west virginia department of environmental protection

Groundwater Programs and Activities Biennial Report to the West Virginia 2022 Legislature

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Promoting a healthy environment.

GROUNDWATER BIENNIAL REPORT
TO THE
2022 LEGISLATURE

I. EXECUTIVE SUMMARY

The Groundwater Protection Act, West Virginia Code Chapter 22, Article 12, Section 6.a.3, requires the West Virginia Department of Environmental Protection (WVDEP) to submit a biennial report to the legislature on the status of the state's groundwater and groundwater management program, including detailed reports from each agency that holds groundwater regulatory responsibility. This is the fourteenth Groundwater Biennial Report to the legislature since the passage of the Act in 1991 and covers the period from July 1, 2019 through June 30, 2021.

The WVDEP Division of Water and Waste Management (DWWM) Groundwater Program is responsible for compiling and editing the information contained in this report. The WVDEP, the West Virginia Department of Agriculture (WVDA), and the West Virginia Department of Health and Human Resources (WVDHHR) all have groundwater regulatory responsibility and have contributed to this report. The boards and standing committees that share the responsibility for developing and/or implementing rules, policies, and procedures for the Ground Water Protection Act are the Environmental Quality Board [EQB], the Groundwater Coordinating Committee, the Groundwater Protection Act Committee, the Groundwater Monitoring Well Drillers Advisory Board, the Well Head Protection Committee, and the Non-Point Source Coordinating Committee.

The purpose of this report is to provide a concise, yet thorough, overview of the programs charged with the responsibility of protecting and ensuring the continued viability of groundwater resources in West Virginia and to express the challenges faced, and the goals accomplished as the agencies, programs, and committees work together to protect and restore West Virginia's water resources.

Research includes specific hydrogeologic information about the state's groundwater, such as regional and local potentiometric surfaces (water levels), groundwater quality, groundwater flow studies, and access to statewide dedicated groundwater monitoring data continues.

The Ambient Groundwater Quality Monitoring Network was established by DWWM in cooperation with the United States Geological Survey (USGS) in 1992 and is an ongoing project. This network provides valuable data critical to the management of West Virginia's groundwater resources. The major objective of the study is the assessment of the ambient groundwater quality of major systems (geologic units) within the state, and the characterization of the individual systems. Characterization of the quality of water from the major systems will help to (1) determine which water quality constituents are problematic, (2) determine which systems have potential water quality problems, (3) assess the severity of water quality

problems in respective systems, and (4) prioritize these concerns. Only by documenting the present ambient groundwater quality of the major systems can regulatory agencies assess where water quality degradation has occurred and where potential degradation is a result of natural processes or human activity.

Topical studies are conducted in the four years between rounds of sentinel well sampling. In topical studies water-quality samples are collected, analyzed, and the results presented in a USGS Scientific Investigation Report. Since 2011 the USGS has collected samples to determine baseline water-quality conditions in Upper Monongahela River Basin, an area of Marcellus Shale gas development. Groundwater samples from 41 wells and baseflow samples from 50 surface-water sites were collected and analyzed for major ions, metals, trace elements, and naturally occurring radioactive materials. The results of these analyses were published in a USGS report *Water quality of groundwater and stream base flow in the Marcellus Shale Gas Field of the Monongahela River Basin, West Virginia, 2011–12* (Chambers and others, 2014, available at: http://dx.doi.org/10.3133/sir20145233).

While many challenges remain, much has been done to provide protection and continued viability of West Virginia's groundwater resources. The WVDEP, WVDA, WVDHHR, and USGS continue to work closely to fulfill the mission of the Department of Environmental Protection, "Promoting a healthy environment".

