Maryland's DRAFT 2024
Integrated Report of Surface Water Quality

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ABBREVIATIONS

Abbreviation	Definition
AUID	Assessment Unit Identifier
BAV threshold	Beach Action Value threshold
BEACH Act	Beaches Environmental Assessment and Coastal Health Act
BMP	Best management practices
BSID	Biological Stressor ID
CDC	Center for Disease Control’s
CBP	Chesapeake Bay Program
CMC	Chesapeake Monitoring Cooperative
CWA	Clean Water Act
CFD	Cumulative frequency distribution
DO	Dissolved oxygen
ELISA	Enzyme linked immunosorbent assay
EPA	Environmental Protection Agency
EJ	Environmental justice
E. coli	Escherichia coli
GHG	Greenhouse gas
HAB	Harmful algal bloom
IBI	Indices of Biotic Integrity
IR	Integrated Report
MD	Maryland
MD DNR	Maryland Department of Natural Resources
MBSS	Maryland’s Biological Stream Survey
MOU	Memorandum of understanding
MS4	Municipal separate storm sewer system
NWCA	National Wetland Condition Assessment
PFAS	Per- and polyfluoroalkyl substances
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PCBs	Polychlorinated biphenyls
PEPCO	Potomac Electric Power Company

QA/QC	Quality assurance/quality control
QAPP	Quality assurance project plan
SDWA	Safe Drinking Water Act
SHA	State Highway Administration
SAV	Submerged aquatic vegetation
SO4	Sulfate
TDS	Total dissolved solids
TMDL	Total maximum daily load
TN	Total nitrogen
TP	Total phosphorus
TSS	Total suspended solids
USGS	United States Geological Survey
DEQ	Virginia Department of Environmental Quality
WSA	Water and Science Administration
WQS	Water quality standards
WSP	Water Supply Program

DEFINITION OF TERMS

Term	Definition
Assessment Unit	A specific waterbody portion that an assessment applies to. Assessment unit sizes differ based on the assessment conducted. These sizes range from large (e.g. Maryland 8-digit watersheds and Chesapeake Bay segments) to small (e.g. from one confluence to another in a stream).
Parameter	The pollutant or characteristic being assessed.
Designated Use	The goal for water quality as determined by the intended uses of a specific waterbody.
Assessment Record	An assessment unit, parameter, and designated use combination. There can be multiple assessment records for a given assessment unit.
Reporting Category	The five-category approach to classifying the attainment status of each assessment record. Detailed descriptions of each category are provided in section A.3.
Impairment	Assessment records that are not meeting water quality standards for their designated use. These are in reporting categories 4 (TMDL not necessary) and 5 (TMDL required).
Listing	A term that refers only to Category 5 impairments. This terminology came from being 'listed' or placed on the 303(d) list of impaired waters.
Delisting	When an impairment (Category 4 of 5) comes off the impaired waters list and is supporting the designated use.

INTEGRATED REPORT EXECUTIVE SUMMARY

Maryland's 2024 Integrated Report (IR) presents the status of water quality in Maryland alongside the State's efforts to monitor, assess, and improve the biological, chemical, and physical integrity of its waters. As with Maryland's previous IRs, it is submitted in compliance with sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA).

In the 2024 IR cycle, The Maryland Department of the Environment (MDE) collected data from 47 water quality programs for the period between January 1, 2017- December 31, 2021. For a given assessment unit, these data were compared against the water quality standards and thresholds specific to the parameters and designated uses assessed. Assessment records, defined as an assessment unit, parameter, and designated use combination, that do not meet standards are considered impaired (Category 4 and 5). Assessment records that are not impaired include those that are meeting standards (Category 2) and those that do not have sufficient information to make assessment decisions (Category 3). In the 2024 IR cycle, Maryland assessed 798 assessment units and 20 parameters for a total of 919 assessment records.

In comparison to the previous combined 2020-2022 IR, Maryland added a net difference of 250 impaired and 225 not impaired assessment records to its 2024 IR. These net differences reflect the many removals, additions, category changes, and splits that occur during an IR cycle.

Given their regulatory importance, Maryland specifically tracks the additions and removals of impairments included in these net differences. Maryland added 329 new impairments to its IR, including assessment records never assessed before and those changed into impaired categories. Of the impairments added, 293 were Category 5 listings. These are of particular importance and are approved or disapproved by EPA under section 303(d). Table 1 below shows the notable parameters or parameter groups contributing to these Category 5 listings.

Table 1: Notable 2024 IR Category 5 Listings by Parameter or Parameter Group

Parameter	Assessment Record Count	Assessment
Temperature	196	Temperature in Class III and III-P Cold Water Streams
Bacteria	52 (43 shellfish and 9 beach listings)	Shellfish Harvesting and Beaches
PFOS	36	Fish Tissue
Nutrients	6	Lakes

Despite this IR cycle's large number of new impairments, specifically Category 5 listings, there were also 71 delistings, meaning assessment records that moved from an impaired Category (4a, 4b, 4c, 5) to Category 2. Table 2 below shows the notable delistings by parameter.

Table 2: Notable 2024 IR Delistings by Parameter

Parameter	Assessment Record Count	Assessment
Fecal Coliform	28	Shellfish
Sulfate	22	Sulfate Reassessment
Mercury	2	Fish Tissue
PCBs	6	Fish Tissue
Oil	5	Oil Spill

In addition to these delistings, one TMDL was completed in the 2024 cycle for total suspended sediments in the Baltimore Harbor.

Overall, including the 2024 IR cycle changes, Maryland has a total of 2071 assessment records documenting water quality status. Of these assessment records, 59 percent are impaired, 9 percent require more information to assess whether they meet standards, and 32 percent meet some water quality standards. Nutrients, sediment, temperature, and bacteria pollution are some of the leading causes of these impairments across the state. Of the impaired assessment records, 41 percent have a completed Total Maximum Daily Load (TMDL) meaning a pollution reduction target is already in place.

The following sections of this report provide details on Maryland's IR water quality assessment process; the 2024 assessment results, which expand on the highlights discussed above and includes discussion of water quality trends; the State's challenges and achievements; and an overview of MDE's monitoring and pollution control programs.

This IR document is accompanied by other resources, including a copy of the IR database, that allows users to view detailed information for a single assessment record as well as view every assessment record in the State. Upon EPA approval of the 2024 IR, MDE will publish an updated version of the MDE Water Quality Assessment Map, which displays this water quality assessment information along with watersheds that have TMDLs. The Department will also publish an updated Searchable Integrated Report on the MDE website that enables users to search on a variety of database fields. Lastly, EPA's How's My Waterway provides both summary information for all of Maryland as well as a searchable interface for users to explore areas of interest and see the data spatially.

2025-2032 Vision for Clean Water Act Section 303(d) Program

In addition to the typical information provided with the IR, Maryland has developed its 2025-2032 Vision for CWA Section 303(d) Program document and is releasing it alongside the 2024 Integrated Report for public review and comment. This document builds off Maryland's previous Vision covering 2016-2022. This Vision updates MDE's prioritization and planning goals and identifies Maryland’s priorities related to addressing Category 5 listings, along with the rationales for those priorities. Throughout this document, actions towards the other CWA Vision goals are integrated where applicable. The Vision is included as Appendix C in this Integrated Report.

PART A: ASSESSMENT BACKGROUND

Maryland's Integrated Report (IR), when approved by the Environmental Protection Agency (EPA), will satisfy Sections 303(d), 305(b) and 314 of the federal Clean Water Act (CWA). The CWA requires States, territories, and authorized tribes to 1) develop water quality standards for all jurisdictional surface waters; 2) monitor these waters; and 3) identify and list those waters not meeting water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as fishing, swimming, drinking water supply, and oyster propagation and harvest. Each use has associated water quality criteria, both numeric and narrative (see Code of Maryland Regulations 26.08.02). Waters that do not meet standards may require a Total Maximum Daily Load (TMDL) to determine the maximum amount of an impairing substance or parameter that a particular water body can assimilate and still meet water quality criteria.

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. Besides being required by EPA, the IR serves many other purposes relating to water quality planning for several state, county, and local agencies. By providing an update on the status of water bodies, the IR helps to prioritize which watersheds should be addressed by restoration and which watersheds need protection.

In Maryland, the Maryland Department of Environment (MDE) and the Maryland Department of Natural Resources (MD DNR) are the two principal agencies responsible for water resources monitoring, assessment, and protection. MD DNR is the primary agency responsible for ambient water monitoring. MDE sets water quality standards (WQS), compiles, and assesses water quality data, submits the Integrated Report, regulates discharges to Maryland waters through multiple permits, enforcement, and compliance activities, and develops TMDLs for impaired waters.

As done previously, MDE is submitting this IR to EPA through the Assessment, TMDL Tracking and Implementation System (ATTAINS), an online system for accessing information about the condition of the nation's surface waters. As in previous reports, MDE utilized the ATTAINS reporting function to produce all assessment results and summary calculations in the report. All IR information will be made available in ATTAINS through web reports and other query tools.

ATTAINS data are made available to the public through EPA's How's My Waterway interactive webpage and mapping tool and the ATTAINS homepage contains general information about the ATTAINS reporting system. MDE will also continue to make Maryland's IR information available to the public in several user-friendly formats on MDE's webpages. Accessible via the web, MDE will provide a full copy of the IR database in excel format for users to query. Users can also query MDE's searchable IR database tool or clickable map to find individual assessments or groups of assessments that are of interest. MDE will also continue to maintain the water quality assessment map, which displays water quality assessment information and TMDL watersheds. Users should note that the MDE's searchable database tool and water quality assessment map will only be updated following EPA approval of Maryland's IR. MDE also hosts a TMDL Data Center webpage online that contains documents, maps, and additional information on TMDLs.

A.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 3.

Table 3: Scope of Maryland's Surface Waters.

		Value	Scale	Source
State population		6,177,224	N/A	U.S. Census Bureau, 2020
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)	EPA, 1991
	Significant Publicly owned (number/acres)	60 lakes / 21,876	1:24,000 NHD Coverage	United States Geological Survey (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.

A.2 Monitoring Program

In December 2009, Maryland completed the last update of its comprehensive water monitoring strategy. Maryland's water quality monitoring programs are designed to support State WQS (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.

A.3 Reporting Categories

EPA utilizes five reporting categories to classify whether assessment units meet standards, require a TMDL, or need additional monitoring. These reporting categories can be generalized to entire assessment units or to specific assessment unit -parameter combinations. Maryland uses the assessment unit-parameter categories as reported from ATTAINS which include four of these categories. Doing this often causes a single assessment unit to have assessment records in multiple categories for different parameters. For example, Loch Raven Reservoir is listed in Category 4a (impaired, TMDL completed) for sedimentation/siltation and in Category 2 (meets WQS) for having levels of copper that meet WQS. This helps Maryland track the status of each parameter for which the assessment unit has been assessed. These categories are:

Category 2: Assessment record meeting WQS.

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 an assessment record's attainment status.

Category 4: Assessment record does not meet WQS and is impaired, 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.
- **Subcategory 4b**: Other pollution control requirements (i.e., permits, consent decrees, etc.) are expected to attain WQS; and,
- **Subcategory 4c**: Impairment is not caused by a pollutant (e.g., habitat is limiting, dam prevents attainment of use, etc.).

Category 5: Assessment record is impaired, does not attain the WQS, 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.

Subcategory 5s: Assessment record impairment is caused by chloride from road salt. Waters assessed in Category 5s are high priority to be addressed through pollution control requirements and restoration approaches, and lower priority for TMDL development. This category is a Maryland subcategory, meaning that it is counted simply as Category 5 in ATTAINS, How's My Waterway reporting, and the charts shown in Part B: Assessment Results of this report.

A.4 Designated Uses

For a given parameter assessed, a water body is considered "impaired" when it does not support a designated use [see Code of Maryland Regulations §26.08.02.02]. 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 warm water aquatic life.
Class II waters: Support of estuarine and marine aquatic life and shellfish harvesting.
Class III waters: Non-tidal cold water.
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. 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 parameters that can be monitored and quantified to known levels of precision and accuracy, such as toxins 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.

Maryland has uses and standards specific to the 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 for Chesapeake Bay and its tidal tributaries, including Migratory Fish Spawning and Nursery, Shallow-Water Submerged Aquatic Vegetation, Open Water Fish and Shellfish, Deep-Water Seasonal Fish and Shellfish, and Deep-Channel Seasonal Refuge.

For more information see MDE's Designated Uses Webpage, or use MDE's Designated Uses/Use Class Map to view an interactive map of Maryland's Designated Use Classifications. For more information on the Designated Uses in the Chesapeake Bay, see MDE's webpage on Chesapeake Bay Water Quality Standards.

The Federal CWA and its amendments require that states update their WQS every three years in what is referred to as the Triennial Review of WQS. This action includes a robust public comment process and is subject to review and approval by EPA. Maryland's WQS are updated through changes to the regulatory language in the Code of Maryland Regulations (COMAR). For more information please visit MDE's Water Quality Standards Webpage.

A.5 Data Sources

Section 130.7(B)(5) of the CWA requires that states "assemble and evaluate all existing and readily available water quality-related data and information" when compiling their Integrated Report. To provide the most comprehensive report, the Department relies on water quality data from a variety of sources including federal and state agencies, local government agencies, researchers, students, and watershed organizations. Because the IR is a regulatory document, data quality is a critical component of the evaluation and assessment process. Some data received may not be suitable for water quality assessments in the report. For the purposes of evaluating data submitted for Maryland's IR, MDE adopted a three-tier data quality system in alignment with the Virginia Department of Environmental Quality (DEQ) and the Chesapeake Monitoring Cooperative (CMC). MDE's data tiers are based on data quality and the authorized uses of the data provided to the agency. The tiers increase from Tier I to Tier III in conjunction with greater data standardization and quality assurance/quality control (QA/QC) protocols.

See Appendix A for the list of organizations and/or programs that submitted data to MDE for the 2024 IR. For more information on data quality tiers, please see MDE's webpage for submitting water quality data.

For the 2024 IR, MDE solicited for data collected for the period of January 1, 2017, through December 31, 2021. MDE used data outside this period in select instances where additional data was required by the assessment methodology or was necessary to make sound regulatory decisions.

Quality Control and Review of Water Quality Datasets

Data quality in Maryland's water monitoring programs is of the highest importance and defined through implementation of the agency's quality control program, Quality Assurance Project Plan (QAPP) for each monitoring program, and field and laboratory Standard Operating Procedures (SOP). Water monitoring programs supported in part or whole by EPA funding must have QAPPs approved by the EPA Regional or Chesapeake Bay Program Quality Assurance (QA) Officer prior to initiating monitoring activities.

Water monitoring programs conducted by a local agency, educational institution, consultant, or citizen group that intend to have their data used for regulatory decisions (Tier III data) should also have a QAPP consistent with EPA data guidance specified in Guidance for QAPPs (U.S. EPA 2002a). For state analysts to review these contributed data with any confidence, the quantitative aspects of these data need to be defined.

Once a QAPP or other reports defining monitoring objectives and quality control have been evaluated, the data are then reviewed for sufficient sample size, data distribution (type and outliers/errors) and spatial and temporal distribution in the field before they are assessed for regulatory use.

Please see MDE's webpage for submitting water quality data for more information on quality control and water quality data review.

A.6 Assessment Methodologies

Maryland has developed Assessment Methodologies to document the decision-making process by which water body impairment determinations are made. The assessment methodologies document the minimum data requirements, analytical/statistical methods, and other standard operating procedures used to determine if water quality standards are attained. 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 assessment decisions. The assessment methodologies are living documents that can be revised as new statistical approaches, technologies, or other improved methods are identified.

New for the 2024 reporting cycle, MDE held a separate public comment period for the draft assessment methodologies and responded to comments separately from the Integrated Report. For the 2024 reporting cycle, the Department made changes to three assessment methodologies. The Listing Methodology for Identifying Waters Impaired by Bacteria in Maryland's Integrated Report, The Fish Tissue Assessment Methodology section which is part of the Methodology for Determining Impaired Waters by Chemical Contaminants for Maryland's Integrated Report of Surface Water Quality, and the Temperature Assessment Methodology for Use III (-P) Streams in Maryland were all updated. The public was invited to review and comment on the methodologies between October 11, 2023, and November 12, 2023.

To see all of Maryland's current assessment methodologies, view the summary of the 2024 IR cycle assessment methodology updates, and review the 2024 assessment methodology comment response document, please see MDE's Assessment Methodology Webpage.

A.7 Assessment Results Disclaimers

Given the complexity of MDE's 2024 assessments, the presentation of results in the following sections has a few important caveats including net change reporting, impairment assessment bias, MDE's assessment unit size, and ATTAINS reporting category and use. Figures in the Assessment Results, sections B.1 and B.2, where these disclaimers apply reference this section.

Net Changes

In the Assessment Results section, MDE presents 'net change' assessment record statistics between 2022 and 2024. These calculations do not differentiate between new assessment records, existing assessment records that may have changed reporting category, and a select few removed assessment records in 2024. However, reporting the net change allows for a simplified summary to track the overall progress between the 2022 and 2024 cycles. This report also breaks down important individual additions and changes in its B.1 New Impairments- 2024 and Delistings-2024 subsections.

Impairment Assessment Bias

The following section also compares Category 2 assessment records to impairments, a useful practice to measure water quality progress in the state. However, historically, impairments were better tracked than Category 2 assessment records. This difference in documentation is due to more stringent 303(d) CWA regulations, which was referred to as 'The impaired waters list' rather than the 305(b) list. Going forward, Maryland is committed to tracking not only impairments but also non impairments.

Assessment Unit Count vs Size Statistical Bias

The Assessment Results section provides summary statistics of assessment both in assessment unit counts (e.g. for new impairments) and in assessment unit size (e.g. miles of streams by reporting category). In Maryland, assessment unit segment size depends on the given parameter. This differential complicates comparisons across parameters for these summary statistics. For instance, temperature assessment units span from one confluence to another confluence of a river whereas all biological, most inorganic, many sediment, and many bacteria assessment records are assessed at a watershed scale. Similarly, tidal nutrient assessments are for entire Chesapeake Bay segments whereas bacteria and sediment assessment records are much smaller sub segments that represent Shellfish and Submerged Aquatic Vegetation use areas in the Bay. Thus, parameter counts are biased towards parameters with smaller assessment unit sizes, like temperature assessment records. Whereas parameter size comparisons are biased towards parameters with larger assessment unit sizes, like biological, chloride, and nutrient assessment records. Despite this limitation, MDE varies the reporting to include comparisons by assessment unit counts, assessment unit size, and other ratios, revealing important assessment changes and water quality summaries that are discussed alongside these statistics.

Parameter and Use Reporting Using ATTAINS

Reporting categories and use attainment described in Part B: Assessment Results are calculated using EPA's ATTAINS system. MDE uses the four categories specific to assessment records as described in section A.3 along with ATTAINS's use attainment definitions.

Reporting the categories by assessment record means that water bodies with more than one parameter assessed are counted multiple times in count and size summary statistics. For instance, if a Chesapeake Bay segment has both a phosphorus and nitrogen assessment records, this assessment unit is counted twice in count statistics. Perhaps more significantly, the assessment unit's size is also duplicated in size statistics. Similarly, if a Chesapeake Bay segment has multiple phosphorous assessment records for different uses, that assessment unit would be counted multiple times. This reporting method explains why the chart showing parameter reporting categories shows that nutrient assessment records cover more than 12,000 square miles of estuary when there are only 2,451 square miles of bays and estuaries in Maryland.

Assessment units that overlap compound this issue. For instance, the chart showing use attainment for rivers shows over 22,000 miles of streams assessed for Aquatic Life and Wildlife use even though Maryland only has 19,127 total miles. This discrepancy is because if an assessment unit is assessed for more than one parameter, those parameters and associated assessment records can overlap each other since assessment scale is parameter specific and therefore, would be counted multiple times in the summary.

Additionally, charts showing use attainment default to the worst-case use attainment scenario for a given assessment unit. This means that if a certain assessment unit's use is being met for three parameters but not meeting standards for one, this assessment unit would be considered not meeting standards overall.

These approaches make total assessment statistics difficult to calculate. However, the advantage of this approach is that MDE can more accurately interpret the extent of certain parameters across an assessment unit and its uses.

PART B: ASSESSMENT RESULTS 2024

In the 2024 Integrated Report, Maryland assessed a total of 919 assessment records, almost double the amount in the combined 2020-2022 IR cycle. Table 4 below shows the number of assessments conducted in the combined 2020-2022 cycle vs. the 2024 cycle.

Table 4: Assessment Comparison– 2020-2022 vs 2024

Assessment Metric	Assessed in 2020-2022	Assessed in 2024
Assessment records	531	919
Assessment units	413	798
Parameters	20	20

These assessments led to many new and changed assessment records, meaning additions or alterations of assessment unit parameter combinations. This part of the report first summarizes these 2024 assessment record decisions and then provides a wider analysis of the status of Maryland's waters. A spreadsheet with all assessment records accompanies this section for users to explore specific waters of interest.

B.1 Overall Assessment Record Changes 2024

For the 2024 Integrated Report, Maryland added a net difference of 476 assessment records to its Integrated Report. The following figure breaks these changes down by reporting categories specific to assessment unit parameter combinations.

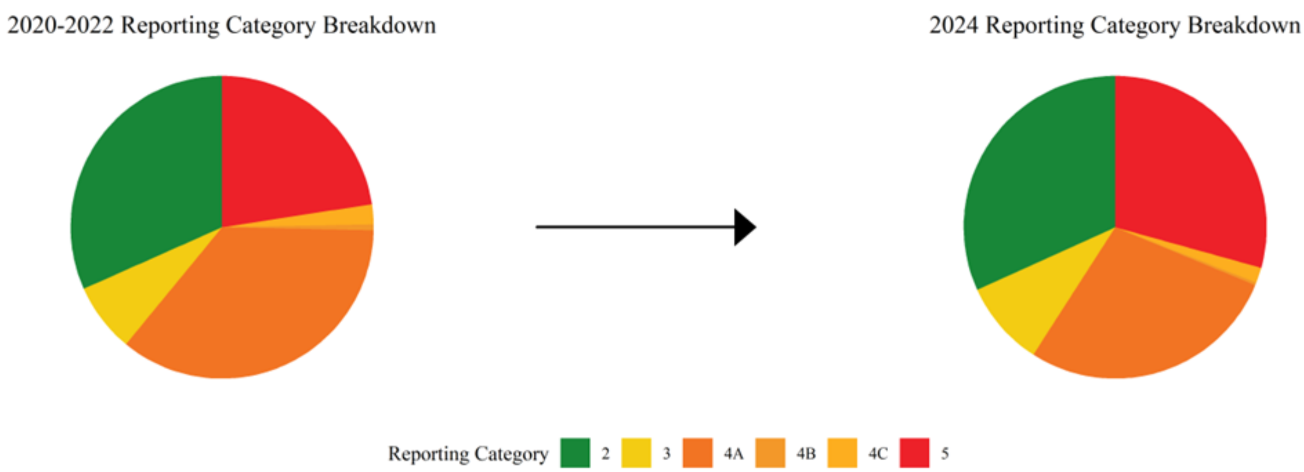

Figure 1: Reporting Category Changes Summary

Table 5: Reporting Category Changes Summary

Reporting Category	2020-2022 Counts	2024 Counts	Net Difference
2	505	659	+ 154
3	118	189	+ 71
4A	568	576	+ 8
4B	10	6	-4
4C	34	34	0
5	360	607	+ 247
Total	**1595**	**2071**	**+476**

See section A.8 for information on assessment results disclaimers.

Of the 476 net changes between the 2020-2022 IR cycle and 2024 IR cycle, 250 are impairments, which are Category 4 and 5 assessment records. 247 of those impairments are Category 5 listings, meaning impairments that are not covered by existing TMDLs. There is also a net difference of 154 assessment records that meet criteria for the parameter they were assessed for and were placed in Category 2. These Category 2 and 5 additions come from assessment records assessed for the first time that were placed directly into the respective categories and existing assessment records that moved into Category 2 or 5 after they met or failed water quality standards in 2024 assessments. Finally, a net change of 71 Category 3 assessment records were added in assessments where there was not enough information to determine if an assessment unit met the relevant water quality standard.

As previously mentioned, summarizing the net change doesn't differentiate between brand new 2024 assessment records, category changes, splitting/merging assessment units, or any other detailed change that take place during the two-year cycle, but instead allows for a simplified summary to track the overall progress between the 2022 and 2024 cycles. For details on the specific 2024 changes, see the results sections below.

Despite the increase in assessment records in 2024, the ratio of impaired to not impaired assessment unit parameter combinations remain relatively the same compared to the state's combined 2020-2022 IR assessment as shown in the following table.

Table 6: Impaired Ratio Comparison– 2020-2022 vs 2024

Assessment Record Status	2020-2022	2024
Impaired (Categories 4 and 5)	61%	59%
Not Impaired (Categories 2 and 3)	39%	41%

See section A.8 for information on assessment results disclaimers.

Maryland's waters are neither significantly more impaired nor less impaired than in 2020-2022, as demonstrated by similar ratios between the two cycles. However, the distributions of impairments and assessment records new and changed in 2024 are not evenly distributed across parameters. The following sections discuss these changes for new impairments and delistings. While the sections below highlight some of the main differences in the 2024 IR cycle, for a complete table of all the assessment records and changes in the 2024 IR cycle, please see the excel spreadsheet of the 2024 IR cycle assessment records.

B.1.1 New Impairments-2024

Maryland's monitoring focus on particular parameter groups was a driving reason behind the increase in new impairments this cycle. There were 329 assessment records added or changed into impairment categories (4 or 5) for the 2024 IR. This number doesn't include the delistings that moved out of impairment categories, which accounts for the total net difference of impairment categories detailed in the tables above. Of these new impairments, 293 were new Category 5 listings. The following table shows 2024 impairments by parameters, highlighting Maryland's monitoring and assessment work on temperature, Perfluorooctane sulfonic acid (PFOS), and shellfish bacteria data in the latest Integrated Report cycle.

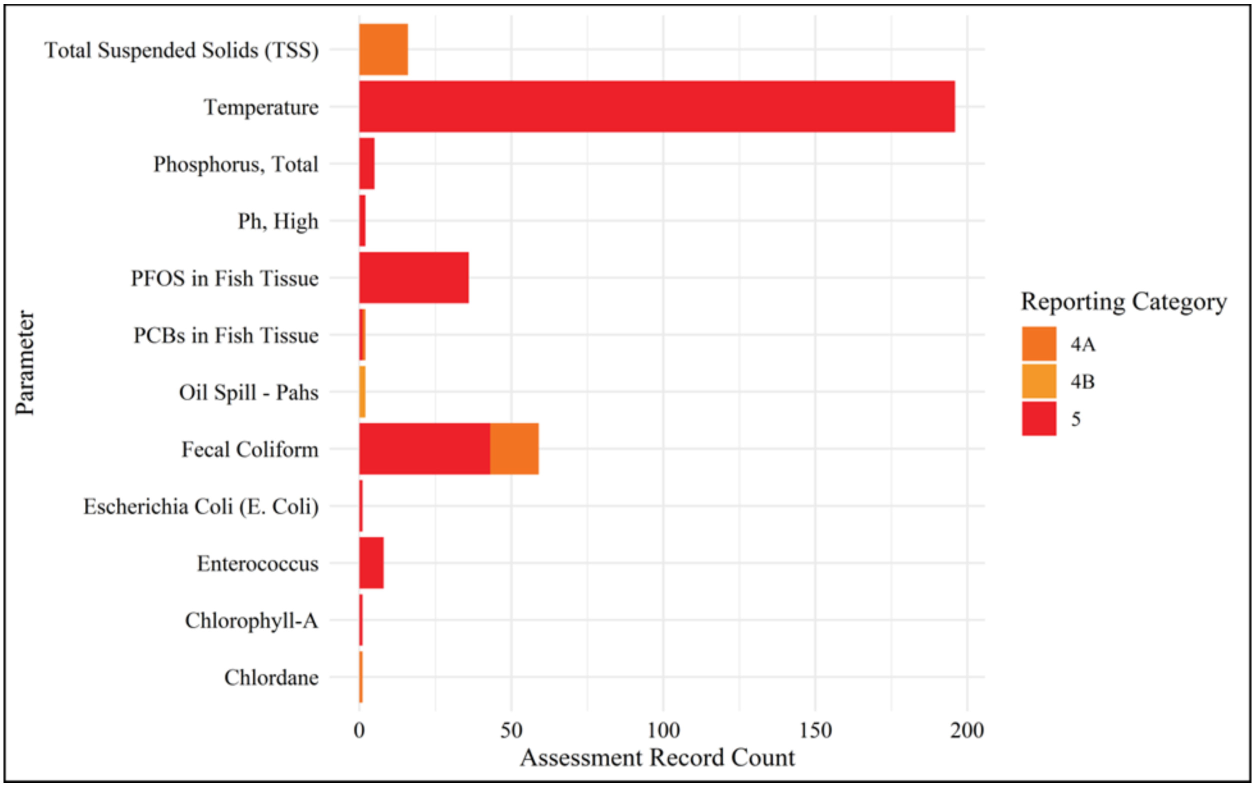

Figure 2: New Impairments by Parameter- 2024 (Includes Reporting Categories 4 and 5)
See section A.8.2 for more information on assessment results disclaimers.

One of the main reasons for the increase in new impairments, and particularly Category 5 listings, was MDE's comprehensive 2024 temperature assessment. This cycle, MDE used 10 years of continuous temperature data to assess Maryland use class III and III-P cold water streams. Data used for this assessment was provided by MD DNR's Maryland's Biological Stream Survey (MBSS) program, MD DNR Fisheries, the Antietam Conococheague Watershed Alliance, Trout Unlimited, and MDE Field Investigations and Environmental Response Program. The assessment of this much data was only possible due to updates to and automation of the assessment methodology. Overall, this assessment led to 196 new Category 5 impairments, 14 new Category 3 assessment records, 92 new Category 2 assessment records, and 1 delisting for temperature in use Class III and III-P waters. This thorough temperature assessment was necessary to assess the status of MD's waterways. Doing so may protect cold-water aquatic life from thermal impacts caused by climate change, stormwater, point source discharge, and other sources. For more information on the work MDE is doing to protect against climate change, see section C.3.

The monitoring and assessment of Per- and polyfluoroalkyl substances (PFAS) and perfluorooctane sulfonates, one of the more widely studied PFAS compounds, has also been a top priority for Maryland. MDE's field collection team sampled extensively for PFOS in fish tissue, resulting in 36 new Category 5 listings, 1 new Category 3 assessment record, and 14 new Category 2 assessment records. PFAS and PFOS monitoring and assessment will continue to be a focus for the department. For more information on MDE's work on PFAS and PFOS, see section C.2.

Bacteria impairments, including fecal coliform, enterococcus, and Escherichia coli (E. coli) were the other largest contributors of new impairments. Nine of these bacteria impairments resulted from the 2024 updated bacteria assessment methodology which assesses beaches for long term bacteria issues described further in section B.2.4 Beach Assessment Results. Out of these 9 beach impairments, there are eight beaches not meeting enterococcus standards and one new beach not meeting E. coli standards.

The remaining 59 fecal coliform impairments are for the shellfish harvesting designated use. Of these new impairments, 43 were Category 5 listings and 16 went directly into Category 4A since these assessment units were covered by an existing fecal coliform TMDL. Many of these new impairments were the result of splits in assessment units, which are necessary to accurately track which sections of the shellfish harvesting areas are meeting bacteria criteria and which are not. Tracking shellfish harvesting assessments and impairments is difficult due to the changes in assessment units necessary to accurately reflect the data, as well as the variability in the bacteria data. As such, these shellfish harvesting assessment records often change from cycle to cycle. MDE will continue to update its methodologies to better track these impairments in future cycles.

B.1.2 Delistings- 2024

In the 2024 IR cycle, MDE delisted 71 waters that were previously listed as impaired and are now meeting water quality standards. The rationale for most of these delistings was new data that indicated improved conditions. However, 22 of these delistings, for Sulfate specifically, were the result of an assessment method change. The following table breaks down these delistings by parameter and delisting reason.

