127.0	19,127.0	19,127.0	0	0
Industrial Water Use		19,127.0	19,127.0	19,127.0	0	0
Public Water Supply		8,154.0	8,154.0	8,154.0	0	0

*Data on public beaches is measured as a beach count rather than as stream mileage.

Table 29: Summary of Sizes of Riverine Waters Impaired by Various Sources.

Waterbody Type - River	
Sources	**Water Size in Miles**
Acid Mine Drainage	265.0
Agriculture	3,593.5
Anthropogenic Changes to Stream Channel	572.1
Anthropogenic Land Use Changes	210.9
Atmospheric Deposition - Acidity	155.2
Atmospheric Deposition - Toxics	127.9
Combined Sewer Overflows	205.7
Contaminated Sediments	121.9
Crop Production (Crop Land or Dry Land)	2,609.2
Discharges from Municipal Separate Storm Sewer Systems (MS4)	383.9
Inappropriate Waste Disposal	277.5
Lack of riparian buffer and upstream impoundments	1.1
Livestock (Grazing or Feeding Operations)	2,163.5
Loss of Riparian Habitat	337.0
Manure Runoff	481.1
Municipal (Urbanized High Density Area)	774.5
Municipal Point Source Discharges	72.1
On-site Treatment Systems (Septic Systems and Similar Decentralized Systems)	71.7
Post-development Erosion and Sedimentation	53.1
Sanitary Sewer Overflows (Collection System Failures)	914.9
Source Unknown	1,690.2
Upstream Dam Operations	4.3
Urban Development in Riparian Buffer	534.8
Urban Runoff/Storm Sewers	3,326.9
Wastes from Pets	879.8

C.3.4.1 National Rivers and Streams Assessment (NRSA)

The National Rivers and Streams Assessment is a national probability-based survey of rivers and streams that collects data on physical, chemical and biological parameters.[7] Similar to the other National Aquatic Resource Surveys (NARS), this survey is meant to report on the health of rivers and streams and provide information on the predominant stressors impacting their health. Additionally, this survey is used to compare the condition of streams to an earlier national survey. Field sampling for this survey was conducted in the 2008-2009 and 2013-2014 time-frames. Maryland DNR participated in both surveys. The next survey is currently planned for 2018-2019. Though this information is not generally used for IR assessment purposes it does help to inform regional comparisons in stream conditions. For more information about this survey and to access reports, please visit: https://www.epa.gov/national-aquatic-resource-surveys/nrsa.

[7] Much of the text in this section was borrowed from EPA's web pages on this survey https://www.epa.gov/national-aquatic-resource-surveys/nrsa.

C.3.5 Total Maximum Daily Loads

Maryland continues to make progress completing Total Maximum Daily Loads (TMDL) for waters listed as impaired on Category 5 of the IR. TMDLs determine the sources of pollution for an identified impairment as well as the estimated reductions necessary to bring the water body back into compliance with Water Quality Standards. Once Maryland completes a TMDL for a water body-pollutant combination, it must then be approved by EPA, in order for it to take force. When this has occurred, the water body-pollutant combination will get moved to Category 4a on the IR. Table 30 lists the water bodies with TMDLs completed since the last IR cycle. The reader may note that the number of TMDLs completed since the 2016 IR is smaller than in previous iterations. The reason for this is that Maryland's 2016 Integrated Report (IR) was delayed and as a result was completed less than a year ago. Therefore, not much time has passed in which TMDLs could have been developed by MDE and then subsequently reviewed and approved by EPA (after which they are reflected in the IR).

Table 30: Recently Approved TMDLs in Category 4a of the Integrated Report. This list does not include any TMDLs that were captured on the 2016 Integrated Report.

Cycle First Listed	Assessment Unit ID	Basin Name	Water Type Detail	Designated Use	Pollutant	Sources
2012	MD-02130802	Lower Gunpowder Falls	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Urban Runoff/Storm Sewers
2012	MD-02130901*	Back River	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Urban Runoff/Storm Sewers
2014	MD-02131003	South River	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Urban Runoff/Storm Sewers
2014	MD-02131005*	Other West Chesapeake Bay	1st thru 4th order streams	Aquatic Life and Wildlife	Total Suspended Solids (TSS)	Anthropogenic Land Use Changes
2010	MD-CHOMH2-Lower_Choptank_River_Mainstem-2*	CHOMH2 - Lower Choptank River Mesohaline 2	Tidal Shellfish Area	Shellfishing	Fecal Coliform	Source Unknown
2008	MD-PAXOH	PAXOH - Lower Patuxent River Oligohaline	Chesapeake Bay segment	Fishing	PCB in Fish Tissue	Non-regulated watershed runoff
2016	MD-PAXTF	PAXTF - Middle Patuxent River Tidal Fresh	Chesapeake Bay segment	Fishing	PCB in Fish Tissue	Non-regulated watershed runoff
2008	MD-PAXMH	Lower Patuxent River	Chesapeake Bay segment	Fishing	PCB in Fish Tissue	Atmospheric Deposition - Toxics

*TMDL approved since the 2018 Draft was released for public review.

Tables 31 and 32 list those waters for which TMDLs will likely be initiated over the next two years.

Table 31: Anticipated Submissions to Address Category 5 Integrated Report Listings in FFY 2018.

Listing Year	Listed Waterbody	Impairing Substance	2014 303(d) List Count
2012	Back River	Chlorides	1*
2008	Breton Bay	PCBs- Fish Tissue	1
2010	Cabin John Creek	Chlorides	1*
2002	Conococheague Creek	pH	1
2014	Gwynns Falls	Temperature	3
2014	Jones Falls	Temperature	3
2002	Lower Susquehanna River	PCBs - fish tissue	1
2008	Lower Pocomoke River	PCBs	1
2012	Lower Choptank River	Sediments	1*
2012	Marshyhope Creek	Sediments	1*
2014	Mattawoman Creek	PCBs	1*
2006	Middle River	PCBs	1
2014	Patuxent River Lower	Sediments	1*
2014	Patuxent River Middle	Sediments	1*
2014	Piscataway Creek Tidal Fresh	PCBs	1*
2014	Potomac River Frederick County	PCBs	1*
2008	Potomac River Montgomery County	PCBs	1*
2006	Potomac River Frederick County	Impacts to Biological Communities+	1
2006	Potomac River Upper tidal	Impacts to Biological Communities+	1
2004	Rocky Gorge Dam	Impacts to Biological Communities+	1
2012	Upper Chester River	Sediments	1*
2012	Upper Choptank River	Sediments	1*
2010	Wicomico River Mesohaline (extended area)	Bacteria	1*
Total Listings Addressed from 2014 303(d) List			27

* Identified as a priority under USEPA's prioritization known as WQ-27.

+ The biological stressor identification reports for these watersheds may have been completed. However, the listings are refined through the Integrated Report Process and additional impairments may be identified as a result.

Table 32: Anticipated Submissions to Address Category 5 Integrated Report Listings in FFY 2019.

Listing Year	Listed Waterbody	Impairing Substance	2014 303(d) List Count
1996	Aberdeen Proving Ground	Toxics	1
2010	Tidal Waters Upstream of the Harbor Tunnel	Bacteria	1*
2014	Baltimore Harbor	Sediments	1*
1998	Bear Creek	Zinc	1*
2014	Catoctin Creek	Temperature	4
2014	Conococheague Creek	Mercury	1*
1998	Curtis Bay/Curtis Creek	Zinc	1*
2012	Deep Creek Lake	Sediments	1*
1998	Adkins Pond	Nutrients/Sediment - Revisited	2*
1998	Centennial Lake	Nutrients/Sediment - Revisited	2*
1996	Lake Linganore	Nutrients/Sediment - Revisited	2*
2010	Jones Falls	Chlorides	1*
2014	Liberty Reservoir	Temperature	12
2014	Lower North Branch Potomac River	Mercury	1*
2002	Lower Susquehanna River	PCBs	1*
1998	Middle Harbor	Zinc	1*
1998	Northwest Branch, Inner Harbor	Zinc and Lead	2*
2010	Patapsco River Lower N. Branch	Chlorides	1*
2012	Patuxent River Lower	Bacteria	1*
2010	Patuxent River Lower	Bacteria	2*
2014	Lower Patuxent River Mesohaline	Bacteria	2*
2006	Port Tobacco River	Bacteria	4*
2014	Potomac River Frederick County	Mercury	1*
2014	Potomac River Washington County	Mercury	2*
2008	Susquehanna River/Conowingo Dam	PCBs	1*
2014	Upper North Branch Potomac River	Mercury	1*
2010	Youghiogheny River Lake	Mercury	1*
Total Listings Addressed from 2014 303(d) List			**51**

* Identified as a priority under USEPA's prioritization known as WQ-27

\+ The biological stressor identification reports for these watersheds may have been completed. However, the listings are refined through the Integrated Report Process and additional impairments may be identified as a result.

In an effort to continue to make progress in developing TMDLs for waters and pollutants where they are most needed, Maryland has developed a prioritization of impairments for TMDL development. This prioritization methodology describes Maryland's ongoing work on the Chesapeake Bay TMDLs and Watershed Implementation Plans (WIP) and lays out the different high priority pollutants that will be addressed between now and 2022. Documentation describing this prioritization was incorporated as part of Maryland's 2016 Integrated Report and can be accessed at: http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.aspx.

C.4 Wetlands Program

C.4.1 Wetland Monitoring Strategy

MDE completed the project to develop a wetland monitoring strategy. The report contains background information on goals and objectives; discussions and decisions made to date; pilot project summaries that may guide strategy development; and other related monitoring efforts. Wetland monitoring and assessment is undertaken in Maryland to meet various objectives. The strategy includes recommendations and tasks for two options: those that can be done with existing resources, and those that are recommended, but will need additional resources. Recommendations were prepared for monitoring and assessment related to Maryland's wetland permit programs; voluntary restoration, large scale landscape assessments; preservation; and Clean Water Act requirements.

There are multiple objectives for Maryland's wetland monitoring and assessment program (shown below), which will be related to other regulatory and non-regulatory wetland management programs. Monitoring will be designed to assess both wetland condition and wetland function and to:

1) Meet 305(b) reporting requirements;
2) Improve existing wetland and waterway regulatory programs;
3) Provide additional information for targeting wetland/waterway restoration and protection efforts;
4) Comply with TMDL requirements, if applicable;
5) Develop use designations and water quality standards for wetlands;
6) Assist in evaluating the effectiveness of compensatory mitigation and voluntary restoration projects;
7) Improve our ability to comprehensively assess landscape and watershed function;
8) Develop the capability to study and assess the status of wetland condition over time; and,
9) Make wetland condition and functional value information available for use in federal, State, local and citizen group-driven natural resource conservation and restoration efforts (examples include TMDL implementation plans, Green Infrastructure Assessment, Strategic Forest Lands Assessment, etc.).

Deliverables from the strategy development effort include literature reviews of existing GIS-based landscape assessments (Level 1); rapid field assessments (Level 2); and more intensive field assessments (Level 3). In addition, the work group also prepared a template for an intensive long-term Level 3 monitoring approach and a conceptual framework for water quality standards specific to wetlands. The final Maryland Wetland Monitoring Strategy was completed in September of 2010 (http://www.mde.maryland.gov/programs/Water/WetlandsandWaterways/AboutWetlands/Documents/www.mde.state.md.us/assets/document/wetlandswaterways/Final%20Strategy%20Report%20commentsNRCSaddr2.pdf). More details on Maryland's wetlands strategy can be found on MDE's web site at http://mde.maryland.gov/programs/Water/WetlandsandWaterways/Pages/index.aspx.

C.4.2 National Wetland Condition Assessment

As a participant in the National Aquatic Resources Survey program, in 2016, Maryland completed the field work for the National Wetland Condition Assessment (NWCA). MDE and its subcontractor, Riparia, at Pennsylvania State University, sampled fifteen sites with broader distribution across Maryland than what was previously sampled in 2011. Additional information about the National Wetland Condition Assessment can be found at: https://www.epa.gov/national-aquatic-resource-surveys/nwca.

C.4.3 Wetland Program Plan

MDE received a State Wetland Program Development Grant in 2014 to develop, with other State agencies (DNR, MD Department of Agriculture, and State Highway Administration), a Wetland Program Plan to identify actions the State will undertake over the next several years. Tasks will include those related to regulatory, monitoring and assessment, voluntary restoration, preservation, and wetland water quality standards. A draft plan was submitted to EPA for review in 2015 and comments were incorporated. Draft final and final plans were submitted to EPA in 2017. Consistent with the aforementioned Wetland Monitoring Strategy, the Wetland Program Plan includes the following draft goals for monitoring and assessment:

> Objective: Develop capacity and tools to improve assessment of wetland condition, function, vulnerability to stressors and ecosystem service benefits in order to better inform regulatory and non-regulatory programs for restoration and preservation.
>
> Rationale: Maryland agencies implement a wide range of programs for wetland management, including regulatory programs for review of activities which may result in wetland loss, restoration programs in degraded resources, and preservation programs to protect vital resources. Tools are needed to better predict outcomes of management actions.

MDE and associated agencies will seek grants for tasks needed to accomplish the objective and meet the goals.

C.4.4 Mitigation

MDE's Wetlands and Waterways Program continues attempts to improve assessment of mitigation sites to determine if they are on the proper trajectory to replace lost wetland acreage and functions. The Program is a member of the State/federal Interagency Review Team considering revised performance standards for compensatory mitigation projects.

MDE staff and staff from the U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and U.S. Fish and Wildlife Service began working on assessment protocols for stream impacts and potential mitigation sites to determine the amount of functional improvement, and available credit, which could be available at a stream mitigation bank. Assessment would evaluate existing and proposed stream condition. Various assessment methods, including a rapid assessment developed for MDE based on the U.S. Fish and Wildlife Service functional pyramid, are being examined and may be modified for use.

C.5 Trend Monitoring

Although water quality trend results are not used in the State's water quality assessment methodologies or listing process, they can be a useful tool for measuring incremental improvements in water quality. Typically, such datasets must be collected over sufficiently long temporal periods so as not to draw conclusions from changes caused by natural variability. Most trend analyses applicable to Maryland waters come from two sources, the United States Geological Survey (USGS) and the Maryland Department of Natural Resources (MD DNR).