II. GROUNDWATER PROTECTION and WATERSHED MANAGEMENT

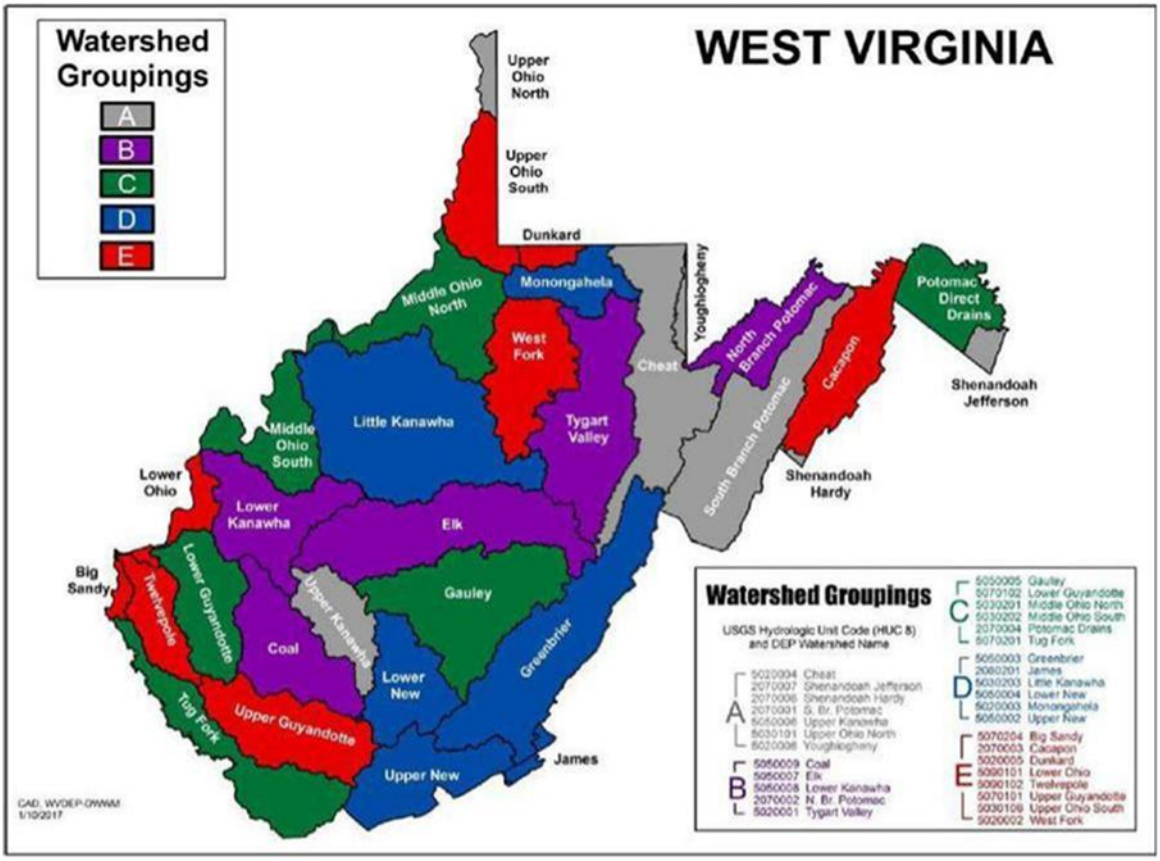
Under the guidance of the United States Environmental Protection Agency (EPA) and the signing of the West Virginia Watershed Management Framework Document (signed in 1997), a new approach to management of the state's groundwater has begun. Total watershed management strives to bring a holistic approach to protecting the waters of the state. The signing of this document by the agencies that chose to participate as partners indicates their understanding that, by collective agreement and cooperation, stakeholders can better achieve the goals of individual water quality programs. WVDEP has chosen to participate as a partner and stakeholder in watershed management in West Virginia.

Agencies having groundwater regulatory authority and responsibility provide repositories for ground and surface water data collected about those facilities under their authority. As stated in this report's executive summary, compilation of the available groundwater data into a collective database continues as a work in progress, providing a picture of the state's groundwater protection activities and the contributions of the associated programs.

Eventually, all groundwater data that is generated by these activities and facilities will be housed in a central data repository overseen by senior scientists from each agency under the guidance of the WVDEP's Groundwater Coordinating Committee and Information Technology Office. We anticipate that population of the central database will be implemented using a watershed approach.

Each watershed is comprised of smaller divisions called sub-watersheds from which data will be gathered and entered systematically until the larger picture emerges.

A map depicting the 32 watersheds and the hydrologic groupings is shown below in Figure 1.



West Virginia Watershed Groups

III. BOARDS and COMMITTEES

The following boards and committees are responsible for developing and implementing policies, procedures and rules to ensure proper application of the Groundwater Protection Act (GWPA).