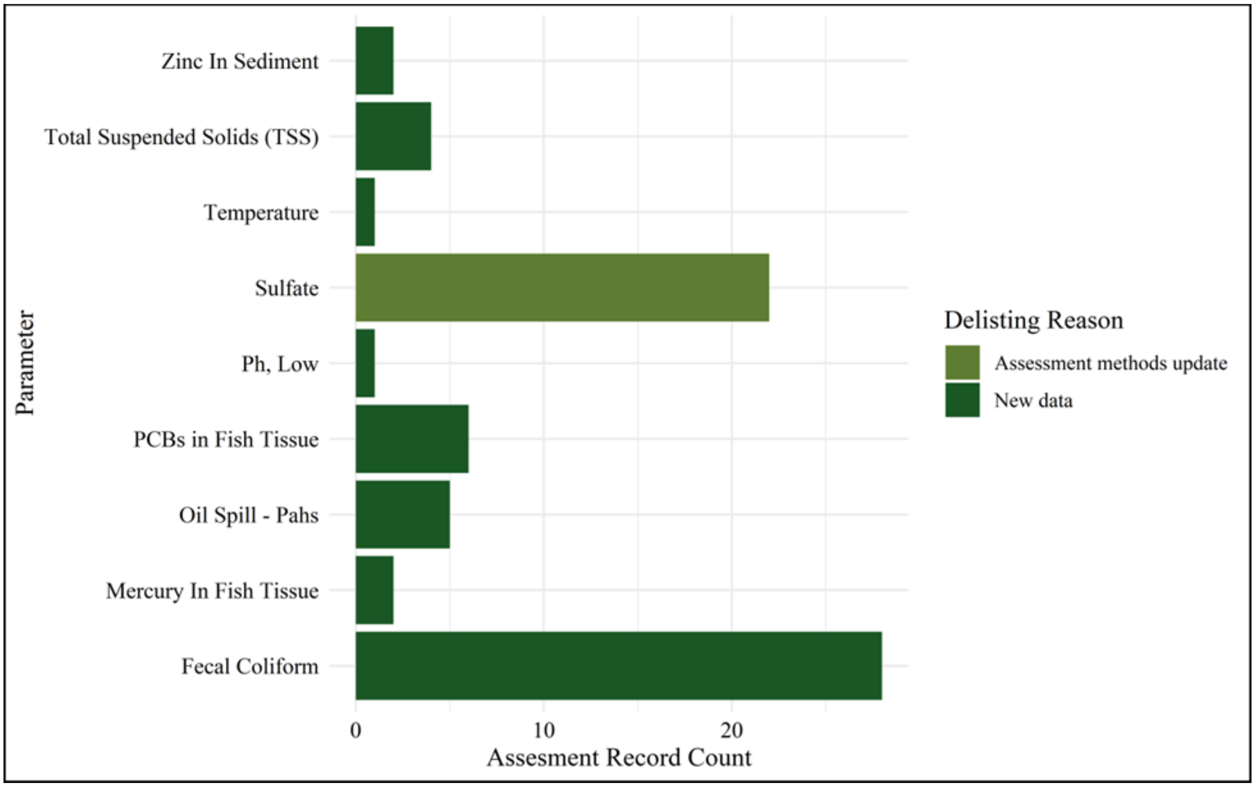

Figure 3: 2024 Delistings by Parameter (Composed of those delisted from Categories 4 and 5)

See section A.8 for more information on assessment results disclaimers.

In the 2024 cycle, MDE reevaluated all Maryland 8-digit watershed sulfate listings. These impairments were the result of the Biological Stressor ID (BSID) process that identified sulfate as the stressor to biological impairments. The listings were reevaluated this cycle due to inappropriately low sulfate thresholds in the BSID. Based on an extensive literature review, and in consultation with EPA, MDE replaced the previous BSID threshold with an ultra-conservative screening threshold. The assessment is further outlined in Appendix D. Of the 26 watersheds that were impaired based on the original BSID assessments, 22 watersheds passed the new conservative screening threshold. MDE delisted these 22 watersheds and moved them to Category 2 due to the assessment methods threshold update. The 4 remaining watersheds did not meet the updated thresholds and will remain impaired by sulfates. MDE will revisit them in the future for TMDL development.

MDE also reassessed all five previous Category 4b Patuxent River oil spill impairments, from the Potomac Electric Power Company (PEPCO) oil spill on April 7th, 2000, based on new data from the Qualitative Long Term Monitoring Plan. Persimmon Creek, Trent Hall Creek, and Indian Creek assessment units were all delisted since all stations meet criteria. These stations were also discontinued from monitoring. The other two delistings, Ramsey Creek and Swanson Creek, required splits, since each were monitored using two stations that had conflicting results. Thus, Ramsey Creek and Swanson Creek remain with a subsegment in Category 4b awaiting further monitoring. Based on these delistings and the two existing Category 2 assessment records, there are now seven assessment records meeting criteria out of nine total assessment records.

MDE also progressed with more delistings for both polychlorinated biphenyls (PCBs) and Mercury in fish tissue. Two impairments for mercury reached attainment as concentrations in fish have been steadily declining throughout Western Maryland due to natural attenuation. Mercury emissions from coal and oil-fired power plants, the predominant source of Hg in the environment responsible for bioaccumulation in fish, have declined substantially due to the implementation of Maryland's Healthy Air Act and EPA's Mercury and Air Toxics Standards. Many coal fired power plants have also been decommissioned since the 2010's as electrical energy production has shifted to natural gas and renewables. While PCBs remain persistent in the environment, levels have been steadily declining since their production and use in many commercial and industrial applications were banned in 1979. This decline may be explained by PCB natural attenuation, where PCB concentrations in soil and water decline as PCB contaminated sediments are slowly buried by the deposition of cleaner materials over time. In the 2024 cycle, six impairments for PCBs in fish tissue reached water quality standard attainment, which could be caused by this process.

Based on five years of tidal shellfish bacteria data, MDE also delisted 28 assessment units for fecal coliform. Of these delistings, 14 moved from Category 5 to Category 2 and 14 moved from Category 4a to Category 2. Many of these changes were the result of splits in assessment units. All assessment decisions followed the shellfish assessment methodology that was updated in the 2024 IR cycle as mentioned in section A.6.

In addition to the 71 delistings, four impairments for Enterococcus in the Port Tobacco Watershed for the water contact designated use were removed from Category 5 and from the Integrated Report all together because they were determined to be erroneous listings. In consultation with EPA, a weight of evidence approach, including more recent data in the surrounding area, was used to demonstrate that the original listings were not appropriate and there is not a bacteria impairment in those specific assessment units.

In addition to these delistings, MDE approved one TMDL for total suspended sediments in the Baltimore Harbor. As discussed more in section D.3 and Appendix C of this report, MDE will continue working on TMDLs and other restoration plans in the coming years to improve the quality of Category 5 impaired waters.

B.2 The State of Maryland Waters

The 2024 impairment changes, highlighted above, get added to MD's larger IR database that tracks the status of all of Maryland's surface water quality. The following figure shows the total current reporting categories by different parameters for all of Maryland, including the 2024 updates.

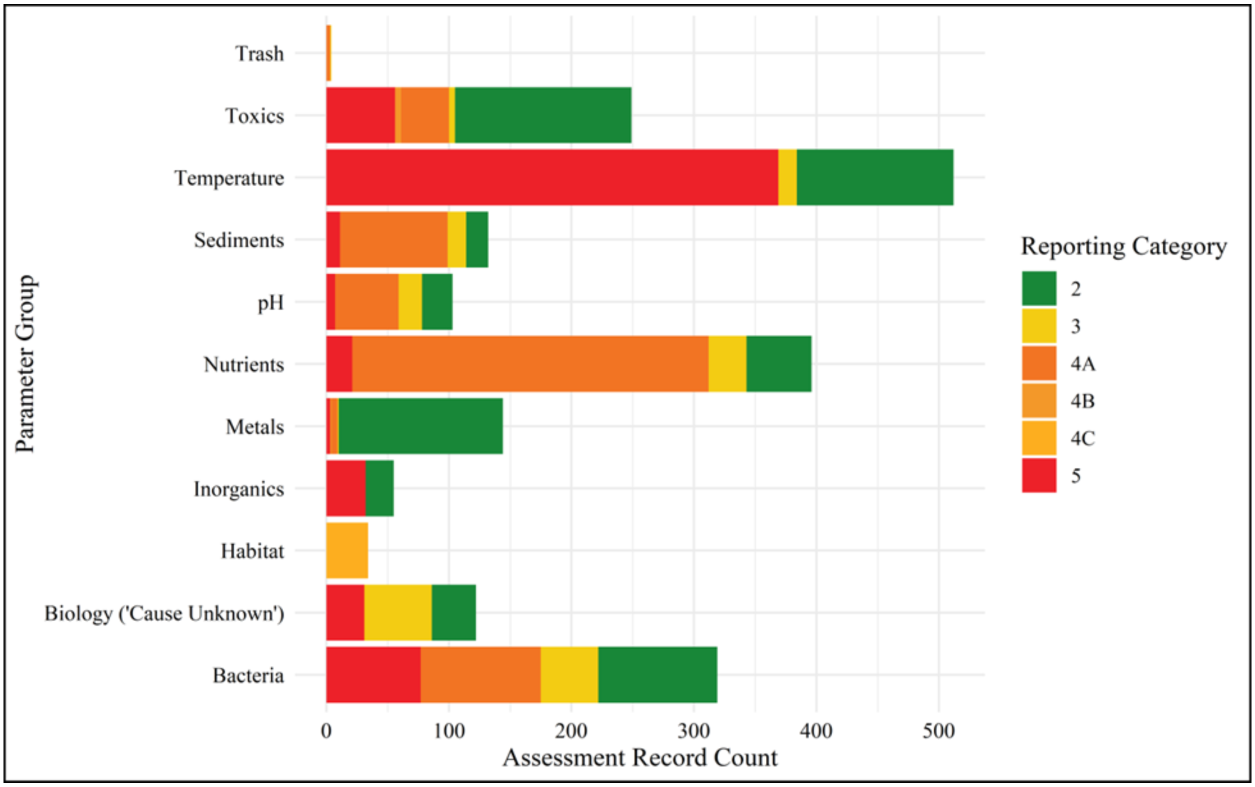

Figure 4: Reporting Category Results by Parameter Group
See section A.8 for information on assessment results disclaimers.

In 2024, nutrients and sediments remain some of the most persistent pollutants in Maryland, with few assessment records marked as meeting criteria. Nevertheless, these impairments, as well as the bacteria impairments, are mostly in Category 4a, meaning they have TMDLs already in place.

Elevated water temperature emerges as another notable impairment in MD as water temperatures have been increasing statewide and resulted in 196 new temperature impairment listings being added in the 2024 cycle. This brings the total number of temperature impairments to 369 listings across the state. See section B.3 for more information on increasing water temperature trends throughout the State.

For many impairments, Maryland has tracked predominant sources of pollution either through the TMDL or the BSID process. The sources for assessment records that have not gone through these processes are typically designated as 'source unknown', which is what is currently noted in 61% of impaired assessment records. However, for the 445 impairments that have been tracked, the following chart shows a breakdown of grouped sources by parameter. This table shows the primary or largest source of the parameter as identified through TMDL or other source tracking processes. There are typically many sources that could be contributors to each parameter and as such, it may be difficult to draw specific conclusions. In this figure, similar colors roughly denote similar types of sources.

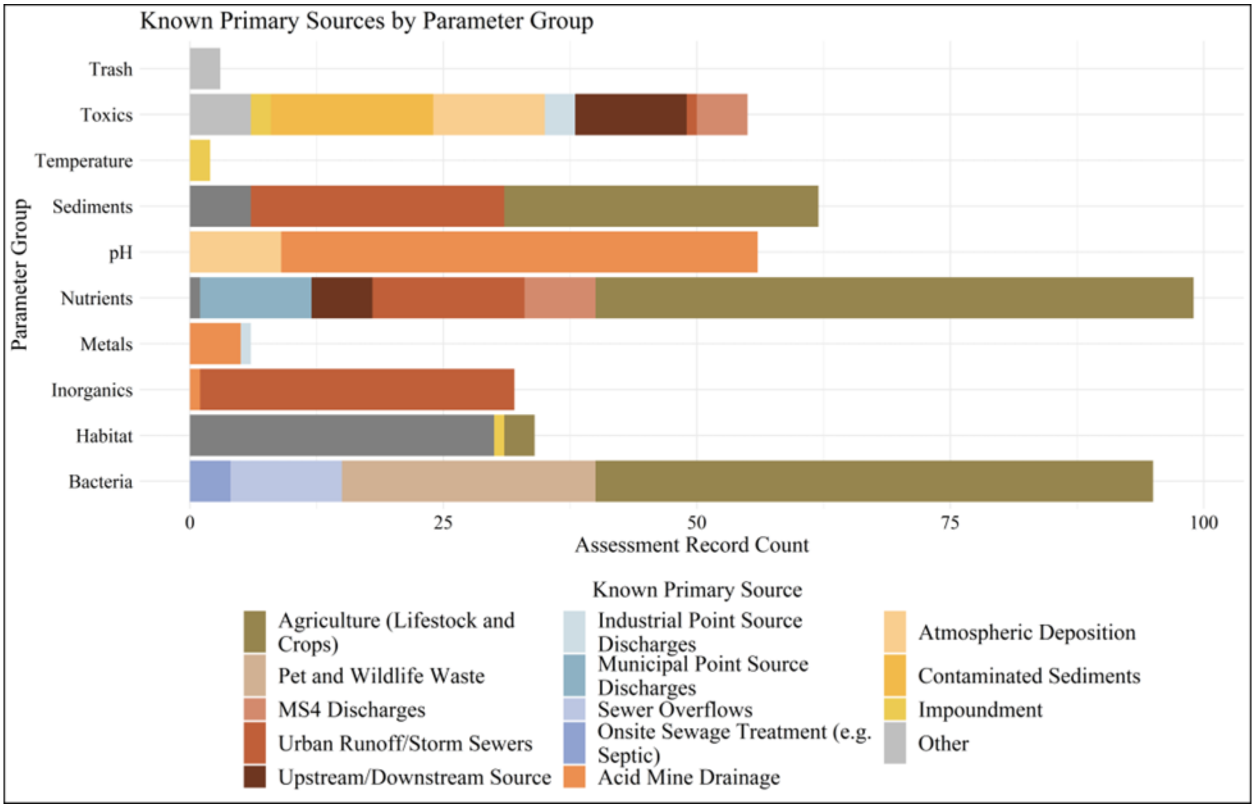

Figure 5: Primary Known Sources by Parameter Group

From MDE's data of the primary sources for given impairments, a few trends emerge. Non-point sources such as agriculture and urban runoff are some of the most prominent primary sources of pollution. This trend is especially true for nutrients and sediments, two of the Chesapeake Bay's most significant parameters. Bacteria pollution arises primarily from agricultural livestock waste, with waste from pets and wildlife contributing significantly as well. Unsurprisingly, habitat-based impairments tend to arise from habitat alteration; some common examples of these changes include channelization, hydrological modifications, or riparian development. Chloride pollution is largely caused by urban runoff and more specifically road salt runoff. Acid mine discharge along with atmospheric deposition are the predominant primary sources behind pH issues. Finally, toxics come from an array of sources; two primary sources listed are upstream or downstream sources and contaminated sediments. MDE not only tracks these sources of impairments but also works to control them through a variety of programs discussed in more detail in section D.3.

The next four sections break the overall assessment results seen above into information based on assessment unit waterbody type which includes estuaries, rivers/streams, lakes/impoundments, and beaches.

B.2.1 Estuary Assessment Results

Maryland's estuarine waters are the waterbody type most covered by TMDLs due to the Chesapeake Bay TMDLs and Coastal Bays TMDLs. In the summer of 2023, the Chesapeake Bay experienced the smallest dead zone on record. While this success is in part due to the relatively low amount of precipitation in 2023, decreased dead zone area over the last several years may indicate progress towards Chesapeake Bay restoration. The Integrated Report assessment records for estuaries emphasize this water quality progress but show that there remains much work to do. The following chart shows the square miles of given reporting categories in estuaries for different parameter groups.

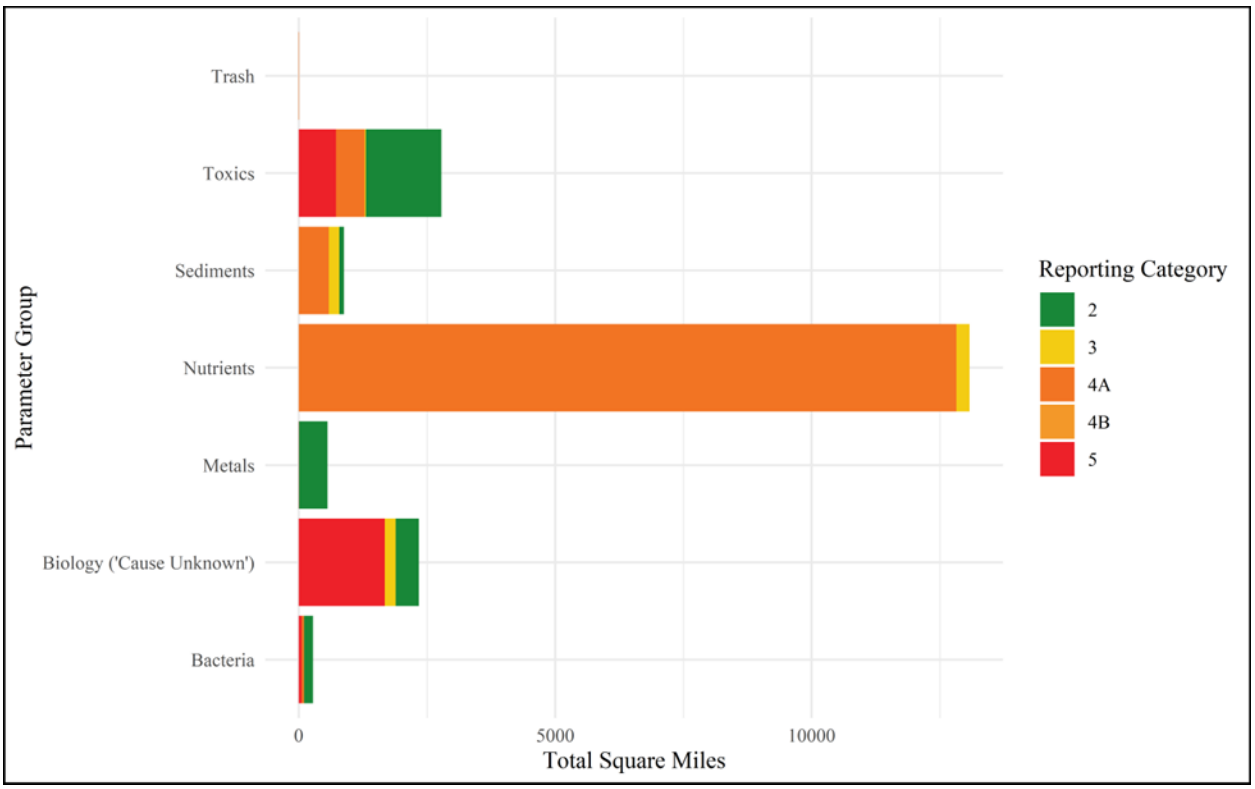

Figure 6: Estuary Reporting Category by Parameter Group
See section A.8 for more information on assessment results disclaimers.

In Maryland, nutrients remain the most widespread estuarine parameter assessed and listed as impaired. All segments of the Bay are covered by nutrient TMDLs. There are a few designated uses in some of the segments that have never been assessed and are listed in Category 3, but they too are covered by a nutrient TMDL.

Sediments in the Chesapeake Bay are assessed by comparing submerged aquatic vegetation (SAV) presence to restoration goals and water clarity data for each segment. Sediment impairments for estuaries are also already covered by the Bay TMDLs. There are also some Category 2 assessment records which meet SAV restoration goals and Category 3 assessment records that don't meet SAV goals and don't have water clarity data which require more information. Overall, most estuarine waters remain impaired for nutrients and sediments. Nevertheless, as further described in section C.1, nutrient and sediment loads continue to improve in the Chesapeake Bay as TMDL implementation takes place.

Toxics, bacteria, and biological impairments are also leading contributors of Category 5 impaired listings in estuaries. Prior to developing TMDLs, Category 5 biological listings will need to have specific stressors or parameters causing the biological impairment identified. Then a control plan can be developed for the specific stressor. Bacteria and toxics impairments are listed as a high priority for the development of TMDLs in the coming years, given their prevalence and adverse effects on human and ecosystem health.

Another important part of assessments is the support of the designated use of the assessment unit. The following chart shows the square miles of standard attainment by designated use in estuaries.

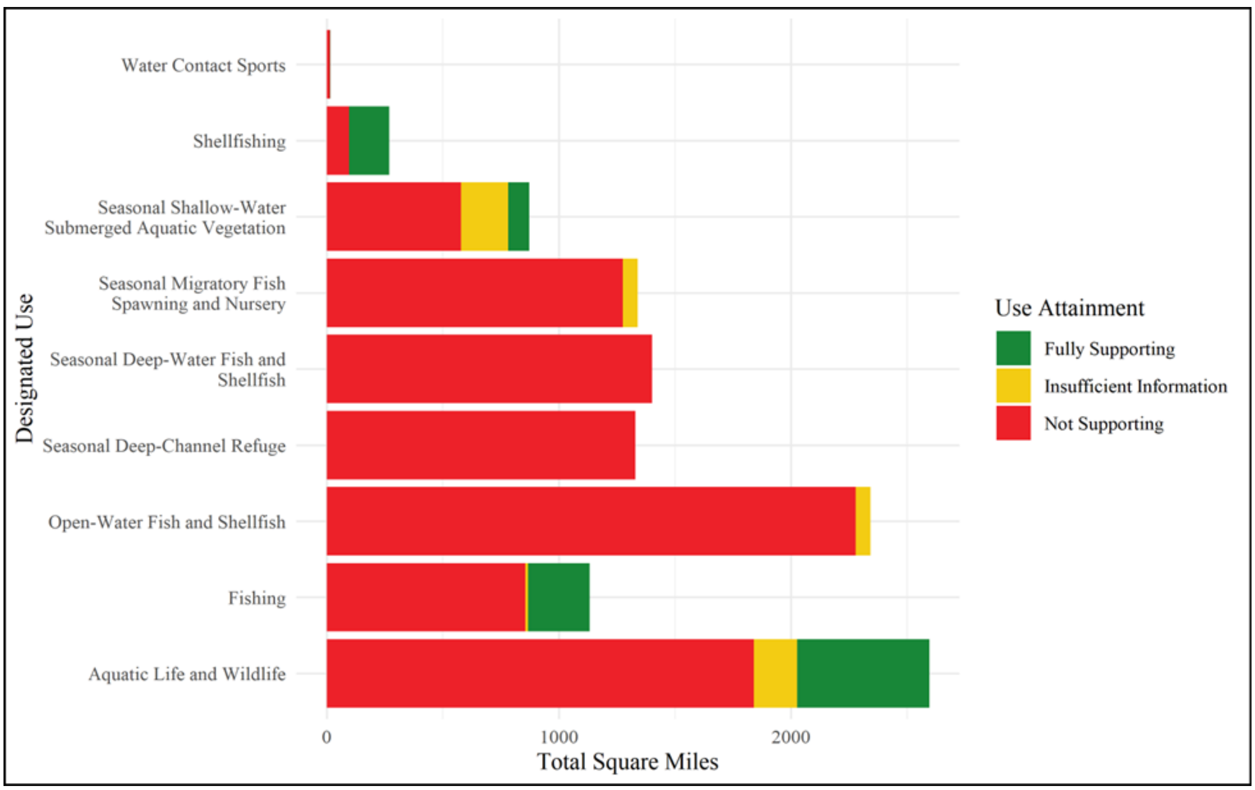

Figure 7: Estuary Use Attainment
See section A.8 for more information on assessment results disclaimers.

MD has detailed WQS and designated uses for the Chesapeake Bay and its tidal tributaries to protect aquatic resources and to provide for safe consumption of shellfish. As identified in the figure above, there are six additional designated uses that are subcategories for estuarine waters that include Shellfishing, Seasonal Migratory Fish Spawning and Nursery, Seasonal Shallow-Water Submerged Aquatic Vegetation, Seasonal Deep-Channel Refuge Open-Water Fish and Shellfish, and Seasonal Deep-Water Fish and Shellfish. Overall, almost all these uses remain impaired due to nutrient impairments. For these nutrient impairments, Maryland has been unable to assess all applicable short-duration dissolved oxygen (DO) criteria which is necessary to delist these segments for certain designated uses. As previously mentioned, all designated uses in each assessment unit default to the worst-case scenario. Therefore, many of the estuarine waters remain impaired. MDE is currently conducting a pilot study in the Fishing Bay segment to assess all applicable dissolved oxygen criteria for each designated use within the segment for the first time. MDE is collaborating with the MD DNR, Chesapeake Bay Program (CBP), EPA Region 3, and VADEQ to develop a methodology to properly assess all uses for nutrients for Fishing Bay as well as other segments in the Bay in the coming years.

B.2.2 River and Streams Assessment Results

Maryland's rivers and streams span more than 19,000 miles and are a primary focus of MDE's assessments. The following chart breaks down the miles of reporting categories by parameter groupings.

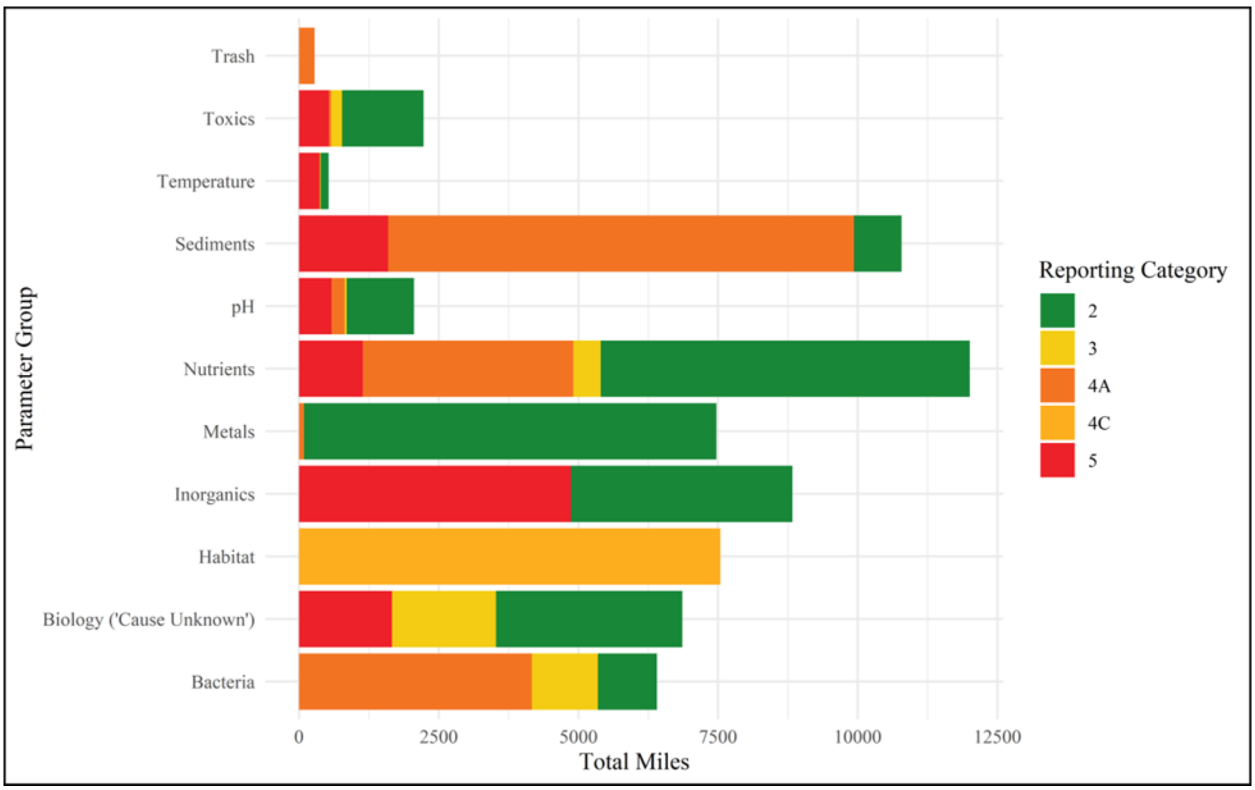

Figure 8: River and Stream Reporting Categories by Parameter Group

See section A.8 for more information on assessment results disclaimers.

In 2024, the largest contributors to Category 5 stream miles are biological, inorganic (mostly chloride), and sediment impairment listings. The biology (cause unknown) listings will require further analysis to identify the specific parameters causing the biology to become impaired prior to being addressed through TMDLs or other actions. Chlorides are an example of one of the stressors or parameters identified through the Biological Stressor Identification (BSID) process and listed as one of the impairing parameters impacting the biology. MDE is actively targeting these chloride impairments through a statewide pollution reduction program. This approach will more effectively and rapidly address chloride pollution through immediate implementation methods like reducing road salt application, rather than traditional methods, such as TMDLs. MDE lists these impairments in their own subcategory, 5S, to reflect this alternative approach which can be noted in this report's accompanying spreadsheet. Overall, MDE has seen great success in its chloride reduction strategy and will continue working to improve road salt management activities. See appendix E for more information.

Toxics and temperature also have Category 5 listings that have not been covered by TMDLs yet since many of these listings are new for the 2024 IR cycle. Again, for temperature, although the size of the assessment unit remains small given the assessment methodology, the total number of assessment records is much larger than any other parameter, as highlighted in the new 2024 impairment section above. Moreover, trend analysis emphasizes that temperature is increasing across streams all over Maryland as further discussed in Section B.3. In rivers, nutrients and sediments also have many miles of impairment. However, like tidal waters, a large portion of these waters are covered by TMDLs.

2024 delistings for zinc in sediments as well as mercury in fish tissue show improvements in metals pollution in Maryland. A water quality analysis was approved in 2022 for zinc in sediments in the Baltimore Harbor which led to the zinc delistings.

From a use attainment standpoint there is still a lot of work to be done in Maryland riverine systems. However, as with estuaries, use attainment status defaults to “not supporting” in ATTAINS reporting if any parameters in the assessment unit are impaired and therefore, doesn’t tell the entire story. The following chart shows the miles of water quality standard attainment for rivers by designated use.

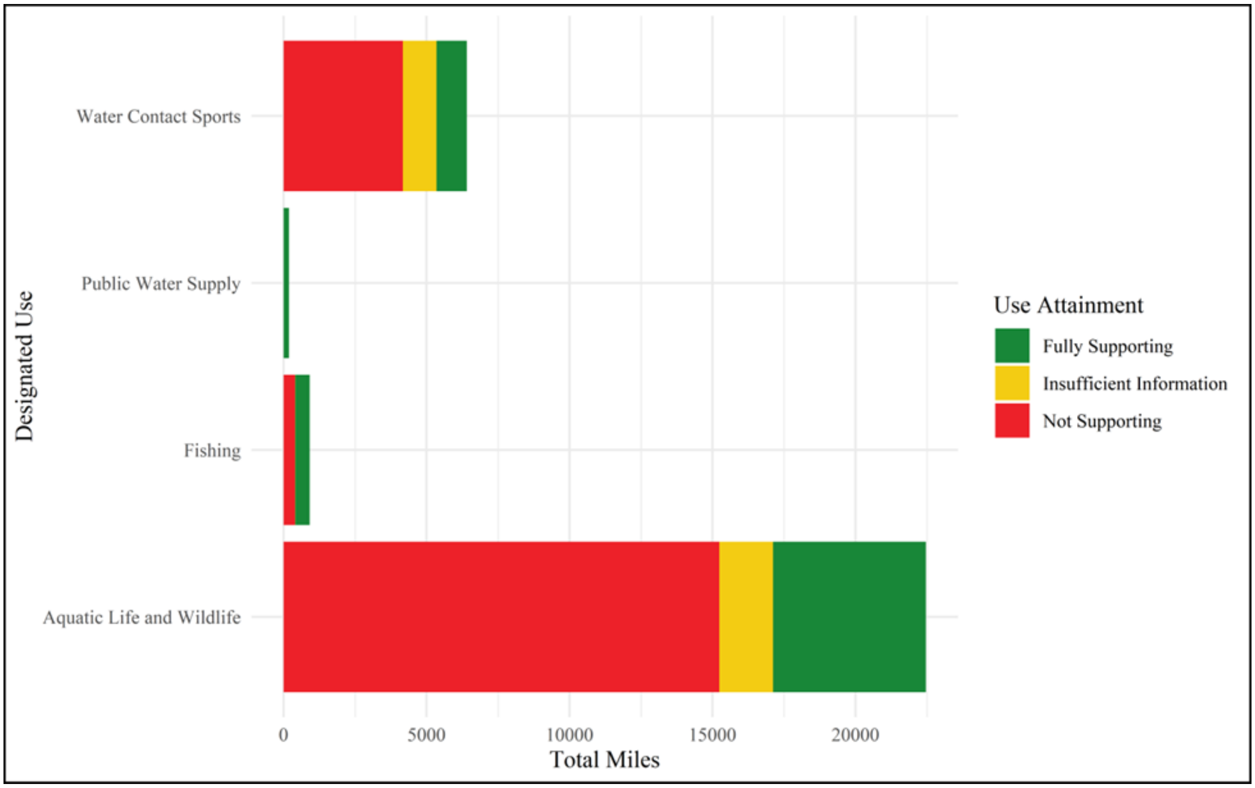

Figure 9: River and Stream Use Attainment
See section A.8 for more information on assessment results disclaimers.

Aquatic Life and Wildlife is the designated use most assessed in rivers, with almost the entire state's flowing freshwater assessed. Fish and benthic Indices of Biotic Integrity (IBI) are used as indicators of the health of the biological communities and are one of the main ways that the Aquatic Life and Wildlife use is assessed in rivers and streams. Maryland DNR's Biological Stream Survey Program conducts a random probabilistic IBI (biological) survey that allows MD to make unbiased estimates of stream conditions with known precision. This stratified random design is a cost-effective way to characterize Maryland's 10,000+ miles of freshwater streams and support assessments of the aquatic life designated use at the 8-digit basin level.

B.2.3 Lake Assessment Results

On top of long-standing ad hoc lake monitoring to address fish kills, investigate algal bloom complaints, and provide input for parameter loading models, MDE and MD DNR have recently prioritized lake monitoring because of recent funding allocations and a recognition that more routine monitoring was needed. One of the primary goals of this monitoring effort is to monitor and assess all significant (>5 acres surface area), publicly owned lakes, also referred to as impoundments, in Maryland for impacts due to nutrients. To inform current and future lake monitoring efforts, MDE and MD DNR have jointly developed a lake prioritization list to identify a strategy for sampling all of Maryland's lakes.

