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2024 West Virginia Integrated Water Quality Monitoring and Assessment Report

Prepared to fulfill the requirements of Section 303(d) and 305(b) of the federal Clean Water Act and Chapter 22, Article 11, Section 28 of the West Virginia Water Pollution Control Act

Prepared by the Division of Water and Waste Management, Water Quality Standards and Assessment Section

July 2025

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1.0 INTRODUCTION

West Virginia Code Chapter 22, Article 11, Section 28 requires a biennial report of the quality of the state's waters. In addition to state code, the federal Clean Water Act and 40 CFR§130.8 contain requirements to report on the quality of a state's waters. Section 305(b) of the Clean Water Act requires a comprehensive biennial report. Section 303(d) requires a list of waters for which effluent limitations or other controls are not sufficient to meet water quality standards, referred to as impaired waters. Section 314 specifies that states will report an assessment of the water quality of all publicly owned lakes, including the status and trends of such water quality. The United States Environmental Protection Agency (USEPA) has recommended that these requirements be accomplished in a single report, referred to as an Integrated Report, which combines the comprehensive Section 305(b) report on water quality, the Section 303(d) list of waters that are not meeting water quality standards, and Section 314 assessment of publicly own lakes.

When reading this report, consider two major programmatic goals:

1) Characterizing general water quality in West Virginia – Section 2 describes the random data that best reaches this goal.
2) Identifying pollution and developing restoration plans to clean up waters– For more than 20 years WVDEP has focused monitoring efforts to document impairment, plan for restoration and qualify for federal clean up dollars. Section 3-5 describe how impaired waters are identified.

The WVDEP has prepared this Integrated Report to communicate the quality of the State's waters, as well as to explain the methods to monitor and assess water quality. WVDEP will also be reporting results of the assessments to the USEPA through the Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). This Integrated Report and data preparation have been organized for efficient reporting through ATTAINS.

ATTAINS is a relatively new internet-based data management system prepared by the USEPA to better track water quality, restoration planning, and implementation consistently across all regions and states. The data reported to USEPA through ATTAINS is made available through public information web application, How's My Waterway (**https://mywaterway.epa.gov/**). Because the federal tracking system and applications make generalities to accommodate data needs of all jurisdictions, the best source of specific information regarding the WV water quality and restoration plans remains the WVDEP webpage. To help navigate the webpages and to provide an interactive platform to visualize the data presented in this Integrated Report, WQSAS has prepared a corresponding web-based tool. To access the tool, visit the WVDEP webpage and select 2024 in the menu on the right:

https://dep.wv.gov/wwe/watershed/ir/pages/303d_305b.aspx.

2.0 GENERAL WATER QUALITY CONDITION

Staff of the agency's Water Quality Standards and Assessment Section are responsible for establishing water quality standards, monitoring state waters, assessing the results of the monitoring using water quality standards, and reporting on the water quality condition. The Monitoring Unit carries out a variety of monitoring programs designed to gather different types of information. For instance, the Ambient monitoring program has decades worth of data for 26 major waterways. Reviewing Ambient monitoring results allows resources managers to quickly gauge the health of the state's major waterways. While the pre-Total Maximum Daily Load (pre-TMDL) monitoring program focuses on known exceedances of water quality standards and studies anthropogenic impacts to determine how to reduce pollutant loads. Through another type of monitoring program, referred to as Probabilistic Monitoring, data is collected to determine the general water quality conditions in state waters. The design of the Probabilistic program is intended to *feasibly* gather data to generalize the water quality condition. Currently, limited or no data have been specifically collected for more than 58.9% of stream miles in the State. As a result, the streams are considered "unassessed" in ATTAINS. However, the benefit of the Probabilistic Monitoring program is that it is statistically valid to apply the monitoring results to generally characterize all waters of the State, even the "unassessed" streams. The following section describes Probabilistic Sampling and Results, See Appendix A to learn about other monitoring programs.

2.1 Probabilistic (Random) Sampling

Probabilistic monitoring results indicate that the majority of West Virginia streams have fair to excellent condition for most biological, chemical, and habitat indicators. However, water quality is widely impacted by marginal to poor habitat conditions due to erosion, sedimentation and disturbed riparian areas.

In 1997, the WQSAS-Monitoring Unit (previously referred to as the Watershed Assessment Branch) began sampling randomly selected sites to better estimate and assess the ecological health of watersheds and ecoregions within the state. The data generated from this random selection (also known as probabilistic) sampling effort allows the WVDEP to make statistically valid assessments of aquatic integrity on a statewide basis, as well as make comparisons between watersheds and ecoregions. The data also contribute to monitoring long-term trends in watershed and ecoregion health. The WVDEP started a fifth round of probabilistic sampling in 2019. A full round of monitoring is normally conducted over a five to six-year period to characterize conditions in wadeable streams over a range of baseflow regimes and weather conditions and minimize the impacts of short-term weather events (e.g., droughts and floods). It is important to note that the pre-TMDL monitoring program targets high and low flows to consider season variation, flow critical conditions, and runoff events; thus, the pre-TMDL results differ from those of the Probabilistic Monitoring program.

The goal of WVDEP's probabilistic monitoring program is to provide statistically unbiased estimates of stream condition without assessing every stream mile in the state. This approach can be used to

describe various aspects of stream condition including, the proportion of stream miles with aquatic life attainment, the proportion of stream miles with specific water quality criterion violations, and the characterization of the relative importance of stressors such as sedimentation or acidity.

The probabilistic design used for this summary allows WVDEP to characterize general water quality conditions at three scales: Basin (N=6, Figure 2-1), Ecoregion (N=3, Figure 2-2), and Statewide. Basins consist of four to six 8-digit Hydrologic Unit Code (HUC) watersheds that are grouped based on ecological significance and location into similar-sized areas that are somewhat equivalent to 4-digit HUCs. The USGS 8-Digit HUC watershed names for each basin combination are provided in Table 2-1.

Table 2-1. Probabilistic basins and their combined USGS 8-digit HUC names

Basin	USGS 8-digit HUC Watershed Names and Descriptions
Potomac	North Branch Potomac, South Branch Potomac, Cacapon, Potomac Direct Drains, Shenandoah Hardy, and Shenandoah Jefferson; All 8-digit HUCs in WV that drain into the Atlantic Ocean via Chesapeake Bay
Monongahela	Tygart Valley, West Fork, Cheat, Monongahela, Dunkard, and Youghiogheny; Streams draining into the Monongahela River
Upper Ohio	Upper Ohio North, Upper Ohio South, Middle Ohio North, Little Kanawha, and Middle Ohio South; Streams draining into the Ohio River upstream of the Kanawha River
Lower Kanawha	Lower Kanawha, Coal, Elk, and Upper Kanawha (not to be confused with the Upper Kanawha 8-digit HUC watershed); streams that drain into the Kanawha River downstream of Kanawha Falls
Upper Kanawha	Gauley, Lower New, Greenbrier, Upper New, and James; Streams that drain into the Kanawha River upstream of Kanawha Falls (except for the James)
Lower Ohio	Lower Ohio, Lower Guyandotte, Upper Guyandotte, Twelvepole, Big Sandy, and Tug Fork; streams that drain into the Ohio River downstream of the Kanawha River

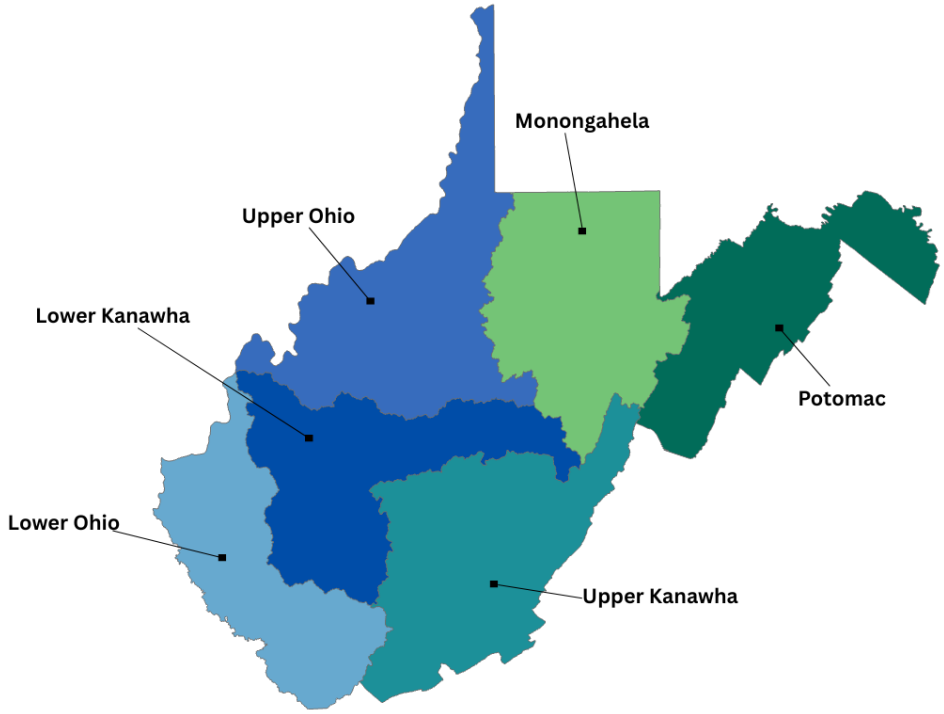


Figure 2-1. Map of probabilistic basins in West Virginia

Ecoregions are areas or regions where climate, soils, geology, vegetation, ecosystems, and anthropogenic use history are generally similar (Omernik, 1987). The three major ecoregions in West Virginia are the Western Allegheny Plateau (70), Central Appalachians (69), and Ridge and Valley (67). Due to its small extent in West Virginia, the Blue Ridge Mountain Ecoregion (66) was combined with Ecoregion 67 for assessments and data analysis. Key differences among the ecoregion are elevation, public lands, land use, soil erodibility, stream slope/sinuosity.

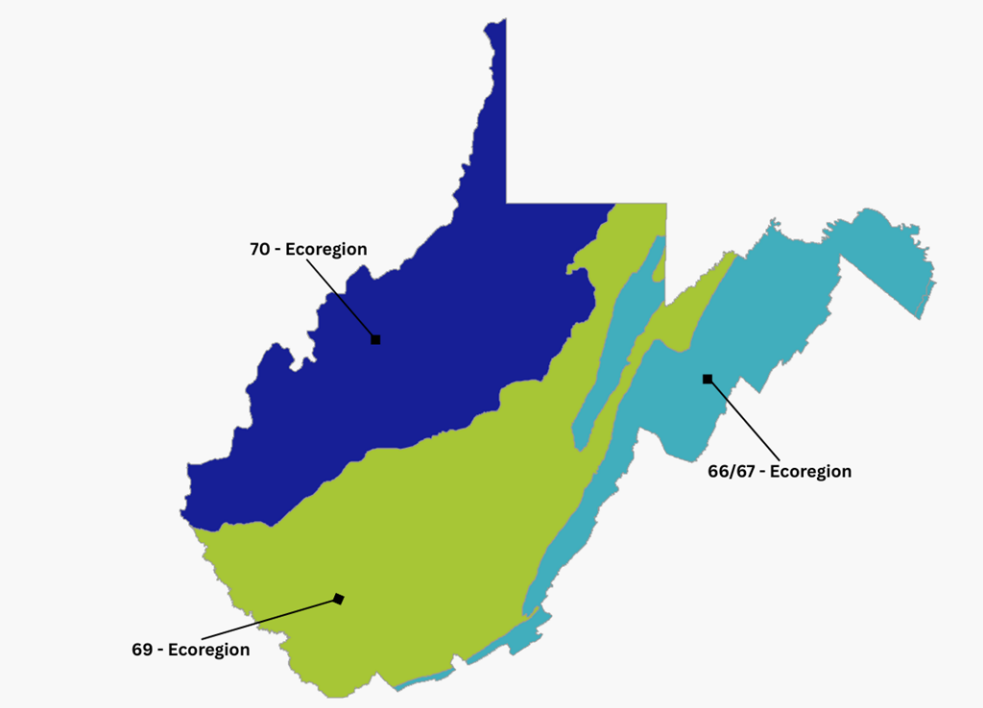
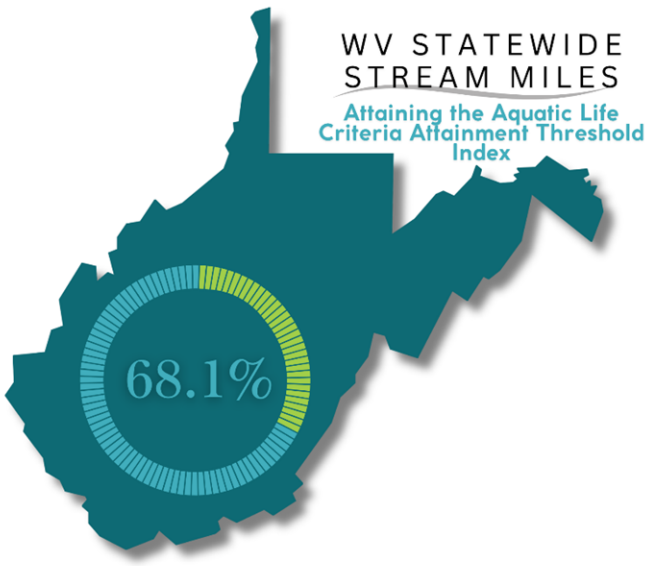


Figure 2-2. Map of West Virginia Ecoregions

The data used for these analyses are from 343 sites that were sampled at baseflow conditions during the late spring/early summers of 2018 – 2022. The probabilistically selected sites are assessed using three broad categories of aquatic integrity indicators: Aquatic Life, Water Quality, and Habitat Indicators of Integrity. From these, several individual indicators were chosen to help illustrate the condition of West Virginia's rivers and streams during the period of interest in this report.

2.2 Probabilistic Data Results

2.2.1 Aquatic Life Indicators of Integrity



Aquatic life communities living in West Virginia are exposed to many stressors, including contaminants, sedimentation, nutrient enrichment, acid precipitation, and hydrologic modifications. The WVDEP uses benthic macroinvertebrates to assess the aquatic life condition of streams in the state. These organisms provide reliable information on water and habitat quality in streams and have been used as indicators all over the world for nearly 100 years. They are extremely diverse, exhibit a wide range of tolerances to pollutants, and are

relatively long-lived, allowing them to represent recent water quality and habitat conditions. Further, they serve as an excellent tool for measuring general ecological health, especially when summarized into a single index of integrity.

The biological communities living in West Virginia streams are exposed to stressors, including contaminants, sedimentation, nutrient enrichment, and acidity. The WVDEP uses benthic macroinvertebrates to assess the biological condition of streams in the state. These organisms provide reliable information on water and habitat quality in streams, because of their diversity and wide range of tolerances to pollutants. Measures of benthic macroinvertebrate communities are assessed through family-level and genus-level based indices of biotic integrity. The IBIs' metrics compare biological samples to reference conditions. The Aquatic Life Criteria Attainment Threshold (ALCAT) uses genus-level data specifically to determine attainment. A technical memorandum describing ALCAT can be found in Appendix B.

Based on the ALCAT percent of threshold (where scores <100 are not attaining and >= 100 are attaining), an estimated 68.1% of wadeable stream miles in the state are attaining for aquatic life use, while 30.4% of stream miles are non-attaining, and 1.5% are Non-Comparable (Figure 2-3). The basin with the most attaining stream miles for aquatic life (78.3%) is Potomac. The basin with the lowest number of attaining stream miles (62.0%) is Monongahela. A portion of streams in the Potomac Basin (8.4%) are not considered comparable because of natural conditions from karst limestone geology.

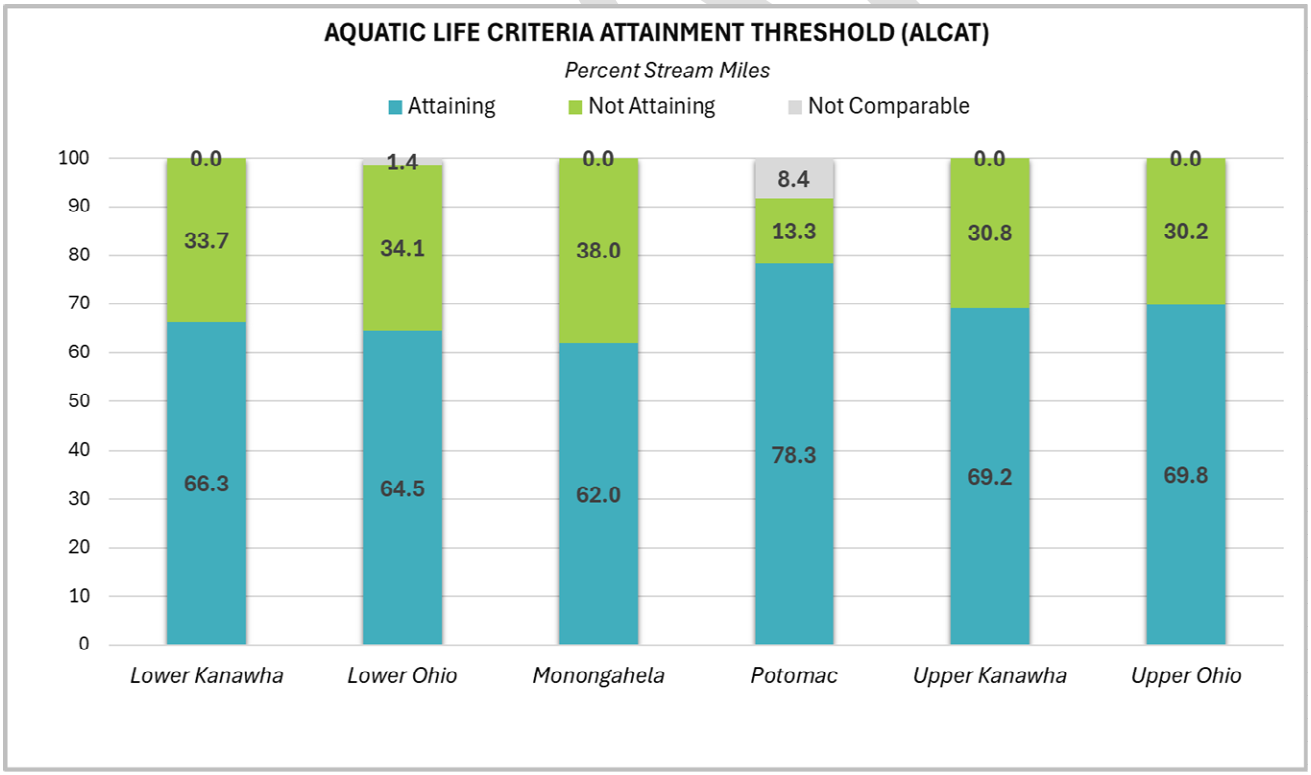


Figure 2-3: Percentage of miles that meet or exceed the Aquatic Life Criteria Attainment Threshold in each Basin.

The ecoregion with the highest percentage of streams attaining the Aquatic Life Use was the Ridge and Valley (66/67) at 84.1%, followed by the Central Appalachians (69) at 67.3%, and Western Allegheny Plateau (70) at 60.7% (Figure 2-4).

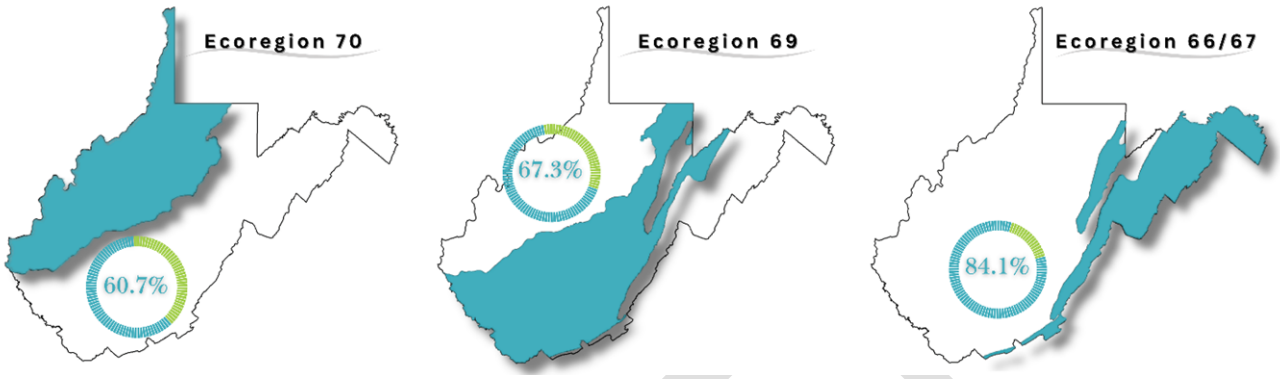


Figure 2-4: Percentage of miles that meet or exceed the Aquatic Life Criteria Attainment Threshold in each Ecoregion.

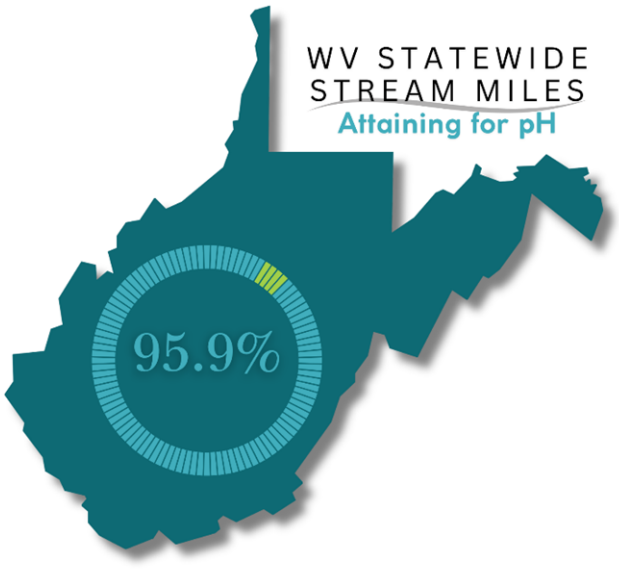
2.2.2 Water Quality Indicators of Aquatic Integrity

The WVDEP analyzes 39 different water quality parameters at each of the sites sampled as part of the probabilistic monitoring program. Below are the results of five of these parameters, including:

pH
Sulfate
Fecal coliform bacteria
Nutrients – total nitrogen and total phosphorus

pH

pH (S.U.) is a measure of water's acidity or basicity. It is one of the most influential properties of water. As pH levels fall below 6.0 or rise above 9.0, physiological stress occurs in many aquatic organisms. Lower pH levels (increasing acidity) may heighten the toxicity of ammonia and many metals. In WV, acid precipitation and acid mine drainage are the most common causes of low pH acidic waters. High pH waters may be the result of naturally alkaline rocks and soils leaching into streams and may be exacerbated by physical disturbances such as tilling, mining, and construction. Treatment for acidic streams using



alkaline materials may also cause high pH waters. An additional cause of elevated pH is excessive photosynthetic activity, which removes carbon dioxide from water and raises pH. For attainment, West Virginia §8.24 (requirements governing water quality standards) states that pH should have "no values below 6.0 nor above 9.0. Higher values due to photosynthetic activity may be tolerated."

An evaluation of statewide probabilistic data indicates that approximately 95.9% of the stream miles in WV are attaining the pH criterion. Notably, only 4.1% are non-attaining and all for pH less than 6.0. On a smaller scale, the basins with the fewest pH impacted stream miles from this dataset are Upper Ohio (0.0%) and Potomac (0.0%) (Figure 2-5). The Monongahela basin has the highest level of low pH impacted waters among basins with 8.2% of stream miles estimated to be acidic.

The Western Allegheny Plateau had 0.0% of stream miles impacted by pH while the Ridge and Valley only had 2.8% (Figure 2-6). The Central Appalachians had the most stream miles impacted by pH at 8.3%. It should be noted that the Central Appalachians are where the majority of Acid Deposition in WV has been documented.

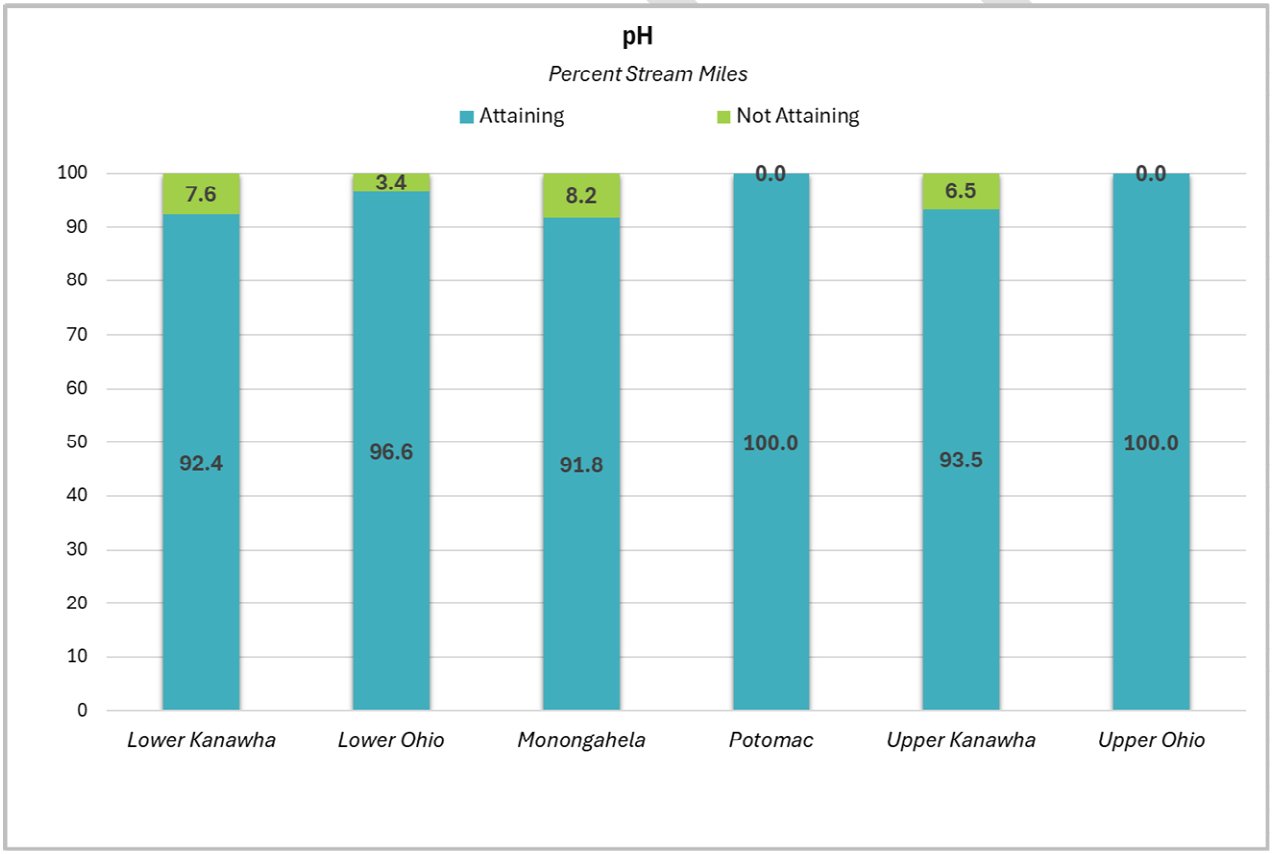


Figure 2-5: Percentage of stream miles that meet or exceed the pH water quality criteria in each Basin.

The ecoregion with the highest percentage of streams attaining pH was the Western Allegheny Plateau (70) at 100% followed by the Ridge and Valley (66/67) at 97.2% and Central Appalachians (69) at 91.7%.

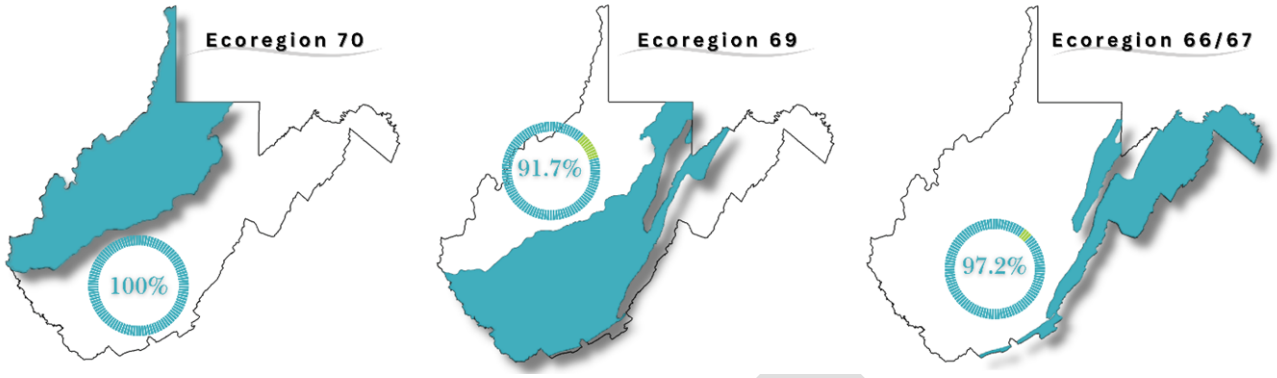
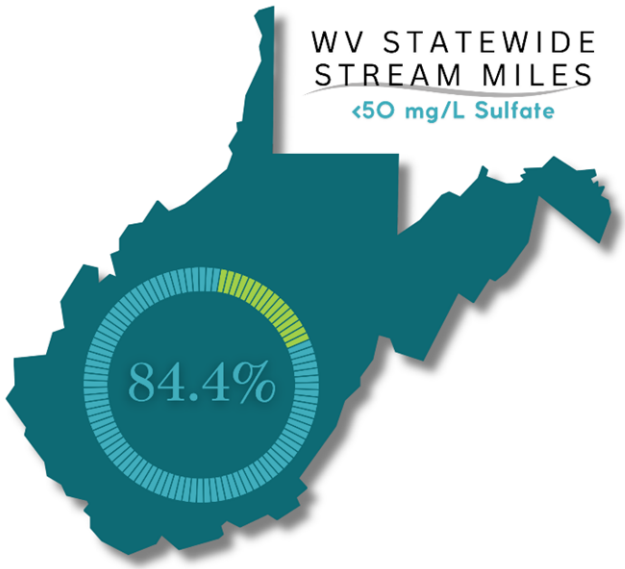


Figure 2-6: Percentage of miles that meet or exceed the pH water quality standard in each Ecoregion.

Sulfate



Streams receiving mine drainage may be impaired by low pH and/or elevated concentrations of metals, including iron, aluminum, and manganese. Other contaminants such as sulfate may also be present in concentrations above background levels. A sulfate concentration greater than 50 mg/L was used to identify probabilistic sites influenced by mine drainage.

Following this guideline, approximately 15.6% of the stream miles statewide are influenced by mine drainage. Among basins, the Lower Ohio (29.2%) and Lower Kanawha (20.7%) had the highest percentage of streams miles exceeding the 50 mg/L threshold of sulfate (Figure 2-7). The Potomac Basin had the lowest percentage of stream miles with 3.4%.

Observed on an ecoregional basis, mine drainage influences a greater proportion of stream miles in the coal-rich Central Appalachians (27.3%) than in the Ridge and Valley (2.5%) or Western Allegheny Plateau (9.2%). The ecoregions with their corresponding percentage of streams below 50 mg/L sulfate are the Western Allegheny Plateau (70) at 90.8%, Central Appalachian (69) at 72.7%, and Ridge and Valley (66/67) at 97.5%. (Figure 2-8).

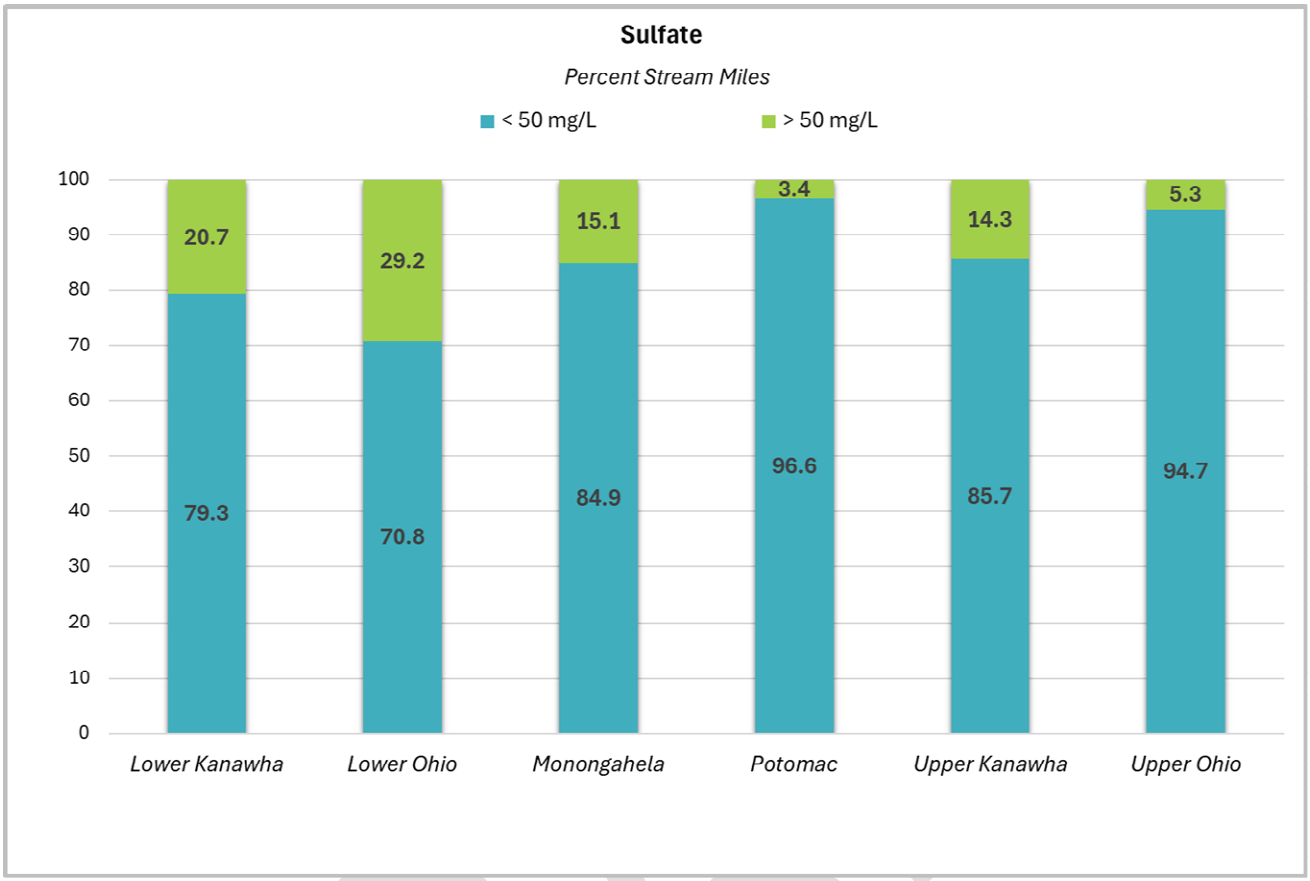


Figure 2-7: Percentage of stream miles that are above and below a 50 mg/L comparison threshold in each Basin.

