West Virginia's Water Quality Monitoring Strategy
Watershed Assessment Branch
Division of Water and Waste Management
Updated: December 2007

dep

west virginia department of environmental protection

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Introduction - Monitoring Strategy

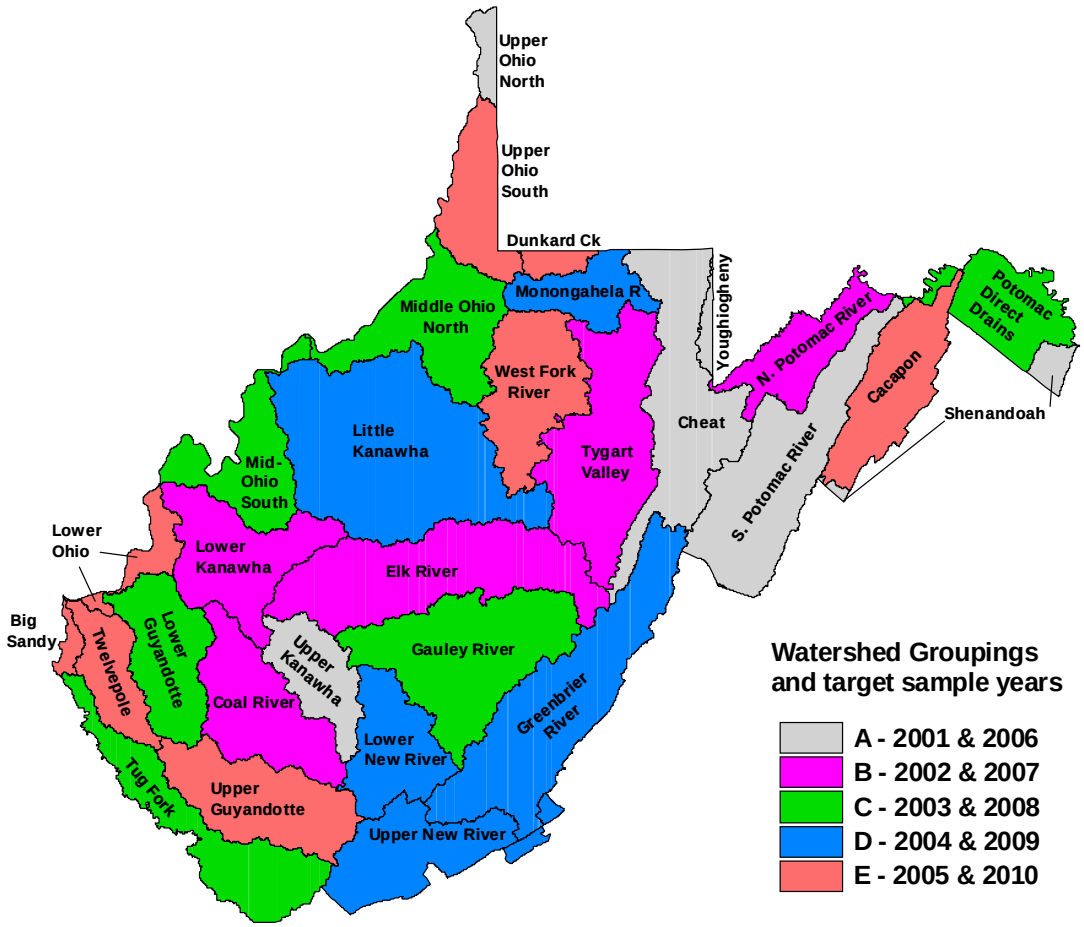
This document describes West Virginia's current strategy to monitor and assess all waters of the state. The report was initially developed in 2002, and was rewritten in 2004 to better describe our efforts as they related to the 10 *Elements of State Monitoring and Assessment Program* (EPA - March 2003). It was updated in July 2005 and approved shortly thereafter.

The West Virginia Department of Environmental Protection (DEP) regulates oil, gas, and coal extraction and monitors and enforces regulations involving solid and hazardous wastes, air quality and water quality. DEP's Division of Water and Waste Management (DWWM) collects much of the state's water quality data. The Watershed Assessment Branch of DWWM is responsible for surface water quality monitoring and watershed assessment.

In 1996, DEP's Office of Water Resources (now DWWM) initiated a new approach to address water quality issues by developing a statewide watershed management framework. The objective of the watershed management scheme is to coordinate the operations of existing water quality programs and activities in West Virginia to achieve shared water resources management goals. On May 29, 1997, eleven agency and program directors from state and federal water quality agencies signed a resolution of mutual intent to form a partnership for statewide watershed management. The goals of the watershed management partners are to: 1) improve public awareness; understanding and involvement; 2) improve program efficiency; 3) improve program effectiveness and cost effectiveness; and 4) improve information/data management. To achieve these goals, the state was divided into a set of 32 hydrologic regions, or watersheds (Figure 1) that are based on eight-digit hydrologic unit codes (HUCs). These watersheds have been grouped into five units to formulate a sequence for phasing-in the Watershed Management Framework, creating a five-year cycle (hereafter referred to as the "framework cycle"). Stakeholders plan their activities to coincide with this cycle.

Agencies and organizations inside and outside the framework contribute to the monitoring of West Virginia's water resources. The US Army Corps of Engineers manages 11 of the largest reservoirs in the state and collect water quality data from these waters. The West Virginia Division of Natural Resources (WVDNR) assesses streams & lakes for fish populations and in so doing, collect useful water quality information. WVDNR is also active in wetland monitoring tools development. The Ohio River Valley Water Sanitation Commission (ORSANCO) collects data from the Ohio River and its major tributaries. The Interstate Commission on the Potomac River Basin (ICPRB) collects and compiles data from waters of the Potomac River, which includes West Virginia's eastern panhandle. The WV Department of Health and Human Resources (DHHR) is responsible for the assessment of all public water supply systems. The National Park Service, The US and WV Forestry Agencies, Universities, Private Corporations and Volunteer Watershed Associations and many individuals, all collect and contribute data to help DEP monitor and assess the conditions of the state's waters.

Figure 1. West Virginia's Major Watersheds, showing 5-year framework cycle.



West Virginia has recently formed the WV Water Quality Monitoring Council that is made up of all of the above-mentioned agencies. The Council's plan is to have annual meetings to share data and to provide a forum for the coordination of sampling efforts in order to maximize the benefits of limited budgets. It is anticipated that this group will be a great resource in the development of a quality and cost-effective monitoring design for wetlands, which still lack a statewide monitoring effort.

The following paragraphs introduce monitoring efforts by waterbody type. The details of each of these efforts are further described under the nine remaining 'elements' - each of which is a separate chapter.

Streams and Rivers

West Virginia has a comprehensive strategy for monitoring the streams and rivers of the state. The Watershed Assessment Branch utilizes a tiered approach, collecting data from:

- long-term monitoring stations on large streams and rivers, *Ambient Sampling*
- long-term monitoring on smaller streams – LiTMuS sites (new in 2007)
- Deployed water quality meters – collecting 'continuous' data
- targeted sites within watersheds on a rotating basin schedule
- randomly selected sites
- and sites chosen to further define stream impairment in support of TMDL development.

These approaches are described under 'Monitoring Design' and other element chapters and include anticipated enhancements necessary to better assess non-wadeable streams

Timeline for future activities:

Streams

2007

- Collect benthic macroinvertebrate samples at our 'Ambient' sites to assess biological integrity of our largest rivers
- Continue the increased frequency of sample collections at Ambient sites to bi-monthly
- Begin new probabilistic survey that includes fish community surveys at subset of sites
- Begin assessment of nonwadeable streams, which will include the collection of fish

2008

- Refine non-wadeable assessment protocols

Lakes / Reservoirs

West Virginia makes no distinction between lakes and reservoirs. DEP will assess any lake, reservoir, or pond that meets the definition of "waters of the State" (WV State Code § 22-11-3), is owned by a government agency or public utility, and is managed as a recreational resource for the general public.

Timeline for future activities:

Lakes

2007 and beyond: Continue with targeted sampling of lakes according to 5-yr rotating basin approach.

2008 – Consider addition of appropriate biological indicator assessments.

DEP conducted lake water quality assessments from 1989 through 1996. This program was funded by the federal Clean Lakes Program, which was phased out in 1995. Without a federal funding source, DEP had been unable to perform water quality monitoring on the State's public reservoirs.

Our goal of starting our assessment of lakes in 2006 became a reality with the monitoring of 11 lakes in Hydrologic Group A watersheds. Samples were collected four times over the growing

season (May through October). Lake assessments continue this year, focusing on ten lakes from HG B watersheds. More information on the lakes program can be found in the Monitoring Design section.

This new lakes monitoring effort has resulted in the need to further define what a lake is. With many of our reservoirs, the retention time is so short that the waterbodies are more like 'wide spots in the river'. We are considering waterbodies with average summer retention times greater than 14 days as lakes; those with retention times less than 14 days will be considered lotic systems

West Virginia's largest reservoirs are controlled by the US Army Corps of Engineers (USACE). Although the USACE's primary mission is to manage structures to provide navigation and flood control, the agency also is committed to water quality management. Data generated by the USACE has been used for assessment purposes.

Additional lake information is available from the WV Division of Natural Resources (WVDNR). WVDNR conducts fish community surveys on many of the state's reservoirs.

Wetlands

Both the West Virginia Department of Environmental Protection (Watershed Assessment Branch) and the West Virginia Division of Natural Resources (Wildlife Resources Section) are interested in cooperating to develop a program for monitoring state wetlands for ecological health, functionality, and water quality. Currently, there exists no formal statewide program to monitor and assess wetlands across the state. The WVDNR, with collaboration from DEP, has applied for and received a grant to develop wetland monitoring tools for the state. WVDNR has applied the most current grant money towards the enhancement of the National Wetlands Inventory (NWI) for WV. Both WVDNR and DEP believe that this is an appropriate and needed project that will eventually allow for more meaningful surveys to be completed.

Managers from both the DEP and WVDNR have been participating in the Mid-Atlantic Wetlands Workgroup (MAWWG) to collaborate with other regional states in the development of useful wetland monitoring tools. DEP Watershed Assessment Section personnel are scheduled to attend several wetland courses in order further develop expertise within the monitoring section.

There are individual research projects being carried out by several local universities, and volunteers in the state are participating in a national program that monitors amphibian populations from wetlands. Data from this program are available and could be used to augment other monitoring that may develop.

Groundwater

The Ambient Groundwater Quality Monitoring Network was established by the DEP-DWWM in cooperation with the USGS in 1992 and is an on going project. The Ambient Groundwater Quality Monitoring 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 the state of West Virginia and to characterize the individual systems. Characterization of the quality of water from the major systems helps to (1) determine which water quality constituents are problems within the state, (2) determine which systems have potential water-quality problems, (3) assess the severity of water quality problems in respective systems, (4) and prioritize these concerns. Only by documenting present ambient groundwater quality of the State's major systems can regulatory agencies assess whether water quality degradation has occurred in certain areas and whether potential degradation is a result of natural processes or those associated with human activity.

Spatial variability in water quality is determined for specific geologic units based on probabilistic sampling of approximately 30 wells annually. Wells are selected in specific drainage basins in given years, rotating annually to new basins, thus providing sampling of ground water in all watersheds of the state over the five year period. Then, the cycle of sampling begins again. All associated groundwater quality data for each well sampled and summaries of groundwater quality for each respective watershed are published in the U.S. Geological Survey (USGS) Water Resources Data for West Virginia annual report.

Fish Tissue Monitoring

Information about fish contamination in West Virginia has been collected since the late 1970s. Beginning in the 1980s, the Division of Natural Resources and the Bureau for Public Health were issuing advisories and posting notices in the area of affected waters. DNR, BPH and DEP have maintained an informal technical work group composed of staff from each agency to assess, manage, and consistently communicate to the public issues related to fish contamination. Through Governor Underwood's September 2000 Executive Order, however, the agencies operate under a more formalized collaborative process through an interagency agreement to guide activities associated with fish consumption advisories. More information on fish consumption advisories can be found at: http://www.wvdhhr.org/fish/general.asp and information on specific contaminant values can be found in the WV Sportfish Consumption Advisory Guide at: http://www.wvdhhr.org/fish/current.asp.
The planned enhancements to our streams and lakes monitoring efforts will provide additional opportunities to collect much needed fish for the purpose of contaminant analysis.

Future modifications to existing strategy

Potential improvement to West Virginia's overall monitoring strategy include improvements to our already robust streams and rivers assessment programs; modifications to our recently resumed lakes program; and eventual development of a wetlands monitoring program. The development a wetland monitoring program is largely dependent on increased funding. With streams and rivers being the most dominant waterbody type in the state, it would be ill-considered to cut into the resources currently allocated to their assessment. The following table summarizes proposed improvements to our overall monitoring strategy.