C.5.1 USGS Water Quality Trends

The USGS monitoring program includes stations in all 7 of the Chesapeake Bay jurisdictions (Delaware, D.C., Maryland, New York, Pennsylvania, Virginia, and West Virginia).[8] The primary purpose of this monitoring program is to assess the trends in loads that are delivered downstream to the Bay. The Non-Tidal Network (NTN) program began in 2004 and now has 117 stations spread throughout the Bay watershed (see figure below). The analysis for the NTN stations only includes short term trends (2007-2016) since most stations have only been monitored since 2007. Please note that the total number of NTN stations analyzed varies for each pollutant. Within this analysis, decreasing loads are classified as improving conditions, while increasing loads are classified as degrading conditions.

The trends for nitrogen loads show that half of the NTN stations are improving; while, 31 percent are degrading and the remainder do not show a trend (86 stations total). For phosphorus, just over one-third of the NTN stations are improving; while a quarter are degrading and the remainder are showing no trend (66 stations total). Patterns in suspended-sediment loads show that less than a quarter of the NTN stations are improving; while 37 percent are degrading and the remainder do not show a trend (65 stations total).

[8] Much of the text in this section was borrowed from USGS web pages on water-quality loads and trends at https://cbrim.er.usgs.gov/index.html

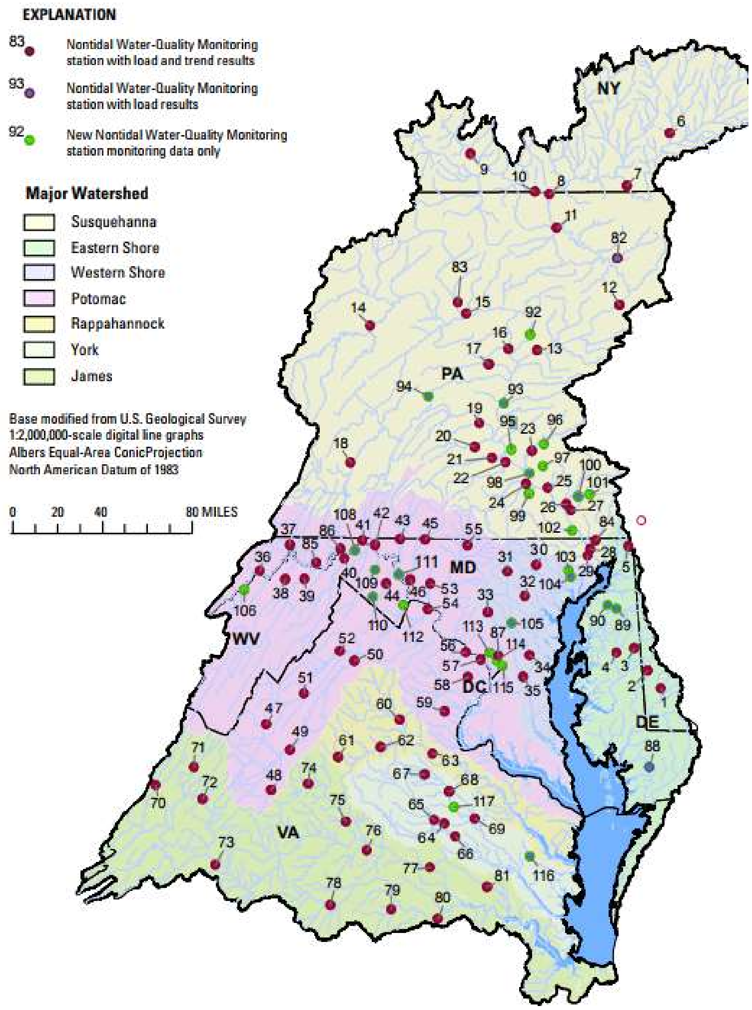

Figure 7: Map showing the Chesapeake Bay nontidal network. Maroon circles represent stations that were included in the analysis of loads and trends; blue circles represent stations that were included in the analysis of loads only; and stations represented by green circles have fewer than 5 years of monitoring data (no load and trend analysis). (USGS)

The 117 NTN stations include 9 River Input Monitoring (RIM) stations that have been in place since 1985 (see figure 8). Located in non-tidal waters along the fall line, the RIM stations are used to determine trends in loads delivered from the watershed to the tidal waters. Although there are only 9 RIM stations, their placement along major Bay tributaries allows USGS to account for pollutant loading from 78 percent of the 64,000 square-mile-watershed. Since these RIM stations have been monitored for over 30 years, USGS splits their analysis to include both long term (1985-2016) and short term trends (2007-2016). Within this analysis, decreasing loads are classified as improving conditions, while increasing loads are classified as degrading conditions.

For the 9 RIM stations, long term nitrogen trends indicate improving conditions at the majority (6) of the stations, including the four largest rivers. The Choptank River is the only station showing degrading conditions and the remaining two stations indicate no trend. Short-term trends in total nitrogen loads indicate improving conditions at 4 stations and degrading conditions at 5 stations. Long-term trends in total phosphorus loads indicate improving conditions at only 3 stations and degrading conditions at another 5 stations with only one station showing no trend. Short-term trends in total phosphorus loads indicate improving conditions at one station with degrading conditions at 5 stations, and no trend at the remaining 3 stations. Long-term trends in suspended-sediment loads indicate improving conditions at 3 stations, degrading conditions at 4 stations, and no trend at 1 station. The short-term trends in suspended-sediment loads indicate improving conditions at only the James station; degrading conditions at 4 stations and no trend at the remaining 4 stations.

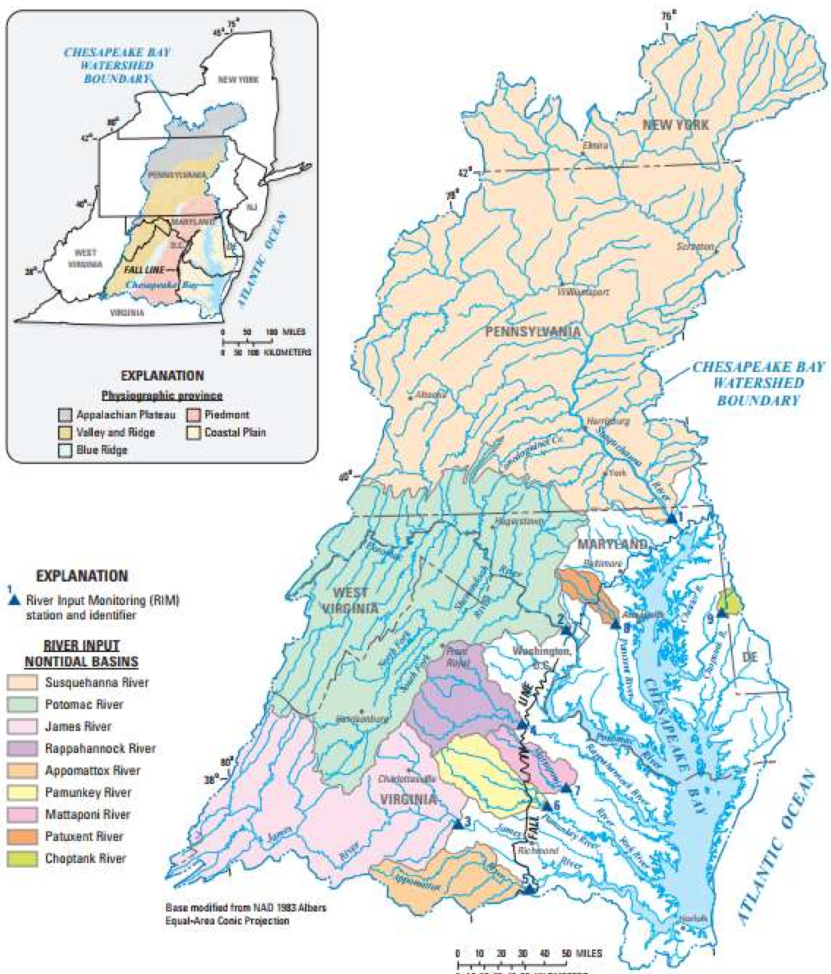

Figure 8: Map showing the location of the 9 RIM stations monitored by USGS.

USGS calculated nutrient and sediment loads and trends for the entire Chesapeake Bay watershed using a multiple linear regression model known as the weighted regressions on time, discharge and season (WRTDS) method (Hirsh et al. 2010). "The WRTDS model uses a sparse set of discrete water-quality observations combined with a continuous daily discharge record to estimate concentration on days for which no water-quality data are available. Daily concentration and load estimates are then aggregated to monthly and annual time scales. An algorithm is then applied to estimate the trend in "flow-normalized load," namely a trend that minimizes the confounding effect of any concurrent trend in discharge. Confidence in the flow-normalized trend is assigned through application of likelihood analyses using bootstrapped replicates (Hirsch and others, 2015). Detailed comparative studies by Chesapeake Bay River Input Monitoring (RIM) team staff (Moyer and others, 2012; Chanat and others, 2015) have documented that WRTDS performs better than regression-based approaches used historically. " (USGS 2016). For more information on USGS water–quality loads and trends and to access the full report and data tables, please visit: https://cbrim.er.usgs.gov/index.html

C.5.2 MD-DNR Trends

The Maryland Department of Natural Resources (MD DNR) analyzes trends for a variety of water quality parameters in both the tidal and non-tidal waters of Maryland.[9] Since 1999, DNR has monitored 54 non tidal and 71 tidal stations (125 total stations). Besides nutrients and sediments, DNR collects dissolved oxygen, water clarity, and chlorophyll a. These data are used to calculate trends both for the purpose of tracking progress with Chesapeake Bay restoration efforts (mainly concerning nutrient and sediment reductions) but also for tracking changes in the health of non-tidal river systems. As with the USGS analyses, decreasing nutrient concentrations are classified as improving conditions, while increasing concentrations are classified as degrading conditions.

The data from 1999-2015 was analyzed using the Seasonal Kendall nonparametric trend technique. However, starting in 2017, the Chesapeake Bay Program, MDDNR, and partner agencies began analyzing the Chesapeake Bay tidal water quality data for trends over time using a new approach based on Generalized Additive Models (GAMs, Wood 2006). GAMs are used on data sets including nutrient concentrations, dissolved oxygen, and chlorophyll-a, to first identify both linear and nonlinear changes over time, and ultimately to test hypotheses of the relevant factors affecting these changes. Due to time constraints, the department wasn't able to include the GAM analyses in this Integrated Report, but will be incorporating the GAMs approach in the 2020 Integrated Report. For more information on the statistical methods used in analyzing status and trends, and the history of those methods over time, please visit: https://www.chesapeakebay.net/channel_files/26076/draft-gam_method_for_chesapeake_5-10-18.pdf

Seasonal Kendall analysis of the 125 total stations (including both tidal and nontidal), for the time period of 1999-2015, demonstrates improvements in nitrogen concentrations at 38 percent of the stations, no consistent change at 58 percent of the stations, and degrading conditions at 4 percent of the stations.

Analysis of trends in phosphorus concentrations show improving conditions at 50 percent of the stations, no consistent change at 49 percent, and degrading conditions at 1 percent of the stations.

[9] Much of the text in this section was borrowed from the 2016 Historical and Projected Chesapeake Bay Restoration Spending Report at http://www.mde.state.md.us/programs/Water/TMDL/TMDLImplementation/Documents/Webinars/April_25_2017/MD_Section_38_Cover_Letter-Complete_Report_12.2.16.pdf

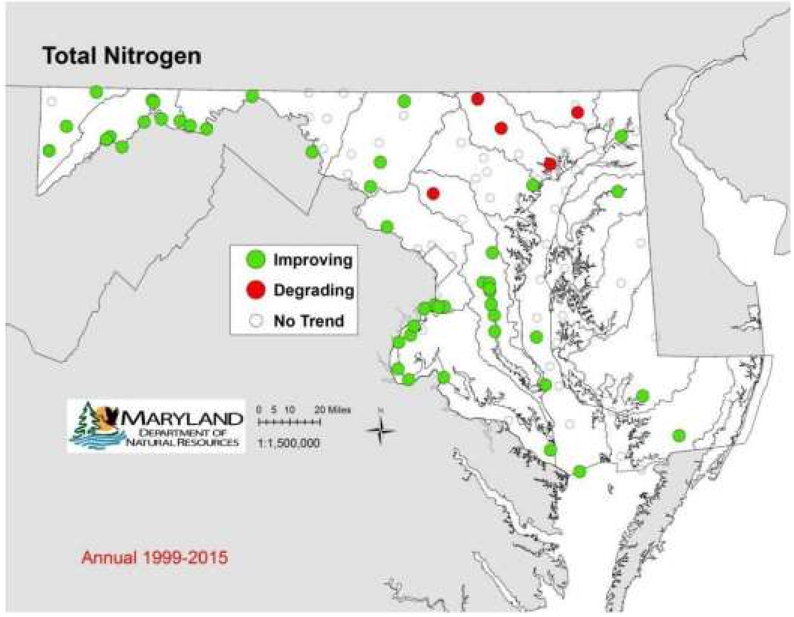

Figure 9: Map showing trends in monitored total nitrogen concentrations 1999-2015 by MD-DNR.