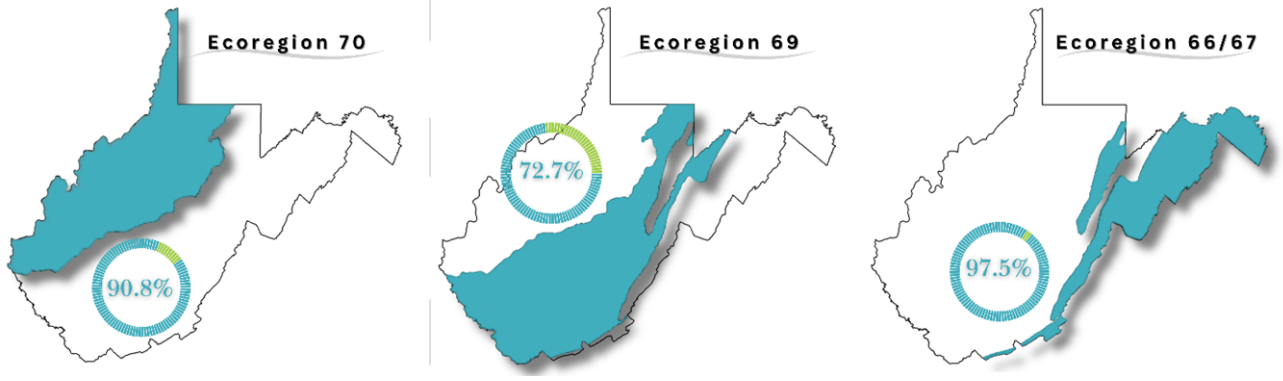
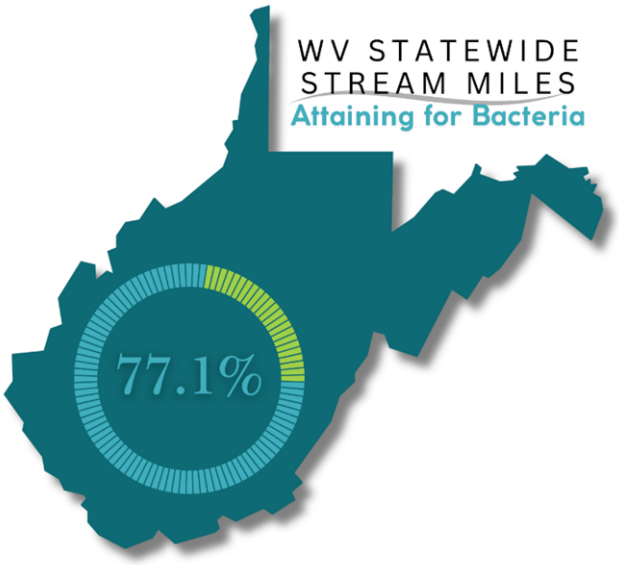


Figure 2-8: Percentage of miles that meet or exceed a 50 mg/L comparison threshold in each Ecoregion.

Bacterial Contamination

Many West Virginia streams contain elevated levels of fecal coliform bacteria. Analysis of fecal coliform is used to indicate potentially harmful bacteria in a waterbody. Contributors to the problem include leaking or overflowing sewage collection systems, homeowner sewage discharges via straight

pipes or failing septic systems, and runoff from urban or residential areas and agricultural lands with livestock.



Based on statewide probabilistic data, 17.5% of stream miles have fecal coliform bacteria levels that exceed the WV criterion of 400 colonies/100mL. The basin with the highest percentage (88.1%) of attaining stream miles is Upper Kanawha and the basin with the fewest (67.0%) is Lower Ohio (Figure 2-9). 27.2% of stream miles in the Western Allegheny Plateau had fecal coliform bacteria levels that exceeded the WV criterion compared to 14% in the Central Appalachians and 6.3% in the Ridge and Valley. The Western Allegheny Plateau tends to have a higher population density and broader agricultural land cover than the two other ecoregions. It should be noted that WVDEP's probabilistic monitoring is performed at baseflow conditions. Because samples are not collected during storm runoff events, bacteria levels that may increase under these higher flow conditions are not represented in the data.

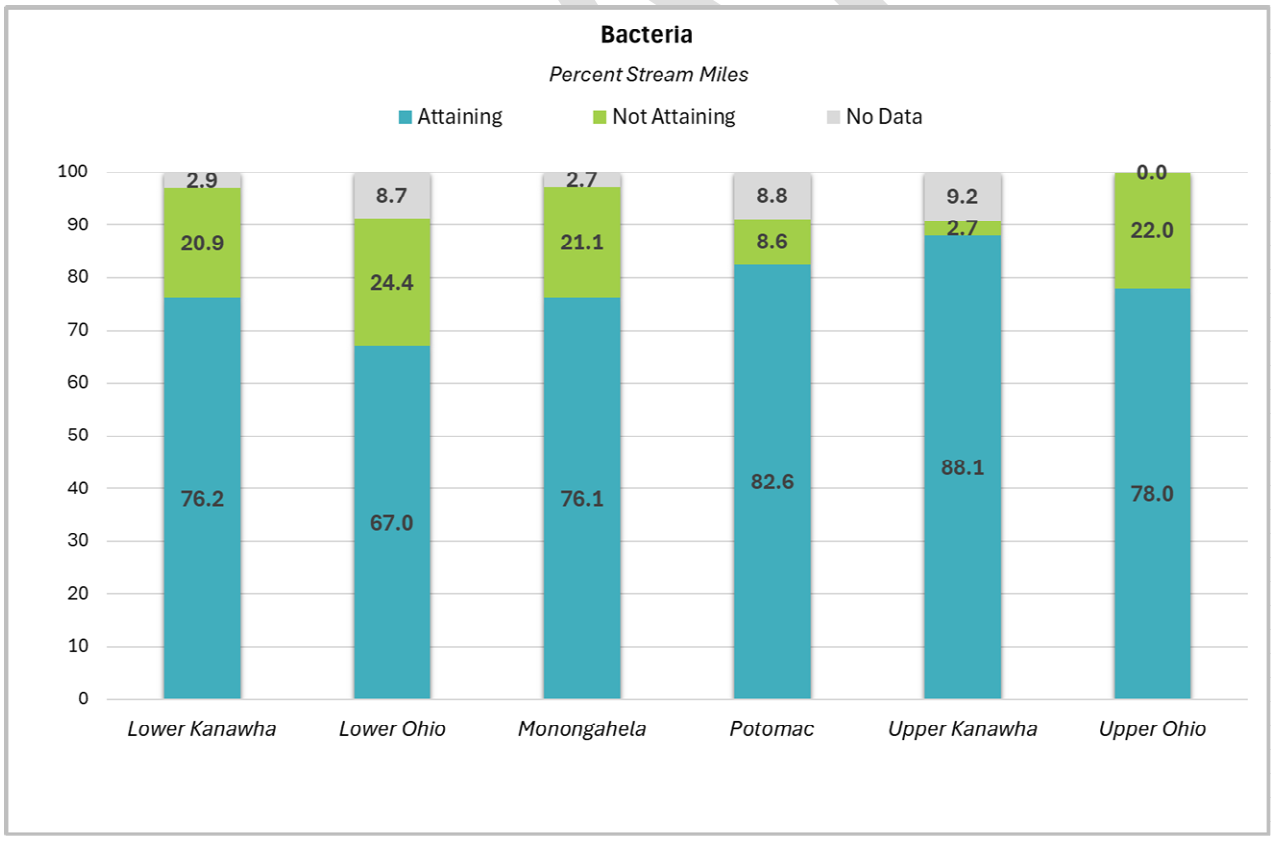


Figure 2-9: Percentage of stream miles that meet or exceed the Fecal Coliform water quality criteria in each Basin.

The ecoregions with their corresponding percentage of streams that meet the Fecal Coliform standard are the Western Allegheny Plateau (70) at 72.8%, Central Appalachians (69) at 77.4%, and Ridge and Valley (66/67) at 84.7% (Figure 2-10).

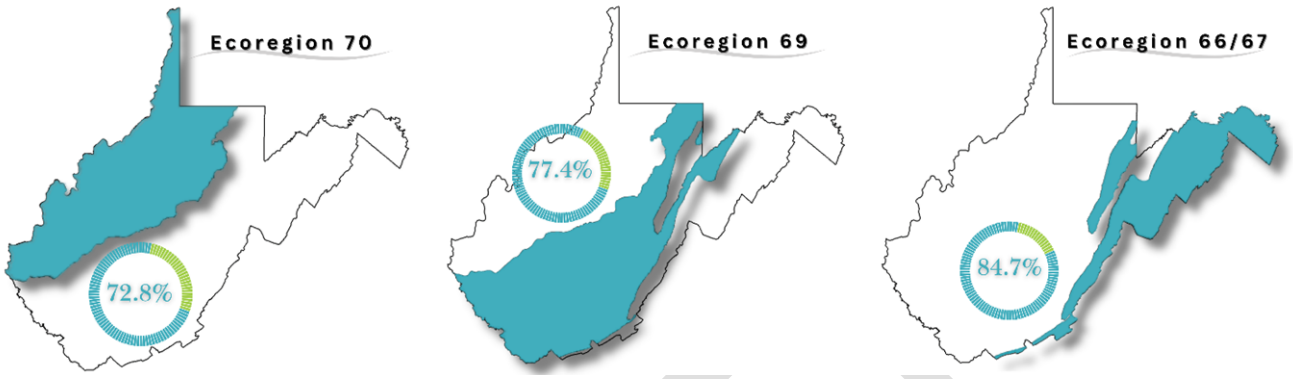
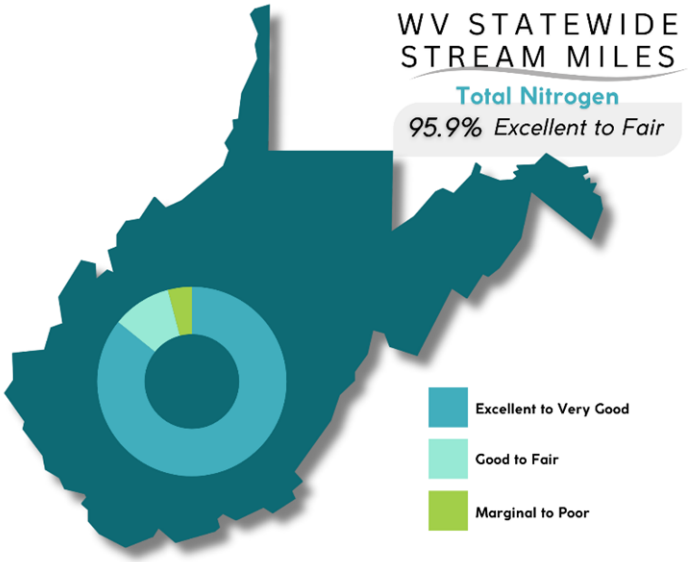


Figure 2-10: Percentage of miles that meet or exceed the Fecal Coliform standard in each Ecoregion.

Nutrients

Excess nutrient concentrations in aquatic environments—often from fertilizer runoff, animal waste, and wastewater discharges, but also from atmospheric deposition—can stimulate excess algal growth. Streams enriched with excess nitrogen may exhibit overabundances of filamentous algae and diatoms, low dissolved oxygen concentrations, and frequent aquatic life kills including fish. Excess nutrient concentrations in aquatic environments—often from fertilizer runoff, animal waste, and wastewater discharges, but also from atmospheric deposition—can stimulate excess algal growth. Streams enriched with excess nitrogen may exhibit overabundances of filamentous algae and diatoms, low dissolved oxygen concentrations, and frequent aquatic life kills including fish.

Total Nitrogen



Nitrogen (N) is a critical constituent of proteins and nucleic acids in all living organisms. It is an essential nutrient for growth in aquatic plants and algae. Total nitrogen (TN) measures the amount N from all nitrogen forms. These include elemental nitrogen (N^2), nitrite (NO_2^-), nitrate (NO_3^-), ammonia nitrogen (NH_4^+), and organic nitrogenous compounds).

West Virginia does not have a criterion for TN to assess attainment in streams. Therefore, for this probabilistic assessment, WVDEP used USEPA's method for the National Rivers and Streams Assessment (2018-

19) to establish benchmarks. The 75th percentile of WVDEP reference samples (<=0.82 mg/l) was used to establish Excellent to Very Good conditions for TN and the 95th percentile (>1.33 mg/L)) to define Marginal to Poor. Total nitrogen concentrations >0.82 mg/L & <=1.33 mg/L were in Good to Fair condition.

An evaluation of statewide probabilistic data indicates that approximately 85.8% of the stream miles in WV are Excellent to Very Good in terms of TN concentrations, and only 4.1% are Marginal to Poor. The basin with the highest percent (92.9%) of stream miles rated as Excellent to Very Good is Upper Ohio, and the basin with the fewest is Potomac with an estimate of 70.4% (Figure 2-11). The Potomac had the most streams in Marginal to Poor at 9.4%.

The Western Allegheny Plateau had both the highest percentage of stream miles in Excellent to Very Good condition (92.6%) and the lowest percentage of stream miles in Marginal to Poor condition (0%) (Figure 2-12). The Central Appalachians and Ridge and Valley had roughly the same percentage of stream miles in Marginal to Poor condition (6.6 and 6.9% respectively). However, the Central Appalachians had more stream miles in Excellent to Very Good condition (84.2%) than the Ridge and Valley (75.9%). The disparity in TN between the Western Allegheny Plateau and the Central Appalachians/Ridge and Valley may point to sources of Nitrogen outside of urban and agricultural origins (e.g., Atmospheric Deposition).

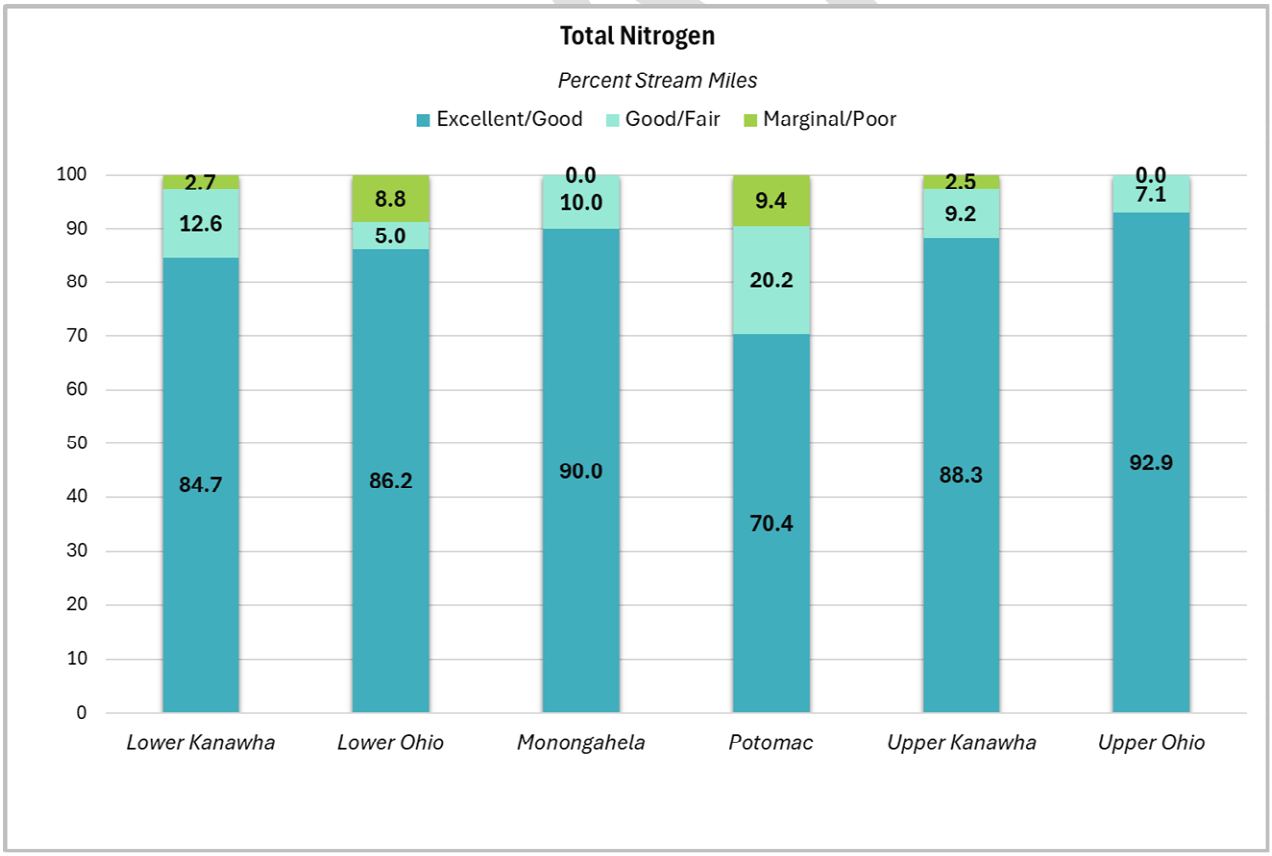


Figure 2-11: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Total Nitrogen in each Basin.

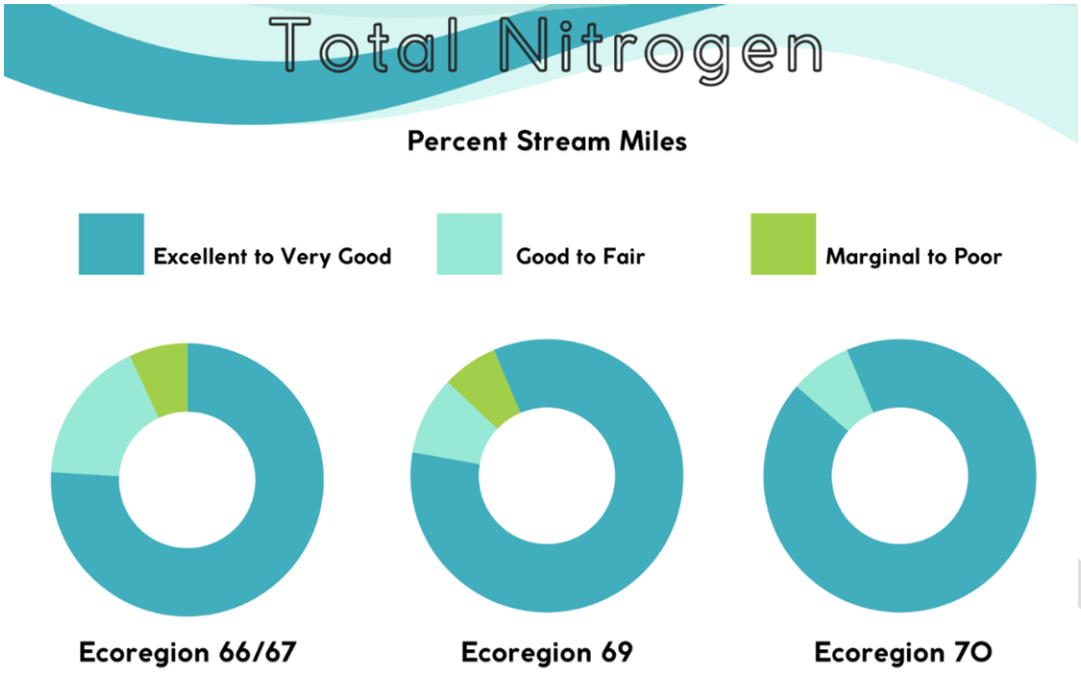
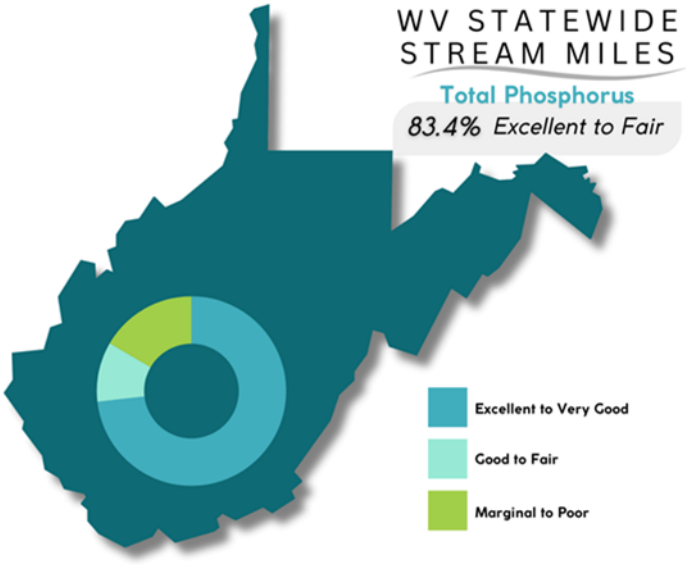


Figure 2-12: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Total Nitrogen in each Ecoregion.

Total Phosphorus

Phosphorus (P) is a highly reactive, non-metallic element and an essential nutrient for all living organisms. Phosphate minerals are the most common form of P. Free ortho-phosphate (PO_4^{3-}) is the "limiting nutrient" in many aquatic ecosystems because it is often the first nutrient to drop to levels that slow or limit plant growth. Consequently, even small increases in available phosphorus can cause substantial increases in algal growth. WVDEP measured total phosphorus (TP) concentrations, the amount P from in all phosphorus forms, for this probabilistic survey.



Because there is no WV criterion for TP in streams, WVDEP used USEPA's method for the National Rivers and Streams Assessment (2018-19) to establish benchmarks. The 75th percentile of WVDEP reference samples (<=0.02 mg/L) was used to establish Excellent to Very Good conditions for TP and

the 95th percentile (>0.03 mg/L) to define Marginal to Poor. Total phosphorus concentrations >0.02 mg/L & <=0.03 mg/L were considered in Good to Fair condition.

Based on a statewide scale, an estimated 73.2% of stream miles are Excellent to Very Good in terms of TP levels, and 16.6% are Marginal to Poor. The basin with the highest percentage (84.8%) of stream miles in Excellent to Very Good condition is Potomac, and the basin with the fewest is Lower Ohio with an estimate of 65.7% (Figure 2-13). The Upper Ohio basin has the most streams miles in Marginal to Poor condition at 23.7%. The percentage of stream miles in Marginal to Poor condition (20.3%) is also relatively high in the Lower Ohio basin.

Unlike TN, the more densely populated Western Allegheny Plateau had the lowest percentage of stream miles with TP in Excellent to Very Good condition (60.1%) and highest percentage in Marginal to Poor condition (25.9%) (Figure 2-14). The Ridge and Valley was the best ecoregion regarding TP (86.7% Excellent to Very Good; 9.0% Marginal to Poor) followed closely by the Central Appalachians (78.7% Excellent to Very Good; 11.9% Marginal to Poor).

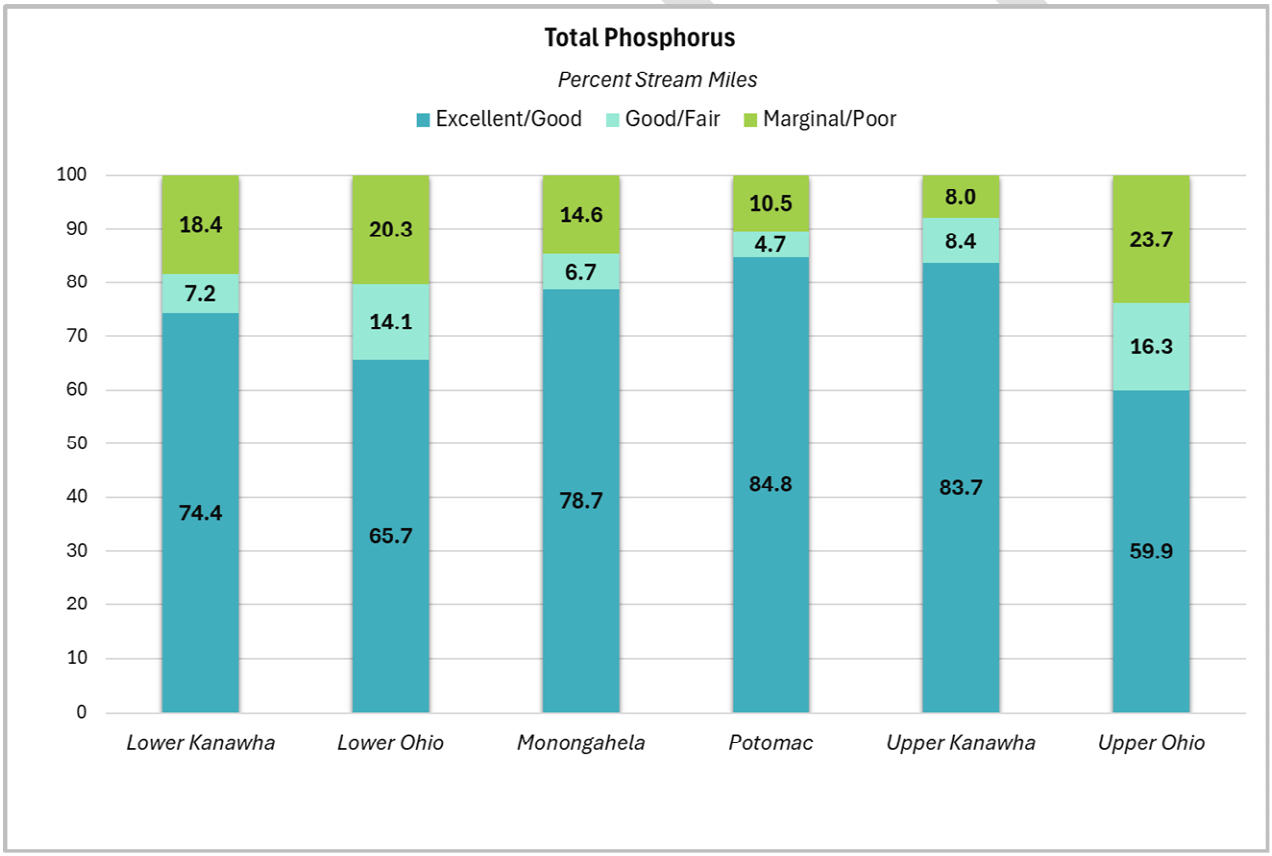


Figure 2-13: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Total Phosphorus in each Basin.

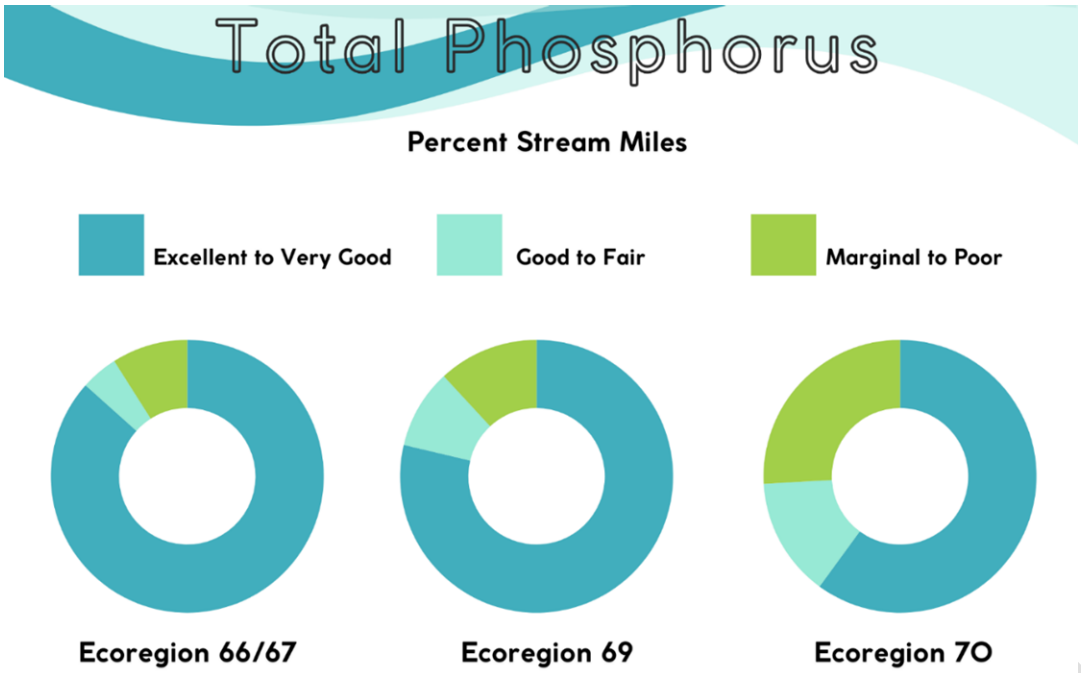


Figure 2-14: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Total Phosphorus in each Ecoregion.

2.2.3 Habitat Indicators of Aquatic Integrity

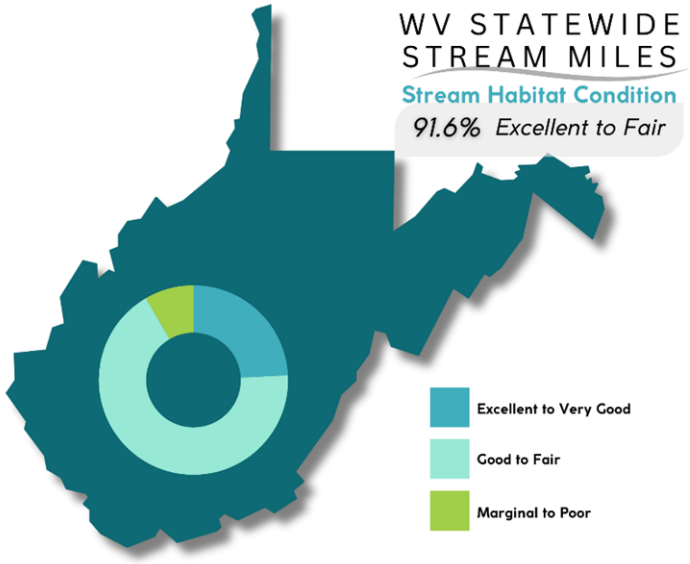
During probabilistic sampling, WVDEP personnel collect data on many features of both riparian and instream habitat known to be important to the biological communities of streams, including benthic macroinvertebrates and fish. Habitat quality is evaluated using the USEPA Rapid Bioassessment Protocol's (RBP) Visual-Based Habitat Assessment (VBHA). The VBHA was developed by USEPA as a standardized habitat assessment method for rivers & streams (lotic) habitats nationwide.

Ten individual VBHA parameters are evaluated and scored (on a scale of 0-20) based on their quality ranging from Poor to Optimal conditions. The ten parameters are then combined into a Total Habitat Score that reflects the general physical habitat condition of the site. The total habitat score has a maximum score of 200 points (10 parameters x up to 20 points each).

Among others, these ten VBHA parameters include measures of the amount of sediment deposition and embeddedness in the stream channel as well as measures of the quality of the riparian zone vegetation along the stream corridor.

Below are the results of the Total Habitat Score, three of the ten VBHA parameters (Embeddedness, Sediment Deposition, & Riparian Vegetative Zone Width), as well as a measure of the extent of trash and aesthetics at the stream assessment sites developed by WVDEP that uses a scoring system identical to that of the VBHA parameters (i.e., 0-20).

Total Habitat Score



For this report, habitat quality is considered Excellent to Very Good if the Total Habitat Score is 151-200, Good to Fair if 101-150, and Marginal to Poor if 0-100.

Based on probabilistic data, 24.2% of stream miles statewide have Excellent to Very Good habitat quality, 67.4% of stream miles have Good to Fair habitat quality, and 8.4% of stream miles have Marginal to Poor habitat quality. The basin with the best general habitat quality is Upper Kanawha with an estimate of 59.4% of stream miles rated as Excellent to Very Good (Figure 2-15). The Lower Ohio basin has the fewest stream miles (1.7%) in Marginal to Poor condition and Potomac has the second highest percent (33.5%) in Excellent to Very Good condition. The Upper Ohio basin had the fewest (5.3%) stream miles rated Excellent to Very Good. The Monongahela basin has the most stream miles in Marginal to Poor condition with an estimate of 16.0%.

The Central Appalachians had the highest percentage of stream miles in Excellent to Very Good condition (38.1%) followed closely by the Ridge and Valley (34.2%) (Figure 2-16). The Western Allegheny Plateau had both the lowest percentage of stream miles in Excellent to Very Good condition (3.5%) and highest in Marginal to Poor condition (12.7%). The more mountainous Central Appalachian and Ridge and Valley ecoregions have a much higher percentage of land that is publicly owned (e.g., Monongahela National Forest) and typically lower population densities compared to the Western Allegheny Plateau ecoregion. This disparity in land use is partially the reason why the Western Allegheny Plateau performs so much lower than the other two ecoregions regarding Total Habitat Score and other habitat metrics (see below).