Waterbody Type	Proposed Activity	Implementation timeline
Streams & Rivers	Development of *revisited sites*[1] list (see pg 14)	Initiated December 2006
	Increased monitoring of completed NPS improvement projects (pg 13)[2]	Ongoing
	Addition of fish assemblage monitoring[3]	Pilot (small) program in 2006
	Explore possibility of expanding fishing effort[4]	2007
Streams, rivers, & Lakes	Obtain electrofishing boat for large streams & lakes – utilize 106 enhancement $	Completed
Lakes	Develop better understanding of data & resources available from other agencies via Monitoring Council. (pg 3)	Ongoing
	Explore cooperative efforts / funding possibilities	2005 & beyond
	Begin WQ sampling effort	Ongoing, Began Spring 2006
Wetlands[5]	Cooperate with WVDNR in assessing appropriate monitoring tools (pg 6)	2007 & 2008
	Continue to participate in MAWWG (pg 6)	Ongoing
	Apply for grant money to apply newly developed tools -	2008
	Begin monitoring – scale dependent on funding (small pilot if $ limited or non-existing)	2009

[1] A list of 44 stream sites were developed in the winter of 2006-2007. These were sampled in the spring and summer of 2007. These sites (plus another 6 to 10 sites picked from existing pre-TMDL sites) will be resampled annually or semi-annually depending on suspected changes in their watersheds.
[2] WAS personnel have initiated a bacteria monitoring effort in streams /areas that are scheduled for new sewage projects.
[3] Fish were collected from eighteen sites in the summer of 2006. Fish assessments were added to the probabilistic survey for the 5-year effort started in 2007.
[4] WAS began collecting fish from non-wadeable streams and rivers (n =1 as of printing) in fall 2007.
[5] See discussion in Monitoring Design chapter.

Monitoring Objectives

This element defines the programmatic objectives of West Virginia's monitoring program to assure that the data generated serve the needs of decision-makers and meet the goals of the Clean Water Act. The data obtained are intended to support the following goals:

- Provide pertinent information in order to establish, review and revise water quality standards
- Determine the attainment of water quality standards
- Provide estimates on the condition / use support of all state waters
- Identify impaired waters (i.e. 303(d) List)
- Identify causes and sources of impairments (303(d) List and 305(b) Report)
- Support the implementation of new water management programs and the modification of existing programs
- Support the evaluation of program effectiveness.

West Virginia DEP's stream & rivers programs currently provide comprehensive information to meet all of the above stated objectives for the state's flowing surface waters. The Ambient Sampling Program addresses the current status and trends in water quality of the state's largest streams, while other watershed assessment activities assess the condition of the state's wadeable streams.

The lake program was developed in 2006 and future modifications to the program will be made with consideration to the objectives listed above.

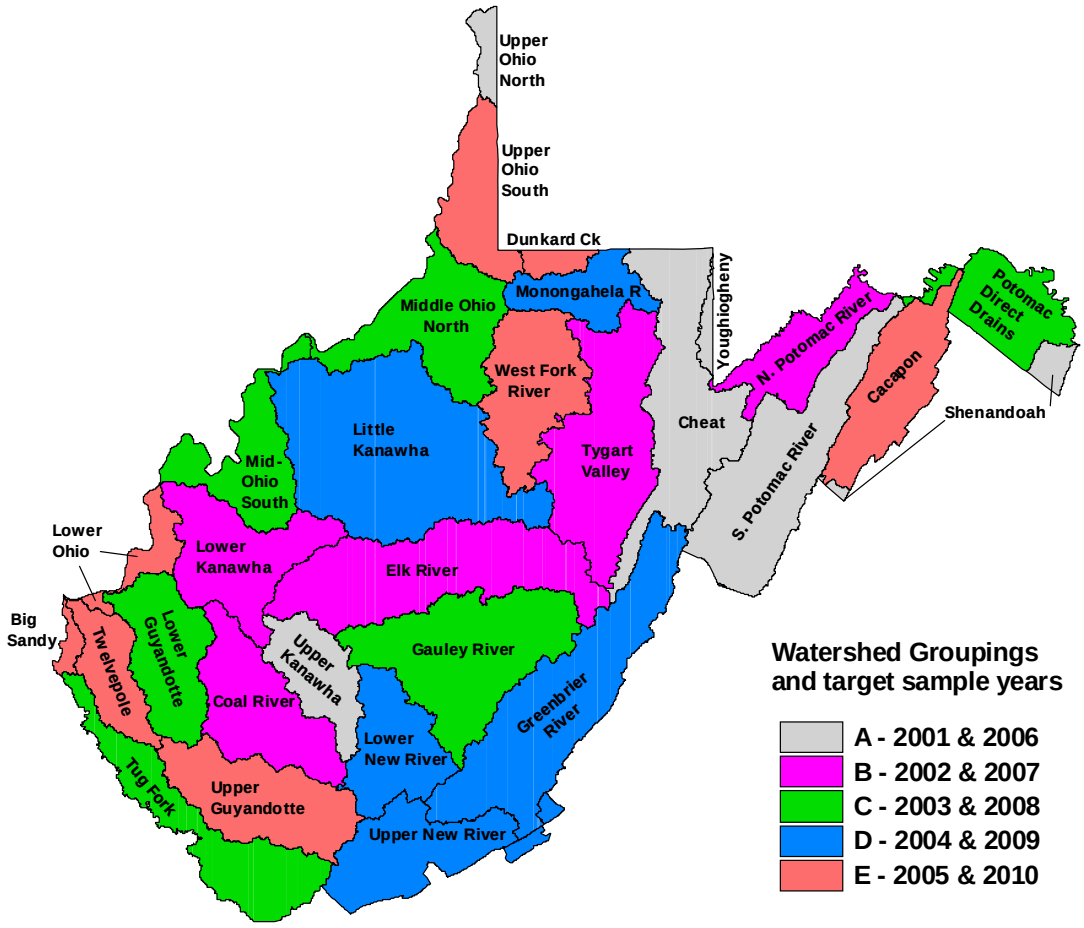
The wetlands programs will be developed with consideration to the objectives listed above.

The program has strived to maintain consistency in sampling protocols to allow the state to assess current overall quality and detect changes in water quality over time. DEP's probability-based effort should be most useful in providing a high degree of consistency in data collection and in reporting on not only current status and trends statewide, but also on the watershed and/or ecoregion scale around which our programs are designed.

Monitoring Design

West Virginia utilizes a combination of: a stratified probabilistic monitoring design; targeted sampling; long-term or "ambient" site network (largest streams and rivers); deployable water quality meters to collect continuous data; and a thorough pre-TMDL development sampling design to meet the objectives outlined in the previous chapter. In 2007, DEP added the 'LiTMuS' monitoring program, which entails annual sampling of wadeable streams throughout the state to better understand annual variation and track changes in different streams types. These programs are all managed by the same group (Watershed Assessment Branch) and strive to keep the previously stated objectives in mind when program designs are reviewed.

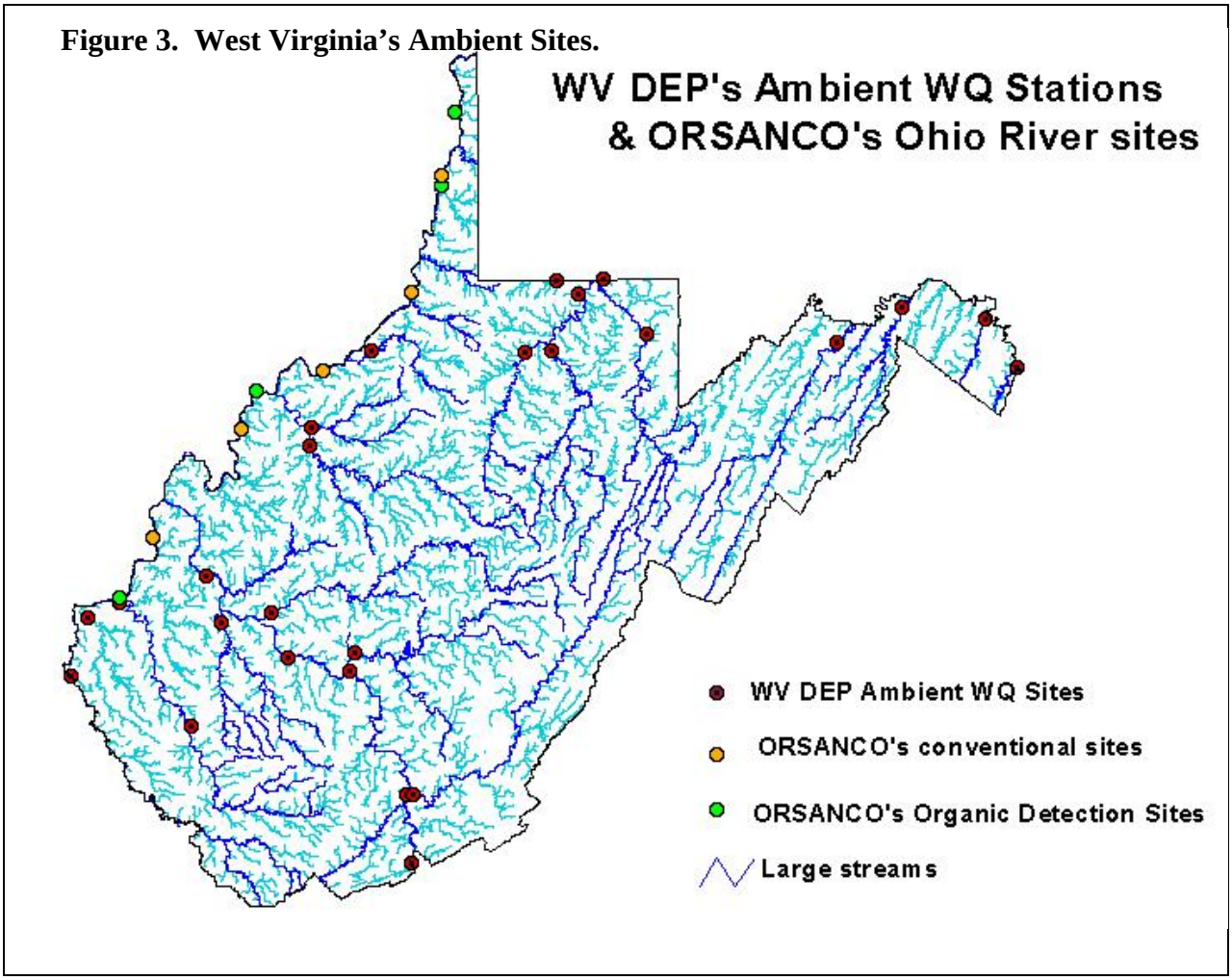
Figure 2. West Virginia's Major Watersheds, showing 5-year framework cycle.



The Targeted and Pre-TMDL sampling programs are based on a five-year rotating basin schedule, whereas the Ambient, Probabilistic and LiTMuS programs collect data statewide annually. The five-year approach, known as the Watershed Management Framework cycle, divides the state into 32 major watersheds. The watersheds are divided into five hydrologic groups (A - E). Each group of watersheds is assessed once every five years. A map depicting the 32 watersheds and the hydrologic groupings is shown above as Figure 2.

The Ambient Water Quality Monitoring (AWQM) Network was established in the 1960s, although it has undergone several modifications during this period. The network currently consists of 26 fixed stations (see Figure 3 and Appendix A), which are sampled bi-monthly. Sampling stations are located at the mouths of the state's larger rivers and additional sites are situated to isolate the impacts from major industrial complexes and other potential sources of impairment. The data provides information for trend analyses, general water quality assessments, pollutant loading calculations, and many other valuable uses. Macroinvertebrates will be collected starting in 2007 at sites where our wadeable streams protocols can be used effectively. It is hoped that fish will be collected at a couple of the 'ambient sites' as part of the non-wadeable assessment pilot project in 2007. Resuming biologic monitoring on these larger waterbodies will aid in assessing the aquatic life use.