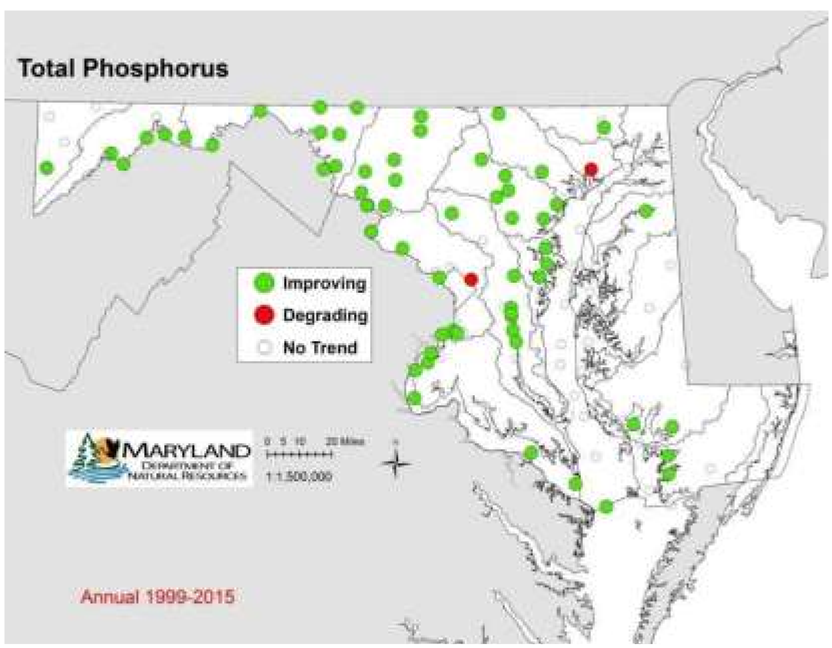

Figure 10: Map showing trends in monitored total phosphorus concentrations 1999-2015 by MD-DNR.

Suspended sediment concentrations are improving in only 16 percent of stations while 80 percent have no consistent change and 4 percent are showing degrading conditions.

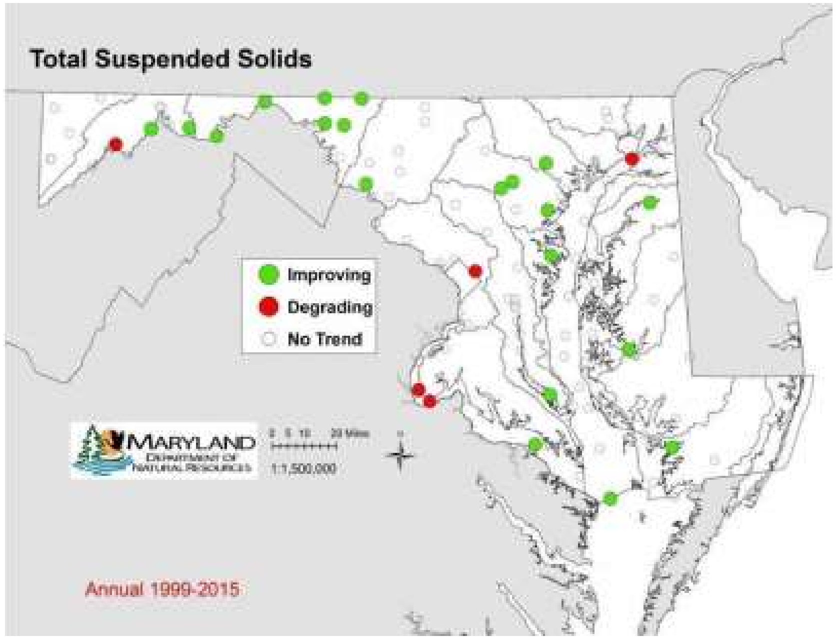

Figure 11: Map showing trends in monitored total suspended sediment concentrations 1999-2015 by MD-DNR.

According to DNR, "monitoring recorded more Submerged Aquatic Vegetation or sea grasses in 2015 (than in any year) since the monitoring program began in 1984 (Figure 12). We are also seeing some initial signs of improved bottom dissolved oxygen levels, a key parameter for all aquatic resources and an indicator of Bay health (Figure 13)." (MDE Dec. 2016)

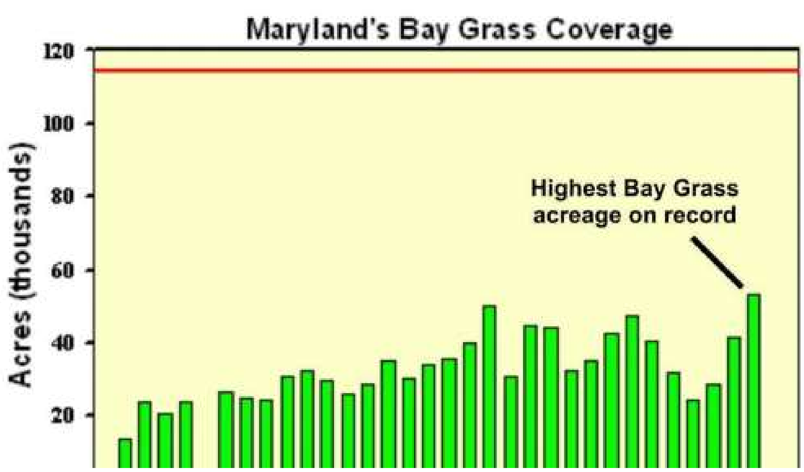

Figure 12: Total Submerged Aquatic Vegetation in Maryland's portion of the Chesapeake Bay, 1985-2015 by MD-DNR and Virginia Institute of Marine Science.

Bottom dissolved oxygen concentrations were only sampled at the 71 tidal sites and trends indicate that 13 percent of stations are showing improving conditions, 83 percent are showing no consistent change, and 4 percent of stations demonstrate degrading conditions since 1999.

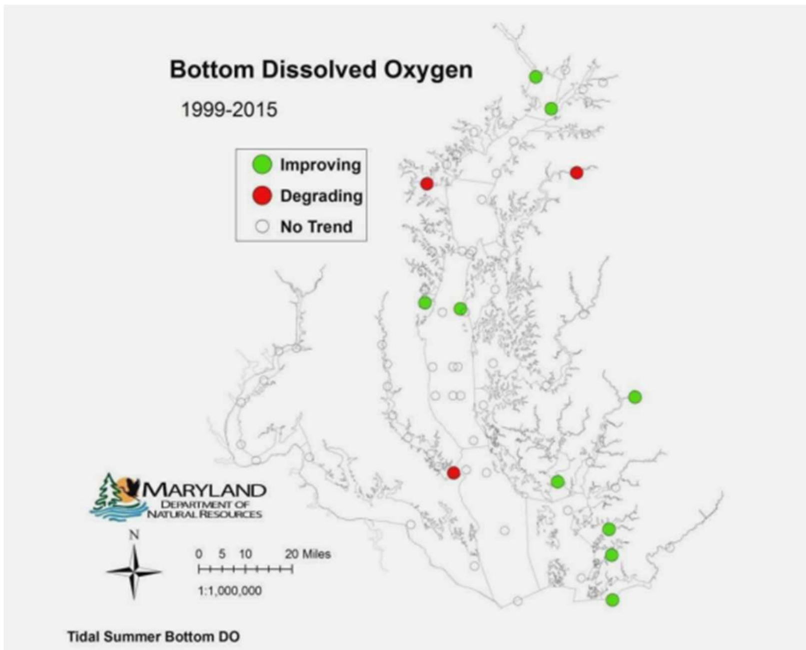

Figure 13: Trends in monitored bottom dissolved oxygen concentrations 1999-2015 by MD-DNR.

"Despite the above referenced encouraging signs of improvements in Chesapeake Bay grasses and bottom dissolved oxygen, further action on nutrients and sediments are required to see continued movement in the right direction and corresponding improvements in tidal water clarity (Figure 14) and chlorophyll a (Figure 15)." (MDE Dec. 2016)

Trends in water clarity concentrations were provided for 68 of the 71 tidal stations with only 3 percent of stations showing improvement, 75 percent of stations having no consistent change, and 22 percent of stations demonstrating degrading conditions.

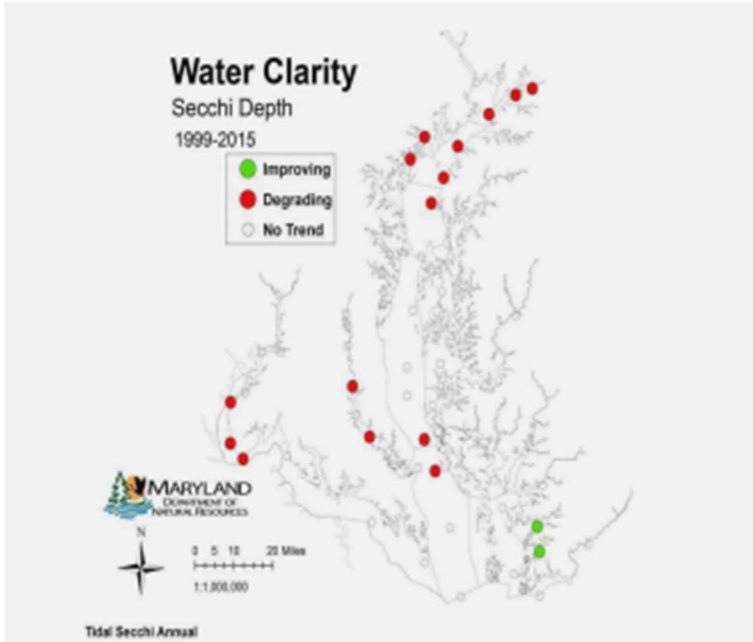

Figure 14: Trends in monitored water clarity concentrations 1999-2015 by MD-DNR.

Finally, trends in chlorophyll a concentrations were analyzed for the 71 tidal stations and indicate that 2 percent of stations are showing improvement, 73 percent of stations are showing no consistent change, and 25 percent of stations demonstrate degrading conditions. For more information on MD-DNR's water quality sampling, please visit: http://dnr.maryland.gov/waters/bay/Pages/water-quality.aspx.

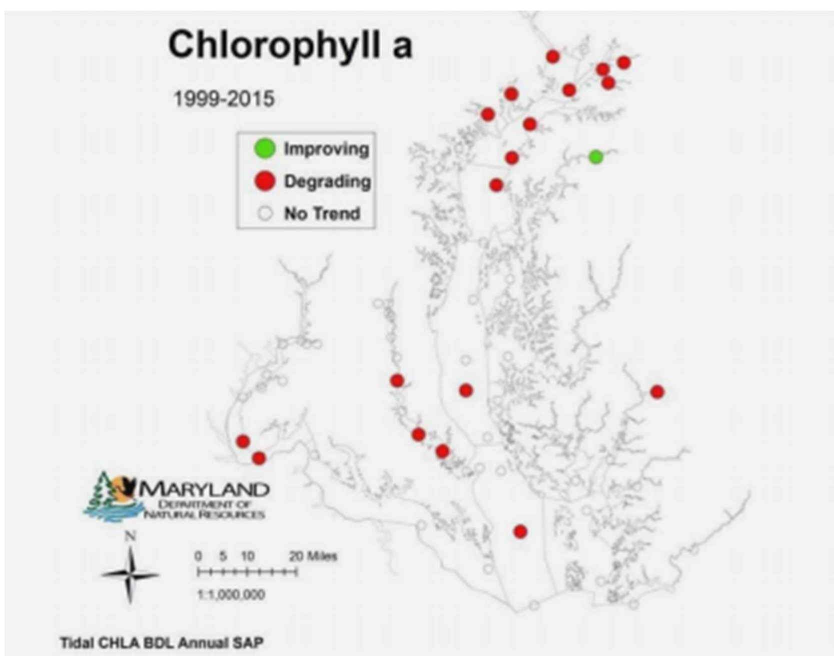

Figure 15: Trends in monitored chlorophyll a concentrations 1999-2015 by MD-DNR.

C.5.3 Temperature Trends

Collection and analysis of water temperature data has become an increasing focus of many monitoring and assessment efforts due to concerns about the effects of climate change and increased water quality impacts from urban stormwater. Studies completed in 2014 by USGS explored the potential relationship between rising water temperatures and the impact on eutrophication of the Chesapeake Bay (Rice and Jastram 2015). In this study, the authors describe the potential for rising water temperatures to cause chemical reductions of iron and manganese oxides. The reduction of these oxides could then trigger the release of soluble reactive phosphorus (SRP) and nitrates from the sediments and thereby exacerbate current water quality problems caused by excess nutrients. In analyzing the water temperatures of streams in the Chesapeake Bay watershed, this study revealed that temperatures have risen, on average, 1.4°C (2.52 °F) between 1960 and 2010. In addition, the authors compared two time periods, 1960-1985 and 1986-2010, and found that the 1986-2010 time-frame is statistically significantly warmer than the 1961-1985 time-frame. Additional monitoring will be necessary to assess the potential impact of rising temperatures on nutrient levels in the Chesapeake Bay even as major efforts are underway to drastically reduce the quantity of nutrients discharged to the Bay. (Rice and Jastram 2015)

C.6 Public Health Issues

C.6.1 Waterborne Disease

In the report "Outbreaks of Illness Associated with Recreational Water – United States, 2011-2012" (Centers for Disease Control 2015), data was summarized from the Waterborne Disease and Outbreak Surveillance System, a system that tracks the occurrences and causes of waterborne disease and outbreaks associated with recreational waters (both natural and artificial (e.g., pool, spa waters are included). During 2011 and 2012, waterborne disease and outbreaks associated with recreational water were reported by more than half of the states (32 states and Puerto Rico). However, there were no outbreaks of illness reported for untreated waters in Maryland during the years 2011 and 2012.

The Cholera and Other Vibrio Illness Surveillance (COVIS) system, also supported by the CDC, identifies illnesses due to the naturally-occurring aquatic bacteria, *Vibrio sp*. "Most people become infected by *Vibrio* by eating raw or undercooked shellfish, particularly oysters. Certain *Vibrio* species can also cause a skin infection when an open wound is exposed to brackish or salt water" (CDC 2016). In 2012, a total of 944 *Vibrio* cases were reported from 42 different states. Cases classified as confirmed or probable non-foodborne (likely associated with recreational water) comprised approximately 37% (335) of this total. Food-borne cases accounted for 54% (492) with the remaining 8% having an unspecified transmission route. A total of forty-seven cases of *Vibrio sp*. illness (both food-borne and non-foodborne) were reported in Maryland waters in 2012. In this report, the majority of all *Vibrio* patients had illness onset in the summer months with the illness records peaking in the July-August timeframe.