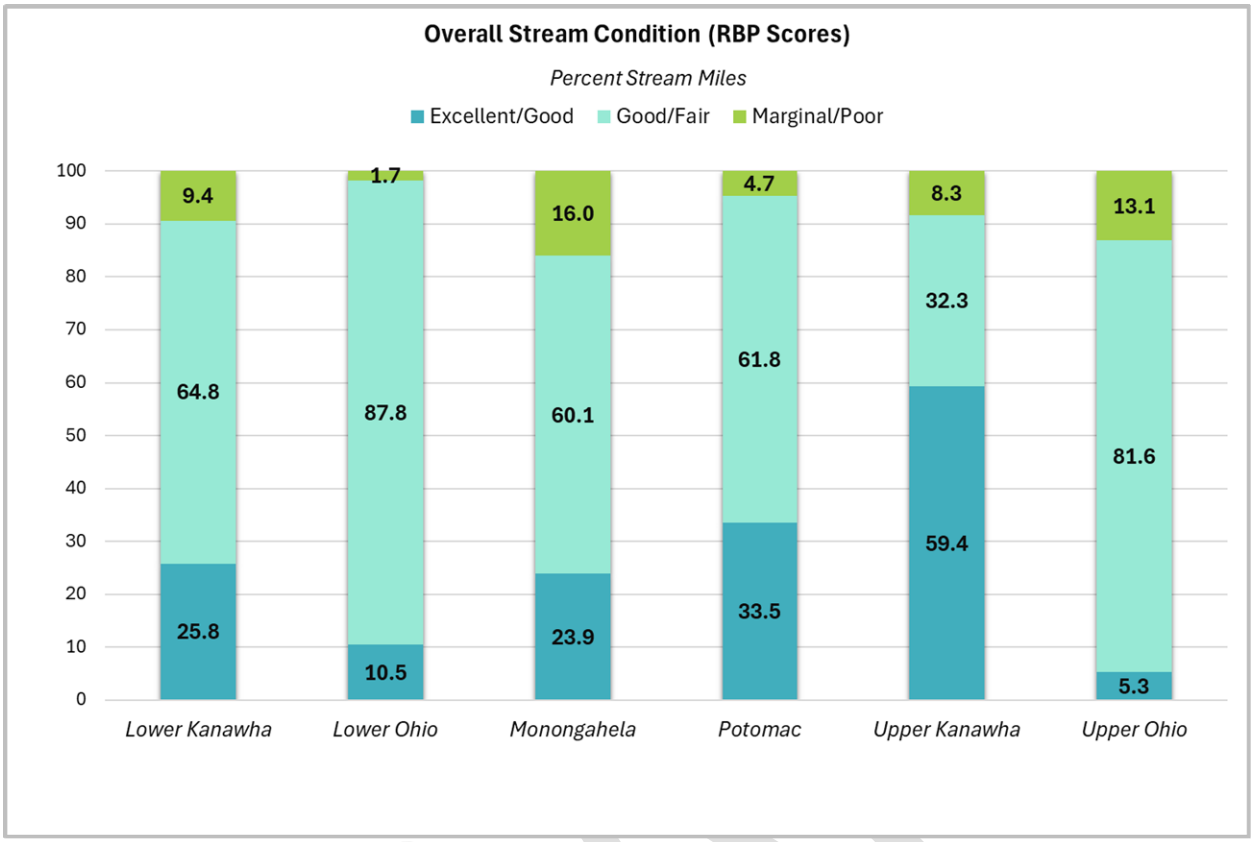


Figure 2-15: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for General Stream Condition (RBP Scores) in each Basin.

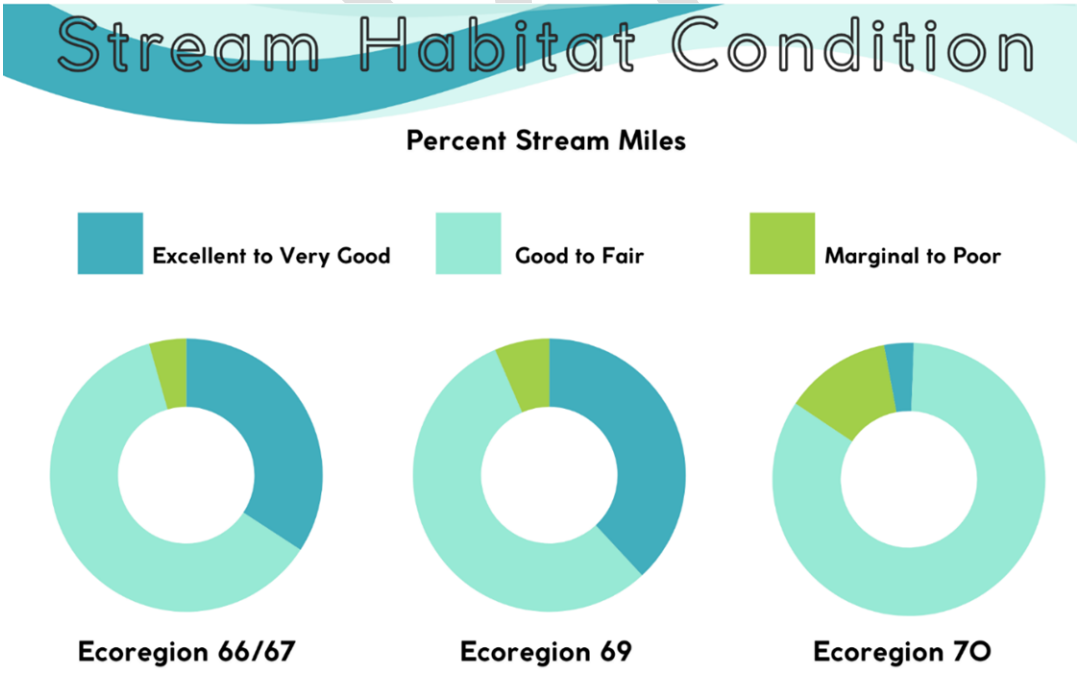


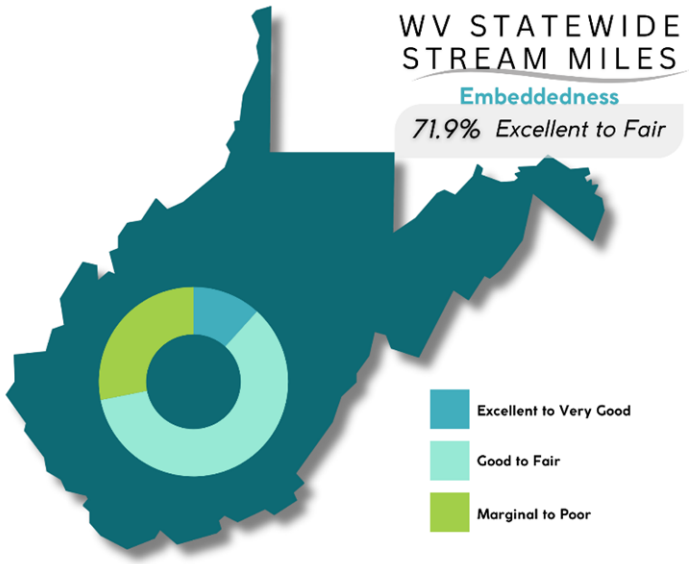
Figure 2-16: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for General Stream Condition in each Ecoregion.

Sedimentation

Excessive sedimentation in streams may have significant negative effects on instream habitats and the biological communities that use them. Interstitial spaces used by aquatic life for cover, feeding, and reproduction are often filled when sedimentation rates are high. Two of the most common sediment particles documented in WV streams are sand and silt. Soil erosion is the most common source of these sediment particles and although natural to some degree, is exacerbated by human disturbances/activities such as roads, construction projects, logging, oil/gas extraction, farming, and various types of mining to name a few. Two habitat parameters in the VBHA directly measure Sedimentation: Embeddedness and Sediment Deposition.

Embeddedness

Relative Presence of Embeddedness Sedimentation, and the resulting embeddedness, is one of the most important problems facing West Virginia streams. Embeddedness measures the extent to which rocks (gravel, cobble, and boulders) are covered or sunken into the silt, sand, or mud of the stream bottom. Generally, as rocks become embedded, the surface area available to macroinvertebrates and fish for shelter, spawning, and egg incubation is decreased. Embeddedness is primarily rated in the erosional areas of a stream (fast moving water).



Embeddedness was assessed at probabilistic sites using the component VBHA parameter. The scoring for this parameter ranges from 0-20. Sites with scores ranging from 16-20 are considered Excellent to Very Good, 11-15 are Good to Fair, and 0-10 are Marginal to Poor.

Based on probabilistic data, 11.7% of stream miles statewide are in Excellent to Very Good condition in terms of sedimentation, 60.2% are Good to Fair, and 28.1% are Marginal to Poor. The basin with the best embeddedness scores is Upper Kanawha with an estimate of 21.4% of stream miles rated as Excellent to Very Good, and only 19.7% rated as Marginal to Poor (Figure 2-17). The Potomac basin has the fewest stream miles (19.3%) in Marginal to Poor condition and has the second highest percent (21.2%) in Excellent to Very Good condition. The Upper Ohio basin has only 1.8% stream miles rated Excellent to Very Good. The Monongahela basin has the highest percentage of stream miles in Marginal to Poor condition with an estimate of 36.9% followed closely by the Lower Kanawha at 34.1%.

The Western Allegheny Plateau had both the lowest percentage of stream miles rated as Excellent to Very Good (1.7%) and highest percentage rated as Marginal to Poor (42.0%) for embeddedness (Figure 2-18). This is likely because this ecoregion has slower, low-gradient streams, has more erodible soils, and more land-disturbing activities than in other areas. The Ridge and Valley had the highest percentage in Excellent to Very Good condition (27.1%) followed by the Central Appalachians (13.6%).

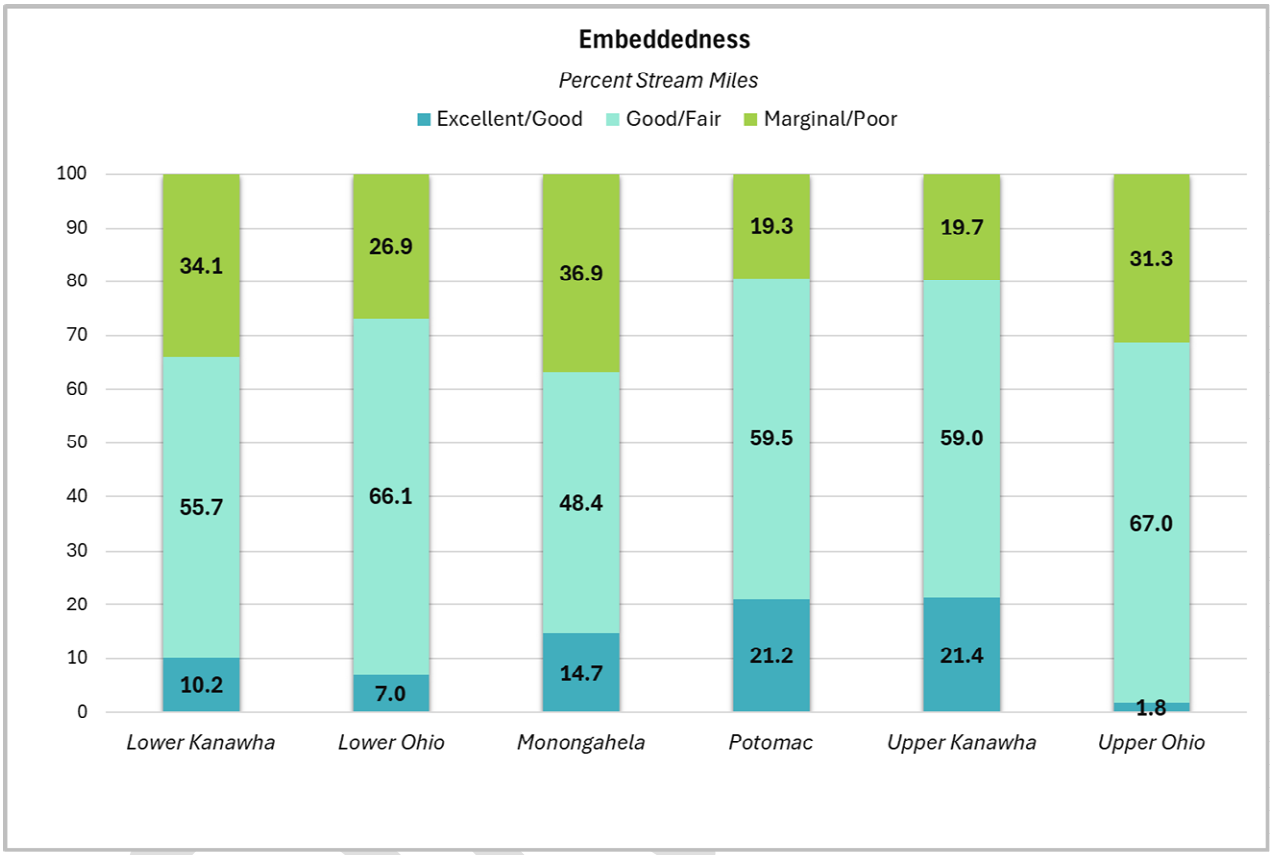


Figure 2-17: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Embeddedness in each Basin.

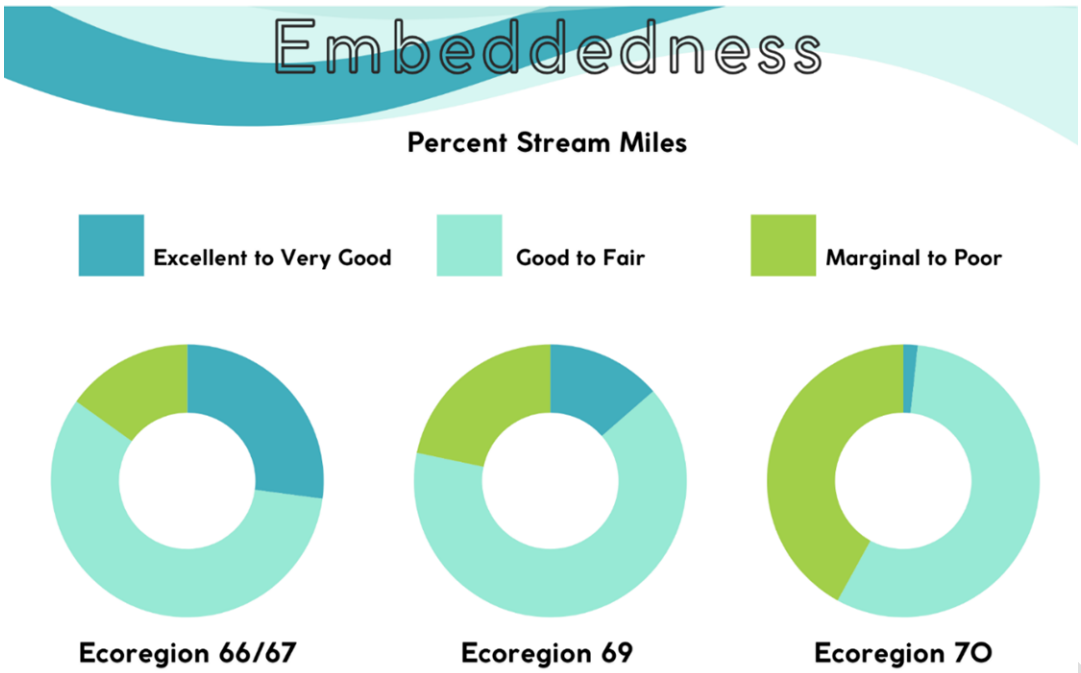
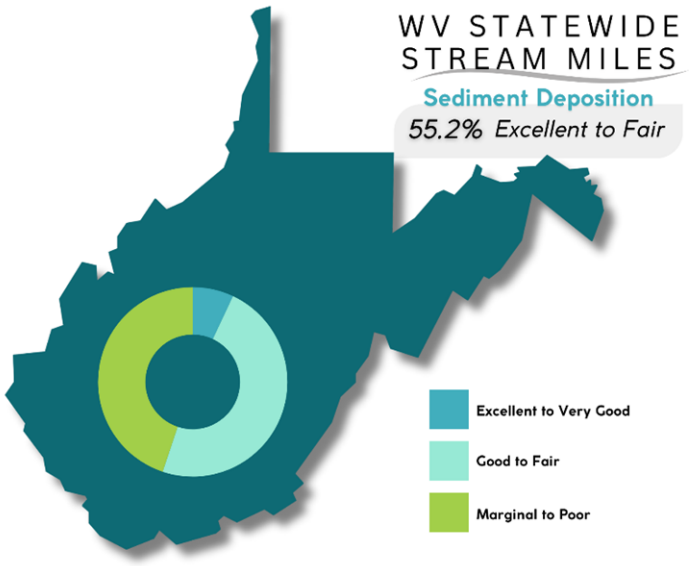


Figure 2-18: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Embeddedness in each Ecoregion.

Sediment Deposition



While Embeddedness focuses on the erosional habitats in a stream (fast moving water), Sediment Deposition evaluates the depositional habitats (slow moving water). Sediment deposition was assessed at probabilistic sites using the component VBHA parameter. The scoring for this parameter ranges from 0-20. Sites with scores ranging from 16-20 are considered Excellent to Very Good, 11-15 are Good to Fair, and 0-10 are Marginal to Poor.

Based on probabilistic data, only 7.0% of stream miles statewide are in Excellent to Very Good condition in terms of sedimentation, 48.2% are Good to Fair, and 44.9% are Marginal to Poor. The basin with the best sedimentation scores is Upper Kanawha with an estimate of 19.8% of stream miles rated as Excellent to Very Good, and 34.4% rated as Marginal to Poor (Figure 2-19). The Potomac basin has the fewest stream miles (29.0%) in Marginal to Poor condition and has the second highest percent (17.0%) rated Excellent to Very Good. The Upper Ohio basin does not have any stream miles rated Excellent to Very Good for sediment deposition and

has the most rated as Marginal to Poor with 59.7%. The Lower Ohio basin has a relatively high percentage of stream miles in Marginal to Poor condition with an estimate of 52.9%.

The sediment deposition conditions by ecoregion were very similar to embeddedness above: the Western Allegheny Plateau had 0% of stream miles in the Excellent to Very Good condition and the highest percentage of stream miles rated Marginal to Poor (66%); The Ridge and Valley had the highest percentage in Excellent to Very Good condition (18.4%) followed by the Central Appalachians (8%) (Figure 2-20). This is not surprising given that both the Embeddedness and Sediment Deposition parameters of the VBHA are measures of stream sedimentation.

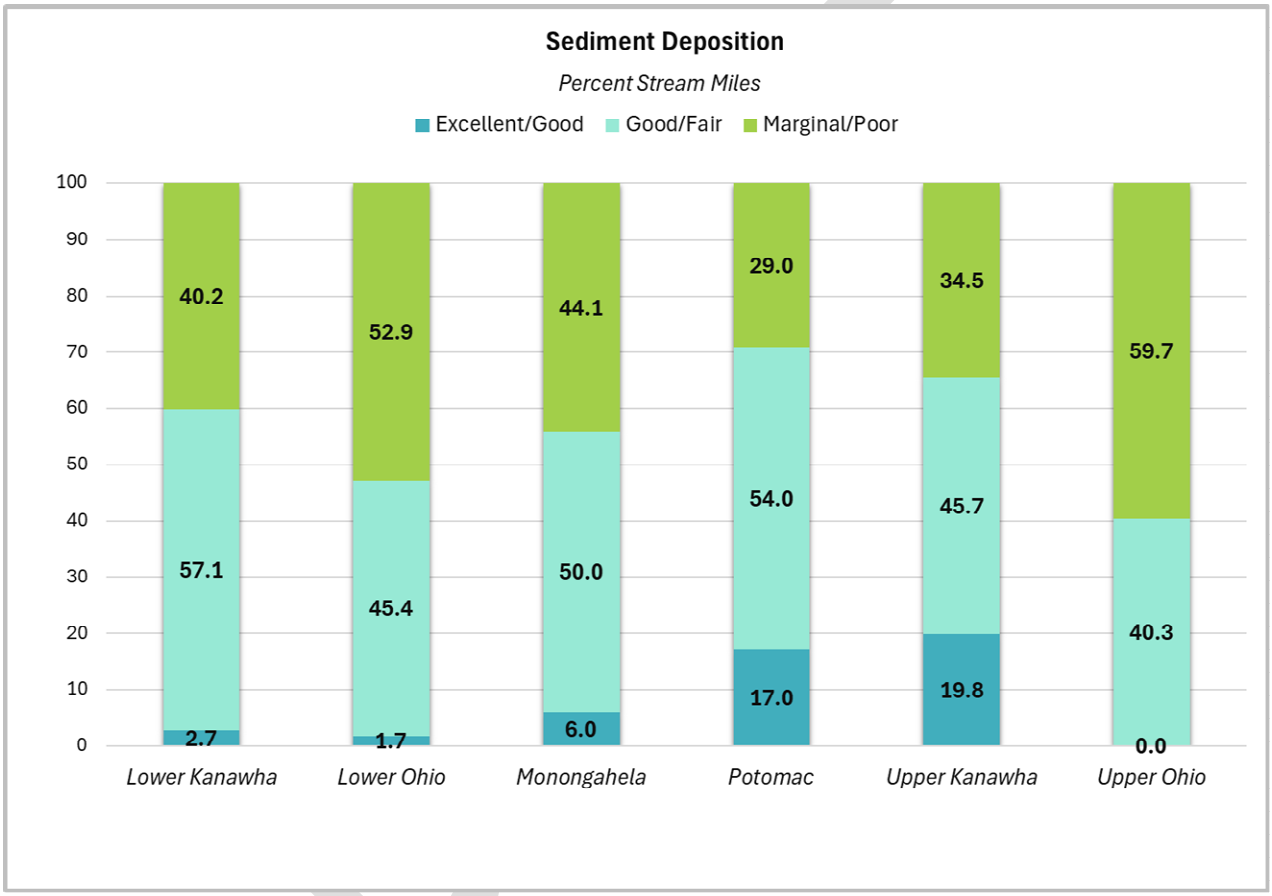


Figure 2-19: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Stream Deposition in each Basin.

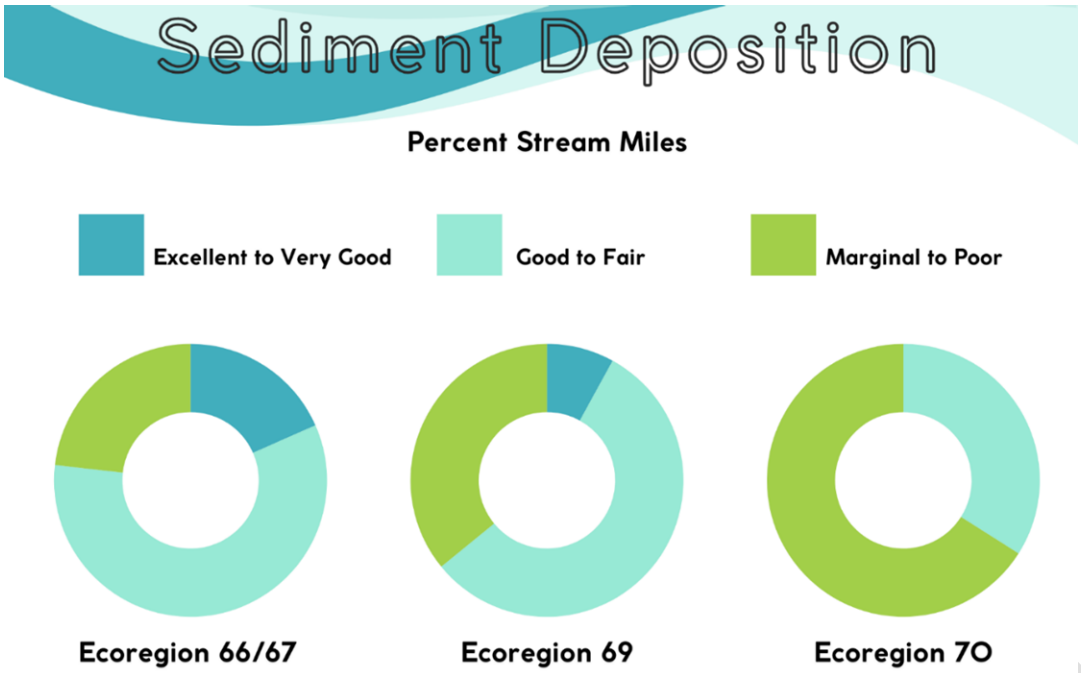
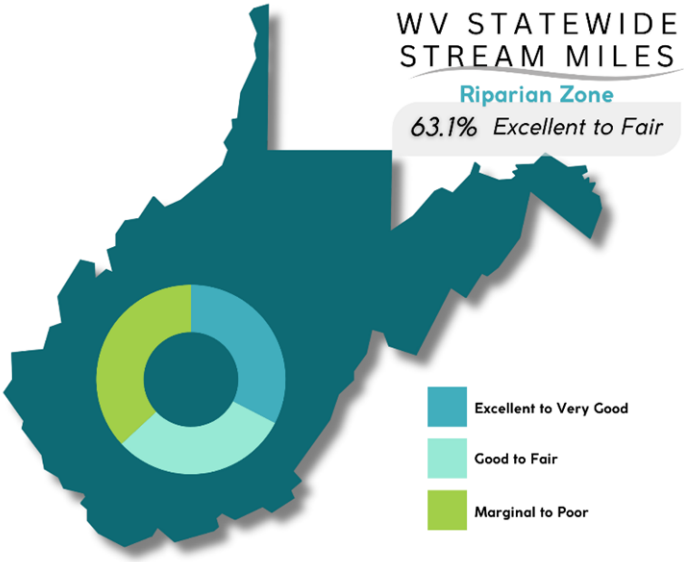


Figure 2-20: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Stream Deposition in each Ecoregion.

Riparian Vegetative Zone Width



This indicator rates streamside (or riparian) zones on the amount (width and quality) of undisturbed vegetation present. Undisturbed riparian zones are desirable as they provide shade (which prevents the water temperature from rising), create a more stable stream bank, and minimize the amount of sediment, excess nutrients, and other pollutants entering the stream. Wide, vegetated Riparian zones can also help reduce floodwater velocity. The most desirable situation is for streamside riparian zones to have large native trees in the canopy, smaller native trees and shrubs in the understory, and native herbs/grasses with leaf litter for ground cover. Examples of poor-quality riparian zones are well manicured lawns mowed to the water's edge, barren or unvegetated soil, and paved surfaces (e.g., parking lots or roads) with no trees or shrubs.

The Riparian Vegetative Zone Width was assessed at probabilistic sites using the component VBHA parameter. The scoring for this parameter ranges from 0-20. Sites with scores ranging from 16-20 are considered Excellent to Very Good, 11-15 are Good to Fair, and 0-10 are Marginal to Poor. Statewide, 32.6% of stream miles have Excellent to Very Good riparian vegetative zones, 30.5% have Good to Fair

Riparian zones, and 36.9% have Marginal to Poor riparian zones. The Upper Kanawha basin has the most intact riparian zones with 58.8% of stream miles Excellent to Very Good and only 14.6% Marginal to Poor (Figure 2-21). The Potomac basin has the second fewest stream miles (27.7%) in Marginal to Poor condition and has the second highest percent (42.7%) in Excellent to Very Good condition. The Upper Ohio basin has the least intact riparian zones overall with 12.5% of stream miles Excellent to Very Good and 59.6% Marginal to Poor.

The Ridge and Valley and Central Appalachians had similar percentages of stream miles in Excellent to Very Good (44.1% and 45.3%) and Marginal to Poor (26.6% and 22.8%) conditions (Figure 2-22). However, the Western Allegheny Plateau did not perform as well as the other two ecoregions with only 12.5% of stream miles rated as Excellent to Very Good and 58% rated as Marginal to Poor. As stated above, the Western Allegheny Plateau has a higher population density and lower percentage of publicly owned land than the mountainous Central Appalachian and Ridge and Valley ecoregions. These two factors help explain the differences in Riparian Vegetative Zone Width between the ecoregions.

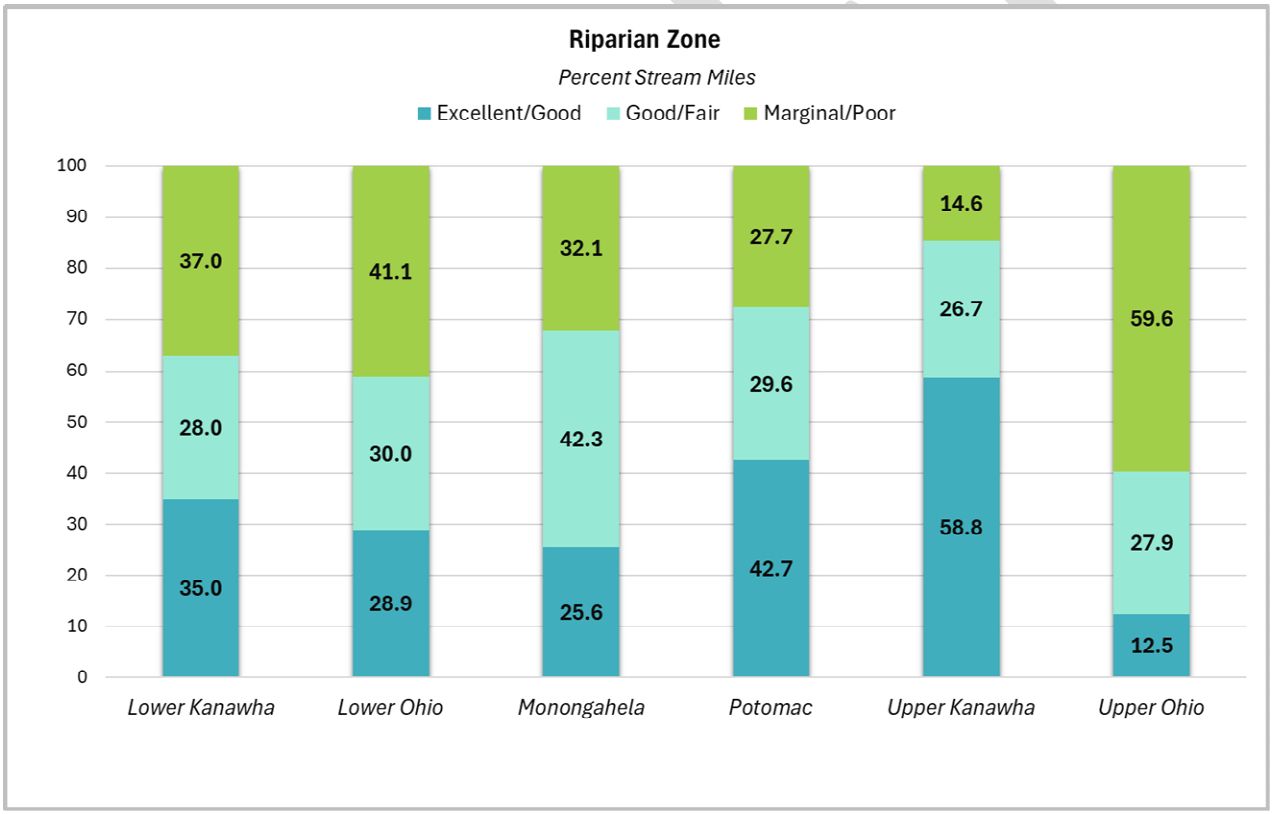


Figure 2-21: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Riparian Zone in each Basin.

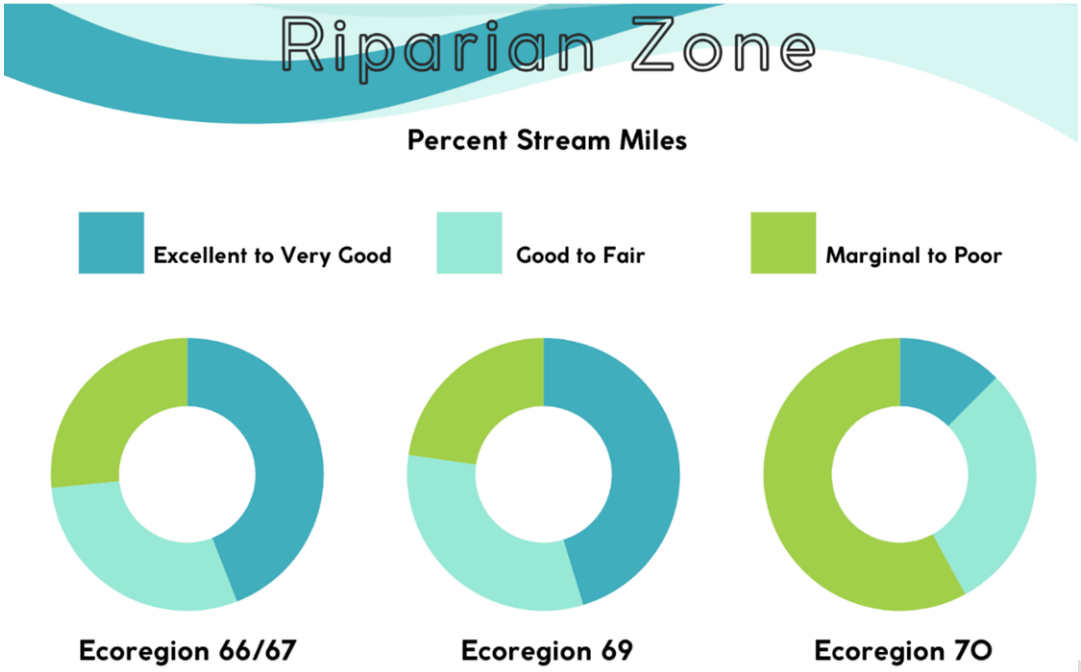
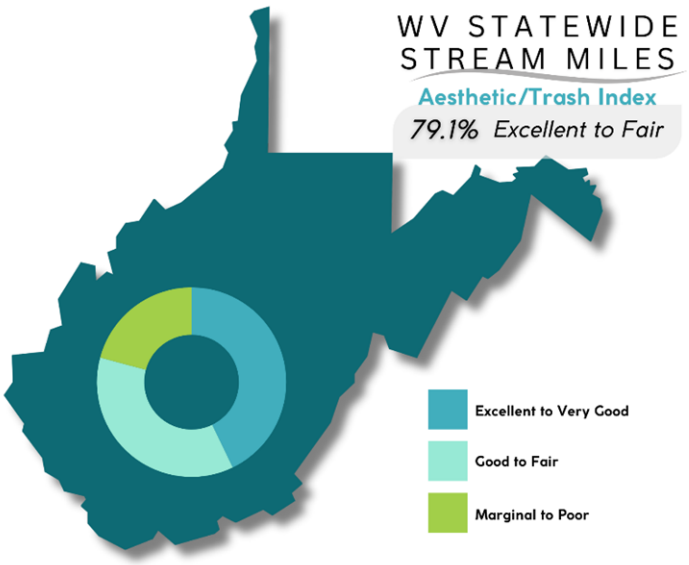


Figure 2-22: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Riparian Zone in each Ecoregion.

Aesthetic/ Trash Index



The "Aesthetic/Trash Index" is a measure of the amount of human refuse or "trash" that is in and around the stream including that which could be washed into the stream at high flows. Trashy conditions in streams can have negative impacts on recreation, tourism, and the economy. When it accumulates in or near a community, it may create health and safety risks for those living there. While it is primarily used as a measure of the aesthetic condition of a stream site, trash pollution can cause damage to aquatic habitats by smothering them and by reducing living spaces, for example. Other trash items have the potential to release pollutants that are toxic to aquatic life.