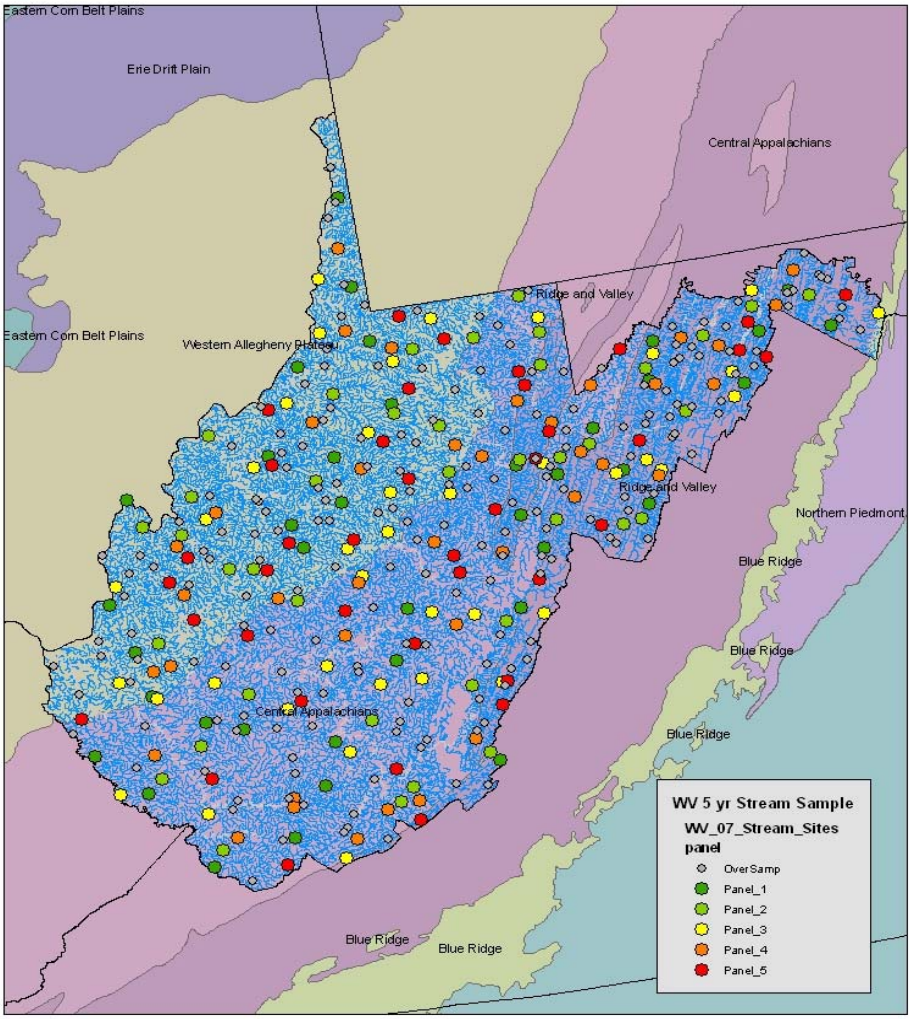
Figure 3. West Virginia's Ambient Sites.



DEP started its 3rd five-year cycle of ***probabilistic monitoring*** in 2007. As in the previous two rounds, it is designed to ensure adequate coverage across all watersheds and allows the state to characterize statewide estimates of water quality conditions of 1st through 4th order wadeable streams. Whereas previous probabilistic efforts were designed to allow the characterization of water quality down to the 8-dig HUC watershed level, the effort now underway will have the 3 major ecoregions as the primary reporting units. This allows for a reduction in sites per year: from 150 down to ~ 78. Half of the sites will be new sites and half will be sites that were sampled as part of our 2nd 5ive-year cycle. Approximately one-third of the sites will include the collection of fish community data.

As the program strives to enhance the monitoring of larger, non-wadeable streams, the use of a separate probabilistic design is being considered.

Figure 4. Sample sites for 2007-2011 Probabilistic Monitoring efforts



Targeted sampling has been a component of West Virginia's assessment toolbox since the Watershed Assessment Program's inception in 1996.

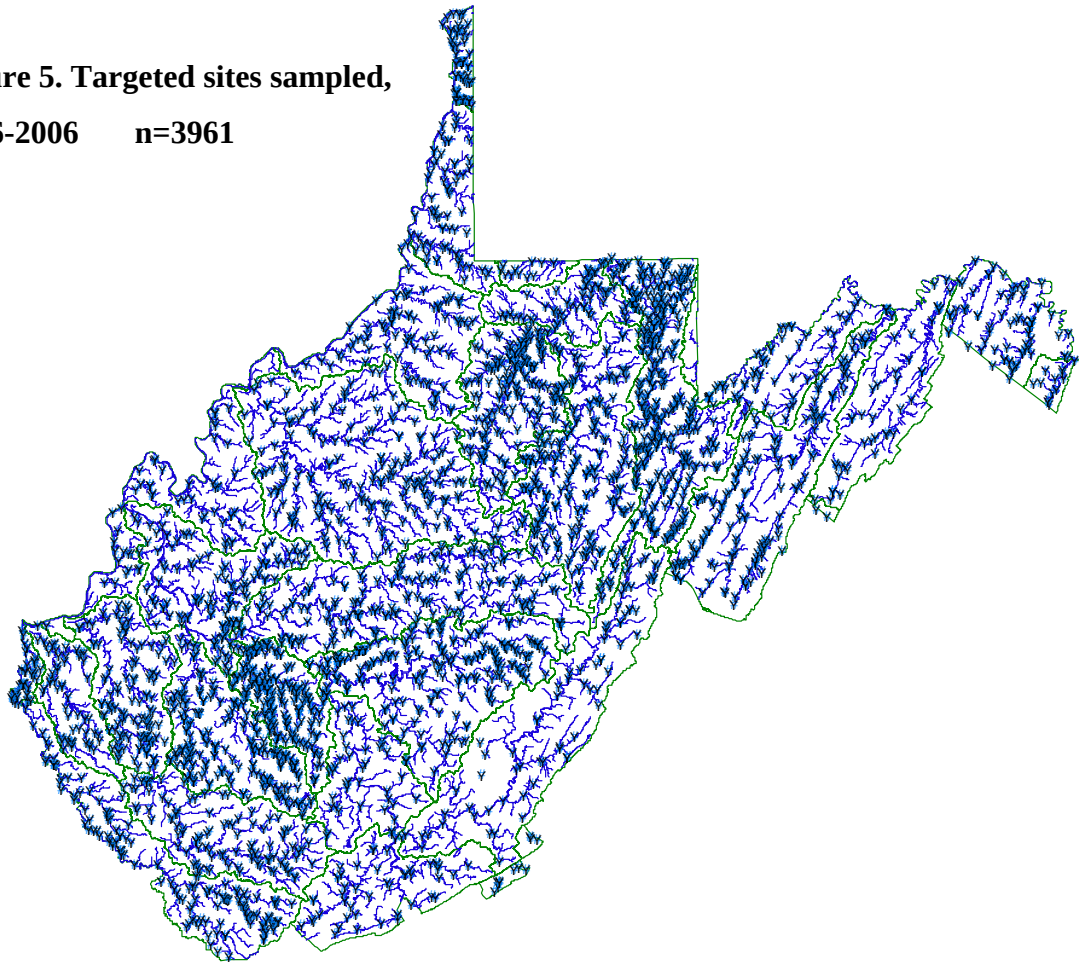
Streams are sampled according to a five-year rotating basin approach (See Figure 2). Sites are selected from the watersheds targeted for each particular year. Each site is subjected to a one-time evaluation of riparian and instream habitat, targeted water quality parameters, and benthic macroinvertebrate and periphyton communities.
Sites are selected to meet a variety of the stakeholders' needs and include the following classifications:

- Impaired streams
- Reference (minimally impacted) streams
- Spatial trends (multiple sites on streams exceeding 15 miles in length)
- Areas of concern as identified by the public and stakeholders
- Previously unassessed streams, i.e., "data gaps"
- Refinement of impairment
- Areas of concern as identified by other agency programs

Targeted sites are selected in the winter/spring prior to sampling. Site selection is "done by committee". After resources (personnel time is the primary constraint) are allocated to the Ambient, Probabilistic, and Pre-TMDL development monitoring programs, an estimate of how many targeted sites can be done within the remaining sampling season is determined. These resources are then allocated to the candidate watersheds (those slated for assessment in particular year of 5-year rotation) according to total stream miles. Once the allocations are made, the committee will assemble all available data and make final site selections, utilizing GIS coverages to identify areas previously unassessed, areas with likely problems (based on point-source and landuse information), and areas where previous assessments were ambiguous. Sites are added to 'unassessed areas' where any third order (or larger) stream was not sampled in the previous round of sampling. It is not the goal of the program to collect data from every named stream in the state. If these larger streams show signs of impairment, the upstream reaches will receive more attention in following years. The probabilistic design provides statistically valid estimates about the condition of all wadeable streams.

At the end of the 2005 sampling season, each of the 32 watersheds had been monitored twice. Most of the impaired reaches have been identified and will be further addressed when TMDLs are developed for their respective watersheds. With this in mind, some of the resources that had been used for targeted sampling will be shifted to more specific monitoring in areas where longer term and more informative data is needed. Targeted sampling will still occur, but will consume a smaller proportion of our personnel resources than it had in the past. The deployment of water quality meters to better understand daily changes in pH and dissolved oxygen has and will likely continue to increase; the collection of fish assemblage data is continuing; and efforts to assist the Non-Point Source Program monitor in areas where improvement projects have been or will be completed will likely increase as well. The NPS program currently has a minimal monitoring capacity, which is required in order to continue to receive 319 funding.

Figure 5. Targeted sites sampled, 1996-2006 n=3961

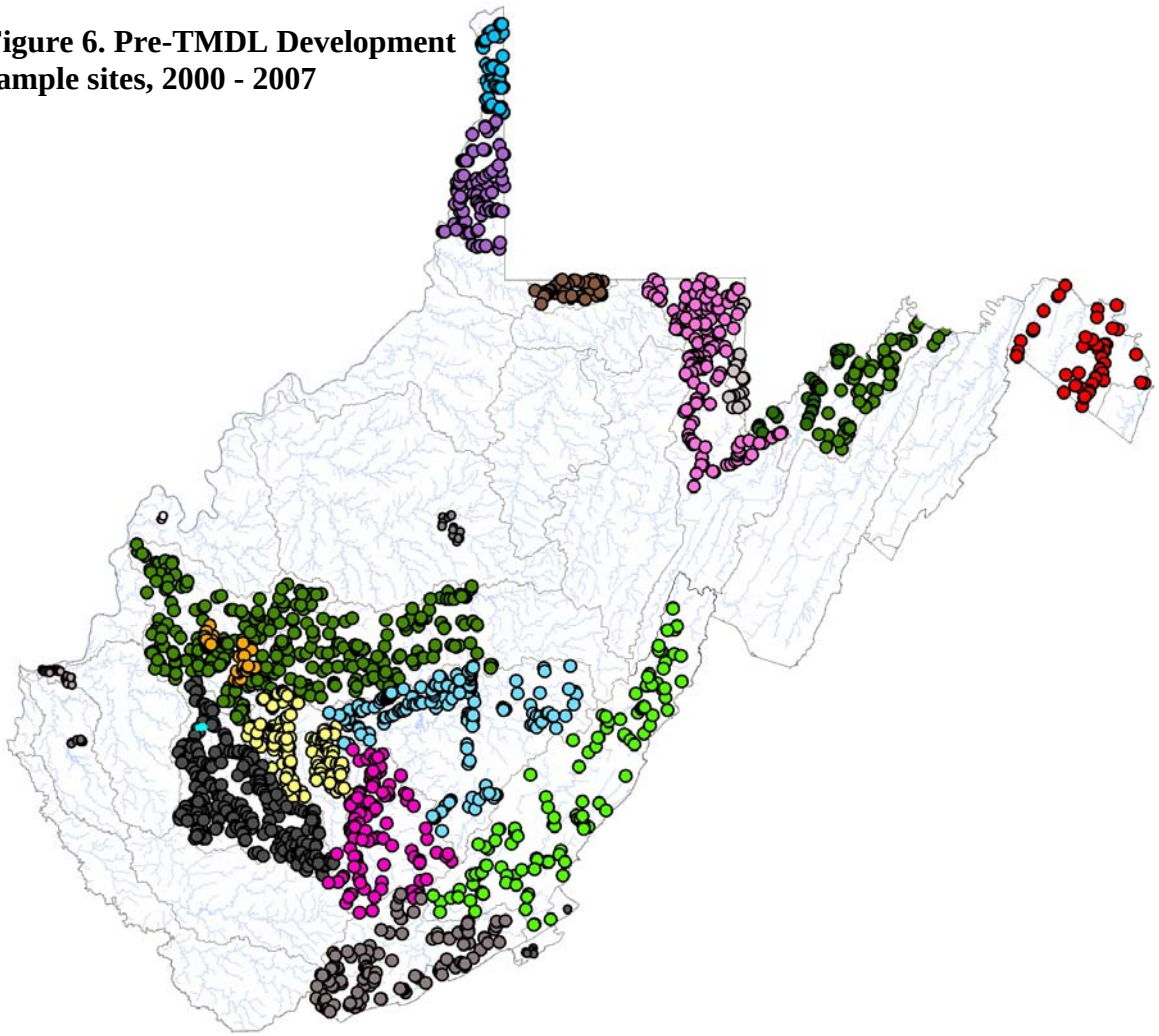


LiTMuS (Long-Term Monitoring Stations). One recognized shortfall was the lack of wadeable sites re-sampled on a regular basis. We have recently developed a list of stations (Appendix C) that will be revisited every year (possibly every other year for minimally impacted sites). Stations were primarily selected from those already sampled and that represented a wide array of unique and varying impairments (Acid Mine Drainage, Acid Rain, Sediment, etc.) as well as representing best attainable or reference conditions. Benthic macroinvertebrates, intensive habitat, and water quality data were collected at each site. Some selected sites may also be surveyed for fish. These sites were visited during early spring 2007 and will be sampled in subsequent years during the same months. Results from these sites, specifically any changes in benthic macroinvertebrate samples, will be beneficial in interpreting data from our other single visit samples.