West Virginia Environmental Quality Board

Appellate Activities

The Environmental Quality Board is authorized by *W. Va. Code* §22-11-21 to hear appeals of agency decisions concerning groundwater protection. The following are administrative appeals which were filed with or addressed by the Board during the last biennial reporting period and include issues arising under provisions of the Groundwater Protection Act:

Mainline LLC
Appeal No. 17-13-EQB
Filed: July 20, 2017
Pending Final Order

H.A.M. Sanitary Landfill, LLC
Appeal No.17-17-EQB
Filed: December 18, 2017
Pending Settlement Agreement

Mercer County Solid Waste Authority
Appeal No. 18-04-EQB
Filed: April 4, 2018
Pending Final Order

WV Environmental Services, Inc.
Appeal No. 18-09-EQB
Filed: June 14, 2018
Pending Agreed Order

Kokosing Construction Company, Inc.
Appeal No. 18-16-EQB
Filed: October 30, 2018
Pending Evidentiary Hearing

Peabody Energy Corporation and Peabody Holding Company, LLC
Appeal No. 19-01-EQB
Filed: January 3, 2019
Pending Pursuant to Order Granting Motion to Continue Hearing and Stay Enforcement of Order

West Virginia Oil and Natural Gas Association and Independent Oil and Gas Association of West Virginia, Inc.
Appeal No. 19-05-EQB
Filed: February 28, 2019
Agreed Order: July 23, 2019

David C. Tabb
Appeal No. 19-08-EQB
Filed: April 29, 2019
Pending Resolution

Form Tech Concrete Forms, Inc.
Appeal No. 19-14-EQB
Filed: December 4, 2019
Dismissed: July 7, 2020

Murray American Energy, Inc.
Appeal No. 20-07-EQB
Filed: June 26, 2020
Pending Final Order

Curtis Wykle Trucking Company
Appeal No. 20-10-EQB
Filed: September 25, 2020
Final Order: March 2, 2021

Lone Wolfe Natural Resource Services, Inc.
Appeal No. 20-12-EQB
Filed: December 1, 2020
Pending Evidentiary Hearing

Union Carbide Corporation
Appeal No. 21-01-EQB
Filed: January 7, 2021
Pending Evidentiary Hearing

Panhandle Dumpsters, LLC
Appeal No. 21-02-EQB
Filed: February 11, 2021
Pending Evidentiary Hearing

Review of Civil Administrative Penalties

W. Va. Code §22-12-10 establishes procedures for review of the assessment of civil administrative penalties. This provision provides for an informal hearing to review the penalty and gives the Board appellate authority for review of the final decision of the agency. There was one appeal filed during the reporting period pursuant to this section.

IV. WEST VIRGINIA DEPARTMENT OF AGRICULTURE

Regulatory and Environmental Affairs Division
Water Quality Protection

Pesticide Regulatory Programs

A pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest. Often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, rodenticides and various other substances used to control pests. Pesticides can cause harm to humans, animals or the environment as they are designed to kill potential disease-causing organisms and control insects, weeds and other pests. This presents a risk-benefit scenario where humans, animals and the environment, including water, are at risk to be adversely affected. Therefore, it is deemed necessary to regulate and control pesticides by their registration, use and application.

The Pesticide Regulatory Programs Unit regulates and controls pesticides through ARTICLE 16A - WEST VIRGINIA PESTICIDE CONTROL ACT and the following legislative and procedural rules:

TITLE 61 SERIES 12 - FEE STRUCTURE FOR THE PESTICIDE CONTROL ACT OF 1990

TITLE 61 SERIES 12A - CERTIFIED PESTICIDE APPLICATOR RULES AND REGULATIONS

TITLE 61 SERIES 12B - LICENSING OF PESTICIDE BUSINESSES

TITLE 61 SERIES 12C - WOOD DESTROYING INSECT TREATMENT STANDARDS

TITLE 61 SERIES 12D - AERIAL APPLICATION OF HERBICIDES TO UTILITY RIGHTS-OF-WAY

TITLE 61 SERIES 12E - REGISTRY OF PERSONS WITH HEALTH SENSITIVITY TO PESTICIDE DRIFT

TITLE 61 SERIES 12F - ASSESSMENT OF CIVIL PENALTIES AND PROCEDURES FOR CONSENT AGREEMENT OR NEGOTIATED SETTLEMENT

TITLE 61 SERIES 12G - GENERAL GROUNDWATER PROTECTION FOR PESTICIDES

TITLE 61 SERIES 12H - BULK PESTICIDE OPERATIONAL RULES

TITLE 61 SERIES 12I - NON-BULK PESTICIDE RULES FOR PERMANENT OPERATIONAL AREAS TITLE 61 SERIES 12J - INTEGRATED PEST MANAGEMENT PROGRAMS IN SCHOOLS AND DAY CARE CENTERS