The Aesthetic/Trash Index was developed by WVDEP as a supplement to the ten standard VBHA habitat parameters. The scoring for this parameter ranges from 0-20, with lower scores indicating more trash present in the stream. Sites with scores ranging from 16-20 are considered Excellent to Very Good, 11-15 are Good to Fair, and 0-10 are Marginal to Poor.

Based on probabilistic data, 42.8% of stream miles statewide have little to no trash in them and are in Excellent to Very Good condition, 36.3% are Good to Fair, and 20.8% are Marginal to Poor. The Upper Kanawha basin has the least trashy conditions with 71.0% of stream miles Excellent to Very Good and only 9.6% Marginal to Poor (Figure 2-23). The Potomac basin was also relatively clean in terms of trash abundance with 60.2% of stream miles rated Excellent to Very Good and only 7.5% rated Marginal to Poor. Trash was most abundant in streams of the Lower Ohio basin with 46.3% of stream miles rated Marginal to Poor and only 27.6% Excellent to Very Good.

The Ridge and Valley had the highest percentage of stream miles rated Excellent to Very Good (61.9%) and lowest percentage rated Marginal to Poor (6.3%) (Figure 2-24). The Central Appalachians had the most stream miles rated as Marginal to Poor (25.7%) followed by the Western Allegheny Plateau (22.8%). The Western Allegheny Plateau also had the lowest percentage of stream miles in the Excellent to Very Good condition (25.4%).

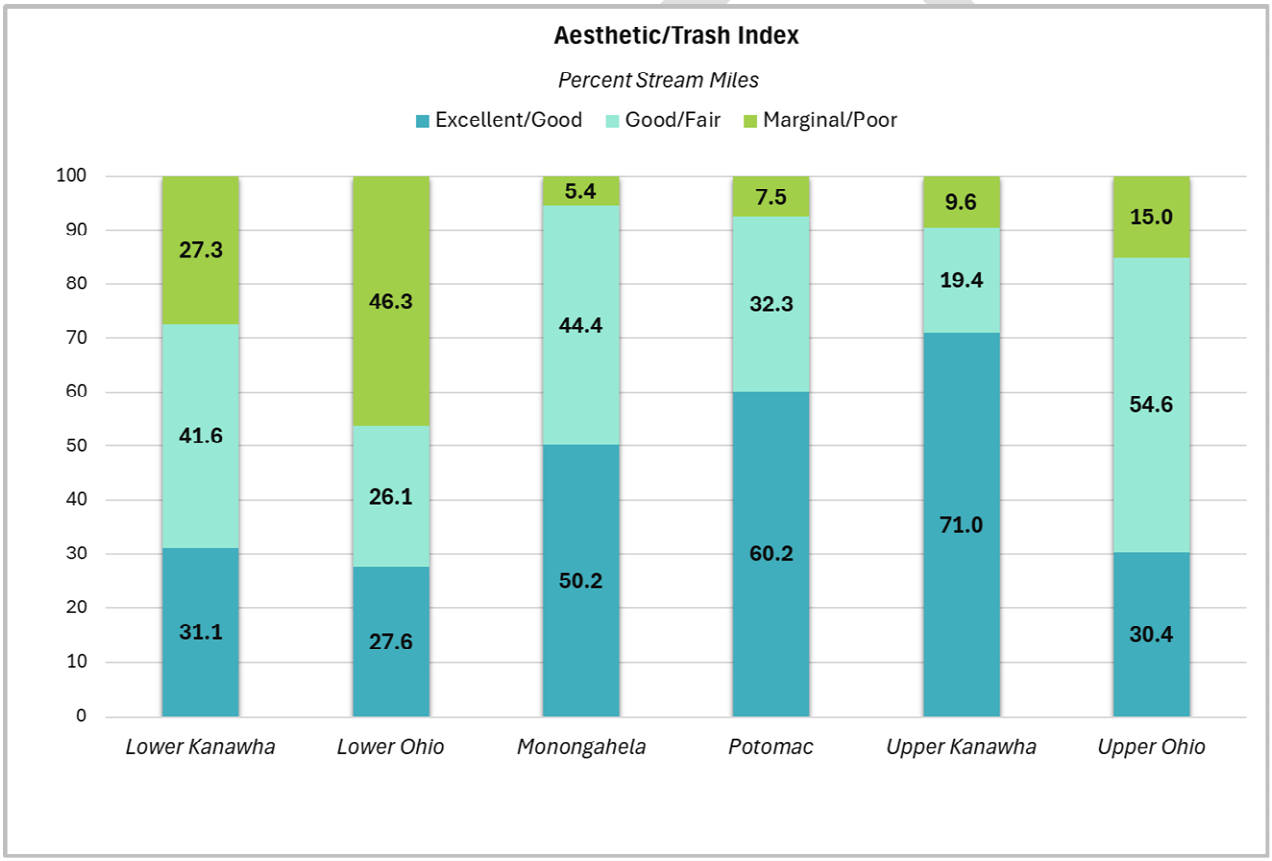


Figure 2-23: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Aesthetic/Trash Index in each Basin.

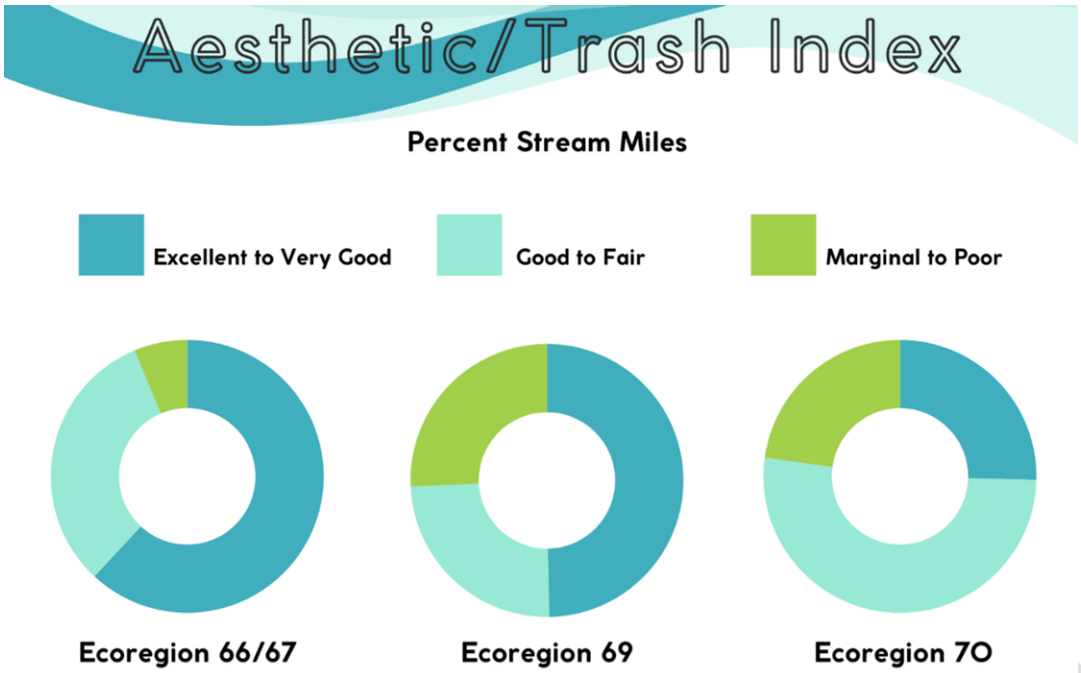


Figure 2-24: Percentage of stream miles that are excellent/good, good/fair and marginal/poor for Aesthetic/Trash Index in each Ecoregion.

2.3 Probabilistic Conclusions

To summarize, according to Probabilistic data results, the majority of West Virginia streams can be categorized from fair to excellent condition for biological, chemical, and habitat indicators. A review of all indicators in the Probabilistic analysis statewide, found that water quality is impacted by marginal to poor habitat conditions due to erosion/sedimentation and disturbed riparian areas. The biological, chemical and habitat indicators provided in this summary are a small subset of the parameters that are monitored and analysed.

Specific pollutants have significant localized impacts in certain basins and streams. Results signalling stream impairments often helps inform planning for other monitoring programs, such as plans for pre-TMDL monitoring. It is during pre-TMDL monitoring stage, that an adequate dataset is collected on which to make final attainment determination. The following section discusses water quality standards and how they are applied to assess impairment or attainment of state waters. Section 3.0-5.0 and appendices provides details on how attainment of water quality standards is assessed. Results of the assessment process are summarized in Section 5.0 of this Integrated Report and detailed in Supplemental Tables.

3.0 WATER QUALITY STANDARDS

Water quality standards are the basis of the assessment process. In West Virginia, the water quality standards are codified as 47CSR2 – Legislative Rules of the Department of Environmental Protection – Requirements Governing Water Quality Standards. Impairment assessments conducted for the Integrated Report are based only upon water quality standards that have received the EPA's approval and are currently considered effective for Clean Water Act purposes. Standards are expressed as numerical or narrative criteria. Information regarding the Water Quality Standards can be found at:

http://www.dep.wv.gov/WWE/Programs/wqs/Pages/default.aspx.

ATTAINS uses the term "parameter" to refer to different criteria for which data are collected and assessed. When assessing parameters, WVDEP determines if a parameter is the cause of impairment for a water body or whether the parameter data meets water quality standards. In instances where too few data are available, it may not be possible to determine if a certain parameter is causing impairment or is attaining water quality standards. In those instances, WVDEP reports there were insufficient data to assess. If no data are available, a parameter will be reported as unassessed.

Every waterbody is assigned designated uses, described in detail beginning in Section 6.2 of 47CSR2 and summarized in Table 3-1. Each designated use has associated water quality criteria describing specific conditions required to ensure the waterbody can support that use. For example, Category B1 – Warm Water Fishery Use requires pH remain within the range of 6.0 to 9.0 standard units. If water quality monitoring finds that the pH is below 6 or above 9, the waterbody is considered impaired, because it is not supporting its designated use. Appendix C- Use Assessment Procedure provides more information on use attainment determination.

Table 3-1: West Virginia Water Use Designations Applicable for Assessment Period

Category	Use Subcategory	Use Category	Description
A	Public Water	Human Health	Waters, after conventional treatment, used for human consumption.
B1	Warm Water Fishery	Aquatic Life	Propagation and maintenance of fish and other aquatic life in streams or stream segments which contain populations composed of all warm water aquatic life.
B2	Trout Waters	Aquatic Life	Propagation and maintenance of fish and other aquatic life in waters which sustain year-round trout populations. Excluded are those waters which receive annual stockings of trout, but which do not support year-round trout populations.
B3	Limited AQL	Aquatic Life	Promulgated in the 2025 Legislative Session, this category would contain waters where an approved Use Attainability Assessment has determined the aquatic life designated use has not been met on or after November 28, 1975. No waters are classified as B3 for the 2024 Integrated Report assessments.

Category	Use Subcategory	Use Category	Description
B4	Wetlands	Aquatic Life	Propagation and maintenance of fish and other aquatic life in wetlands, which generally include swamps, marshes, bogs, and similar areas.
C1	Water Contact Recreation	Human Health	Swimming, fishing, water skiing, and certain types of pleasure boating, such as sailing in very small craft and outboard motorboats. In ATTAINS, Category C is split into subcategories: Water Contact Recreation - Recreation and Water Contact Recreation - Fish Consumption. The Fish Consumption subcategory applies specifically to those waters for which the State has published advisories limiting consumption, described in Section 5.7. This distinction is needed to inform How's My Waterway. The Fish Consumption subcategory is applied to all waters in the state in this reporting cycle.
C2	Limited Water Contact Recreation	Human Health	Promulgated in the 2025 Legislative Session, this category would contain waters where an approved Use Attainability Assessment has determined the contact recreation designated use has not been met on or after November 28, 1975. No waters are classified as C2 for the 2024 Integrated Report assessments.
D1	Irrigation	All Other	All stream segments used for irrigation.
D2	Livestock Watering	All Other	All stream segments used for livestock watering
D3	Wildlife	All Other	All stream segments and wetlands used by wildlife.
E1	Water Transport	All Other	All stream segments modified for water transport and having permanently maintained navigation aids.
E2	Cooling Water	All Other	All stream segments having one or more users for industrial cooling.
E3	Power Production	All Other	All stream segments extending from a point 500 feet upstream from the intake to a point one-half mile below the wastewater discharge point.
E4	Industrial	All Other	All stream segments with one or more industrial users; Does not include water for cooling.

Numeric water quality criteria consist of a concentration value, exposure duration and an allowable exceedance frequency. The water quality standards prescribe numeric criteria for all designated uses. For the B1, B4, and B2 Aquatic Life uses, there can be two forms of criteria for each parameter: an acute criterion that prevents lethality, and chronic criterion that prevents retardation of growth and reproduction. The numeric criteria for acute aquatic life protection are specified as one-hour average concentrations not to be exceeded more than once in a three-year period. The criteria for chronic aquatic life protection are specified as four-day average concentrations not to be exceeded more than once in a three-year period. The exposure time criterion for human health protection (i.e., Category Uses A and C) is specified as an annual geometric mean and there are no allowable exceedances.

Narrative water quality criteria are also referred to as conditions not allowable (CNA). For example, the water quality standards contain a provision stating that wastes present in any waters of the state, shall not adversely alter the integrity of the waters or cause significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems. WVDEP has a protocol to determine if waters exhibit conditions not allowable for the biological component (CNA-biology), which relies upon index of biological integrity for benthic macroinvertebrates. In 2024, the Aquatic Life Criteria Attainment Threshold was developed based on genus-level data. ALCAT is further described in a technical memorandum (Appendix B).

Ohio River Criteria

For the Ohio River, both Ohio River Valley Water Sanitation Commission (ORSANCO) and West Virginia water quality criteria were considered, as agreed upon in the ORSANCO Compact. Where both ORSANCO and West Virginia standards contain a criterion for a particular parameter, instream values were compared against the more stringent criterion. WVDEP supports ORSANCO's efforts to promote consistent decisions by the various jurisdictions with authority to develop 305(b) reports for the Ohio River. In support of those efforts, West Virginia has, and will continue to, work with ORSANCO and the other member states through a workgroup charged with improving consistency of 305(b) reporting among compact states. ORSANCO standards may be reviewed at:

http://www.orsanco.org/programs/pollution-control-standards/

4.0 DATA

In addition to data collected by the WQSAS-Monitoring Unit, the agency considered data from external sources for assessment. The agency considered data submitted in permittee discharge monitoring reports for instream monitoring locations. The agency sought water quality information from various state and federal agencies, including other WVDEP programs. Additionally, news releases and public notices requesting data submissions were published on WVDEP Water and Waste Management's website.

WVDEP has developed guidance for those wishing to submit data to be assessed for 303(d) list development, including requirements for data assembly and submission, along with helpful internet links and a checklist for data submitters. The guidance is available at:

https://dep.wv.gov/WWE/watershed/IR/Documents/3rdPartyQAGuidelines.pdf

Beyond requesting data from partners, WVDEP also obtained data from the USEPA Water Quality Portal, the West Virginia Save Our Streams Volunteer Assessment Database, and USGS Continuous Data via the 'dataRetrieval' package in R Statistical analysis software for use in assessments. Data collected from July 1, 2017 through June 30, 2022 were downloaded from these sources. Data were examined to identify those for which water quality criteria exist. Stations data were mapped

geospatially to associate the data with appropriate assessment units. Entities that provided information in response to the agency's request for data for the 2024 Section 303(d) list, agencies whose data were obtained only from the Water Quality Portal (i.e., having a WQX prefix), or agencies whose data were obtained only from the West Virginia Save Our Streams Volunteer Assessment Database (i.e., having a WVSOS prefix) are shown in Table 4-1.

Table 4-1: Data contributors for the 2024 303(d)/305(b) Lists and Integrated Report

Data Contributors	
Blue Ridge Watershed Coalition	Coal River Group
Friends of Cheat	Friends of Deckers Creek
National Park Service	US Army Corps of Engineers
US Forest Service	US Geological Survey
West Virginia Conservation Agency	West Virginia Rivers Coalition
WV Department of Agriculture	WV Water Research Institute
WQX-Adventure Scientists (Volunteer)	WQX-Chesapeake Bay Program
WQX-Division of Surface water (Ohio)	WQX-EPA National Aquatic Resources Survey (NARS)
WQX-Izzak Walton League of America	WQX-State of KY
WQX-Maryland Department of Natural Resources	WQX-New River Conservancy (Volunteer)
WQX-Ohio River Valley Water Sanitation Commission (ORSANCO)	WQX-PA Department of Environmental Protection
WQX-USEPA	WQX-Virginia Department of Environmental Quality
WQX-Watershed Improvement Branch	WVSOS-Blue Ridge Career and Technical Center
WVSOS-Camp Waldo	WVSOS-Canaan Valley Institute and Rubenstein Center
WVSOS-Elkins Middle School	WVSOS-Envirothon
WVSOS-Experience Learning	WVSOS-Friends of Cacapon
WVSOS-Friends of the Lower Greenbrier	WVSOS-Harmon School
WVSOS-Huntington High School	WVSOS-Hurricane Middle School
WVSOS-Individual Volunteers	WVSOS-Musselman High School
WVSOS-Piney Creek Watershed Association	WVSOS-Preston High School AP Envs
WVSOS-RC Byrd High School	WVSOS-Sleepy Creek Watershed Association
WVSOS-Trout Unlimited Ernie Nester Chapter	WVSOS-Warm Springs Run Watershed Association
WVSOS-WV Science Teachers	Permittees – discharge monitoring reports submitted to WVDEP for mining permit compliance

All readily available data were considered during the evaluation process. WVDEP's staff reviewed data from external sources to confirm collection methods, analytical methods, detection levels, quality assurance and quality control were consistent with approved procedures. In select instances, when contributors reported pH results collected using litmus paper opposed to a calibrated probe, pH data were excluded. In cases where the third-party data was greater than 1000% different from all currently available WAB observed data for that parameter that third party data were excluded from analysis, that data was not used in the assessment.

See Appendix C to learn the specifics of how all data were assessed.

5.0 ASSESSMENT RESULTS

Waters are placed in one of the five Overall Integrated Report Categories (IR Category) based on how well they support their designated uses. Table 5-1 provides descriptions of each Overall IR Category. For more information about each category and how waters are placed in each category refer to Appendix C- Use Assessment Procedures.

Table 5-1: Overall IR Categories for West Virginia Waters

Category		Description
Category 1		Waters fully supporting all designated uses. Requisite data to assess all uses are infeasible to attain statewide. See Appendix C for more details.
Category 2		Waters fully supporting some designated uses, but insufficient or no information exists to assess the other designated uses
Category 3		Waters where insufficient or no information exists to determine if any of the uses are being met
Category 4		Waters impaired or threatened but do not need a total maximum daily load (TMDL)
	4A	Waters that already have an approved TMDL but are still not meeting standards
	4B	Waters that have other control mechanisms in place which are reasonably expected to return the water to meeting designated uses
	4C	Waters determined to be impaired, but not by a pollutant (e.g., low flow alteration)
Category 5		Waters assessed as impaired and are expected to need a TMDL

The following section describes the results of the assessments completed for stream and lake assessment units. The results of assessments have been uploaded into ATTAINS. The quantification of miles or acres of water bodies, figures, and tables are those reported directly from ATTAINS. Data results are organized at three levels: Overall IR Category (how well does a waterbody support its uses), Designated Use (how well is each designated use support in the State), and Parameter. Each level provides scenarios of attainment, impairment, and insufficient information. Assessment results have also been included in the Integrated Report web-based interactive tool.

Individual assessment unit results are also provided in spreadsheets. The first is titled 2024_303(d)List and provides the 303(d) listings for the 2024 assessment cycle. An introductory tab provides a description of the data included in the workbook's individual sheets or "tabs". For example, one tab is called "303d List-Category 5". This is where the user can find the current 303d listed streams.

A second workbook is titled IR Category Designated Use. This workbook provides the overall IR Category for each assessment unit, as well as details on whether an assessment unit supports each of its designated uses.

Both workbooks can be downloaded as "Supplemental Tables" from the following website: https://dep.wv.gov/wwe/watershed/ir/pages/303d_305b.aspx.

As noted previously, this report refers to a corresponding interactive web-based tool. The amount of data shown on a map of the entire state can be overwhelming. There are many small unassessed

streams and lakes. The interactive web-based tool provides a layer of unassessed streams and a layer of unassessed lakes that can be viewed or turned off to allow the user to focus on those waterbodies that have been monitored and assessed. Layers of assessed streams and lakes display information regarding designated use attainment and parameter impairment. The interactive web-based tool can be accessed at the website:

https://dep.wv.gov/wwe/watershed/ir/pages/303d_305b.aspx

5.1 IR Category Results

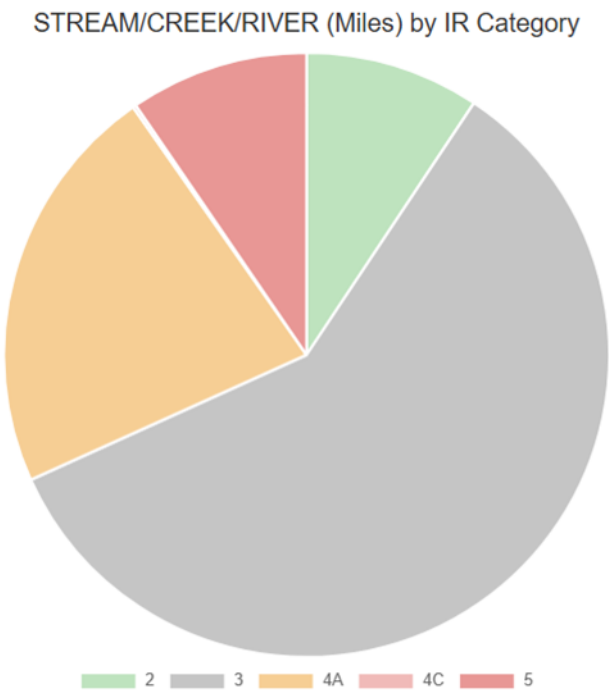
5.1.1 Streams

Table 5-2 shows a summary of the classification of West Virginia stream miles by the five IR Categories. Table 5-2 also includes the percentage of miles for each IR Category. Nearly fifty-nine percent (58.9%) of stream miles are unassessed. The streams with limited or no data are typically small unnamed tributaries, which usually contribute to larger waterbodies which have been assessed. All major rivers in the state have been assessed and placed into categories. Figure 5-1 provides a pie chart to visualize the assignment of IR Categories for streams.

Table 5-2: 2024 Category Summary for West Virginia Stream Miles.

Overall Category	Category Description	Miles	% Miles
2	Fully Supporting Some Uses	5,008	9.3
3	Insufficient Data/ Unassessed	31,655	58.9
4A	Not Supporting w/TMDL	11,881	22.1
4C	Not Supporting/not caused by a pollutant	92	0.2
5	Not Supporting needs TMDL	5,111	9.5
TOTALS		53,747	

Category 5 includes approximately 5,111 stream miles that are impaired and need TMDLs developed. The number and length of impaired streams varies from one list year to the next due, in part, to the TMDL development timeline. TMDLs are always in various stages of development and, with the additional sampling data generated, streams and stream segments may move from Categories 1, 2 or 3 to Category 5. Additionally, TMDLs that have not yet been approved by the EPA remain listed in Category 5. Once these TMDLs are approved for all impaired parameters, those assessment units will move to Category 4A. Section 7 .0 TMDL Development Process provides more information.



Note: So few miles are categorized in 4C that the portion is not visible.

Figure 5-1: Stream miles broken out into overall IR Categories

5.1.2 Lakes

As with streams, many lake assessment units have not been monitored or assessed directly. The State's largest lakes have been assessed, resulting in only 41.2% of the total lake acreage categorized as unassessed or having insufficient information. See Table 5-3 for acreage placed in each IR Category. Figure 5-2 provides a pie chart to visualize the assignment of IR Categories for lakes.

Table 5-3: 2024 Category Summary for West Virginia Lake Assessment Units (AUs)

Overall Category	Acres	% Acres
2	3,335	13.4
3	10,675	42.9
4A	95	0.4
5	10,759	43.3
TOTALS	24,864	

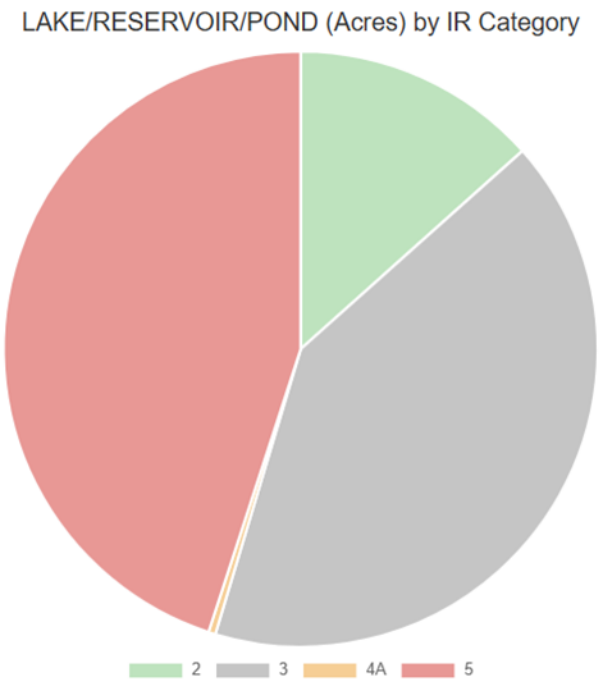


Figure 5-2: Lake areas broken out into overall IR Categories

5.2 Use Support Results

The IR Category placement provides an overall status of attainment or impairment of a waterbody. The overall status is derived from the collective attainment statuses for each designated use. If any use is not supported, the entire waterbody will be placed in IR Category 4 or IR Category 5. Table 5-4 summarizes the miles of streams that are not supporting each designated use, fully supporting each designated use, or have insufficient data or no data to assess. Tables 5-5 summarize the lake acreage by use. WVDEP has prepared a workbook called *IR Category Designated Use* to provide the Overall IR Category for every assessment unit, as well as use attainment status for every designated use. The workbook can be assessed at the following site and found under the 2024 Cycle Year tab:

https://dep.wv.gov/wwe/watershed/ir/pages/303d_305b.aspx

Table 5-4: Designated use support summary for West Virginia streams

Designated Use	Not Supporting	Insufficient Information	Not Assessed	Fully Supporting	Total
	miles	miles	miles	miles	miles
A-Public Water Supply	12,604	7,955	29,482	3,704	53,745
B1- Warm Water Fishery	12,960	3,450	29,449	3,540	49,400
B2- Trout Waters	1,512	701	471	1,662	4,347
C-Water Contact Recreation: Recreation	12,459	5,483	31,450	4,356	53,747
C-Water Contact Recreation: Fish Consumption	530	79	53,137	0	53,747
D-Agriculture and Wildlife	1,745	7,561	31,534	12,907	53,747
E- Water Supply Industrial, Water Transport, Cooling and Power	1,745	7,561	31,534	12,907	53,747

Table 5-5: Designated use support summary for West Virginia lakes

Designated Use	Not Supporting	Insufficient Information	Not Assessed	Fully Supporting	Total
	acres	acres	acres	acres	acres
A-Public Water Supply	9,555	7,672	4,323	3,314	24,864
B1- Warm Water Fishery	2,513	10,268	5,842	0	18,624
B2- Trout Waters	31	3,529	2,680	0	6,240
C-Water Contact Recreation: Recreation	1,681	11,320	8,544	3,319	24,864
C-Water Contact Recreation: Fish Consumption	9,936	0	14,927	0	24,864
D-Agriculture and Wildlife	2	11,878	4,286	8,698	24,864
E- Water Supply Industrial, Water Transport, Cooling and Power	2	11,878	4,286	8,698	24,864

5.3 Causes for Impairment

The information in Tables 5-6 and 5-7 provides an overview of the miles or acres of water bodies attaining or impaired for specific water quality criteria. The stream lengths and lake areas only account for those specifically assessed for each parameter. Unassessed streams for each parameter is excluded.

Table 5-6: The assessment results by parameters for West Virginia streams shown in miles (excludes "unassessed" waters for which no data existed).

Parameter	Impairment Cause (miles)	Meeting Criteria (miles)	Insufficient Information (miles)	Total Assessed (miles)
Iron	10,870	5,641	1,800	18,311
Fecal Coliform	11,475	1,778	1,199	14,452
Benthic Macroinvertebrates Bioassessments	7,383	6,056	139	13,579
pH	1,139	9,001	3,324	13,464
Aluminum, Dissolved	1,104	5,843	3,005	9,953
Dissolved Oxygen	166	5,220	3,976	9,362
Selenium	736	2,978	3,901	7,614
Chloride	42	2,707	4,753	7,501
Barium	0	628	3,666	4,294
Zinc, Dissolved	0	1,035	3,093	4,128
Beryllium	25	561	3,493	4,079
Lead, Dissolved	0	857	3,166	4,023
Arsenic	0	1,142	2,399	3,541
Nickel, Dissolved	0	650	2,334	2,984
Silver, Dissolved	0	464	2,318	2,782
Cadmium, Dissolved	0	406	2,344	2,750
Manganese	35	974	744	1,752
Ammonia	0	579	203	782
Nitrate	0	6	561	566
Lead	5	284	251	540
Nickel	0	258	251	508
Algae	75	418	0	493
PCBs In Fish Tissue	441	0	0	441
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	360	70	0	430
Mercury	0	329	63	391
Antimony	0	70	266	336
Copper	1	248	81	330
Copper, Dissolved	0	185	96	281
Fluoride	0	0	189	189

Parameter	Impairment Cause (miles)	Meeting Criteria (miles)	Insufficient Information (miles)	Total Assessed (miles)
Phenol	0	0	144	144
Thallium	0	80	63	143
Zinc	0	139	0	139
Dioxin In Fish Tissue	66	61	0	127
Silver	0	74	40	115
Methylmercury In Fish Tissue	84	0	0	84
Aluminum, Total	64	0	0	64
Flow Regime Modification	62	0	0	62
Buried Stream	55	0	0	55
Fluoranthene	0	0	13	13
Benzo[A]Pyrene	0	0	13	13
Anthracene	0	0	13	13
Benz[A]Anthracene	0	0	13	13
Chrysene	0	0	13	13
Pyrene	0	0	13	13
Fluorene	0	0	13	13
Temperature	7	0	0	7
Chromium, Hexavalent, Dissolved	0	0.4	0	0.4
Chlorine, Total Residual (TRC)	0	0.4	0	0.4

Table 5-7: The assessment results by parameters for West Virginia lakes shown in acres (excludes "unassessed" waters for which no data existed).

Parameter	Impairment Cause (acres)	Meeting Criteria (acres)	Insufficient Information (acres)	Total Assessed (acres)
pH	0	0	11,058	11,058
Dissolved Oxygen	2	0	11,019	11,022
Methylmercury In Fish Tissue	9,393	0	0	9,393
Iron	60	47	9,253	9,360
Chlorophyll-A	706	8,243	0	8,949
Phosphorus	1,885	6,415	424	8,724
Chloride	0	0	7,902	7,902
Beryllium	0	0	7,597	7,597
Aluminum, Dissolved	0	0	7,597	7,597
Barium	0	0	7,558	7,558
Selenium	0	0	7,390	7,390
Zinc, Dissolved	0	0	6,633	6,633
Fecal Coliform	0	2,280	3,668	5,948
Lead, Dissolved	0	0	4,482	4,482
Arsenic	0	0	3,891	3,891
Nickel, Dissolved	0	0	3,616	3,616

Parameter	Impairment Cause (acres)	Meeting Criteria (acres)	Insufficient Information (acres)	Total Assessed (acres)
Silver, Dissolved	0	0	3,616	3,616
Cadmium, Dissolved	0	0	3,616	3,616
PCBs In Fish Tissue	543	0	0	543
Nickel	0	0	275	275
Silver	0	0	242	242
Sedimentation/Siltation	162	0	0	162
Trophic State Index (TSI)	81	0	0	81
Fluoride	0	0	33	33

5.4 Streams and Lakes Delisted from 2022 Draft to 2024 Summary

The term delisted means that a waterbody has moved from the EPA IR Category 5 to any other category. A waterbody can be delisted for any single parameter, multiple parameters, and multiple reasons. Tables 5-8 and 5-9 show the delisted lake acres and stream miles from the draft combined 2018/2020/2022 list to this 2024 list. Beech Fork Lake (station a) was delisted for Phosphorus based on new data meeting the water quality standard. Castleman Run Lake was delisted for Chlorophyll-A based on new data meeting the water quality standard. The most stream mileage delistings were for iron, then Benthic Macroinvertebrate Bioassessments (CNA-Biology), then Fecal Coliform bacteria.

Table 5-8: 2024 Lake acres and stream miles that have been delisted by parameter.

Parameter	Acres	Miles
Aluminum, Dissolved		230.18
Benthic Macroinvertebrates Bioassessments		1,724.90
Beryllium		5.3
Chloride		18.12
Chlorophyll-A	18.7	
Dissolved Oxygen		16.54
Fecal Coliform		1,532.61
Iron		2,193.90
Manganese		2.53
pH		229.46
Phosphorus	927.47	
Selenium		69.3
Grand Total	946.17	6,022.84

The most common delisting reason is due to new stream data meets the applicable water quality standard. A stream now meeting water quality standards could be from many reasons or a combination of these: Best Management Practices (BMPs) have been implemented and are performing effectively, permitted discharges have come into compliance with their TMDL issued load, the newer data could have been sampled during or after more optimal flow regimes than the

original listing data, or a previously active land disturbance is now inactive or reclaimed. The next most common reason for delisting is that a TMDL was completed for that stream. This means the stream moved from EPA Category 5 (Impaired and needs a TMDL) to Category 4A (Impaired with a TMDL), which means the stream is still impaired, but now has a TMDL plan in place to help guide the streams' recovery.

Table 5-9: 2024 Lake acres and stream miles that have been delisted by reason.

Parameter	Acres	Miles
Delisted due to TMDL Completed		1,976.92
Basis for Original Listing Was Incorrect	424.17	0.19
Refinement of the AUID		70.51
Water Quality Standard Attained According to New Assessment Method		913.47
Water Quality Standard Attained Based on New Data	522	3,061.75
Grand Total	946.17	6,022.84

5.4.1 Filamentous Algae Resulting in Delisting

Advanced nutrient removal technology was installed on several wastewater treatment plants (WWTPs) discharging to the South Branch of the Potomac River and the Greenbrier River after these streams were first listed for filamentous algae impairment in 2010. WVDEP has monitored in-stream water quality and levels of filamentous algae growth since the installation of the nutrient removal units. Following the upgrades, reductions in filamentous algae biomass occurred quickly, due to reductions in phosphorous loading from the treatment plants.