Pre-TMDL development sampling. As DEP started the process to assume TMDL development responsibility from EPA, the need for more and newer data in developing useful TMDL's was

obvious. The objective of this effort is to collect sufficient data for TMDL modelers to develop stream restoration plans. Pre-TMDL sampling follows the framework cycle, i.e., impaired streams from watersheds in Hydrologic Group A will be sampled in the same year as the targeted sampling. The 303(d) list is the basis for initial site selection and numerous additional monitoring sites are added to allow identification of the suspected sources of impairment. Benthic macroinvertebrate sampling is conducted in 303(d) listed streams having aquatic life impairments. Assessment of water quality impaired streams is more intensive and consists of monthly sampling for parameters of concern. This method captures data under a broad variety of weather conditions and flow regimes. Pre-TMDL sampling also includes an effort to locate the specific sources of impairment, with particular attention to identify non-point landuse stressors as well as any permitted facilities that may not be compliant with the effluent limits set forth in their permit.

Figure 6. Pre-TMDL Development sample sites, 2000 - 2007



Citizen Monitoring

Another stream assessment project is the *West Virginia Save Our Streams* (SOS) volunteer monitoring program. Initiated in 1989, this program encourages citizens to become involved in the improvement and protection of the state's streams. The focus is largely on non-point source abatement. SOS has two objectives: 1) to provide the state with enhanced ability to monitor and protect its surface waters through increased water quality and benthos data collection; and 2) to improve water quality through educational outreach to the state's citizens. After citizens are actively involved in stream monitoring and restoration activities, they can initiate improvement projects within their own watersheds. Training workshops are conducted annually to provide quality assurance. The information becomes part of a database, which is used for program reports, public information and outreach, and for assisting other sections of DEP with the overall characterization of West Virginia's streams and rivers. Stream summary data is also entered into the Volunteer Assessment Database (VAD)**.**

West Virginia Source Water Assessment and Wellhead Protection Program

The mission of the West Virginia Source Water Assessment Program (SWAP) is to assess, preserve, and protect the state's source waters that are used to supply water for the state's public water systems. The West Virginia Bureau for Public Health (BPH), is the lead agency responsible for the state's SWAP. The 1996 amendments to the Safe Drinking Water Act require all states to adopt a SWAP program. The program is integrated with the Wellhead Protection Program and West Virginia Watershed Management Framework which networks with many state and federal agencies as well as other governmental entities. The stakeholder mosaic of the SWAP will include and encourage full participation extending from the largest governmental entity through local governments and individual members of the public. The goal of the SWAP is to prevent degradation of source waters that may preclude present and future uses of our drinking water supplies to provide safe water in sufficient quantity to users.

More information on West Virginia's source water protection efforts can be found at: http://www.wvdhhr.org/oehs/eed/swap/

Lakes

WVDEP resumed its assessment efforts of lakes and reservoirs in 2006. Eleven lakes from Hydrologic Group A were sampled four times over the growing period. This sample frequency was chosen in order to determine compliance with the phosphorus and chlorophyll A criteria recently proposed for lakes. In 2007, ten sites were selected from HG B for similar assessments. Field forms and database tables will continue to be modified as needed improvements become evident. Future lake sampling will continue to focus on lake water quality and evaluation of upstream drainage areas. Nutrients, dissolved oxygen, chlorophyll A, and clarity are the current parameters being measured. The use of fish community data will be difficult to use because of the extent of stocking and other management activities as well as the lack of any type of reference condition, however we do hope to include some biological monitoring (phytoplankton, zooplankton, and/or benthic macroinvertebrates) in the future.

Fish Tissue Analysis

With the addition of fish collection equipment, DEP will have the ability to collect fish for contaminant analysis more easily than in the past. It is anticipated that a subset of those fish collected at probabilistic sites will be analyzed in order to get a better understanding of the level of contamination by various pollutants statewide. The number of sites from which samples will be collected will depend on available funding. We currently have no funding source identified for this purpose, but will consider re-allocation of existing sources.

Screening values for fish consumption advisories are included as Appendices B & C.

Core and Supplemental Indicators

West Virginia's water monitoring program has a tiered approach that includes a core set of baseline indicators intended to evaluate each designated use. Targeted assessments include the collection of water for fecal coliform enumeration to address support of Contact Recreation Use and benthic macroinvertebrates are collected to measure the Aquatic Life Use support. Supplemental indicators are added when specific pollutants are suspected (e.g., Aluminum, Iron, and Manganese are analyzed at sites with suspected mine drainage). Probabilistic and Ambient Sampling programs include a wider array of indicators, and Pre-TMDL development include indicators that address the known or suspected cause(s) of impairment.

Core and supplemental indicators for stream sampling programs are presented in the following table. All data from these programs are considered for use support / impairment decisions as described in Data Analysis / Assessment Section. To find which indicators apply to which uses, see Appendix E of our current WQ Standards at: http://www.wveqb.org/2004finalfiledruleforadobe.pdf.

Table 1. Core (C) and Supplemental (S) indicators for Streams

Sampling Programs / Indicator	Targeted	Ambient[1]	Probabilistic	LiTMuS	Pre-TMDL[2]
Macroinvertebrates	C	S	C	C	S
Periphyton	C-		C		S
Dissolved Oxygen	C	C	C	C	C
Water Temperature	C	C	C	C	C
Conductivity	C	C	C	C	C
pH	C	C	C	C	C
Fecal Coliform	C	C	C	C	S
Habitat Assessment	C	C	C	C	S
Land use	C		C	C	C
Other field observations	C	C	C	C	C
Flow	S	C		C	S
Nutrients	S	C	C	C	S
Aluminum, Iron, Manganese	S	C	C	C	S
Trace Metals	S	C	C	C	S

1 See Table 1 of Appendix A for complete list of sample parameters

2 Pre-TMDL sample parameters are dependant upon the impairment identified or suspected. If biologically impaired, all indicators likely to have effect on aquatic life would be monitored.

Biological Indicators

Benthic macroinvertebrates are collected from riffle substrate in wadeable streams and identified to genus level. DEP currently uses the West Virginia Stream Condition Index (WVSCI), a family level multimetric index developed specifically for use in West Virginia. More information on the development of the index can be found at http://www.wvdep.org/Docs/536_WV-Index.pdf. This is the primary means of assessing attainment of the Aquatic Life Use. DEP is in

WV Stream Condition Index or WVSCI

The WVSCI consists of six benthic community metrics combined into a single multimetric index. The WVSCI was developed by Tetra Tech Inc. (2000) using WVDEP & EPA data collected from riffle habitats in wadeable streams.

WVSCI Scoring Criteria
> 68.0 Unimpaired
> 60.6 to 68 "Gray Zone"
< 60.6 Impaired

In general terms, all metric values were converted to a standard 0 (worst) to 100 (best) point scale. The six standardized metric scores were then averaged for each benthic sample site to come up with a final index score ranging from 0.0 to 100.0. Using the distribution of scores from all sites that are considered reference sites, an impairment threshold of 68.0 was established. If a stream site received a WVSCI score greater than 68.0, it was considered to be unimpaired. Initially, a site that received a WVSCI score equal to or less than 68.0 was considered impaired. However, because the final WVSCI score can be affected by a number of factors (collector, micro-habitat variables, subsampling, etc.), agency personnel sampled sites in duplicate to determine the precision of the scoring.

Following an analysis of the duplicate data, agency personnel determined the precision estimate to be 7.4 WVSCI points for a single sample. This value (7.4) was then subtracted from the impaired threshold score of 68.0 and generated what is termed the "gray zone" that ranges from 60.6 to 68.0. If a site had a WVSCI score within the gray zone, a single kick sample was considered insufficient for classifying it as impaired. If a site received a WVSCI score less than 60.6, the agency was highly confident that the site was truly biologically impaired based on that benthic macroinvertebrate sample.

the process of developing a genus level IBI for use in WV in conjunction with US EPA – Wheeling Office.

Lakes and Reservoirs

As stated previously, Secchi Disk measurements, TSS, Chlorophyll A concentrations, total phosphorus and nitrogen will be analyzed several times over the growing period. Field parameters (temperature, pH, DO, specific conductivity) will be measured from several profiles per lake. These data can be used to determine a Trophic Status Index score and determine if a lake is, or is susceptible to becoming, hypoxic or anoxic. A supplemental indicator may be benthic macroinvertebrate and/or algae community studies as well as landuse / land disturbance evaluations from the source watershed.

Wetlands

When implemented, wetland monitoring will likely use methods similar to the Ohio Rapid Assessment Method for Wetlands (ORAM)[6], developed by Ohio EPA. ORAM is a general assessment tool and has broad enough geographic applications to be applied to West Virginia wetlands. ORAM's protocols consist of on-site evaluations, no vegetative, animal, or water samples are collected. Among the core ORAM indicators are the size of the wetland, its water source and depth, and the duration of inundation. Surrounding land use, buffer zones, modifications and development are documented. Plant communities are documented on a

[6] Mack, John J. et al. August 1, 2000. Vegetation Indices of Biotic Integrity (VIBI) for wetlands and Calibration of the Ohio Rapid Assessment Method for Wetlands v. 5.0. ORAM documents are available online at http://www.epa.state.oh.us/401/401html

general scale (i.e., vegetative types vs. specific identification) and their density is documented. Invasive species and wetland topography are also documented.

Groundwater

The probabilistic sampling conducted by USGS includes data for selected properties and constituents that are grouped by geologic unit, topographic setting, geologic age, well depth, and season. The constituents include field parameters such as specific conductance, pH, oxidation-reduction potential, and turbidity; dissolved oxygen and other gases; bacterial counts of fecal coliform, total coliform, and E. coli; organic carbon, hardness, and acidity; ionic concentration of calcium, magnesium, sodium, potassium, bicarbonate, alkalinity, chloride, fluoride, bromide, sulfate, and dissolved solids; nutrients such as nitrogen including nitrate plus nitrite, and phosphorus; concentration of metals such as aluminum, antimony, arsenic, barium, beryllium, cadmium, iron, lead, manganese, zinc; radon, and a variety of hydrocarbons, volatile organic compounds, and pesticides. Other information on West Virginia's Groundwater program can be found at http://www.wvdep.org/dwwm/2004Report/index.htm.

Quality Assurance

DEP maintains a QAPP for its stream monitoring programs that generally adheres to the principles of EPA guidelines. This QAPP, which is updated annually and is provided to all data collectors, covers: watershed assessment; Pre-TMDL; and probabilistic sampling efforts. The Ambient Sampling Program's QAPP is currently a separate document and is being updated. We expect this to be completed by December 2007. The 2007 sampling protocols are available on our agency computer network drive. These protocols include descriptions of QA requirements for all aspects of the programs (habitat evaluations, GPS reading quality, biological collections, water quality – both field and lab parameters, etc).

The QAPP discusses project organization and description, sampling process and design, sample handling and analytical methods, QA/QC, and data management and evaluation. Standard Operating Procedures (SOPs) for each component of these studies are included in the QAPP as appendices.

Personnel involved in stream and river sampling attend a weeklong training session each spring, prior to watershed assessment sampling. All aspects of the programs are reviewed. Trainees break into small groups for hands-on experience with newly implemented and/or technically complex procedures. All new employees are paired with the most experienced samplers to further ensure consistency. Follow-up training sessions to re-emphasize particular aspects of sample collection are common throughout the year.

Contract laboratories that are certified by DEP's Quality Assurance Program carry out all (non-field determined) water quality analyses. More info at:
http://www.wvdep.org/item.cfm?ssid=11&ss1id=166

The following information pertains to all monitoring programs. All field-measurement instruments are calibrated according to the manufacturer's directions daily, or as needed. Calibration adjustments and repairs are documented in logbooks. Prior to the sampling season, all field personnel are required to attend an intensive on-site training session. Field crews are required to prepare field blanks and to conduct duplicate sampling at specified intervals. Surface water samples are sent to West Virginia-certified laboratories. Groundwater samples are sent to a USGS laboratory, which is certified by the National Environmental Laboratory Accreditation Conference. To maintain certification, laboratories are required to test blank, spiked, and duplicate samples at regular intervals (10%).