In addition to lakes monitored as part of the fish tissue monitoring program, MDE assessed five lakes for nutrient pollution in the 2024 IR cycle. All were listed in Category 5 for phosphorus for the Aquatic Life and Wildlife use; Piney Run Reservoir was also listed as Category 5 and Savage Reservoir listed as Category 2 for chlorophyll-a for their Public Water Supply designated uses. For the other three lakes, chlorophyll-a assessments are not conducted since they only have the Aquatic Life and Wildlife designated use and not the Public Water Supply Designated Use. The following table shows these assessment results.

Table 7: 2024 IR Lake Assessments

Lake Name	Reporting Category	Parameter	Designated Use
Piney Run Reservoir	5	Phosphorous	Aquatic Life and Wildlife
Piney Run Reservoir	5	Chlorophyll-a	Public Water Supply
Savage Reservoir	5	Phosphorous	Aquatic Life and Wildlife
Savage Reservoir	2	Chlorophyll-a	Public Water Supply
Allen Pond	5	Phosphorous	Aquatic Life and Wildlife
Higgins Mill Pond	5	Phosphorous	Aquatic Life and Wildlife
Lake Lariat	5	Phosphorous	Aquatic Life and Wildlife

For all existing lake assessment records, the following chart displays the acreage of lakes assigned to each reporting category by major parameter grouping.

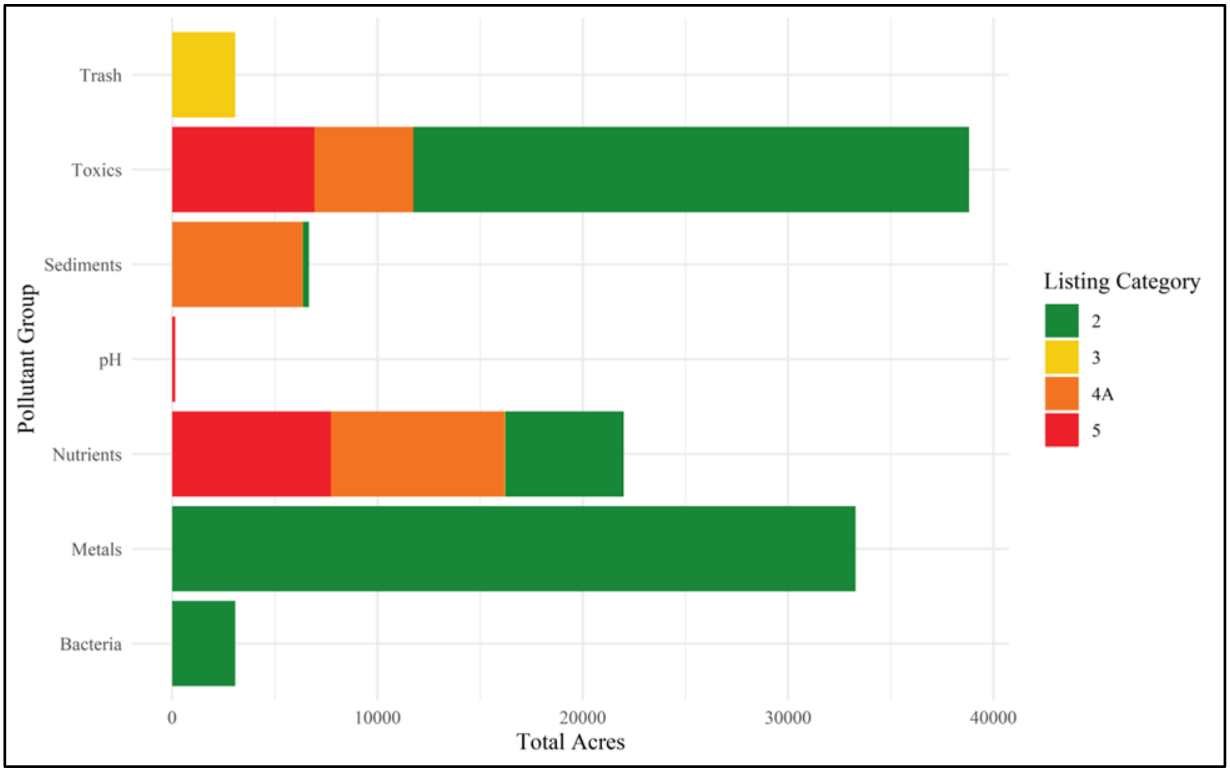

Figure 10: Lake Reporting Categories by Parameter Group
See section A.8 for information on assessment results disclaimers.

In lakes, toxics and nutrients make up many impairments. Common toxics include PCBs, PFOS, and mercury in fish tissue. Phosphorus and chlorophyll-a impairments are the predominant forms of nutrient impairment. Overall, lakes also have many assessment records that are meeting water quality standards and thus in Category 2, especially among metals, some toxics, and bacteria pollution.

The following chart shows the acres of water quality standard attainment by designated use. Like other water body types, use attainment defaults to the worst-case reporting category.

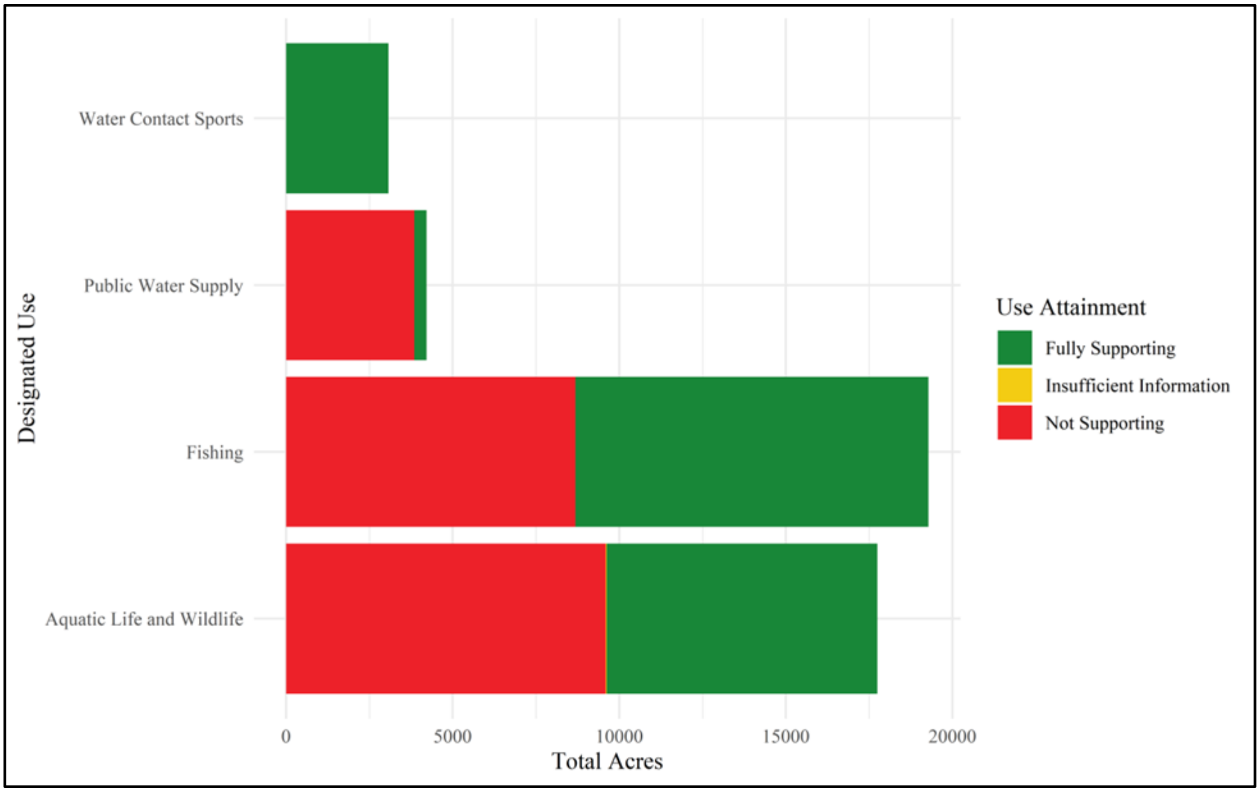

Figure 11: Lake Use Attainment
See section A.8 for more information on assessment results disclaimers.

In lakes, the Fishing and Aquatic Life and Wildlife designated uses are the most assessed designated uses. Due to the overlapping parameters assessed within the same lake assessment unit, the assessment records default to the worst-case scenario and many of the designated uses are not supported. Although the use is not supported, many of the parameters that are impaired are covered by TMDLs already. It will take time and continued implementation efforts to achieve the improvements necessary to delist an entire lake. MDE will continue monitoring lakes to assess and reduce impacts due to nutrients, especially where public health is concerned. MDE and MD DNR are working together to routinely monitor MD's lakes and have developed a Lake Monitoring Prioritization Strategy for determining sampling needs and monitoring order. Also, see MDE's Lake Monitoring webpage for more information.

B.2.4 Beach Assessment Results

Under EPA's Beaches Environmental Assessment and Coastal Health (BEACH) Act, Maryland aims to protect public health at all recognized public bathing beaches. MDE's Beaches program facilitates the collection of bacteria data and determines whether beaches are safe for swimming during the summer recreational season. See section D. 2 for more information on MDE's Beaches program. The data collected for the Beaches Program is also used for IR assessment decisions. As the 2024 updated bacteria assessment methodology details, the IR assessments cover a longer time frame to reveal any potential chronic bacteria impairments versus the daily and weekly swimming advisories determined by the Beaches program. The first chart below shows the count of beaches in given reporting categories by the two types of bacteria measured. The second chart below displays summary counts of beach attainment status of the water contact sport use.

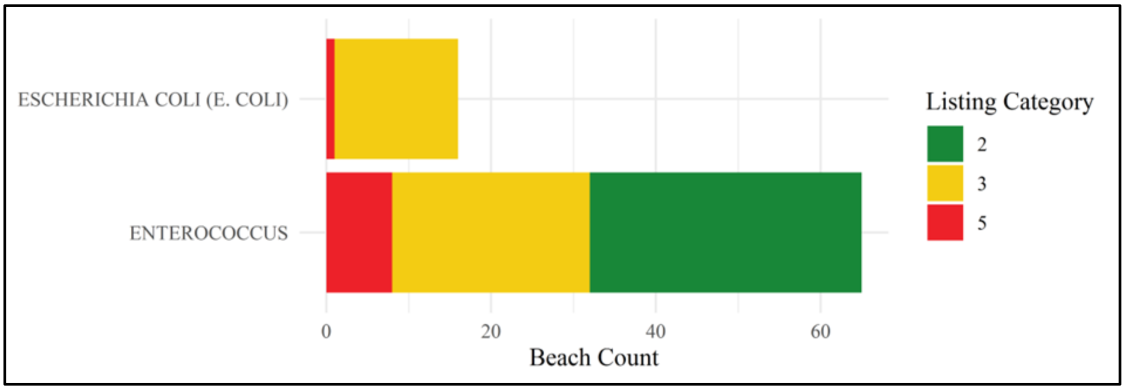

Figure 12: Beach Reporting Categories by Parameter

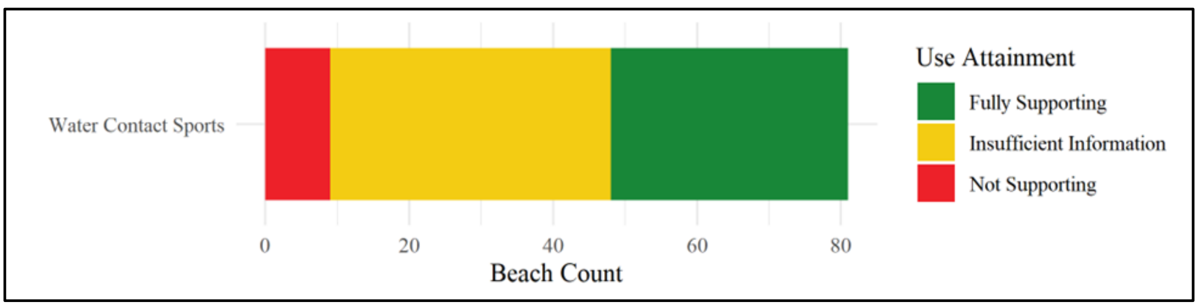

Figure 13: Beach Use Attainment

Due to the high spatial and temporal variability of bacteria indicators, the 2024 updates to the assessment methodology suggest that weekly sampling is necessary to adequately characterize the assessment unit for chronic bacteria issues. 77 state recognized beaches under the Beach Act were assessed in the 2024 IR cycle. Out of those, 9 beaches are not meeting bacteria water quality criteria and are listed as impaired (Category 5) while 38 of them are meeting bacteria water quality criteria and are supporting the Water Contact designated use (Category 2). The remaining 30 beaches that were assessed and the 4 beaches that were assessed in previous cycles had insufficient data to determine attainment status and were placed in Category 3. Bacteria monitoring for all beaches continues to be a priority for MDE to protect public health.

B.3 Water Quality Trends

Although water quality trend analysis results are not used in the state's water quality assessment methodologies or listing process, they can be useful metrics for quantifying the changes in pollutants over time and tracking progress of restoration efforts. Typically, water quality information must be collected over sufficiently long temporal periods so as not to draw conclusions from changes caused by natural variability. As DNR presents in its Chesapeake Bay Restoration Spending Report SFY 2023, one notable trend in MD is increasing surface water temperatures.

In the report, DNR notes that 89% of all stations have increased surface water temperatures, as highlighted in their figure replicated below.

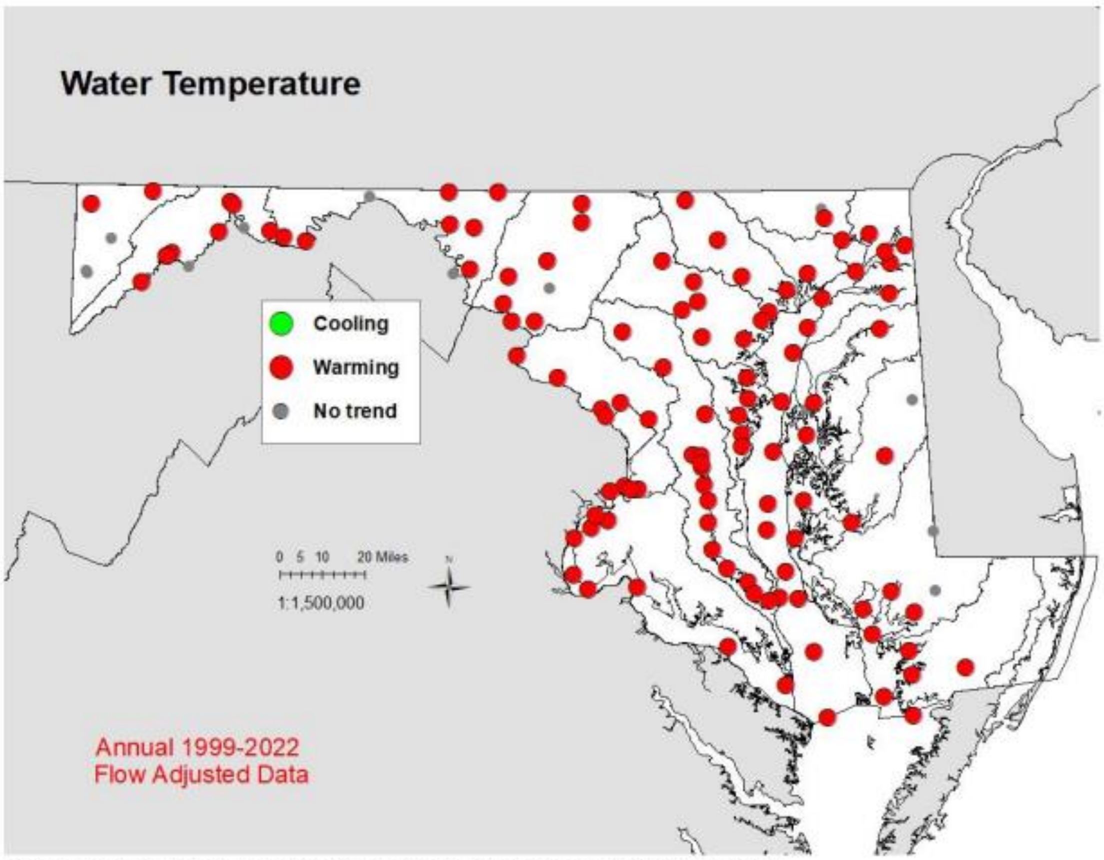

Figure 12. Trends in flow-adjusted surface water temperature 1999–2022.

- 0% of stations (0 of 125) have cooling surface water temperatures compared to 1999
- 89% of stations (111 of 125) have warming surface water temperatures compared to 1999
- 11% of stations (14 of 125) do not have surface water temperatures that are significantly different from 1999

Figure 14: Warming Temperatures Across MD DNR Long-term Monitoring Stations

Additionally, in the report MD DNR shows that warming rates vary across Maryland water bodies. Overall, 69% of non-tidal and tidal stations are one degree Fahrenheit or warmer as highlighted in their figure replicated below.

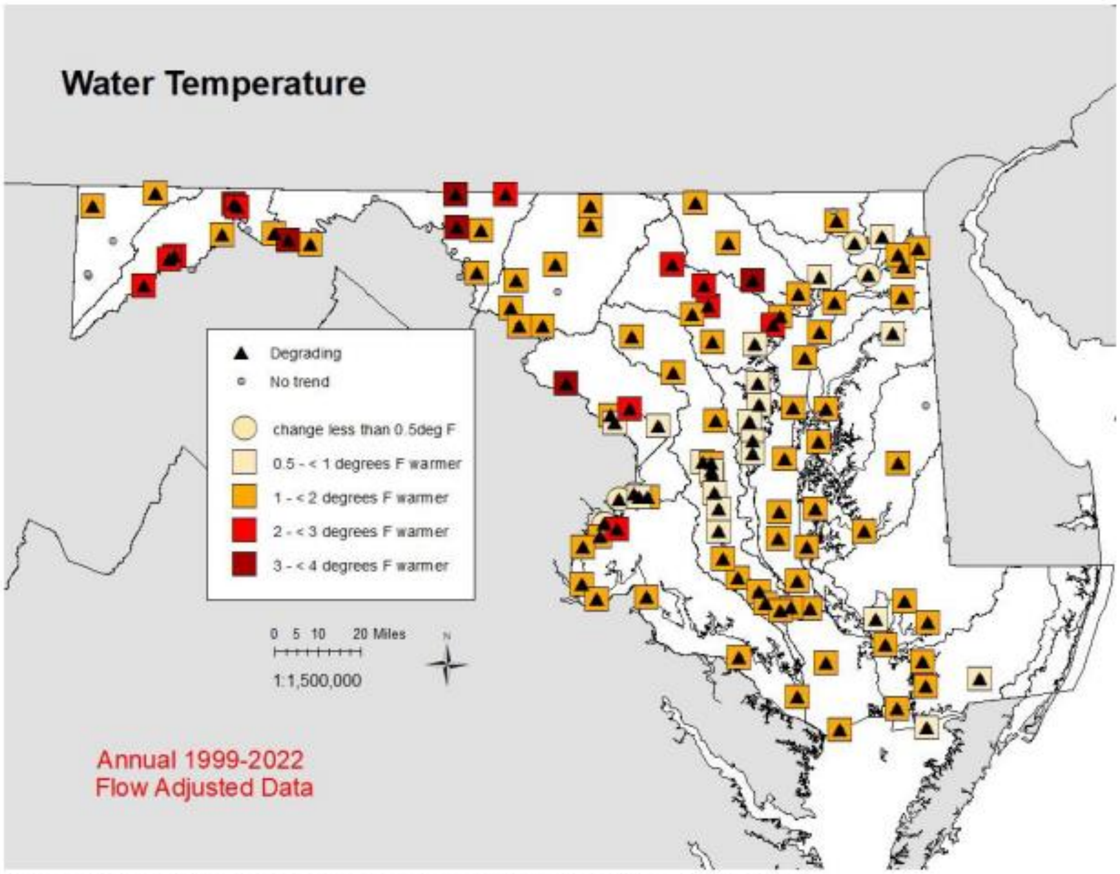

Figure 13. Magnitudes of change in surface water temperature 1999–2022.

- 4% of stations (5 of 125) are less than 0.5 degree F change
- 16% of stations (20 of 125) are between 0.5 and less than 1 degree F warmer
- 55% of stations (69 of 125) are between 1 and less than 2 degrees F warmer
- 9% of stations (11 of 125) are between 2 and less than 3 degrees F warmer
- 5% of stations (6 of 125) are between 3 and less than 4 degrees F warmer

Figure 15: Warming Temperature Magnitude Across MD DNR Long-term Monitoring Stations

These temperature increases have negative effects on flora and fauna. For instance, higher temperatures decrease dissolved oxygen concentrations in the water, decreasing habitat suitability for fish, crabs, and other organisms. For more information on how these warming trends are impacting Maryland’s waterways and how MDE is addressing them, see section C.3 of this report.

Although temperature trends are increasing, nutrient and sediment pollution has improved in Maryland. According to MD DNR's analysis, between 1999-2022, nitrogen concentrations at

63% of stations, phosphorus concentrations at 50% of stations and sediment concentrations at 26% of stations have statistically significantly improved. These statewide improvements contribute to larger load reductions to the Chesapeake Bay discussed in section C.1.

For more information on MD DNR's trend analyses along with trend analyses of a variety of other key pollutants and water quality indicators see MD DNR's The Chesapeake Bay Restoration Spending Report: A Report to the Maryland General Assembly pursuant to the 2023 Joint Chairmen's Report. Also see Chesapeake Bay Program's STAC report on Rising Water Temperatures.

Additionally, MD DNR analyzes trends for a variety of other water quality parameters in both the tidal and non-tidal waters of Maryland. For non-tidal trends, see DNR's report on non-tidal long-term monitoring program trends results through 2022. For tidal water quality status and trends, see DNR's Eyes on the Bay webpage.

USGS and The Chesapeake Bay Program conduct Bay-wide trend analyses. The USGS trend monitoring program includes stations in all 7 of the Chesapeake Bay jurisdictions (Delaware, D.C., Maryland, New York, Pennsylvania, Virginia, and West Virginia). The primary purpose of this monitoring program is to assess the trends in loads that are delivered downstream to the Bay. See USGS's report describing Summary of Nitrogen, Phosphorus, and Suspended-Sediment Loads and Trends Measured at the Chesapeake Bay Nontidal Network Stations for Water Years 2011-2020 or their accompanying Chesapeake Bay Nontidal Monitoring Network Loads and Trends StoryMap.

Finally, the CBP's Integrated Trends Analysis Team, composed of members from the Chesapeake Bay Program, state and local agencies, and nonprofits, has enhanced the trends analysis provided by MD DNR, by supplementing the analysis with additional information on land use, criteria attainment, and predicted outcomes to produce Bay-wide trend summaries. For access to these tributary summaries and more information please visit the Integrated Trends Analysis Team's website.

PART C: MARYLAND'S CHALLENGES, ACCOMPLISHMENTS, AND PRIORITIES

C.1 The Chesapeake Bay

Chesapeake Bay water quality improvement remains a critical focus for Maryland. A healthier Bay contributes not only to the health of Maryland's citizens and communities, but also provides outdoor recreation and strengthens industries that contribute to our State's economic health. Overall, nutrients and sediment remain two of the most significant pollutants in the Bay, creating unsuitable oxygen and water clarity conditions for aquatic life among other detrimental effects. Now and in the future, higher precipitation rates caused by anthropogenic climate change, as well as urbanization throughout the watershed, will exacerbate these issues.

To address these nutrient and sediment loads, Maryland continues to decrease pollution input in the Bay. Since 1985, Maryland has reduced the Bay's annual pollution loads by an estimated 35 million pounds of nitrogen, 3.7 million pounds of phosphorus, and 757 million pounds of sediment. As of 2022, pollution control solutions, called Best Management Practices (BMP), achieved 51% of the nitrogen reductions, 60% of the phosphorus reductions, and 100% of the sediment reductions compared to the 2009 baseline. As Maryland continues its efforts to reduce nutrients, it will continue targeting pollution from the leading sources of nutrient pollution: agriculture, wastewater systems, and stormwater from developed areas. Alongside these efforts, MDE incentivizes restoration and BMPs that not only reduce nutrient and sediment loads but also provide additional benefits to Maryland's water quality, economy, and historically disenfranchised communities. For more information on Maryland's Chesapeake Bay cleanup, please see MDE's Chesapeake Cleanup Center website and Chesapeake Bay Annual Progress Story Map.

C.2 PFAS

The risk posed by exposure to per- and polyfluoroalkyl substances (PFAS) is an emerging state public health concern. Since the 1940s, United States manufacturers have used PFAS chemicals for their unique heat, water, and oil resistant properties. These same traits make PFAS persistent in the environment and harmful to humans. Current science suggests that exposure to PFAS, which often occurs through consumption of contaminated fish or drinking water, can lead to adverse human health effects such as increased cholesterol levels, pregnancy complications, increased risk of certain cancers, among others. Given this concern, Maryland has targeted these pollutants through increased monitoring, exposure prevention, and pollution source control.

MDE has conducted intensive PFAS monitoring in fish tissue to document and prevent risk to these harmful chemicals. Between 2020 and 2022, the agency collected 150 PFOS fish composites, prioritizing water bodies with frequent subsistence fishing and nearby potential sources of PFAS. MDE also recently updated PFOS thresholds for fish tissue consumption advisory to align with the Center for Disease Control's (CDC) more stringent reference doses. With these limits, new fish tissue data have resulted in 106 fish consumption advisories for PFOS. This led to 36 new Category 5 listings, 14 new Category 2 assessment records, and one new Category 3 assessment record for PFOS in fish tissue on the 2024 IR. WPRPP has made

TMDL development for these 36 impaired listings a high priority which will reduce future PFOS impacts and improve already affected water bodies.

MDE's drinking water and wastewater programs similarly prevent PFAS exposure through monitoring and effective response. In 2024, MDE completed PFAS sampling at all 473 Maryland Community Water Systems (CWS). Maryland continues this effort by sampling all Non-Transient Non-Community Water Systems, which include schools, office buildings, and day care centers. MDE also notified customers of the 73 community water systems where PFOA or PFOS concentrations were higher than EPA's final regulatory limit of 4 parts per trillion. Wherever possible, systems used an alternate source, installed a treatment process, or had the affected water treatment facility go offline. MDE also requires PFAS monitoring at wastewater treatment facilities that create biosolids to be used as fertilizer which can also contain these contaminants. MDE continues to provide technical assistance to these facilities and connects them to state and federal funds.

Maryland has also taken action to prevent further use of these chemicals. In 2020, Maryland banned the use of Class B fire-fighting foams containing PFAS for training and testing purposes after 2021. The George "Walter" Taylor Act, passed in 2022, expanded this ban to Class B fire-fighting foams containing PFAS at airports, ports, refineries, or chemical plants after September 2024 and at terminals after December 2027. MDE is working with the Maryland Environmental Service to facilitate a take back program to recover and dispose of these fire-fighting foam products. MDE is collaborating with the Department of Defense and EPA as well to assess and remediate sites with PFAS present to prevent these parameters from entering waterways.

MDE will continue PFAS monitoring, response, and pollution reduction across the state to reduce the risk of these contaminants for all Marylanders. For more information, please see MDE's PFAS website.

C.3 Climate Change

Maryland is engaged in the global and local concerns that climate change poses. With 3,100 miles of shoreline, Maryland is the fourth most vulnerable state to suffer the effects of sea-level rise associated with climate change. As mentioned in section B.3 on trend monitoring, data shows that Maryland's tidal and nontidal water bodies are warming. This change stresses aquatic species, particularly cold water obligate species. Increased precipitation in the state will also exacerbate runoff issues, intensifying pollution in Maryland's waterways. In response, Maryland is taking a leading role in the nation to prevent and adapt to these climatic changes.

The state is actively fighting to reduce greenhouse gas (GHG) emissions, the source of many of these ecological issues. Maryland has already reduced GHG emissions faster than almost any other state in the nation, decreasing emissions by 30% between 2006 and 2020. To add to this progress, Maryland recently set the country's most aggressive GHG emissions reduction goals as of 2022. Under the Climate Solutions Now Act, it targets a 60% reduction by 2031 and net-zero emissions by 2045. As documented in Maryland's Climate Pollution Reduction Plan, Maryland will achieve this goal through a series of large investments. Some of these projects include home and building electrification, electric vehicle incentives, infrastructure investments, and nature-based carbon reduction projects like tree plantings. These new policies will not only push the state towards its climate goals but also generate up to $1.2 billion in public health benefits, $2.5 billion in increased personal income, and a net gain of 27,400 jobs between now and 2031 as compared against current policies. For more information on The Department's work, see MDE's Climate Change Program Webpage.

MDE's WPRPP Program is taking a leading role in protecting cold water streams as well. MDE formed a Cold Water Advisory Committee composed of stakeholders and subject matter experts, which spurred clarification of water quality standards to protect cold water streams from rising temperatures. Notably, 19 existing use determinations were made during the 2019 Triennial Review of Water Quality Standards that add additional cold water protection to waters that contain cold water obligate species and that have a thermal regime that is cooler than the criteria specified under their currently recognized designated use. MDE and MD DNR have renewed emphasis on monitoring and assessments as well by deploying continuous temperature sensors and updating the temperature assessment methodology. In combination, this standards, monitoring, and assessment work led to 196 new Category 5 temperature impairments identified in the 2024 IR. This change brings the total number of temperature impairments in Use Class III and III-P waters to 369. WPRPP is also currently developing temperature modeling tools for temperature TMDL development to ultimately guide local restoration and management actions.

C.4 Chlorides

Another persistent water quality challenge facing the state is the increase of chloride in non-tidal streams. There are 28 watersheds impaired by chlorides across Maryland. Winter salt runoff is the primary source of these impairments, which poses a risk not only to freshwater species but also drinking water quality and green infrastructure meant to mitigate other stormwater pollutants. Once salt flows into waterways, it is very difficult to remove; the residence time of road salt in a watershed can be as long as 40-70 years. Thus, MDE is promoting a widespread, decreased use of winter salts through its chloride reduction strategy. This plan includes public outreach, salt application training and certification, permit conditions in Municipal Separate Storm Sewer System (MS4) permits aimed at reducing salt application, and collaboration with the State Highway Administration (SHA), which is one of the state's largest applicators. Since adopting MDE's salt reduction practices, the SHA has already reduced its total salt usage on roadways by almost 50% while simultaneously maintaining safe roads.

For more information on MDE's chloride reduction strategy, see appendix E, MDE's Salt Webpage, or MDE's Salt StoryMap.

C.5 Environmental Justice

Pollution disproportionately harms low income, minority, and limited English proficiency communities both historically and today. In Maryland, state law defines environmental justice (EJ) as "equal protection from environmental and public health hazards for all people regardless of race, income, culture, and social status." MDE recognizes current inequity and injustice in Maryland and has made addressing them a key part of its mission.

One significant step towards this goal is MDE's development and release of the Maryland EJ Screen in June 2022. This tool leverages data not available in federal screening tools by combining demographic and socioeconomic data with MDE data on potential pollution sources such as industrial facilities, wastewater treatment plants, and active or historic coal mining sites. Community consultation was critical in the development of this tool and helped guide what pollution exposure metrics were included. Currently, permit applicants are required to use this tool in their permit applications. MDE staff use this information to make EJ oriented decisions for not only permitting but also pollution control and resource distribution. By providing all Marylanders equal access to information about potential environmental hazards in their communities, the tool enables communities to participate in the decision-making process of environmental permits and supplemental environmental projects.

WPRPP has used this tool to guide where to invest its limited resources. WPRPP uses EJ scores as a parameter to prioritize impairments for TMDL, as described and shown in the 2025-2032 Vision for Clean Water Act Section 303(d) Program in Appendix C. In preparation for MDE's 2024-25 lake nutrient sampling, WPRPP staff ranked prospective sampling sites by EJ score and prioritized locations with high scores. Doing so provides water quality data for at risk communities.

Maryland's nonpoint source pollution program's (CWA §319 program) most recent work includes funding restoration and outreach projects within underserved communities in the Middle Gwynns Falls, Lower Jones Falls, and Upper Choptank River watersheds. Notably, WPRPP's nonpoint source pollution program has coordinated with Envision the Choptank to promote water quality improvements in the underserved areas that it helps manage. The program is looking to provide funding to build local capacity and provide technical support needed to achieve this goal.

For more information on MDE's EJ initiatives, including many not discussed here such as its work alongside the Curtis Bay community to secure the largest environmental crime fines in State history, visit MDE's EJ Landing Page. For more information on Maryland's 319 work see Maryland's 2021-2025 Nonpoint Source Management Plan or MDE's Nonpoint Source Program Webpage.

C.6 Participatory Science

Maryland continues to make significant efforts to engage and include the public with respect to their monitoring efforts, especially as they relate to the Integrated Report process. MDE included more community-based data in the 2024 IR assessments than ever before. Three organizations, Blue Water Baltimore, Nanticoke Watershed Alliance, and Arundel Rivers Federation collected and submitted high quality, Tier III, tidal DO data that was incorporated into the Chesapeake Bay Program's, and subsequently Maryland's IR, DO Assessments for the Chesapeake Bay. An additional seventeen different non-governmental organizations submitted data for the 2024 IR to support assessment decisions. For the complete list of organizations that submitted data for the IR and to see how their data was used in assessments, see appendix A.