TITLE 61 SERIES 22 - GENERIC STATE MANAGEMENT PLAN FOR PESTICIDES AND FERTILIZERS IN GROUNDWATER

TITLE 61 SERIES 22A - BEST MANAGEMENT PRACTICES AT TEMPORARY OPERATIONAL AREAS FOR NON-BULK PESTICIDE MIXING AND LOADING LOCATION

CHAPTER 22 ARTICLE 12. GROUNDWATER PROTECTION ACT

In addition to enforcing the above regulations, the Pesticide Regulatory Programs works with the United States Environmental Protection Agency (USEPA) Office of

Pesticide Programs (OPP) and the Office of Enforcement and Compliance Assurance (OECA) through a cooperative agreement to enforce the Federal Insecticide Fungicide and Rodenticide Act (FIFRA). As outlined in guidance and written in the agreement, the Pesticide Regulatory Programs works with EPA Region 3 to establish priorities for the protection of water resources from pesticides. This program is known as the Pesticides in Water Program. Jennifer Hathaway, Environmental Programs Specialist oversees this program as well as the others referenced in this report.

The goal of West Virginia Department of Agriculture's (WVDA) Pesticides in Water Program is to ensure pesticides do not adversely affect the nation's water resources. The Pesticides Regulatory Programs utilizes a three-tier approach to manage pesticides in water:

1. Evaluate Pesticides of Interest over time to identify pesticides of concern.
2. Take actions (actively manage beyond the pesticide label) to reduce or prevent contamination from pesticides of concern over time.
3. Demonstrate the progress of the management strategy in reducing or maintaining concentrations below reference points.

Tier 1 Pesticides of Interest: Pesticides of interest are those pesticides that have been identified by State Regulatory Agencies for pesticide enforcement through a National survey conducted by the States FIFRA Issues Research and Evaluation Group (SFIREG) in 2005 (Appendix 1). Other pesticides of interest could be added if they cause water quality impairments under the Clean Water Act §303(d) as listed or become an interest of the WVDA.

Pesticides of interest are those pesticides that have the potential to occur in ground or surface water at concentrations approaching or exceeding a human health or ecological reference point. It may be based on a Maximum Contaminant Level (MCL), drinking water health advisory, surface or ground water quality standard (which can address human or aquatic life toxicity), EPA reference dose, EPA drinking water level of concern, or another benchmark adopted by regulation or policy. A pesticide of interest could be an active ingredient alone or the active ingredient collectively with degradates of toxicological concern.

Monitoring our States surface and groundwater for pesticide residues is the best measure to determining when an active ingredient(s) should be moved to **Tier 2**. See **Groundwater Monitoring Program** description below.

Tier 2 Pesticides of Concern: Pesticides that are identified as a concern from Step 1 must be managed. A pesticide is actively "managed" when activities are carried out to prevent or reduce contamination of water by a particular active ingredient so that it is prevented from reaching a specific reference point as mentioned above.

The herbicide Atrazine is an example of a Tier 2 pesticide. Atrazine's widespread use on corn and high solubility in water chemistry led to detections nationwide of the

parent compound and its break down products (also known as degradants) in both surface and ground water.

WVDA relies heavily on public outreach and user education to manage pesticides of concern. The pesticide applicator certification process continuously addresses concerns of pesticides in water. This includes study material supplied for written examinations as well as initial certification training sessions. All commercial applicators using general or restricted use pesticides and all private applicators must maintain certification by attending recertification training sessions. Recertification training sessions are another opportunity to manage pesticides of concern.

Routine agricultural use inspections by Pesticide Regulatory Officers address existing water quality-related label restrictions and State regulations. Adherence to label specified setbacks from surface water and field drainage sites is emphasized. Under the existing enforcement process first time violators are notified by letter. Additional violations can result in monetary fines or license revocation.