The following graph (Figure 5-3) compares the percent of the Greenbrier River covered by filamentous algae, before and after the treatment plant upgrades, during peak growing season in years with a similar flow rate in the river. Treatment plant effluent phosphorous loadings were reduced by more than 80%, and this resulted in an 85% reduction in the surface acres of the river covered by filamentous algae.

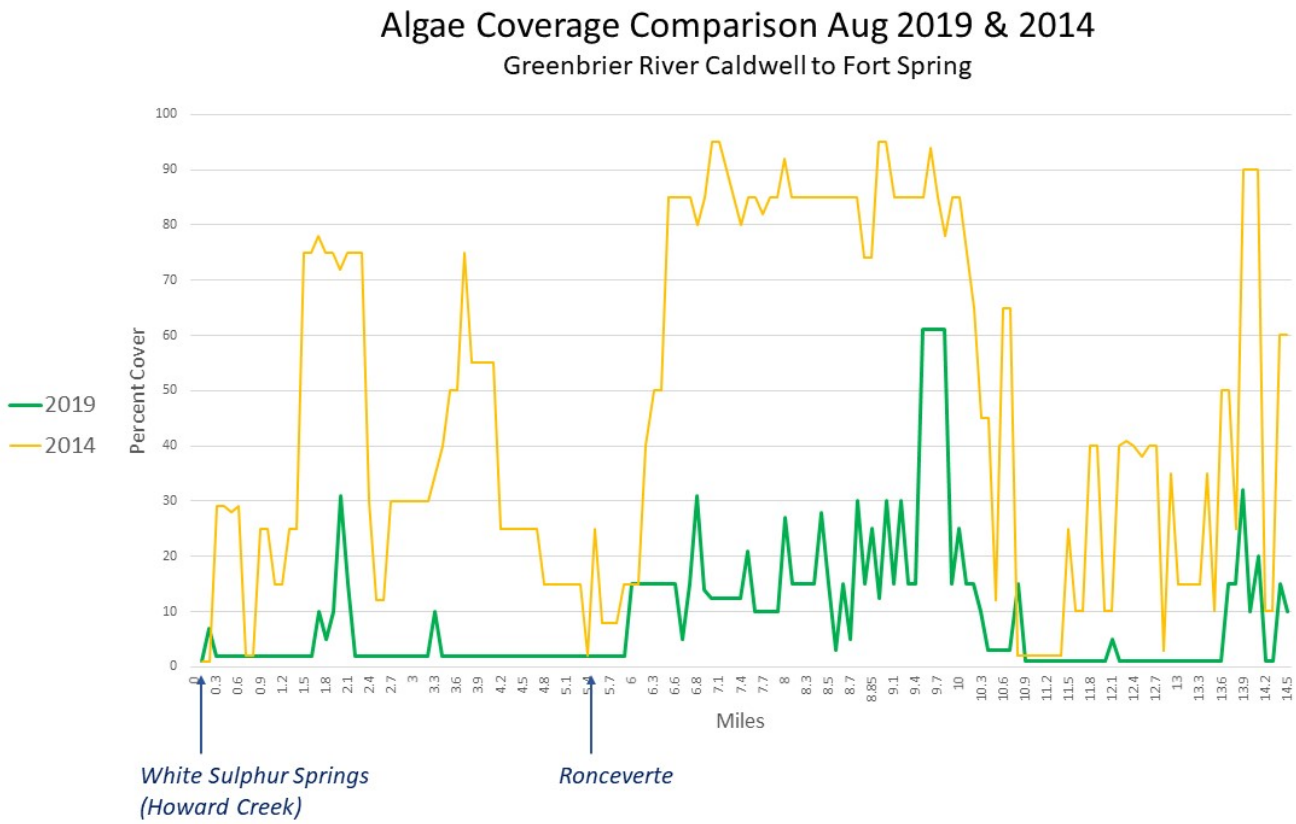


Figure 5-3: Observed filamentous algae coverage in the Greenbrier River

WVDEP's observation and measurement of filamentous algae growth, and its monitoring of taste and odor complaints in drinking water, have resulted in the removal of the South Branch of the Potomac River and portions of the Greenbrier River from the 303(d) list. The photos (below) contrast the filamentous algae coverage in the South Branch and Greenbrier Rivers.

South Branch of Potomac at public access for the famed "Trough" section (2009)

South Branch of Potomac at the "Trough" public access after the Moorefield Regional WWTP installation (2019)

Greenbrier River at Fort Spring (2008)

Greenbrier River at Fort Spring following WWTP upgrades at White Sulphur Springs and Ronceverte (2019)

All previously impacted portions of the Greenbrier River have improved significantly since the WWTP upgrades, but a three-mile section of river below one of the wastewater treatment plants exhibited algal growth above the listing threshold during the summer of 2021. Because this three-mile segment of river overlaps portions of two larger Assessment Units, the Greenbrier River remains listed from RM 35.6 to RM 49.7. WVDEP will continue monitoring this WWTP and the river below it to determine if the 2021 bloom was the result of an operational problem, aging equipment, or the extremely low river flow in the summer of 2021.

Application of the assessment methodology to observations from the 2017-2021 growing seasons resulted in the following impairments on the 2018-2022 Draft West Virginia 303(d) List:

- Greenbrier River – RM 35.6 (Davis Spring) to RM 49.7 (Howards Creek) – refinement of 2016 listing
- Cacapon River – RM 39.0 (North River) to RM 76 (Route 259 Bridge near Wardensville)
- Tygart River – RM 73.2 (Grassy Run) to RM 90.1 (Dodson Run)

6.0 TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT PROCESS

From 1997 until 2003, EPA Region III developed West Virginia TMDLs under the settlement of a 1995 lawsuit, Ohio Valley Environmental Coalition, Inc., West Virginia Highlands Conservancy, et. al. v. Browner, et. al. The lawsuit resulted in a consent decree between the plaintiffs and the EPA that specified TMDL development requirements and compliance dates. While the EPA was working on developing TMDLs, WVDEP concentrated on building its own TMDL program. With the help of the TMDL stakeholder committee, the agency secured funding from the state legislature and created the TMDL section of the Watershed Assessment Branch within the Division of Water and Waste Management.

The TMDL Section is committed to implementing a TMDL process that reflects the requirements of TMDL regulations, provides for the achievement of water quality standards, and ensures that ample stakeholder participation is achieved in development and implementation of TMDLs. The DWWM's approach to TMDL development allows four years to develop a TMDL from start to finish. This approach enables the agency to carry out an extensive data generation and gathering effort to produce scientifically defensible TMDLs; and allows sufficient time for modeling, report drafting, and frequent public participation opportunities.

WVDEP's TMDLs are generally developed according to the Watershed Management Framework cycle. The framework divides the state into 32 major watersheds and operates on a five-year, five-step process. The TMDL process begins in the first year of the cycle with pre-TMDL sampling and public meetings in the affected watersheds. The data is compiled and TMDL development begins in year two of the cycle. In the third year, TMDL development continues and the TMDL is drafted. The TMDL is finalized in the fourth year. In the fifth year of the cycle, TMDL implementation is initiated through the

NPDES permitting process and efforts toward limiting nonpoint source loading. Throughout the TMDL development process, there are numerous opportunities for public participation and input.

For ongoing TMDL projects, the 303(d) list identifies and prioritizes the waters and impairments for which future TMDLs will be developed by specifying the year in the "Projected TMDL Year" column. For other waters and impairments, where the timing of TMDL development is less certain, a high priority has been placed on TMDL development in this Integrated Report. Refer to Appendix D for additional details on prioritization.

Some aspects of TMDL development are constantly going on in any one of the five Hydrologic Groups (A-E). Each set of TMDLs moves through several stages of development prior to finalization and the EPA's approval. Table 6-1 shows the state's TMDL development progress. The number after the Hydrologic Group letter indicates the number of TMDL cycles that have occurred in each group. For example, Cacapon River represents the fifth TMDL cycle in Hydrologic Group E; while Tug Fork River represents the fifth TMDL cycle for Hydrologic Group C. Tug Fork River was prioritized because WVDEP's programmatic goal to revisit watersheds where TMDLs were developed under the consent decree.

Table 6-1: WVDEP TMDL Development Progress and Planning 2016 Integrated Report through May 2025

Hydrologic Group	Watersheds	Progress
A	Shenandoah Jefferson	TMDL development ongoing
B	Tygart Valley	EPA Approved 2016
B	Elk River (above Sutton Lake) North Branch Potomac (Stony River)	TMDL development ongoing
C	Gauley (Meadow River) Potomac Direct Drains (Rockymarsh Run and Warm Springs Run)	EPA Approved 2016
C	Lower Guyandotte	EPA Approved 2022
C	Tug Fork River	EPA Approved 2023
C	Potomac Direct Drains (including Back Creek and other tributaries)	TMDL development ongoing
C	Gauley River	Pre-TMDL monitoring completed Data Entry and QAQC ongoing
D	Monongahela mainstem Hughes River in the Little Kanawha watershed	EPA Approved 2018
D	Little Kanawha (other than Hughes River)	EPA Approved 2023
D	Upper New River, Lower New River, and Greenbrier River	Pre-TMDL monitoring ongoing
E	Upper Guyandotte	EPA Approved 2021
E	Big Sandy Lower Ohio Twelvepole Creek	EPA Approved 2021
E	Cacapon River	TMDL development ongoing

WVDEP believes the TMDL development process, which links extensive water quality monitoring and source tracking efforts with pollutant sources through computer modeling, provides the best assessment of criterion attainment and the most accurate identification of the watershed sources for which pollutant reductions are necessary. TMDL modeling predicts water quality over a wide range of climatic and stream flow conditions, incorporates the specific exposure duration and exceedance frequency terms of water quality criteria and prescribes pollutant(s) allocations that will result in attainment of criteria in all stream segments.

WVDEP's website contains all approved TMDL documents and the draft TMDL documents currently out for public comment. These documents can be found at:

http://www.dep.wv.gov/WWE/watershed/TMDL/Pages/default.aspx

7.0 INTERSTATE WATER COORDINATION

7.1 Virginia DEQ on Bluestone River PCB monitoring and TMDL development

WVDEP has been working with the Virginia Department of Environmental Quality (VADEQ) to assess Polychlorinated Biphenyls (PCBs) impairment along the Virginia section of the Bluestone River. The product of this cooperative effort will be a TMDL for the Bluestone River and tributaries with loadings and allocated reductions for sources in both Virginia and West Virginia. The West Virginia DEP, Virginia DEQ, and EPA Region III have been cooperating to locate and reduce sources of PCBs to the Bluestone River. As part of this effort, the remediation of former industrial sites has been completed. Efforts included leveling and removal of the electric motor remanufacturing buildings on the site. Also, contaminated water and debris were removed from the site and clean material used to backfill the open basement areas of the property. Within the watershed, additional monitoring and source evaluation is on-going to determine what steps may be necessary in the future.

Continued monitoring has determined in part that groundwater rising into the Bluestone River watershed is contaminated by PCBs and contributes to the impairment of the river. Virginia DEQ has prioritized the development of a TMDL in the watershed that will likely address the contaminant sources in both states.

7.2 Virginia DEQ on New River PCB TMDL development

Virginia DEQ developed a PCB TMDL for the mainstem New River and selected tributaries and impoundments. WVDEP contributed to the TMDL via the Technical Advisory Committee to ensure the final TMDL meets both state's water quality standards. The New River PCB TMDL developed for the Virginia portion of the watershed was approved in March 2019.

7.3 Ohio River Valley Water Sanitation Commission – ORSANCO

As with previous reports, WVDEP Integrated Report includes assessments based on data provided by ORSANCO. Throughout the development of ORSANCO's Biennial Assessments, WVDEP has been involved with ORSANCO's efforts to standardize assessments among the compact states. WVDEP's personnel continue to participate in several standing committees, along with representatives from other compact states, charged with helping direct ORSANCO's water quality and biological monitoring efforts.

7.4 Chesapeake Bay

The Chesapeake Bay is impaired by nutrients and sediments from multiple sources originating locally and in upstream states. This biologically diverse waterbody is an important economic and recreational resource. The need to restore this waterbody is a high priority for many agencies, organizations and the public in general. Approximately ten percent of West Virginia's stream miles drain into the Potomac River and on into the Bay. In addition, the James River Watershed in West Virginia flows to the Bay.

In June 2002, Governor Bob Wise signed the Chesapeake Bay Program Water Quality Initiative Memorandum of Understanding, committing West Virginia to nutrient and sediment load reductions. In November 2005, West Virginia proposed pollutant reduction plans in the West Virginia Potomac Tributary Strategy. In December 2010, EPA finalized TMDLs for the Chesapeake Bay and other impaired tidal waters in Virginia and Maryland. In response to the TMDLs, West Virginia and the other Bay jurisdictions developed Watershed Implementation Plans (WIPs). The West Virginia WIP identifies actions and controls the State will pursue to implement the TMDLs, and West Virginia will accomplish its TMDL responsibilities if the WIP is successfully executed. Progress in meeting the TMDL responsibilities is measured and reported regularly. The WIP has been revised to ensure TMDL 2025 implementation goals are met. Many DEP programs are actively participating in this effort. The West Virginia WIP and supporting documents may be viewed at:

http://www.wvchesapeakebay.us/WIP/WIP3.cfm

7.5 Interstate Commission on Potomac River Basin

The Commission is a non-regulatory agency of basin states (Maryland, Pennsylvania, Virginia and West Virginia), Washington, D.C. and the federal government, promoting watershed-wide solutions to the pollution and water resources challenges facing the basin and its more than 6.11 million residents. Examples of current commission efforts include the Chesapeake Bay Program involvement, stream biological assessments, support of selected stream gages, the Potomac Groundwater Assessment, Potomac Basin Drinking Water Source Protection Partnership coordination, and Potomac Watershed Toxic Spill Model support. In addition, the Commission's public outreach program supports and helps coordinate an annual watershed-wide cleanup effort and produces and distributes the newsletter

Potomac Basin Reporter to 20,000 subscribers. The commissioners are appointed by their respective jurisdictions and provide policy guidance and oversight for a skilled staff of scientists and educators.

8.0 WATER POLLUTION CONTROL PROGRAMS

8.1 Division of Water and Waste Management

The Division of Water and Waste Management's mission is to preserve, protect, and enhance West Virginia's watersheds for the benefit and safety of all its citizens through implementation of programs controlling hazardous waste, solid waste, and surface and groundwater pollution from any source.

The DWWM strives to meet its mission through implementation of programs controlling surface and groundwater pollution caused by industrial and municipal discharges, and through the oversight of construction, operation, and closure of hazardous waste, solid waste, and underground storage tank sites. In addition, the DWWM works to protect, restore, and enhance the state's watersheds through comprehensive watershed assessments, groundwater monitoring, wetlands preservation, inspection and enforcement of hazardous and solid waste disposal, and proper operation of underground storage tanks.

Environmental Enforcement (EE), within the Division of Water and Waste Management, is charged with assuring compliance with many state pollution control regulations, including the Solid Waste Management Act, Water Pollution Control Act, Groundwater Protection Act, Hazardous Waste Management Act, Underground Storage Tank Act, and Dam Safety Act by providing assistance, inspecting regulated sites, and enforcing conditions required by these acts.

8.2 National Pollution Discharge Elimination System (NPDES) Program

The DWWM's primary mechanism for controlling point sources is the West Virginia NPDES permitting program. This program, administered by the Permitting Branch, regulates activities and facilities involved in the installation, construction, modification, and operation and maintenance of industrial and wastewater treatment systems, as well as their discharges. Individual and general permits are issued to implement the program and typically include effluent limits, requirements for facility operation and maintenance, discharge monitoring, and reporting. Other permits require installation and implementation of best management practices in lieu of effluent limitations and discharge monitoring requirements. In addition to the NPDES program, the Permitting Branch administers a pretreatment program, which outlines procedures for regulating proposed industrial wastewater connections to publicly owned treatment works (POTW). The program imposes discharge limitations for these indirect discharges and requires the installation of pretreatment facilities where necessary to ensure that the pollutants contributed by industrial users do not pass through the POTW and violate water quality standards, and to prevent interference with POTW operations and sludge disposal practices. The National Combined Sewer Overflow (CSO) Policy is implemented as a component of

the NPDES Permits for POTWs with CSOs. WVDEP has issued three Concentrated Animal Feeding Operation (CAFO) permits with no further permits currently under consideration. Activities administered by the Permitting Branch include regulation of industrial solid waste landfills, land application of sewage sludge, and developing wasteload allocations for new or expanding sewage treatment facilities. Table 8-1 (below) contains a list of permit applications processed from July 1, 2021 through June 30, 2023.

Table 8-1: WVDEP-DWWM-Permit Branch NPDES Permit Action Summary

	New Permits	Permit Modifications	Permit Reissues	Permit Transfers
Industrial	252	184	434	39
Sewage Treatment	499	113	2558	133
Construction Stormwater	1041	900	96	28
Total	1792	1197	3088	200

In addition to permitting, compliance assessment and enforcement activities are coordinated between Permitting and Environmental Enforcement. Noncompliance, initially addressed by administrative actions to compel compliance, may include warning letters and, if necessary, progresses to notices to comply, enforcement orders, and/or referrals for civil action.

8.3 Nonpoint Source Control Program

The Nonpoint Source Program in WVDEP's Watershed Improvement Branch focuses on restoration and protection of streams from nonpoint source pollution. The program assesses nonpoint source impacts, then develops and implements watershed-based plans and projects designed to reduce pollutant loads from agricultural, silviculture, resource extraction, urban runoff, construction activities, and failing septic systems. Program initiatives are based upon education, technical assistance, financial incentives, demonstration projects, and enforcement, as necessary. The Nonpoint Source Program supports overall administration and coordination of the nonpoint source activities through these participating state agencies: the West Virginia Conservation Agency, the Office of Oil and Gas, and the Division of Health and Human Resources. Specific activities are funded annually under the Nonpoint Source Program.

Many of the streams included on the state's list of impaired waters are affected by nonpoint sources. The majority of the Total Maximum Daily Loads being developed involve nonpoint source water quality impacts. To more effectively respond to TMDL implementation needs, the Nonpoint Source Management Plan was updated in 2000 to incorporate watershed management principles, including integration of TMDL and Watershed Management Framework scheduling. In addition to several plans currently under development, the Nonpoint Source Program has a total of 46 watershed-based plans: 27 are currently active, 14 are not active and five are in development. Implementation has occurred in 85% of the active WBPs within the past six years. These watershed-based plans, addressing a variety of nonpoint pollution sources, are in various stages of implementation. They are developed in cooperation with the stakeholders, including federal, state, and local government agencies within the

watershed. As a result of these plans, numerous nonpoint source remediation projects for acid mine drainage, agriculture, streambank erosion, and dirt roads have been undertaken. The goal of the watershed-based plans is restoring the impaired streams to meet water quality standards. The successes to date emphasize the need to focus more resources on voluntary installation of best management practices in identified priority watersheds where local stakeholders are interested in making a difference.

8.4 Groundwater Program

Under the Groundwater Protection Act, West Virginia Code Chapter 22, Article 12, Section 6.a.3, DEP's Groundwater Program is responsible for compiling and editing information for a biennial report to the Legislature on the status of the state's groundwater and groundwater management program. WVDEP, the West Virginia Department of Agriculture, and the West Virginia Department of Health and Human Resources all have groundwater regulatory responsibility and contribute to the report. The biennial report provides a concise, thorough overview of those programs charged with the responsibility of protecting and ensuring the continued viability of groundwater resources in West Virginia. The current biennial report to the Legislature covers the period from July 1, 2021 through June 30, 2023. Copies of the report "Groundwater Programs and Activities: Biennial Report to the West Virginia 2024 Legislature" may be obtained by contacting the Groundwater Program at the Division of Water and Waste Management, 601 57th St., S.E., Charleston, WV 25304 or by calling (304) 926-0495. The report also may be reviewed at:

https://www.wvlegislature.gov/legisdocs/reports/agency/E05_CY_2023_26220.pdf

The Ambient Groundwater Quality Monitoring Network was established in 1992 by the DWWM in cooperation with the USGS. The network provides critical data needed for proper management of West Virginia's groundwater resources. The major objective of this USGS study is to assess the ambient groundwater quality of major systems (geologic units) within West Virginia and to characterize those individual systems. Characterization of water quality from the major systems helps to:

- determine which water quality constituents are problems within the state;
- determine which systems have potential water quality problems;
- assess the severity of water quality problems in respective systems; and
- prioritize these concerns.

The USGS and WVDEP have worked jointly on several groundwater monitoring efforts including monitoring sentinel wells and a wide variety of topical studies. All associated groundwater quality data for each well sampled and summaries of groundwater quality from the topical studies are published in the USGS Water Resources Data for West Virginia annual report. There is a joint funding agreement with USGS for the "Ground Water Monitoring Network" through September of 2026.

8.5 Division of Mining and Reclamation

The mission of the Division of Mining and Reclamation (DMR) is to regulate the mining industry in accordance with federal and state law. Activities include issuing both NPDES and Surface Mining Control and Reclamation Act (SMCRA) permits for mineral extraction sites and related facilities, inspecting facilities for compliance, monitoring water quality, tracking ownership and control, and issuing and assessing violations. The DMR is responsible for the computer databases that track their regulatory activities - Environmental Resources Information System (ERIS) and Applicant Violator System (AVS, the federal OSM database). The Permitting unit is responsible for reviewing permit applications for surface and underground coal mines, preparation plants, coal loading facilities, haulage ways, and coal-related dams. This unit also reviews permit applications for non-coal quarry operations (sand, gravel, limestone, etc.). Permit review teams staffed with geologists, hydrologists, engineers, and others are located in each regional office throughout the state and in the headquarters office.

The DMR's Inspection and Enforcement unit is responsible for inspecting all coal mining and quarry operations in the state. It enforces compliance through regular inspections and Notices of Violation; and it ensures site reclamation through final release of the operation. This unit is also responsible for civil penalty assessments, show cause proceedings, bond forfeiture and collection. The DMR's Program Development unit is responsible for implementing a proactive approach to policy issues, legislation, and training. This unit is designed to keep the DMR staff current with technological advances and to provide clear direction through development of cogent policy and guidance to meet legal and regulatory requirements. This unit provides regulatory interpretation and support to field offices, develops and updates handbooks and forms, drafts legislation, and initiates regulation changes. Other responsibilities of this unit include the Small Operators Assistance Program, public relations, special projects, employee training, and research of laws, regulations, and policy.

9.0 COST BENEFIT ANALYSIS

A true cost/benefit analysis on the economic and social costs and the benefits of water pollution control is a difficult and time-consuming task. Particularly, the evaluation of industrial facilities would be a monumental task considering the various types of industry (mining, chemical, power generation, etc.), each having a very different process of pollution control. However, the information contained in the following paragraphs provides an idea of the amount of money currently expended to construct and upgrade both the municipal facilities within the state, as well as programs available to homeowners wanting to correct failing onsite sewage systems.

WVDEP is responsible for administering a combination of state and federal funds expended for projects to improve water quality in State streams. The following narrative provides an overview of the programs within WVDEP's Division of Water and Waste Management that provide funding for water

quality improvements and a summary of the funds dispersed between July 1, 2021 and June 30, 2023 to improve water quality.

9.1 Clean Water State Revolving Fund Program

The Clean Water State Revolving Fund (CWSRF) program is a funding program administered by the State Revolving Fund Section to address water quality problems through wastewater facility construction, upgrades, or expansions. The CWSRF Section is charged with general oversight, fiscal management, and technical and administrative compliance review of local governmental entities that receive funds and provides information and guidance on administrative actions needed to process a loan through the program. When a community has been recommended by the West Virginia Infrastructure and Jobs Development Council to seek CWSRF program funding for financial assistance, the community is contacted by a financial manager and project engineer. A meeting may be scheduled to advise the community leaders about the overall program requirements and specifically what they should do next to obtain a CWSRF loan. There are federal, state, and program requirements that must be met prior to scheduling a loan closing. The CWSRF currently has three financial assistance programs available. These three programs are described below.

9.1.1 Low Interest Loan Program

A low interest loan program for construction of municipal wastewater treatment works is available for municipalities and public service districts to build, upgrade, or expand treatment facilities and collection systems. Conventional loans with a repayment period of 20 years are available with an interest rate and annual administrative fee not exceeding 3.0% for certain communities. Loans with repayment periods from 21 to 40 years are available for disadvantaged communities where financial affordability is an issue. The interest rate and annual administration fee on these loans range from 2.0% to 0.5%. Based on meeting a variety of factors, communities can potentially receive forgivable loans for some of or possibly all of the project, in which there is no interest, administration fee or principal to be repaid. From July 1, 2021 through June 30, 2023, 25 wastewater treatment facility loans totaling approximately $77,624,187 were funded.

9.1.2 Agriculture Water Quality Loan Program

The Agriculture Water Quality Loan Program, a partnership with the West Virginia Conservation Agency developed to address pollution from nonpoint sources, has been discontinued. Potential partners are now evaluating alternatives to reinvigorate the program.

9.1.3 Onsite Systems Loan Program

In cooperation with the West Virginia Housing Development Fund and the Safe Housing and Economic Development office, a low interest loan program has been established to address onsite sewage disposal problems. The “Onsite Systems Loan Program” provides loans to replace malfunctioning

septic systems and to install new onsite sewage systems for homes that have direct sewage discharges to ditches and streams. Centralized treatment for these homes will not be available in the next five years. For the current reporting period of July 1, 2021 through June 30, 2023, a total of $510,000 in pass through funding was provided to the two agencies.

9.2 Cost Benefit Analysis Conclusion

Although it may be difficult, or even impossible, to fully quantify costs and benefits of water pollution control measures, WVDEP recognizes that multiple millions of dollars are expended annually by businesses, municipalities, and private and public entities (including state and federal agencies) to improve and maintain water quality in West Virginia. These expenditures address pollutants from various media, including solid and hazardous waste, air, and water.

10.0 PUBLIC PARTICIPATION AND RESPONSIVENESS SUMMARY

The draft Section 303(d) List is being advertised for public comment through a press release announcing the availability of this draft document and request for public comments. The draft document is also being promoted via e-mail and the Internet. The WVDEP will consider all comments and modify the Integrated Report and 303(d) list as appropriate to make corrections and add clarification.

Appendix A – Monitoring Programs

APPENDIX A WVDEP SURFACE WATER MONITORING

In Section 2.0, the Probabilistic monitoring program results were discussed. This section describes West Virginia's strategy to monitor and assess the surface waters of the state. The Watershed Assessment Branch is responsible for general water quality monitoring and assessing throughout the state. Visit the WV Integrated Report web-based interactive tool to see the monitoring station locations for the entire state. Planning and monitoring follow the watershed grouping framework, in which the state's 32 USGS 8-digit Hydrologic Unit Code (HUC) watersheds are organized into one of five groups, A-E (Figure A-1).

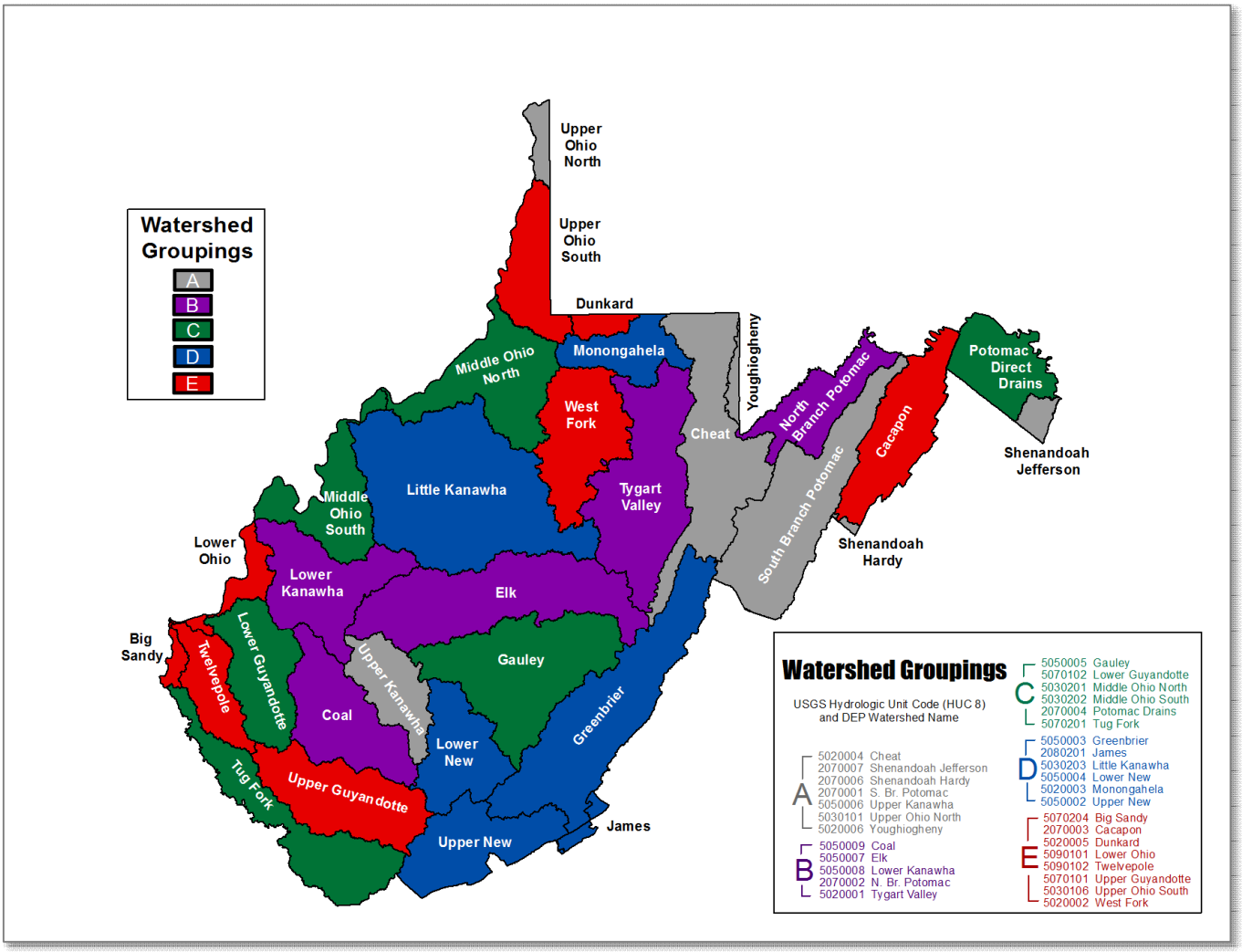


Figure A-1: West Virginia Watershed Framework Groupings

Using the watershed framework, the focus of several monitoring programs rotates from one grouping to the next each year, while other programs retain a statewide focus every year. Given program goals and requirements, the schedule for monitoring has occasionally deviated from the rotating framework. This has occurred primarily in the pre-TMDL monitoring program when the priority or quantity of impairments on the 303d list influences a decision to target specific watersheds.

Table A-1 provides a summary of monitoring activities that occurred during 2017-2022. The remainder of this section describes each Watershed Assessment Branch monitoring program in detail.

Table A-1: Monitoring Activities from 2017 through 2022

Monitoring	Effort
Ambient	26 Ambient Sites are currently, and will continue to be, monitored monthly in the Monongahela River Basin Sites or bi-monthly for all other ambient sites. Ambient monitoring resulted in 1005 samples being collected from 2017 through 2022.
Probabilistic	Described in Section 2.0
Pre-TMDL	Pre-TMDL development monitoring was completed for select streams in the Lower Ohio, Big Sandy, and Twelvepole Creek watersheds in 2017; in the Lower Guyandotte River Watershed in 2018; in the Tug Fork River Watershed in 2019 (additional monitoring for the Tug Fork River mainstem continued into 2020); in the Little Kanawha River Watershed in 2020; and in the Cacapon River Watershed in 2022.
Targeted	Targeted Sampling was completed at 420 sites on 282 streams in 23 watersheds representing all five Hydrologic Groups (A-E) from 2017 through 2022.
Lakes	Two lakes from Group A, 8 lakes from Group B, 10 lakes from Group C, 9 lakes from Group D and 7 lakes from Group E were sampled at one or more monitoring locations four times during the May – October assessment seasons in 2017, 2018, 2019, 2020, 2021 and 2022, respectively. A full round of lake monitoring was not conducted in 2020 due to COVID travel restrictions.
Continuous	Water quality meters were deployed at 138 locations on 104 streams during the 2017-2022 term. Measured parameters varied based on individual project goals but include pH, temperature, conductivity, dissolved oxygen, pressure, and turbidity. A total of 59 stations with pH and 30 stations with Dissolved Oxygen were assessed in the 2024 reporting period.
Long Term	Long Term Monitoring Sites (LTMS) – 326 sites were sampled during the 2017-2022 sampling seasons representing all five Hydrologic Groups.
Wetlands	WVDEP has completed 114 probabilistic West Virginia Wetland Rapid Assessment Method (WVWRAM) assessments during the first two years of its first 5-year-round of stratified probabilistic wetland monitoring.
Harmful Algal Bloom	Harmful Algal Bloom (HAB) monitoring occurs in response to a potential HAB sighting reported to the WVDEP. In addition, in the summer of 2019, the WVDEP Watershed Assessment Branch implemented a Harmful Algal Bloom Long-Term Trend Sampling program. In total, 15 sites were selected with an approximate statewide distribution, focusing on larger waterbodies including rivers, large streams, and lakes.
Filamentous Algae	WVDEP monitors numerous rivers in the state for filamentous algae blooms, including the Greenbrier River, Tygart River, South Branch Potomac River, and the Cacapon River. Monitoring generally occurs in late summer to early fall, when flows decrease, and temperatures begin to rise in the rivers.
Fish Tissue	Monitoring from 2017-2022 resulted in the analysis of 308 samples for PCBs and mercury, and 267 samples for selenium. These samples were collected from 19 8-digit HUC watersheds representing 34 different waterbodies, including 7 lakes.

The WQSAS-Monitoring Unit water quality data are currently available at: https://tagis.dep.wv.gov/wabbase/map/. Any additional data requests can be sent to depwqsas@wv.gov. Data from the WQSAS-Monitoring Unit databases are also being prepared to share on the Water Quality Exchange (WQX) network. The WQX is a mechanism through which data partners can submit water quality data to the USEPA for public access through the Water Quality Portal. Currently, a limited amount of data has been uploaded to WQX.