Contract laboratories for macroinvertebrate and periphyton identification are required to have a minimum of 2.5% of the total samples re-identified by an alternative taxonomist. The two results are compared and, if they fail to meet the minimum criteria, the discrepancies are investigated. In addition, the efficiency of macroinvertebrate sample processing is verified.

Upon implementation, QAPPs will also be prepared for wetland monitoring programs.

Data Management

Currently all targeted, probabilistic, and TMDL monitoring data, and now lakes data is managed in an Access database that was developed in-house and was originally based somewhat on the EDAS (Ecological Data Application System) format developed by TetraTech. WABBASE houses all water quality, habitat, watershed characteristics, macroinvertebrate data – both raw data and calculated metrics. At present most data is entered manually, however we are beginning to receive the laboratory derived water quality results electronically, and all DEP certified labs will be providing results electronically in the future (see description of EQuIS below).

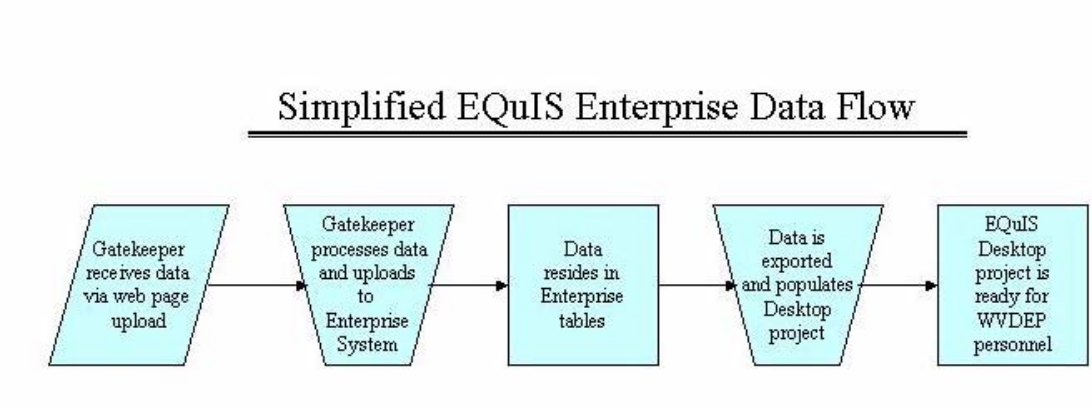
The results from our Ambient Program had not been included in WABBASE historically, but had been housed in EPA's STORET system for many years. West Virginia is a national leader in the use of STORET with nearly all water quality information generated by DWWM's Watershed Assessment Branch available for retrieval. We now have all recent data (~ last 10 years) from this program included in WABBASE.

As we develop our Wetland Monitoring programs, we will add components to WAPBASE to allow inclusion of these data. These data will also be uploaded to STORET assuming appropriate platforms exist to house them.

We have developed (and continually refine) reports and queries within our database that allow for easy retrieval of information for anyone who requests it. We would like to develop a web-based query tool to make our data even more available to the public. To that end, we are currently in the process of moving from an Access based platform to Oracle, which should make the goal of making our data available via our website easier. A centralized database is currently being developed for use by all of DEP. EQuIS (Environmental Quality Information System) which is based on Microsoft Office products, written for the Microsoft Windows operating system, and residing in an Oracle platform--provides an integrated suite of applications and a common database management system for all organizations involved in the data collection, processing, management and evaluation aspects of environmental project work. EQuIS has historically resided on a desktop platform. DEP, in conjunction with Earthsoft, is developing an agency wide Enterprise system for EQuIS, a first in the nation. By developing a central repository and a uniform format for the data collected, DEP's goal is to expedite the transfer of information and data between DEP personnel and DEP data providers. For the first time in the history of the agency, all of the environmental programs will be able to evaluate or cross reference each programs data for a given facility or project. This will increase efficiency by allowing DEP data providers to fully understand DEP requirements, and to communicate these requirements to its employees and contractors.

Along with being a central repository for data and information, EQuIS acts as an interface with many third party software packages. The EQuIS system uses ESRI's ArcGIS as a 'data broker' to serve data to several different analysis applications within a GIS environment. The EQuIS ArcGIS Interface provides a flexible yet simple means of accessing, analyzing, and viewing geology and environmental chemistry from within ESRI's ArcGIS. EarthSoft's EQuIS Chemistry and EQuIS Geology extensions make available many options for 1D, 2D, and 3D visualization

and modeling, as well as reporting and enhanced labeling options. The EQuIS interface will allow management to make effective and timely decisions without the complication of needing to process data for the modeling programs used. It is anticipated that routines will be included in EQuIS that will frequently update STORET.



Data will be delivered via a web page in an electronic data deliverable format (EDD). These are a series of tab delimited files which have been pre-defined by DEP. DEP has adopted EPA Region 2 format for chemistry EDDs. This format is now called the Multi-Media Electronic Data Deliverable (MEDD) and has been adopted by several EPA regions including Regions 1, 2, 3, and 5 along with several other states. The Geo_Lite format, part of the MEDD format, is not robust enough for DEP geological data needs. Thus, DEP has adopted the existing EPA Region 5 format for geology EDDs. By adopting the data deliverable formats accepted by other federal and state agencies, DEP can readily share and transfer data with these other entities.

National Hydrography Dataset

West Virginia DEP has contracted with West Virginia University to update our existing stream coding conventions utilizing the streams that are part of 1:24k NHD. This effort includes tables that will allow the referencing of old stream codes to the new NHD segments. The initial coding has been completed and is in the process of being proofread. Upon completion of the process, this new dataset will become the standard by which all streams and rivers will be evaluated.

Data Analysis / Assessment

DEP's data analysis and assessment procedures are well described in the 2006 Water Quality Monitoring and Assessment Report or 'Integrated Report'. These procedures will be updated for the 2008 IR. The 2006 report can be found at: http://www.wvdep.org/Docs/12686_EPA_Approved_Final_Narrative_Only_M07.pdf.

DEP is planning on making several changes to the assessment methodology for 2008. Specific procedures are still being developed, but the goal is to better coordinate the listing assessment and TMDL development procedures. Rather than trying to delineate certain segments of streams that are not meeting criteria based on where sampling sites are; we are moving towards listing longer stretches of streams (entire length in most cases) when impairment is identified prior to the completion of the TMDL. The TMDL process, including the associated modeling, will be relied on more heavily to determine the extent of impairment.

The following pages describe the data assess process used for the 2006 Water Quality Monitoring and Assessment Report.

The primary focus of the Integrated Report is to assess water quality information and determine if the designated uses of state waters are supported. After use assessment, waters are placed into one of five categories as described in the introduction. Section 5 first describes the various protocols used to determine use impairment and place waters on the Section 303(d) List. It then describes the protocols to categorize the remaining waters where uses have not been determined to be impaired. If a water has any impaired use, it is placed in Category 5. Other waters may be placed in Category 1, 2, or 3, depending upon the available water quality data.

Listing Decision for Numeric Water Quality Criteria

The EPA's most recent guidance for assessment and listing encourages decision criteria commensurate with the implementation provisions of a state's water quality standards, such as the concentration value, exposure duration and allowable exceedance frequency as described in the Water Quality Standards section. Historically, EPA has encouraged 303(d) listing decisions relative to numeric water quality criteria to be based primarily upon the frequency of exceedance of the numeric criteria and the "10-percent rule." Usually, if more than 10 percent of the observed values exceeded the concentration value of an applicable numeric criterion, then the water was considered impaired and placed on the 303(d) List.

Typically, if an ample data set exists and exceedences of chronic aquatic life protection and/or human health protection criteria occur more than 10 percent of the time, the water is considered to be impaired. If the rate of exceedance demonstrated is less than or equal to 10 percent, then the water is considered to be meeting the designated use under evaluation. Ample data sets are defined as sets with 20 or more distinct observations. If fewer than 20 samples per station or representative area exist and three or more values exceed a criterion value, then the water also is considered to be impaired. For this scenario (three observed violations), if additional non-

exceeding monitoring results were available that would increase the data set size to 20 observations, a greater than 10 percent exceedance frequency would still exist.

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 exceedences of acute criteria are observed in any three-year period, the water is considered to be impaired.

If the data being evaluated is generated as part of a comprehensive network being monitored for a specific purpose, the data may be assigned a higher level of assessment quality, and the "10-percent rule" may be applied with confidence to data sets containing less than 20 observations per station. The primary example of an intensified monitoring program that generates higher assessment quality data is that which is conducted by DEP to support TMDL development. 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 is performed in conjunction with water quality monitoring. The information generated under this format is among the most comprehensive available for assessing water quality. Upon conclusion of monitoring, it is then necessary for agency personnel to 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 exceedences of a criterion are demonstrated.

Table 2. Numeric Water Quality Decision Criteria for Listing of Impaired Waters

Water Quality Criteria	Impairment Thresholds	Exceptions
Acute Aquatic Life Protection (Use Category B)	The water is impaired if two exceedences of acute aquatic life protection numeric criteria occur within any three-year period.	If, in the most recent three-year period, no exceedances of criteria are evidenced and at least 12 monitoring results are available, then the water is not considered impaired.
Chronic Aquatic Life Protection (Use Category B) Human Health Protection (Use Categories A and C)	The water is impaired if a greater than 10% frequency of exceedance is demonstrated in an ample dataset (20 or more available observations). The water is impaired if three exceedances of criteria occur with less than 20 available monitoring results. The water is impaired if a greater than 10% frequency of exceedance is demonstrated with less than 20 available observations, if the data being evaluated is of high assessment quality (> two violations).	If, for waters with regularly scheduled monitoring, in the most recent two-year period, no exceedances of criteria are evidenced and at least eight (8) observations are available, then the water is not considered impaired.

Table 2 summarizes the criteria used to make 303(d) impairment decisions relative to numeric water quality criteria.

Some streams have water quality data available at multiple locations. Segmentation of these streams is necessary to determine its impairments by applying the decision criteria to the available water quality data at each monitoring station. If available data at a particular station indicates impairment, the water is considered impaired both upstream and downstream until a station with available data indicates a non-impaired condition. In limited circumstances, deviation from that segmentation approach occurred through the application of professional judgment. Most cases of deviation involved an abundance of water quality information at multiple locations in a waterbody, where DEP determined that an integrated whole waterbody approach resulted in a more representative assessment of existing conditions. Other cases involved targeted or incidental monitoring of a specific streamflow condition at certain locations in a waterbody, and a lack of monitoring of that condition at other locations. DEP determined that water quality results from the monitored site would similarly exist at unmonitored locations, rather than labeling some sections impaired and others "supporting" based upon strict adherence to the segmentation procedure.

DEP does not intend to interpret the impacts of a single pollution event as representative of the current condition of a water if it is known that the problems have been abated. Similarly, the DEP 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. Data sets are screened for excessive clustering of monitoring, in space or time, to avoid misinterpretation.

The decision of whether to place a waterbody on the 303(d) List must be driven by sound science whether the decision is based on a review of water quality monitoring data or on values obtained from sophisticated water quality modeling efforts. The Clean Water Act recognizes both types of assessment as valid and appropriate. Certain waters are included on the 2006 303(d) List based upon modeling results associated with TMDL development. All such waters are currently in the final stages of TMDL development and modeling of their baseline condition indicates that pollutant reductions from existing sources are needed to ensure compliance with water quality criteria. In the majority of cases, water quality monitoring and predictive modeling reach consistent conclusions regarding the impairment status of waterbodies. In other cases, monitoring data may not be available, may not have been obtained at critical conditions or locations, or may not reflect the conditions that would exist if point sources were discharging at their permit limits. Evaluation of the results of predictive modeling is mandated by 40CFR130.7(b)(5)(ii) and the prediction of impairment through modeling is validated by applicable federal guidance for 303(d) listing. Where predictive modeling indicates that discharge in accordance with existing permit limits would cause violation of water quality criteria, the designated use of the water quality may be classified as "threatened," thereby subjecting it to 303(d) listing and TMDL development pursuant to 40CFR130.7(b)(5).

Evaluation of Fecal Coliform Numeric Criteria

Fecal coliform assessments were based on the previously described decision criteria for numeric water quality criteria. Given the complexity of this particular 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. Numeric fecal coliform water quality criteria are applicable to the Water Contact Recreation and Public Water Supply designated uses. Section 8.12 of Appendix E of the West Virginia Water Quality Standards states:

Maximum allowable level of fecal coliform content for Primary Contact Recreation 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.