C.6.1.1 Research Summary

In 2006, US Environmental Protection Agency's (EPA) Office of Research and Development and Office of Water published a series of papers summarizing the research conducted on waterborne disease in the last 10 years. The work includes research supported by EPA and others and is limited to gastrointestinal illness as the health effect of concern. The 1996 Safe Drinking Water Act Amendments mandated that EPA and the US Centers for Disease Control (CDC) and Prevention conduct five waterborne disease studies and develop a national estimate of waterborne disease. In response, EPA, CDC, and other authors produced a series of papers that reviewed the state of the science, methods to make a national estimate of waterborne disease, models that estimate waterborne illness, and recommendations to fill existing data gaps. Additional information on estimates of waterborne disease and data gaps can be found on CDC's website at https://www.cdc.gov/healthywater/burden/.

C.6.2 Drinking Water

The Maryland Department of the Environment (MDE) is charged with ensuring that all Marylanders have a safe and adequate supply of drinking water. The Department has programs to oversee both public water supplies, which serve about 84 percent of the population's residential needs, and individual water supply wells, which serve citizens in most rural areas of the State. Marylanders use both surface water and ground water sources to obtain their water supplies. Surface water sources such as rivers, streams, and reservoirs serve approximately two-thirds of the State's 5.8 million citizens. The remaining one-third of the State's population obtains their water from underground sources. For more details on the State's drinking water program, go to http://mde.maryland.gov/programs/water/water_supply/Pages/index.aspx. For specific information regarding annual consumer confidence reports provided by water systems for their customers please see: http://mde.maryland.gov/programs/Water/water_supply/ConsumerConfidenceReports/Pages/index.aspx. For information on Maryland's water well construction program, which is the primary regulatory mechanism for protecting new individual water supplies please see: http://mde.maryland.gov/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/WellConstruction.aspx. County Environmental Health Departments implement the State's well construction program and respond to water quality concerns of individual well owners. MDE's regional consultants assist County Environmental Health Departments in addressing water quality issues from individual well owners.

C.6.3 Shellfish Harvesting Area Closures

Maryland's Chesapeake Bay waters have long been known for their plentiful shellfish. The Maryland Department of the Environment is responsible for regulating shellfish harvesting waters so as to safeguard public health.

Shellfish include clams, oysters, and mussels. The term shellfish does not include crabs, lobsters, or shrimp. Shellfish are filter-feeding animals: they strain the surrounding water through their gills which trap and transfer food particles to their digestive tract. If the water is contaminated with disease-causing bacteria, the bacteria are also trapped and consumed as food. If shellfish are harvested from waters which the Department has restricted (closed) and eaten raw or partially cooked, they have the potential to cause illness. Therefore, it is mandatory for oysters and clams to be harvested from approved (open) shellfish waters only.

Shellfish harvesting waters which are open or approved for harvesting are those where harvesting is permitted anytime during the shellfish season. Areas which are conditionally approved mean that shellfish harvesting is permitted except for the three days following a rain event of greater than one inch in a twenty-four hour period. Runoff from such a rainfall can carry bacteria into surface waters from adjacent land. Information about which areas have conditional closures is updated daily on the web and via a phone message. Click http://mde.maryland.gov/programs/Marylander/fishandshellfish/Pages/shellfishadvisory.aspx to find out which conditional closures are in effect or call 1-800-541-1210. The Department of the Environment has also created an online interactive map that provides timely information showing approved shellfish harvesting areas, conditionally approved areas, and closed or restricted areas. This map can be accessed at: http://mde.maryland.gov/programs/Marylander/fishandshellfish/Pages/shellfishmaps.aspx.

MDE's Water and Science Administration is responsible for regulating shellfish harvesting waters. This effort has three parts: 1) identifying and eliminating pollution sources, 2) collecting water samples for bacteriological examination; and 3) examining shellstock samples for bacteriological contamination and chemical toxicants.

C.6.4 Toxic Contaminants Fish Consumption Advisories

The U.S. Food and Drug Administration (FDA) issues fish consumption guidance for common commercial fish (fish bought in stores and restaurants) sold throughout the nation. The Maryland Department of the Environment (MDE) is responsible for monitoring and evaluating contaminant levels in recreationally-caught fish (includes fish, shellfish and crabs) in Maryland waters. The tissues of interest for human health include the edible portions of fish (fillet), crab (crabmeat and "mustard"), and shellfish ("meats"). Such monitoring enables MDE to determine whether the specific contaminant levels in these species are within safe limits for human consumption. Results of such studies are used to issue consumption guidelines for fish, shellfish, and crab species in Maryland http://mde.maryland.gov/programs/water/FishandShellfish/Pages/index.aspx. Additionally, since fish, shellfish, and crabs have the potential to accumulate inorganic and organic chemicals in their tissues (even when these materials are not detected in water), monitoring of these species becomes a valuable indicator of environmental pollution in a given water body.

C.6.4.1 Fish Tissue Monitoring

The Maryland Department of the Environment has monitored chemical contaminant levels in Maryland's fish since the early 1970s. The current regional sampling areas divide the State waters into five regions:

- Eastern Shore water bodies,
- Harbors and Bay,
- Baltimore/Washington urban waters,
- Western Bay tributaries, and
- Western Maryland water bodies.

Maryland routinely monitors watersheds within these five zones on a 5-year cycle. When routine monitoring indicates potential hazards to the public and environment, additional monitoring of the affected area may be conducted to verify the initial findings and identify the appropriate species and size classes associated with harmful contaminant levels. Findings from such studies are the basis for the fish consumption guidelines found at:
http://mde.maryland.gov/programs/Marylander/fishandshellfish/Pages/fishconsumptionadvisory.aspx.

The types of fish sampled include important predatory game species (such as small mouth bass and striped bass), common recreational panfish species (white perch, bluegill, and crappie) as well as bottom dwelling accumulator species with relatively high fat content (such as carp, catfish and American eel). Also, periodically, MDE conducts intensive surveys of contaminant levels in selected species in specific water bodies. Past targets of intensive surveys conducted in Patapsco River/Baltimore Harbor included: white perch, channel catfish, eel, and striped bass.

C.6.4.2 Shellfish Monitoring

In the 1960s, the Maryland Department of the Environment began surveying metal and pesticide levels in oysters and clams from the Chesapeake Bay and its tributaries. Prior to 1990, this effort was conducted every one or two years. In response to low levels of contaminants found and very little change from year to year, shellfish are not monitored routinely for chemical contaminants. This allows MDE to devote its limited resources toward intensive surveys in areas where contamination is more likely.

While monitoring has shown no chemical contaminants at levels of concern in any of the oysters sampled, recreational harvesters should still be aware of possible bacterial contamination and avoid shell-fishing in areas that are closed to commercial shellfish harvesting.

C.6.4.3 Crab Monitoring

Between 2001 and 2003 a study of blue crab (Callinectes sapidus) tissue revealed elevated levels of polychlorinated biphenyls and other contaminants in the “mustard” (hepatopancreas) of crabs caught from the following locations:

- Cedar Point,
- Fairlee Creek,
- Hart-Miller Island,
- Middle River, and
- Patapsco River/Baltimore Harbor.

Crabmeat was found to be low in contaminants. Specific recommendations for crab “mustard” have not been developed for all locations. However, in general, it is advised that the “mustard” from crabs taken from the Northern Chesapeake Bay (above Magothy River) should be consumed in moderation, while “mustard” from the previously mentioned locations should be eaten sparingly and avoided for the crabs from the Patapsco River/Baltimore Harbor area.

C.6.5 Harmful Algal Blooms

Algae are a natural and critical part of our Chesapeake and Coastal Bays ecosystems. Algae, like land plants, capture the sun’s energy and support the larger food web that leads to fish and shellfish. They occur in size range from tiny microscopic cells floating in the water column (phytoplankton) to large mats of visible “macroalgae” that grow on bottom sediments.

Algae may become harmful if they occur in an unnaturally high abundance or if they produce a toxin. A high abundance of algae can block sunlight to underwater bay grasses, consume oxygen in the water leading to fish kills, produce surface scum and odors, and interfere with the feeding of shellfish and other organisms that filter water to obtain their food. Some algal species can also produce chemicals that are toxic to humans and aquatic life. Fortunately, of the more than 700 species of algae in Chesapeake Bay, less than 2 percent of them are believed to have the ability to produce toxic substances.

Cyanobacteria toxins have caused animal poisonings in Maryland and in other parts of the world. These toxins present risks to human health through drinking and recreational activity. In Maryland, five lakes are known to have recurring toxic cyanobacteria blooms including Lake Lariat, Lake Needwood, Fountain Rock Quarry, Higgins Millpond, and Northwest Creek. These lakes, as well as other waters with less frequent toxic blooms, have had water contact advisories issued due to toxic cyanobacteria blooms.

In Maryland, the Department of Health (MDH), the Department of Natural Resources (DNR), and the Department of Environment (MDE) collaborate to manage a state-wide harmful algae bloom (HAB) surveillance program which includes issuing health advisories as warranted. MDE and DNR conduct algal bloom complaint response and monitoring that provides useful water quality data, a priori data related to fish kills, and protection for recreational water users and shellfish consumers. MDE also employs ELISA technology to test water and shellfish tissue for ambient and bio-accumulated toxins in support of this effort.

In the three year period from 2014 to 2016, the State identified and investigated 18 Harmful Algae Bloom (HAB) events where significant risk to human health from contacting or ingesting water existed (11 Contact advisories were initiated), 3 fish kills associated with toxic algae, and 10 fish kills associated with oxygen deprivation caused directly by non-toxic algal blooms. An additional 28 fish kills occurred that were attributed to low dissolved oxygen with indirect links to algae and nutrient enrichment. Both MDE and DNR will continue to work with the Bay Program and the Maryland Department of Health to develop, where appropriate, standards or other measures to protect both human health and aquatic life from harmful algal blooms.

Table 33: Number of water samples tested for microcystin, number with microcystin above 10 ppb and number of no-contact advisories issued to protect human health from over the most recent 5-year period (source: MDE unpublished data).

Year	Number of Samples Tested	Number of Samples with Elevated Toxins	Number of Advisories Issued
2012	55	21	5
2013	33	13	7
2014	49	14	7
2015	3	3	3
2016	53	26	5
2017	15	8	2
Total	**208**	**85**	**29**

For more information on the science of harmful algal blooms (HAB) and how HABs are managed in Maryland please visit the following websites:

Maryland Department of Environment HAB page
http://mde.maryland.gov/programs/Water/HAB/Pages/index.aspx

Maryland Department of Health HAB page
https://phpa.health.maryland.gov/OEHFP/EH/Pages/harmful-algae-blooms.aspx

Maryland Department of Natural Resources HAB pages
http://dnr.maryland.gov/waters/bay/Pages/algal_blooms/Ecosystem-Disruptive-HABs.aspx

C.6.6 Fish Kills

Fish kills occur for a variety of reasons such as natural water chemistry, biological changes, chemical pollution or miscellaneous human activity. Forty-one percent of Maryland fish kill occurrences are attributed to natural water chemistry conditions such as low dissolved oxygen, winter kill, excessive salinity, and temperature. Miscellaneous human activity is the next largest contributor with 21% of occurrences due to factors like explosive shock, turbine effect, thermal shock, sport or commercial fishing discards or a combination of these factors.

MDE is the lead agency with the responsibility for investigating, responding, and reporting on fish kills throughout the state. DNR jointly investigates when fish kills are the result of disease and provides other support as needed. The two agencies operate with a standard monitoring plan to ensure that basic information is obtained in a timely manner. Depending upon the nature of the event and the condition of the fish, field investigators will collect, count, and identify affected organisms. Appropriate water, algae identification and enumeration, and tissue samples are collected for laboratory analysis. This includes samples for nutrients, pesticides, (and other hazardous materials), the presence of harmful algae species and their toxins. Field measurements, such as temperature, pH, dissolved oxygen, and other related water quality measures are taken and recorded. Fish and fish tissue samples for histological and pathological examination are collected, when required, and transported to cooperating laboratories. The Department releases an annual summary report of fish kills that can be found here:
http://www.mde.state.md.us/programs/Water/FishandShellfish/Documents/2016_FK_ANNUAL_Report.pdf

For more information on fish kills, please visit MDE's website:
http://www.mde.state.md.us/programs/water/FishandShellfish/Pages/mdfishkills.aspx

C.6.7 Bathing Beach Closures

In October 2000, the U.S. Environmental Protection Agency (EPA) passed the Beaches Environmental Assessment and Coastal Health (BEACH) Act and provided funding to improve beach monitoring in coastal states. The BEACH Act allows states to define and designate marine coastal waters (including estuaries) for use for swimming, bathing, surfing, or similar water contact activities. The State of Maryland defines beaches in the Code of Maryland Regulations (COMAR, http://www.dsd.state.md.us/comar/getfile.aspx?file=26.08.09.01.htm) as "natural waters, including points of access, used by the public for swimming, surfing, or other similar water contact activities." Beaches are places where people engage in, or are likely to engage in, activities that could result in the accidental ingestion of water. In Maryland, the beach season is designated from Memorial Day to Labor Day. Maryland's water quality standards and regulations for beaches are published in COMAR 26.08.09 and 26.08.02.03. Some important points are:

1. *E. coli* and Enterococci are the bacteriological indicators for beach monitoring;
2. Prioritization of monitoring of beaches is based on risk; and
3. All beaches, whether permitted or not, now receive protection.

The Maryland Department of the Environment works with local health departments to enhance beach water quality monitoring and improve the public notification process to protect the health of Marylanders at public bathing beaches. The State Beaches program is administered by MDE; however, the responsibility of monitoring and public notification of beach information is delegated to the local health departments (http://www.mde.maryland.gov/programs/Water/Beaches/Pages/beaches_healthdepts.aspx). To protect the health of citizens visiting beaches across Maryland, MDE's Beaches Program is working to standardize and improve recreational water quality monitoring. In addition, MDE provides access to timely information to inform the public of beach closures, advisories, and algal blooms before they head to the beach. This information is accessible through the web or by downloading a smartphone application from the following web page (http://www.marylandhealthybeaches.com/current_conditions.php).

Worth noting, in November 2012, the United States Environmental Protection Agency (EPA) released new recommendations for recreational water quality criteria to meet the requirements of the amendments to the Clean Water Act by the Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, the federal law that refined standards for water quality at public beaches. Maryland adopted the new nationally recommended recreational water quality criteria in its 2016 Triennial Review of Water Quality Standards[10]. The criteria adopted are shown in the following table.