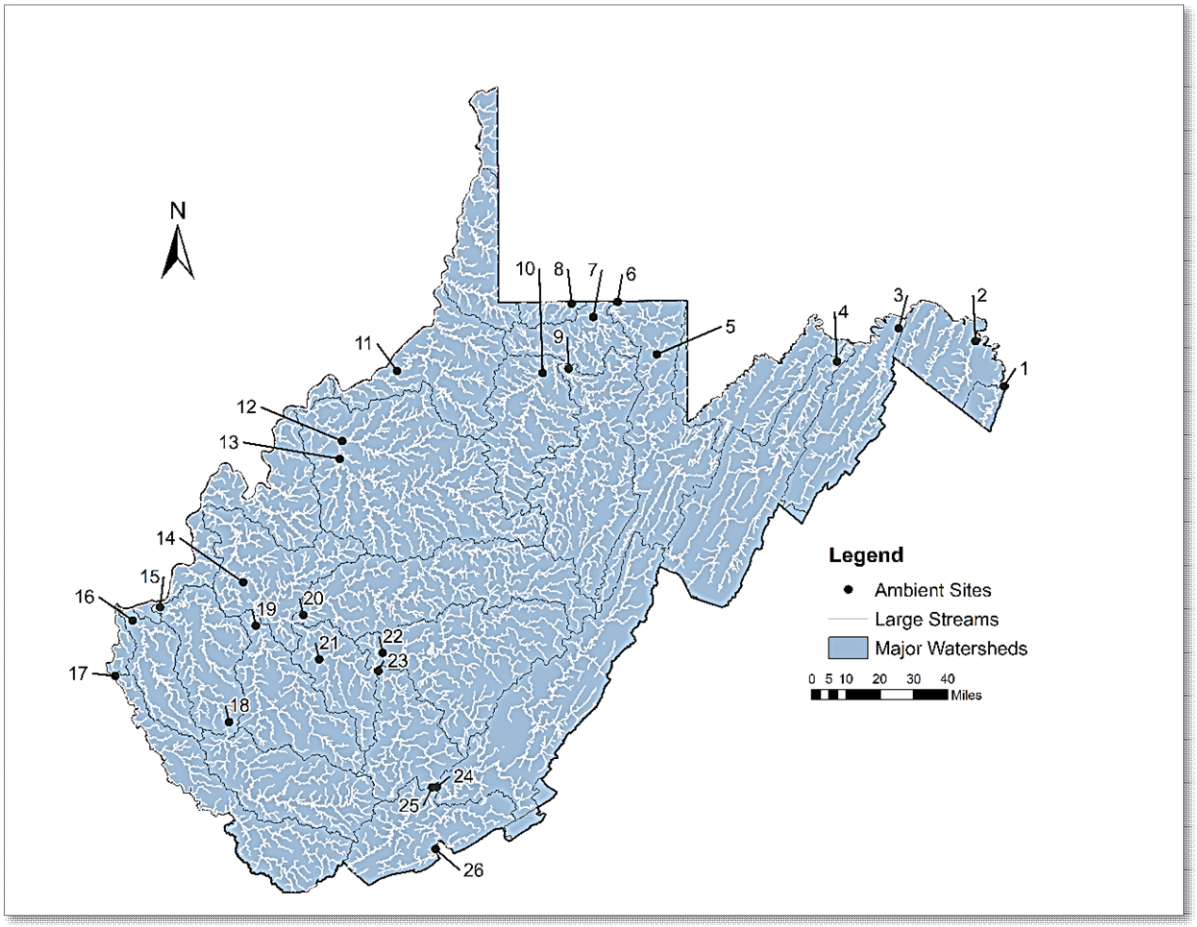
Streams and Rivers

West Virginia has a comprehensive strategy to monitor streams and rivers. The Watershed Assessment Branch utilizes a tiered approach, collecting data from long-term monitoring stations, targeted sites within watersheds on a rotating basin schedule, randomly selected sites, and sites chosen to further define impaired stream segments in support of TMDL development. The following paragraphs further describe these programs. For full details on monitoring programs, see the Watershed Assessment Branch Field Sampling Standard Operating Procedure at:

https://dep.wv.gov/WWE/watershed/Pages/WBSOPs.aspx.

Ambient Water Quality Monitoring Network

The ambient water quality monitoring network concept was established in the mid-1940s. The network currently consists of 26 fixed sites sampled monthly, bimonthly in the Monongahela River basin. Sampling stations are generally located near the mouths of the state's larger rivers and are co-located with USGS stream gages. Biological monitoring, using benthic macroinvertebrate communities, is conducted once annually at or near 20 of these stations. The data provides information for trend analyses, general water quality assessments, and pollutant loading calculations, and allows water resources managers to quickly gauge the health of the state's major waterways. Ambient water quality monitoring resulted in 881 samples being collected from 2016 through 2020. The sites are displayed on Figure A-2 and listed below.



1. Shenandoah River at Harpers Ferry
2. Opequon Creek east of Bedington
3. Cacapon River near Great Cacapon
4. SB Potomac River near Springfield
5. Cheat River at Albright
6. Cheat River below Cheat Lake
7. Monongahela River in Star City
8. Dunkard Creek east of Pentress
9. Tygart Valley River at Colfax
10. West Fork River at Enterprise
11. Middle Island Creek at Arvilla
12. Hughes River west of Freeport
13. Little Kanawha River at Elizabeth
14. Kanawha River at Winfield
15. Guyandotte River at Huntington
16. Twelvepole Creek south of Ceredo
17. Tug Fork at Fort Gay
18. Guyandotte River at Pecks Mill
19. Coal River at Tornado
20. Elk River at Coonskin Park
21. Kanawha River at Chelyan
22. Gauley River at Beech Glen
23. New River above Gauley Bridge
24. Greenbrier River at Hinton
25. New River at Hinton
26. New River at Virginia State line

Figure A-2: West Virginia Ambient Monitoring Sites

Pre-Total Maximum Daily Load (TMDL) Development Monitoring

The primary objective of this major effort is to collect sufficient data for Total Maximum Daily Load (TMDL) modelers to develop stream restoration plans. Pre-TMDL monitoring has traditionally followed the 5-year framework cycle, (i.e., impaired streams from watersheds in Hydrologic Group A were sampled in the same year as sampling by other stakeholder agencies

participating in the watershed management framework). The 303(d) list is the basis for initial site selection and additional sites are added to comprehensively assess tributary waters and allow identification of the suspected sources of impairment. More recently, to address impairments that have been listed for several years, watersheds were selected for TMDL development outside of the schedule established by the framework cycle.

Pre-TMDL monitoring is intensive, consisting of monthly sampling for parameters of concern, which captures data under a variety of weather conditions and flow regimes. Pre-TMDL monitoring also includes an effort to locate the specific sources of impairment, with particular attention paid to identifying pollutant sources and land use stressors.

Targeted Monitoring

Targeted monitoring has been a component of West Virginia's assessment strategy since the Watershed Assessment Program's inception in late 1995. Streams are sampled on a five-year rotating basin approach. Sites are selected from the watersheds targeted for sampling each year, with each site subjected to a one-time evaluation of riparian and instream habitat, basic water quality parameters, and benthic macroinvertebrate communities.

Site selections are based on informational needs in the following areas:

- Impaired streams
- Reference streams (minimally impacted)
- Spatial trends (multiple sites on streams exceeding 15 miles in length)
- Areas of concern as identified by the public and stakeholders
- Previously unassessed streams

Long Term Monitoring Sites (LTMS)

Data from LTMS are used to monitor water quality and habitat trends over time at targeted wadeable streams throughout the state. The stations represent a wide array of impairments commonly identified in WV (acid mine drainage, acid deposition, sediment, nutrient enrichment, etc.). Importantly, the network also includes streams that represent reference or best-attainable conditions.

Sampling frequency is variable. Most sites are sampled annually, while others are sampled every two to three years. Critical elements include habitat evaluations, benthic macroinvertebrate assemblages, on-site measurements, and water quality sampling. The sampling events take place between March and October, inclusive. Most sites are sampled once per year, however, a subset of the LTMS sites is sampled twice per year to document seasonal differences.

Continuous Monitoring

Deployable sondes are used for a variety of applications to provide more detailed information on a stream. These devices can capture conditions that may not be captured with grab samples, such as diurnal changes and episodic events and are used to support existing studies, such as TMDL development and trout stream determinations. As these units are frequently moved to meet the agency's needs, the number of sites is variable.

Sondes are typically programmed to record parameters hourly. However, if frequent fluctuations in water quality are suspected, parameters may be recorded at 30-minute or 15-minute intervals. Deployed sondes are visited periodically to download data, perform maintenance, and retrieve or replace the sonde. A critical element of data integrity is conducting discrete checks, wherein a second recently calibrated multi-probe meter is used to record field readings (temperature, pH, dissolved oxygen, and/or conductivity) immediately adjacent to the deployed unit first without disturbing the deployed unit and again after cleaning the deployed unit of any biofouling or sediment that may be present. The discrete checks provide a baseline and aid in compensating for drift in the deployed unit's recordings. The deployed unit is then re-calibrated with the differences between pre- and post-calibration being used to determine the effect of calibration drift, if any, throughout the deployment.

Lakes and Reservoirs

In 2006, WVDEP resumed a lake monitoring component that focuses on physicochemical water quality parameters. WVDEP added the collection of aquatic macroinvertebrates to the lake monitoring program in 2011.

The objectives of lake monitoring are to identify areas of impairment and to document recovery where abatement plans have been implemented. Sites are selected to update existing data or to address sites with little or no information. Lakes are sampled in accordance with the five-year hydrologic grouping watershed cycle. Seven lakes from Group A, 7 lakes from Group B, 9 lakes from Group C, and 7 lakes from Group D were sampled at one or more monitoring locations four times during the May - October assessment seasons in 2016, 2017, 2018, and 2019, respectively. A full round of lake monitoring was not conducted in 2020 due to COVID travel restrictions.

The number of sites per lake is proportional to the size and shape of the impoundment. One site is established at the deepest part of the impoundment and additional sites may be added to evaluate different arms of the lake or to provide longitudinal information. Each lake is sampled four times during the summer months (June - September or May - August), coinciding with the primary growing season in WV. Critical elements are vertical chemistry profiles for temperature, pH, dissolved oxygen, and conductivity (on-site measurements); nutrients, fecal coliform bacteria, and chlorophyll-a sampling; and Secchi depth.

Many of West Virginia's largest reservoirs are controlled by the U.S. Army Corps of Engineers. Although the Corps' primary mission is to manage structures to provide navigation and flood

control, the agency is also committed to water quality management. Data generated by the Corps has been used for assessment purposes.

Additional lake information is available from the West Virginia Division of Natural Resources (DNR). The DNR, one of the signatory agencies in the Partnership for Statewide Watershed Management, conducts fish community surveys on many of the State's reservoirs.

Wetlands

WVDEP contributes to management of the State's wetlands. Wetlands are areas where the land is covered by shallow water, or the soil is saturated to the surface for at least two weeks during the growing season. Wetlands are wet enough to affect the types of soils and plants that can occur, but they may also be dry at certain times of the year. Some common names for different types of wetlands are swamp, marsh, and bog. According to the National Wetlands Inventory for WV in 2021, the current total acreage of wetlands within the state is approximately 111,000 acres and comprises less than one percent of the State's total acreage; yet wetlands are critical to the overall health of our state's aquatic resources by reducing the impacts of floods, providing baseflow to streams, reducing bank erosion, removing pollutants, processing excess nutrients, capturing sediment, and providing habitat to a high diversity of plants and animals. Management efforts are currently geared toward protection of wetlands by regulatory proceedings or acquisition. Permitting authority for activities impacting wetlands lies with the U. S. Army Corps of Engineers (Clean Water Act, Section 404). WVDEP supports protection through the Clean Water Act, Section 401 certification program.

WVDEP's Watershed Assessment Branch has developed functional and condition assessments for West Virginia's wetlands. The indices developed for assessment are used throughout the state to better describe the functions different wetlands provide along with their overall health or condition. The West Virginia Wetland Rapid Assessment Method (WVWRAM) includes desktop GIS Wetland Assessment Tool (level 1), and a rapid field assessment method (level 2). These two assessments enable calculation of debits and credits for wetland impacts and mitigation sites, as well as help to prioritize sites for land acquisition, restoration, and preservation. In 2022-2023, WVWRAM is expected to be incorporated into the WV Stream and Wetland Valuation Metric (SWVM), which is used by the U.S. Army Corp of Engineers (USACE) and the WV Inter-agency Review Team to assess impacts in West Virginia.

Statewide desktop GIS assessment of wetland function was completed in 2019 for all wetlands mapped in the National Wetlands Inventory (43,124 wetland complexes). These are preliminary scores which must be field verified for any wetlands entering the regulatory process. GIS-based wetland function scores are publicly available on the WVDEP GIS viewer at:

https://tagis.dep.wv.gov/wvdep_gis_viewer/

Targeted monitoring has been a component of West Virginia's wetland assessment strategy since WVWRAM sampling began in 2017. Sites are selected to meet a variety of informational needs. The following sites were sampled using WVWRAM (level 1 & 2) in 2017-2022:

43 reference wetlands (minimally impacted)
66 restored wetlands (pre-construction and/or post-construction data)
28 wetlands facing impacts (pre-impact data)
24 training sites

In 2020, the Watershed Assessment Branch began sampling wetland sites selected through the USEPA's random stratified (probabilistic) procedure. The data generated from this sampling effort allows the WVDEP to make statistically valid assessments of wetland conditions on a statewide basis, as well as make comparisons between watersheds and ecoregions. This data also assists with monitoring long-term trends in wetland health. WVDEP has completed 114 probabilistic WVWRAM assessments during the first two years of its first 5-year-round of stratified random wetland monitoring.

Other Monitoring

When the need arises, WVDEP responds to specific conditions or pollutants of concern in any waterbody. The Watershed Assessment Branch may partner with other agencies to collect data to better understand threats to water quality standards and designated uses.

Harmful Algal Blooms

The focus of West Virginia's Harmful Algal Bloom Response Plan is on public recreational waters, although these principles and practices can apply to any body of water. A coordinated effort is crucial to successfully respond to harmful algal blooms (HABs) in West Virginia. Agencies primarily responsible for HAB response in West Virginia include West Virginia's Bureau for Public Health, WVDEP, Division of Natural Resources (DNR), and local health departments. Responsibilities of WVDEP in the development of this response plan include:

- Conduct sampling when blooms are sighted
- Report potential HAB to West Virginia's HAB mailbox at HAB@wv.gov
- Train partners/stakeholders in sampling protocols
- Conduct aerial surveillance to monitor HABs
- Maintain database of all reported HAB data
- Maintain website, reporting app, and interactive map of HAB advisories
- Provide outreach to the public about HABs
- Coordinate with the USACE on all USACE lakes

Sampling will be conducted on a case-by-case basis, depending on water conditions as algae starts to appear, especially during the peak recreational season. Samples should be collected and, if it is determined the algal bloom is dominated by potentially toxigenic genera of cyanobacteria, the site will be classified as a HAB with cyanotoxin analysis conducted. Initial testing is performed in-house via an mBio/LightDeck analysis unit to quantitatively determine concentrations of microcystin and cylindrospermopsin. If the toxins are detected at levels of concern, or if the algae present can produce additional toxins beyond microcystin and cylindrospermopsin, the sample would be submitted to a lab for quantitative testing. The HAB location should be monitored closely and, if cyanotoxin concentrations are above the Public Health Watch Advisory threshold, the area would be sampled at least weekly. Sampling should continue until two consecutive results collected one week apart indicate that cyanotoxin concentrations are below the watch advisory threshold. However, monitoring may continue based on environmental conditions and relative health risk.

In the summer of 2019, the WVDEP Watershed Assessment Branch implemented a Harmful Algal Bloom Long-Term Trend Sampling program. In total, 15 sites were selected with an approximate statewide distribution, focusing on larger waterbodies including rivers, large streams, and impoundments (lakes). In 2021, three additional sites were established, and additional sites may be established as needed in the future. Sites were selected either due to a history of harmful algal blooms, a history of elevated nutrient concentrations, or neither HAB history nor history of elevated nutrients. These locations will be sampled multiple times per year for several years to attempt to determine trends in the occurrence of HABs in West Virginia. Sampling efforts consist of a visual survey for algae (including benthic/bottom substrate, water column, and water surface), collection and identification of algae present with emphasis on cyanobacteria, algal toxin testing via semi-quantitative methods (Abraxis field test strips) for microcystin and cylindrospermopsin, and water column nutrient concentration analysis. Nutrient samples were collected in accordance with Watershed Assessment Branch Standard Operating Procedures.

Filamentous Algae

Filamentous algae are connected algae cells that form long threads or filaments as the cells reproduce. When growth is excessive, large mats can form that stretch from the river bottom to the surface and cover significant portions of a river reach. The term “Filamentous Algae” refers to any number of species found in rivers and streams. There are numerous species of algae native to West Virginia that can be found at any one location. WVDEP is monitoring numerous rivers in the state for filamentous algae blooms, including the Greenbrier River, Tygart River, South Branch Potomac River, and the Cacapon River. Monitoring generally occurs in late summer to early fall when flows decrease and temperatures begin to rise in the rivers.

Fish tissue

In recent years, fish tissue analysis has been conducted annually, collecting fish from targeted sites on a 5-year rotation. Monitoring from 2016-2020 resulted in the analysis of 407 samples

for PCBs and mercury, and 174 samples for selenium. These samples were collected from 27 8-digit HUC watersheds representing 55 different waterbodies, including 11 lakes. All five Hydrologic Groups (A-E) were represented. In 2016 and 2017, WVDEP conducted a rigorous fish tissue evaluation of the Kanawha and Monongahela rivers with samples analyzed for mercury and PCBs, as well as dioxin at most Kanawha River sites.

Appendix B – Aquatic Life Criteria Attainment Threshold Technical Memo

APPENDIX B AQUATIC LIFE CRITERIA ATTAINMENT THRESHOLD TECHNICAL MEMORANDUM

September 3, 2024 (revised January 10, 2024)

Overview

WVDEP has two benthic macroinvertebrate indices of biotic integrity (IBIs), the family-level West Virginia Stream Condition Index (WVSCI) and the Genus Level Index of Most Probably Stream Status (GLIMPSS). The IBIs rely on different component metrics to compare benthic macroinvertebrate samples to those collected in reference conditions (*i.e.*, a Reference Sample Population or Reference Condition) to determine if biological integrity has been altered. Reference conditions for the IBIs have been developed to identify the samples or streams with biotic integrity. For example, Level 1 references (***Table 1***) do not have obvious point or nonpoint sources near the sample station.

Using GLIMPSS as the foundation, WVDEP developed a Level 4 reference condition tier to create the Aquatic Life Criteria Attainment Threshold (ALCAT). This technical memorandum is intended to describe how ALCAT was developed. Any new GLIMPSS CF calculation information found in this document is meant to supersede the information found in the original GLIMPSS document and preceding technical addendum memos.

More information regarding these IBIs, including links to the original GLIMPSS document (Pond et al. 2011) and GLIMPSS CF v2-2021 Technical Memorandum (WVDEP 2022) can be found on the WVDEP Biological Monitoring webpage:

https://dep.wv.gov/WWE/watershed/bio_fish/Pages/Bio_Fish.aspx

Dataset Description

The GLIMPSS CF v2-2021 recalibration dataset was handled using the same rules as outlined in Section 7.1 in the original GLIMPSS development document (Page 15 of Pond et al. 2011).

The WVDEP Water Quality Standards and Assessment Section (WQSAS) Database (also known as WABbase) has a total of 9667 benthic samples collected from 1997-2020 that are identified to the appropriate taxonomic levels (i.e., genus-level except Chironomidae were left at family-level). A total of 710 samples were removed as they were considered not useable for recalibration. These include:

- Non-comparable collection methods or stream conditions (312)
- <100 Benthic Macroinvertebrate Sub-Sample Count (252)
- Limestone Streams (146)

To address pseudo replication, 221 same day duplicates and 982 visits to the same sampling station less than 5 years apart within the same Seagion (Season + Region) were also removed from the recalibration dataset.

Table 1. Summary of WVDEP Level 1 reference site selection criteria

	Parameter and Criterion	Explanation
1	D.O. > 5.0 mg/l	Taken from "WV Water Quality Standards" (47CSR2).
2	pH between 6.0 and 9.0 S.U.	Taken from "WV Water Quality Standards" (47CSR2).
3	Conductivity < 500 µmhos/cm	Criterion for conductivity was established from analysis of DEP data. A value > 500 may indicate the presence of dissolved ions exceeding the background levels for the area. A conductivity reading can be used as a means of flagging a site for further investigation before it can be considered a reference site.
4	Fecal coliform bacteria < 800 colonies/100 ml	Fecal coliform bacteria data is used as a means of flagging a site for further investigation before it can be considered a reference site.
5	Epifaunal substrate/ available fish cover ≥ 11	Lowest score possible for sub-optimal rating - USEPA-RBP habitat score - 0 to 20 point scale. [2]
6	Channel alteration ≥ 11	Lowest score possible for sub-optimal rating - USEPA-RBP habitat score - 0 to 20 point scale. [2]
7	Sediment deposition ≥ 11	Lowest score possible for sub-optimal rating - USEPA-RBP habitat score - 0 to 20 point scale. [2]
8	Bank vegetative protection (right bank ≥ 6 & left bank ≥ 6)	Lowest score possible for marginal rating - US EPA-RBP habitat score - 0 to 10 point scale for each bank. [2]
9	Undisturbed riparian vegetative zone width (right bank ≥ 6 & left bank ≥ 6)	Lowest score possible for marginal rating - US EPA-RBP habitat score - 0 to 10 point score for each bank. [2]
10	Total habitat score ≥ 130	Mid suboptimal score - U.S. EPA-RBP habitat score - 0 to 200 point scale. [2]
11	No known point source discharges upstream of assessment site (*i.e.*, NPDES)	GIS coverages provide easy access to locations of many permitted point sources. Field reconnaissance is also performed to ensure that point sources do not exist above the site.
12	Evaluation of anthropogenic activities and disturbances at the assessment site	Visual inspection is performed within the stream assessment area. Best professional judgment is employed to make reference site inclusions based on the number and type of disturbance(s). GIS coverages are also used to validate the reference sites.
13	No obvious sources of NPS (Non-Point Source) pollution near assessment site	Obvious sources of NPS are documented within the assessment area. If sources of NPS are documented for areas above the assessment site, they are also considered. Best professional judgment is employed to make reference site inclusions based on the type and intensity of the NPS.
14	No known violations of state water quality criteria	Because of their toxicity, metals are the primary consideration when evaluating data for violations. If there is a violation of a water quality criterion as set forth in 47CSR2, the site is eliminated from reference site consideration.

[1] As provided in "WVDEP Watershed Branch 2010 Standard Operating Procedures (WVDEP 2010). [2]EPA Rapid Bioassessment Protocols (RBP) Habitat Assessment scoring from Barbour et al. (1999).

For this ALCAT version, the 7754 remaining benthic samples were then classified into one of three groups: Reference (n=1238), Non-Reference (n=5004), and Stressed (n=1512). See ***Table 2*** below for a detailed breakdown of changes between the GLIMPSS v2 and ALCAT classification changes.

Table 2. Sample Classification Changes between GLIMPSS v2 and ALCAT

Change From (GLIMPSS v2)	Change To (ALCAT)	n
Non-Reference	Reference (Levels 1-3)	60
	Reference (Level 4)	372
	Total	432
Stressed	Non-Reference	444
	Reference (Levels 1-3)*	1
	Reference (Level 4)	5
	Total	450
Non-Reference	Reference Outlier (Level 4)=> Non-Reference	39
Stressed	Reference Outlier (Level 4)=> Non-Reference	6
	Total Reference Outliers Removed	45

*One sample was mis-classified in the GLIMPSS CF v2 as Stressed when it was a Reference (Level 3).

Evaluation/Reevaluation of Existing Samples for Level 1-3 Reference

In the previous versions of the GLIMPSS CF (v1-2011 & v2-2021) the Reference Sample Population (or Reference Condition) was designated by samples assigned to one of three reference tiers:

- **Level 1 Reference**: Samples that meet all the Reference Criteria (as outlined in ***Table* 1** above). Items 1-10 are field-measured abiotic factors. Items 11 & 14 are subject to data availability. Items 12 & 13 are subject to a level of best professional judgement as to the type and number of anthropogenic activities/disturbances or sources of Non-Point Source Pollution allowable for a Level 1 Reference.
- **Level 2 Reference**: Samples that meet most of the Level 1 criteria but may narrowly fail to meet some of the criteria. The total number of criteria that may fail and margin of failure are subject to best professional judgement.
- **Level 3 Reference**: Samples that represent the best available conditions in a geographical area (e.g., Plateau - Ecoregion 70) or stream size class (e.g., >60 square mile drainage area). These samples generally fail to meet as many of the Level 1 criteria as Level 2 samples.

Some of the data that was included in the GLIMPSS CF v2-2021 recalibration had not yet been subjected to reference sample evaluation (2019 & 2020 samples) and were classified as non-reference samples (i.e., neither reference nor stressed). Additionally, some samples that did undergo Reference Sample evaluation were reevaluated using newly available GIS datasets. In total, 60 samples from the v2-2021 dataset were reclassified as Level 1-3 reference samples in the ALCAT version.

Level 4 Reference Condition Tier

To set expectations for attainment that allow for landuse development and particularly point and non-point sources, a fourth Reference Condition Tier (**Level 4**) was created solely using field-measured and GIS calculated abiotic factors. Most of the same field-measured abiotic factors were carried over from the Level 1 Reference Criteria (see ***Table 3***).

Table 3. Level 4 Reference Criteria

Parameter or Criterion	Value (Units)	Explanation
Temperature	<30.6 °C	Not to exceed 87 F (30.6 C) May-Nov and not to exceed 73 F (22.8 C) Dec-April.
pH	Between 6 and 9 (S.U.)	Meets "WV Water Quality Standards" (47CSR2); Same as Level 1 Criterion
DO	>=5 (mg/L)	Meets "WV Water Quality Standards" (47CSR2); Same as Level 1 Criterion
Fecal Coliform	<800 (col/100mL)	Value is twice the Criterion in the "WV Water Quality Standards" (47CSR2); Doubling the value accounts for the extended holding time used to collect the samples; Same as Level 1 Criterion
Al (Dissolved)	<0.75 (mg/L)	0.75 mg/L is the Acute Water Quality Criterion for Al (Dissolved); WV Water Quality Standards (47CSR2)
Fe (Total)	<1.5 (mg/L)	1.5 mg/L is the Chronic Water Quality Criterion for Fe (Total)); WV Water Quality Standards (47CSR2)
Epifaunal Substrate/Available Fish Cover	>=11	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 20 point scale; Same as Level 1 Criterion
Channel Alteration	>=11	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 20 point scale; Same as Level 1 Criterion
Sediment Deposition	>=11	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 20 point scale; Same as Level 1 Criterion
Left Bank Vegetation Protection	>=6	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 10 point scale; Same as Level 1 Criterion
Right Bank Vegetative Protection	>=6	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 10 point scale; Same as Level 1 Criterion
Left Bank Undisturbed Riparian Vegetative Zone Width	>=6	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 10 point scale; Same as Level 1 Criterion
Right Bank Undisturbed Riparian Vegetative Zone Width	>=6	Lowest Possible Score for a Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 10 point scale; Same as Level 1 Criterion
Total Habitat Score	>=130	Mid Sub-Optimal rating - USEPA RBP VBHA Riffle/Run Parameter – 0 to 200 point scale; Same as Level 1 Criterion
% Watershed Disturbance	<22%	Sum of Percent Grassland/Herbaceous, Pasture/Hay, Row Crop, Open-Space Developed, Low-Intensity Developed, Medium-Intensity Developed, High-Intensity Developed, and Barren Land from StreamCat Watershed 2019 LULC Dataset (based on 100k NHDPlusv2)
% Impervious Landuse[1]	<5%	Sum of Developed, Low-Intensity Developed, Medium-Intensity Developed, High-Intensity Developed from StreamCat Watershed 2019 LULC Dataset (based on 100k NHDPlusv2)

[1]Note: Impervious Surface Landuse criterion was added as further analysis of the landuse disturbance was undertaken during the review of the reference selection methodology, described below.

Percent Watershed Disturbance Criterion

In order to have a quantifiable and reproducible criterion for specific site disturbances, a Percent Watershed Disturbance criterion was created using StreamCat (Hill et.al, 2016). WVDEP considered what is a reasonable amount of landuse development in a watershed and ultimately decided to use <22% total disturbance as a starting point for the Level 4 reference condition tier. Twenty-two percent was chosen because of the overall landuse in West Virginia. According to the WV Division of Forestry, approximately 78% of the state is covered by forest, a non-disturbed class (WVDOF, 2024). When contemplating an

appropriate amount of disturbance, the percent impervious surface LULC was also considered and is discussed below.

StreamCat (found at: https://www.epa.gov/national-aquatic-resource-surveys/streamcat-dataset) is a USEPA derived GIS dataset based on the 100k NHDPlusv2 stream network. It contains over 600 local catchment-level and watershed-level metrics with variables representing both natural (e.g., soils and geology) and anthropogenic (e.g., urban areas and agriculture) landscape information as well as special metrics derived through modeling or combining other StreamCat metrics (e.g., predicted water temperature or biological condition; indexes of catchment or watershed integrity).

To utilize this dataset, each benthic sample station is linked to a 100k NHD line segment's unique COMID. Each benthic sample station's COMID is then linked to a corresponding COMID in the StreamCat dataset. If a benthic sample station was on a stream that is not represented in the 100k NHD, then it was excluded from Level 4 consideration as there would be no metrics available from StreamCat to associate with it.

The watershed-level 2019 NLCD (National Land Cover Database) metrics were selected to calculate Percent Watershed Disturbance. The NLCD classifies Land Use/Land Cover (LULC) into 16 classes. The Percent Watershed Disturbance criterion was calculated as the sum of the Percent Grassland/Herbaceous, Pasture/Hay, Row Crop, Open-Space Developed, Low-Intensity Developed, Medium-Intensity Developed, High-Intensity Developed, and Barren Land classes (see ***Table 4*** below).

Table 4. StreamCat Metrics used to Calculate Percent Watershed Disturbance

Metric Name	Metric Description	Disturbed Class
PctOw2019Ws	Open Water Percentage (NLCD class 11)	No
PctIce2019Ws	Ice/Snow Cover Percentage (NLCD class 12)	No
PctWdWet2019Ws	Woody Wetland Percentage (NLCD class 90)	No
PctHbWet2019Ws	Herbaceous Wetland Percentage (NLCD class 95)	No
PctDecid2019Ws	Deciduous Forest Percentage (NLCD class 41)	No
PctConif2019Ws	Evergreen Forest Percentage(NLCD class 42)	No
PctMxFst2019Ws	Mixed Deciduous/Evergreen Forest Percentage (NLCD class 43)	No
PctShrb2019Ws	Shrub/Scrub Percentage (NLCD class 52)	No
PctGrs2019Ws	***Grassland/Herbaceous Percentage (NLCD class 71)***	***Yes***
PctHay2019Ws	***Pasture/Hay Percentage (NLCD class 81)***	***Yes***
PctCrop2019Ws	***Row Crop Percentage (NLCD class 82)***	***Yes***
PctUrbOp2019Ws	***Developed, Open Space Land Use Percentage (NLCD class 21)***	***Yes***
PctUrbLo2019Ws	***Developed, Low Intensity Land Use Percentage (NLCD class 22)***	***Yes***
PctUrbMd2019Ws	***Developed, Medium Intensity Land Use Percentage (NLCD class 23)***	***Yes***
PctUrbHi2019Ws	***Developed, High Intensity Land Use Percentage (NLCD class 24)***	***Yes***
PctBl2019Ws	***Barren Land (Bedrock and Similar Earthen Material Percentage) NLCD class 31)***	***Yes***

It should also be noted that when a sample station is linked to a COMID, StreamCat data associated with the COMID will include a watershed delineation downstream of the station to the confluence with the next stream segment. In most cases, this is not an issue as sampling stations are typically situated upstream of the confluence of two stream segments (i.e., mouth of tributary and/or mainstem upstream of the tributary). However, since the 100k NHD has a lower resolution compared to the 24k NHD (which includes many smaller streams), a sampling station may be located mid-segment in the 100k NHD. In such situations, the StreamCat data will include disturbance classes below the station in the total percentage of land disturbance.

Percent Imperviousness LULC Considerations

One aspect of LULC that is of particular interest is Percent Impervious Surface (or Imperviousness). Impervious surfaces are artificial structures constructed out of water-resistant materials that do not allow normal percolation/seepage of precipitation into the ground/water table (i.e., impermeable to water). Impervious structures include pavements (roads, sidewalks, driveways, and parking lots), buildings (i.e., rooftops), and even compacted soils. The type of materials used to build the artificial structures also vary in their level of imperviousness (e.g., solid concrete/cement or asphalt versus brick or stone).

As the level imperviousness increases, normal precipitation is more likely to become surface runoff that eventually is directed into waterbodies (streams, rivers, or lakes). Since imperviousness is associated with urban environments, the runoff water is more likely to contain contaminants that are detrimental to water quality (e.g., applied fertilizers and pesticides, pathogens, automotive fluids and dust, sediment, road salts, trash, etc.). Impervious surfaces also collect solar heat which elevates the temperature of the runoff water which negatively impacts the receiving waterbody's temperature and dissolved oxygen levels. Additionally, increased runoff water due to imperviousness tends to result in more frequent flooding events as runoff tend to become flashier (i.e., quick onset and ebbing of runoff flow).

The NLCD LULC dataset includes a product called the Fractional Impervious Surface which measures the percentage of each pixel (30-meter resolution) in the NLCD that is covered by impervious surfaces. This percentage is then used to assign each pixel into one of four Developed LULC classes (see **Table *5*** below).

Table 5. NLCD LULC Classes Defined by Fractional Impervious Surface (USGS, 2024)

NLCD LULC Class	Fractional Impervious Surface Description
Developed, Open Space Land Use Percentage (NLCD class 21)	Impervious surfaces account for less than 20% of total cover
Developed, Low Intensity Land Use Percentage (NLCD class 22)	Impervious surfaces account for 20% to 49% percent of total cover
Developed, Medium Intensity Land Use Percentage (NLCD class 23)	Impervious surfaces account for 50% to 79% of the total cover
Developed, High Intensity Land Use Percentage (NLCD class 24)	Impervious surfaces account for 80% to 100% of the total cover

The effects of imperviousness on aquatic life are well documented. Stepenuck et.al. (2002) detected sharp declines in macroinvertebrate diversity and richness when imperviousness was between 8-12%. There were also sharp declines in fish IBI scores and trout abundance when imperviousness was between 6-11% and had consistently low values when it was above 11% (Wang, et.al., 2003). Stranko, et.al (2008) found that Brook Trout were absent in Maryland streams when imperviousness was greater than 4%.