A practical difficulty exists in accurate assessment of criteria compliance due to the resource commitment that would be necessary to perform monitoring at a sufficient frequency to make determinations using the geometric mean criteria, since the monthly geometric mean criterion is conditioned upon the availability of at least five distinct sample results in a month. The maximum daily" criterion is not conditioned by a minimum sample set requirement, but practical use of the apparent 10 percent exceedance allowance would involve at least 10 samples per month.

The most frequent and regular fecal coliform water quality monitoring conducted by the Watershed Assessment Section is once per month. That monitoring frequency precludes assessment of the monthly geometric mean criterion and hampers accurate assessment of the maximum daily criterion. Due to limited resources, more frequent fecal coliform monitoring could only be accomplished by significantly reducing the number of West Virginia streams and/or stations where water quality assessments are performed. The DEP does not consider that to be a reasonable alternative.

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

- 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.
- 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 insufficient data (two months per 12 months 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 nonsupporting (four months per 12 months exceedance), provided that the monthly geometric means were below the 200 counts/100 ml criteria.

The decision criteria does not provide for 303(d) listing of waters with severely limited data sets and exceedance (i.e., one sample in a five-year period > 400 counts/100ml). Such waters would be classified as having insufficient data available for use assessment. DEP will target these "fecal 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 immediately initiated, even though the water may not be included in Category 5 of the current Integrated Report.

Evaluation of pH Numeric Water Quality Criteria Data

For the 2006 303(d) List, the DEP evaluated all recent (July 2000 – June 2005) pH water quality data under the previously described listing criteria requirements for numeric water quality criteria. Waters were identified as impaired for pH if the data exceeded listing requirements criteria or if the water was previously listed and insufficient new data were available to reassess the water. The impaired lengths of certain streams were adjusted to recognize ongoing limestone treatment operations that have resulted in the attainment of the pH criterion in the treated segments.

Narrative Water Quality Criteria – Biological Impairment Data

The narrative water quality criterion of 47CSR2 – 3.2.i. prohibits the presence of wastes in state waters that cause or contribute to significant adverse impact to the chemical, physical, hydrologic and biological components of aquatic ecosystems. Streams are listed as biologically impaired based on a survey of their benthic macroinvertebrate community. Benthic macroinvertebrate communities are rated using a multimetric index developed for use in wadeable streams of West Virginia. The West Virginia Stream Condition Index (WVSCI) is composed of six metrics that were selected to maximize discrimination between streams with known impairments and reference streams. Streams with WVSCI scores of less than 60.6 are considered biologically impaired and included on the 303(d) List. Benthic macroinvertebrates are collected with a 500 mm mesh rectangular dip net. The kick sample is collected from the 1.0 m_2 area of substrate. Identifications are completed for a 200-organism subsample. The WVSCI was developed from data using these methods. Streams are listed as being biologically impaired only if the data was comparable (i.e., collected utilizing the same methods used to develop the WVSCI, adequate flow in riffle/run habitat, and within the current index period of April through October).

Streams with low biological scores are listed as having an unknown source/cause of impairment on the 303(d) List and most are listed, by default, for their entire length. It is doubtful that the entire length of every stream is impaired, but without further data, the exact length of impairment is unknown. Each listed stream will be revisited prior to TMDL development. The additional assessments performed in the pre-TMDL monitoring effort will better define the impaired length. The causative stressor(s) of the impairment and the contributing sources of pollution also will be identified during the TMDL development process. If the stressor identification process demonstrates that the biological impairment is not caused by a pollutant, then no TMDL will be developed.

Certain biologically impaired streams have been evaluated but they were not immediately placed on the 303(d) List or in Category 5. The impairment source for these streams has been linked to a pollutant for which a TMDL has already been developed. An example scenario would be a low biological score on a stream that has a TMDL developed for mine drainage. If the pollutant

reductions specified by the TMDL are achieved, the biological community would likely restore itself. In these cases, after careful evaluation, the stream was not listed or placed in Category 5 because the full implementation of an existing TMDL is expected to correct the problem. If implementation of the TMDL resolves the pollutant specific impairment but biological scores remain low, then the biological impairment would be listed and the stream would return to Category 5.

Narrative Water Quality Criteria – Fish 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. The DEP, DNR, and the Bureau for Public Health have collaborated on fish contamination issues since the 1980s; however, an executive order by the governor in 2000 mandated a formal collaborative process to issue fish consumption advisories. Fish consumption advisories are developed and issued in accordance with an interagency agreement. In the absence of specific body-burden criteria, the presence of contaminants in fish tissue in amounts equivalent to a two meal per month advisory is considered sufficient evidence of impairment.

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 streams. 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.

There are currently waterbody-specific fish consumption advisories on 15 state streams and five lakes for a variety of fish species and contaminants. Additionally, there is a general statewide advisory that recommends limiting the consumption of certain sport-caught fish from all West Virginia waters in relation 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 listing of waters based on fish consumption advisories is strongly supported by EPA. For PCBs, waters are considered impaired if at least one monitoring result for tissue from a commonly consumed species exceeds the two meal per month advisory trigger. In regard to mercury, West Virginia water quality standards contain a numeric body-burden criterion for methylmercury in fish tissue. The criterion for protection of public water supply and water contact recreation designated uses is 0.5 μg/g. In the Ohio River, the applicable ORSANCO body-burden criterion is 0.3 μg/g. Fish tissue mercury impairment decisions are based upon a direct comparison of available observations to the body-burden criteria.

Categorization of Non-impaired Waters

The following paragraphs describe protocols used to determine use support and to place waters in either Category 1, 2, or 3.

Use support

Stream segments that support **all** of the designated uses are placed in Category 1. This section describes the guidelines used by the DEP to demonstrate use-support for each of the designated uses.

Not all parameters with applicable numeric criteria must be monitored to determine use support. A supporting assessment is made if certain mandatory parameters have been monitored and those results demonstrate compliance with criteria. If monitoring results are available for "non-mandatory" parameters, they also must indicate compliance with the criteria for those parameters if a fully supporting assessment is made. For limited data sets (less than 20 samples per station), no criteria exceedences can be evident. If 20 samples per station or more are available, then compliance would be determined by application of the listing criteria (i.e., less than 10 percent exceedance rate for chronic aquatic life and human health criteria, less than two violations of acute criteria in a three-year period, no violations in the most recent two- or three-year period, as applicable).

Category B (aquatic life) designated uses

For this use to be supported, biomonitoring must have been performed and results must show a WVSCI score > 68.0. Also, there must not be any exceedance of any other aquatic life protection water quality criteria (less than 20 samples per station) or any exceedance of listing criteria (20 samples per station or more).

The WVSCI methodology can be applied only to wadeable streams. Most nonwadeable streams are part of the Ambient Water Quality Monitoring Network and are sampled quarterly for a variety of pollutant parameters. If no exceedance of listing criteria (for aquatic life criteria) is demonstrated and no other information demonstrates adverse impact to aquatic ecosystems, then the aquatic life use is considered supported.

Category A (public water supply) and C (contact recreation) designated uses

For these uses to be supported, at least one fecal coliform monitoring result less than 400 counts/100ml must be available. Also, there must not be any exceedance of any other human health protection water quality criteria (less than 20 samples per station) or any exceedance of listing criteria (20 samples per station or more) for the uses to be supported.

Category D (agriculture and wildlife) and E (water supply industrial, water transport, cooling and power) designated uses

For these uses to be supported, pH and dissolved oxygen must have been monitored and results must indicate compliance with criteria. Also, there must not be any exceedance of any other Category D and E water quality criteria (less than 20 samples per station) or any exceedance of listing criteria (20 samples per station or more).

Insufficient data and not assessed

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. Waters are placed in Category 3 if insufficient or no information exists to determine if any of the uses are being met.
The use is not assessed when there is some water quality data available, but not enough to conclude that the use is fully supporting or not supporting. The following situations produce an insufficient data designation:

- Instream monitoring results demonstrated criteria exceedences, but at a frequency insufficient to deem the use impaired (see Table 4)
- Water quality data is available for some parameters but is not available for mandatory parameters
- Biological assessment returned a gray result (WVSCI score between 60.6 and 68.0)

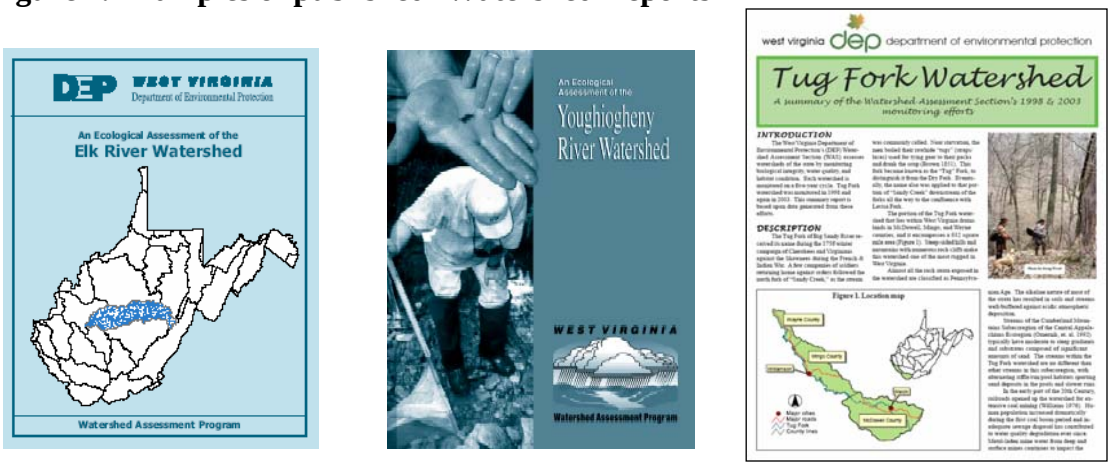
A use is not assessed if a stream has not been sampled within the last 15 years for any parameter that has an applicable water quality criteria for the use being evaluated.

Reporting

The Watershed Assessment Branch of DEP's DWWM has submitted 303(d) and 305(b) reports as required. West Virginia's first Integrated Report was submitted in 2004. This report combines the overall assessment of the state's waters (305(b)) with the listing of impaired streams (303(d)).

The DWWM also publishes reports on specific watersheds. There are fourteen "Ecological Assessments" published to date, which are currently available electronically at: http://www.wvdep.org/item.cfm?ssid=11&ss1id=718. These reports include: background information on historical landuse, geology, and topography; assessment methodologies; and a thorough results and discussion section. The amount of detail that has gone into the preparation of these reports and the associated time it takes to get these published has resulted in a re-thinking of how to make our data available to the public in a useful and timely way. Our reports have evolved to be much more streamlined with more detailed information available via our website or by request. The first of these more streamlined reports was published in 2007 (Tug Fork River Watershed). It is the goal of the program to have these reports developed within 12 months after all data has been received.

Figure 7. Examples of published 'Watershed Reports'



The Save our Streams program, which is funded under CWA 319, creates semi-annual newsletters that describe current issues and activities and are available on our website at: http://www.wvdep.org/item.cfm?ssid=11&ss1id=202. This program, which organizes citizen monitoring in the state, has hired a summer intern to develop a database for all citizen-generated data that can be accessed by anyone through our webpage. Other 319 funded activities are reported on in the Nonpoint Source Program's annual reports available at: http://www.wvdep.org/item.cfm?ssid=11&ss1id=588 .

Programmatic Evaluation

The intent of the Watershed Management Framework is to include the needs of a diverse group of agencies in the objectives and final products of DEP's monitoring efforts. DEP and USEPA Region 3 work closely to evaluate program objectives and outcomes. This process is continuous. Biologists in USEPA's Wheeling Field Office continue to be a vital resource regarding the biological components of DEP's monitoring programs. Meetings and workshops, such as the Mid-Atlantic Water Pollution Biology Workshop and the WV Monitoring Council, provide opportunities to share monitoring ideas and to discuss program successes and failures.

DEP continually evaluates its own monitoring processes and adjusts them to meet the needs of the end users. New monitoring components are added each year (e.g. LiTMuS Monitoring added in 2007). Biological monitoring has undergone a series of evaluations to make the program more efficient and more precise. Studies to address: how seasonality effects index scores; precision of our collection and scoring methods; verification of reference sites; and results from varying macroinvertebrate collection methods and subsampling procedures have been commissioned. Future revisions include the development of a genus-based WVSCI scoring mechanism and a Periphyton IBI. Further programmatic evaluation is provided by the QA/QC systems previously discussed.