To facilitate this use of community science data, MDE decreased the barriers to submitting data and information for the Integrated Report by creating a data submittal webpage and by allowing multiple different formats of data submission, including gathering data from existing external databases. For the 2024 IR, MDE again partnered with the Chesapeake Monitoring Cooperative (CMC) to obtain community science and volunteer-based data for water quality assessments. Partnering with the CMC has allowed MDE to compile a greater quantity and spatial coverage of water monitoring data by sharing the workload of organizing, storing, evaluating, and ensuring quality data. MDE incorporated the majority of the volunteer-based water quality data into the IR by retrieving data from the CMC's Chesapeake Data Explorer for this 2024 IR cycle and plans to continue working closely with the CMC in future cycles.

MDE is also working with the CMC and community scientists to decrease the barriers in achieving and documenting the data quality necessary for regulatory decisions. MDE has adopted a data quality tier system consistent with VADEQ and the CMC to make it easier for the public to understand how their data can be used and what the requirements are for use in the regulatory decisions of the IR. Additionally, MDE, the CMC, and community science groups are working together to identify current limitations to data submittal and data use in the IR and develop solutions that work for all parties involved. MDE will continue to work towards incorporating volunteer-based water quality data in ways that increase the resolution of the state's water quality assessments.

PART D: STATE WATER QUALITY EFFORTS

D.1 Cost/Benefit Assessment

One specific reporting requirement of the CWA 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 several 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). MDE evaluates the cost effectiveness of reducing nutrient pollution in the Chesapeake Bay Annual Progress Report. 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 difficult. There are increasing efforts, led 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 currently to apply values broadly across a range of regional and jurisdictional boundaries.

A substantial level of federal funding for water pollution control efforts comes from some agencies (EPA) 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) (National parameter Discharge Elimination System), 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 (CWA §106, §319, §104b planning, wetlands, targeted watersheds, public water supply, and beach monitoring) to state agencies is shown in Figure 16.

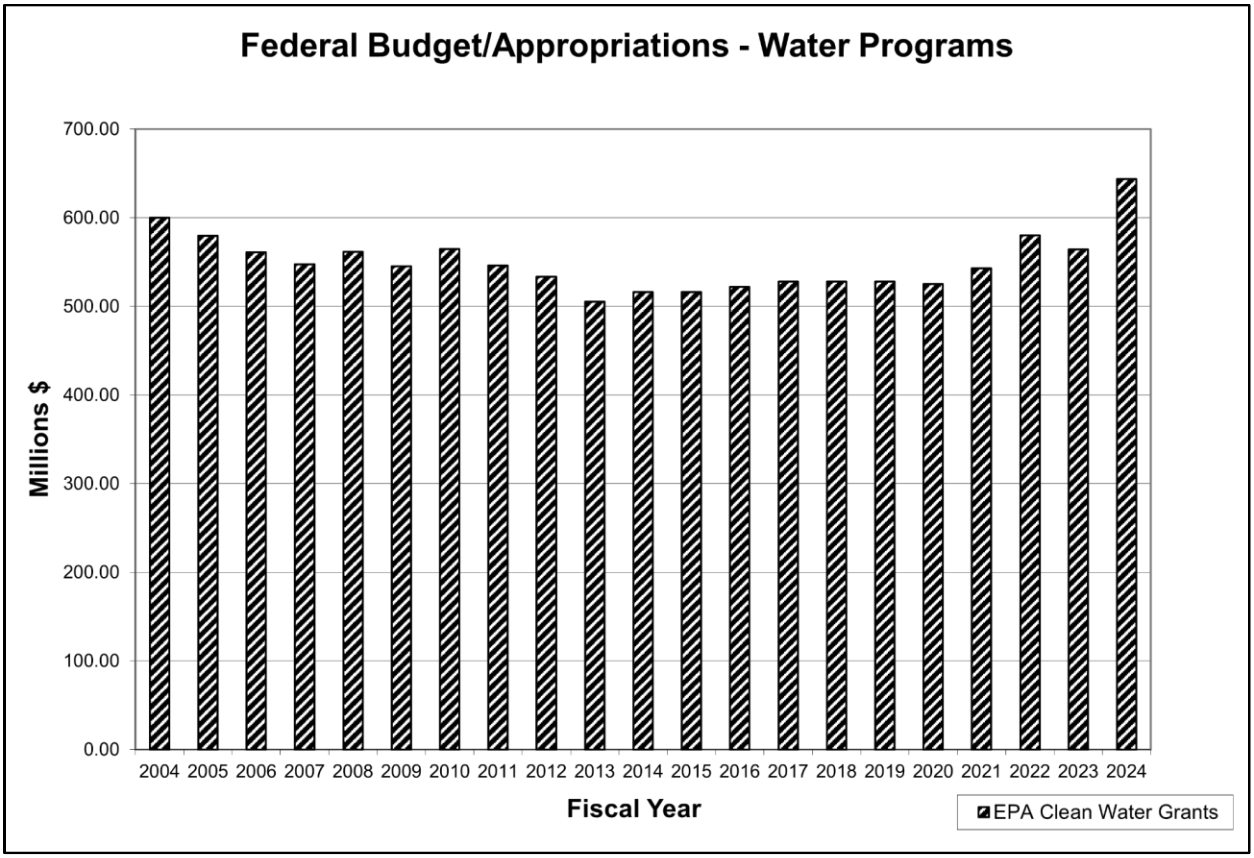

Figure 16: Federal Budget Appropriations to Water Programs (2004-2024). (Source: Association of Clean Water Administrators President's FY24 Budget Request Funding Chart, Updated 8-15-23)

Although federal funding to water programs has generally increased over the past few years, what each state and program receives fluctuates. An example of the impact of national funding variance can be seen in Figure 17 below which shows EPA's §319 funding appropriation and what Maryland received over that same time.

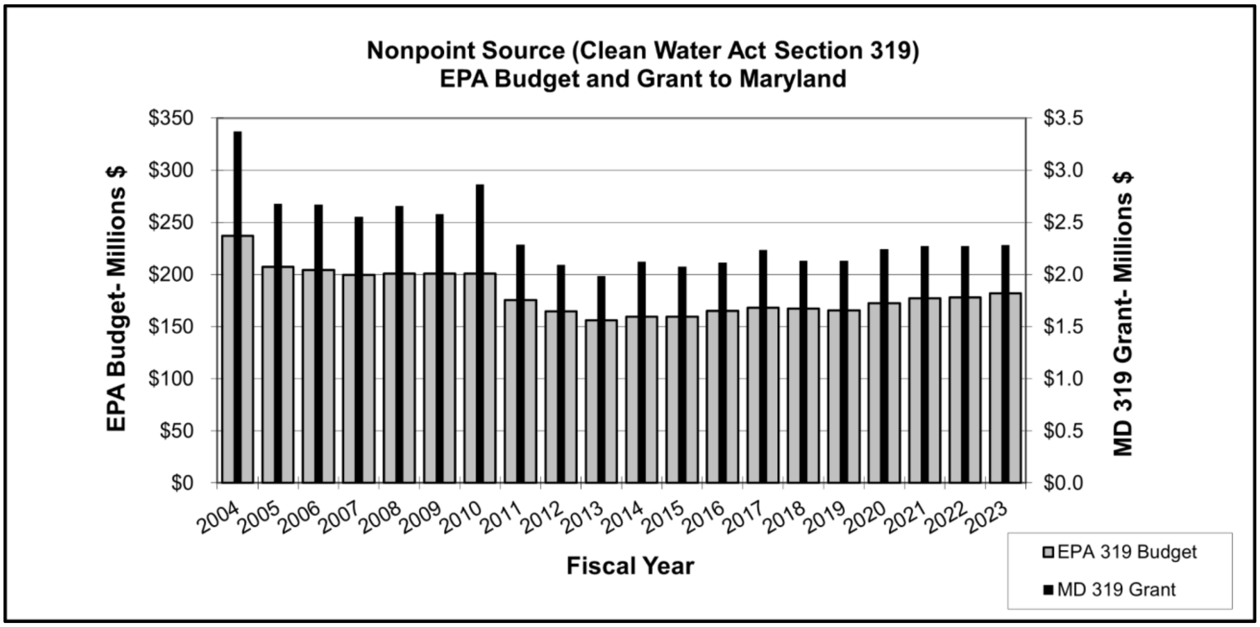

Figure 17: Federal nonpoint source total budget allocation including the Maryland totals. (Sources: Association of Clean Water Administrators FY24 Report and MDE's 319 Annual Report)

As the federal funding for water programs varies 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.

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 the recreation and tourism industry. A plentiful supply and good quality drinking water encourages economic growth and development, increased property values, water-based recreational opportunities, and commerce. Though 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, in 2022 MD DNR data shows there were 277,638 unique anglers in MD and 75.16% of them were MD residents. According to the US Fish and Wildlife Services 2022 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, in 2022, anglers in the nation spent $99.4 billion on fishing related expenses- an average of $2,490 per angler per year. Most of these expenses ($40.7 billion- 41 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 ($36.6 billion- 37 percent) and other items (membership dues, magazines, permits, stamps, and leases) amounted to $22.1 billion (22 percent). In the South Atlantic Geographic Division, there were 8,386,234 Anglers which is 21% of the total population in the region.

In 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 CWA. 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.

D.2. Monitoring Programs and Public Health Protection

Maryland's monitoring programs provide not only public health protection from water quality parameters but also much of the data necessary for the IR's assessments. Many of these programs and projects are described below with relevant links for additional information.

Toxic Contaminants Fish Consumption Advisories

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 (filet), 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. 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 each water body. More information about these programs can be found at the Fish and Shellfish Programs webpage.

Fish Tissue Monitoring

MDE 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. MDE has routinely monitored for PCBs and Mercury in fish tissue and in 2021, began monitoring for PFAS in fish tissue. Findings from such studies are the basis for the fish consumption guidelines published on the Fish Consumption Advisory webpage.

Shellfish Monitoring

In the 1960s, MDE 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. MDE also analyzes water and shellfish meats as needed for Harmful Algal Bloom (HAB) toxins during certain potentially toxic blooms.

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.

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.

Shellfish Harvesting Area Closures

Maryland's Chesapeake Bay waters have long been known for their plentiful shellfish. MDE is responsible for regulating shellfish harvesting waters to safeguard public health. 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. MDE also conducts some harmful algal bloom (HAB) surveillance in shellfish harvesting waters and uses the Enzyme Linked Immunosorbent Assay (ELISA) method for toxin testing in water and shellfish as needed to protect public health.

Information about shellfish harvesting areas that have conditional closures is updated daily on the Maryland Shellfish Advisory and Maps webpage and via a phone message at 1-800-541-1210. MDE has also created an online interactive Shellfish Harvesting and Closure Area Maps that provides timely information showing approved shellfish harvesting areas, conditionally approved areas, and closed or restricted areas.

Bathing Beach Closures

In October 2000, EPA passed the Beaches Environmental Assessment and Coastal Health Act (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) 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 WQS and regulations for beaches, including the Beach Action Value (BAV) thresholds, 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.
3. All beaches, whether permitted or not, now receive protection.
4. MDE does algae bloom sampling and ELISA work using EPA threshold guidance, to protect bathers from cyanotoxins and issue contact advisories as needed.

MDE 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, whose phone numbers are provided at MDE's Local Health Departments webpage. In addition to the application of the BAV, the local health department may consider other factors and environmental conditions in making public health decisions such as a beach advisory or closure. MDE conducts algae bloom sampling and ELISA work, using EPA threshold guidance, to inform local health departments in case a water contact advisory is needed to protect bathers from cyanotoxins.

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 risks associated with natural water contact before they head to the beach. This information is accessible at MDE's Beach Status webpage.

Waterborne Disease

The 1996 Safe Drinking Water Act Amendments mandated that EPA and the US Centers for Disease Control and Prevention conduct five waterborne disease studies and develop a national estimate of waterborne disease. Additional information on national estimates and waterborne diseases can be found on CDC’s waterborne disease webpage.

Combined and Sanitary Sewer Overflows

MDE requires and tracks reports of sewage overflows by owners and operators of sewage systems in the State. These sewage overflows can adversely impact State waters and pose a risk to public health from raw or partially treated sewage containing elevated levels of bacteria and disease-causing pathogens. MDE maintains an online sewer overflow database of reported sanitary sewer overflows, combined sewer overflows, and bypasses.

Harmful Algal Blooms

Algae are a natural and critical part of Maryland's non-tidal, Chesapeake and Coastal Bays, and Atlantic Ocean ecosystems. However, algae may become harmful if they occur in an unnaturally high abundance or if they produce toxins. In Maryland, the Department of Health (MDH), MD DNR, and MDE collaborate to manage a state-wide harmful algae bloom (HAB) surveillance program which includes issuing health advisories as warranted. MDE and MD 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.

From 2015-2022, the State identified and investigated 84 potential harmful algae bloom events where significant risk to human health from contacting or ingesting water existed and 15 no-contact advisories were initiated. Both MDE and MD DNR will continue to work with the Bay Program and MDH to develop, where appropriate, standards or other measures to protect both human health and aquatic life from harmful algal blooms. The following table shows the number of water samples tested for microcystin, number of samples that exceeded an older threshold of 10 parts per billion or, more recently, the newer threshold of 8 micrograms per liter, and the number of no-contact advisories issued to protect human health.

Table 8: Maryland HAB Sampling, Elevated Toxins, and Advisories

Year	Number of Samples Tested	Number of Samples with Elevated Toxins	Number of Advisories Issued
2015	3	3	3
2016	53	26	5
2017	15	8	2
2018	37	5	5
2019	50	7	6
2020	75	16	4
2021	123	12	2
2022	38	5	3
Total	**332**	**42**	**15**

For more information on the science of HABs and how they are managed in Maryland please visit the **MDE HAB webpage**, **MDH HAB webpage**, and **MD DNR HAB webpage**.

Fish Kills

Fish kills occur for a variety of reasons such as natural water chemistry, biological changes, chemical pollution, or miscellaneous human activity. MDE is the lead agency with the responsibility for investigating, responding, and reporting on fish kills throughout the state. MD DNR jointly investigates when fish kills are the result of disease and provides other support as needed. MDE releases an annual summary report of fish kills. The most recent report is the 2022 Fish Kill Summary.

For more information on fish kills, please visit MDE's Fish Kills webpage.

Drinking Water

MDE is charged with ensuring that all Marylanders have a safe and adequate supply of drinking water. MDE's programs 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 the 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 6.2 million citizens. The remaining one-third of the State's population obtains their water from underground sources.

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. See MDE's webpage on Consumer Confidence Reports for specific information provided by water systems on customers satisfaction and the Well Construction program webpage, which is the primary regulatory mechanism for protecting new individual water supplies. For more details on the State's drinking water program, go to MDE's Water Supply webpage.

National Aquatic Resource Surveys (NARS)

EPA, in partnership with the states, assesses the condition of the nation's waters using a standardized statistical survey that encourages data consistency and allows water quality results to be comparable across states and over various years. The resource surveys include the National Coastal Condition Assessment (NCAA), the National Lakes Assessment (NLA), the National Rivers and Streams Assessment (NRSA), and the National Wetland Condition Assessment (NWCA). For more information on each assessment and to see the most recent results and reports, see the National Aquatic Resource Surveys website.

D.3 Water Pollution Control Programs

Maryland implements several water pollution control programs to ensure that water quality standards are attained, many of which are funded by federal dollars under the CWA. Some of the programs administered by MDE are briefly cited below and web links are provided for access to more detailed information.

Total Maximum Daily Loads (TMDLs) and Prioritization

Waters listed on Category 5 of this Integrated Report may require a TMDL. A TMDL is an estimate of the amount or load of a particular parameter that a water body can assimilate and still meet WQS. After a TMDL has been developed, upstream discharges will be further regulated to ensure the prescribed loading amounts are attained. Maryland only added one TMDL in the 2024 Integrated Report Cycle as identified in section B.1.2.

However, Maryland continues to make progress in establishing TMDLs for the state's impaired water bodies. The following table shows anticipated TMDL submissions in 2024 and 2025. For more information on how these specific impairments were targeted for TMDLs, see Appendix C for Maryland's 2025-2032 CWA Section 303(d) Vision Long-Term Planning and Prioritization.

Table 9: Anticipated Submissions to Address Category 5 Integrated Report Listings in FFY 2024 and 2025

Listing Year	Listed Waterbody	Impairing Substance	2022 303(d) List Count
1998	Baltimore Harbor	Metals	4
1996	Aberdeen Proving Ground	Toxics	1
2002	Lower Susquehanna River	PCBs	1
2006	Middle River	PCBs	1
2008	Susquehanna River/Conowingo Dam	PCBs	1
2014	Prettyboy Reservoir	Temperature	2
2012	Deep Creek Lake	Sediment	1
2014	Gwynns Falls	Temperature	3
	Total Listings Addressed from 2022 303(d) List		**14**

MDE has created a TMDL data webpage 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.

See the MDE's Maryland TMDL Data Center or Maryland's TMDL program webpage for more information.

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 Maryland's Water Permits webpage.

Grant Programs

Several financial assistance programs are offered and/or facilitated by MDE. Funding may be in the form of grants, low interest loans, or direct payments for specific projects. MDE's Water Infrastructure Financing webpage contains more detailed information on the range of financial assistance administered by MDE.

Drinking Water Source Protection

MDE's 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, promoting a holistic approach toward protection, usage, and management of the State water resources. The WSP oversees numerous activities to make sure public water systems that serve about 84% of Marylanders provide a safe and adequate supply of drinking water.

To do so, they promote and encourage local governments and water suppliers to protect the watershed areas contributing to their surface water supplies and the areas providing recharge to their groundwater supplies. For more information on MDE's Source Protection efforts visit MDE's Source Water Assessment webpage.

To protect the sustainability of the State water resources for present and future generations, the Program additionally administers the Water Withdrawal Appropriation and Use Permitting Program. Maryland law requires that water users do not unreasonably impact the State's water resources for other users. The WSP implements testing and evaluation procedures to ensure that the potential impact from a proposed use is well understood, and that an appropriate permit decision can be made. More information on Water Appropriation and Use Permits may be found at MDE's Water Appropriations or Use Permits webpage.

Additional information on Maryland's WSP can be found at MDE's Water Supply webpage.

Tier II Waters and Antidegradation

Tier II, high-quality waters are those that have existing water quality that is better than the requirements specified by water quality standards (COMAR 26.08.02.04). Maryland continues to implement antidegradation regulations to better protect these high-quality waters from degradation. MDE has recently updated its web resources to clarify how these regulations are implemented and created web pages designed to assist permit applicants in understanding what is expected during a Tier II review of their proposed project. The antidegradation program aims to protect high quality waters by requiring more rigorous permit application reviews for projects impacting Tier II waters. The reviews identify practices that avoid, minimize, and/or mitigate the effects of the project. Maryland's Tier II webpage contains more information on this process.

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.

To meet this need, MDE's Wetlands and Waterways Program entered into an interagency agreement with the U.S. Fish and Wildlife Service to tailor their functional pyramid approach to stream restoration for Maryland restoration projects. This approach assesses potential adverse impacts and benefits of proposed restoration projects in Maryland. Detailed, rapid assessments and a restoration process were developed, as well as specific checklists according to the type of stream restoration. 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 along with its final guidance documents.

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 were developed. 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. The most recent data show long-term (2006-2018) statistically significant downward trends for both nitrogen and phosphorus loads for all three non-tidal tributaries in the Corsica River Watershed. Partners to the Corsica River Targeted Program include MD DNR, MDE, Queen Anne's County Soil Conservation District, the Town of Centreville, Queen Anne's County, and the Corsica River Conservancy. More detailed progress information on this project can be found in the 2005-2011 Progress report, the Section 319 brief, and the 2019 monitoring report. For other information related to the restoration of the Corsica River, please visit the Corsica River Conservancy website.

Maryland Coastal Bays

The Maryland Coastal Bays program is a non-profit partnership that aims to improve the long-term water quality of Maryland's six coastal bays which include the Sinepuxent Bay, Chincoteague Bay, Assawoman Bay, Isle of Wight Bay, Newport Bay, and St. Martin River. The partnership addresses water quality challenges, supports fish and wildlife, and monitors restoration progress in these water bodies while promoting community development, economic development, and coastal resilience in the region. For more information see the Maryland

Coastal Bays website, the 2022 Maryland Coastal Bays Report Card, or the Comprehensive Conservation & Management Plan for Maryland's Coastal Bays (2015–2025).

D.4 Groundwater 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 as a source for drinking water. As the population in Maryland continues to grow, the demand for groundwater for drinking, irrigation, industry, and other uses is increasing, along with threats to groundwater quality.

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

The most recently approved Groundwater Protection Program Report provides an overview of the 2021 activities and accomplishments of state programs that are designed to implement Maryland's Comprehensive Groundwater Protection Strategy.

D.5 Wetlands Program

Maryland has an estimated 757,000 acres of mapped vegetated wetlands that provide both socio-economic and ecological benefits to the State and its waterways. MDE's Wetlands and Waterways Program works to protect and restore MD's wetlands and developed a Maryland Wetland Program Plan in 2021 that describes Maryland's wetland regulation; wetland restoration and protection; wetland monitoring and assessment; and wetland quality standards. This plan updates the Maryland Wetland Conservation Plan of 2003 and the Wetland Monitoring Strategy of 2010. The document also outlines four main objectives for the program, aimed to be completed by 2025.

The first goal aims to enhance the efficiency of wetland regulation methods and management by updating screening systems, evaluating the effectiveness of restorations, and reviewing coordination with other resource agencies. The second goal proposes developing tools to improve wetland condition, function, and vulnerability assessments. The third goal is to strengthen the function of 150,000 acres of wetlands and conserve an additional 225,000 acres with the assistance of the new mapping tool BUILD (Beneficial Use Identifying Locations for Dredge). The fourth, and final, objective involves revising the water quality certification review process to ensure that federal wetland water quality standards are met.

Additionally, MDE's Wetlands and Waterways Program has included a nontidal wetland mitigation section since the program's inception in 1991. Maryland's Nontidal Wetlands Act requires a "no net loss" of wetland acreage and function. To achieve this goal, compensatory mitigation is required when wetland impacts are unavoidable. The mitigation section is tasked with ensuring that the compensatory mitigation is successfully completed.

For further information, see MDE's Maryland's Wetland Program Plan, Wetland Compensatory Mitigation webpage, or Wetlands and Waterways webpages.

Maryland is also a participant in the National Aquatic Resources Survey program and completed the field work for the National Wetland Condition Assessment in 2016. MDE and its subcontractor, Riparia, at Pennsylvania State University, sampled fifteen sites with broader distribution across Maryland than what was previously sampled in 2011. See the National Wetland Condition Assessment for more information.

D.6 Program Coordination

Program coordination both within MDE and across agencies is imperative in maintaining the framework necessary to monitor, assess, protect, and restore Maryland's surface waters. State agency staff participate in many work groups, committees, task forces, and other forums. Coordination with the Chesapeake Bay Program and participation 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 WQS development, water quality monitoring and assessment, TMDL development, and permitting. State staff 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.

PART E: MARYLAND'S CONTINUED INTEGRATED REPORT PROJECTS

Maryland continues its efforts to improve assessment methodologies and assess data to properly characterize the health of Maryland's waters and provide accurate information for restoration action. This section briefly describes ongoing projects Maryland has undertaken to reach these goals. Note that these projects are specific to the assessment process for future IRs and are in progress. They will be fully described in future IR cycles when completed. Maryland continues to separately innovate and achieve success across other components of the Clean Water Act, such as criteria adoption, TMDL development, or restoration implementation.

E.1 Dissolved Oxygen Criteria Assessment

MDE is currently conducting a pilot study in Fishing Bay to assess all applicable dissolved oxygen (DO) criteria for each designated use within the segment. This work will inform MDE's ongoing collaboration through the Chesapeake Bay Partnership to develop a methodology to properly assess all uses for the effects of nutrients on DO. As mentioned in section B.2, up till now, Maryland has been unable to monitor and assess all applicable short-duration dissolved oxygen (DO) criteria. Assessing these criteria is necessary to not only better understand conditions for aquatic life in the Bay, but also to measure and document improvements and changes within the Bay systems because of nutrient reductions. Successes in this project can be used to guide work for other segments in the Bay in the coming years.

E.2 Biological Assessment and Biological Data Integration

Maryland DNR's Biological Stream Survey Program conducts a random probabilistic biological survey that allows MD to make unbiased estimates of stream conditions with known precision. This stratified random design is a cost-effective way to characterize Maryland's 10,000+ miles of freshwater streams and support assessments of the aquatic life designated use at the 8-digit basin level.

MDE is currently working with MD DNR on updates to the Biological Assessment Methodology for Non-Tidal Wadeable Streams. These updates include data vetting processes, guidance on MBSS data collected at different map scales, and assessment procedures for incorporating high quality biological data collected by local governments as part of their Municipal Separate Storm Sewer System (MS4) permits. In the future, MDE is working to include targeted sampling into these watershed-based assessments to find and document areas of good biological quality. For more information on the delisting methods created for biology specifically, see MDE's delisting methodology for biological assessments.

E.3 The Whole Watershed Act

In the 2024 legislative session, the Watershed, Stream, and Floodplain Restoration - Chesapeake and Atlantic Coastal Bays Restoration and Stream and Floodplain Restoration Funding (Whole

Watershed Act) was passed (see brief description below). The Whole Watershed Act (Senate Bill 969/House Bill 1165) is a pilot project that will establish a Whole Watershed Restoration Partnership (WWRP) composed of local and state representatives to select and provide funding for specific restoration projects that result in accelerated improvements in water quality, provide additional co-benefits to the environment or surrounding community, are cost effective, and are supported by the local government and communities. MDE will be part of the State Management Team that will implement the Whole Watershed Act and will incorporate data collected at these restoration projects into future IR assessments where appropriate.

PART F: PUBLIC PARTICIPATION

MDE utilizes a public participation process for the 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. MDE's public review of the draft 2024 IR of Surface Water Quality will begin on May 31, 2024 and end on July 1, 2024. Besides posting an announcement on the Department's home web page, MDE will also post announcements through the following outlets:

- MDE's IR 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 IR is being made available in electronic format to the public via MDE's IR webpage https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Pages/2024IR.aspx and in hard copy format by special request to Becky Monahan at becky.monahan@maryland.gov or 410-537-3947. *Please note that MDE 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 virtually at 6pm on Thursday, June 13, 2024 to facilitate dialogue between MDE and stakeholders concerning the format, structure, and content of the draft IR. The public meeting will be recorded and shared with stakeholders that may not be able to attend the virtual public meeting. Please register for the virtual meeting at https://forms.gle/zRyGWxXzxVMGUJAS8.

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 IR submitted for EPA approval.

F.1 Informational Public Meeting Announcement

Maryland Department of the Environment

Wes Moore, Governor
Aruna Miller, Lt. Governor

Serena McIlwain, Secretary
Suzanne E. Dorsey, Deputy Secretary

Department of the Environment
Informational Public Meeting Announcement:
Maryland's Draft 2024 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 2024 IR for public review and comment. The 2024 IR includes the 303(d) 2025-2032 Vision, which provides a long-term vision for assessment, restoration, and protection under the Clean Water Act Section 303(d). Maryland's 2025-2032 Vision focuses on TMDL prioritization for current impairments. The Vision is being released for public review and comment along with the 2024 IR.

The public review and comment period for both the IR and the 2025-2032 Vision will run from **May 31, 2024- July 1, 2024**. The Draft IR is posted on MDE's website at https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Pages/2024IR.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.* Public comments or questions on the IR and the 2025-2032 Vision may be directed in writing to Becky Monahan, MDE, Water and Science Administration, 1800 Washington Blvd., Baltimore, Maryland 21230, or emailed to Becky.Monahan@maryland.gov, on or before **July 1, 2024**.

The Department is hosting a virtual informational public meeting for both the IR and the 2025-2032 Vision at **6 pm on Thursday, June 13, 2024**. Please register for the virtual meeting at https://forms.gle/zRyGWxXzxVMGUJAS8 Any hearing-impaired person may request a closed caption option for the meeting in advance. An in-person meeting may also be requested in advance, if necessary. The virtual meeting will be recorded, and a copy will be posted on the IR webpage. 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. Please contact Becky Monahan at Becky.Monahan@maryland.gov or (410) 537-3947 with any meeting requests or questions.

Public Meeting Announcement
Date: June 13, 2024.
Start Time: 6:00 p.m.
Virtual Registration: https://forms.gle/zRyGWxXzxVMGUJAS8
Phone Number: United States 1 209-850-2368
Attendee- Pin: 383 350 004#

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Appendix A: Organizations That Submitted Water Quality Data

Table A- 1:The Organizations/Programs That Submitted Water Quality Data for Assessment in the 2024 IR

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
Alliance for the Chesapeake Bay MD	RiverTrends MD - Started in 2020 and follows the same VA DEQ QAPP as the VA program, monthly sampling in DC and Maryland for air and water temp, dissolved oxygen, pH, conductivity, water clarity, and salinity.	Air and water temp, dissolved oxygen, pH, conductivity, water clarity, and salinity.	II	Data assessed for use in Category 3 assessment to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
Anacostia Riverkeeper	Washington D.C. Department of Energy and Environment (2018) and CBP (2020) approved QAPP - Weekly summer bacteria monitoring using the IDEXX system in DC, Virginia, and Maryland.	E. coli (MPN/100mL), turbidity (NTU), pH, DO	II	Data assessed for use in Category 3 assessment to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
Anne Arundel Community College	CBP Approved QAPP in 2022 - weekly or bi-weekly samples Coordinates with Spa Creek Conservancy and 3 other projects.	Conductivity, dissolved oxygen, pH, salinity, secchi, water temperature, chlorophyll a, enterococcus, total nitrogen (TN), total	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
		phosphorus (TP), and total suspended solids (TSS).		
Anne Arundel County Bureau of Watershed Protection and Restoration	Biological monitoring data from Anne Arundel County.	Benthic Indices of Biotic Integrity	III	Data used for informational purposes. Biological data has undergone full vetting and will be integrated into the biological assessment for future IRs.
Antietam-Conococheague Watershed Alliance	Continuous water temperature data collected with loggers	Water temperature, Air Temperature	III	Data used to update temperature assessments.
Antietam-Conococheague Watershed Alliance	Monthly sampling year-round for conductivity, dissolved oxygen, nitrate-nitrogen, orthophosphate, pH, total dissolved solids (TDS), water temperature, and bacteria.	Conductivity, DO, nitrate-nitrogen, orthophosphate, pH, total dissolved solids (TDS), water temperature, bacteria.	II	Data assessed for use in Category 3 assessment to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
Baltimore County Department of Environmental Protection and Sustainability	Water quality and biological monitoring data from streams around Baltimore County.	Benthic and Fish Indices of Biotic Integrity, Water Quality Data	III	Data used for informational purposes. Biological data has undergone full vetting and will be integrated into the biological assessment for future IRs.
Blue Water Baltimore	Nontidal water quality data from ambient water monitoring.	Conductivity, dissolved oxygen, pH, salinity, secchi and water temperature. Also sample chlorophyll a, TN, and TP analyzed at the Chesapeake Bay Laboratory (CBL).	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
Blue Water Baltimore	Tidal DO data integrated with the Chesapeake Bay Program Assessments- Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of cumulative frequency distribution (CFD) curves	III-Tidal DO	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries
Chesapeake Bay Program and MD DNR	Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of CFD curves	III	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
Elk and North East Rivers Watershed Associations	All the data is in the Alliance for the Bay's Chesapeake Data Explorer (web site). It consists of monthly values (April through November of each year) of 10 measured parameters for each of ~18 sites (exact number varies by year) in the Elk River and North East River watersheds, in Cecil County, MD, including both tidal and non-tidal sites.	Air temperature (C), water temperature (C), pH, conductivity (uS/cm), dissolved oxygen (% saturation), dissolved oxygen (mg/l), turbidity (NTU), clarity (Secchi tube cm), total nitrogen (mg/l), and total phosphorus (mg/l). All are from near-surface (0.3 m deep) samples. Total nitrogen and total phosphorus are lab measurements, the others are in-situ at the date and time of sampling.	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
Gunpowder Valley Conservancy	River Trends in MD	DO and pH	II	Data assessed for use in Category 3 assessment to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
Howard County Government, Stormwater Management Division	BIBIs and component metrics (raw values and normalized scores; 1, 3, 5) for Piedmont, RBP habitat for high gradient, MBSS PHI for Piedmont.	Benthic Indices of Biotic Integrity, Water Quality Data	II	Data used for informational purposes. Biological data will undergo full vetting to be integrated into the biological assessment for future IRs.