Table 34: Maryland's Proposed (for the 2016 Triennial Review) Recreational Water Quality Criteria.

	Geometric Mean (Counts/100 mL)	**Statistical Threshold Value (Counts/100 mL)**
E. coli (freshwater) - culturable	126	410
Enterococci (freshwater or marine) - culturable	35	130

C.6.8 Combined and Sanitary Sewer Overflows

Previously, Maryland's bacteria assessment methodology (2014) included a decision process for assessing water bodies that were affected by combined sewer overflow (CSO) and/or sanitary sewer overflow (SSO) events in the absence of water quality data. In response to public comments provided for the 2014 Integrated Report, in 2015 MDE reviewed the basis for this decision process and decided that it was inappropriate to list waters (as impaired) based solely on overflow information alone. Rationale for this change centered on the shortcomings of using CSO/SSO records as a surrogate for the standard public health assessment methods that use indicator counts and sanitary surveys. The wide

[10] Maryland's 2016 Triennial Review of Water Quality Standards was approved by EPA on July 11, 2018.

variability in water body size, flow characteristics, and residence time also made it difficult to apply this decision process with the scientific rigor necessary to make impairment determinations. In addition the Department noted the various mechanisms, already in place, that are designed to remediate and provide public notification of CSOs and SSOs. As a result, the Department has decided that it will not assess waters on the basis of CSO or SSO event information alone. Instead, for general notification purposes, MDE will provide tables showing those waters that have received 3 or more overflows of 30,000 gallons or more in the previous 5 year period. The Department will also include information in these tables on whether a consent decree has been established and/or whether water quality data has already been collected and resulted in an impairment listing. Doing this will continue to provide the public with information on which sewage collection systems are most in need of repair without making unsupported water quality impairment determinations. The tables below describe the pertinent overflow events.

Table 35: Summary of combined sewer overflows (CSO) of 30,000 gallons or more that occurred 3 or more times over the past 5 years (2012-2016).

Receiving Waters	NPDES Permit	# CSOs (≥30,000 gallons) from 2012 thru 2016	City/County	Consent Decree	IR Status for Bacteria
Braddock Run	MD0067547	142	La Vale/Allegany	✓	Listed and TMDL complete
Choptank River	MD0021636	123	City of Cambridge/Dorchester	✓	Multiple shellfish areas listed with TMDLs complete
George's Creek	MD0067384	6	Westernport/Allegany	✓	Listed and TMDL complete
George's Creek	MD0067407	50	Dept. Public Works/Allegany	✓	Listed and TMDL complete
George's Creek	MD0067423	43	Frostburg/Allegany	✓	Listed and TMDL complete
Jennings Run	MD0067423	4	Frostburg/Allegany	✓	Listed under Wills Cr. And TMDL complete
North Branch Potomac River	MD0021598	327	City of Cumberland/Allegany County	✓	Listed on Category 3 (insufficient information)
Sand Spring Run	MD0067423	11	Frostburg/Allegany	✓	Listed and TMDL complete
Wills Creek	MD0021598	188	City of Cumberland/Allegany County	✓	Listed and TMDL complete

Table 36: Summary of sanitary sewer overflows (SSO) of 30,000 gallons or more that occurred 3 or more times over the past 5 years resulting from the same facility or occurring within the same jurisdiction (2012-2016).

Receiving Waters	Owner of Collection System	# SSOs (≥30,000 gallons) from 2012 thru 2016	City/County	Consent Decree	IR Status for Bacteria
Broad Creek	Washington Suburban Sanitation Commission	8	Prince George's County	✓	Not listed
Bush River	Harford County DPW/Dept. of the Army	5	Harford County		Not listed
Chesapeake Bay	Calvert County DPW/Anne Arundel County DPW/ Town of Chesapeake Beach	3	Calvert County/Anne Arundel County		Not listed
Falls Creek	Washington County Dept. of Water Quality/ Washington County DPW	3	Washington County		Listed and TMDL complete
Gwynns Falls	City of Baltimore/Baltimore County DPW	37	City of Baltimore/Baltimore County	✓	Listed and TMDL complete

Receiving Waters	Owner of Collection System	# SSOs (≥30,000 gallons) from 2012 thru 2016	City/County	Consent Decree	IR Status for Bacteria
Herring Run	City of Baltimore/Baltimore County DPW	25	City of Baltimore/Baltimore County	✓	Listed and TMDL complete
James Creek	Washington Suburban Sanitation Commission	3	Montgomery County		Not listed
Jennings Run	Allegany County/ Allegany County DPW	13	Allegany County	✓	Listed under Wills Cr. and TMDL complete
Jones Falls	City of Baltimore/ Baltimore County DPW	27	City of Baltimore/Baltimore County	✓	Listed and TMDL complete
Little Patuxent River	Howard County DPW/Anne Arundel County DPW/ Government of D.C.	6	Howard County/Anne Arundel County	✓	Listed on Category 3 (insufficient information)
Maidens Choice Creek	Baltimore County DPW	14	Baltimore County	✓	Listed and TMDL Complete
North Branch Potomac River	Allegany County DPW/ Allegany County	23	Allegany County	✓	Listed on Category 3 (insufficient information)
Tidal Patapsco including Inner Harbor	City of Baltimore	8	City of Baltimore	✓	Listed on Category 5, TMDL not yet complete
Non-tidal Patapsco River	Baltimore County DPW/ Carroll County DPW/ Howard County DPW	5	Baltimore County/Carroll County/Howard County	✓	Listed and TMDL Complete
Pea Vine Run	Allegany County DPW/ Allegany County	9	Allegany County	✓	Not listed
Piscataway Creek	Washington Suburban Sanitation Commission	4	Prince George' County	✓	Listed and TMDL complete
Port Tobacco Creek	La Plata WWTP	3	Charles County	✓	Listed on Category 5
Potomac River	City of Cumberland/ Brunswick WWTP	3	Frederick County/ Allegany County		Listed on Category 3 (insufficient information)
Stemmers Run	Baltimore County DPW	10	Baltimore County	✓	Not Listed
Swan Creek	City of Aberdeen	3	Harford County		Not listed
Warrior Run	Allegany County DPW/ Allegany County	18	Allegany County	✓	Listed in Category 3

Receiving Waters	Owner of Collection System	# SSOs (≥30,000 gallons) from 2012 thru 2016	City/County	Consent Decree	IR Status for Bacteria
Western Run	City of Baltimore/ Baltimore County DPW	3	City of Baltimore/ Baltimore County		Listed and TMDL complete
Wicomico River	City of Salisbury	9	Wicomico County	✓	Not Listed
Wills Creek	Allegany County DPW/ Allegany County/ City of Cumberland	19	Allegany County	✓	Listed and TMDL complete

C.7 Invasive aquatic species

'New' species are being introduced at an increasing rate into Maryland. Since colonization, new species have been introduced through a variety of pathways, including ship ballast, in packing materials, and through deliberate import for various uses. While most of these introduced species are beneficial or benign, about 15 percent become invasive - showing a tremendous capacity for reproduction and distribution throughout its new environment. These invasive species can have a negative impact on environmental, economic, or public welfare priorities.

Many introduced species once thought to be beneficial have demonstrated invasive characteristics and are proving difficult to control - out-competing native species (species of plants and animals that have evolved in the State and have developed mutually-sustaining relationships to each other over geologic time) for food, shelter, water or other resources, as well as affecting economic interests and human welfare.

Some of the many aquatic invasive species that have recently consumed a significant level of state and federal agency resources include:

- mute swans (*Cygnus olor*)
- nutria (*Myocaster coypus*)
- zebra mussels (*Dreissena polymorpha*)
- Hydrilla (*Hydrilla verticillata*)
- water chestnut (*Trapa patens*)
- phragmites (*Phragmites australis*)
- purple loosestrife (*Lythrum salicaria*)
- wavyleaf basketgrass (*Oplismenus hirtellus ssp. undulatifolius*)
- Chinese mitten crab (*Eriocheir sinensis*)
- several species of crayfish
- snakehead (*Channa argus*)
- Didymo (*Didymosphenia Geminata*)
- Blue catfish (*Ictalurus furcatus*)
- Flathead catfish (*Pylodictis olivaris*)

Information about these and other invasive species are available online from the Department of Natural Resources (http://dnr.maryland.gov/invasives/Pages/default.aspx), the Smithsonian Research Center, and the US Department of Interior's Fish and Wildlife Service and Geological Survey.

In 2007, the Department of Natural Resources (DNR) created an Invasive Species Matrix Team to study and direct scientifically-based policy and management responses to the ecological, economic, and public health threats of invasive species in Maryland's native ecosystems (contact Jonathan McKnight at: 410-260-8539; mailto: jonathan.mcknight@maryland.gov. Specific objectives of this intra-agency team are to:

- Provide recommendations to the Secretary of Natural Resources on invasive species policies and regulations.

- Develop a framework for surveillance and monitoring programs designed to detect invasive species introductions and track their dispersal.
- Coordinate rapid response efforts when new invasive species are detected.
- Recommend agency actions and public education programs to prevent new introductions and control the increase/spread of invasive species into non-infested landscapes/waters.
- Develop a list of non-native species introductions into Maryland.
- Share and interpret data, knowledge, and experience on invasive species within Maryland, as well as other state, local, interstate, and federal agencies.
- Develop an Invasive Species Management Plan for Maryland, in cooperation with other organizations that provides a coordinated, multi-agency strategy to achieve the objectives listed above.

The Invasive Species Management Plan for Maryland was adopted in 2016. It clarifies and strengthens the roles and relationships between agencies in conducting all anti-invasive species efforts.

With the adoption of Maryland's Invasive Species Management Plan, the state became eligible for federal funding through USFWS. Thus, in 2017, DNR proposed several projects for funding including: a project to capture time-lapse photography that will show the long term effects of fouling from zebra mussels; a project to update and increase signage related to invasive species in the State; a project to test the use of eDNA analysis as an aquatic invasive species (AIS) early detection tool in tidal and non-tidal waters; a project to develop a sampling methodology for flathead catfish on the non-tidal Potomac River that is consistent with the survey work conducted by Pennsylvania Fish and Boat Commission on Conowingo Reservoir; an herbicide treatment at two high-traffic boat ramps at Lake Habeeb in Rocky Gap State Park; and a project to analyze and adopt one or more scientifically rigorous, taxon-appropriate risk assessment systems to prevent AIS introduction and spread within state waters.

PART D: GROUND WATER MONITORING AND ASSESSMENT

Groundwater is a finite natural resource that sustains Maryland's natural ecosystems in addition to supporting significant and growing human water supply demands. Approximately one third of Maryland's population currently depends on groundwater for drinking water. As the population in Maryland continues to grow, the demand for groundwater for drinking, irrigation, industry, and other uses is increasing, while threats to groundwater quality related to that development increase as well.

Senate Joint Resolution No. 25 of 1985 requires the Maryland Department of the Environment (MDE) to provide an annual report on the development and implementation of a Comprehensive Ground Water Protection Strategy in the State and on the coordinated efforts by state agencies to protect and manage ground water. Since the development of the original strategy, a variety of state programs at MDE, the Maryland Department of Agriculture (MDA) and the Maryland Department of Natural Resources (DNR) have endeavored to protect ground water resources and characterize the quality and quantity of these resources.

Programs to better understand and manage this critical resource must be strengthened to ensure that an adequate supply of groundwater is available for existing and future generations. Continuation and enhancement of programs that protect this resource must remain a priority, yet the financial support for this important program is often overlooked. In order to ensure the long-term viability of Maryland's groundwater resource, MDE will need additional resources to facilitate a better understanding and implement a comprehensive strategy for the protection of this critical resource.

The most recently approved groundwater protection report provides an overview of the Fiscal Year 2013 activities and accomplishments of state programs that are designed to implement Maryland's Comprehensive Ground Water Protection Strategy. Stakeholders interested in reading the full FY2013 groundwater report can visit: https://mde.maryland.gov/programs/Water/water_supply/Source_Water_Assessment_Program/Documents/FINAL_GWR%20report_1__2013%20_3_.pdf.

PART E: PUBLIC PARTICIPATION

MDE utilizes a public participation process for Integrated Report (IR) similar to that used for promulgation of new regulations. The Administrative Procedures Act mandates that a minimum of 30 days from the date of publication in the Maryland Register must be allowed for public review and comment. The Department is granting 30 days for public review of the draft 2018 Integrated Report of Surface Water Quality which will begin on February 16, 2018 and end on March 19, 2018. Besides posting an announcement on the Department's home web page, MDE will also post announcements through the following outlets:

- MDE's Integrated Report web page,
- Several of MDE's social media outlets (e.g. Facebook),
- The Maryland Water Monitoring Council Announcement web page (http://dnr.maryland.gov/streams/Pages/MWMC/BulletinBoard.aspx), and
- Targeted emails to the TMDL contact list (approximately 500+ contacts) which includes representatives of federal, state, and local government, academia, and other non-government organizations.

The draft Integrated Report is being made available in electronic format to the public via the Internet (http://www.mde.state.md.us/programs/Water/TMDL/Integrated303dReports/Pages/2018IR.aspx) and in hard copy format by special request to Becky Monahan at becky.monahan@maryland.gov or 410-537-3947. *Please note that the Department charges a fee (36¢/page) for printing and shipping hard-copy reports.*

During the open comment period for the IR, an informational public meeting will be held on February 27, 2018 at MDE's headquarters to facilitate dialogue between MDE and stakeholders concerning the format, structure, and content of the draft IR. The Department can also meet with stakeholders that may not be able to attend this public meeting and can provide full presentations on Maryland's Integrated Report if requested.

All comments or questions should be directed in writing to the Department. All comments submitted during the public review period will be fully addressed in the comment response section below which will be included with the final Integrated Report submitted for EPA approval.