WVDA works very closely with the West Virginia Conservation Agency in the promotion of and adoption of voluntary Best Management Practices (BMP) shown to reduce impacts by pesticides. Examples include riparian buffer zones, filter strips and no till cultivation.

Tier 3 Demonstration of Progress: After a pesticide has advanced through the first two tiers, progress toward reductions in concentrations below a previously exceeded reference point should be demonstrated in Tier 3. At this stage the steps taken to manage a pesticide of concern to keep or return pesticide concentrations in water to below a reference point should be outlined or the certification if widespread adoption of control measures should be demonstrated. Progress toward reduction of maintenance of concentrations below the reference point could be demonstrated by:

- Targeted monitoring of water samples from vulnerable use areas that determines that mitigation measures are preventing residue levels from approaching or exceeded a reference point.
- Downward trends in concentration levels established by monitoring data in geographic areas where the pesticide of concern is being used (data from WVDA, USGS, USDA, registrant or other sources).
- The results of targeted surveys or inspections that document the wide adoption of voluntary or regulatory measures which have been proven via research to protect water quality.
- While monitoring is not required under Tier 3 it is the most representative method of showing a decrease in a particular pesticide's occurrence in water. WVDA has historically reference studies from allied agencies such as the United States Geological Service. In addition, WVDA closely observes the data provided by the

West Virginia Department of Environmental Protection's Ambient Water Quality Monitoring (AWQM) Network.

- Cancellation of a pesticide's use in the state would be the most severe action taken under Tier 3. Historically, Tier 3 actions have involved the reclassification of a general use pesticide (as classified by the USEPA) to a State restricted use pesticide (RUP). Use of State RUPs require that applicators become certified under state licensing programs before the product can be purchased for use. Other conditions could be placed on the restricted use license such as product specific training program completion prior to renewal of license.

- WVDA is confident that the uniformity of the development of its environmental programs, the continued interagency cooperation, and the reliance on successfully demonstrated management practices will facilitate the accountability tier of the management program.

Pesticides in Water Program – Reporting Requirements

Activities related to the Pesticides in Water Program are reported under the web-based Pesticides of Interest Tracking System (POINTS). POINTS is a national reporting funded by USEPA and can be found at http://points.wsu.edu. WVDA updates the system as analytes of interest or concern are revised or managed.

From the POINTS system data, USEPA on a national level expects to be able to:

- Determine how pesticides of interest were evaluated.

- Identify pesticides of concern (pesticides that approach or exceed reference points).

- Identify pesticides of concern that are being actively managed, and which may need more effective management at the national level (e.g., label changes, special studies).

- Identify pesticides for which national water quality standards, aquatic life criteria, or other national regulatory standards or reference points are needed.

- Demonstrate that state and tribal water quality management programs are effective at reducing pesticide risks to water quality locally.

- Identify states in which the FIFRA lead agency is using its resources to address pesticide impaired waters under CWA §303(d).

Other activities that advance the goal of developing and carrying out programs to protect water resources from pesticide risks:

Plastic Pesticide Container Recycling Program

More than 66,000 lbs. of plastic pesticide containers have been collected for recycling over that last eight growing seasons, including 16,980 lbs. in 2019 and 2020. WVDA maintains pesticide collection container facilities in Berkeley, Greenbrier, Hardy, Hampshire, Kanawha, Lewis, Jefferson, Mason, Ohio and Raleigh Counties. Sea containers are utilized to store the plastic containers for recycling. As this program continues to grow, we hope to offer more pesticide collection facilities in areas where there is heavy pesticide usage. This program requires containers to be triple or pressure rinsed to be accepted for recycling. This reduces the number of plastic pesticide containers that may enter the waste stream containing pesticide residues, therefore protecting ground water sources. Containers are shred and remanufactured into shipping pallets, drainage tile, composite lumber or other low contact nonfood grade plastic items.

Properly rinsed pesticide containers are stored in sea containers at 11 locations around the state.

Pesticide Waste Disposal Program

The ongoing collection and annual disposal of waste and unwanted pesticides is another program aimed at reducing the potential of pesticides to reach water. The program specialist fields phone calls and emails to pick up waste and unwanted pesticides from private pesticide applicators and homeowners. In addition to individual pickups, WVDA also coordinates with county solid waste authorities to hold pesticide drop off events around the state. There have been 11 collections between July of 2019 and June of 2021 in Barbour, Berkeley, Hampshire, Kanawha and Mercer Counties. A total of 16,766 lbs. of waste pesticides were collected.