Data Provider	**Data Description and Notes**	**Parameter(s) Measured**	**Data Tier**	**Data Use**
	EMCs and concentrations (1 for each rise, peak, falling limb for storms) for MS4 storm sites, including MS4 mandated parameters. EMCs and concentrations (1 for each rise, peak, falling limb for storms) for voluntary monitoring including nitrate/nitrite-N, nitrate, nitrite, Total Kjeldahl Nitrogen, total nitrogen, total phosphorus, TSS. Biological and habitat data are collected following a QAPP and associated SOPs for the Howard County Biological Monitoring and Assessment Program.			
Lancaster Water Quality Volunteer Coalition	The Water Quality Volunteer Coalition program is a partnership program with the Lancaster County Conservation District, and other community partners. Volunteers conduct monthly testing on streams like	Physical, chemical, and biological water quality	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
	Climbers Run, Kellys Run, Pequea Creek, Fishing Creek, Steinman Run, Tucquan, and Trout Run.			
MD DNR- Coastal Bays Monitoring Program	MD DNR Coastal Bays Monitoring Program	Nutrients, Oxygen, Algae	II	Data used for informational purposes. Integration with state datasets is not yet possible.
MD DNR- Core Trends Program	Maryland's portion of this national ambient monitoring effort includes 37 Core stations located in non-tidal and tidal freshwater and estuarine areas and 25 Trend stations located on larger, non-tidal streams and rivers (4th order and larger). The 62 stations that comprise this monitoring program are sampled monthly, year-round, for physical and chemical parameters.	Temp, DO, pH, Specific Conductance, TSS, Nutrients, Turbidity, Chl-a, Phaeophytin, Sulfate, Alkalinity, Temperature.	III	Data used to update pH and nutrient assessments.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
MD DNR- Freshwater Fisheries	Continuous water temperature data collected with loggers	Water temperature, Air Temperature	III	Data used to update temperature assessments.
MD DNR- MBSS	Maryland Biological Stream Survey Data collected to assess current condition of ecological resources in Maryland's streams and rivers	Data is collected at each site on the physical, chemical, and biological (fish and insects) characteristics, and then combined into an overall assessment.	III	Data used in updating the Biological Assessment Methodology for Non-tidal Wadeable Streams.
MD DNR- MBSS	Continuous water temperature data collected with loggers	Water temperature, Air Temperature	III	Data used to update temperature assessments.
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	III	Data summarizes the areas with the most frequent sewage overflows. Information included in the IR narrative.
MDE- Abandoned Mine Lands Division	pH and mine discharge information from Georges Creek and McDonald Mine.	pH, acidity, specific conductance, TDS, TSS, alkalinity, sulfates, and metals.	III	Data used to update Georges Creek pH assessment.

Data Provider	**Data Description and Notes**	**Parameter(s) Measured**	**Data Tier**	**Data Use**
MDE- Beach Certification Program	Bacteria data collected at designated bathing beaches by County HDs.	Enterococcus levels	III	Data used to update beach assessments.
MDE- Fish Tissue Monitoring Program	Fish Tissue data on Chlordane, PCBs, Hg, and PFAS content	Concentration of Chlordane, PCBs, mercury, and PFOS in fish tissue	III	Data used to update fish consumption assessments for Chlordane, PCBs, mercury, and PFOS.
MDE- Lakes	Water quality and profile data collected at lakes	Nutrients, depth, temperature, salinity, pH, DO, secchi depth, chlorophyll a, flow.	III	Data used to update lake assessments.
MDE- National Wetland Condition Assessment	The NCWA is a collaborative survey of our Nation's wetlands.	The NWCA examines the chemical, physical and biological integrity of wetlands through a set of commonly used and widely accepted indicators.	III	Data used for informational purposes. Integration with state datasets is not yet possible.
MDE- Port Tobacco	Follow up monitoring for Port Tobacco bacteria impairments.	Qualitative watershed data	III	Data used to demonstrate that Port Tobacco was erroneously listed.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
MDE- Shellfish Certification Program	Bacteria data for stations in the Tidal areas of the Chesapeake Bay and Coastal Bays in MD	Fecal coliform	III	Data used to update bacteria assessments as they relate to the shellfish harvesting designated use.
MDE- Shellfish Certification Program	Tidal DO data integrated with the Chesapeake Bay Program Assessments- Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of CFD curves	III-Tidal DO	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries
MDE- Sulfates	Sulfate study to review previous Biological Stressor Identification impairment listings for sulfates.	Literature review and sulfate concentrations from MBSS data, MD Ion Study Data, Western MD pH TMDL Data, Marcellus Shale Natural Gas Baseline Data, and MD DNR Monthly Core Trend Data	III	Data used to update sulfate assessments.
MDE- Temperature	Continuous water temperature data collected with loggers	Water temperature, Air Temperature	III	Data used to update temperature assessments.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
MDE- Tier II Biological Sampling	Raw count data of biological sampling of fish and aquatic macroinvertebrates; station summary data on some of Maryland's Tier II streams.	Benthic and Fish Indices of Biotic Integrity, Water Quality Data	III	Data was used to update MD's Tier II High Quality Waters.
MDE- WQA and TMDLs	WQA approved for Harbor (MD-PATMH-Middle_Harbor and MD-PATMH-Curtis_Bay_Creek) Zinc in Sediments- TMDL approved for TSS in MD-02130903	Zinc in Sediments and TSS	III	Data used to update Zinc in Sediments and TSS assessments.
Nanticoke Watershed Alliance	Tidal DO data integrated with the Chesapeake Bay Program Assessments- Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of CFD curves	III-Tidal DO	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries
Nanticoke Watershed Alliance	Nanticoke River watershed sites, plus four Fishing Bay sites through 2021.	DO, water clarity, temp, salinity, pH (since 2020), conductivity, total nitrogen, total phosphorus, chlorophyll a	pH-II, DO-II	Tier II data used in Category 3 IR assessments to prioritize follow-up monitoring. Tier III data is used to update pH and DO assessments;

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
			and III	however, additional data are required for a conclusive assessment.
Nature Forward (formerly Audubon Naturalist Society)	Benthic macroinvertebrate surveys for 20+ stream sites in Maryland. Collections subsampled - approximately 100 macroinvertebrates identified to Family level, some to Genus. (Data in CMC Chesapeake Data Explorer also includes 3 stream sites in Washington DC. Data submitted under "Audubon Naturalist Society" (organization name changed in October 2022 to Nature Forward.)	Benthic macroinvertebrate surveys	I	Data used for informational purposes - Benthic index of biotic integrity calculated using family or genus level identification inconsistent with MD assessment methods.
Patapsco Heritage Greenway	Physical & chemical data, 11 stations on the Patapsco & tributaries, twice a month, some bio monitoring	Physical and chemical water quality data	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
Prince George's County Department of the Environment	Non-tidal biological monitoring data and accompanying water quality data from streams around Prince George's County.	Benthic and Fish Indices of Biotic Integrity, Water Quality Data	III	Data used for informational purposes. Biological data has undergone full vetting and will be integrated into the biological assessment for future IRs.
Prince George's County Department of the Environment	Prince George’s County Department of the Environment (DoE) received a 2017 Community-based Marine Debris Removal grant from the National Oceanic and Atmospheric Administration (NOAA). The grant funded the installation of two Bandalong™ Litter Trap at Cabin Branch in the Lower Beaverdam Creek subwatershed and on Guilford Run in the Northeast Branch subwatershed. The grant also required stream surveys be conducted for pre- and post-installation scenarios to evaluate: 1) trash levels 2) benthic macroinvertebrate	Benthic and Fish Indices of Biotic Integrity, Water Quality Data, trash levels	III	Data used for informational purposes. Biological data has undergone full vetting and will be integrated into the biological assessment for future IRs.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
	community health and 3) fish community health.			
Severn River Association	Water Quality Monitoring Data profiles at 52 stations on the Severn River, collected weekly April-October.	Water column -- depth, temperature, dissolved oxygen, pH, salinity, clarity.	II	Data used in Category 3 IR assessments to prioritize follow-up monitoring for pH and DO. Tier III data is necessary for regulatory decisions.
South River Federation (Now part of Arundel Rivers Federation)	Tidal DO data integrated with the Chesapeake Bay Program Assessments- Results of Water Quality Interpolator Model, based on measured DO levels in Chesapeake Bay	Percent exceedance of CFD curves	III-Tidal DO	Data used to update the DO/nutrient assessments for the Chesapeake Bay and its tidal tributaries
Susquehanna River Basin Commission	Water Quality (43 parameters total) and fish population data	Water Quality (43 parameters total) and fish population data	I	Data used for informational purposes. Data needs to be accompanied by metadata and a QAPP or similar documentation.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
SWCA Environmental Consultants on behalf of PEPCO	Qualitative Long Term Monitoring plan to characterize the spatial extent of natural attenuation (of oil presence) over time. Visual inspections of oil based on modified Shoreline Cean-up Assessment Technique procedures at the tidal Patuxent River 2000 oil spill site.	Qualitative Oil spill data including visual inspection notes	III	Data used to update oil spill assessments.
Town of Preston	Drinking Water Contaminants Report	Inorganic Contaminants, Volatile Organic Contaminants	I	Data used for informational purposes. The Integrated Report assesses surface water quality and not groundwater or well water.
Trout Unlimited	Continuous water temperature data collected with loggers	Water temperature, Air Temperature	III	Data used to update temperature assessments.
Upper Potomac Riverkeeper	Acid Mine Drainage metals data (Aluminum, Manganese, Iron).	Aluminum, Manganese, Iron	II	Data used to support and refine metals assessments. Data needs to be accompanied by a QAPP or similar documentation.

Data Provider	Data Description and Notes	Parameter(s) Measured	Data Tier	Data Use
Virginia Institute of Marine Science and MD DNR	Counts of acres submerged aquatic vegetation (SAV) coverage and measured water clarity for select tidal tributaries to the Chesapeake Bay.	SAV coverage (acres) and water clarity acres	III	Data used to update the SAV/sediment assessments for the Chesapeake Bay and its tidal tributaries.
Waterfront Partnership of Baltimore	Surface water bacteria data and other parameters in the Baltimore Harbor	Enterococcus levels	I	Data used for informational purposes. Data needs to be accompanied by metadata and a QAPP or similar documentation.

Appendix B: The 2024 Integrated Report Assessment List

In the 2024 IR, MDE provides the list of all assessment records as an Excel spreadsheet that can be queried. This spreadsheet replaces static reports used for each reporting category in previous IRs. Users can filter the spreadsheet by basin code, assessment unit, reporting category, parameter, new impairments in 2024, delistings in 2024, and other relevant fields. The data dictionary included as a tab in this spreadsheet provides relevant information about these fields, for instance, the unique characteristics of the subbasin or basin name fields, which make these fields not ideal for querying.

The spreadsheet tab with MDE's assessment record information was exported from EPA's ATTAINS for the 2024 IR. Doing so supports consistency between EPA tools like How's My Waterway and MDE's Integrated Report publications. For more information on ATTAINS please see https://www.epa.gov/waterdata/attains.To access How's My Waterway please see https://www.epa.gov/waterdata/hows-my-waterway

The Draft 2024 Integrated Report Assessment List spreadsheet is on the 2024 Draft IR Webpage here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Pages/2024IR.aspx or found through the direct link here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Integrated_Report_Section_PDFs/IR_2024/2024_Public_Draft_IR_Database_Spreadsheet_5_31_24.xlsx

2025-2032 Vision for Clean Water Act Section 303(d) Program

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Table of Contents

List of Abbreviations

APG	Aberdeen Proving Ground
BIBI	Benthic Index of Biotic Integrity
BMP	Best Management Practice
BSID	Biological Stressor Identification
CBL	Chesapeake Biological Laboratory
CBP	Chesapeake Bay Program
CBPO	Chesapeake Bay Program Office
CBP5.2	Chesapeake Bay Model Phase 5.2
CBRAP	Chesapeake Bay Regulatory and Accountability Program
CDC	Center for Disease Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Chl-a	Chlorophyll a
Cl	Chloride
CWA	Clean Water Act
DC	District of Columbia
DFIRMs	Digital Flood Insurance Rate Maps
DO	Dissolved Oxygen
DOEE	DC Department of Energy and Environment
EFDC	Environmental Fluid Dynamics Code
EJ	Environmental Justice
FEMA	Federal Emergency Management Agency
FIRMs	Flood Insurance Rate Maps
FFIT	Maryland Forest Financing Implementation Tool
FFY	Federal Fiscal Year
Gen X	Hexafluoropropylene oxide dimer acid or HFPO-DA
GIS	Geographic Information Systems
HFPO-DA	Hexafluoropropylene oxide dimer acid or GenX
Hg	Mercury
HOA	Homeowner's Association
IBI	Index of Biotic Integrity
ICPRB	Interstate Commission on the Potomac River Basin
IR	Integrated Report of Surface Water Quality
LMA	Land Management Administration
MATS	Mercury and Air Toxics Standards (EPA's)
MBM	Main Bay Model
MBSS	Maryland Biological Stream Survey
MCLs	Maximum Contaminant Levels
MDA	Maryland Department of Agriculture
MDDNR	Maryland Department of Natural Resources
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MeHg	Methylmercury
MOU	Memorandum of Understanding
MS4	Municipal Separate Stormwater Sewer System
MTMs	Multiple Tributary Models
NADP	National Atmospheric Deposition Network
ng/g	Nanogram/gram
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulation

NPL	National Priority List (Superfund)
NRDC	Natural Resources Defense Council
Pb	Lead
PCB(s)	Polychlorinated Biphenyls
PEARL	Patuxent Environmental & Aquatic Research Laboratory, Morgan State University
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFAS	Per and Polyfluoroalkyl Substances
PFBS	Perfluorobutane sulfonate
PFHxS	Perfluorohexanesulfonic acid
PFOS	Perfluorooctane Sulfonic Acid
pH	Percent of Hydrogen
Phase 6 Model	Chesapeake Bay Program's Phase 6 Model
POTW	Publicly Owned Treatment Works
QA/QC	Quality Assurance/Quality Control
SERC	Smithsonian Environmental Research Center
SHA	State Highway Administration
SO_4	Sulfate
SSN	Spatial Statistical Network model
SWAT	Soil and Water Assessment Tool
SWI	Sediment Water Interface
SW-WLA	Stormwater Wasteload Allocation
TIPP	TMDL Implementation Progress and Planning Tool
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
UMBC	University of Maryland Baltimore County
UMD	University of Maryland
UMCES	University of Maryland Center for Environmental Science
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
VIMS	Virginia Institute of Marine Science
WIP	Watershed Implementation Plan
WLA	Waste Load Allocation
WPRPP	Watershed Protection, Restoration and Planning Program
WQA	Water Quality Analysis
WQLS	Water Quality Limited Segment
WQS	Water Quality Standards
WREC	Wye Research and Education Center
WSA	Water and Science Administration
WWTP	Wastewater Treatment Plant
Zn	Zinc

Introduction

The Maryland Department of the Environment (MDE) is largely responsible for fulfilling Maryland's mandates under the federal Clean Water Act (CWA). One important mandate is monitoring the State's waters to determine attainment of water quality standards. Section 303(d) of the Federal Clean Water Act directs states to identify and list waters, known as water quality limited segments (WQLSs), for which technology-based effluent controls of a specified substance are inadequate to achieve water quality standards (33 U.S.C. § 1313(d); see also 40 Code of Federal Regulations 130.7(b) (i - iii)). For each WQLS, the State must establish a total maximum daily load (TMDL) of the impaired substance that the WQLS can receive without violating water quality standards. Each TMDL addresses a single pollutant or stressor for a specified waterbody. Therefore, waterbodies with multiple impairments may require multiple TMDLs. If the existing water quality information demonstrates that water quality standards are being met, a Water Quality Analysis (WQA) may be conducted, and the waterbody-pollutant listing would be removed from the impaired waters list.

In 2013, the United State Environmental Protection Agency (USEPA) developed a vision for Section 303(d) of the federal Clean Water Act. The Vision is designed to help coordinate and focus efforts to advance the effectiveness of the CWA. It consists of Engagement, Prioritization (of a state's watersheds), Protection (i.e., of unimpaired watersheds), Alternatives (to traditional TMDL development), Integration (with other major environmental statutes), and Assessment (of overall results). The Engagement and Prioritization components are implemented first, followed by Protection, Alternatives and Integration, with Assessment last. The first 'cycle' of full implementation of the New Vision began with the 2016 Integrated Report of Surface Water Quality (IR) and ended in 2022. New TMDL development focused on (1) the protection of public health, and (2) the protection of aquatic life in all of Maryland's waterways.

Maryland developed and submitted its list of priority watersheds in 2016 after presenting the information at a public meeting. The presentation can be found here: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Documents/prioritiz_IR_Pubmeet_hdt.pdf.
The full documentation of this prioritization is available in the 2016 IR Part G available at: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Documents/Integrated_Report_Section_PDFs/IR_2016/Final_2016_IR_Part_G.pdf.

The CWA Section 303(d) Program made significant advances implementing the 2013 Vision. States and territories have been using the goals outlined in the 2013 Vision to guide program management for the past ten years. With lessons learned from the last decade, USEPA finalized the development of the 2022-2032 Vision (MDE's 2025-2032 Vision). The 2025-2032 Vision builds on the experience gained from implementing the 2013 Vision outlined in A New Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program. Like the 2013 Vision, the 2025-2032 Vision is intended to encourage flexible and innovative approaches for states, territories, and authorized tribes ("states, territories, and tribes") to implement CWA Section 303(d), as well as to identify ways to best use limited resources to lead to restoration and protection, to leverage partnerships, and to encourage development of solutions to emerging and difficult water quality issues.
The goals presented in the 2025-2032 Vision are Planning and Prioritization, Restoration, Protection, Data and Analysis, and Partnerships. Maryland has built upon its 2016 Vision and components of that

document are incorporated herein. This document updates the Prioritization and Planning goal and identifies Maryland's priorities related to addressing Category 5 listings, along with the rationales for those priorities for the years 2025-2032. Throughout this document, actions towards the other goals are integrated where applicable, as Maryland's water quality management has operated in an integrated fashion for some years.

Background

In Maryland, the responsibility for the preparation of the IR, TMDLs, and other restoration, management or action plans belongs to Maryland Department of the Environment's Water and Science Administration, specifically the Watershed Protection, Restoration & Planning Program (WPRPP).

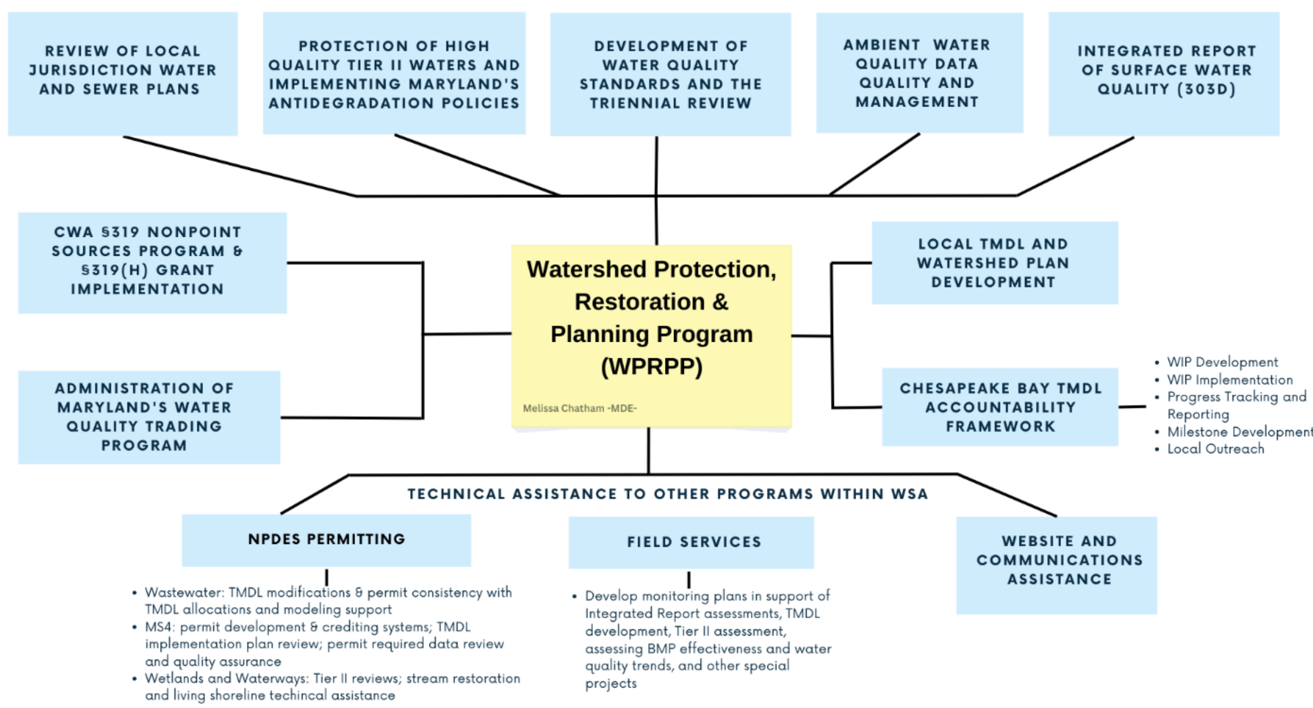


Figure C- 1: Functions of the WPRPP

The many functions and facets of WPRPP play a significant role in the development of Maryland's 2025-2032 Vision for TMDLs and other plan development. Because of the Program's many and variable responsibilities which requires interactions with not only other MDE programs but also other State agencies, the 2025-2032 Vision reflects a comprehensive strategy for addressing §303(d) impairment listings that align with Departmental priorities that also have the highest likelihood of resulting in tangible actions to improve water quality in waterbodies throughout the State of Maryland.

Water quality management in Maryland is a cyclical process.

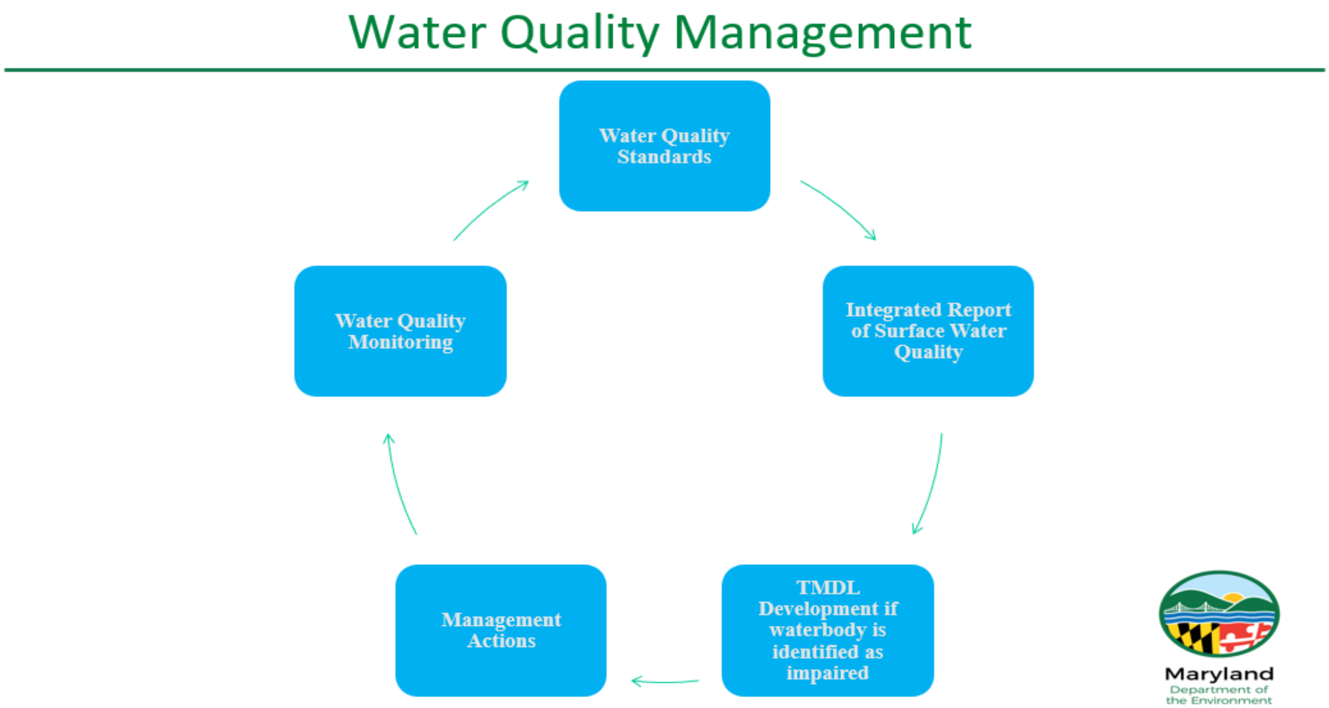


Figure C- 2: Maryland's Water Quality Management process.

Water quality monitoring is conducted by a wide variety of agencies including but not limited to Maryland Department of the Environment, Maryland Department of Natural Resources, various county agencies, the State Highway Administration, non-government organizations and citizen scientists. Water quality standards are developed and reviewed in what is called the Triennial Review. This process occurs every three years and the standards are based on the best science available and an opportunity for the public to review and comment is provided. Maryland's water quality standards and information can be found at: https://mde.maryland.gov/programs/water/TMDL/WaterQualityStandards/Pages/index.aspx. The Integrated Report of Surface Water Quality uses the best readily available data and methodologies to determine if a waterbody is impaired by a specific pollutant. This process is currently repeated every two years. Information about what data qualifies, the methodologies used and the actual reports is available at: https://mde.maryland.gov/programs/Water/TMDL/Integrated303dReports/Pages/index.aspx. TMDL development occurs when a waterbody is considered impaired. Maryland has established over 488 TMDLs and 161 Water Quality Analyses (WQAs) which are available at: www.mde.maryland.gov/tmdl. If a TMDL is in place, implementation of plans to reduce the amount of the affecting pollutant can begin. These management actions such as best management practices, reductions at wastewater treatment plants and upgrading septic systems are implemented and the waterbody continues to be monitored to hopefully see trends of water quality improvement. Maryland's 2025-2032 Vision for TMDL and other plan development reflects a continuation of this overall process and will prioritize waterbodies within this schema.

Methodology

When Maryland conducted analysis for this Vision, the latest approved IR was the 2020/2022 IR. The list included impairments without TMDLs for nutrients, sediment, chlorides, sulfates, temperature, polychlorinated biphenyls (PCBs), bacteria, mercury, per and polyfluoroalkyl substances (PFAS), pH (acidity/basicity) and unidentified biological impairments. There was a total of 359 waterbody/pollutant combinations without a TMDL identified on the impairment list (Category 5/5s of the IR). These include 15 pollutants at various waterbody and watershed scales.

Maryland's primary objective under the 2022 Vision was to identify which of the 359 category 5 impairment listings on the 2022 Integrated Report would be priorities for TMDL and other plan development over the eight-year span covered by the 2022 Vision. Maryland developed a robust methodology utilizing both objective metrics and subjective best professional judgment to identify these priority listings. Initial, potential decision factors and metrics were developed and ultimately grouped into four main categories: policy (orange boxes), science (green boxes), collaboration opportunities (yellow boxes) and implementation factors (pink boxes).

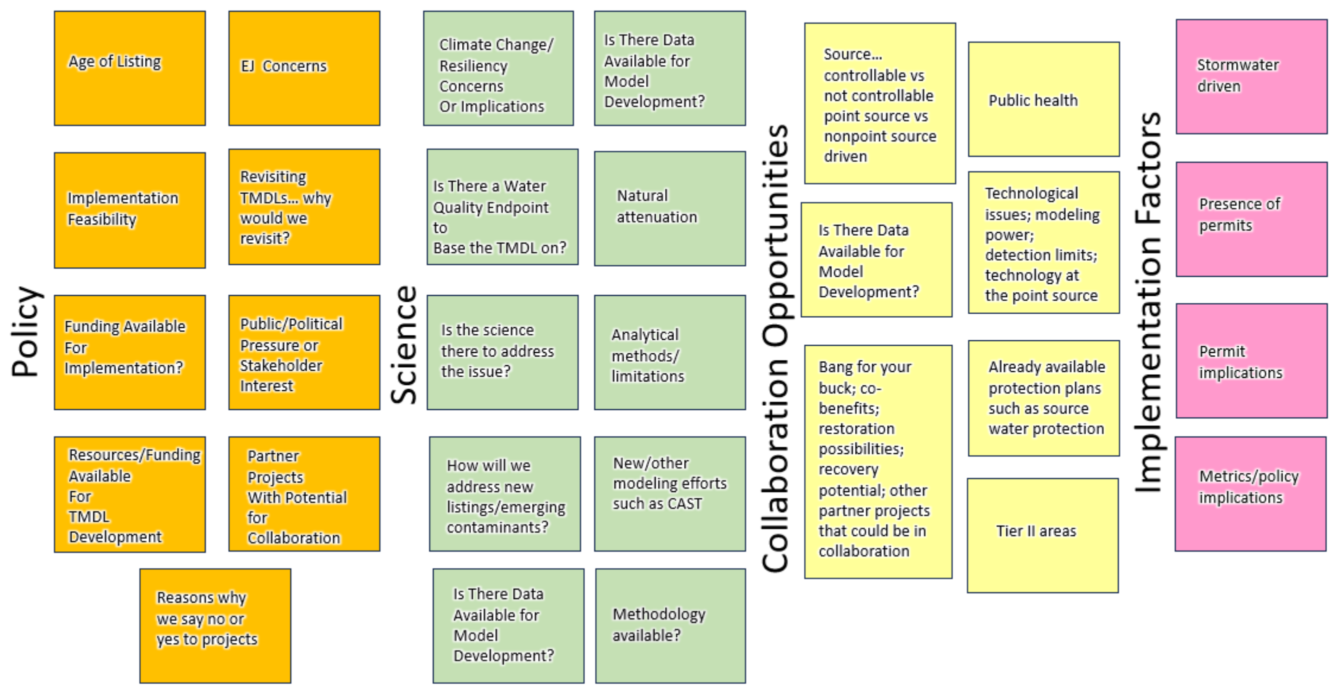


Figure C- 3: Initial Decision factors and how they were grouped.

Using many of the categories identified in Figure C- 3, a geographic information system (GIS) analysis was conducted as well as a weighting exercise for categories or items that did not have enough information to be included in a GIS analysis. Table C- 1 below provides further information about the categories. Many of the metrics in Groups 2 and 3 were assessed based on the best professional judgment of WPRPP staff. The GIS data for three of the key variables included in WPRPP's GIS analysis are shown in Figures C- 4, C- 5, and C- 6. Flood mitigation and the Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRMs) were used as a surrogate for a climate resiliency metric. The Department, in early July 2022, released an environmental justice (EJ) screening and mapping tool which was posted on MDE's website at https://mdewin64.mde.state.md.us/EJ/ . The tool is being used by MDE staff, permit applicants, and the public to facilitate engagement during permitting and environmental protection processes. It incorporates demographic and socioeconomic data with MDE elements like industrial facilities, wastewater treatment plants, and proximity to dams to prioritize EJ concerns. WPRPP utilized the same tool in its GIS analysis for its EJ metric. For Tier II watersheds, the Department utilized its own Tier II watershed maps located on its website here: https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx.

Table C- 1: Decision Factors Groups

Group 1: GIS Analysis	Group 2	Group 3
Flood mitigation	Stakeholder Interest/External Pressures	Data Availability
Environmental Justice (EJ)	Funding Availability for Restoration	Available Methodology
Tier II Watershed Protection	Source Characterization	Technical Limitations (example, lab detection limits)
Public Health	Degree of Impairment	Age of Listing
Emerging contaminants (PFAS)	Alignment with other Programs	
Chesapeake Bay Restoration	Address multiple stressors (co-benefits) example: CERCLA	
Drinking Water Protection		

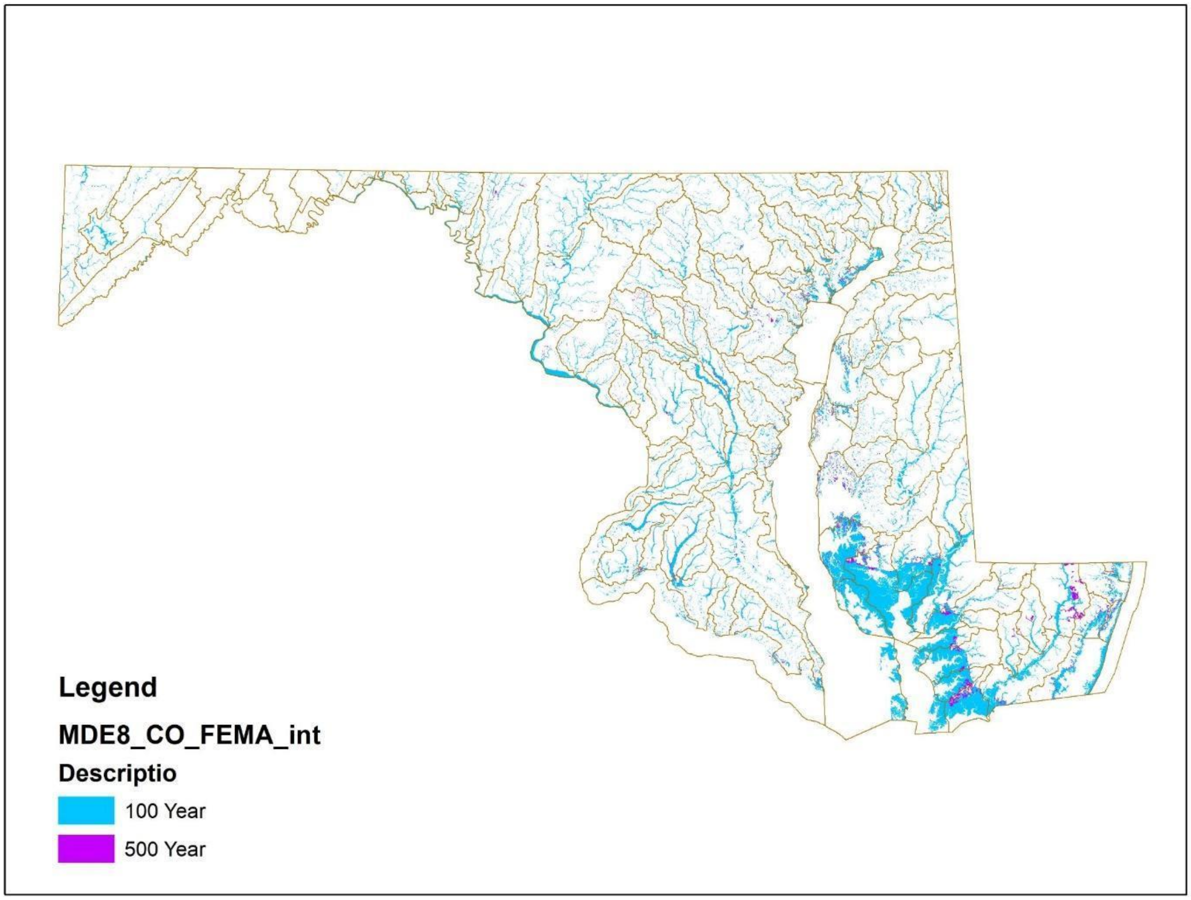


Figure C- 4: Areas where the 100 year and 500-year flood plain occurs.