E.1 Informational Public Meeting Announcement

Maryland
Department of
the Environment

Larry Hogan, Governor
Boyd K. Rutherford, Lt. Governor

Ben Grumbles, Secretary
Horacio Tablada, Deputy Secretary

Department of the Environment
Informational Public Meeting Announcement:
Maryland's Draft 2018 Integrated Report of Surface Water Quality

The Federal Clean Water Act requires that States assess the quality of their waters every two years and publish a list of waters not meeting the water quality standards set for them. This list of impaired waters is included in the State's biennial Integrated Report (IR) of Surface Water Quality. Waters identified in Category 5 of the IR are impaired and may require the development of Total Maximum Daily Loads (TMDLs). The Maryland Department of the Environment (MDE) is announcing the availability of the Draft 2018 IR for public review and comment. The public review period will run until **March 19, 2018**. The Draft IR is being posted on MDE's website at http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2018IR.aspx. Hard copies of the Draft IR may be requested by calling Becky Monahan at (410) 537-3947. *Please note that the Department charges a fee to cover printing and shipping costs.*

The Department is hosting an informational public meeting and conference call in Baltimore at 6pm on February 27, 2018. Any hearing impaired person may request an interpreter to be present at the meeting by giving five (5) working days notice to Becky Monahan at Becky.Monahan@maryland.gov or by calling (410) 537- 3947. Anyone wanting to participate in this meeting via conference call should also contact Becky Monahan, in advance, for instructions. Given enough interest, the Department may schedule additional meetings. Comments or questions may be directed in writing to Mr. Matthew Stover, MDE, Water and Science Administration, 1800 Washington Blvd., Baltimore, Maryland 21230, or emailed to Matthew.Stover@maryland.gov, on or before **March 19, 2018**. After addressing all comments received during the public review period, a final IR will be prepared and submitted to the U.S. Environmental Protection Agency for approval.

Public Meeting Announcement
Date: February 27, 2018.
Start Time: 6:00 p.m.
Location: MDE Headquarters
Lobby Conference Rooms (*to the left after entering the front door*)
1800 Washington Blvd.
Baltimore MD, 21230
Parking: Red Lot, Front (south) of building

E.2 Attendance List from Informational Public Meeting

Integrated Report Public Meeting Sign-in Sheet
Baltimore, MD February 27, 2018 at 6:00 p.m.

NOTICE

This Notice is provided pursuant to § 10-624 of the State Government Article of the Maryland Code. The personal information requested on this sign-in sheet is intended to be used to contact you concerning further information about the subject of this public hearing or meeting. Failure to provide the information requested may result in you not receiving further information. You have the right to inspect, amend, or correct this sign-in sheet. The Maryland Department of the Environment ("MDE") is a public agency and subject to the Maryland Public Information Act. This form may be made available on the Internet via MDE's website and subject to inspection or copying, in whole or in part, by the public and other governmental agencies, if not protected by federal or State law.

Name	Address	Affiliation	Email
Alice Volpitta		Blue Water Baltimore	avolpitta@bluewaterbaltimore.org
ANDREA DANUCALU		EXELON	andrea.danucalu@exelon.com
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Becky Monahan		MDE	
Matt Stover		MDE	
John Backus		MDE	
Jay Apperson		MDE	
Lisa Ochsenhirt	(on phone)	Aqua Law PLC	lisa@aqualaw.com
Mary Searing	(on phone)	Brudis and associates	msearing@brudis.com

E.3 Comment-Response for the 2018 Integrated Report

Table 37: List of Commenters.

Author	Affiliation	Date Received	Comment Numbers
Jillian Adair	Environmental Protection Agency (Region 3)	March 19, 2018	1-17
Submitted by Betsy Nicholas and Katlyn Clark (Waterkeepers Chesapeake) on behalf of multiple Riverkeepers	Waterkeepers Chesapeake submitted comments on behalf of the Baltimore Harbor Waterkeeper and Director of Advocacy, Chester Riverkeeper, Miles-Wye Riverkeeper, Sassafras Riverkeeper, Choptank Riverkeeper, and Upper Potomac Riverkeeper	March 19, 2018	18-25
Colleen E. Hicks	Exelon Power	March 19, 2018	26-30
Andrew D. Dehoff	Susquehanna River Basin Commission	March 19, 2018	31
Ronald H. Fithian	Clean Chesapeake Coalition Chairman and Kent County Commissioner	March 20, 2018	32-36

United States Environmental Protection Agency Region III (EPA), 1650 Arch Street, Philadelphia, Pennsylvania 19103-2029, Evelyn S. MacKnight, Associate Director, Office of Standards, Assessment and TMDLs (OSAT).

EPA Comment 1: Category 2: MD02140504-Multiple_segments_2 (Aquatic Life and Wildlife, high pH) and MD02140504_Multiple_segments_1 (Aquatic Life and Wildlife, high pH) notes that the high pH observed is due to natural conditions. An impairment due to natural conditions may be more appropriate in Category 4C.

MDE Response: In one of the listings cited by the commenter, MD02140504_Multiple_segments_2, further sampling and assessment demonstrated that this water was meeting pH criteria according to Maryland's pH Assessment Methodology and should remain on category 2. The other listing cited by the commenter, MD02140504_Multiple_segments_1 will remain on category 5 as additional follow-up monitoring is needed.

EPA Comment 2: Category 2: Several segments were moved to category 2 because the SAV restoration goals were met. Please explain how the SAV restoration goals relate to the applicable water quality standards.

MDE Response: Maryland uses EPA's "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries" document series as our assessment methodology for water clarity. According to these documents and the applicable addenda, "Water clarity criteria and SAV restoration acreages are used to define attainment of the shallow-water bay grass designated use in Chesapeake Bay, its tidal tributaries and embayments. EPA provided three measures for assessing attainment of the shallow-water Bay grass designated use for a Chesapeake Bay segment which are also captured in Maryland's water quality standards in Code of Maryland Regulations 26.08.02.03-3. Section 26.08.02.03-3 C.9. states:

(9) Water Clarity Criteria for Seasonal Shallow-Water Submerged Aquatic Vegetation Subcategory.

(a) Water Clarity Criteria Measurement. A Bay segment has attained the shallow water designated use if:

(i) Submerged aquatic vegetation (SAV) acreage meets or exceeds the SAV acreage restoration goal in Table 2 of this regulation;

(ii) The shallow-water acreage that meets or exceeds the water clarity criterion expressed in Secchi depth equivalence from Table 1 of this regulation at the segment specific application depth specified in Regulation .08 of this chapter (excluding SAV no grow zones) is 2.5 times greater than the SAV Acreage Restoration Goal from Table 2 of this regulation; or

(iii) A combination of the actual SAV acreage attained and meeting the applicable water clarity criteria in an additional, unvegetated shallow water surface area equals 2.5 times the remaining SAV acreage necessary to meet the segment's restoration goal.

(a-1) If none of §C(9)(a)(i), (ii), or (iii) applies, the segment has not attained the water clarity designated use.

EPA Comment 3: Category 3: Several segments note that data show stations exceeding pH or D.O criteria, but MDE has determined to collect more data before making an attainment decision. Please explain why MDE has determined to collect additional data before making an attainment decision for these segments.

MDE Response: In these instances data was provided by a non-traditional monitoring partner and MDE assessors noted inconsistencies that led staff to seek additional data to make an accurate attainment decision. pH data received by the Department showed exceedances of water quality criteria but when the data were compared to nearby Maryland DNR CORE sites that also recorded pH values, there were significant differences between the values from the DNR CORE data and the nontraditional monitoring partner data. The DO data that we received had a small sample size, inconsistent coordinates and is considered Tier II data. In both cases, we used the data to prioritize follow-up assessments which is why they were placed on category 3.

EPA Comment 4: Category 3: Please explain why the potential pollutant is listed as "not applicable" for segment MD-02130101-T for the Atlantic Ocean.

MDE Response: The Atlantic Ocean has not yet been assessed and so this assessment record currently serves as a placeholder until it can be assessed.

EPA Comment 5: Category 3: Assessment Unit MD-BOHOH-SWSAV notes that the "segment meets the SAV restoration goal and was thus moved to category 2", but the segment still resides in Category 3, Please correct.

MDE Response: This has been corrected.

EPA Comment 6: Category 3: Several segments note that temperature measurements exceed criteria, but because coldwater obligate taxa are present, additional data is needed to make a conclusive assessment. This approach is inconsistent with EPA's longstanding policy of independent application of chemical, biological, and toxicity data. This approach also may be inconsistent with applicable numeric and narrative criteria. Please explain.

MDE Response: Upon further review, MDE agrees with the commenter that the concept and policy of independent applicability is germane to this assessment scenario. As a result, the 30 listings in the table below were placed in category 5 (impaired, TMDL needed) since they are not meeting Class III (or Class III-P) water quality criteria for temperature. Additional explanation has been added to Section C.3.1.1.

Table 38: Temperature listings moved to category 5

AU_ID	Basin Name	Water Type	Designated Use	Listing Category	Cause
MD-021202030344-Basin_Run2	Octoraro Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021202050340-Deep_Run	Broad Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021308050302-Baisman_Run	Loch Raven Reservoir	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021308050309-Little_Falls	Loch Raven Reservoir	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309041036-DippingPond_Run	Jones Falls	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309041036-NBranchJones_Falls	Jones Falls	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309071050-Joe_Branch	Liberty Reservoir	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309071057-Beaver_Run	Liberty Reservoir	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081025-Gillis_Falls1	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081025-SBranchPatapsco_River1	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081028-SBranchPatapsco_River2	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081029-Middle_Run	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081030-Gillis_Falls2	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021309081031-Gillis_Falls3	South Branch Patapsco River	RIVER	Aquatic Life and Wildlife	5	Temperature

MD-021403030244-Buzzard_Branch	Upper Monocacy River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021403030251-BigHunting_Creek1	Upper Monocacy River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021403030251-BigHunting_Creek2	Upper Monocacy River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021403030251-High_Run	Upper Monocacy River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021405020201-UTLittleAntietam_Creek	Antietam Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021405120129-UTTown_Creek	Town Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021405120132-Murley_Branch	Town Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021410010055-Mill_Run	Lower North Branch Potomac River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021410020104-UTEvitts_Creek2	Evitts Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021410030098-UTJennings_Run1	Wills Creek	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021410060077-Dry_Run	Savage River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-021410060081-Savage_River1	Savage River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-050202010013-Ginseng_Run	Youghiogheny River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-050202010016-Bear_Creek3	Youghiogheny River	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-050202030028-MeadowMountain_Run	Deep Creek Lake	RIVER	Aquatic Life and Wildlife	5	Temperature
MD-050202040036-Red_Run	Casselman River	RIVER	Aquatic Life and Wildlife	5	Temperature

EPA Comment 7: Category 4B: No segments were revised since 2016. Please explain any progress made since the last IR reporting cycle.

MDE Response: Maryland has a total of ten Category 4B assessment records in the 2018 IR including: 5 water segments in the tidal Patuxent River caused by an oil spill that occurred in 2000, 4 assessment records for areas around Sparrows Point for cyanide and copper impairments, and 1 record for a pH impairment to Georges Creek due to issues with acid mine drainage. The assessment records for oil impacted waters describe portions of the Patuxent River watershed where clean-up was not an effective option. Instead, EPA and the Natural Resources Trustees determined that these waters be addressed using a Qualitative Long Term Monitoring (QLTM) plan to characterize the spatial extent of natural attenuation (of oil presence) over time. The QLTM plan consists of "visual inspections of oil and is based on modified Shoreline Clean-up Assessment Technique (SCAT) procedures. Each shoreline zone is required to pass two levels of clean-up criteria before being signed-off by the trustees and approved by the Unified Command (consisting of EPA, MDE, and PEPCO)" (Summary of 2013 Qualitative Long-Term Monitoring Activities: Swanson Creek and Patuxent River). The remaining waters impacted by the historical oil spill now undergo sampling every 3 years to determine if residual oil is still impacting aquatic resources. This area is slated to be sampled again in 2019.

The four assessment records related to cyanide and copper in waters near Sparrows Point were monitored as recently as 2015 and found to be in violation of, or potentially in violation of water quality criteria. Since it is highly likely that these water quality issues resulted from legacy industrial contamination in this area, and efforts are currently underway (through a consent decree) to remediate that contamination, the Department is planning to reassess these waters after significant remediation has completed.

The Category 4B assessment record for pH impairment in Georges Creek is being addressed through ongoing efforts by MDE's Abandoned Mine Land Division to remediate acid mine drainage at a variety of points along the Creek. The Department also conducts regular monitoring along Georges Creek to assess progress towards meeting Maryland's pH criteria.

EPA Comment 8: Category 4C: MD-02130705 for the Aberdeen Proving Ground notes that the Biostressor analysis indicates total phosphorus as a major stressor, but assigns the impairment cause as channelization. Would a phosphorus impairment be better place in Category 5? Please correct or explain if needed.

MDE Response: The note indicating that total phosphorus was a major stressor was made in error for this particular assessment record. The notes for this assessment record have been corrected to specify that channelization is the major stressor.

EPA Comment 9: Category 5: Please explain the reason for the designated use revision for MD-02120204-Conowingo_Reservoir from Aquatic Life and Wildlife to Public Water Supply.

MDE Response: In the public draft of Maryland's 2018 Integrated Report, the Department erroneously replaced the previous assessment record for Conowingo Reservoir (Assessment unit ID: MD-02120204-Conowingo_Reservoir) that assessed the aquatic life and wildlife designated use with the assessment for the public water supply designated use. The Department realized this mistake during the public comment period as new data had also become available with which to assess the aquatic life use for dissolved oxygen criteria attainment. These assessment records have now been corrected to characterize, separately, an assessment of the aquatic life designated use and another to show an assessment of the public water supply designated use. A summary of those assessments is shown below.

Table 39: Summary of assessment records for Conowingo Reservoir

Assessment Unit ID	Water Body Type	Designated Use	Listing Category	Cause/Pollutant	Indicator
MD-02120204-Conowingo_Reservoir	Impoundments	Public Water Supply	5	Phosphorus, Total	Chlorophyll a

MD-02120204-Conowingo_Reservoir	Impoundments	Aquatic life and Wildlife	2	Phosphorus, Total	Dissolved Oxygen

EPA Comment 10: G.1, figure 19: Does this figure represent average monthly exceedances from 1986-2016? Or is it limited to more recent data?