Waste pesticides collected for disposal.

Groundwater Monitoring Program

In collaboration and with financial support from the WVDEP and groundwater protection fees, we have created a five-year groundwater monitoring program. The objective of this program is to monitor groundwater for pesticides and respond as necessary to manage concentrations that exceed reference points. When residues are found that threaten water quality standards or other reference points, WVDA will respond to pesticide water contamination events by proposing risk mitigation. Leading up to the start of the program the environmental programs specialist contacted and visited various sites around the state to determine at least 10 sample collection sites. The groundwater sampling program began in March 2019. Samples were collected once per month from 12 sites in Berkeley, Greenbrier, Harrison, Jefferson and Mason Counties in 2019.

Laboratory analysis began in March 2019. Thirty-four samples received from March 29, 2019 through May 22, 2019 were analyzed for atrazine. Twenty-six samples received from May 23, 2019 through September 25, 2019 were analyzed for atrazine and simazine. Neither of these pesticides were detected in any of the analyses. The laboratory did identify several issues to address during this timeframe. The first issue was the need to expand our testing capabilities to include more pesticides of interest. The next issue was the need to improve our extraction equipment and methodology to improve our recoveries.

The next year the WVDA laboratory hired a contractor to work with our laboratory analyst to expand the scope of our analysis. The following compounds were added: 2,6 dinitrotoluene, tebuthiuron, molinate, 2,4 dinitrotoluene, DEET, propachlor, cycloate, atraton, prometon, simazine, atrazine, propazine, propyzamide, metribuzin, vinclozoine, simetryn, ametryn, alachlor, prometryn, tebutryn, metolachlor, cyanazine, triadimefon, MGK 264a, diphenamid, MGK 264b, butachlor, napropamide, oxyfluorfen, nitrofen, tebuconazole, fenarimol, fluridone, chlorneb, beta lindane, gamma lindane, acetochlor,

DCPA, heptachlor epoxide, endosulfan I, DDE, diedrin, endrin, chlorobenzilate, endosulfan II, DDD, DDT, methoxychlor, cis-permethrin, and trans-permethrin. The WVDA also purchased a newer manual extractor to improve analyte recovery.

Forty-seven samples were collected from March 10, 2020 to June 16, 2020. A power outage led to twenty of those samples exceeding their hold temperature of 6°C and were therefor unable to be analyzed. The remaining twenty-seven samples were analyzed, but the data was not released. Although no pesticides were detected, the recoveries of the quality control surrogates were considered too low to have a high confidence in the accuracy of the results. Sampling was placed on hold to troubleshoot the problem.

After consulting with other laboratories and analyzing standards in-house it was determined that the main source of error was in the manual extraction. The WVDA recently purchased a new automated SPE instrument to remove a large portion of potential analyst error. Also, the WVDA has invested in a generator to power the entire building so samples won't be lost during a power outage.

In July of 2021 sampling was paused due to staffing challenges. Lab staff have been hired and will soon begin methodology training. The environmental programs specialist is currently vacant.

One of the 12 groundwater collection sites.

Bulk Pesticides Storage Facilities

Bulk pesticides storage facilities are inspected annually. In addition, the secondary containment having an adequate capacity to capture a catastrophic spill the Bulk Operational Rules (§61-12H) require that pumps, transfer lines and other appendages be inspected and maintained in good operational condition and written emergency and discharge response plan be in place. Appropriate enforcement action is taken when facilities are found to be non-compliant.

Secondary containment at a bulk facility.