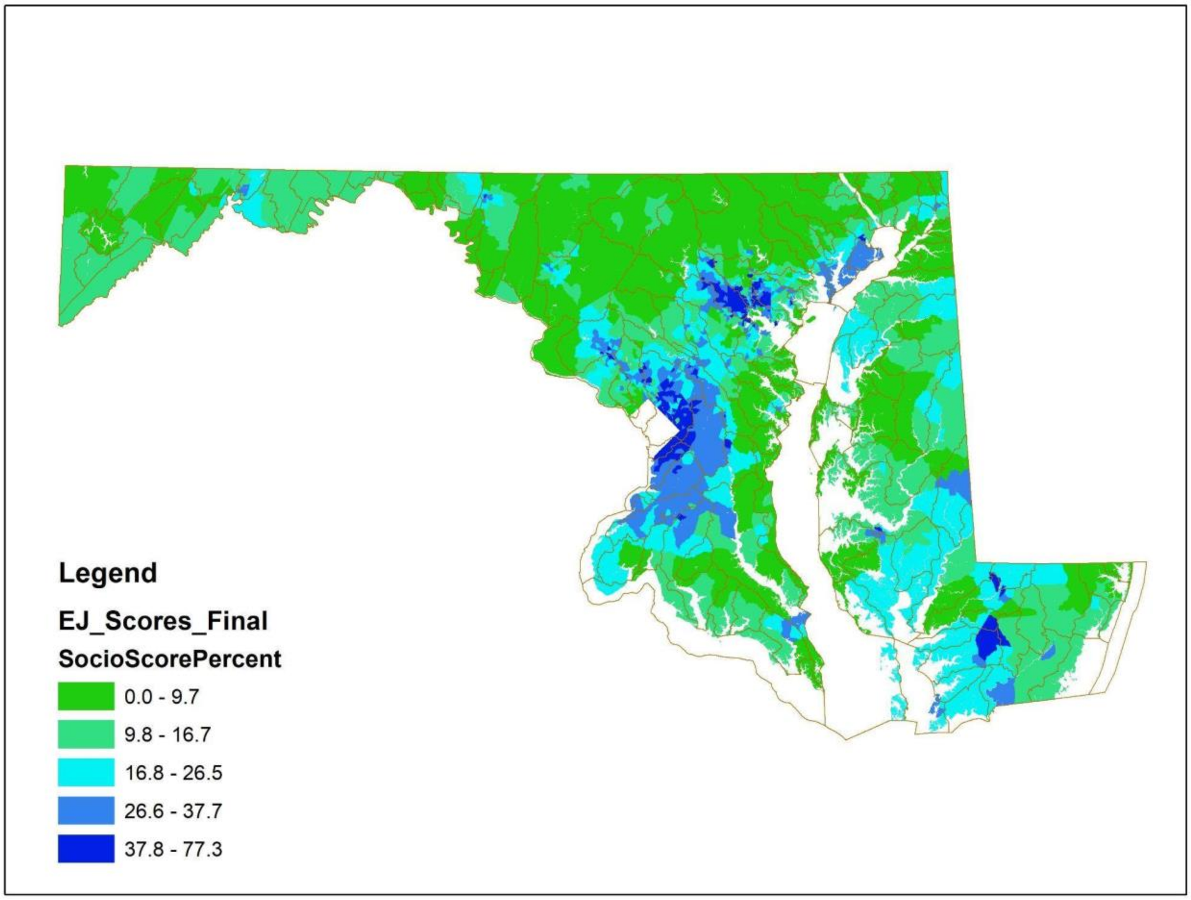


Figure C- 5: Results from using the MDE EJ Screening Tool

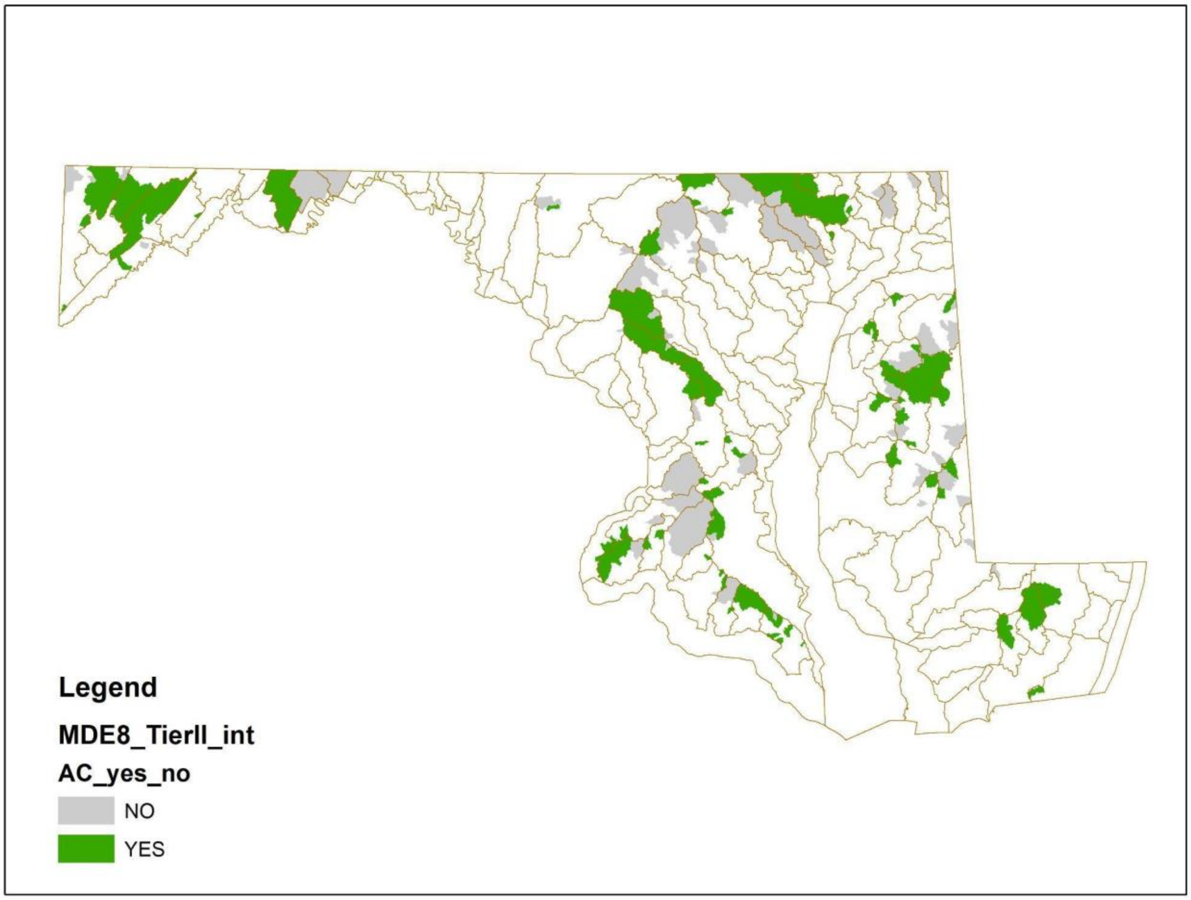


Figure C- 6: Locations of Tier II catchment areas and if there is assimilative capacity available for that catchment.

When these layers are weighted and combined, the map below indicates watersheds that become priorities for TMDL and other plan development.

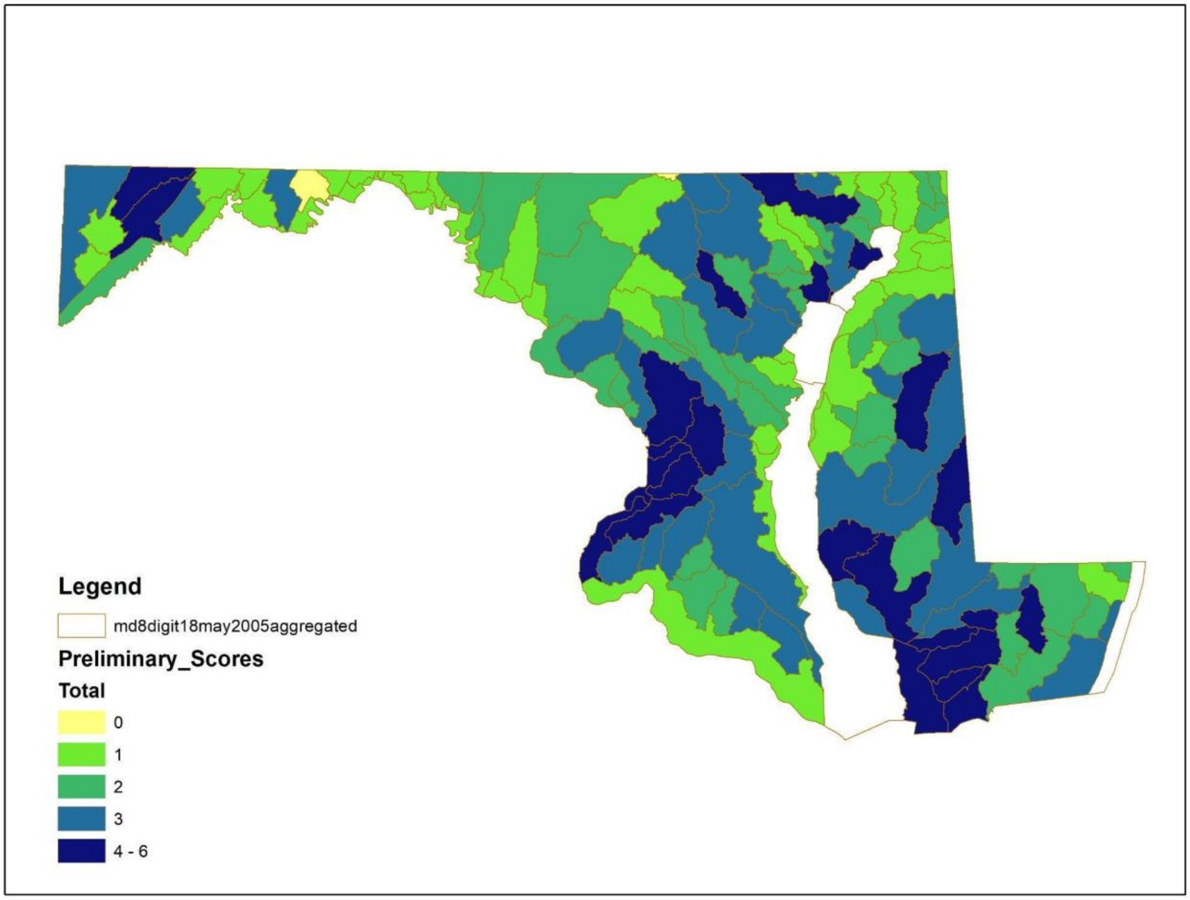


Figure C- 7: Results of combining the flood, EJ, and Tier II layers. The higher the score, the more overlap between the layers. This gives a geographic idea of where TMDL development could be targeted.

Based on the factors listed above, WPRPP's GIS weighting exercise, and the knowledge the Department has gained over the last 25 years of TMDL development, a prioritization list for TMDL development was determined (Table C- 2 below). Note in the 2024 IR, there are an additional 293 Category 5 listings, which fall under the same 15 pollutants as 2022 listings. Most of these listings are smaller geographic scale temperature listings, several of which fall into watersheds that have been identified in this prioritization process.

Table C- 2: Category 5 Listings to be addressed from 2025-2032.

8-Digit Basin Number	Basin Name	Pollutant/Impairing Substance	Priority Rationale	2024 303(d) List Count
02130306	Marshyhope Creek	Non-tidal Sediment	High EJ Score, Age of listing	1
02130403	Lower Choptank River	Non-tidal Sediment	Stakeholder interest, Age of listing	1
02130308	Transquaking River	Non-tidal Sediment	Flooding, Age of listing	1
05020203	Deep Creek Lake	Non-tidal Sediment	Stakeholder interest, Age of listing, In-progress project	1
02130806	Prettyboy Reservoir	Temperature	Climate Change, Tier II, In-progress project	37
02140303	Upper Monocacy River	Temperature	Climate Change	24
02120202	Deer Creek	Temperature	Climate Change, Tier II	29
02140305	Catoctin Creek	Temperature	Climate Change	13
02130904	Jones Falls	Temperature	Climate Change	19
02130905	Gwynns Falls	Temperature	Climate Change, Previous project available, High EJ Score	11
MD-02140203-Mainstem	Piscataway Creek Mainstem	PFOS - Fish Tissue	Emerging contaminant, High EJ Score, Public Health	1
MD-PISTF	PISTF – Piscataway Creek Tidal Fresh	PFOS – Fish Tissue	Emerging contaminant, public health	1
02130403	Lower Choptank River	Non-tidal Nutrient	Age of Listing	1
02130301	Lower Wicomico River	Non-tidal Nutrient	Flooding, Age of Listing	1
02130509	Middle Chester River	Non-tidal Nutrient	Tier II, Age of Listing	1
02130706	Swan Creek	Non-tidal Nutrient	EJ areas, Age of Listing	1
02130903/ PATMH	Baltimore Harbor	Bacteria	Technical fixes may be appropriate (4b plan), stakeholder interest, age of listing, public health	1
02120204	Susquehanna River/Conowingo Dam	PCBs – Fish Tissue	Public Health, Age of listing, project in progress	1
02120201	Lower Susquehanna River	PCBs – Fish Tissue	Public Health, Age of listing, project in progress	1
02130807	Middle River	PCBs – Fish Tissue	Public Health, Age of listing, EJ areas, project in progress	1
02130904	Jones Falls	PCBs – Fish Tissue	Public health, EJ areas	1
02130905	Gwynns Falls	PCBs – Fish Tissue	Public health, EJ areas	1
02130903	Bear Creek in the Baltimore Harbor watershed	Zinc	Potential 4b plan, Superfund National Priorities List (NPL) site, Age of listing	1
02130903	Bear Creek in the Baltimore Harbor watershed	Lead	Potential 4b plan, Superfund National Priorities List (NPL) site, Age of listing	1
	2025-2032	**Total Listings Addressed from 2024 303(d) List**		**151**

Per EPA guidance on the 2022 Vision, WPRPP can reassess its priorities for the development of TMDLs and other plans every two years in conjunction with the Integrated Report. WPRPP has every intention of reassessing its priorities on a rolling basis. There are many applicable factors that WPRPP did not consider in its prioritization that could alter priorities in the future. For instance, WPRPP is working closely with the Chesapeake Bay Program on the development of its Phase 7 water quality and watershed modeling tools. These updated modeling tools may cause WPRPP to revisit nutrient TMDLs for some of its tidal waters, especially in areas where a high level of effort has been made in water quality improvements, such as the Baltimore Harbor and Back River. In addition, MDE's Stormwater, Dam Safety, and Flood Management Program is in the process of developing priority watersheds for quantifying flooding impacts. There is a desire, both internally and externally, to tie these models to water quality models for the same basins. Therefore, some of these joint initiatives could become priorities for TMDL or other plan development. There are many factors still to be considered to set priorities going forward. WPRPP intends to continually evaluate these factors over the next eight years. Detailed information about the ongoing work WPRPP is doing related to specific watershed/pollutant combinations are presented below in groups by pollutant categories in alphabetical order.

Bacteria

The Maryland Department of the Environment (MDE) routinely monitors shellfish harvesting waters for fecal coliform bacteria and conducts pollution source surveys to ensure that shellfish harvested in Maryland are safe for human consumption. In addition, MDE coordinates the State's Beach Bacteria Monitoring Program. Beach sample collection and notification of advisories are delegated to the Counties to protect public health at Maryland's designated bathing beaches.

Fecal indicator bacteria are used in these programs since monitoring for actual pathogens is not feasible. It is assumed that if fecal indicator bacteria are present, then human pathogens may also be present. Since the primary goal of both the Shellfish and Beach Programs is to ensure that public health concerns are addressed in a timely fashion, ongoing day-to-day management decisions by these programs are designed to be overly conservative. One such example is that beach advisories may be based on a single sampling event which shows a high level of indicator bacteria. However, bacteriological indicators are known to be variable in the environment and a single high measurement does not always coincide with fecal contamination. For this reason, the assessment methodology, developed for conducting Integrated Report (IR) assessments, will make use of larger longer-term sample sizes before making impairment determinations that could result in listings requiring a Total Maximum Daily Load (TMDL). Doing this allows MDE to continue to protect public health in a timely fashion (by both the Shellfish and Beach Programs) but also allows for a higher level of confidence to be used prior to initiating potentially costly TMDL development and implementation efforts. This helps to enhance the accuracy with which impairment determinations are made and enables the Department to focus on the highest priority impairments first. Additionally, for TMDL development to occur, the waterbody/impairment must be identified in three consecutive Integrated Report cycles. Waterbody impairments related to human health are a high priority for identification in the Integrated Report, however, there are other programs that manage these waters in a timelier manner than TMDL or other plan development.

Please note, a restricted shellfish harvesting area may have an active shellfish lease where prohibited shellfish harvesting areas may not. Therefore, relay of oysters from restricted to approved or conditionally approved waters may occur upon request to MDE and observation by Maryland Department of Natural Resources (MDDNR). After the 14-day depuration period, oysters may be harvested from the approved or conditionally approved waters and marketed.

Two portions of the non-tidal Baltimore Harbor watershed, the Middle Branch, and the Northwest Branch, were listed as impaired by bacteria on the 2010 IR, indicated by the presence of enterococcus. Baltimore City has been under a federal consent decree since 2002 to eliminate discharges of untreated sewage from its publicly owned treatment works (POTWs). The consent decree was modified in 2017, with increased requirements for compliance of Phase I (83% reduction in sewer overflow volume) by 2021 and Phase 2 (100% reduction of sewer overflows) by 2030. In FFY20, MDE began development of a 4b plan demonstration for the Harbor bacteria IR listing. A 4b plan is appropriate when other pollution control requirements are expected to result in the attainment of an applicable water quality standard (WQS) in a reasonable period. In FFY22, MDE anticipated completing the development of the 4b plan and soliciting feedback from USEPA and local stakeholders. However, this project was delayed. Development of this 4b plan is still a priority for WPRPP, and it has been added to Maryland's plan for 2025-2032. The intent is to work with Baltimore City and MDE's Municipal Permits Division to demonstrate that current regulations and future required controls will ensure attainment of water quality standards in these sections of Baltimore Harbor related to elevated fecal bacteria concentrations.

Biological Impairments

Non-Tidal

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 MDDNR). 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.), nutrient species, and aquatic insects. 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.

In 2002, Maryland began listing biological impairments in the IR. Biological listings are resolved through stressor identification, citing specific pollutants identified in the Biological Stressor Identification (BSID) analysis. Using this approach, most of the listings have been revised in the IR. Additional data was incorporated into the assessment methodology analysis from specific counties to provide better sampling resolution for stream bioassessments. Adding this higher geographic resolution data resulted in the addition of more watersheds to Category 5 for biological impairment. In addition, in the next several years, all Phase I Municipal Separate Storm Sewer System (MS4) jurisdictions will be collecting biological monitoring data consistent with MDDNR's MBSS protocols and will be submitting this data for integration into Maryland's IR bioassessments. Maryland is currently in the process of rerunning its biological assessments statewide for all 8-digit watersheds using the most recent MDDNR MBSS data as well as additional data from Maryland's local jurisdictions. It is anticipated that these new biological assessments will be updated and revised again in the next several years with a new influx of data from local jurisdictions. New BSID analyses will be conducted in addition to the biological assessments. It is anticipated that some new biological listings will appear, some previous biological impairments will be resolved, new stressors will be identified, and some stressors will be resolved, either due to restoration work that has been ongoing throughout the State or improvements to the BSID and biological assessment methodologies. All but five of the original 2002 Category 5 biological listings have been addressed through the BSID process.

Tidal

In 2006, Versar completed an analysis of biological data to determine if a watershed is impaired using Chesapeake Bay Program data. As a result of this analysis and an erring on the side of caution, Maryland listed several tidal watersheds as impaired for effects on the biological community. In non-tidal areas, a BSID analysis is conducted to identify the cause of the degraded biological community. A BSID analysis evaluates numerous key stressors using the most comprehensive data sets available that meet the requirements outlined in the methodology report. It is important to recognize that stressors could act independently or act as part of a complex causal scenario (e.g., eutrophication, urbanization, habitat modification). Also, uncertainties in the analysis could arise from the absence of unknown key stressors and other limitations of the principal data set. The results are based on the best available data at the time of evaluation. A reliable dataset and benthic index of biotic integrity (B-IBI) play an integral role in the development and performance of a BSID analysis. Thus far, academia is still conducting research evaluating the performance and use of the B-IBI in the identification of stressors and sources of biological impacts for tidal waters. Compared to freshwater systems, estuaries pose additional challenges due to the complexity and variability of physical and chemical factors such as tidal mixing and salinity gradients. The habitat specificity of biotic communities also hampers estuarine studies at large spatial scales. For example, the numbers of and kinds of benthic organisms vary with salinity zone and sediment type and confound efforts to assess relative condition and to associate causes and effects across boundaries (Dauer, Weisberg, and Ranasinghe 2000).

Due to the spatial and temporal data limitations, salinity gradients, missing data, various sources for data or consistent data collection from one source, etc. and all the work in progress to improve water quality, developing a BSID methodology for these listings is not a priority for the 2025-2032 period. MDE in cooperation with CBP, will continue to work with academia to develop reliable benthic and fish indices for tidal waters and subsequently stressor identification methodologies. However, because of the massive effort in Maryland and the rest of the Chesapeake Bay watershed to reduce nutrient inputs and resolved dissolved oxygen (DO), chlorophyll a (chl-a), and clarity issues in the tidal Bay, development of these indices and methods is not a top priority, since it is anticipated that tidal biological communities should respond positively to the on-going nutrient and sediment reductions to the Chesapeake Bay. In the meantime, Maryland participates in the cooperative partnership of the Chesapeake Bay Program from a variety of angles including toxics subcommittee, the Criteria Assessment Protocols workgroup, various elements of model input development, including participation in the Best Management Practices (BMP) expert panel process, and providing updates to the Modeling Workgroup on various state efforts such as the development of local stream temperature, sediment, and phosphorus models. In addition, WPRPP provided feedback to the CBP on the development of the Phase 7 suite of modeling tools, including the development of the new Watershed Model, the Main Bay Model (MBM), and Multiple Tributary Models (MTMs). These new models will significantly increase overall resolution and improve the simulation and assessment of shallow waters. In addition, there are watershed implementation plans (WIPs) for the Chesapeake Bay TMDL, stormwater implementation plans as required by Municipal Separate Storm Sewer System (MS4) permits and TMDLs developed for those areas. Participation and implementation of these efforts should help improve tidal biological communities.

Chloride

For the 2020-2022 combined IR, Maryland established a new subcategory, 5s, for waters impacted by chloride. Twenty-eight waters were moved from Category 5 (2018 IR) to Subcategory 5s on the 2020-2022 IR. Waters assessed in Category 5s are to be addressed through pollution control requirements and restoration approaches, and not TMDL development.

Chloride is naturally present in most surface waters, but elevated concentrations can harm freshwater organisms. The main source of elevated chloride in Maryland Category 5s waters is urban runoff of road salt. Road salt, primarily composed of sodium chloride, is applied to paved surfaces during winter to either remove snow and ice (de-icing), or to prevent them from accumulating (anti-icing). The salt then enters Maryland's waterways and impacts aquatic life and wildlife. The use of road salt also results in higher levels of sodium in drinking water and causes damage to public and private infrastructure including bridges, roads, cars, and stormwater treatment devices. Maryland's biological stressor identification process indicated that chloride is a major stressor affecting biological integrity in these Category 5s watersheds. There are no effective structural best management practices to remove chloride; therefore, an adaptive management approach to reducing salt application is appropriate. Adaptive management is an iterative decision-making process, incorporating monitoring and feedback for evaluating past actions to adjust future actions. Chloride pollution controls will be applied statewide. Maryland's salt reduction strategies include: 1. Requirement for a Salt Management Plan in State law for State Highway Administration (SHA); 2. Requirements for Salt Management Plans in MS4 permits, which cover over 90% of Maryland's impervious surface area; 3. Voluntary actions, such as private applicator training; and 4. Public awareness, partnerships with other State agencies and non-governmental organizations, and engagement with elected officials. Through adaptive management, trend analysis, and responsible implementation, long-term goals can be established to lessen the usage of salt and reduce its impact while maintaining safety and mobility. State requirements for SHA's Salt Management Plan are already in place and being implemented. The Plan has helped reduce salt application through increased training, tracking and recording usage, and techniques such as the use of brines. Implementation of SHA's Plan has already resulted in approximately 50% reduction of road salt application. More information can be found on MDE's road salt web page.

In 2025-2032, Maryland will continue applying the best science and methods to address the aquatic life impairments caused by elevated Cl concentrations while recognizing public safety issues. In FFY2021/2022, Maryland drafted a loading analysis for Cl in the Cabin John Creek watershed. The methodology used focuses on Cl loads during winter months using continuous sampling and endpoints defined by a draft laboratory-based Cl criteria Maryland developed in the past but decided not to promulgate.

As a result of the Cabin John Creek analysis, the Department's strategy for reducing the application of winter salts has been two-fold. First, MDE has been actively engaging watershed stakeholders to reduce chloride loads and has implemented a strategy to reduce chloride levels in surface water through requirements in Municipal Separate Storm Sewer System (MS4) permits and through voluntary efforts. Second, the Department is working to create a voluntary training and certification program that will target non-governmental applicators within the State.

The majority of Phase I MS4 permits in Maryland were recently reissued. Phase I Large jurisdictions' permits were finalized on November 5, 2021, and the Phase I Medium permits were finalized on December 30, 2022. MDE included a condition within both sets of permits requiring countywide salt management plans to better manage the application of chlorides and reduce surface water chloride levels. This includes:

- Plans for continual improvement
- Training for applicators
- Education and outreach
- Tracking and reporting of material used

Surface water monitoring is a requirement of the permit to determine the effectiveness of chloride reduction strategies. Following the end of the 5-year permit term MDE plans to evaluate the monitoring results and determine future permit conditions and actions, including but not limited to whether establishing chloride TMDLs will be necessary.

Through this work, WPRPP will also be looking for a way to engage directly with homeowners, property managers and private applicators, to drive reductions of winter salt applications on homeowner association (HOA) roads and commercial parking lots. It is anticipated that the result of this work will demonstrate the effectiveness of salt management on water quality and will serve as a validation of the reduction methodology used in the study. MDE's current strategy for resolution of these impairment listings is the creation of a statewide implementation and protection plan.

Heptachlor Epoxide

The Maryland portion of the non-tidal and tidal Anacostia River is currently listed for heptachlor epoxide in Maryland's IR. The District of Columbia (DC) is currently under consent decree to develop a TMDL for several toxics impairments including heptachlor epoxide for its portion of the tidal Anacostia River by January 1, 2017. The USEPA submitted an extension request to the US District Court for DC in September 2016 to extend the consent decree deadline of January 1, 2017, to January 1, 2020, which was granted. MDE informed the USEPA and DC that the Department was interested in collaborating in the development of an inter-jurisdictional TMDL to address all three heptachlor epoxide listings. The USEPA modified their work plan to include development of a TMDL to address the heptachlor epoxide listings in Maryland. The USEPA funded a contract with TetraTech to review historical data, identify data gaps, and develop a monitoring plan to support TMDL development. The USEPA is currently funding a second contract with TetraTech to develop the TMDL. The TMDL was originally anticipated for completion and approval by USEPA by January 31, 2020, to meet the deadline under the consent decree extension. However, due to delays in data collection and model development a second extension request was submitted by USEPA to the US District Court for DC in January 2020 to extend the consent decree deadline of January 31, 2020, to September 30, 2021, which was granted. Maryland actively coordinated and participated in the TMDL development and report writing. The TMDL was made available for public comment in July 2021. A third extension was submitted by USEPA and granted by the US District Court to extend the consent decree deadline by four months to January 31, 2022, to provide USEPA and the jurisdictions sufficient time to complete the comment response document and submit the TMDL document. Several sets of comments were received and because of MDE's careful review and consideration of those comments, this project has been delayed while MDE considers how best to address this impairment. It is uncertain how much time or what format addressing this listing will take as more recently collected fish tissue samples were all below the listing threshold except for one fish composite of brown bullhead catfish in the MD segment of the Tidal Anacostia River. The sample was barely above the listing threshold. MDE anticipates that newly collected data for catfish will demonstrate that levels are attained.

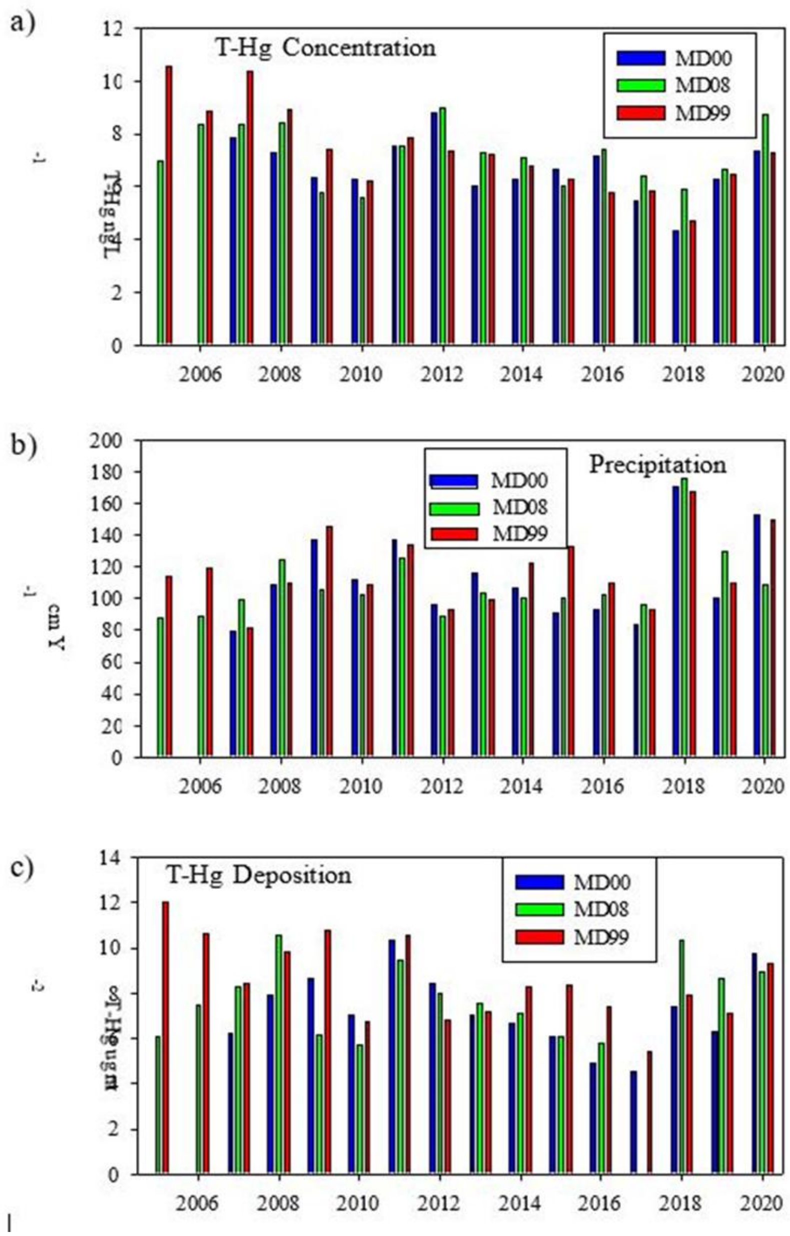
Mercury Impairments

In Maryland's 2018 Integrated Report (IR), there were six mercury (Hg) fish tissue impairment listings in Category 5, all of which are located within Western Maryland. These listings included the Youghiogheny River Lake (2010), the Potomac River Frederick County (2014), Potomac River Washington County (Dam 4 to 5) (2014), the Lower North Branch of the Potomac (2014), Conococheague Creek (2014 IR), and Jennings Randolph Reservoir (2014). The Potomac River Washington County (Dam 3 to 4) mainstem segment was delisted in the 2018 IR as fish tissue data for channel catfish collected in 2015, the species on which the listing was based, demonstrated Hg concentrations were below the listing threshold of 300 ng/g. Fish collections were also conducted for the remaining listings in 2015, and annually from 2018 through 2020. Fish tissue data from the Lower North Branch of the Potomac, Conococheague Creek, and Jennings Randolph Reservoir for smallmouth bass and channel catfish, the fish species that the original listing was based on, were below the listing threshold and no longer required TMDLs.

