



West Virginia Dept. of Environmental Protection
Division of Water and Waste Management
Watershed Assessment Branch
John Wirts, Program Manager

Introduction

The goal of WVDEP's probabilistic monitoring program is to provide statistically unbiased estimates of stream condition throughout a region (i.e., watershed, ecoregion or state) without assessing every stream mile in that region.

The target population for these efforts was small to medium sized (*1st - 4th order*) wadeable streams. Ninety-eight percent of West Virginia's stream miles are of this size class and approximately 70% of these are wadeable. The design used for this summary allows DEP to characterize overall water quality conditions at an ecoregion scale (*Figure 1*), basin scale (*Figure 2*), and statewide. The basins are groups of four to six 8-digit HUC watersheds that provide data sufficient to develop estimates of condition with small confidence boundaries.

Figure 1. West Virginia Ecoregions

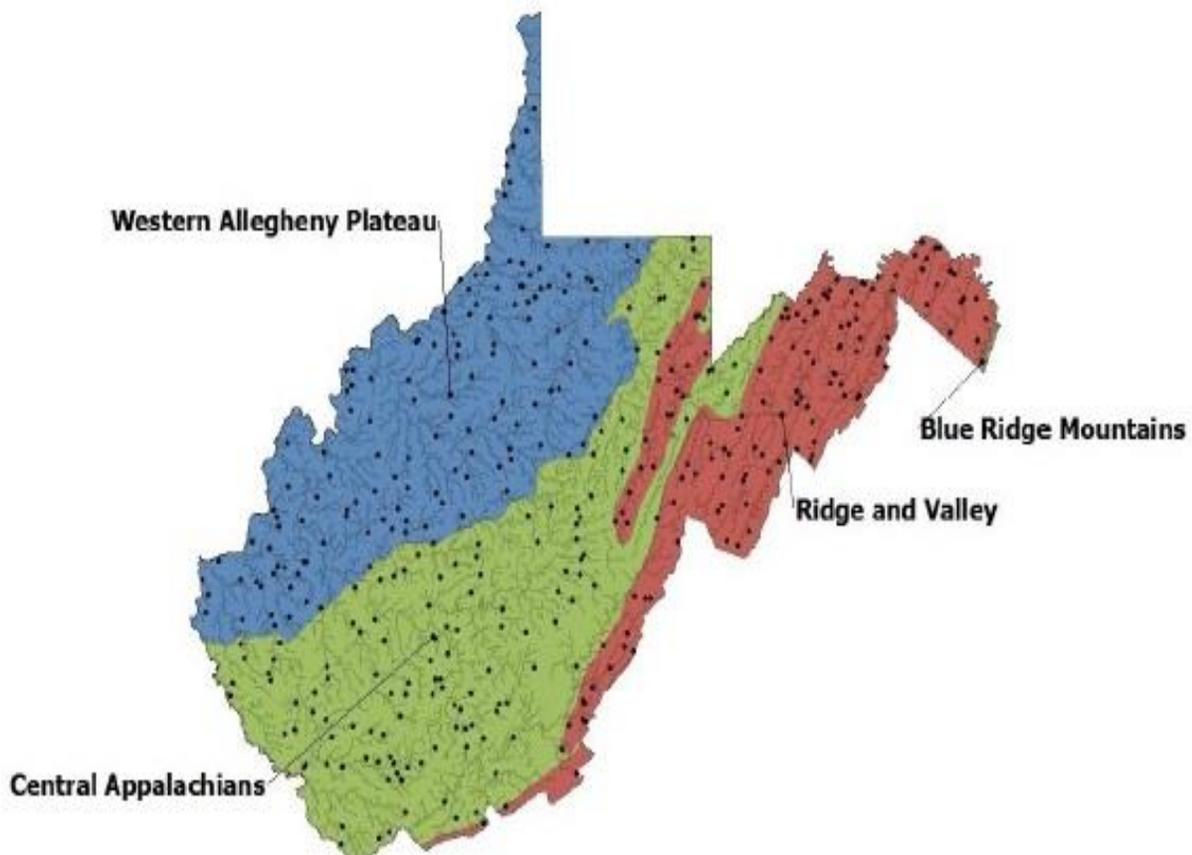


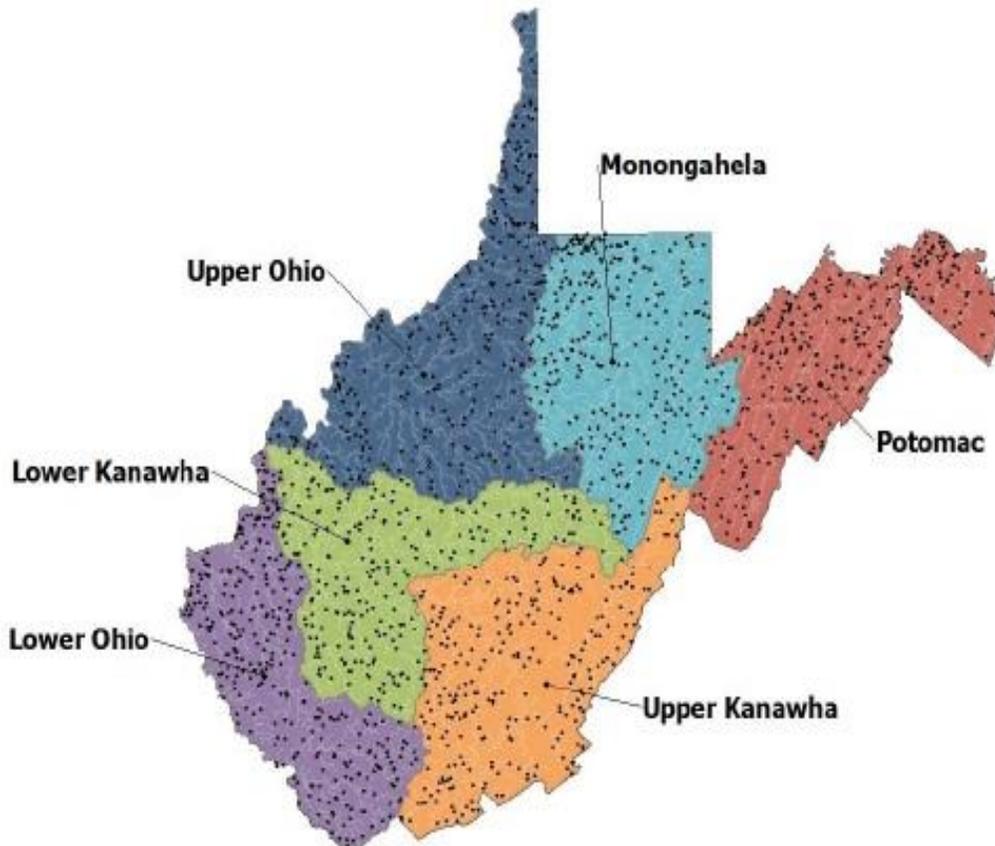


Table 1. Indicator categories

Biological	Habitat
<i>Genus level macro-invertebrate IBI</i>	<i>Overall habitat condition</i>
Water quality	
<i>Conductance</i>	<i>Acidity</i>
<i>Sulfate</i>	<i>Phosphorus</i>
<i>Bacteria</i>	

The selected sites are assessed using three broad categories of aquatic integrity indicators: biological community quality; water quality; and habitat quality. From these, several individual indicators (*Table 1*) were chosen to help illustrate the condition of West Virginia’s rivers and streams. They are presented for statewide, the ecoregions and six basins.

Figure 2. West Virginia basins



Biological conditions

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 and exhibit a wide range of tolerances to pollutants. Furthermore, they serve as an excellent tool for measuring overall ecological health, especially when summarized into a single index of biological integrity.