Appendix 1

State List of Pesticides of Water Quality Concern

Includes chemicals of concern for both ground and surface water
Source: State Survey for Water Resource Monitoring Programs and Analytical Parameters
October 2005 – Conducted by the SFIREG Environmental Quality Issues Working Committee

2,4-D	Lambda-cyhalothrin
Acetochlor (+ ESA, OXA)	Lindane (cancelled)
Alachlor (+ESA)	Malathion
Aldicarb (+degradates)	Mesotrione
Atrazine (+ DEA, DIA, DACT, Hydroxy)	Metalaxyl
Azinphos-methyl (cancelled)	Metolachlor (+ ESA, OXA, SMetolachlor)
Bentazon	Metribuzin (+ DA, DADK, DK)
Bromacil	Metsulfuron Methyl
Carbaryl	MSMA + other arsenical herbicides
Carbofuran (cancelled)	Napropamide
Chrlorothalonil	Norflurazone (+ degradates)
Chlorpyrifos (+ TCP)	Pendimethalin
Clopyralid	Phenoxy herbicide group
Copper Pesticides	Phosmet
Dacthal (+degradates)	Picloram
DBCP	Prometon
Diazinon	Prometryn
Dicamba	Propazine
Dimethenamid	Propiconazole
Diuron	Simazine (+ DACT, DIA)
Endosulfan (cancelled)	Sulfometuron (et. al.)
Esfenvalerate	Tebuthiuron
Ethoprop	Terbacil
Glyphosate (+ AMPA)	Thiamethoxam
Hexazinone (+ Metabolite B)	Tralkoxydim
Imazamethabenz	Triallate
Imazapyr	Triclopyr
Imidacloprid	Trifluralin
Isoxaflutole	

West Virginia Department of Agriculture Regulatory and Environmental Affairs Division
Environmental Programs

The West Virginia Department of Agriculture's Regulatory and Environmental Affairs Division - Environmental Programs Section is headquartered at the Regional Agricultural Center in Moorefield, WV. The Environmental Programs Section focuses on water quality monitoring, nutrient management planning, and promoting agricultural best management practices which protect and improve water quality.

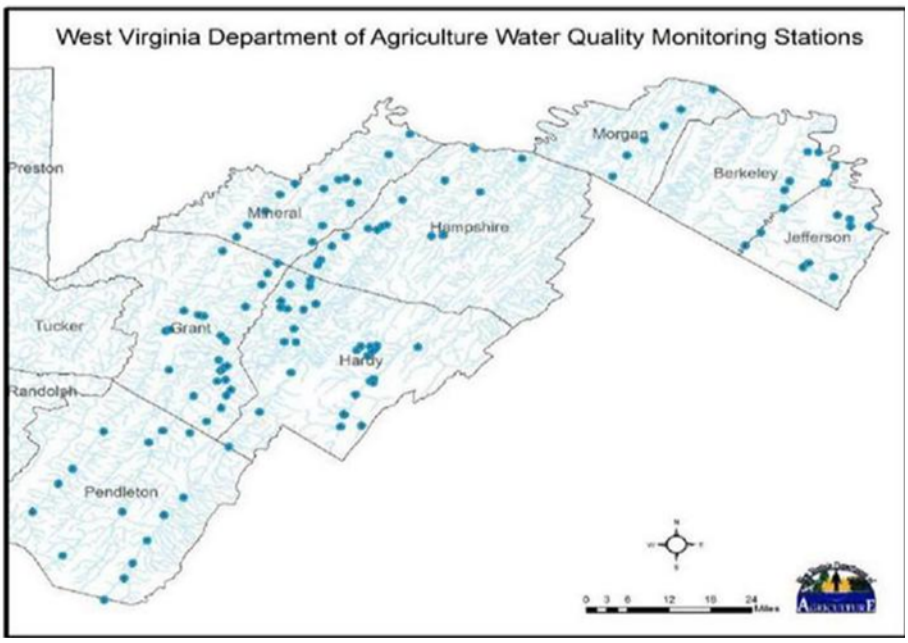
Since the program's inception in July 1998, many of the state's streams in the Eastern Panhandle in the eight counties that represent West Virginia's Potomac River Watershed. Streams that are routinely monitored include:

Anderson Run
Bullskin Run
Cacapon River
Elk Run
Elks Branch
Lost River
Lunice Creek
Mill Creek

New Creek
North Fork of the South Branch
Opequon Creek
Patterson Creek
Rockymarsh Run
Sleepy Creek
South Branch of the Potomac River
South Fork of the South Branch

Water samples are analyzed in the field for pH, temperature, conductivity, and dissolved oxygen and are then transported to WVDA's Laboratory in Moorefield for further analysis.The Water Quality Laboratory analyzes all water samples for Nitrate, Nitrite, Ammonia, Orthophosphate, Total Phosphorus, Turbidity, Total Suspended Solids, and Fecal Coliforms.