MDE Response: Figure 19 represents total exceedances per month from 1986-2016. The figure has been updated to reflect this.

EPA Comment 11: G.1: The non-tidal Conococheague Creek is listed as impaired for total phosphorus and pH as well as other parameters. MDE proposes to move the pH listing for Conococheague Creek from category 5 to category 2 due to the impairment being caused by the natural geology of the area. In addition to geology, other water quality factors can influence pH. For instance, seasonal patterns of high pH during spring and fall may arise from high levels of photosynthesis, which in some cases, is a result of excessive nutrients. MDE's pH assessment method states "Another natural condition which should not be used to identify a water body as pH impaired is an abundance of algae or aquatic plans that elevate pH levels about 8.5 as a result of photosynthetic-drive chemical reaction, unless the condition is being caused by a defined nutrient enrichment source." The BSID analysis identified nutrients as a stressor impacting aquatic life in the Conococheague Creek watershed. To the extent the pH levels may be associated with the identified nutrient enrichment, it may be useful for MDE to explain this link as an additional causative factor, particularly as the phosphorus impairment remains in category 5. It also may be useful for MDE to compare observed pH and alkalinity values in a biologically unimpaired, reference watershed with 75 to 100 percent karst coverage with observed pH and alkalinity values in the Conococheague Creek watershed.

MDE Response: Upon further review and discussion, MDE agrees with the commenter that additional follow-up monitoring and assessment is needed to further evaluate if the high pH levels are caused by the natural geology of the area or another factor. This listing will remain on category 5 for the 2018 IR.

EPA Comment 12: G.2 EPA agrees with MDE's assessment and conclusion that the Susquehanna River downstream of the Conowingo Dam is impaired due to flow alterations and changes in depth and flow velocity due to the operations of the Conowingo Dam, which alter depth and flow velocity beyond the expected natural variations and negatively impact biological resources such as migratory fish, endangered turtles, mussels, macroinvertebrates, etc. EPA encourages MDE to continue collecting water quality data to assess whether the segment is impaired by additional parameters/pollutants.

MDE Response: MDE appreciates the commenter's support of the Maryland's monitoring and assessment efforts.

EPA Comment 13: Page 12, Figure 1: Please correct the x –axis pollutant heading, "Non-Tidal…" if needed, or clarify the meaning.

MDE Response: The "Non-Tidal…" pollutant label has been changed to "Non-Tidal Biological" to indicate the results of non-tidal biological assessments.

EPA Comment 14: MDE states that Tier 2 data are used to assess the general condition of surface waters and may result in a category 2 or 3 designations, but are not used to determine an impairment in category 5. This is inconsistent with EPA guidance and EPA suggests placing those waters, in which only Tier 2 data are used, in Category 3 if higher quality data are unavailable.

MDE Response: Prior to the 2020 IR, the Department will be reevaluating Maryland's data quality rating system and will be sure to make this change at that time.

EPA Comment 15: Page 45: footnote 6 refers to eleven waterbodies, but the text of the paragraph body refers to twelve. Please correct if needed.

MDE Response: The footnote has been corrected to reflect twelve waterbodies.

EPA Comment 16: EPA expects that MDE will utilize EPA's updated Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) to submit the final 2018 Integrated Report, including, but not limited to the: narrative report, IR category tables, assessment data and GIS files.

MDE Response: MDE plans to submit their final 2018 Integrated Report including narrative report, IR category tables, assessment data and GIS files through EPA's Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS).

EPA Comment 17: EPA encourages MDE to evaluate whether any surface waters are not meeting public water supply use and/or any applicable narrative criteria due to negative drinking water impacts from elevated nutrient levels (e.g., nitrates) and/or taste and odor issues related to excess algae growth. Some states list waters as impaired for public water supply use where additional treatment beyond conventional treatment is required. EPA encourages MDE to consider implementing this practice, as it further supports drinking water source protection. EPA also suggests that MDE contact drinking water utilities that withdraw surface water as potential sources of water quality monitoring data.

MDE Response: The Department agrees with the commenter that drinking water utilities are a potentially valuable source of ambient water quality data for inclusion into Maryland's Integrated Report (IR). As such, the Department will be ramping up efforts to solicit high quality data from this sector of the monitoring community.

Waterkeepers Chesapeake, P.O. Box 11075 Takoma Park, MD 20913-1075, Betsy Nicholas, Executive Director and Katlyn Clark, Staff Attorney, Waterkeepers Chesapeake.

WKC General Comment 18: The commenter would like to applaud the Maryland Department of the Environment (MDE) for some progress over the last two years in assigning Total Daily Maximum Loads ("TMDLs") to critical impaired waterways. For instance, a portion of the Magothy River Mesohaline, Severn River Mesohaline, South River Mesohaline and West River received TMDLs for PCB in fish tissue. The Patapsco River Mesohaline received a TMDL for debris, floatables, and trash in the Middle Branch around the harbor. The Rhode River Mesohaline received a TMDL for fecal coliform. Just this year, the South River and Lower Gunpowder Falls received a TMDL for Total Suspended Solids due to urban runoff and storm sewers. Different parts of the Patuxent River received three TMDLs for PCB in fish tissue. It is imperative that MDE continue to take action to protect these waterways from such detrimental pollutants.

MDE Response: The Department agrees with the commenter that it is important to continue work in developing TMDLs as well as in developing other pollution reduction tools such as watershed implementation plans, permits, etc.

WKC Condensed Comment 19: The commenter reiterates comments that were submitted during the public comment period for Maryland's 2012, 2014, and 2016 Integrated Reports. The comments highlight the concern that impaired segments covered by the Chesapeake Bay Total Daily Maximum Loads ("TMDLs") still require local TMDLs and that MDE should disclose its analysis of pre-existing TMDLs through Integrated Reporting, not in a separate document or process. The commenter contends that there is no clear explanation for listing over 230 local water segments as Category 4a in the 2018 IR.

MDE Response: MDE acknowledges the receipt of these comments and refers the commenter to the Department's responses on those previous Integrated Reports (starting on page 122 of Maryland's 2012 Integrated Report, page 159 of Maryland's 2014 Integrated Report, and page 140 of Maryland's 2016 Integrated Report). These responses to comments along with explanatory text in Part G and H on the 2014 Integrated Report address this concern. These reports can be found at:
http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/index.aspx.

MDE reiterates that each entry in Category 4a has a TMDL established at a level to meet applicable water quality standards for the specific pollutant and the specific segment.

WKC Condensed and Paraphrased Comment 20: The commenter reiterates their concern, previously expressed in the 2016 Integrated Report, that even after several years, there are a number of impaired segments of waterways listed in Category 5 that have not yet received TMDLs. The commenter feels that there is little to no justification for why these impaired waterways have not yet received a TMDL over the years, some of which have been listed for over a decade.

MDE Response: MDE acknowledges the receipt of the comments previously submitted and refers the commenter to the Department's responses on the previous Integrated Report (starting on page 140 of Maryland's 2016 Integrated Report). The report can be found at: http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.aspx. Additionally, MDE recommends that the commenter review Tables 31 and 32 in Section C.3.5 of this Integrated Report to see the list of TMDLs/WQAs that the Department intends to submit to EPA in the next two years. The Department continues to make every effort to develop TMDLs for applicable waterbody-pollutant combinations. As mentioned in the 2016 IR, assessment and modeling challenges can sometimes delay the development of specific TMDLs. However, the Department is committed to addressing these challenges in a thoughtful and scientifically-defensible manner. There are numerous steps in the process of providing a credible water quality assessment and having a completed EPA-approved TMDL that cannot be efficiently described in the Integrated Report. If the commenter would like more information about specific assessment records and progress towards a completed TMDL, the Department recommends that you contact Becky Monahan at becky.monahan@maryland.gov or 410-537-3947.

WKC Comment 21: The South Branch of the Patapsco River is listed as Category 5, but the pollution source and cause of the impairment (i.e. Fish and Benthic IBIs) are unknown. While a TMDL is scheduled for development within the next two years for this water segment, it's unclear how a TMDL will be developed when MDE does not know what constituent needs to be addressed.

MDE Response: In the case of the South Branch Patapsco River, a biological stressor identification (BSID) analysis will need to be completed prior to TMDL development. The BSID analysis will hopefully elucidate the impairing pollutant(s) which will then be slated for TMDL development. For additional information about the BSID process please visit: http://mde.maryland.gov/programs/Water/TMDL/Pages/bsid_studies.aspx.

WKC Comment 22: MDE is violating the state's antidegradation policy by failing to approve TMDLs for Category 5 waterways also categorized as Tier II waterways. For instance, parts of the Patuxent River are listed on Category 5 and have not received a TMDL for years, despite being categorized by MDE as Tier II waterways. These segments have been impaired for years by harmful pollutants without the assignment of TMDLs by MDE to protect the quality of those waterways – this seems to be in direct violation of COMAR 26.08.02.04-1, or the "Antidegradation Policy Implementation Procedures."

MDE Response: MDE would like to clarify that it is not the Department which has approval authority for TMDLs but rather EPA. Most often, the Department develops a TMDL for a particular waterbody-pollutant combination and then submits the TMDL documentation to EPA for approval. The Department takes protection of the State's Tier II waters very seriously and has developed review processes under its authority to meet the requirements of COMAR Section 26.08.02.04. It should be noted that MDE developed a TMDL Prioritization Process which was discussed in detail and open for public comment during the 2016 IR. This prioritization list is what largely informs the Department's TMDL workplan for the years leading up to 2022. It should be noted that some of the TMDLs on this prioritization list coincide with watersheds containing Tier II waters including the planned sediment TMDLs for the Lower Choptank River watershed, Upper Choptank River watershed, Marshyhope Creek watershed, Upper Chester River watershed, Middle Patuxent River watershed, and Lower Patuxent

River watershed. If the commenter has specific recommendations as to how this priority list should be updated or modified, they should contact Greg Busch at gregory.busch@maryland.gov.

WKC Comment 23: The commenter reiterates their concern, previously expressed in the 2016 Integrated Report, that many waterways listed as Category 3 have been listed as such for many years now, with no progress made on obtaining any new information to decide whether water quality standards are being met. Many of the notes remained exactly the same from the 2016 IR to the 2018 IR. Further, many of the waterways have been listed (in Category 3) for significantly more than two years. It is important that MDE gather more information on these waterways and work with local water quality organizations to ensure that water quality standards are being attained and that Maryland's anti-degradation policy is being followed.

MDE Response: MDE acknowledges the receipt of comments previously submitted by Waterkeepers Chesapeake and refers the commenter to the Department's responses on the previous Integrated Report (starting on page 144 of Maryland's 2016 Integrated Report). The report can be found at: http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.aspx. The response provided in 2016 is still relevant and continues to express the Department's position and strategy for addressing Category 3 listings. The Department continues to make progress in sampling Category 3 waters, focusing most recently on nutrient assessments for several impoundments (e.g. Hunting Creek Lake, Cunningham Lake, and others) and also collecting temperature data in several unassessed streams.

WKC Condensed and Paraphrased Comment 24: The Jones Falls and Gwynns Falls watersheds are listed as Category 2 waterways (on the Integrated Report) for Total Phosphorus, meaning that they are meeting current water quality standards and are not impaired due to this constituent. However, the Integrated Report uses Dissolved Oxygen measurements as a surrogate indicator for Total Phosphorus. Blue Water Baltimore has direct measurements of Total Phosphorus in much of the Jones Falls and Gwynns Falls watersheds showing that these waterways exceed the Mid-Atlantic Tributary Assessment Coalition (MTAC) threshold levels of TP that negatively affect benthic macroinvertebrate health (i.e. IBI scores). Blue Water Baltimore has routinely shared this data directly with MDE through its solicitation process. There are multiple stream segments in both the Gwynns Falls and Jones Falls watersheds that routinely receive water health scores of Moderately Poor, Poor, or Very Poor based on Total Phosphorus content. While the State of Maryland has not yet promulgated numeric water quality standards for total phosphorus, using direct measurements of this constituent is an appropriate method for determining waterway impairments based on IBI scores.

MDE Response: The Department appreciates Blue Water Baltimore's (BWB) efforts in collecting, analyzing, and submitting water quality data to the Department. MDE has used several of BWB's monitoring parameters for IR assessment purposes. While the MTAC thresholds may serve as a valuable comparison tool, these thresholds are not water quality standards and have not gone through the same level of scientific scrutiny and other processes that a water quality criterion must undergo.

In addition, the Department has completed biological stressor identification analyses for both the Jones Falls and Gwynns Falls watersheds using physical, chemical, and biological data from DNR's Maryland Biological Stream Survey (MBSS) data. In the analyses for each watershed, none of the nutrient stressor indicators (i.e., total nitrogen, total phosphorus, dissolved oxygen, etc.) showed a significant association with degraded benthic macroinvertebrate or fish communities. To read the BSID reports for each watershed please visit the following internet links.

- Gwynns Falls: http://mde.maryland.gov/programs/Water/TMDL/Documents/BSID_Reports/Gwynns_Falls_BSID_Report_020912_RevisedFinal.pdf
- Jones Falls: http://mde.maryland.gov/programs/Water/TMDL/Documents/BSID_Reports/Jones_Falls_BSID_Report_020912_revisedfinal.pdf.

Given the results of the two BSID analyses, the Department respectfully disagrees that the available data confirms the presence of a total phosphorus impairment of the nontidal Gwynns Falls and Jones Falls streams. Even so, both of these watersheds will still be required to reduce nutrient pollution so as to meet the nutrient loading rates specified in the TMDLs for the downstream tidal waters including the Patapsco River Mesohaline (PATMH) and others.

WKC Comment 25: The commenter reiterates their concern, previously expressed in the 2016 Integrated Report, that MDE should make clearer any designation changes from previous IRs for increased public participation and awareness. In order to assess any changes to designations from previous reports, MDE should simply add a column to Parts F.2 – F. 7 that includes the waterway's designation from the prior report. This would make it easier for the public to see whether there have been any changes, improvements, degradations, or assigned TMDLs over the prior two years. This information is essential not only for transparency, but will allow citizens and water quality organizations to more easily assess whether water quality standards are being attained in their watersheds.