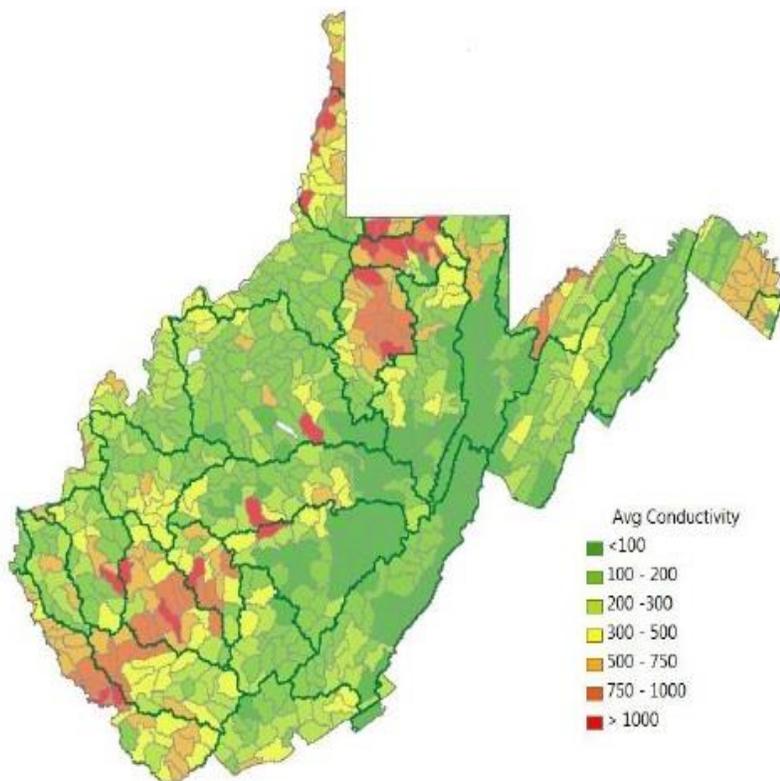


Based on the data utilized in this summary and a comparison reference conditions, 64.3% of wadeable stream miles have scores equal to or above an acceptable threshold (i.e., generally in good biological condition) statewide. Ridge and Valley has the highest percentage of streams with healthy aquatic ecosystems, with 82.4%. The Western Allegheny Plateau ecoregion scores lowest with an estimated 55.8% of stream miles comparable to reference. The percent of stream miles in the Central Appalachians scoring above the acceptable threshold is estimated to be 63.3%. Among basins, the Upper Kanawha had the highest percent of streams miles (70.8) above the reference threshold, while the Lower Ohio had the fewest (45.7).

Conductivity

Conductivity, or specific conductance, is a measure of how well water conducts electricity which is determined by what and how much is dissolved in the water. In certain areas, conductivity is naturally elevated because of calcium and other minerals dissolved from limestone and other soluble rocks. In others, it is high because of added pollution from a variety of sources.

Figure 3. Average conductance by basins



In general, West Virginia streams have relatively low conductivity – with 80% of wadeable stream miles statewide having late spring /early summer levels below 300 uS/cm. Conductance was variable throughout the ecoregions, with the high conductance streams often associated with coal mining. The map in *Figure 3* shows average specific conductivity by 12-digit HUC watersheds using all available data (not limited to probabilistic data). The higher conductivity values in the eastern panhandle is attributable to the limestone geology of the area.

Sulfate

Streams receiving mine drainage may be impaired by low pH and/or elevated concentrations of metals,

including iron, aluminum, and manganese. Other dissolved ions such as sulfate may also be present in



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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 18.5% of the stream miles statewide are influenced by mine drainage; observed on an ecoregional basis, mine drainage influences a greater proportion of stream miles in the coal rich Central Appalachians (30.5%).

Bacteria

Many West Virginia streams contain elevated levels of fecal coliform bacteria. Contributors to the problem include leaking or overflowing sewage collection systems, illegal homeowner sewage discharges by straight pipes or failing septic systems, and runoff from urban or residential areas and agricultural lands. Based on probabilistic data, 14.0% of stream miles in the state have fecal coliform bacteria levels that exceed the criterion of 400 colonies/100mL.

The proportions of stream miles exceeding the criterion were considerably lower in the Central Appalachians at 7.7% and Ridge and Valley Ecoregions at 5.7%. It should be noted that DEP'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 results. The Upper Ohio and Lower Ohio basins had the highest percent of stream miles exceeding the bacteria criterion with 22.9% and 20.3%, respectively.