StreamCat includes Mean Impervious metrics for each NLCD LULC dataset year. The watershed-level 2019 Mean Impervious metric was selected and cross-referenced with the Percent Watershed Disturbance criterion (see above) to determine where Level 4 Reference Condition Tier samples met the < 22% Watershed Disturbance criterion but had significant percent imperviousness (i.e., a large proportion of the total watershed disturbance was represented by impervious surfaces). Based on the studies above, a threshold of 5% imperviousness was set as a benchmark.

Only two reference samples in the dataset (across all four reference condition tiers) exceeded the 5% imperviousness threshold. One (6.33%) was considered a statistical outlier and removed from the Reference Sample Population using the method describe in the next section. The other (a Level 4) was barely over the 5% threshold (5.01%). Upon closer examination, the percent imperviousness value was determined to be overestimations due to the delineation method used by the StreamCat dataset (i.e., by

COMID). The actual sampling station was located some distance upstream of the majority of impervious surfaces in the watershed (e.g., buildings, parking lots, and roads near the mouth of the stream). The remaining Reference Sample Population (Level 1 through Level 4) had a maximum imperviousness of 3.83%, a mean of 0.31%, and a median of 0.18%.

Removal of Statistical Outliers from the Reference Sample Population

The GLIMPSS CF scores for each reference sample were evaluated for outliers by GLIMPSS CF Seagion. Outliers were identified using the Interquartile Range (IQR) method and **Equation *1*** below.

Equation 1. Calculation of Low-End Outliers

$$\boldsymbol{Seagion's\ Lower\ Outlier\ Fence = Q1 - (1.5 * IQR)}$$

Where:

Q1 = A Seagion's Reference Sample Population First Quartile

Q3 = A Seagion's Reference Sample Population Third Quartile

IQR = Q3 – Q1; A Seagion's Interquartile Range

If a GLIMPSS CF Score was less than the Lower Outlier Fence for a given GLIMPSS CF Seagion, it was identified as a low-end outlier and removed from the given GLIMPSS CF Seagion's Reference Sample Population. This process was done iteratively until no more low-end outliers were present within a Seagion's Reference Sample Population. A total of 45 Level 4 reference members across all seven GLIMPSS CF Seagions were identified as outliers and removed from the Attainment Threshold calculations.

Classification Efficiency and Alteration of Stressed Criteria

Classification Efficiency (CE) is a performance metric that measures an IBI's ability to correctly assign sites to either reference or stress categories. To do this, sites must be classified to either Reference, Non-Reference, or Stressed Sample Populations. In the previous versions of the GLIMPSS CF (v1-2011 & v2-2021) the Stressed Sample Population (or Stress Condition) was designated by samples meeting at least one of the Stressed Criteria (see ***Table 6*** below).

Table 6. Criteria for assigning stressed samples sites (from page 17 Pond et al. 2011). Only an exceedance of any one criterion is required

pH	<4 or >9 S.U.
D.O.	<4mg/l
Fecal Coliform	>5000 col./100 ml
Specific Conductance	>1000 uS/cm
Epifaunal Substrate Score	<7 and Total Hab Score <120
Channel Alteration Score	<7 and Total Hab Score <120
Sediment Deposition Score	<7 and Total Hab Score <120
Total Bank Vegetation Score	<7 and Total Hab Score <120
Total Riparian Zone Score	<4 and Total Hab Score <120

One alteration to the Stressed Criteria was made for the ALCAT: Specific Conductance >1000 uS/cm was removed as a Stressed Criterion. Of the 638 samples that met this Stressed Criterion for GLIMPSS, 444 were redesignated as Non-Reference, 5 as Reference (Level 4), and 6 were identified as Reference Outliers. A total of 183 samples remained designated as Stressed due to meeting one of the 8 remaining Stressed Criteria.

Classification Efficiency Calculations

Classification Efficiency (CE) was calculated for each GLIMPSS Seagion using ***Equation 2*** below.

Equation 2. Calculation of Classification Efficiency (CE)

$$CE = \frac{REF\ A + STRESS\ NA}{REF\ N + STRESS\ N}$$

Where:

REF A= Total Number of Reference Samples >= the Attainment Threshold

STRESS NA= Total Number of Stressed Samples < the Attainment Threshold

REF N= Total Number of Samples Classified as Reference in a Seagion

STRESS N= Total Number of Samples Classified as Stressed in a Seagion

A Seagion's ALCAT is set at a specified percentile (e.g., 5th or 10th) of the Reference Sample Population's GLIMPSS score distribution. This would mean that, by default, a given percentage of Reference Samples (i.e., 5% or 10%) will never meet the Attainment Threshold. To offset this, a Corrected Classification Efficiency (CorCE) is calculated for each ALCAT Seagion using

Equation 3 below.

Equation 3. Calculation of Corrected Classification Efficiency (CorCE)

$$CorCE = \frac{REF\ N + STRESS\ NA}{REF\ N + STRESS\ N}$$

Where:

REF N= Total Number of Samples Classified as Reference in a Seagion

STRESS NA= Total Number of Stressed Samples < the Attainment Threshold

STRESS N= Total Number of Samples Classified as Stressed in a Seagion

It is generally accepted that a CE > 70% are credible, with CEs greater than 85% being ideal. Most ALCAT Seagions had CEs ranging from 86.0-95.5% (CorCE 90.0-100%) except for two: Summer Plateau had a CE of 76.4% (CorCE 77.9%) when using the 10th percentile as a threshold; and Spring Plateau had a CE of 80.1% (CorCE 81.4%) with the 5th percentile used as the threshold.

Bioregion and LULC Considerations

With a goal to maximize Reference sample inclusion while maintaining the effectiveness of the IBI (using Classification Efficiency or CE as a benchmark) in each ALCAT Seagion, considerations were given to varying the Level 4 criteria by Bioregion (i.e., Mountains vs. Plateau) to account for the natural variation between the two. An example would be lowering the Bank Vegetative Protection and Bank Undisturbed Riparian Vegetative Zone Width criteria from >=6 to >=5, and the Total Habitat Score criterion from >=130 to >=119 for Plateau sites. However, this produced poor quality Reference Samples that caused the CE to fall below acceptable levels (i.e., <70%) in certain ALCAT Seagions. Additionally, a range of Land Use/Land Cover (LULC) % Watershed Disturbance was evaluated (0-50%). Ultimately, ≤25% total land disturbance was used as the reference criterion.

Updates to Attainment Threshold

The attainment thresholds for each Seagion are recalibrated periodically to incorporate new data as recommended in section 7.3 (Maintaining the Index) of the original WVSCI document (Gerritson, et al. 2000). The original recommendation was to recalibrate on an annual basis. However, this was deemed to be too frequent and a target recalibration period of every 5 to 10 years was selected. The last recalibration was performed in 2021 (WVDEP Watershed Assessment Branch, 2022), 10 years after the finalization of the original GLIMPSS CF IBI (Version 1-2011). The previous GLIMPSS CF Versions' BSV/WSVs are found in ***Tables 7-8*** on the following pages They are included in this document for reference only. ***Tables 9-10*** provide ALCAT Attainment Thresholds and CEs for each Seagion.

Adjustments to the Attainment Thresholds were made due to 3 factors:

1) The evaluation/reevaluation of existing samples for designation in the Level 1-3 Reference Condition Tiers
2) The creation of a new Reference Condition Tier (Level 4)
3) The removal of statistical outlier samples from the Reference Sample Population

Table 7. GLIMPSS CF v2 (2021) Component Metric Best and Worst Standard Values (BSV/WSVs)

GLIMPSS v2 (2021)	Metric Best and Worst Standard Values (BSV/WSVs)																	
Metric Direction	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-
GLIMPSS Seagion	# Total Taxa	# Intolerant Taxa < 3	# Intolerant Taxa < 4	# Ephemeroptera Taxa	# Plecoptera Taxa	# Trichoptera Taxa	# EPT Taxa	# Scrapper Taxa	# Shredder Taxa	# Clinger Taxa	HBI	% Tolerant Taxa >6	% 5 Dominant Taxa	% Ephemeroptera	% EPT minus Cheumatopsyche	% Chironomidae	% Orthocladiinae	% Annelida + Chironomidae
Winter Mountains			22/0	9/0	10/ 0	8/2		8/1		20/ 5	2.55/ 6.59		55.5/ 94.7	51.0/ 0.0				5.0/ 56.2
Spring Mountains			19/1	10/1	8/0	7/1		8/0		20/ 4	2.62/ 6.66		55.3/ 96.7	64.0/ 0.7				2.8/ 72.4
Summer Mountains <60 sq. mi.	31/ 10		16/0	9/0	7/0				4/0	19/ 5	3.45/ 6.72		56.6/ 95.4		86.4/ 8.4			
Summer Mountains >60 sq. mi.			10/0				19/ 7			19/ 8	4.58/ 6.53		52.2/ 89.1		80.7/ 22.1	0.9/ 40.8		
Winter Plateau			18/1	9/0	8/0					19/ 6	2.68/ 6.70				88.5/ 5.8			3.1/ 76.6
Spring Plateau			14/1	10/1	7/0					17/ 3	3.19/ 6.94				88.8/ 2.7			2.0/ 81.6
Summer Plateau	26/ 9	4/0		7/0				7/1		14/ 4	4.84/ 6.96		64.9/ 97.1		67.1/ 2.4	2.6/ 66.9		

Table 8. GLIMPSS CF v1 (2011) Component Metric Best and Worst Standard Values (BSV/WSVs)

GLIMPSS v1 (2011)	Metric Best and Worst Standard Values (BSV/WSVs)																	
Metric Direction	+	+	+	+	+	+	+	+	+	+	-	-	-	+	+	-	-	-
GLIMPSS Seagion	# Total Taxa	# Intolerant Taxa <	# Intolerant Taxa <	# Ephemeroptera	# Plecoptera Taxa	# Trichoptera Taxa	# EPT Taxa	# Scrapper Taxa	# Shredder Taxa	# Clinger Taxa	HBI	% Tolerant Taxa	% 5 Dominant	% Ephemeroptera	% EPT minus	% Chironomidae	% Orthocladiinae	% Annelida +
Winter/Spring Mountains			18/1	10/1	8/0	7/1		8/0		19.5 /3.5	2.19/ 5.87		55.5/ 96.7	59.7/ 0.5				2.8/ 75.2
Summer Mountains <60 sq. mi.	30/8		15/0	9/0	7/0				4/0	18/4	2.80/ 5.90		57.7/ 96.7		86.0/ 5.2			
Summer Mountains >60 sq. mi.			10/1				18/5			18/7	4.03/ 5.75		55.1/ 92.1		76.9/ 13.8	1.5/ 46.1		
Winter/Spring Plateau			14.5 /1	10/1	7/0					16.5 /3	2.45/ 5.94				90.8/ 2.5			1.8/ 84.6
Summer Plateau	25/8	7/0		7/0				7/1		14/3	3.84/ 5.98		64.4/ 97.5		67.1/ 1.3	3.3/ 68.8		

Table 9. ALCAT (2024), v2 (2021) & v1 (2011) Attainment Thresholds

	ALCAT (2024)			GLIMPSS CF v2 (2021)			GLIMPSS CF v1 (2011)		
GLIMPSS Seagion	Number of Samples	Number of Reference	Attainment (Impairment)	Number of Samples	Number of Reference	Attainment (Impairment)	Number of Samples	Number of Reference	Attainment (Impairment)
Winter Mountains	124	52	63	124	51	63	36	29	64
Spring Mountains	1512	346	47	1512	246	57	697	128	51
Summer Mountains <60 sq. mi.	2592	487	44	2593	305	56	1530	181	54
Summer Mountains >60 sq. mi.	534	156	43	533	65	56	315	53	51
Winter Plateau	107	26	62	107	25	62	39	18	65
Spring Plateau	1196	86	58	1196	63	62	653	44	57
Summer Plateau	1689	85	51*	1689	45	65	857	38	62
Total	7754	1238		7754	800		4127	491	

*All Attainment Thresholds in the ALCAT are at the 5th Percentile of the Reference Sample Population except Summer Plateau which is at the 10th Percentile.

Table 10. ALCAT and Classification Efficiency

	ALCAT (2024)									
GLIMPSS Seagion	Sample N	Level 1 REF N	Level 2 REF N	Level 3 REF N	Level 4 REF N	REF Outliers	Attainment Threshold	STRESS N	Classification Efficiency	Corrected Classification Efficiency
Winter Mountains	124	28	23	0	1	3	63	15	95.5	100
Spring Mountains	1512	107	140	4	95	11	47	190	87.5	90.7
Summer Mountains <60 sq. mi.	2592	167	162	0	158	17	44	409	89.5	92.5
Summer Mountains >60 sq. mi.	534	0	0	70	86	8	43	22	91.0	95.5
Winter Plateau	107	8	18	0	0	1	62	24	86.0	90.0
Spring Plateau	1196	20	45	2	19	3	58	322	80.1	81.4
Summer Plateau	1689	17	32	17	19	2	51*	530	76.4	77.9
Total	7754	347	420	93	378	45		1512		

*All Attainment Thresholds in the ALCAT are at the 5th Percentile of the Reference Sample Population except Summer Plateau, which is at the 10th Percentile.

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Appendix C – Use Assessment Procedures

APPENDIX C USE ASSESSMENT PROCEDURES

C.1 Assessment Units

An effort to establish relatively static assessment units was undertaken in 2018-2019 in order to conform to data reporting requirements of ATTAINS and enable straightforward tracking of waters between cycles. In this strategy, assessment units are not regularly re-delineated between cycles as they were historically. Instead, any data collected from an existing or new monitoring station anywhere on the assessment unit reach will be assessed to make impairment/attainment determinations.

In 2018-2019, the assessment units were delineated based on designated uses, existing impairments, drainage area size, upland land use, influence from tributaries, existing loading scenarios from TMDLs, and other site-specific considerations. In specific scenarios where during the assessment significant variability exists in an assessment unit, the termini may be reconsidered considering the listed factors. During the 2024 assessment period, there were five assessment units that were modified/split to better demonstrate the water quality in those specific stream reaches.

When the new assessment units were established in 2018-2019, care was taken to retain impairment status to ensure known water quality issues are addressed in the future. If a newly delineated assessment unit includes any segment previously identified as impaired, the entirety of the new assessment unit was considered impaired. There may be exceptions to this general rule when examining a scenario where the original impaired reach comprises a relatively insignificant length of the newly delineated assessment unit. A different attainment call may be made for an assessment unit, if supported by an examination of land use, pollutant sources, and historical data. These determinations are made on a case-by-case scenario. A crosswalk between the previously listed stream codes and current assessment unit identifiers (AUIDs) is provided and named "WV_2016_2022_2024AUID_Crosswalk", downloadable at the following website under Supplemental Tables:

https://dep.wv.gov/wwe/watershed/ir/pages/303d_305b.aspx

Assessment units are identified alphanumerically based on coding from a 1:24,000 scale stream layer obtained and adapted from the National Hydrography Dataset (NHD). WVDEP has joined data from this refined stream layer to existing stream codes and names originally derived from a 1:100,000 scale stream layer. As a result, the coding system used to identify streams/stream reaches is different. There were approximately 12,000 assessment units in the 2016 Integrated Report. In comparison using the new NHD 1:24,000 scale streamlines to derive the assessment units, there are now 47,504 assessment units loaded to ATTAINS. Because the scales of the streamlines are so different, many more small streams are represented that have not been monitored or assessed. See Figure C-1 to visualize the difference the change in streamline scales makes. During assessment, the WQSAS Monitoring

Unit and Assessment Unit considers 53,746.83 miles of streams, based on coded from a 1:24,000 scale stream layer obtained and adapted from the National Hydrography Dataset (NHD). There are 24,863.84 acres of lakes. Considering all streams and lakes, there are a total of 47,504 assessment units.

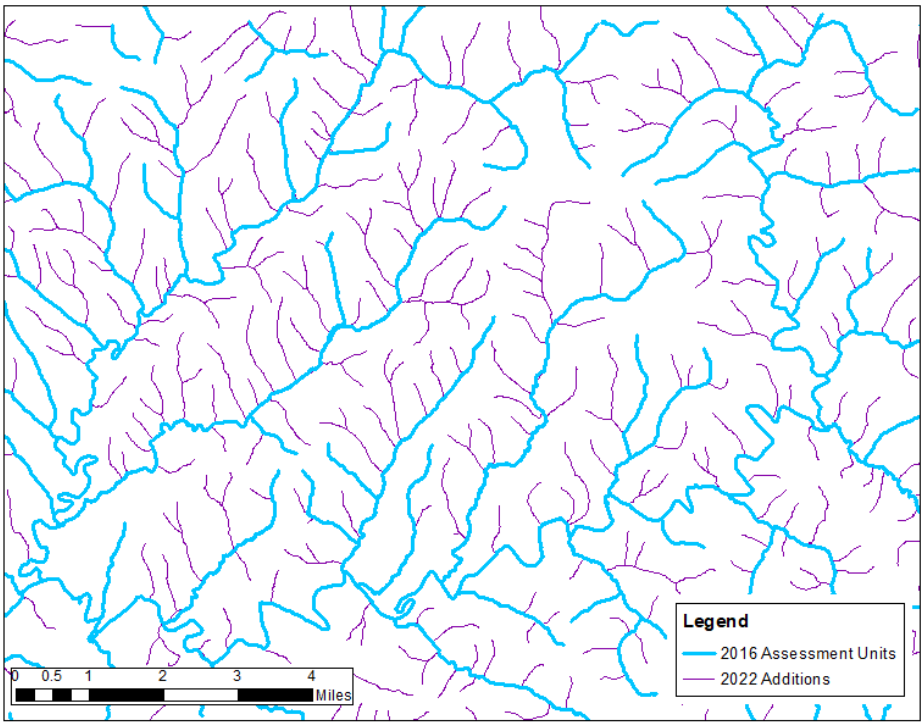

Figure C-1: Comparison of the streamline resolution in the 2016 Integrated Report with additions for the 2018/2020/2022 Combined Integrated Report and the 2024 Integrated Report.

When delineating the assessment units for lakes, many small lakes that had not been previously assessed were identified and added for possible assessment in the future. Lakes with more than one major tributary forming "arms" of the lake were separated into smaller assessment units. If an entire lake was listed previously in the 303d list as impaired, that impairment status was applied to all delineated assessment units of the lake.

C.2 Assigning Overall Integrated Report Categories

The primary focus of this report is assessing water quality data to determine if waters support their designated uses. The first step in assessing whether a waterbody is supporting its uses is to determine if monitored parameters meet water quality criteria. If any parameter measured in a waterbody is not meeting criteria protective of a designated use, then that waterbody will be categorized as impaired or "not supporting" its use. See Section 3.0 Water Quality Standards for more details on water quality standards.

Waters are placed in one of the five Overall Integrated Report Categories (IR Category) based on their level of designated use support. Table C-1 provides details of each Overall IR Category.

Table C-1: Overall IR Categories for West Virginia Waters

Category		Description
Category 1		Waters fully supporting all designated uses. Requisite data to assess all uses are infeasible to attain statewide.
Category 2		Waters fully supporting some designated uses, but insufficient or no information exists to assess the other designated uses
Category 3		Waters where insufficient or no information exists to determine if any of the uses are being met
Category 4		Waters impaired or threatened but do not need a total maximum daily load (TMDL)
	4A	Waters that already have an approved TMDL but are still not meeting standards
	4B	Waters that have other control mechanisms in place which are reasonably expected to return the water to meeting designated uses
	4C	Waters determined to be impaired, but not by a pollutant (e.g., low flow alteration)
Category 5		Waters assessed as impaired and are expected to need a TMDL

C.2.1 Overall IR Category 1, 2, or 3

The guidelines used by WVDEP to demonstrate use support for streams (and subsequent classification into Categories 1, 2, or 3) vary for each of the designated uses. It is important to note that it is infeasible to regularly monitor many water quality standards in every location. When developing monitoring plans, WVDEP considers which pollutants are likely to occur in a waterbody and analyzes water quality for those pollutants. "Supporting" assessments for individual uses are made if certain mandatory (requisite) parameters have been monitored and those results demonstrate compliance with criteria. To demonstrate support, aquatic life uses (Warm Water Fisheries or Trout Waters) in wadeable streams require benthic macroinvertebrate monitoring and results showing attainment. Public Water Supply and Water Contact Recreation uses require compliant fecal coliform monitoring and all other uses require compliant pH and dissolved oxygen monitoring. If monitoring results are available for "non-mandatory" (ancillary) parameters, they also must indicate compliance with any criteria prescribed for the use before a designated.

No WV waters are currently classified as Category 1, primarily because fish consumption is a designated use for all waters and requisite data, fish tissue, are difficult to obtain. In general fish tissue data results only exist for relatively large, public fisheries that support gamefish. With this current assessment methodology, there is most often insufficient information to assess the fish consumption designated use, meaning those water cannot be classified as Category 1.

Stream segments without sufficient data to determine use support or impairment may be placed in either Category 2 or 3. Category 2 houses waters with some uses determined to be supported but lacking sufficient information to assess other uses. Previous assessment tools targeted impaired waters and did not report on many attaining parameters and supported

uses. WQSAS-AU developed a R-code to aid in assessment for the 2024 cycle that allowed for the efficient assessment and reporting of not only the impaired parameters, but also attaining parameters. For this reason, many uses are not supported that were previously labeled as "not assessed".

Waters are placed in Category 3 if insufficient or no information exists to determine if any of the uses are being met. An "insufficient data" designation may result where some water quality data are available, but not enough to conclude that the use is supported or impaired, or when water quality data for mandatory (requisite) parameters is absent.

Water Contact Recreation: Fish Consumption was added to ATTAINS to accommodate the design of USEPA's "How's My Waterway" tool. This subcategory has been assigned to all assessment units, even when the waterbody may not support fish populations because of size, stream flow, topography, etc. In most waterbodies, no fish tissue data are available for assessment, so fish consumption is "unassessed"; thus, any waterbody that is otherwise fully supporting other uses is placed in Category 2.

The number of Insufficient or Unassessed lakes (category 3) is larger than in previous Integrated Reports, because of a change in the methodology for assigning use attainment categories. Previously, if a lake was assessed and was meeting the Total Phosphorus and Chlorophyll-a water quality standards, the lake was said to be meeting all associated uses, even in the absence of a lake-specific pH and Dissolved Oxygen assessment methodology. For this Integrated Report, if a lake was found to be meeting the Total Phosphorus and Chlorophyll-a water quality standards, all associated uses were determined to be Insufficient (category 3) pending the development of an appropriate assessment methodology for pH and Dissolved Oxygen in lakes as surface water data is not representative of the entire water column and is not necessarily indicative of overall lake health.

C.2.2 Overall IR Category 4 or 5

In order for a stream to be placed in Categories 1, 2, or 3, there can be no impairments. When any parameter is not meeting criteria, then the waterbody is not supporting a designated use. The entire assessment unit is considered impaired and placed in IR Category 5 (needs a TMDL) or Category 4 (does not need a TMDL). Prior to TMDL development, waters impaired by a pollutant are placed on the Section 303(d) List and in Category 5. After TMDLs are developed and approved, those waters are placed in Category 4A. Other impaired streams for which TMDLs need not be developed are placed in Categories 4B or 4C. Category 4B includes waters impaired by a pollutant for which other control mechanisms are in place that will reasonably result in the water meeting designated uses. Waters impaired by something other than a pollutant, for which no TMDL can be developed, are categorized as 4C (ex. low flow alterations or buried).

C.3 Data for Assessment

For the 2024 cycle, data from July 2017 through the end date of June 2022 were considered for assessment. The data cutoff date was established in order to allow for data assembly, quality assurance and control, assessment, and report development. Data collected after June 2022 will be assessed in the next reporting cycle. The five-year data period intentionally limits the use of older data. However, in the absence of newer information, previous assessments are carried forward even if the data becomes older than five years. Additionally, if a water quality criteria change is approved which affects an older assessment, the new assessment is based upon the current criteria. For instance, when a change to the duration of human health criteria occurred, older total iron data for the drinking water designated use were reassessed (See Section 5.3). In 2024, to resolve aquatic life attainment determination, all available biological data were assessed for the period of July 1, 2015-April 2024.

Waters are not deemed impaired based upon water quality data collected when stream flow conditions were less than 7Q10 flow (the seven-consecutive-day average low flow that recurs at a 10-year interval) or within regulatory mixing zones. Further, waters are not deemed impaired based upon "not-detected" analytical results from methodologies with detection limits that are not sensitive enough to confirm criteria compliance. For example, a dissolved aluminum result of "not detected" using a method with a detection limit of 0.1 mg/l would not prompt a dissolved aluminum listing for trout waters with a criterion of 0.087 mg/l.

Additionally, WVDEP does not interpret the impacts of a single pollution event (such as a spill) as representative of current conditions if it is believed that the problem has been addressed. Similarly, WVDEP does not intend to interpret the results of clustered monitoring of a single event as being representative of water quality conditions for longer time periods. Datasets are screened for excessive clustering of monitoring, in space or time, to avoid misinterpretation. No data were excluded based on a single pollution event or clustered monitoring of a single event for this Integrated Report assessment cycle.

The decision criteria do not provide for 303(d) listing of waters with severely limited data sets and exceedance (e.g., one sample in a five-year period exceeding water quality standards). Such waters would be classified as having insufficient data available for use assessment. WVDEP will target these "one-hit" waters for additional monitoring by incorporating them into the pre-TMDL monitoring plans at the next opportunity for TMDL development in their watershed. Where the intensified pre-TMDL monitoring (monthly sampling for one year) indicates impairment, TMDL development will be initiated even though the water may not be included in Category 5 of the current Integrated Report.

With the creation of relatively static assessment units, water quality data collected from individual monitoring stations in the assessment unit were assessed separately to determine attainment. If water quality at any monitoring station within the assessment unit was considered impaired, the entire assessment unit was considered impaired. The only exception to this general rule was relative to data collected by ORSANCO along the Ohio and Kanawha

Rivers at the dams. Data collected at the dam was applied to assessment units both upstream and downstream of the monitoring location.

C.4 Numeric Water Quality Criteria

The assessment methodology for numeric water quality criteria used in preparation of the 2024 Integrated Report is consistent with those used in previous reporting cycles, with one exception, continuous instream monitoring data were considered. The following section presents a summary of the assessment methods.

C.4.1 Chronic Criteria Protective of Aquatic Life

Typically, in cases where exceedances of chronic aquatic life protection criteria occur more than 10 percent of the time, the water is impaired. If the rate of exceedance demonstrated is less than or equal to 10 percent, then the water is supporting the designated use under evaluation.

Table C-2 presents guidelines for sample counts to determine whether a parameter is meeting criteria or causing impairment for chronic criteria protective of aquatic life. Importantly, in order to assess parameters and capture the critical conditions for designated uses, a dataset should represent variations expected in water quality due to seasons, weather conditions, and flow regimes. Regardless of the sample count, if results do not represent critical conditions, data will not be used to delist known impaired waterbodies.

If the data being evaluated is assigned a higher level of assessment quality, and the "10-percent rule" may be applied with confidence to smaller data sets. The primary example of a high-quality dataset is the WVDEP pre-TMDL monitoring program. The pre-TMDL monitoring format includes flow measurement and monthly water quality monitoring for one year at multiple locations throughout a watershed. Information is generated over a range of stream flow conditions and in all seasons. Habitat assessment and biological monitoring are performed in conjunction with water quality monitoring. The information generated under this format is among the most comprehensive available to assess water quality. Upon conclusion of monitoring, agency personnel make a definitive judgment relative to impairment. In most instances, application of the "10-percent rule" to the pre-TMDL monitoring data sets result in the classification of waters as impaired if two or more exceedances of a criterion are demonstrated.

Table C-2: Guidance to determine status when assessing parameters for chronic criteria protective of aquatic life

Sample Count	Exceedance Count	Parameter Status	Additional Consideration
≥20	>10%	Causing impairment	Assess data collected within 3 years. If longer than 3 years, determine frequency of exceedances/year.

Sample Count	Exceedance Count	Parameter Status	Additional Consideration
<20	2 or more	Causing impairment	Assess data collected within 3 years. If longer than 3 years, determine frequency of exceedances/year.
>20	≤10%	Meeting Criteria	Do not list new impairment. To delist a known impairment, samples must be evaluated to determine if monitoring captured low and/or high flow critical condition in waterbody. Ideally, delisting decisions would be based on at least 20 samples. Data from multiple years may be assessed to consider at least 20 samples.
5-19	One or less	Meeting Criteria	To delist a known impairment, samples must be evaluated to determine if monitoring captured low and/or high flow critical condition in waterbody. Frequency and quality of samples will also be considered when making delisting decisions. Ideally, delisting decisions would be based on at least 20 samples. Data from multiple years may be assessed to consider as many samples as possible. In instances where fewer than 20 samples are available, best professional judgement will be applied to determine if enough information is available to change a listing status.
<5	One or less	Insufficient Information	No listing decision will be made.
<5	2 or more	Causing Impairment	Assessed data collected within 3 years. If longer than 3 years, determine frequency of exceedances/year

C.4.2 Acute Criteria Protective of Aquatic Life

Under West Virginia Water Quality Standards, acute aquatic life protection criteria have associated exposure durations of one hour and may be exceeded once every three years. The normal practice of "grab-sampling" ambient waters is generally consistent with the one-hour exposure duration specified in the standards. Therefore, a direct application of the allowable exceedance frequency provided in the standards is made when assessing impairment relative to acute aquatic life protection criteria. If two or more exceedances of acute criteria are observed in any three-year period, the water is considered impaired. This rule is applied to acute criteria and to excursions of the water quality criteria for pH and dissolved oxygen.

C.4.3 Nutrient Criteria for Lakes to Protect Aquatic Life and Contact Recreation

Following 47CSR2 Section 8.3, WVDEP's lake assessment of chlorophyll-a and total phosphorus results were based on the average of a minimum of four samples collected within the May 1 through October 31 sampling season. Lake assessments are based on data collected within one meter of the surface.

C.4.4 Total Iron Numeric Criteria for Drinking Water

To assess the iron impairments assigned to the drinking water designated use, annual geometric means were calculated for datasets with counts of five or more per year, including modeled data when available. When it was determined that the annual geometric mean did not exceed 1.5 mg/L at any time, an assessment unit was not listed or delisted for the drinking water use. In order to assess modeling impairments identified through TMDL modeling projects, all baseline output files were analyzed using an R-code routine to calculate discrete annual geometric means. Those assessment units that had no exceedances of 1.5 mg/L in any annual geometric mean were not listed or delisted for the drinking water use. This effort was completed in order to accurately report impairment to the public relative to metals in their drinking water.

C.4.5 Fecal Coliform Numeric Criteria for Contact Recreation and Drinking Water

Fecal coliform assessments were based on the previously described decision criteria for numeric water quality criteria. Numeric fecal coliform water quality criteria are applicable to the Water Contact Recreation and Public Water Supply designated uses. Section 8.13 of Appendix E of the West Virginia Water Quality Standards states:

> *8.13 Maximum allowable level of fecal coliform content for Water Contact Recreation (either MPN or MF) shall not exceed 200/100ml as a monthly geometric mean based on not less than five samples per month; nor to exceed 400/100ml in more than 10 percent of all samples taken during the month.*
>
> *8.13.1 Ohio River mainstem (zone I) - During the non- recreational season (November through April only) the maximum allowable level of fecal coliform for the Ohio River (either MPN or MF) shall not exceed 2000/100 ml as a monthly geometric mean based on not less than 5 samples per month.*

Given the complexity of fecal coliform criteria, most assessments are performed by comparing observations to the "maximum daily" criterion value of 400 counts/100ml. Evaluation of the monthly geometric mean fecal coliform criterion (200 counts/100ml) occurs only where five or more individual sample results are available within a calendar month.

In general, the most frequent and regular fecal coliform water quality monitoring conducted by the WQSAS-Monitoring Unit is once per month. That monitoring frequency precludes assessment of the monthly geometric mean criterion and hinders accurate assessment of the maximum daily criterion per month. In some instances, more frequent fecal coliform monitoring can be accomplished on limited numbers of streams and/or stations where water quality assessments are performed.

WVDEP uses the following protocols when making assessments relative to fecal coliform numeric criteria:

1. No assessments are based upon the monthly geometric mean criterion (200 counts/100ml) unless an available data set includes monitoring at five per month or greater frequency. When data sets are available, the listing decision criteria for numeric water quality criteria are applied, considering each monthly geometric mean as an available monitoring result.

2. The listing decision criteria are applied to the maximum daily criterion (400 counts/100ml) and available individual monitoring results, but without the monthly prejudice. For example, if twice per month monitoring is conducted for a year and two results in two separate months are greater than 400, the stream would be assessed as fully supporting (2/24 – 8.3 percent rate of exceedance) rather than basing assessments on two months out of 12 in noncompliance (2/12 – 16.7 percent rate of exceedance). If five samples per month monitoring is conducted for one year and four daily results greater than 400 are measured in four different months, the stream would be assessed as fully supporting (4/60 – 6.7 percent rate of exceedance) rather than noncompliance (4/12 – 33.3 percent rate of exceedance), provided the monthly geometric means were below the 200 counts/100 ml criteria.

C.4.6 Ohio River – Total Iron Aquatic Life Standards

Prior to 2012, ORSANCO assessed water quality data along sections of the Ohio River bordering West Virginia based on the state's total iron numeric water quality standard. In 2012, ORSANCO's governing commission began using a weight of evidence approach when assessing all aquatic life standards for its biennial 305(b) report. However, the EPA's Region III office has stated for 303(d) listing purposes, it will only accept assessments based on a philosophy of independent applicability. Therefore, West Virginia's 303(d) assessments for aquatic life will recognize violations based on either water quality or biological survey data. A review of the ORSANCO total iron water quality data revealed violation rates greater than 10 percent for several segments of the Ohio River and, as such, the segments have been listed as impaired on West Virginia's 303(d) list.

C.5 Continuous Monitoring Data

The WVDEP and the USGS use deployable sondes to collect data on a continuous basis on selected streams. These submerged datalogging sondes collect data continuously (most often hourly or twice hourly) for a deployment period ranging from several days to several months, being especially effective for evaluating the specific requirements of water quality criteria such as pH and dissolved oxygen.

As these deployable sondes are left in streams for an extended period of time, sediment build-up and/or biofilms can cover sensor surfaces and impact the recorded values. During deployments, calibration drift can also occur, impacting the recorded values. Continuous

Monitoring data undergoes a rigorous quality control process. This ensures that sensor drift—whether from fouling or calibration drift—is properly accounted for and corrected.