These impairments were delisted from Category 5 in the 2020-2022 IR. Fish tissue data from the Potomac River Frederick County collected in 2015 for channel catfish demonstrated that Hg concentrations were below the listing threshold. However, smallmouth bass was also the basis for the listing which was not collected in 2015. Collection attempts for smallmouth bass were made each year from 2018 through 2020 and were unsuccessful. The smallmouth bass population in this segment appears to be in decline and no longer a representative species for assessing the Hg impairment. This segment no longer requires a TMDL and has been delisted from Category 5 in the 2024 IR. Fish collections in the Potomac River Washington County (Dam 4-5) have been conducted annually from 2018 through 2020. Only one composite of smallmouth bass was collected. Collection attempts for largemouth bass were unsuccessful. The largemouth bass population in this segment also appears to be in decline and no longer a representative species for assessing the Hg impairment. The Hg concentration for the smallmouth bass composite is below the listing threshold. However, the median concentration of all smallmouth bass collected within the past 10 years exceeds the listing threshold. If the smallmouth bass composites from the Conococheague Creek are combined with the composites from this waterbody, which are a part of the same population, the median concentration is below the listing threshold. Since the waterbody has reached attainment, likely through natural recovery as Hg concentrations in fish are declining throughout Western Maryland, MDE delisted it in 2024 so it won't require development of a TMDL.

While fish tissue data in the Youghiogheny River Lake remains above the listing threshold, MDE also anticipates that this waterbody will reach attainment through natural recovery as Hg concentrations in fish are declining throughout Western Maryland and will not require development of a TMDL. Mercury emissions from coal and oil-fired power plants have declined substantially due to the implementation of Maryland's Healthy Air Act and USEPA's Mercury and Air Toxics Standards (MATS). Maryland's Healthy Air Act was established in 2007 requiring a 90% reduction in Hg emissions by 2013 and USEPA's MATS was established in 2011 requiring a 95% reduction nationwide in Hg emissions by 2016. MDE will continue monitoring fish for Hg in this waterbody through MDE's Fish Consumption Advisory Program which routinely conducts a state-wide fish tissue monitoring effort. Fish are collected annually at 58 core monitoring sites throughout the State on a 5-year cycle including a monitoring site within Youghiogheny River Lake.

The following figures display a) average Hg concentrations in rainfall, b) annual precipitation, and c) Hg wet deposition at three National Atmospheric Deposition Network (NADP) sites throughout Maryland. The sites are in Beltsville (MD99), Piney Reservoir (MD08) and Smithsonian Environmental Research Center (SERC) (MD00). The sites may not cover the full range of deposition within Maryland, but they are representative of urban development (MD99), the Chesapeake Bay shoreline region (MD00), and the Western Maryland region (MD08). NADP site location and data can be found at: https://nadp.slh.wisc.edu/maps-data/mdn-interactive-map/.



Figures C- 8a) average Hg concentrations in rainfall, 8b) annual precipitation, and 8c) Hg wet deposition at three National Atmospheric Deposition Network (NADP) sites throughout Maryland.

Metals: Lead (Pb) and Zinc (Zn)

Two tidal segments within the Baltimore Harbor were originally listed for metals in Maryland's IR in 1998: Northwest Branch (Pb and Zn) and Bear Creek (Zn). As Maryland does not currently have sediment quality standards for metals, site-specific sediment quality thresholds were developed in the Baltimore Harbor as an endpoint for TMDL development. MDE previously funded three contracts with Wye Research and Education Center (WREC) from 2010 through 2014 to develop sediment quality thresholds for Pb and Zn. In the first study, sediment quality thresholds were developed based on ambient sediment bioassays using the amphipod, Leptocheirus plumulosus, as the test organism. In the second study, a sediment water interface (SWI) toxicity test for the fish species Cyprinodon variegatus was developed to assess whether a second organism is more sensitive to metals than the amphipod. In the third study, sediment quality thresholds were developed based on SWI toxicity tests using the fish species Cyprinodon variegatus as the test organism. The most conservative sediment quality threshold for the two test organisms was the amphipod, Leptocheirus plumulosus, which was selected to reassess whether Pb and Zn continue to impair the sediments of Baltimore Harbor. MDE contracted University of Maryland Center for Environmental Science (UMCES) Chesapeake Biological Laboratory (CBL) and WREC in 2015 to conduct a sediment contaminant and toxicity survey to provide current sediment quality data to reassess the metals impairment listings in the Baltimore Harbor. Information from this survey was evaluated and found to be insufficient to reassess Pb and Zn water quality to determine whether WQA or TMDL development would be necessary to address these listings. MDE contracted UMCES CBL and WREC in 2017 to conduct metals pore water analyses; chronic sediment and porewater toxicity tests to provide additional sediment quality data to complete the reassessment. An evaluation of the information from this study, along with the data from the previous study in 2015, determined that only a localized portion of the sediments in Bear Creek, adjacent to historical operations at Bethlehem Steel, are impaired for metals. USEPA has completed an investigation of the Bear Creek sediment contamination and added the site to the National Priority List (NPL) in March 2022. Sites on the NPL are designated as a Superfund site and become eligible for federal financial assistance and a long-term cleanup. USEPA anticipates that the remedial investigation will begin Fall 2024. At this time, USEPA has not estimated when remedial action will begin. For more information on USEPA's actions visit:
https://cumulis.epa.gov/supercpad/SiteProfiles/index.cfm?fuseaction=second.cleanup&id=0305762#Status.

MDE plans to address this listing through a TMDL alternative under Category 4b as the remediation effort will address the metals impairment in Bear Creek. MDE will continue to monitor progress on this remediation effort to acquire the necessary documentation to support a Category 4b approach. The evaluation remains inconclusive as to whether Pb and Zn are impairing substances in the Northwest Branch. MDE contracted UMCES CBL and WREC in Spring 2018 to conduct a sediment spiking study for Pb and Zn in the Northwest Branch to determine if these metals are responsible for sediment toxicity and impair the system. The study has been completed and a draft of the report was submitted to MDE in July 2019. The findings of this study will be evaluated in 2024/2025 to determine whether WQA or TMDL development is necessary to address the listings in the Northwest Branch.

Nutrients

Non-Tidal

From 2014 to 2016, MDE conducted monitoring of dissolved oxygen (DO), nutrients and chlorophyll a at lakes across Maryland where TMDLs for phosphorus have been developed, including Centennial and Clopper Lakes. This was done as part of a plan to revisit the TMDLs using updated water quality criteria, modeling methods and requirements such as allocations to MS4s.

As part of this effort, MDE worked with the Virginia Institute of Marine Science (VIMS) to develop a revised phosphorus TMDL for Lake Linganore. The original phosphorus TMDL for Lake Linganore, developed using the Vollenweider Relationship, was approved by the USEPA in 2003. In addition, an analysis to define nutrient fluxes from bottom sediment in Lake Linganore was completed in FFY2017, and the results were used as inputs for the water quality model. The modeling for this project is complete, and the results have demonstrated that the original TMDL is still valid. A technical paper will be drafted showing this information. WPRPP was also working on similar analyses for other lakes, however, that work has been temporarily put on hold while the Program investigates the potential for adopting new lake criteria based on USEPA's "Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs". Once this investigation concludes, WPRPP will resume work to reassess and/or review its lake TMDLs, if applicable. Since TMDLs are in place for many lakes for nutrients, these revisions are not a priority for TMDL redevelopment.

During the GIS analysis, four listings for non-tidal nutrients were identified as priorities. MDE is working on modeling methodologies in other watersheds that may provide a method for addressing these impairments. It should be noted that most watersheds throughout the State have nutrient TMDL allocations assigned to them via the Chesapeake Bay TMDLs and Maryland Coastal Bays TMDLs.

Tidal

In 2010, the USEPA established TMDLs for all Chesapeake Bay Tidal segments for nitrogen and phosphorus to address nutrient and sediment impairments throughout the Chesapeake Bay watershed. These TMDLs addressed all of Maryland's tidal Chesapeake Bay nutrient and sediment impairment listings. As a requirement of the Chesapeake Bay TMDLs, jurisdictions were required to develop and implement watershed implementation plans (WIPs). These are coordinated efforts in Maryland and are tracked for progress. More information about the Chesapeake Bay WIPs can be found here: https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-watershed-implementation-plans-wips

In addition, several tidal nutrient TMDLs were established by the State before the Chesapeake Bay TMDLs. These are still in place and jurisdictions should review both to see which is more stringent. Implementation efforts for both the Bay TMDL and 8-digit watersheds should work together to ensure the best use of resources. There are a total of 277 tidal nutrient impairments addressed by TMDLs.

pH Impairments

Methodology to Address Conococheague Creek High pH Listings.

The Conococheague Creek is listed (2002) for high pH in Maryland's IR. In FFY2015 and FFY2016, the MDE Field Office conducted several rounds of pH monitoring in the Conococheague Creek. An analysis of this data demonstrated that the high levels of pH are most likely due to the Karst geology in the watershed. In FFY2016, MDE developed a report describing this analysis and recommended that the watershed be removed from the Category 5 list due to natural causes. In FFY2017, the document was sent to outside agencies for review and the documentation was submitted for the draft 2018 IR. In FFY2018, USEPA provided comments on the report and recommended a nutrient analysis. In FFY2019, USEPA and MDE worked to address USEPA's comments and determined that nutrient sampling was needed. MDE Field Office began nutrient and continuous pH monitoring at 10 stations in the Conococheague Creek, Antietam Creek, and Little Conococheague Creek watersheds.

In FFY2020, MDE Field Office completed monitoring and the data was analyzed. The data analysis determined that there is a connection between phosphorus and the high pH as described in detail in the 2020/2022 IR. Conococheague Creek is currently listed as impaired by phosphorus on the IR. Upon review by USEPA, it was decided that the entire Conococheague Creek watershed will continue to be listed as impaired by pH on the IR. An appendix was included in the 2020/2022 IR regarding the work that has been done for this listing. A phosphorus TMDL will be developed that will address both the phosphorus and high pH impairment listings. At this time, MDE and ICPRB are testing sediment and phosphorus modeling methodologies in other watersheds which will assist in the assessment of these impairments.

Low pH

Four low pH impairments were listed in Maryland's 2014 IR for St. Mary's River, Mattawoman Creek, Licking Creek, and Little Tonoloway Creek. Biological Stressor Identification (BSID) studies for each of these watersheds determined that low pH was significantly associated with degraded biological conditions resulting in these watersheds being listed as impaired. Streams impaired for low pH are generally found in the western portion of the State due to acid mine drainage from historical mining activities. However, within these watersheds, low pH is likely due to a combination of low acid neutralizing capacity from geology with poor buffering and atmospheric deposition. MDE will need to collect additional data to determine the extent of impairment within these watersheds as low pH will be localized in lower order streams with low buffering capacity. Existing data is insufficient to make this determination as the MBSS surveys used to support the findings of the BSID studies were designed to characterize water quality at the 8-digit watershed scale using random-probabilistic sampling which does not provide sufficient resolution to define localized impairments.

Polychlorinated Biphenyls (PCBs) Listings

There are currently 14 polychlorinated biphenyls (PCB) impairment listings in Maryland's 2024 IR. The number of impairment listings has declined from 25 reported in the 2018 IR as several impairments have been delisted as new fish tissue data demonstrates the waterbodies are now in attainment for PCBs in fish tissue. MDE has completed monitoring and has developed 23 PCB TMDLs to date, which have been approved by the USEPA. MDE generally develops water quality models in-house for PCB TMDL development. For more complex systems, such as Baltimore Harbor and Conowingo Pool, MDE has contracted Virginia Institute of Marine Sciences (VIMS), to develop 3-D hydrodynamic water quality models using the Environmental Fluid Dynamics Code (EFDC) framework for PCB TMDL development. In-house models used to develop PCB TMDLs include the tidal prism model and 1-D multi-segmented numerical model.

MDE is addressing the following five PCB impairment listings in the 2022 Vision priority universe: Conowingo Pool, Lower Susquehanna River, Middle River, Jones Falls, and Gwynns Falls. A detailed summary on the development status of these impairment listings is provided below.

Conowingo Pool/Lower Susquehanna River PCB TMDL

In 2016, MDE contracted VIMS to develop PCB TMDLs for the Conowingo Pool and Lower Susquehanna River. A draft document of the Lower Susquehanna River PCB TMDL was originally completed in November 2013; however, it is now being redeveloped in conjunction with the development of a PCB TMDL for the Conowingo Pool, which drains into the Lower Susquehanna River. PCB TMDL model development has been completed and VIMS provided a draft TMDL document to MDE in Fall 2023. MDE anticipates that the TMDL will be submitted to USEPA in FFY2024.

Middle River PCB TMDL

MDE completed a draft document of the Middle River PCB TMDL in April 2016; however, during internal review the findings of the TMDL were brought into question. The TMDL established that tidal influence and legacy sediments were the predominant source of PCBs in the system and watershed load reductions would not be required to achieve water quality. Further analysis of the modeling results and observed water quality data found that the watershed load may play a greater role in the impact on water quality. MDE conducted a comprehensive sediment survey in Fall 2018 to help determine if ongoing sources from the watershed may contribute to sediment contamination. University of Maryland Center for Environmental Science (UMCES) – Chesapeake Biological Laboratory (CBL) conducted the analysis and provided the data to MDE in June 2018. The results of the study show sediment concentrations are elevated in several headwater tributaries which drain predominantly developed areas within Middle River and the concentrations decline as you move down river into the open water of the estuary. MDE conducted a second survey in May 2019 to investigate sediment PCB concentrations within the non-tidal stream system as well as stormwater outfalls discharging to the headwater tributaries to provide additional information in determining if ongoing sources are responsible for sediment contamination in the estuary. UMCES CBL conducted the analysis and provided the data in October 2019. The results of the study indicate that sediment concentrations in several non-tidal streams and stormwater outfalls are elevated in comparison to estuarine concentrations. Based on the results of these studies, MDE plans to revise the TMDL to include a watershed reduction. It is anticipated that the TMDL will be revised and submitted in FFY2024.

Gwynns Falls PCB TMDL

The Gwynns Falls is a non-tidal tributary of the Baltimore Harbor. A PCB TMDL for the Baltimore Harbor was approved by USEPA in October 2012. At that time Gwynns Falls was not specifically listed as impaired for PCBs as fish had not been collected directly within the non-tidal tributary. In the Baltimore Harbor PCB TMDL, the Gwynns Falls was assigned a tributary load allocation. Based on fish collections following development of the Baltimore Harbor PCB TMDL, the Gwynns Falls was listed as impaired for PCBs in fish tissue in 2016. MDE plans to develop a PCB TMDL for the Gwynns Falls using a similar approach applied in the non-tidal Anacostia River PCB TMDL where tributary load allocations are broken out into load and waste load allocations. Currently, MDE has not determined when the PCB TMDL will be developed within the 8-year time frame of the 2022 Vision.

Upper Jones Falls PCB TMDL

The Upper Jones Falls is a tributary of Lake Roland. A PCB TMDL for Lake Roland was approved by USEPA in June 2014. At that time the Upper Jones Falls was not specifically listed as impaired for PCBs as fish had not been collected directly within the tributary. In the Lake Roland PCB TMDL, baseline loadings and allocations were calculated for the individual subwatersheds which includes the Upper Jones Falls, however, the load and waste load allocations were aggregated for the entire watershed in assigning the TMDL. MDE plans to develop a PCB TMDL for the Upper Jones Falls by disaggregating the allocations for the individual subwatersheds. Currently, MDE has not determined when the PCB TMDL will be developed within the 8-year time frame of the 2022 Vision.

Approach for addressing remaining PCB listings

Four PCB impairment listings in the non-tidal Potomac River watershed, Conococheague Creek, Antietam Creek, Potomac River Frederick County, and Potomac River Montgomery County, show a declining trend in fish tissue concentrations because of natural attenuation of PCBs in the environment. Current PCB concentrations in fish tissue within these waterbodies do not greatly exceed the fish consumption listing thresholds. MDE does not plan to develop TMDLs to address these listings as it anticipates fish tissue concentrations will continue to decline to levels that fall below the listing threshold resulting in the impairments being delisted. Recently collected fish in the Conococheague Creek demonstrate levels are below the listing threshold and was delisted in the 2024 IR. MDE collected fish in the Potomac River Montgomery and Frederick County mainstem in Spring/Fall 2023 and anticipates that the waterbodies could be delisted in 2026 IR. MDE will continue to collect fish within the Antietam Creek through MDE's fish consumption advisory monitoring program to determine when fish tissue concentrations have declined to levels resulting in water quality attainment and impairment delisting.

Seven PCB impairment listings in Lower Wicomico River, Nanticoke River, Choptank River, Herring Bay, Lower and Middle Chester River, and Seneca Creek, are likely due to legacy PCB contamination in sediments and tidal influence due to elevated PCB concentrations from the Chesapeake Bay mainstem. Land use within these watersheds is predominantly forest and agriculture, indicating that PCB watershed loadings would be insignificant and that reductions to these loadings would make no difference in achieving water quality. These watersheds have minimal urban development and historical industrial activity which are the predominant sources of PCBs. Previous PCB TMDLs with similar watershed characteristics (e.g., Bohemia River, Sassafras River) required no watershed load reductions as the TMDL could only be achieved by reducing concentrations at the Chesapeake Bay mainstem boundary and through natural attenuation of PCB contamination within the estuarine sediments. Any reduction to watershed loadings provided no benefit in achieving water quality. Based on this assessment, MDE does not plan to develop PCB TMDLs to address these listings. MDE also anticipates that fish tissue concentrations will continue to decline in these waterbodies as has been demonstrated in similar PCB impaired waterbodies (e.g., Corsica River, Lower Pocomoke River) which were delisted in the 2020-2022 IR. MDE will continue to collect fish within these waters through MDE's fish consumption advisory monitoring program to determine if fish tissue concentrations have declined to levels resulting in water quality standards attainment and impairment delisting.

The PCB impairment listing for Middle Chesapeake Bay requires additional fish tissue data to determine the geographical extent of the impairment within the mainstem segment. It is very likely that fish collected within the mainstem segment are accumulating PCBs in tributaries within their home range that are impaired for PCBs (e.g., Elk River, Bush River) and not directly from the mainstem. MDE will continue to collect fish within the Middle Chesapeake Bay through MDE's fish consumption advisory monitoring program to determine the geographical extent of the impairment. MDE does not anticipate developing a TMDL to address this listing as the source of PCB contamination is most likely within the tributaries and not the mainstem segment.

The PCB impairment listing for Stansbury Pond is based on white perch with elevated levels of PCBs that are likely not resident species within the pond. It is possible that the white perch are resident within Bear Creek, which is adjacent to the pond, and either traveled in through an open pipe connection during spawning season or during high tide when water overflows the pond embankment or were released into the pond. A PCB impairment listing for Bear Creek was addressed by the Baltimore Harbor PCB TMDL which was approved by USEPA in October 2012. MDE Field Services have been unable to collect white perch within the pond since 2017. MDE delisted Stansbury Pond from Category 5 in the 2024 IR based on the results of the resident species of adult sunfish and juvenile largemouth bass and sunfish collected in the pond and expert opinion of MDE's Field Services that the white perch collected in the pond that have historically exceeded the PCB listing threshold are not resident.

Per and polyfluoroalkyl substances (PFAS)

PFAS – short for per- and polyfluoroalkyl substances – refers to a large group of more than 4,000 human-made chemicals that have been used since the 1940s in a range of products, including stain- and water-resistant fabrics and carpeting, cleaning products, paints, cookware, food packaging and fire-fighting foams. These uses of PFAS have led to PFAS entering our environment, where they have been measured by several states in soil, surface water, groundwater, and seafood. Some PFAS can last a long time in the environment and in the human body and can accumulate in the food chain.

Maryland has for several decades monitored for certain chemical contaminant levels (e.g., PCBs and mercury) in Maryland's recreationally caught fish. 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 MDE's fish consumption guidelines. In Fall 2020, MDE began a two-year state-wide monitoring effort to analyze fish tissue for PFAS within five regions of the State: Eastern Shore, Harbors and Bays, Baltimore-Washington Metro Area, Western Bay Tributaries, and Western Maryland.

In addition to 59 core sites under the state-wide monitoring effort, MDE also targeted two additional monitoring sites within the tidal and non-tidal waters of Piscataway Creek due to the presence of a military facility that was known to be a source of PFAS within the watershed and an area near the mouth of the Piscataway Creek, popular for recreational fishing. Fish collections from Fall of 2020 and 2021 found elevated levels of perfluorooctane sulfonic acid (PFOS) resulting in fish tissue impairment listings in Category 5 of the 2020/2022 IR for the non-tidal and tidal waters of Piscataway Creek.

The fish tissue listing threshold from the 2020-2022 IR toxics assessment methodology was based on risk parameters from USEPA's 2016 drinking water health advisories for PFOS as human health criterion for fish consumption has not yet been developed by USEPA.

MDE IR Toxics Assessment Methodology can be accessed at:
https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Toxics_Assessment_Methodology_Final_12_19_23.pdf

USEPA's Drinking Water Health Advisory for PFOS (USEPA 2016) can be accessed at:
https://www.epa.gov/sites/default/files/2016-05/documents/pfos_health_advisory_final_508.pdf

MDE completed the state-wide fish tissue monitoring effort in Fall 2022 and the PFOS fish tissue data was assessed for the 2024 IR. The fish tissue listing threshold for PFOS has been revised based on risk parameters developed by Center for Disease Control (CDC) for use in USEPA's regional screening levels for risk assessment. The revised listing threshold is an order of magnitude more stringent than the previous threshold and resulted in several new listings for PFOS throughout the State in the 2024 IR. MDE has also assessed fish tissue data for four additional PFAS compounds, perfluorobutane sulfonate (PFBS), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), and perfluorononanoic acid (PFNA), for which USEPA has proposed drinking water maximum contaminant levels (MCLs) under the National Primary Drinking Water Regulation (NPDWR). The listing thresholds for these PFAS compounds were also based on CDC risk parameters. The fish tissue concentrations for these compounds were generally not detected or were at very low levels and will not result in any fish tissue impairment listings in the 2024 IR. USEPA also proposed an MCL for the PFAS compound, Gen X (hexafluoropropylene oxide dimer acid or HFPO-DA), under the NPDWR. MDE does not currently have data for this compound as the laboratories contracted to analyze fish tissue for PFAS used a method that does not quantify Gen X. In the future, MDE will ensure the method being used to analyze fish tissue will include this PFAS compound. However, it is unlikely that Gen X will result in additional fish tissue impairment listings as it does not readily bioaccumulate in fish.

To access the USEPA Regional Screening Level Generic Tables please visit:
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

MDE anticipates that a TMDL will not be required to address the non-tidal and tidal fish tissue impairment listings for PFOS in Piscataway Creek. The predominant source of PFAS responsible for the impairment is most likely due to releases from the military facility. MDE's Land and Materials Administration (LMA) is currently working with the facility to address PFAS site contamination. Control and remediation of PFAS sources at the military facility should reduce groundwater and surface water contamination resulting in fish tissue concentrations declining over time and eventually reaching attainment. Category 4b would be applicable for addressing the listing based on the remedial activities at the site. MDE will continue to monitor progress on this remediation effort to acquire the necessary documentation to support a Category 4b approach. There is currently no timeline available for when a remedial action plan will be finalized.

It is likely that for many of the listings in the 2024 IR, that the sources of PFAS contamination may not be driven solely by releases from Department of Defense facilities or other discrete sources of PFOS (i.e., commercial airports, fire training facilities, wastewater treatment plants, and Industrial Dischargers). There is the possibility that due to the stringency of the listing thresholds, PFAS contamination may be due to more diffuse sources (i.e., atmospheric deposition, agriculture, and municipal stormwater). In this situation, a Category 4b approach may not be applicable and a TMDL or other plan will need to be developed to address these listings.

Sediment

Nontidal

MDE originally listed non-tidal sediment impairments on the 1996/1998 303(d) list based on best professional judgment. In 2012, MDE began listing additional sediment impairments based on results of the biological stressor identification (BSID) analysis. The listing methodology can be found here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/AM_Solids_2012.pdf There are currently eleven sediment/total suspended solids (TSS) impairment listings on the 2024 IR.

The methodology for addressing sediment impairments in Maryland's nontidal watersheds for TMDLs was first developed starting in 2007 and updated in 2009. The Chesapeake Bay Program Watershed model (CBP 5.2) was used to establish the difference between reference and impaired watersheds. Forty-nine TMDLs were established using this method. The TMDL methodologies can be found here:
2007 -
https://mde.maryland.gov/programs/Water/TMDL/ApprovedFinalTMDLs/Documents/NT_Sediment_TMDL_Method_Report_20070728.pdf ;
2009 -
https://mde.maryland.gov/programs/Water/TMDL/ApprovedFinalTMDLs/Documents/Methodology_Sed-NT_Addendum_20090505.pdf

A new assessment using the latest CBP model iteration (Phase 6) could not identify significant differences among disturbed and reference watersheds. Furthermore, due to the geographic scale of projects MDE is working on, the latest model resolution might not be appropriate. The Jones Falls Watershed sediment monitoring pilot started in FY 21. This pilot project is intended to provide a framework to monitor, characterize, and simulate sediment in local watersheds at finer scales. The Field Investigations and Environmental Response Program is tasked with collecting continuous sub-hourly turbidity records, automated storm sediment samples, and sediment samples of upland and streambank sources. Data collection for the Jones Falls watershed is complete. Sampling is ongoing in the Catoctin Creek and the Upper Choptank River watersheds. As a part of this study, United States Geological Survey (USGS) was contracted to analyze upland and streambank sediment samples to conduct a fingerprinting analysis to track and quantify all sources of sediment in the watershed.

In FFY 2023, the Interstate Commission on the Potomac River Basin (ICPRB) was contracted to develop a non-tidal sediment TMDL for Deep Creek Lake watershed that is consistent with the assumptions and results of Chesapeake Bay Watershed Model. In this project, ICPRB will evaluate existing approaches, analyze local monitoring, and develop a non-tidal sediment model and TMDL for the Deep Creek Lake watershed.

Tidal

In 2010, the USEPA established TMDLs for all Chesapeake Bay tidal segments for nutrient and sediment impairments throughout the Chesapeake Bay watershed. These TMDLs addressed all of Maryland's tidal Chesapeake Bay impairment listings for total suspended solids (TSS). There is a total of thirty-two tidal sediment TMDLs. As a requirement of the Chesapeake Bay TMDLs, jurisdictions were required to develop and implement watershed implementation plans (WIPs). These are coordinated efforts in Maryland and are tracked for progress. More information about the Chesapeake

Bay WIPs can be found here: https://www.epa.gov/chesapeake-bay-tmdl/chesapeake-bay-watershed-implementation-plans-wips.

Sulfates

MDE has reevaluated all Maryland 8-digit watershed sulfate listings because of issues with the previous Biological Stressor Identification (BSID) listing approach. The BSID compared the data distribution in streams with good and bad Indexes of Biological Integrity (IBI), which led to the development of low sulfate threshold values. This threshold was not based on toxicological impact on aquatic life and did not consider covariance with other contaminants such as chlorides. Based on an extensive literature review, and in consultation with USEPA, MDE replaced the previous BSID threshold with an ultra-conservative screening threshold of 145 mg/L. This threshold is not intended to be used as a surrogate for a water quality criterion, but rather it will indicate where sulfate definitively has no impact on aquatic life. Sulfate thresholds applied in the BSID approach were defined by physiographic eco-region: 25 mg/L for Highland and Coastal, and 15 mg/L for Eastern Piedmont.

An evaluation of historical sulfate data previously used for the BSID analysis (MBSS dataset) and more recently collected data (MD Ion Study, Western MD pH TMDL Data, Marcellus Shale Natural Gas Baseline Data, and DNR Monthly Core Trend Data), found that 22 of the 26 8-digit watersheds currently listed for sulfates have no exceedances using the updated screening threshold. These watersheds were delisted in the 2024 IR. The four remaining watersheds (Conococheague Creek, George's Creek, Potomac River Upper North Branch, and Wills Creek) will remain listed as impaired for sulfates.

Three of the four remaining sulfate impairments (Wills Creek, George's Creek, and Upper North Branch Potomac River) are within watersheds with extensive mining operations and historical abandoned mine lands. Acid mine drainage is likely to be the predominant source of sulfates. MDE will need to collect additional data to determine the extent of impairment within these watersheds as sulfate contamination will be localized due to the presence of acid mine seeps and active mining discharges. Existing data is insufficient to make this determination as the previous surveys were designed to characterize water quality at the 8-digit watershed scale using random-probabilistic sampling which does not provide sufficient resolution to define localized impairments.

MDE currently does not have sulfate criteria to assess impairments. The conservative threshold selected for this delisting effort is not applicable as a surrogate for criteria. MDE had previously shared, with USEPA, a State sulfate criteria developed using USEPA's Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses. However, USEPA and Maryland did not come to agreement on this methodology or the derived criteria, so it was never formally proposed by MDE during any Triennial Review of Water Quality Standards. MDE will need to determine if a field-based method for developing conductivity criteria as a surrogate for sulfates as recommended by USEPA, is applicable or an alternative approach may be applied.

The last remaining sulfate impairment (Conococheague Creek) is due to a single exceedance within a first order stream where there is no active or historical mining activity. MDE will need to collect additional data in this stream to determine whether the data was anomalous or if sources of sulfate other than acid mine drainage (e.g., fertilizer application, atmospheric deposition, natural conditions) are causing an impairment.

Temperature

Maryland has numeric temperature criteria (68°F/20°C) for Use Class III waters. The assessment methodology developed for the IR uses observations taken between June and August, to determine whether water quality standards are being met in Use Class III streams. The 90th percentile temperature of a Use Class III stream must be equal to or less than 68°F/20°C, outside of any mixing zone established by the Department, to be considered not impaired (MDE 2023). The full assessment methodology may be found here: https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Final_Temp_AM_UCIII_12_19_2023.pdf There are 369 temperature impairment listings in Maryland's 2024 IR across forty-one 8-digit watersheds.

Temperature monitoring has been conducted in the Use Class III portions of the following watersheds: Gwynns Falls and Jones Falls (2016 & 2017), Catoctin Creek and Liberty Reservoir (2017 & 2018), Deer Creek and Furnace Bay (2018 & 2019), South Branch Patapsco and Upper Monocacy (2019 & 2020) and Prettyboy Reservoir and Gunpowder Falls (2020 & 2021).
Stream temperature simulations are conducted using both process-based and statistical models, the Soil and Water Assessment Tool (SWAT) and Spatial Stream Network (SSN) models, respectively. These models simulate the combined effects of urbanization and riparian deforestation on hydrology and stream temperature in cold water streams.

In FFY2020, MDE finished a draft TMDL for temperature in the cold-water portions of the Gwynns Falls watershed. Comments were received during interagency review and the project is currently on hold. In FFY22, Prettyboy Reservoir Watershed was selected as the new pilot watershed for the development of a TMDL based on a prioritization exercise that included stakeholder interest, and restorability outcomes. Prettyboy Reservoir Watershed TMDL is under development. A total of six 8-digit watersheds have been identified for TMDL development in the 2025-2032 period.

Toxics

The tidal waters of Aberdeen Proving Ground (APG) are currently listed for toxics in Maryland's 2024 IR. This listing applies to eight individual tidal waterbodies within the APG 8-digit basin. The USEPA funded a contract with TetraTech in 2012 to conduct a chemical contaminant survey of two tidal waterbodies, Dipper Creek and Spesutie Narrows, within APG, as sufficient funds were not available to monitor all tidal waters. Water column and sediment samples were collected at several tidal stations and analyzed for a suite of chemical contaminants that may be present due to historical releases and ongoing activities at the APG military installation. In addition, ambient bioassays of water column and sediment were conducted to assess toxicity. TetraTech completed the survey in 2012 and submitted the report to the USEPA and MDE in February 2013. MDE has evaluated the information from this study and determined that the water column is not impaired by chemical contaminants within Dipper Creek or Spesutie Narrows. However, sediment bioassay results found toxicity was present at three stations within Dipper Creek and Spesutie Narrows.

Additional benthic community monitoring and sediment bioassays are required to determine if sediment organisms are being impacted at these stations. MDE received funding from the USEPA through a Chesapeake Bay Regulatory and Accountability Program (CBRAP) grant in FFY2017 to conduct additional chemical contaminant monitoring in the six remaining tidal waterbodies of APG. The monitoring also included additional benthic community monitoring and sediment bioassays required to assess sediment quality in Dipper Creek and Spesutie Narrows. The MDE Field Office began sample collection in July 2017, and it was completed in October 2017. MDE contracted UMCES CBL and Wye Research and Education Center (WREC) to conduct chemical contaminant analysis of sediment and water column samples, sediment bioassays, and a benthic community analysis, respectively. Laboratory analyses have been completed by UMCES CBL and WREC and the data sets were provided to MDE in March 2018. A preliminary evaluation of the water quality data has determined that the water column and sediment are not impaired within all tidal waters of the APG 8-digit basin. A comprehensive water quality evaluation will be completed by Fall 2024 which will apply guidelines laid out in MDE's Methodology for Determining Impaired Waters by Chemical Contaminants for Maryland's IR https://mde.maryland.gov/programs/water/TMDL/Integrated303dReports/Documents/Assessment_Methodologies/Toxics_Assessment_Methodology_Final_12_19_23.pdf). It is anticipated that MDE will develop a water quality analysis (WQA) in FFY 2025 to delist the toxics impairment for tidal waters of APG.