Acidity

Aquatic life communities in the headwater sections of many West Virginia streams continue to be impacted by low pH, and thus, acidic water quality. The impairment is most prevalent in watersheds with soils of low buffering capacity and most often caused by acid precipitation and less often (but potentially more severely) by acid mine drainage. An evaluation of data indicates that approximately 7.9% of the stream miles in the state have pH values below 6.0. Most of the stream miles identified as impacted by acidic waters are in the Central Appalachians Ecoregion,

Phosphorus

A large proportion of total phosphorus (TP) from our probabilistic efforts have results that are below quantifiable reporting limits of the analytical labs. With nutrients considered one of the country's most widespread pollutants, having so many results below detectable levels are overall a good thing. From the data, we know that the Western Allegheny Plateau has the highest percentage of stream miles with TP greater than 50 ug/L (7.3%) as well as the lowest percentage of stream miles with TP below the lowest detection level (33.1%) and that approximately two thirds of stream miles in the Upper Kanawha basin have TP below the lowest detection limit of 10 ug/L.



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Habitat conditions

For the habitat evaluation, select conditions from EPA's Rapid Bioassessment Protocol (RBP) were measured. These include sedimentation, embeddedness, riparian zone and bank conditions. The complete RBP protocol consists of 10 qualitative habitat conditions scored (0-20). These are combined to determine an overall condition, and rated as good, moderate or poor. Based on the data, just 9.9% of stream miles statewide have good habitat quality, 73.5% of stream miles have moderate habitat quality, and 16.6% of stream miles have poor habitat quality. While these categorical thresholds are somewhat arbitrary, they do provide a good comparison of habitat conditions between geographic areas.

On an ecoregional basis, the Ridge and Valley had the highest proportion of stream miles rated in the good category for overall habitat quality at 19.9%. Additionally, this ecoregion had the least number of stream miles rated as poor for overall habitat quality. Total habitat quality scores are lower in the Western Allegheny Plateau. The presence of more widespread development and factors such as higher rates of soil erosion in this ecoregion are potential causes. Additionally, the percentage of stream miles with poor habitat quality (28.4%) is substantially higher in this ecoregion. The Upper Kanawha basin stands out as having the highest percentage of stream miles (35.1%) with good overall habitat. This basin includes large portions of the Monongahela National Forest and several undisturbed wilderness areas. The Upper and Lower Ohio basins have almost no miles in good condition and over a quarter of their stream miles in poor condition.

It is important to consider that approximately 90% of stream miles in the state are in the moderate or poor habitat categories. This indicates that most of the state's stream miles have at least some degree of habitat degradation.