Funding shortfalls and unforeseen resource drains, such as the chronic fish kills in the Potomac Basin, are always a problem. Existing staff cannot implement new biological components (i.e., fish communities) and wetland and lake monitoring programs without sacrificing the quality or the intensity of the other programs. The additional 106 "enhanced" funding meant to help address monitoring shortfalls has been and will continue to be used to support additional personnel and purchase equipment that will go towards the monitoring and assessment of our larger streams, rivers and lakes, which are currently underassessed.

As stated earlier, we are working with the WVDNR to develop wetlands monitoring protocols. With the start of our 3rd cycle of probabilistic sampling, our plans for this program element are now set through the summer of 2011. It is our plan to review and revise the monitoring strategy during the 2008/2009 winter season and submit an updated strategy document by July 2009. We will review all existing programs and evaluate the availability of funding as we consider the inclusion of wetlands monitoring, and modifications of our lakes and non-wadeable stream monitoring for the 2009 sampling season and beyond.

Obviously, if funding is made available for continuing wetlands monitoring (as opposed money only being for development activities), the likelihood of us including these waters in future assessments is increased.

General Support and Infrastructure Planning

The program currently relies on funding from the Federal Government's 106 grant program to assist in performing enhanced monitoring activities. Importantly, funding for the majority of monitoring activities in West Virginia is from state special and general revenue sources.

The current staffing levels are adequate to carry out the stream and river monitoring programs satisfactorily. Assuming the 'enhanced monitoring' 106 funding continues to be made available, we will be able to retain the additional staff (both permanent and temporary) necessary to continue with the improvements in the monitoring of our larger streams and rivers as well as a satisfactory lakes program.

Currently we do not have a good way to estimate the costs or needs for wetland monitoring, but believe that a wetlands program could be as spartan as simply developing an inventory via desktop computer, which could probably be carried out by a single GIS expert / biologist. Or it could approach a level of effort currently employed for our streams and rivers, requiring several biologists, a supervisor, additional data support, etc. Wetland monitoring will be considered at the end of 2007 when WV DNR completes their protocol development process.

The program utilizes contract laboratories for nearly all water quality analysis and for the processing and identification of biological samples. Strict quality assurance plans are included in all requests for bids, and potential vendors are evaluated on their ability to demonstrate that they can provide quality products. In order to better address the stakeholders in West Virginia and to more efficiently process an increase in data collected and provided, the Department of Environmental Protection has reorganized into four major divisions. The water quality monitoring section is now within the Division of Water and Waste Management and is organized to make better use of existing personnel and to match the needs of the Watershed Framework process.

The management of the Watershed Assessment Branch meets monthly and uses these meetings to discuss all aspects of the programs that fall under the Watershed Assessment Branch, including the progress of current programs, plans for future efforts, as well as funding and personnel issues.

APPENDIX A

Long-Term Monitoring or 'Ambient' Sites

#	STORET ID	Stream Name	ANCode	Watershed
1	BST-000-000.10	Tug Fork	WVBST	Tug Fork
2	K-000-032.20	Kanawha River	WVK	Lower Kanawha
3	K-000-076.90	Kanawha River	WVK	Upper Kanawha
4	KC-000-011.60	Coal River	WVKC	Coal
5	KE-000-004.50	Elk River	WVKE	Elk
6	KG-000-008.30	Gauley River	WVKG	Gauley
7	KN-000-001.20	New River	WVKN	Lower New
8	KN-000-068.40	New River	WVKN	Upper New
9	KN-000-099.00	New River	WVKN	Upper New
10	KNG-000-001.60	Greenbrier River	WVKNG	Greenbrier
11	LK-000-030.10	Little Kanawha River	WVLK	Little Kanawha
12	LKH-000-001.60	Hughes River	WVLKH	Little Kanawha
13	M-000-098.80	Monongahela River	WVM	Monongahela
14	M-001-0001	Dunkard Creek	WVM-1	Dunkard
15	MC-000-003.50	Cheat River	WVMC	Cheat
16	MC-000-031.10	Cheat River	WVMC	Cheat
17	MT-000-006.50	Tygart Valley River	WVMT	Tygart Valley
18	MW-000-012.50	West Fork River	WVMW	West Fork
19	O-002-0001	Twelvepole Creek	WVO-2	Twelvepole
20	OG-000-002.80	Guyandotte River	WVOG	Lower Guyandotte
21	OG-000-079.60	Guyandotte River	WVOG	Lower Guyandotte
22	OMI-000-012.90	Middle Island Creek	WVOMI	Middle Ohio North
23	P-004-0002	Opequon Creek	WVP-4	Potomac Direct Drains
24	PC-000-006.10	Cacapon River	WVPC	Cacapon
25	PSB-000-013.50	South Branch Potomac River	WVPSB	South Branch Potomac
26	S-000-000.90	Shenandoah River	WVS	Shenandoah Jefferson

APPENDIX B

Water chemistry parameters analyzed at Ambient Sites

CHARACTERISTIC	FRACTION		CHARACTERISTIC	FRACTION
Acidity as CaCO3	Total		Manganese	Total
Alkalinity, Carbonate as CaCO3	Total		Mercury	Total
Aluminum	Dissolved		Nickel	Dissolved
Aluminum	Total		Nitrogen, ammonia	Total
Arsenic	Total		Nitrogen, Kjeldahl	Total
Cadmium	Dissolved		Nitrogen, Nitrite + Nitrate	Total
Chloride	Total		pH	
Copper	Dissolved		Phosphorus as P	Total
Dissolved oxygen	Dissolved		Silver	Dissolved
Hardness, carbonate	Total		Specific Conductance	
Iron	Dissolved		Sulfate	Total
Iron	Total		Temperature, water	
Lead	Dissolved		Fecal Coliform	Total
Lead	Total		Total Suspended Solids	Suspended
Manganese	Dissolved		Zinc	Dissolved

APPENDIX C

List of Long-Term Monitoring Sites (LiTMuS)

Stream Name	AN-code	Mile Point	Watershed
Otter Creek	WVMC-60-F	0.2	Cheat
Red Run	WVMC-60-G	0.2	Cheat
Glady Fork	WVMC-60-K	21.4	Cheat
South Fork/Red Creek	WVMC-60-O-4	0.5	Cheat
Gandy Creek	WVMC-60-T-(S)	5.4	Cheat
Big Run	WVMC-60-T-8	0.1	Cheat
South Fork/West Virginia Fork/Dunkard Creek	WVM-1-F-7	1.0	Dunkard
Elk River	WVKE	175.2	Elk
Big Spring Fork	WVKE-138	0.0	Elk
Lilly Fork	WVKE-50-B	6.5	Elk
Sinnett Branch	WVKE-50-B-1	0.2	Elk
Big Branch	WVKE-50-B-3	0.0	Elk
Jim Young Fork	WVKE-50-B-7	0.0	Elk
Beech Fork	WVKE-50-B-8	0.0	Elk
Ash Fork	WVKG-5-H	0.3	Gauley
Howard Creek	WVKNG-25	0.4	Greenbrier
Knapp Creek	WVKNG-53	3.8	Greenbrier
East Fork/Greenbrier River	WVKNG-78	14.7	Greenbrier
Little Hurricane Creek	WVK-24	0.5	Lower Kanawha
Little Hurricane Creek	WVK-24	5.6	Lower Kanawha
Davis Creek	WVK-39	3.3	Lower Kanawha
Hoffman Hollow	WVK-39-M-1-A	1.0	Lower Kanawha
Patterson Creek	WVPNB-4	13.9	North Branch Potomac
Warm Spring Run	WVP-10	5.8	Potomac Direct Drains
Opequon Creek	WVP-4	11.6	Potomac Direct Drains
South Fork/Indian Run	WVP-9-G-2	0.1	Potomac Direct Drains
South Fork/South Branch Potomac River	WVPSB-21	5.5	South Branch of Potomac
Lunice Creek	WVPSB-26	0.4	South Branch of Potomac
North Fork/South Branch Potomac River	WVPSB-28	1.9	South Branch of Potomac
Big Run	WVPSB-28-EE	4.0	South Branch of Potomac
Seneca Creek	WVPSB-28-K	7.9	South Branch of Potomac
Panther Creek	WVBST-60	2.6	Tug Fork
Crane Creek	WVBST-60-F	0.1	Tug Fork
Hurricane Branch	WVBST-60-G	0.9	Tug Fork
Slaunch Fork	WVBST-60-I	3.1	Tug Fork
White Oak Branch	WVBST-60-I-1	0.1	Tug Fork
Kiah Creek	WVO-2-Q-18	1.2	Twelvepole
Little Laurel Creek	WVO-2-Q-18-A	0.4	Twelvepole
Pinnacle Creek	WVOG-124	3.7	Upper Guyandotte
Pinnacle Creek	WVOG-124	11.0	Upper Guyandotte
Spider Creek	WVOG-124-I	0.0	Upper Guyandotte
East River	WVKN-60	0.5	Upper New
Mash Fork	WVKNB-13-D	0.9	Upper New
Shinns Run	WVMW-11	3.8	West Fork
UNT/Shinns Run RM 4.15	WVMW-11-E	0.1	West Fork

Appendix D. Meal Consumption Limits for Chemicals with Noncarcinogenic Effects

Chemical	Skin on/off	Standard	Group 1 225 meal/ year	Group 2 1 meal/ week	Group 3 2 meal/ month	Group 4 1 meal/ month	Group5 6 meal/year	Group 6 Do not eat
		mg/kg/day	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic		0.0003	<0.15	0.15-0.65	>0.65-1.41	>1.41-2.82	>2.82-5.63	>5.63
Cadmium		0.001	<0.5	0.5-2.17	>2.17-4.69	>4.69-9.39	>9.39-18.77	>18.77
Chlordane	on	0.0005	<0.50	0.50-2.17	>2.17-4.69	>4.69-9.39	>9.39-18.77	>18.77
Chlordane	off	0.0005	<0.36	0.36-1.55	>1.55-3.35	>3.35-6.70	>6.70-13.41	>13.41
Chlorpyrifos	on	0.003	< 3.00	3.00–13.0	>13.0-28.16	>28.16–56.32	>56.32-112.63	>112.63
Chlorpyrifos	off	0.003	< 2.15	2.15–9.28	>9.28–20.11	>20.11– 40.23	>40.23– 80.45	>80.45
Chlorpyrifos (sensitive population)	on	0.00003	<0.03	0.03–0.13	>0.13–0.28	>0.28–0.56	>0.56–1.13	>1.13
Chlorpyrifos (sensitive population)	off	0.00003	< 0.02	0.02–0.09	>0.09–0.2	>0.2–0.4	>0.4–0.8	>0.8
DDT/DDD/DDE	on	0.0005	<0.50	0.50-2.17	>2.17-4.69	>4.69-9.39	>9.39-18.77	>18.77
DDT/DDD/DDE	off	0.0005	<0.36	0.36-1.55	>1.55-3.35	>3.35-6.70	>6.70-13.41	>13.41
Diazinon		0.0007	<0.35	0.35-1.52	>1.52-3.29	>3.29-6.57	>6.57-13.14	>13.14
Dicofol		0.0004	<0.20	0.20-0.87	>0.87-1.88	>1.88-3.75	>3.75-7.51	>7.51
Dieldrin	on	0.00005	<0.05	0.05-0.22	>0.22-0.47	>0.47-0.94	>0.94-1.88	>1.88
Dieldrin	off	0.00005	<0.04	0.04-0.15	>0.15-0.34	>0.34-0.67	>0.67-1.34	>1.34