Trash

A Trash TMDL for the Anacostia River Watershed was approved by USEPA in 2010. The TMDL was challenged by the Natural Resources Defense Council (NRDC) in DC Circuit Court in 2016 and the judgment delivered in 2018 required a revision of the TMDL to include a maximum load value. In FFY19 and FFY20, MDE met regularly with USEPA and the DC Department of Energy and Environment (DOEE). In FFY21, MDE pursued a multi-year Memorandum of Understanding (MOU) with Morgan State University Patuxent Environmental & Aquatic Research Laboratory (PEARL) to develop a public survey regarding trash pollution and water recreation. The primary objective of this project is to develop a draft survey that will be administered to the public, to determine the level of trash that is acceptable to the public for water recreation. Results from the survey will be used to develop the endpoint of the revised TMDL. In FFY23, the second year of the MOU, PEARL finalized the development of the public survey and administered it. Data from the survey will be analyzed in FFY24 and recommendations from the report will be reviewed.

References

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Appendix D: Sulfate Listing Threshold Update

Sulfate (SO4) loads to surface waters can be naturally occurring or originate from urban runoff, agricultural runoff, acid mine drainage, atmospheric deposition, and wastewater dischargers. When naturally occurring, they are often the result of the breakdown of leaves that fall into a stream or of water passing through rock or soil containing gypsum and other common minerals (MDE 2014). For the 2024 IR, MDE reevaluated all Maryland 8-digit watershed sulfate listings because of issues that were discovered with the previous BSID listing approach, specific to sulfate. The BSID compared the data distribution in streams with good and bad IBI, which led to the development of low sulfate threshold values. This threshold was not based on toxicological impact on aquatic life and did not consider covariance with other contaminants such as chlorides.

Therefore, based on an extensive literature review, and in consultation with EPA, MDE replaced the previous BSID threshold with an ultra-conservative screening threshold of 145 mg/L. The updated threshold is based on the results of Soucek and Dickinson's 2015 study on the toxicity of sodium salts, including sodium sulfate, to the Mayfly *Neocloeon triangulifer*. See Table D- 2 for a summary of all endpoints considered during the literature review. For definitions on the effects of the endpoints, see EPA's webpage on Aquatic Life Benchmarks and Ecological Risk Assessments. Once the new threshold was selected, the historical data used to list the sulfate impairments was re-evaluating using the updated threshold. Table D- 1 below outlines the summary data for all sulfate impaired watersheds. Data in 22 of the 26 watersheds do not exceed the updated screening threshold. See Figure D- 1 for a map of the sample stations and impaired watersheds. These watersheds were delisted from Category 5 and moved to Category 2 in the 2024 IR, while the remaining 4 watersheds with threshold exceedances will remain in Category 5. As Figure D- 2 demonstrates, there are no active or abandoned mine lands in the delisted watersheds.

Table D- 1: Summary Data of Complete List of Impaired Watersheds.

Watershed	**Data Collection Time Period**	**# of Samples**	**Min SO4 Conc**	**Max SO4 Conc**	**Mean SO4 Conc**	**# of Exceedances**
Anacostia River[1,2]	1997-2012	37	8.77	115.74	20.78	0
Antietam Creek[1,2]	1995-2015	34	4.54	65.30	16.99	0

Watershed	Data Collection Time Period	# of Samples	Min SO4 Conc	Max SO4 Conc	Mean SO4 Conc	# of Exceedances
Back River[1]	1995-2016	29	7.38	53.53	27.09	0
Baltimore Harbor[1,2]	1995-2015	32	14.70	36.80	22.25	0
Bush River[1]	1996-2007	9	4.20	22.48	11.99	0
Cabin John Creek[1]	1997-2003	7	16.09	36.91	23.74	0
Conococheague Creek[1,2]	1995-2016	25	7.55	362.60	49.04	1
Deep Creek Lake[1,2,3,5]	1995-2014	65	2.78	55.21	14.94	0
Evitts Creek[1,2]	1996-2016	22	8.95	81.34	30.35	0
Georges Creek[1,2,3,4,5]	1996-2016	158	5.72	2483.71	285.85	60
Jones Falls[1,2]	1995-2016	30	1.51	78.58	15.57	0

Watershed	**Data Collection Time Period**	**# of Samples**	**Min SO4 Conc**	**Max SO4 Conc**	**Mean SO4 Conc**	**# of Exceedances**
Loch Raven Reservoir[1,2]	1996-2016	61	1.21	27.91	8.37	0
Lower Gunpowder Falls[1,2]	1996-2016	17	4.05	24.38	12.26	0
Lower Pocomoke River	1997-2016	19	9.29	90.24	43.4	0
Marsh Run[1]	1995-2014	8	25.68	36.17	30.32	0
Patapsco River L N Br[1,2]	1995-2015	42	4.99	45.82	25.64	0
Patuxent River Middle[1,2]	1997-2015	27	14.90	40.13	26.21	0
Patuxent River Upper[1,2]	1997-2011	19	11.84	48.81	22.08	0
Port Tobacco River[1,2]	1995-2015	16	8.21	38.86	18.04	0

Watershed	Data Collection Time Period	# of Samples	Min SO4 Conc	Max SO4 Conc	Mean SO4 Conc	# of Exceedances
Potomac River FR Cnty[1]	1996-2016	24	7.23	34.69	17.95	0
Potomac River MO Cnty[1,2]	1997-2016	34	4.18	50.76	16.14	0
Potomac River U N Branch[1,2,5]	1996-2016	75	5.69	361.36	87.72	6
Potomac River U tidal[1,2]	1997-2015	19	9.65	37.28	24.63	0
Potomac River WA Cnty[1,2]	1995-2014	26	7.69	66.63	18.62	0
West River[1]	1997-2016	8	12.62	36.62	25.77	0
Wills Creek[1,2,3,5]	1996-2016	102	9.51	899.30	199.54	49
Data Sources: [1]MBSS Data, [2]MD Ion Study Data, [3]Western MD pH TMDL Data, [4]Marcellus Shale Natural Gas Baseline Data, [5]MD DNR Monthly Core Trend Data						

Table D- 2: Summary of Literature Review Endpoints

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	chronic	145	EC20
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	145	NOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	150	NOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	150	LOEC
Soucek_and_Dickson_2016	Neocloeon	triangulifer	Invert	chronic	164	MATC
Soucek_and_Dickson_2017	Neocloeon	triangulifer	Invert	chronic	170	EC20
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	172	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	176	EC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	205	NOEC
Wang_etal_2011	Pimephales	promelas	vert	chronic	215	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	245	EC10
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	246	EC25
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	chronic	274	MATC
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	288	EC10
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	297	EC10

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	298	EC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	300	LOEC
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	340	LOEC
Simmons_2012	Lemna	minor	plant	chronic	346	EC10
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	356	EC10
Elphick_etal_2011	Hyalella	Azteca	Invert	chronic	380	EC10
Elphick_etal_2011	Pimephales	promelas	vert	chronic	388	EC10
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	393	NOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	431	LC50
Wang_etal_2011	Pimephales	promelas	vert	chronic	436	LOEC
Elphick_etal_2011	Ceriodaphnia	dubia	Invert	chronic	465	EC50
Kunz_etal_2013	Lampsilis	siliquoidea	Invert	chronic	471	NOEC
Kunz_etal_2013	Centroptilum	triangulifer	Invert	chronic	483	NOEC
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	496	IC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	501	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	510	NOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	524	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	531	EC10
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	548	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	560	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	560	NOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	595	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	603	NOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	607	LC50
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	625	IC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	654	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	654	NOEC
Wang_etal_2011	Ceriodaphnia	dubia	Invert	chronic	677	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	678	EC10
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	700	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	703	EC10
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	715	IC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	716	EC10
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	728	LC50
Elphick_etal_2011	Oncorhynchus	mykiss	vert	chronic	734	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	752	EC25
Elphick_etal_2011	Pimephales	promelas	vert	chronic	760	NOEC
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	766	IC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	820	NOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	820	EC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	828	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	844	EC10
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	849	EC25
Wang_etal_2011	Lampsilis	abrupda	Invert	chronic	875	NOEC
Simmons_2012	Lemna	minor	plant	acute	922	EC10
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	941	EC10
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	950	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	960	LOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	978	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	997	EC25
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1027	EC25
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1029	EC50
Elphick_etal_2011	Hyalella	Azteca	Invert	chronic	1056	EC25
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	1057	EC50
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	1060	IC25
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1075	NOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1100	LOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1100	LOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1100	NOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1112	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1116	EC50
Simmons_2012	Pseudokirchneriella	subcapitata	plant	acute	1153	EC50
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1194	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1200	NOEC

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	1210	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1214	EC50
Soucek_and_Dickson_2015	Neocloeon	triangulifer	Invert	acute	1227	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1240	LOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1240	LOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1244	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1250	LOEC
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	1250	LOEC
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1252	EC10
Lasier_and_Hardin_2010	Daphnia	Magna	Invert	chronic	1252	IC50
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1264	EC25
Davies_etal_2003	Daphnia	Magna	Invert	acute	1285	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1292	EC25
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1300	LOEC
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1300	NOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1300	NOEC

Citation	**Genus**	**Species**	**Class**	**Toxicity**	**Endpoint**	**Effect**
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1323	EC10
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1328	EC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1338	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1342	EC10
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1342	EC10
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1345	EC10
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1348	EC25
Soucek_2007	Hyalella	Azteca	Invert	acute	1348	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1359	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1377	EC10
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1400	LOEC
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1430	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1433	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1438	LC50
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1450	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	1460	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	1480	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1485	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1505	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1510	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1558	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1560	EC25
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1563	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	1571	LC50
Wang_etal_2011	Ceriodaphnia	dubia	Invert	chronic	1610	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	1616	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1621	LC50
Simmons_2012	Lemna	minor	plant	chronic	1633	EC50
Elphick_etal_2011	Hyalella	Azteca	Invert	acute	1637	NOEC
Elphick_etal_2011	Hyalella	Azteca	Invert	chronic	1637	NOEC
Wang_etal_2011	Lampsilis	abrupda	Invert	chronic	1638	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	1679	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	1684	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1699	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1727	EC25
Elphick_etal_2011	Oncorhynchus	kisutch	vert	chronic	1755	EC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1758	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	1763	EC25
Soucek_2007	Hyalella	Azteca	Invert	acute	1767	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1779	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1793	EC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	LOEC
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	EC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1800	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1810	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1820	LC50
Soucek_etal_2018	Neocloeon	triangulifer	Invert	acute	1822	LC50
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	1824	EC25

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1828	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1830	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1830	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	1847	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1853	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1869	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1879	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	1901	LC50
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1925	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	1925	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	1950	EC25
Elphick_etal_2011	Pseudacris	regilla	vert	chronic	1950	LOEC
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	1985	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	1993	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2000	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	2000	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Hyalella	Azteca	Invert	acute	2002	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2002	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2029	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2030	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2052	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2056	LC50
Elphick_etal_2011	Hyalella	Azteca	Invert	acute	2069	EC10
Mount_etal_1997	Ceriodaphnia	dubia	Invert	acute	2083	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2095	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2100	LC50
Davies_and_Hall_2007	Hyalella	Azteca	Invert	acute	2101	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2121	LC50
Wang_etal_2011	Lampsilis	abrupda	Invert	acute	2149	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2184	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2188	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2198	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Brachionus	calyciflorus	Invert	chronic	2200	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2203	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2209	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	chronic	2216	LOEC
Davies_and_Hall_2007	Hyalella	Azteca	Invert	acute	2240	LC50
Wang_etal_2011	Ceriodaphnia	dubia	Invert	acute	2241	EC50
Elphick_etal_2011	Hyalella	Azteca	Invert	acute	2246	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2263	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2269	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2270	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2297	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2327	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2333	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2383	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2389	LC50
Simmons_2012	Lemna	minor	plant	acute	2402	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2404	EC50
Elphick_etal_2011	Hyalella	Azteca	Invert	acute	2412	LOEC
Elphick_etal_2011	Hyalella	Azteca	Invert	chronic	2412	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2433	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2446	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2446	LC50
Elphick_etal_2011	Hyalella	Azteca	Invert	acute	2461	EC50
Elphick_etal_2011	Hyalella	Azteca	Invert	chronic	2461	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2472	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2481	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2491	EC10
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2516	EC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2518	EC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	2522	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	2527	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2530	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2542	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2549	LC50
Elphick_etal_2011	Fontinalis	antipyretica	plant	chronic	2575	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2591	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	2653	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2654	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2700	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2706	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2724	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2724	EC50
Davies_and_Hall_2007	Hyalella	Azteca	Invert	acute	2725	LC50
Soucek_2007	Sphaericum	simile	Invert	acute	2732	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2740	LC50
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2742	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2757	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2761	EC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Elphick_etal_2011	Pseudokirchneriella	subcapitata	plant	chronic	2800	LOEC
Soucek_2007	Hyalella	Azteca	Invert	acute	2840	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	2850	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	2853	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2955	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	2986	LC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	chronic	3000	LOEC
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3051	EC50
Soucek_2007	Sphaericum	simile	Invert	acute	3055	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3059	EC50
Soucek_2007a	Ceriodaphnia	dubia	Invert	acute	3065	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3073	EC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	3077	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3091	EC50
Mount_etal_1997	Daphnia	Magna	Invert	acute	3097	LC50
Davies_etal_2003	Daphnia	Magna	Invert	acute	3146	LC50

Citation	Genus	Species	Class	Toxicity	Endpoint	Effect
Davies_and_Hall_2007	Daphnia	Magna	Invert	acute	3203	LC50
Wang_etal_2011	Chironomus	dilutus	Invert	chronic	3223	NOEC
Wang_etal_2011	Chironomus	dilutus	Invert	chronic	3223	LOEC
Soucek_2007	Sphaericum	simile	Invert	acute	3246	LC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3265	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3297	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3338	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3361	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3369	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	3400	LC50
Soucek_2007	Hyalella	Azteca	Invert	acute	3462	LC50
Elphick_etal_2011	Pimephales	promelas	vert	chronic	3463	EC25
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3506	EC50
Soucek_2007	Ceriodaphnia	dubia	Invert	acute	3716	EC50
Soucek_2007	Hyalella	Azteca	Invert	acute	3785	LC50

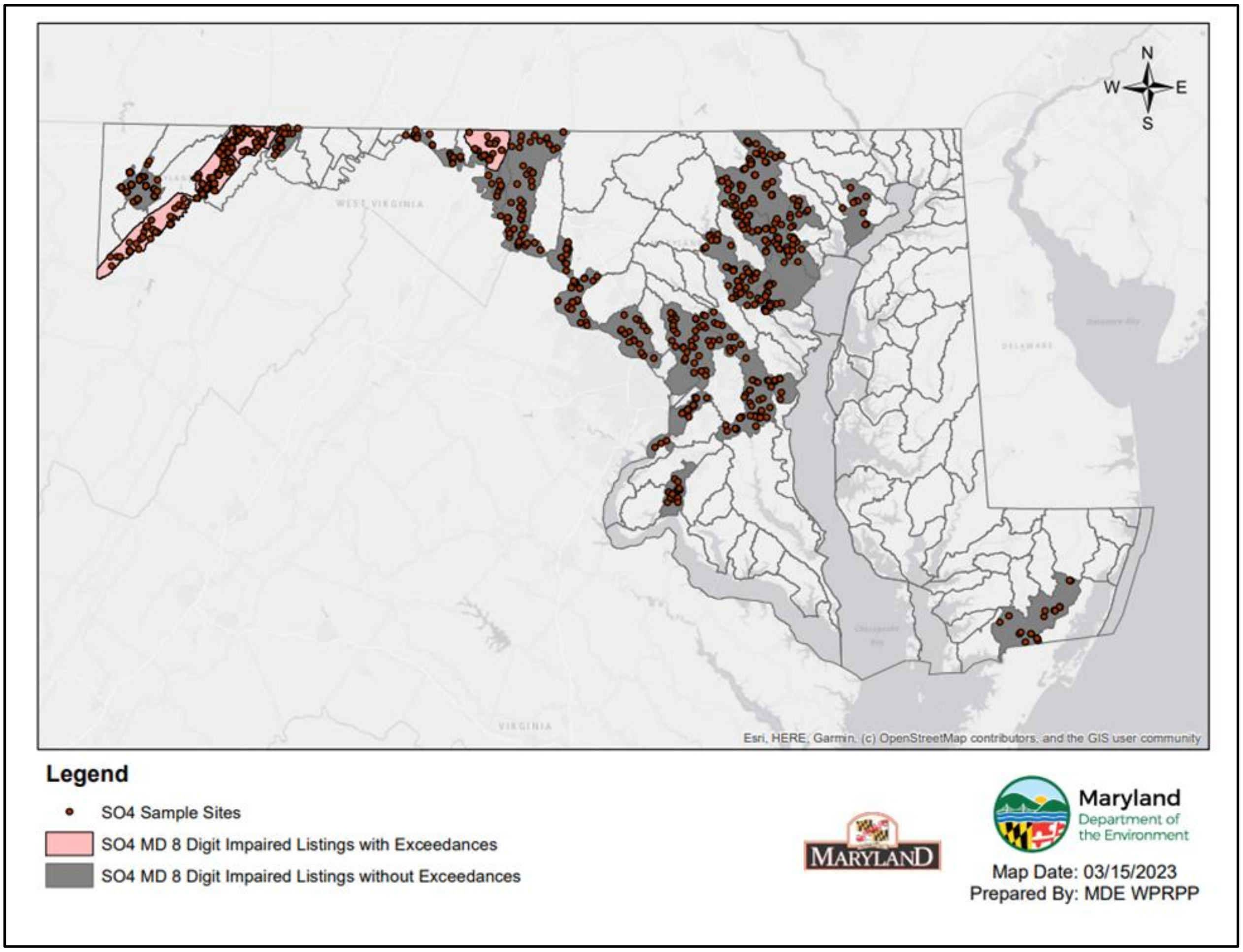

Figure D- 1: Map of Sample Stations in All Impaired Watersheds

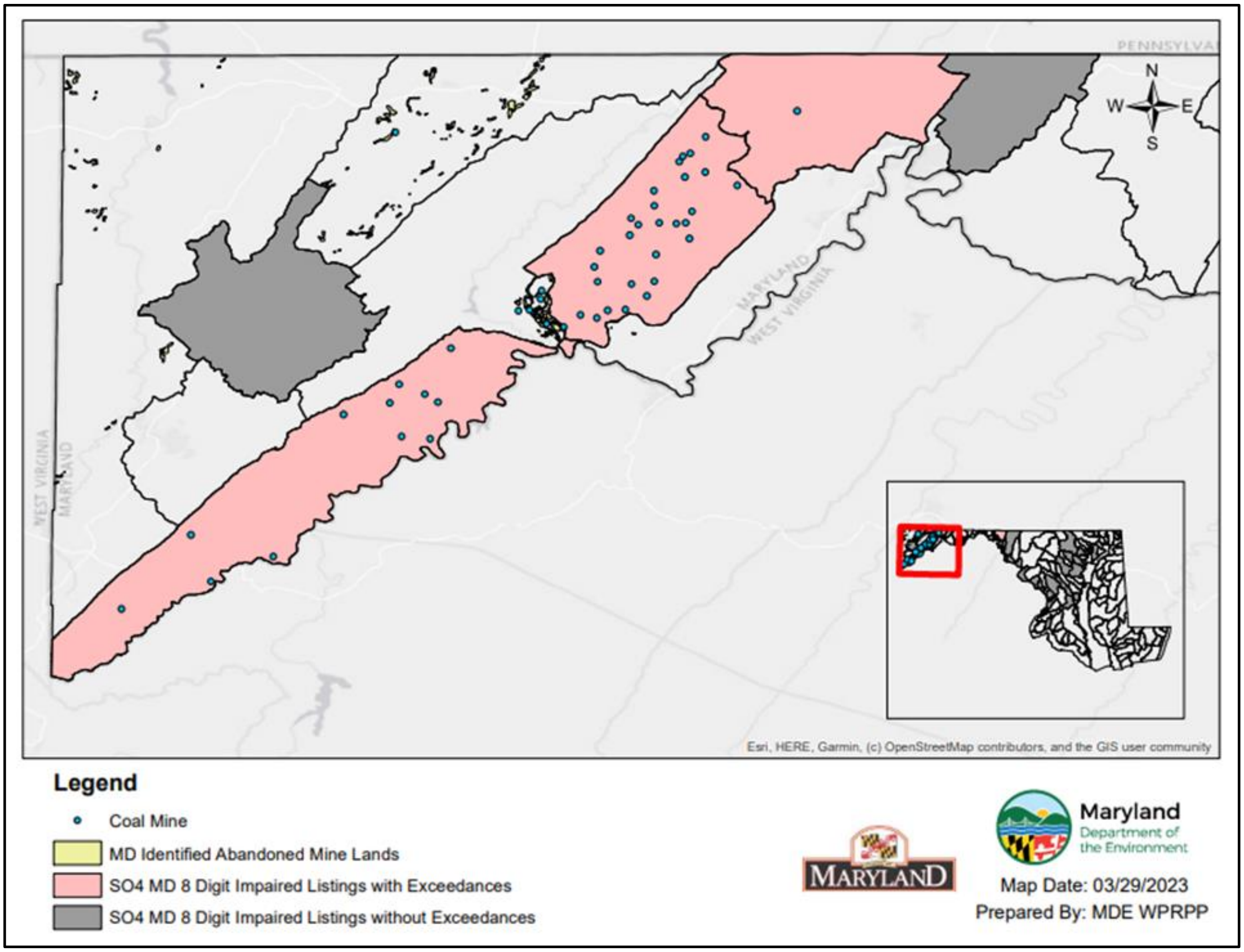

Figure D- 2: Map of Active and Abandoned Mines

Appendix E: Maryland's Chloride Strategy

Chloride Sources and Locations of Impaired Waters

Chloride Sources in Maryland

Chloride is naturally present in most surface waters, but elevated concentrations can harm freshwater organisms. Chloride can enter a watershed from a wide variety of natural and anthropogenic sources. These can include the use of salts as deicing or anti-icing agents on roads, parking lots, and sidewalks; losses from stored winter salt; human and animal wastes; water softeners; fertilizer application; atmospheric deposition; and the dissolution of geologic formations.

The primary source of chloride in Maryland watersheds is winter salt (see biological stressor identification studies). There are no near-surface naturally occurring salt deposits in Maryland. A water quality analysis of Cabin John Creek (MD; MDE, unpublished), a tributary to the Potomac River with a mostly urban watershed, estimated that more than 93% of chloride loading originates from de-icing and anti-icing operations. Salt can accumulate in groundwater and be released to streams throughout the year. The residence time of road salt in a watershed can be as long as 40-70 years.

Winter salt, primarily composed of sodium chloride, is applied to paved surfaces to prevent snow and ice from sticking to impervious surfaces. Winter salt is typically applied in either its crystalline form, as rock salt, or in its aqueous form, as a salt brine. Runoff from surfaces treated with salt tends to have very high chloride concentrations. This document does not include discussion of other winter materials, such as aircraft deicing chemicals (e.g., propylene glycol) and airport pavement deicing/anti-icing chemicals (e.g., sodium formate and potassium acetate).

Assessment Units

The table below lists all the Maryland waters in Category 5s for chloride in the State's 2024 Integrated Report. All the chloride listings are for freshwater rivers and streams. The source of the chloride is urban runoff/storm sewers transporting residual winter salt from impervious surfaces, and the impaired designated use is aquatic life and wildlife. Biostressor analyses indicated that chloride is a major stressor affecting biological integrity in these watersheds. An initial chloride threshold value of 50 mg/L was selected to indicate potential biological degradation for the stressor identification used to determine Category 5 listings for chloride. Further chloride data analysis indicated that the source of the chloride is the application of winter salt.

In the combined 2020-2022 IR, a subcategory of 5s (for salt) was created specifically for the chloride impairments because waters assessed in Category 5s are high priorities to be addressed through pollution control requirements and restoration approaches and are a lower priority for TMDL development.

Maryland's 2024 Category 5s listings for chloride, and links to associated BSID reports, can be found in the table below. BSID reports contain detailed characterizations for each watershed.

Table E- 1: Category 5s Chloride Listings

AU_ID	Basin_Name	HUC	Basin_Code	BSID Report
MD-02130805	Loch Raven Reservoir	02060003	02130805	link
MD-02130901	Back River	02060003	02130901	link
MD-02130903	Baltimore Harbor	02060003	02130903	link
MD-02130906	Patapsco River Lower North Branch	02060003	02130906	link
MD-02130701	Bush River	02060003	02130701	link
MD-02130802	Lower Gunpowder Falls	02060003	02130802	link
MD-02130904	Jones Falls	02060003	02130904	link
MD-02130905	Gwynns Falls	02060003	02130905	link
MD-02130907	Liberty Reservoir	02060003	02130907	link
MD-02131001	Magothy River	02060004	02131001	link
MD-02131003	South River	02060004	02131003	link
MD-02131104	Patuxent River upper	02060006	02131104	link
MD-02131105	Little Patuxent River	02060006	02131105	link
MD-02140109	Port Tobacco River	02070011	02140109	link
MD-02140111	Mattawoman Creek	02070011	02140111	link
MD-02140201	Potomac River Upper tidal	02070010	02140201	link
MD-02140202-Wadeable_Streams	Potomac River Montgomery County	02070008	02140202	link
MD-02140203	Piscataway Creek	02070010	02140203	link
MD-02140205	Anacostia River	02070010	02140205	link
MD-02140207	Cabin John Creek	02070008	02140207	link
MD-02140208	Seneca Creek	02070008	02140208	link
MD-02140501-Wadeable_Streams	Potomac River Washington County	02070004	02140501	link
MD-02140504	Conococheague Creek	02070004	02140504	link
MD-02140509	Little Tonoloway Creek	02070004	02140509	link
MD-02141002	Evitts Creek	02070002	02141002	link
MD-02141003	Wills Creek	02070002	02141003	link
MD-02141004	Georges Creek	02070002	02141004	link
MD-05020204	Casselman River	05020006	05020204	link

Chloride Reduction Approach and Strategies

Approach

The Category 5s waters are a low priority for TMDL developments because there are no structural Best Management Practices (BMP) to remove chloride that do not cause additional negative environmental impacts; therefore, Maryland will implement adaptive management for reducing salt application. Best practices for reducing salt application take into account delivery, storage, handling, placement on roads, and post-storm cleanup operations. Best practices emphasize the importance of using the least amount of salt as possible to provide safe, passable surfaces. They include applicator training, pre-storm planning, spill prevention and clean-up, post-storm reviews, and evaluating and adopting new technologies.

Implementation through required winter salt reductions in NPDES permits is already underway, and these pollution controls are applied statewide. Reducing salt application will also address human health, drinking water treatment, and other concerns. MDE has developed a story map that describes salt impacts.

Strategies
Maryland's salt reduction strategies include:

1. Requirement for Salt Management Plan and implementation in State law for SHA.
2. Requirements for Salt Management Plans and implementation in the State's MS4 permits.
3. Voluntary applicator training and certification.
4. Public awareness through MDE's salt web pages and local government outreach efforts required in their Phase I MS4 permits.
5. Permit requirements for other potential point sources.

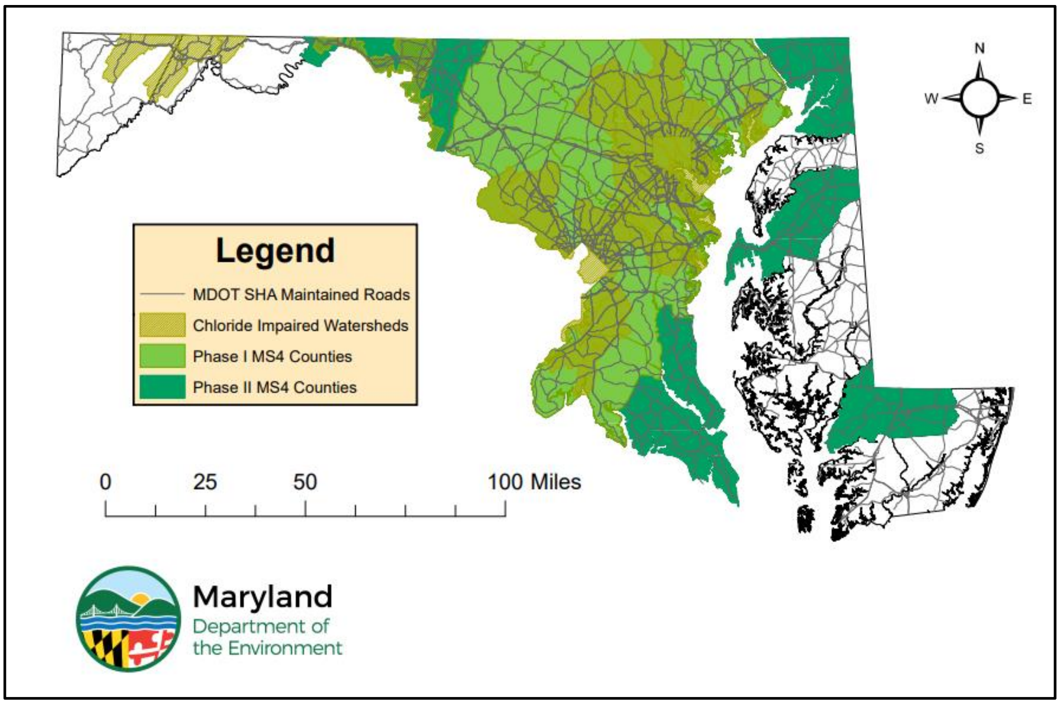

Figure E- 1: Map of Chloride-Impaired Watersheds, SHA-Maintained Roads, and MS4 Counties.

Additional information on Maryland's salt reduction strategies is provided below. Winter storms vary in number, timing, intensity, duration, and type of precipitation. Through adaptive management, trend analysis, and responsible plan implementation, long-term goals can be established to lessen the usage of salt and reduce its impact while maintaining safety and mobility.

1. State Highway Administration

In 2010, the Maryland State Legislature passed a law requiring the establishment of a Statewide Salt Management Plan by the Maryland Department of Transportation SHA. SHA's Salt Management Plan provides a thorough description of technical practices to minimize road salt and salt brine use and a broad system for implementing them. The Plan describes how SHA reduces the cost of materials, along with reducing the environmental impacts of salt overutilization. The Plan also emphasizes the importance of identifying trends in salt application, an element that could potentially link management actions with environmental outcomes. Furthermore, because the Plan is updated on a regular basis, with a mechanism for assimilating new information as it becomes available, it is compatible with an adaptive management approach.

SHA's Salt Management Plan has helped reduce salt application through increased training, tracking and recording usage, and implementing new techniques such as the use of brine-only routes. Implementation of SHA's Plan has already resulted in an approximately 50% reduction in their road salt application.

2. MS4 Jurisdictions

Maryland's MS4 permits cover over 90% of Maryland's impervious surface area. Revised five-year permits (2021) for large Phase I MS4s included Salt Management Plan requirements. Jurisdictions are required to reduce the use of winter weather deicing and anti-icing materials, without compromising public safety, by developing County Salt Management Plans (SMP) to be submitted to MDE in the permit's third year (2024) and implemented thereafter. Plans will include tracking and reporting, training and outreach, and evaluation of new methods and strategies. Each jurisdiction must also annually provide their winter road maintenance operator personnel and contractors with the latest training in deicer and anti-icer management.

Final determinations for Maryland's medium Phase I permits were made in December 2022. These permits contain the same requirements for salt reductions as the large Phase I permits.

Currently, Phase II MS4 permit holders are required to quantify and report pollution prevention efforts related to good housekeeping methods for snow and ice control, such as use of pretreatment, truck calibration and storage, and salt dome storage and containment.

3. Private Applicator Training and Certification

Maryland is developing a statewide voluntary private applicator training and certification program. Private applicators will learn best practices to help improve effectiveness and efficiency and reduce salt application while maintaining safety. A pilot program began in winter 2023. The course curriculum also includes material for people who hire winter salt applicators. By educating salt applicators and those who contract or employ them on ways to apply the minimum amount of salt required for public safety, the negative impacts to State freshwater systems will be reduced.

4. Public Awareness

MDE maintains a winter salt website for the public, and MDE's Office of Communications periodically posts excerpts on social media. MDE is also working with the University of Maryland Extension to develop outreach products to be used for homeowners and seasonal winter maintenance workers. In addition, MS4 permits contain a requirement for jurisdictions to develop and distribute information on best salt management practices to their residents.

5. Permit Requirements for Other Potential Point Sources of Chloride

In permitting municipal and industrial facilities, the potential to discharge chloride, as well as instream impairment, are considered in determining requirements for monitoring and/or limits. These source loads are small compared to contributions from winter salt.

Achieving consistent instream chloride reductions will likely take many years. Fortunately, with the increasing recognition worldwide of the negative environmental impact of salt driving a demand for more efficient application techniques, the introduction of new and promising technologies should enable steady, incremental reductions into the foreseeable future.