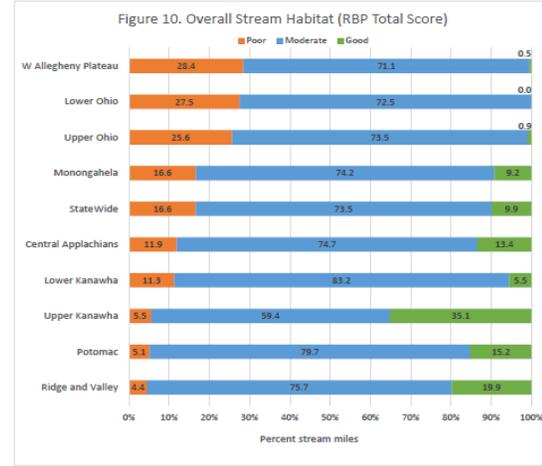
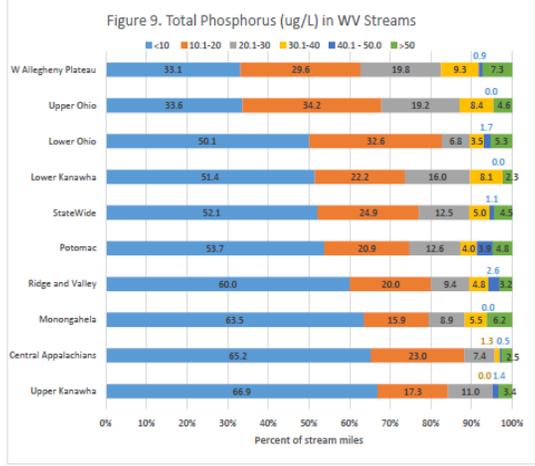
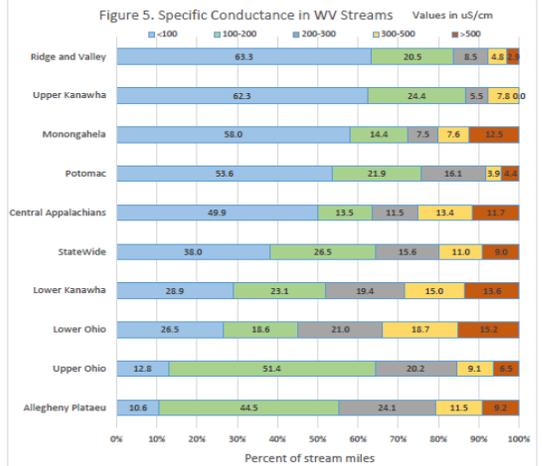
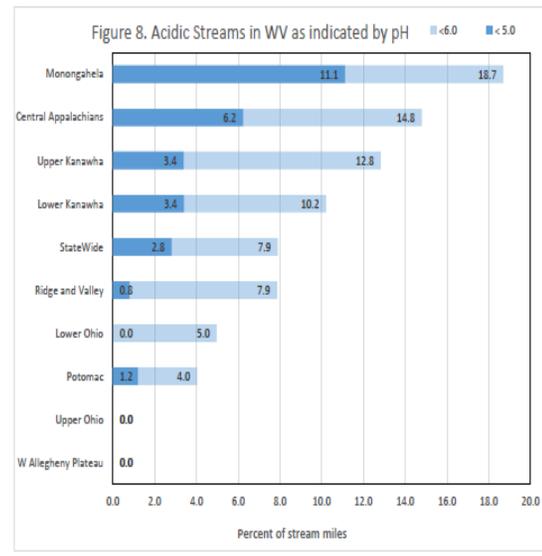
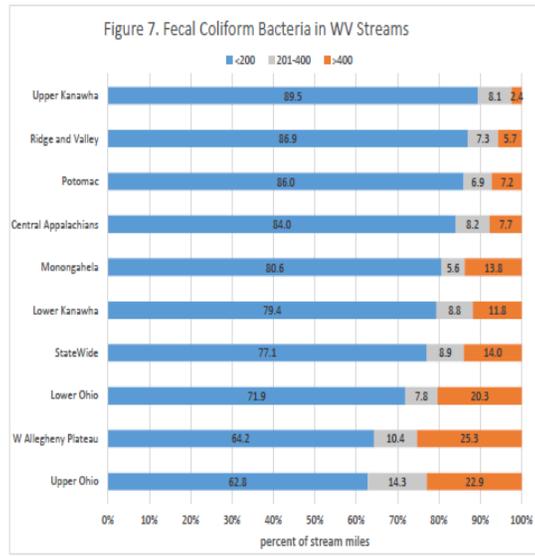
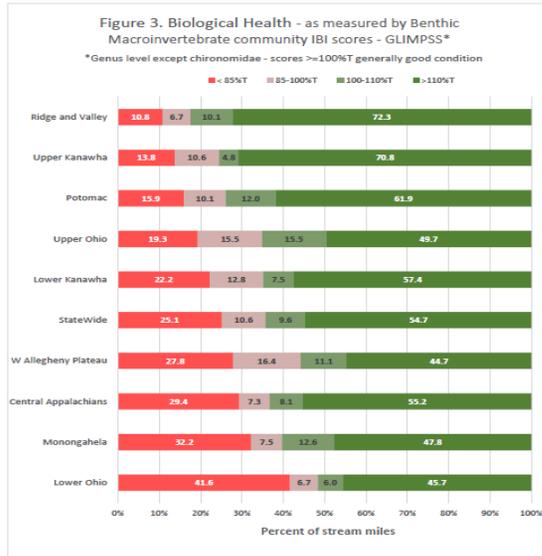


Figure 4. Select water quality conditions in WV streams