Appendix D. Meal Consumption Limits for Chemicals with Noncarcinogenic Effects								
Chemical	Skin on/off	Standard	Group 1 225 meal/ year	Group 2 1 meal/ week	Group 3 2 meal/ month	Group 4 1 meal/ month	Group5 6 meal/year	Group 6 Do not eat
		mg/kg/day	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Dioxin	on	0.001 (ng/kg/day)	<1.00 (ng/kg)	1.00-4.33 (ng/kg)	>4.33-9.39 (ng/kg)	>9.39-18.77 (ng/kg)	>18.77-37.54 (ng/kg)	>37.54 (ng/kg)
Dioxin	off	0.001 (ng/kg/day)	<0.72 (ng/kg)	0.72-3.09 (ng/kg)	>3.09-6.70 (ng/kg)	>6.70-13.41 (ng/kg)	>13.41-26.82 (ng/kg)	>26.82 (ng/kg)
Disulfoton		0.00004	<0.02	0.02-0.09	>0.09-0.19	>0.19-0.38	>0.38-0.75	>0.75
Endosulfan		0.006	<3.00	3.00-13.00	>13.00-28.16	>28.16-56.32	>56.32-112.63	>112.63
Endrin	on	0.0003	<0.30	0.30-1.30	>1.30-2.82	>2.82-5.63	>5.63-11.26	>11.26
Endrin	off	0.0003	<0.21	0.21-0.93	>0.93-2.01	>2.01-4.02	>4.02-8.05	>8.05
Ethion		0.0005	<0.25	0.25-1.08	>1.08-2.35	>2.35-4.69	>4.69-9.39	>9.39
Heptachlor Epoxide	on	0.000013	<0.01	0.01-0.06	>0.06-0.12	>0.12-0.24	>0.24-0.49	>0.49
Heptachlor Epoxide	off	0.000013	<0.01	0.01-0.04	>0.04-0.09	>0.09-0.17	>0.17-0.35	>0.35
Hexachloro-benzene	on	0.0008	<0.80	0.80-3.47	>3.47-7.51	>7.51-15.02	>15.02-30.04	>30.04
Hexachloro-benzene	off	0.0008	<0.57	0.57-2.48	>2.48-5.36	>5.36-10.73	>10.73-21.45	>21.45
Lindane	on	0.0003	<0.30	0.30-1.30	>1.30-2.82	>2.82-5.63	>5.63-11.26	>11.26
Lindane	off	0.0003	<0.21	0.21-0.93	>0.93-2.01	>2.01-4.02	>4.02-8.05	>8.05
Methylmercury		0.0001	<0.05	0.05-0.22	>0.22-0.47	>0.47-0.94	>0.94-1.88	>1.88

Appendix D. Meal Consumption Limits for Chemicals with Noncarcinogenic Effects								
Chemical	Skin on/off	Standard	Group 1 225 meal/ year	Group 2 1 meal/ week	Group 3 2 meal/ month	Group 4 1 meal/ month	Group5 6 meal/year	Group 6 Do not eat
		mg/kg/day	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Mirex	on	0.0002	<0.20	0.20-0.87	>0.87-1.88	>1.88-3.75	>3.75-7.51	>7.51
Mirex	off	0.0002	<0.14	0.14-0.62	>0.62-1.34	>1.34-2.68	>2.68-5.36	>5.36
Oxyfluorfen		0.003	<1.50	1.50-6.50	>6.50-14.08	>14.08-28.16	>28.16-56.32	>56.32
Polychlorinated Biphenyls (PCBs)*	on	0.00005	<0.05	0.05-0.22	>0.22-0.47	>0.47-0.94	>0.94-1.88	>1.88
Polychlorinated Biphenyls (PCBs)*	off	0.00005	<0.036	0.036-0.15	>0.15-0.34	>0.34-0.67	>0.67-1.34	>1.34
Selenium		0.005	<2.50	2.50-10.83	>10.83-23.47	>23.47-46.93	>46.93-93.86	>93.86
Terbufos		0.00002	<0.01	0.01-0.04	>0.04-0.09	>0.09-0.19	>0.19-0.38	>0.38
Toxaphene	on	0.00025	<0.25	0.25-1.08	>1.08-2.35	>2.35-4.69	>4.69-9.39	>9.39
Toxaphene	off	0.00025	<0.18	0.18-0.77	>0.77-1.68	>1.68-3.35	>3.35-6.70	>6.70
Tributyltin Oxide		0.0003	<0.15	0.15-0.65	>0.65-1.41	>1.41-2.82	>2.82-5.63	>5.63
mg/kg = milligram per kilogram or parts per million								
ng/kg = nanograms per kilogram or parts per trillion								
* The standard for PCBs, the HPV, takes into account noncarcinogenic and carcinogenic effects.								

Appendix E. Meal Consumption Limits for Chemicals with Carcinogenic Effects

Chemical	Skin on/off	CSF	Group 1 225 meal/year	Group 2 1 meal/week	Group 3 2 meal/month	Group 4 1 meal/month	Group5 6 meal/year	Group 6 Do not eat
		$(mg/kg/day)^{-1}$	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic		1.5	<0.03	0.03-0.14	>0.14-0.31	>0.31-0.63	>0.63-1.25	>1.25
Chlordane	on	0.35	<0.29	0.29-1.24	>1.24-2.68	>2.68-5.36	>5.36-10.73	>10.73
Chlordane	off	0.35	<0.20	0.20-0.88	>0.88-1.92	>1.92-3.83	>3.83-7.66	>7.66
DDT/DDD/DDE	on	0.34	<0.29	0.29-1.27	>1.27-2.76	>2.76-5.52	>5.52-11.04	>11.04
DDT/DDD/DDE	off	0.34	<0.21	0.21-0.91	>0.91-1.97	>1.97-3.94	>3.94-7.89	>7.89
Dieldrin	on	16.0	<0.0063	0.0063-0.027	>0.027-0.06	>0.06-0.12	>0.12-0.23	>0.23
Dieldrin	off	16.0	<0.0045	0.0045-0.019	>0.019-0.04	>0.04-0.084	>0.084-0.17	>0.17
Dioxin	on	0.156 $(ng/kg/day)^{-1}$	<0.64 (ng/kg)	0.64-2.78 (ng/kg)	>2.78-6.02 (ng/kg)	>6.02-12.03 (ng/kg)	>12.03-24.07 (ng/kg)	>24.07 (ng/kg)
Dioxin	off	0.156 $(ng/kg/day)^{-1}$	<0.46 (ng/kg)	0.46-1.98 (ng/kg)	>1.98-4.30 (ng/kg)	>4.30-8.60 (ng/kg)	>8.60-17.19 (ng/kg)	>17.19 (ng/kg)
Heptachlor Epoxide	on	9.1	<0.011	0.011-0.048	>0.048-0.10	>0.10-0.21	>0.21-0.41	>0.41
Heptachlor Epoxide	off	9.1	<0.008	0.008-0.034	>0.034-0.07	>0.07-0.15	>0.15-0.29	>0.29
Hexachloro-benzene	on	1.6	<0.063	0.063-0.27	>0.27-0.59	>0.59-1.17	>1.17-2.35	>2.35
Hexachloro-benzene	off	1.6	<0.045	0.045-0.19	>0.19-0.42	>0.42-0.84	>0.84-1.68	>1.68
Lindane	on	1.3	<0.077	0.077-0.33	>0.33-0.72	>0.72-1.44	>1.44-2.89	>2.89

Appendix E. Meal Consumption Limits for Chemicals with Carcinogenic Effects

Chemical	Skin on/off	CSF	Group 1 225 meal/year	Group 2 1 meal/week	Group 3 2 meal/month	Group 4 1 meal/month	Group5 6 meal/year	Group 6 Do not eat
		$(mg/kg/day)^{-1}$	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Lindane	off	1.3	<0.055	0.055-0.24	>0.24-0.52	>0.52-1.03	>1.03-2.06	>2.06
Oxyfluorfen	on	0.0732	<0.68	0.68-2.96	>2.96-6.41	>6.41-12.82	>12.82-25.64	>25.64
Polycyclic Aromatic Hydrocarbons (PAHs)	on	7.3	<0.014	0.014-0.059	>0.059-0.13	>0.13-0.26	>0.26-0.51	>0.51
Polycyclic Aromatic Hydrocarbons (PAHs)	off	7.3	<0.010	0.010-0.042	>0.042-0.09	>0.09-0.18	>0.18-0.37	>0.37
Toxaphene	on	1.1	<0.091	0.091-0.39	>0.39-0.85	>0.85-1.71	>1.71-3.41	>3.41
Toxaphene	off	1.1	<0.065	0.065-0.28	>0.28-0.61	>0.61-1.22	>1.22-2.44	>2.44

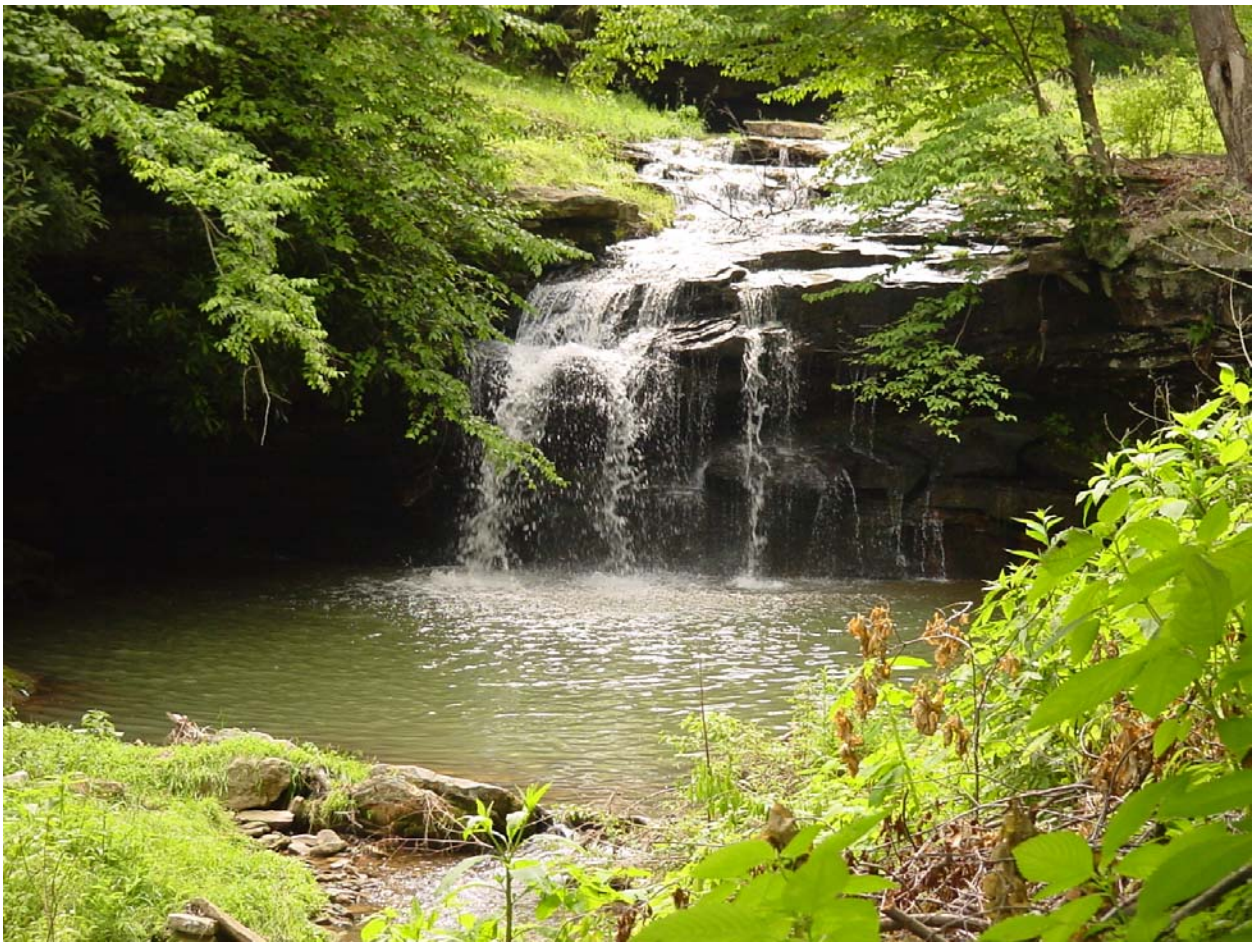
mg/kg = milligram per kilogram or parts per million

ng/kg = nanograms per kilogram or parts per trillion

Note that the meal consumption limits for PCBs listed in Table 3 incorporates both noncarcinogenic and carcinogenic effects

Appendix F. Acronyms

DEP – West Virginia Department of Environmental Protection
DWWM – Division of Water and Waste Management
HUC – Hydrologic Unit Code
WVDNR – West Virginia Department of Natural Resources
ORSANCO – Ohio Valley Water Sanitation Commission
ICPRB – Interstate Commission on the Potomac River Basin
DHHR – Department of Health and Human Resources
USACE – United States Army Corps of Engineers
MAWWG – Mid-Atlantic Wetlands Workgroup
USGS – United States Geologic Survey
BPH – Bureau of Public Health
AWQM – Ambient Water Quality Monitoring
NPS – Non-Point Source
SOS – Save our Streams (citizen monitoring)
SWAP – Source Water Assessment Program
WVSCI – West Virginia Stream Condition Index
MA PIBI – Mid-Atlantic Periphyton Index of Biotic Integrity
TSS – Total Suspended Solids
ORAM – Ohio Rapid Assessment Method
VIBI – Vegetation Indices of Biotic Integrity
QAPP – Quality Assurance Project Plan
QA/QC – Quality Assurance / Quality Control
SOP – Standard Operating Procedures
EDAS – Ecological Data Application System
EQuIS – Environmental Quality Information System
EDD – Electronic Data Deliverable
MEDD – Multi-media EDD
FTE – Full Time Employee



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Promoting a Healthy Environment