MDE Response: MDE acknowledges the receipt of comments previously submitted by Waterkeepers Chesapeake and refers the commenter to the Department's responses on the previous Integrated Report (starting on page 144 of Maryland's 2016 Integrated Report). The report can be found at: http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.aspx.

Tables 7, 8, 9, 10, 12, 13, 25, 29, 43, 44, and 45, in the text of this report, provide the information requested by the commenter.

Exelon Generation, 300 Exelon Way, Kennett Square, PA 19348, Colleen E. Hicks, Manager Regulatory and Licensing, Hydro.

Exelon Condensed Comment 26: The Report lists a new Category 3 (insufficient data) listing for "debris/floatables/trash" in Conowingo Reservoir. However, the Report neglects to acknowledge that upstream sources and operations are the source of the debris/trash that reach the Conowingo Reservoir. The source of debris/trash that reaches the Reservoir is upstream and the operations of upstream dams control the release of debris/trash to the Reservoir. Exelon does its part to intercept, trap, and remove debris and trash.

MDE Response: By placing the assessment for floatable debris in Conowingo Reservoir in Category 3, the Department acknowledges that there is insufficient information at this time to make a use attainment determination. The commenter seems to take issue with this assessment record because it does not mention any particular source of the floatable debris. However, the primary focus of Maryland's Integrated Report (IR) is on compiling water quality information to make use attainment determinations. Although the sources of pollution are sometimes identified in the IR for impairment listings when the source is obvious; most often, the sources of a pollutant are identified during TMDL development and are then added to the assessment record when it moves into Category 4a, following EPA approval. Also worth noting, it has been MDE's practice to not include a source of impairment for assessment records in Category 3, since impairment has not yet been determined.

Exelon Condensed and Paraphrased Comment 27: The commenter states their belief that the Category 4c listing for hydrologic alteration in the Lower Susquehanna River mainstem is inappropriate and that upstream influences, namely the presence of other upstream dams with differing flow controls, were not considered in the listing. The commenter disagrees with the level of biological impacts cited by the Department and to which the Department attributed to flow alterations on the Lower Susquehanna River mainstem.

MDE Response: Currently in Maryland, there are no numeric biological criteria for large (non-wadeable and non-tidal) river systems. Therefore, the IR cites a variety of biological impacts in the Lower Susquehanna River to demonstrate that the effects of flow alteration violate the narrative criteria which support the attainment of the aquatic life and wildlife designated use. In establishing the rationale for this assessment of impairment, the Department reviewed a comprehensive compilation of scientific information that supported the Category 4c listing for flow alteration. The Department and the commenter may interpret differently the extent to which the downstream biota are negatively impacted. However, some impacts, including unnatural hydrologic conditions and impediments to fish passage, are self-evident.

Since the impairment is due to flow alteration (changes in depth and flow velocity) which is categorized as pollution and not a pollutant, this assessment record was placed in Category 4c (impaired, pollution not caused by a pollutant). Flow alteration can be caused by the presence of the dam itself, as well as flows discharging from the dam. Also, as mentioned in MDE's response the comment above, the primary focus of the IR is to make use attainment determinations for waters of the State which it has done. The IR is not the appropriate instrument for establishing the cause or “remedy” needed to achieve attainment of the criteria.

Exelon Condensed and Paraphrased Comment 28: The Commenter states that the Conowingo Reservoir is not a reservoir but rather a “rapidly flowing river” and that as such, the chlorophyll a criteria used to assess Conowingo Reservoir are neither sufficient nor appropriate for assessment of total phosphorus. The commenter states that because the reservoir has a short residence time that applying the chlorophyll a criteria is not appropriate for the Conowingo Reservoir. The commenter also states that the chlorophyll a data used to assess the Conowingo Reservoir as impaired was insufficient to assess the criteria. The commenter also states that the data do not support the association of chlorophyll a and total phosphorus enrichment derived from sediment.

MDE Response: The Conowingo Reservoir is an impoundment created by the Conowingo Dam. The impoundment is used as a drinking water supply. Therefore, the Reservoir is subject to the chlorophyll a criteria used to protect the water supply designated use in impoundments. Excess total phosphorus is the pollutant and cause of elevated chlorophyll a levels in the reservoir. The available data clearly show that the chlorophyll a criteria are exceeded during the growing season as specified in regulation, thus requiring a category 5 listing, and, a TMDL (unless measures taken by Exelon in the context of compliance with the April 27, 2018 401 Water Quality Certification (WQC) address the non attainment issue). The Department respectfully disagrees with the commenter's assertion that the data used to support this impairment listing is insufficient and has shared the data with the commenter. Regardless, additional chlorophyll a data will be collected by the commenter per the conditions of the aforementioned 401 WQC.

Regarding the commenter's assertion that the levels of chlorophyll a above the criteria are not associated with the sediment that has accumulated upstream of the Conowingo Dam, the Department again highlights that the primary focus of the IR is making use attainment determinations and identifying the pollution or pollutant that is violating water quality standards. The commenter should note that the Category 5 listing for total phosphorus in the Conowingo Reservoir does not have a source identified (instead the listing states “Source Unknown”) in the “Source” identifier field.

Exelon Condensed and Paraphrased Comment 29: With regard to the Conowingo Reservoir impairment listing for PCBs in fish tissue, the draft IR does not explain MDE's contention that PCBs in fish tissue are caused by PCBs in sediments from Conowingo Reservoir. It is not transparent as to how data are used to support the Category 5 listing for PCBs in Conowingo Reservoir and therefore should be listed as a Category 3.

MDE Response: As mentioned in MDE’s previous responses to Exelon’s comments, establishing the source of a particular pollutant is not the primary focus of the IR. In this case, contaminated sediments were presumed to be the largest source of PCBs causing this impairment. However, in light of the TMDL currently being developed for PCBs, which will provide a more robust PCB source identification, the Department will replace the currently specified source, “Contaminated Sediments”, with “Source Unknown” on this Integrated Report. Regardless of the source, elevated levels of PCBs have been repeatedly documented in the entire Susquehanna River basin, including the Conowingo Reservoir. More than adequate data exist to make that determination. Furthermore, MDE has contributed data to the Water Quality Portal for all fish tissue assessments for the Conowingo Reservoir. Due to the volume of this data, it has not been included here. However, if the commenter still has trouble locating this data in EPA’s Water Quality Portal, please contact Amy Laliberte at amy.laliberte@maryland.gov.

Exelon Condensed and Paraphrased Comment 30: The IR fails to comply with the requirements of Section 305(b) of the Clean Water Act and associated regulations by failing to conduct the necessary cost/benefit analysis of potential TMDL implementation.

MDE Response: MDE acknowledges the utility of a cost-benefit assessment to evaluate public investment in water quality restoration. However, there are many difficulties in providing such information in a format for useful comparisons. Even so, the Department has provided readily available information in the report and therefore respectfully disagrees with the commenter that the report does not meet applicable requirements.

Susquehanna River Basin Commission, 4423 N. Front Street, Harrisburg, PA 17110-1788, Andrew D. Dehoff, Executive Director, Susquehanna River Basin Commission.

SRBC Comment 31: The existing Conowingo Hydroelectric Project intra-daily peaking operations create a severely altered flow regime in which conditions on the Susquehanna River downstream of the dam routinely fluctuate rapidly between drought (minimum flow) and flood (generation flow) conditions in a single day. The dam itself and the rapidly fluctuating flow conditions resulting from Conowingo's operations significantly impact persistent suitable habitat and hydrologic cues of resident and migratory fishes, cause stranding and mortality of various aquatic organisms, and affect surface water quality.

Excess nutrients, coupled with the higher water temperatures that occur in impounded versus free-flowing waters have profound implications for public water suppliers with intakes in, as well as downstream of, Conowingo Reservoir. Algal blooms produce a suite of challenges and negative consequences for public water suppliers including: strain on filtering and disinfection capabilities, production of harmful by-products, and requirements to suspend intake or switch to secondary sources. By listing total phosphorus as an impairment cause for Conowingo Reservoir, Maryland acknowledges the challenges faced to ensure that its Public Water Supply is safe, affordable, and without undue environmental side effects.

MDE has added several listings for the Conowingo Reservoir and segments of the Susquehanna River downstream of the reservoir to the Draft 2018 IR that the Commission believes will be beneficial to our joint efforts to improve the health of the Susquehanna River and its ecosystems, as well as the public water suppliers within the listed reaches. The Draft 2018 IR includes a new Category 5 listing for total phosphorus in the Conowingo Reservoir and identifying chlorophyll-a as an indicator, a new Category 3 listing for debris in the Conowingo Reservoir, and a new Category 4c listing for flow alteration highlighting changes in depth and flow velocity for the portion of the Susquehanna River immediately downstream of the Dam. The Commission supports each of the new additions to the IR, and thanks MDE for the opportunity to provide comments.

MDE Response: MDE appreciates the commenter's input and looks forward to continued collaboration on various water quality restoration and protection efforts in the Susquehanna River basin.

Clean Chesapeake Coalition, 120 Speer Road, Suite 1 Chestertown, Maryland 21620, Ronald H. Fithian, Chairman and Kent County Commissioner, Clean Chesapeake Coalition.

CCC Comment 32: Notably, and of keen interest to the Coalition counties, the previously neglected but now collected data and information has helped to inform a new Category 5 listing for total phosphorus in the Conowingo Reservoir, a new Category 3 (insufficient data for assessment) listing for surface debris in the Conowingo Reservoir, and Maryland's first ever impairment listing (Category 4c, – impaired by pollution not caused by a pollutant) for flow alteration (changes in depth and flow velocity) for the portion of the Susquehanna River immediately downstream of the Dam and extending to the head of tide. Even though TMDLs are not required for waterbody impairments assigned to Category 4c, the State can, and is hereby encouraged to utilize all water quality management and restoration approaches at its disposal to address the sources of impairment. In this case of downstream water quality (and habitat) impairments due to the alteration of natural river flow by Conowingo Dam, the pending WQC application review by MDE for Dam relicensing is an appropriate regulatory mechanism by which to impose conditions on the operations and maintenance of the Dam to address and minimize such impairments.

MDE Response: The Department appreciates the commenter's suggestion and will take it under advisement.

CCC Comment 33: The commenter notes that the verified amount of chlorophyll a in the Conowingo Reservoir indicates an excessive level of total phosphorus accumulated along with an enormous amount of sediment. The Report's information and category listings with respect to Conowingo Dam and the Lower Susquehanna River confirm the downstream threats posed by the accumulated nutrient-laden sediments in Conowingo Reservoir whenever heavy rains and storms trigger the scouring or flushing of those pollutants out of the Reservoir and into the upper Bay in shock loading proportions.

MDE Response: At the time that this report was written, the current science on the water quality in the Conowingo Reservoir has not established a definitive link between the accumulated sediments behind the Conowingo Dam and the levels of phosphorus which led to high chlorophyll a readings in the Reservoir. This potential linkage will likely be studied in the future as the Chesapeake Bay Program Partnership (which includes Maryland) works toward meeting its commitment to develop a Conowingo WIP for nutrients and as Exelon, in the context of meeting requirements of the 401 WQC, further studies the chlorophyll A issue in the Reservoir and, as necessary, develops its plans to address the issue.

CCC Comment 34: The commenter reiterates the following questions previously expressed during the public review period for the 2016 Integrated Report. How will the PCB pollutants be analyzed in the Conowingo Reservoir and downstream? Is the State of Maryland working with

Pennsylvania in conducting a PCB study in the Conowingo Reservoir? What other types of toxic contaminants will be characterized in the Conowingo Reservoir?

MDE Response: MDE acknowledges the receipt of comments previously submitted by Clean Chesapeake Coalition and refers the commenter to the Department's responses on the previous (2016) Integrated Report (starting on page 140 of Maryland's 2016 Integrated Report). This report can be found at:
http://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/2016IR.aspx.

CCC Comment 35: Given that approximately 3,000 acres of Conowingo Reservoir are in Maryland and the other 6,000 or so acres of the 9,000-acre reservoir are in Pennsylvania, coordination and consensus among these neighboring states is imperative in order to achieve measurable water quality improvement in the Lower Susquehanna River. Can this Report be used to compel Pennsylvania to finally list the Susquehanna River as impaired?

MDE Response: The Department agrees with the commenter that coordination among jurisdictions and the utilization of all regulatory and non regulatory tools and approaches is important for managing interjurisdictional water quality issues. Due to the flexibility afforded to states for establishing their individual monitoring and assessment priorities, Maryland's decision to list the Reservoir as impaired for chlorophyll A does not, itself, compel Pennsylvania to list a waterbody in Pennsylvania as impaired.

CCC Condensed Comment 36: The Integrated Report spotlights the Bay TMDL recalibration (Midpoint Assessment) and significant water quality impacts attributable to Conowingo Dam as areas of special State concern. The new data and information in the Report should further justify the conditions recommended by the Coalition to MDE regarding the pending WQC for Conowingo Dam relicensing. We applaud MDE for its deliberate focus in the Report on impairments to Maryland water quality related to Conowingo Dam. As the Susquehanna River is the single largest source of pollution loading to the Maryland portion of the Chesapeake Bay, and it all flows through Conowingo Dam (even more so now that the Reservoir has lost all trapping capacity), there are significant cost efficiencies to be gained in tackling the Conowingo factor.

MDE Response: By collecting, compiling, and assessing additional water quality information and data from the Conowingo Reservoir and in the Susquehanna River, Maryland was able to address what was previously an under-assessed part of the State. The Department would like to clarify the commenter's statement regarding the "Susquehanna River being the single largest source of pollution". The Susquehanna River is the largest source of freshwater to the Chesapeake Bay and it carries a correspondingly large load of the nutrient-related pollution that makes it to the Bay. However, the commenter should be careful not to discount the significant pollution contributions (especially of nutrients and sediments) from local sources. Restoring water quality to the Chesapeake Bay requires action by entities across the watershed, including actions by Exelon to address nutrient pollution in discharges from the Conowingo Dam.