C.5.1 WVDEP Continuous Monitoring

For WVDEP collected data, this involves collecting paired discrete meter readings during field service visits before the deployed logger is disturbed, after any fouling biofilms and/or sediments are removed from the sensor, and after calibration. Pre- and post-calibration values as observed in calibration solutions are also recorded. These paired values are then used in the office to adjust the deployable data if necessary, accounting for the fouling and calibration drift, resulting in a dataset that is more representative of actual stream conditions. More information about WVDEP Continuous Monitoring can be found in Appendix A.

A difference of +/- 0.2 Standard Units for pH and +/- 0.3 mg/L for Dissolved Oxygen as observed between the deployable logged data and the discrete meter readings indicate that a correction evaluation is necessary. For fouling drift corrections, no correction is applied at the start of the correction interval and the full correction is applied at the end of the correction interval. Data points between the beginning and end points are linearly interpolated. Calibration drift (individual sensor falling away from recent calibration and therefore impacting accuracy) is assumed to occur at a constant rate throughout the correction period. Calibration drift error is the result of an electronic drift in the sensor reading from the last time the sensor was calibrated and is determined in real time upon retrieval by the difference between cleaned-sensor readings in standard buffers and the true, temperature-compensated value of the standard buffers.

If after corrections are applied, data is still in exceedance of +/- 0.2 Standard Units for pH and +/- 0.3 mg/L for Dissolved Oxygen, data is removed from the dataset due to excessive fouling or drift. However, if certain environmental or hydrologic events, (such as rain events or low flow events from drought), can be identified as significant fouling events; then the approximate event onset date/time may be used as the start or end for a deletion or fouling correction.

C.5.2 Assessment of Continuous Monitoring Data

Data recorded by WVDEP and USGS deployable sondes were included in the assessment effort for this Integrated Report. Discrete samples collected by WVDEP during deployment and during monthly maintenance are not included in assessments for the Integrated Report as they were used to ensure deployable data quality control. USGS Continuous Data for pH and Dissolved Oxygen were downloaded via the 'dataRetrieval' package, version 2.7.16, in R statistical analysis software, version 2024.4.2.764. Records considered for analysis were limited to those with an Approved status, indicating the data had been evaluated and corrected, if necessary, by the USGS. Continuous Instream Monitoring (CIM) data for an Assessment Unit is assessed using the same measures as other non-CIM data. In the future, WVDEP will evaluate CIM-specific assessment methods.

The first step in assessing Continuous Data was to determine the attainment status of each individual data point by comparing values to water quality standards. Data were then aggregated to the number of exceedances and the total number of data points per year by station to evaluate trends in attainment throughout the Integrated Report cycle.

Counts of exceedances and total number of data points were then summarized by station for the entire Integrated Report cycle and initial attainment decisions were made. Stations with at least 2 individual data point excursions and greater than 10% of individual data points exceeding the water quality standard were assigned a station attainment status of "Not Meeting Criteria." Stations with less than 4 individual data points were assigned a station attainment status of "Insufficient Information" while stations that did not have greater than 10% of individual data points exceeding the standard or did not have at least 2 individual data point excursions were assigned a station attainment status of "Meeting Criteria."

Station level data were then aggregated to the AUID level; if any single station within an AUID had an attainment status of "Not Meeting Criteria", the entire AUID was assigned an AUID attainment status of "Not Meeting Criteria." If all station attainment statuses were "Meeting Criteria" or a combination of "Meeting Criteria" and "Insufficient Information", the AUID was assigned an AUID attainment status of "Meeting Criteria." If all station attainment statuses were "Insufficient Information", the AUID was assigned an AUID attainment status of "Insufficient Information."

C.6 Narrative Water Quality Criteria – Biological Impairment Data

The narrative water quality criterion of 47 CSR 2 §3.2.9 prohibits the presence of wastes in State waters that cause or contribute to significant adverse impact to the chemical, physical, hydrological, or biological components of aquatic ecosystems. WVDEP bases assessment of biological integrity on a rating of the stream's benthic macroinvertebrate community using a multi-metric index of biotic integrity for use in wadeable streams using genus-level taxonomic data. Streams were listed if the data was comparable (e.g., collected utilizing the same methods used to develop the IBI and adequate flow in riffle/run habitat) and the percentage of threshold, compared to reference seasonal and regional biological scores, fell below 100. Refer to the technical memorandum describing the ALCAT in Appendix B.

C.7 Narrative Water Quality Criteria - Fish Tissue and Consumption Advisories

The narrative water quality criterion of 47CSR2–3.2.e prohibits the presence of materials in concentrations that are harmful, hazardous or toxic to man, animal or aquatic life in State waters. Fish consumption advisories are used to inform the public about potential health risks associated with eating fish from West Virginia's streams. WVDEP, the Division of Natural Resources, and the Bureau for Public Health have worked together on fish contamination issues since the 1980s. An executive order from the governor and subsequent Interagency

Agreement signed in 2000 formalized the collaborative process for developing and issuing fish consumption advisories.

Risk-based principles are used to determine whether fish consumption advisories are necessary. These advisories are used as a public education tool to help citizens make informed decisions about eating fish caught in State waterbodies. The risk-based approach estimates the probability of adverse health effects and provides a statement on the health risk facing the angler and high-risk groups including women of childbearing age and children. West Virginia's fish consumption advisories include guidelines on the number of meals to eat and information on proper fish preparation to further minimize risk.

Waterbody-specific fish consumption advisories exist for five major rivers (including backwaters in tributaries) and five lakes for a variety of fish species and contaminants. Additionally, there is a general statewide advisory that recommends limiting consumption of certain fish from all West Virginia waters due to low-level mercury and/or polychlorinated biphenyl (PCB) contamination. The statewide advisory provides species-specific recommendations ranging from one meal per week to one meal per month. The following webpage contains the most recently issued West Virginia fish consumption advisories:

http://www.wvdhhr.org/fish/

The presence of contaminants in fish tissue from commonly consumed species in amounts leading to a two meal per month or more stringent advisory is considered sufficient evidence of impairment. In addition, methylmercury has a specific body-burden water quality criterion for protection of public water supply and water contact recreation designated uses. The criterion states "The total organism body burden of any aquatic species shall not exceed 0.5 µg/g as methylmercury." Therefore, the WVDEP applies the criterion to all aquatic species rather than just the commonly consumed fish species.

For the mainstem Ohio River, the applicable ORSANCO body-burden criterion is 0.3 µg/g. As with previous 303(d) lists, WVDEP has deferred to ORSANCO's assessment results for mercury listing purposes. ORSANCO's assessment methodology is included in their Biennial Assessment of Ohio River Water Quality Conditions. ORSANCO's assessment methodology can be found at

http://www.orsanco.org/publications/biennial-assessment-305b-report/

C.8 Narrative Water Quality Criteria – Filamentous Algae

The narrative water quality criterion of 47CSR2 – 3.2.g prohibits algae blooms which may impair or interfere with the designated uses of the affected waters. WVDEP lists streams for filamentous algae impairment because the algae blooms impair or interfere with the Water Contact Recreation use and/or the Public Water Supply use of a stream. The methodology

(303(d) Listing Methodology for Algae Blooms) was finalized by DEP in June 2013 and is available at

http://www.dep.wv.gov/WWE/Programs/wqs/Documents/Greenbrier%20Algae/AlgaeListingMethodology2014.pdf

To develop the listing methodology for impairment of the Water Contact Recreation designated use, WVDEP utilized the results of a scientific survey of people who use West Virginia rivers to determine how much filamentous algae cover would adversely impact various recreational activities. The report *West Virginia Residents' Opinions on And Tolerance Levels of Algae In West Virginia Waters* is available at

http://www.dep.wv.gov/WWE/Programs/wqs/Documents/WVAlgaeSurveReport_ResMgmt_WVDEP_2012.pdf .

In general, WVDEP considers the Water Contact Recreation use of a stream segment to be impaired if filamentous algae cover is greater than 20% and extends for a longitudinal distance greater than three times the average stream width OR if filamentous algae cover of greater than 40% is measured, regardless of the longitudinal extent of the bloom.

WVDEP considers the Public Water Supply use to be impaired if algae blooms cause taste or odor in the drinking water that requires a level of treatment beyond "conventional treatment". Additionally, WVDEP considers available taste or odor complaints about finished drinking water when assessing the Public Water Supply designated use and may classify the use as impaired even though additional treatment is not implemented.

A stream may be delisted if any of the following apply:

WVDEP has evaluated the stream for impairments of Water Contact Recreation for a period of five consecutive years and found no blooms which would have caused the stream to be listed as impaired for recreational use.

Specific measures to control algae growth have been implemented, and WVDEP has evaluated the stream for a period of three consecutive years finding no algae blooms causing use impairment.

For algae impairments related to the Public Water Supply use, when taste and odor complaints associated with algae blooms are alleviated and no treatment beyond "conventional treatment" is required at the drinking water treatment facility for three consecutive years.

Appendix D – 2024 Prioritization Framework

APPENDIX D DRAFT VISION 2.0: 2022 -2032 PRIORITIZATION FRAMEWORK

Introduction

The West Virginia Integrated Water Quality Monitoring and Assessment Report (Integrated Report) fulfills the reporting requirements under the federal Clean Water Act, Section 303(d) to provide a list of impaired waters and Section 305(b) to provide an overall assessment of West Virginia's waters to the U.S. Environmental Protection Agency. Ultimately, Total Maximum Daily Loads (TMDLs) will be developed for waters listed in the Section 303(d) list.

Collaborating with states, the US Environmental Protection Agency (USEPA) has prepared a Vision Statement for the 303(d) Program:

> *"The Clean Water Act Section 303(d) program strives to strategically plan and prioritize activities, engage partners, and analyze and utilize data to develop water quality assessments, plans, and implementation approaches to restore and protect the Nation's aquatic resources."*

This statement along with Vision 2.0 Goals and Focus Areas were conveyed in a guidance document in September 2022. The Goals outline opportunities to implement CWA Section 303(d) program activities. The West Virginia Department of Environmental Protection (WVDEP) is responsible for carrying out the Clean Water Act Section 303(d) in West Virginia and is incorporating the Vision 2.0 into the State program. The following document describes WVDEPs' strategy for reaching the Vision 2.0 Goals.

Strategy

WVDEP has a robust rotating basin approach to water resource management activities, including monitoring, assessment, TMDL development, and permitting. The state is divided into five hydrologic groups (A-E), each hydrologic group containing from five to eight, 8-digit Hydrologic Unit Code (HUC) watersheds. Each year a different hydrologic group is the focus for monitoring efforts. All other water resource management activities are organized under this five-year rotating basin framework (Figure C-1).

Annually, the State selects focus areas to begin four-year TMDL development projects with various activities synchronized with the framework. It conducts robust "pre-TMDL" chemical and biological monitoring for a year that is intended to refine/append 303(d) listings and inform TMDL modeling. West Virginia's "watershed" TMDL projects aim to comprehensively and efficiently address 303(d) listed waters and impaired waters identified during pre-TMDL monitoring. Final products include a high volume of nested TMDLs. This approach to TMDL development has resulted in thousands of impaired assessment units being addressed through pollutant TMDLs. Often TMDL development is "comprehensive" for common

pollutants like fecal coliform bacteria and total iron, meaning reductions are made to an entire 8-digit HUC to address mainstem impairment. Looking forward to Vision 2.0, WVDEP anticipates revisiting TMDL watersheds to document implementation and water quality improvements to determine the effectiveness of TMDLs.

The State's Integrated Reports Supplemental Tables are also organized under the framework. The 303(d) listed assessments units are assigned a year for TMDL development when projects are going. Very detailed decisions have been made on which stream/pollutant TMDLs will be developed in the next two years. Useful, but less specific plans for years three and four have been developed. Beyond year four, WVDEP only projects which Watershed Monitoring Framework Hydrologic Group in which TMDL development may occur.

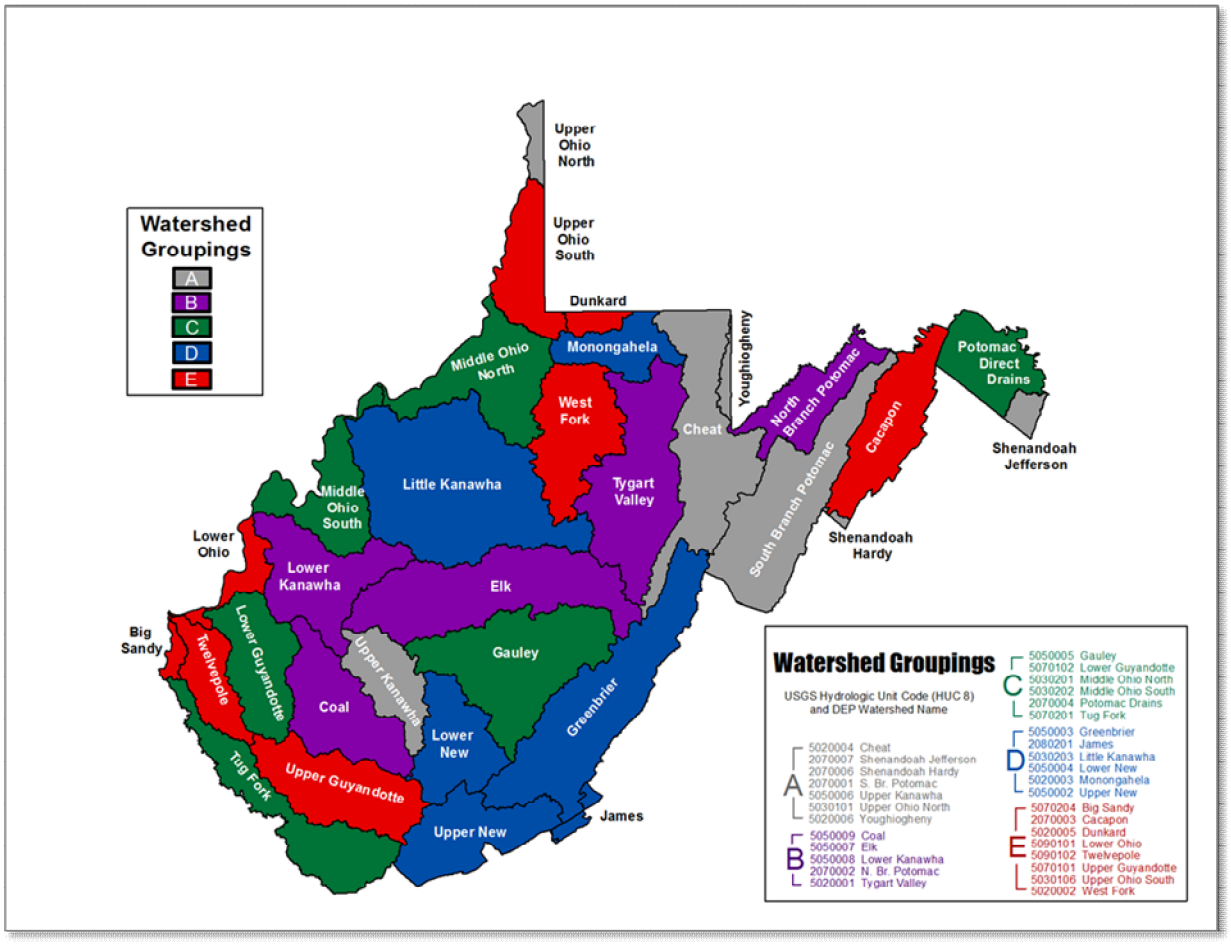

Figure C-1: Watershed Framework map showing Hydrologic Groups for each 8- digit HUC Watersheds

2022-2032 CWA Section 303(d) Vision Goals

Planning and Prioritization Goal

"States, territories, and tribes develop a holistic strategy for implementation of Vision Goals, systematically prioritize waters or watersheds for TMDL and other plan development (restoration and/or protection), and report on the progress towards development of plans for priority waters." (EPA, 2022)

WVDEP has set priorities based on the two-year cycles that coincide with the Integrated Report cycle. The current priorities are based on the draft Combined 2018/2020/2022 Integrated Report and includes TMDLs associated with projects that have started. WVDEP projected years indicate that these priorities will be accomplished during federal fiscal years 2026, 2028, 2030 and 2032. While this Prioritization Framework will be static for a 10-year period, the Integrated Report will provide updated priorities for each cycle. The prioritization will be refined biannually by adding priorities associated with new projects for later years, expanding the priorities to include impairments identified by monitoring and/or modeling, or removing priorities where new assessment information indicates delisting is warranted.

Much of the resources for the pre-TMDL monitoring efforts are expected to be reinvested in TMDL Effectiveness Monitoring where there has been TMDL implementation through permits and non-point restoration efforts, as well as data gathering to inform TMDL revisions and/or watershed-based plan development. WVDEP will revisit watersheds within the rotation of the framework to collect new data to revise 303(d) listings, generate data for the Integrated Reports, and potentially refine existing TMDLs to better empower the non-point community.

The documentation of implementation and improvements within the State with enhanced efficiency is a programmatic goal. WVDEP anticipates monitoring where the State Revolving Fund (SRF), Watershed Improvement Branch (WIB), Abandoned Mine Lands (AML), the Department of Natural Resources (DNR), other agencies, and any citizen groups have planned or completed restoration/upgrade projects. This would involve pre-project and post-project monitoring efforts with an evaluation of effectiveness upon data assessment. These efforts would include stream monitoring, data evaluation, public engagement, and information dissemination.

Completed Priorities from FY2022-FY2024

Completed priorities included fecal coliform and iron TMDLs in the Little Kanawha River watershed and Tug Fork watershed (both approved in 2023).

Also in 2023, an Advance Restoration Plan (ARP) to address algae-related impairments on AUIDs of the Greenbrier River was accepted. In general, the plan included monitoring after three major POTWs were upgraded with enhanced nutrient reduction technology. Annual monitoring of source and stream nutrient concentrations and algal bloom

extents were performed through the summer of 2020 to contrast pre-project and post-project upgrade conditions and judge the effects of the improved treatment under varying temperature and precipitation conditions. Multiple AUID segments of the Greenbrier River were delisted in the Combined 2018/2020/2022 Integrated Report-303(d) list due to the results of the ARP implementation. Monitoring is continuing in segments of the Greenbrier River that have not yet been delisted due to hurdles in the operation at one of the wastewater treatment plants.

Due to the travel restrictions associated with the COVID-19 Pandemic, WVDEP deviated from the Watershed Framework in July 2020-June 2021. Monitoring was completed at locations near the Charleston area. WVDEP focused monitoring efforts to study bacteria in the Lower New River watershed in cooperation with the New River Clean Water Alliance partners. The Lower New River efforts helped characterize bacteria concentrations in waters with a high occurrences of contact recreation. No TMDLs were revised based on this effort. Instead, information was provided to help focus implementation efforts of the 2009 approved TMDL in the watershed.

In July 2021, WVDEP resumed pre-TMDL monitoring in the Cacapon River watershed a year delayed from the Watershed Framework.

Current Priorities (FY2024-FY2026)

The Cacapon 8-digit HUC area was chosen as the TMDL priority for the 2022-2025 time period for multiple reasons. Following the Watershed Framework, Hydrologic Group E was next in line when the monitoring efforts were planned and the Cacapon 8-digit HUC is part of Group E. In addition, Cacapon was prioritized because WVDEP has not performed a comprehensive TMDL monitoring sweep in this watershed. The previous TMDL project (Lost River in 1998) did not address the entire Cacapon 8-digit HUC and was developed using a small dataset (7 samples at 4 stations each).

WVDEP is working with a contractor to complete fecal coliform TMDLs within the Cacapon 8-digit HUC area (02070003). This will include a redevelopment of the older Lost River bacteria TMDL. It will also include the Little Cacapon River which is within this 8-digit HUC area but does not flow into the Cacapon River mainstem. Included in this project is an ARP pilot study for selected streams that are biologically impaired. The contractor is working with WVDEP on an in-depth stressor identification and with other state agency staff to facilitate landowner involvement in Best Management Practice (BMP) implementation.

COVID-19 travel restrictions postponed the monitoring effort for Cacapon River for a year. For this reason, when planning the 2023-2026 project monitoring, WVDEP passed over Hydrologic Group A and focused on Group B, endeavoring to re-align with other water resource management activities. Within Group B, the Elk River watershed

upstream of the Sutton Lake Dam was chosen for pre-TMDL monitoring, as was the Stony River of the North Branch of the Potomac River. Given the logistical challenges of working in the Eastern Panhandle, WVDEP also took advantage of the travel and monitored select streams outside of the Watershed Framework, including Potomac Direct Drains (Group C) and the Shenandoah Jefferson (Group A) watersheds from July 2021-June 2023. This project is referred to as the Selected Elk and Eastern Panhandle Streams (SEEPS) TMDL project. This TMDL project will address any currently 303(d) listed impairments, as well as new impairments identified through updated monitoring. In addition, WVDEP will consider de-listing streams based on updated data. Figure C-2 provides the project areas for all currently planned TMDL projects.

Within the SEEP TMDL project there is a possibility of developing sediment-specific TMDLs for selected Potomac Direct Drains and Shenandoah-Jefferson streams that are biologically impaired. These streams are not specifically impaired for iron, which historically has been used by WVDEP as a sediment surrogate. A reference watershed approach would be utilized to accomplish this goal. This idea is currently in the planning process. Previous TMDLs for Stony River will remain in effect. Sources and updated data will be used to inform future implementation of that TMDL.

The Cacapon 8-digit HUC and SEEPS TMDL project area impaired AUIDs are uploaded into ATTAINS for the TMDL priorities for the 2024 Priority Cycle. It is planned that the Cacapon 8-digit HUC TMDLs will be 'Complete' by the September 2026 deadline and the SEEPS TMDLs will be 'In Progress'.

In addition to the upcoming TMDL projects within the Watershed Framework, WVDEP is working on TMDLs to address ion toxicity for 11 streams within the Lower Guyandotte River watershed. This project will delay the scheduled TMDL projects for one year due to limitations in funding.

Upcoming Priorities (FY2026-FY2032)

With the completion of the SEEPS TMDL project, West Virginia will have completed TMDLs in all 8-digit HUC watersheds in the state. However, there are a few regions within the state where the TMDL efforts were scaled back previously, that will be addressed in the future by following the watershed framework (Figure C-2).

Selection of the subsequent TMDL project is following the watershed prioritization framework into Group C to span 2024-2027 with the Gauley River 8-digit HUC watershed being revisited. The Gauley River watershed was chosen for a few reasons. There was a TMDL completed in 2008, however, at that time the Trout Use iron water quality standard (WQS) was under revision. This TMDL endpoint utilized a 0.5 mg/L Total Fe as the endpoint. Subsequent studies indicated that 1.0 mg/L Total Fe is a scientifically-sound WQS to meet the Trout Use. WVDEP has monitored and will

reassess the iron impairments, as well as any fecal coliform impairments, within this 8-digit HUC. All WLAs will then be revised to protect the current Trout Use water quality standards. Also in the Gauley River watershed, post-implementation monitoring was conducted where there were restoration and implementation efforts in small streams or communities.

WVDEP is following the watershed prioritization framework into Group D to span 2025-2028 with three Group D watersheds: Greenbrier, Upper New, and Lower New. These areas were chosen because the prior TMDLs in these HUCs were completed in 2008. Many upgrades and restoration projects have been completed in these areas that the WQSAS-Monitoring Unit has specifically monitored. Monitoring is also focusing on small watersheds that were not sampled during the older project. During this effort, water samples have been collected for the specific purpose of generating a statewide fecal coliform to E. coli bacteria translator. This data, combined with previously collected data from other 8-digit HUCs, will be used for an upcoming water quality standards change to E. coli.

The next project area will cycle into Group E to span 2026-2029 with Fish Creek near the Northern Panhandle of West Virginia (Figure C-2). This area was chosen because Fish Creek was not targeted during the previous Group E projects in the Upper Ohio South watershed.

The watershed prioritization framework will cycle into Group A for 2027-2030 into the upper Cheat River watershed to target larger streams such as Shavers Fork, Dry Fork, and Blackwater River (Figure C-2). This area will likely be chosen for pre-TMDL monitoring, because the Upper Cheat was not included in the 2011 Cheat River TMDL project due to a high workload.

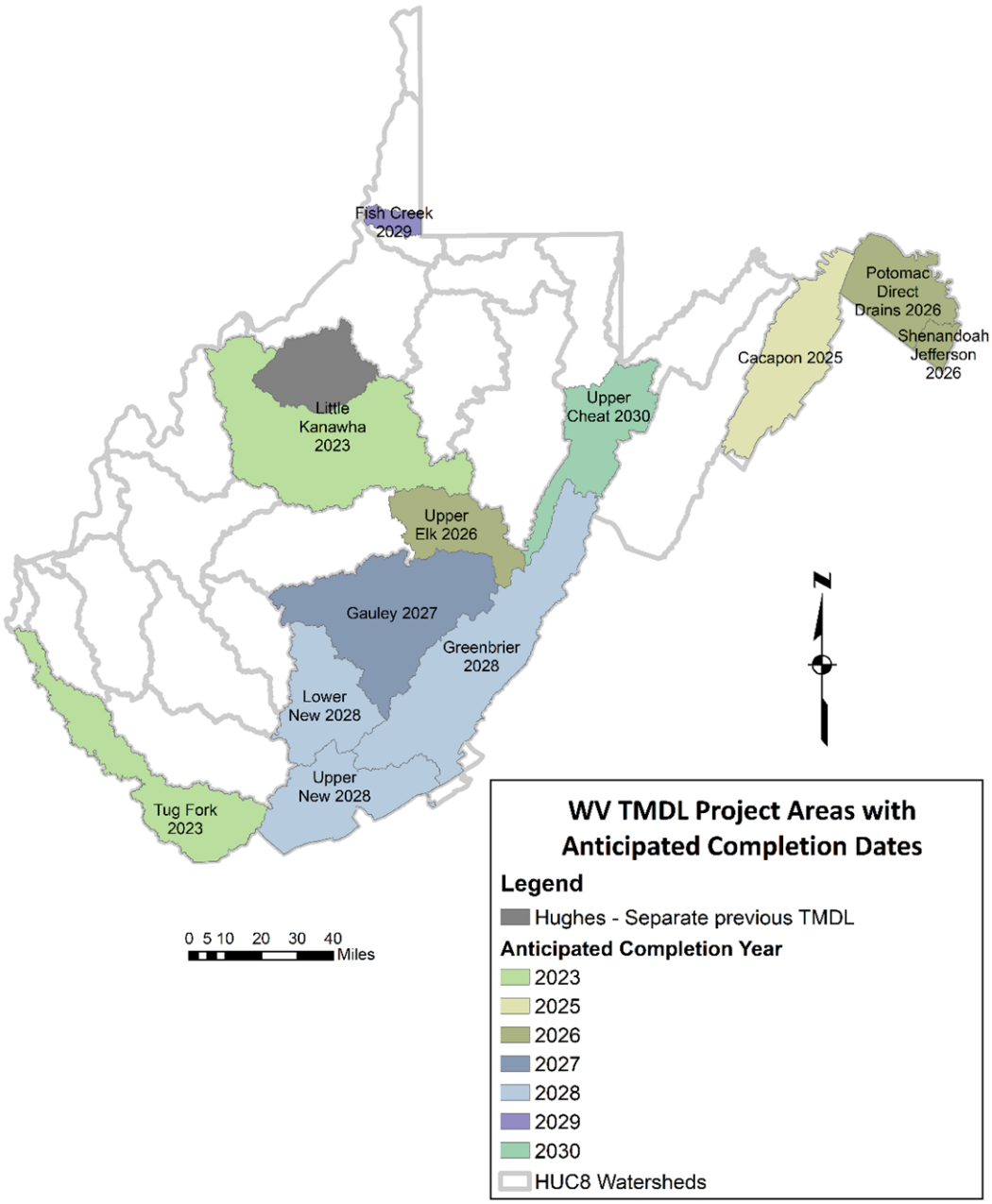

Figure C-2: WVDEP TMDL Projects with Anticipated Completion Goals.

Restoration Goal

"States, territories, and tribes design TMDLs and other restoration plans to attain and maintain water quality standards, facilitate effective implementation, and drive restoration of impaired waters." (USEPA, 2022)

In addition to the TMDL projects described above, WVDEP has pursued TMDL alternatives or Advanced Restoration Plans in specific situations where narrative water quality criteria are not

being met. As discussed previously, plans exist for filamentous algae in the Greenbrier River and are being prepared for biological impairment in the Cacapon River watershed.

Greenbrier River filamentous algae monitoring will continue each summer as the POTW upgrade processes and operator training become established. We will track progress and anticipate delisting the remaining AUID still listed for filamentous algae.

Included in the Cacapon project is a pilot ARP for selected streams that are biologically impaired due to organic enrichment associated with nutrients. This is the first ARP for biologically impaired streams planned by WVDEP. Once completed, WVDEP will apply lessons learned to potentially complete similar studies within the framework watersheds in subsequent years.

Developed by the USEPA in the 2022, the Recovery Potential Screening Tool (RPST) is undergoing testing and adaptation for use with WV's 12-digit HUC watersheds. Considering (a) the primary stressors of impairment and (b) recovery implementation needs, along with (c) the -demographic census data related to education and income; the RPST will be used to guide or advise on which watersheds to focus recovery & implementation efforts. As we progress along the watershed framework, target 12-digit HUC groupings will be analyzed with the RPST for monitoring or implementation potential to determine if communities would benefit from technical assistance. Furthermore, it should serve as a valuable resource for watershed associations and their BMP goals.

The DWWM-WQSAS-Assessment Unit plans to work in coordination with the WIB group to provide technical assistance in the writing of Watershed Based Plans. This work would focus on areas of the state either (a) without active citizen groups that may have no interested people or enough resources to complete a plan, or (b) to assist a citizen group with the technical needs of a Plan. The Recovery Potential Screening Tool, completed TMDLs, the 303(d) impairment list, and the framework grouping will be used in combination to identify potential watersheds. Working with the WIB group will help focus resources and needs into areas to determine the final project watershed.

Based on monitoring results, TMDL results, geologic information, and other data, WQSAS assists other interagency groups by locating and prioritizing impairments, documenting improvements, and distributing results. WQSAS staff will continue monitoring acid rain influenced streams that have current liming efforts by the DNR to assist with dosage regulation and before/after analyses. WQSAS staff will work with the Division of Land Restoration (DLR) within WVDEP to obtain funding for monitoring acid mine drainage (AMD) and abandoned mine land (AML) streams before and after reclamation projects. Story maps will be created to visualize and distribute the results of these special studies within West Virginia.

Protection Goal

"In addition to recognizing the protection benefits that TMDLs and other restoration plans can provide, states, territories, and tribes may develop protection plans to prevent impairments and improve water quality, as part of a holistic watershed approach." (USEPA, 2022)

Utilizing and evolving the policies aimed at protection or anti-degradation is already adopted as a goal of the WQSAS. The updating of Tier 3 streams with current data and generating GIS layers is a protection goal. Similar efforts regarding documented trout waters and collaboration with other agencies such WVDNR or USGS are planned. Another goal is establishing protection and designation of trout waters based on data indicating the highest probability of brook trout presence or seasonal/life stage brook trout use. These data would include proximity to documented trout waters, elevation, and stream temperatures.

Data and Analysis Goal

"The CWA Section 303(d) program coordinates with other government and non-governmental stakeholders to facilitate data production and sharing, and effectively analyzes data and information necessary to fulfill its multiple functions." (USEPA, 2022)

While the WQSAS has been conducting Continuous Instream Monitoring (CIM) for years; this data was not previously assessed due to lack of methodology. A goal for this 2024 Integrated Report was to develop an assessment methodology and include the results in this Integrated Report.

In target watersheds where pre-TMDL monitoring is occurring; WQSAS targets specific streams/watersheds in which to conduct storm sampling studies. These studies provide multifaceted data from storm events such as targeted time series data and site-specific weather data. One data goal is to more accurately identify how and when pollutants enter the stream to inform TMDL model validation. A sub-goal of storm studies is to identify unique sources of pollutants to guide implementation efforts in load reductions.

Designated staff in the WQSAS-Assessment Unit have a Data Analysis & Partnership goal regarding directed enhanced methods with submitted laboratory data. Closer communication with the DWWM-Quality Assurance Program addresses data requiring re-analysis as well as effective notation of unique data points needed for later assessment.

Partnership Goal

"Partnerships Goal: The CWA Section 303(d) program meaningfully communicates and collaborates with other government programs and non-governmental stakeholders to restore and protect water quality effectively and sustainably." (USEPA, 2022)

Currently DWWM-WQSAS-Assessment Unit staff are working with WIB, TU, NRCS, USDA, Farm Bureau, USGS, and others to establish relationships and facilitate landowner participation in the Cacapon River area ARP.

Connecting back to the watershed framework as described above in Strategy, the framework provides cross-program partnership coordination with the National Pollutant Discharge Elimination System (NPDES) program. This allows us to consider prioritizing watersheds for TMDL development where permits are planned for issuance, reissuance, or renewal.

Furthermore, the DWWM-WQSAS-AU plans to work closer with agency groups including the State Revolving Fund (SRF), Watershed Improvement Branch (WIB), DMR-Abandoned Mine Lands (AML) restoration, In Lieu Fee projects, DNR liming for acid deposition, 319, and NRCS for agriculture-related endeavors when deciding which projects to perform pre and post monitoring, data analysis, and story map development.

What could be considered a dual-goal of Partnership & Program Capacity is the recent re-organization in WVDEP-DWWM. The Water Quality Standards section has been integrated in with the Watershed Assessment Branch to form the mentioned Water Quality Standards & Assessment Section (WQSAS). This effort will enhance the agency's ability to address issues such as Tier 3 streams, Trout Water designations, and Wetland 401 concerns with assessment data.

Program Capacity Building

The DWWM-WQSAS-AU has a goal of building meta data explaining processes when shapefiles are sent out to public and used interagency. Also, current staff are writing R-code scripts to run all assessments for an Integrated Report cycle. This will ensure that future staff can perform most assessments within a reasonable amount of time, even with WVDEPs large datasets.

Conclusion

Serving the citizens of the State of WV, as well as fulfilling the charge as outlined for our agency, continue to be priorities for the WVDEP-DWWM-WQSAS. The above content is in line with and meets the intentions of the 2022-2032 Prioritization Framework as outlined by the USEPA. The Goals as outlined are both achievable and targeted to the needs over the 10 years Vision 2.0 timeframe. Status updates of current and upcoming priorities will be addressed as directed in subsequent Integrated Reports.