WVDA continuously evaluates the water monitoring program and looks for ways to improve. One significant way that this has been accomplished is by the purchase of advanced field equipment and laboratory instruments. Over the past couple of years, WVDA has purchased two new YSI ProDSS field meters to replace aging field meters. WVDA has also purchased a new Microwave Digestion System for the laboratory and plans to purchase a new Discrete Photometric Analyzer in the upcoming year to replace an aging LACHAT FIA that has been in use since the 1990's.



Raw water quality data, analyses, and maps of correlating monitoring stations, are often provided to state and federal agencies and non-profits including, but not limited to West Virginia Department of Environmental Protection, Tetra Tech, Cacapon and Lost Rivers Land Trust, Trout Unlimited, and the West Virginia Conservation Agency (WVCA). All maps are created in-house using ESRI ArcGIS software.

This past year, the West Virginia Conservation Agency approached the WVDA Environmental Programs Section with a request to collect water samples to study the effectiveness of two new water quality improvement projects. The collection of these water samples will coincide with WVDA's routine collection of water samples on Anderson Run and North Fork. This is a great example of how the WVDA effectively partners with other organizations to assist with water quality improvement efforts in the watershed.

One thing that has remained constant over the years is the Environmental Programs' dedication to working with area farmers to promote best management practices designed to reduce nutrient and sediment runoff and increase farm productivity. One specific area that Department has focused on is Nutrient Management. Nutrient Management Planning (NMP) is a very effective method to maintain nutrient balances and reduce nutrient losses to local and downstream waterways.

The NMP specifies cropping recommendations for all acreage to which commercial fertilizer, poultry litter, or other types of manure are applied. Results from soil and manure tests, coupled with specific crop yields or soil utilization, are used to develop recommendations regarding the amounts of nutrients to be applied to each field. To facilitate Nutrient Management Plan implementation, the WVDA Laboratory in Moorefield routinely analyzes soil, poultry litter and manure samples and staff continues to maintain over 90,000 acres under Nutrient Management Plan.

The WVDA is also continuing the development of a verification program which will help to document expired cost share and non-cost share BMPs that currently exist on agricultural operations. It will allow the WVDA to collect data and verify that these BMPs were installed and are currently functioning as originally intended.

Through the aforementioned programs, consistent high scores on proficiency tests, maintaining laboratory certifications, along with a dedicated, hardworking staff, the West Virginia Department of Agriculture continues to make a positive impact on the environment, especially on local streams and downstream waterways including the Chesapeake Bay.

IV. DEPARTMENT of AGRICULTURE

West Virginia Conservation Agency

The West Virginia Conservation Agency (WVCA) focuses its resource conservation efforts on the maintenance and/or improvement of water quality relative to natural resource use with a primary focus on agriculture and construction activities. The main concern is for surface water quality but activities impacting groundwater resources are addressed through conservation programs that implement Best Management Practices (BMPs), provide technical support, and involve educational outreach to the citizens throughout the state. The goal is to inspire and empower the people of West Virginia to value and work for clean water.

The WVCA continues its “Conservation Partnerships” with state, federal and local agencies as well as the private sector and many non-profit organizations. This cooperative approach provides benefits such as funding for projects, technical expertise and enables citizen input assisting our agency to pinpoint and target specific problems in specific areas. “Conservation Partnerships” continue to be an effective way to address West Virginia’s concerns and providing the resources vital in the solutions and/or prevention of water quality degradation issues.

Our state has a diversity of terrain and geology that challenges natural resource conservationists with a multitude of issues that must be confronted by methods that are both effective and sensitive to the specific location and individuals affected.

The West Virginia Conservation Agency (WVCA) undertook the following activities which either directly or indirectly protect West Virginia’s groundwater resources during the reporting period of July 1, 2019 through June 30, 2021.

Agricultural Activities

Cost-share programs have been a significant contributor to encourage landowners to develop conservation practices on their property.

Conservation Reserve Enhancement Program (CREP)Reporting is completed each federal fiscal year; October 1-September 30.

- FY19 (October 1, 2018 – September 30, 2019)
- 334.09 acres entered into contract
- FY20 (October 1, 2019 – September 30, 2020)
- 434.7 acres entered into contract

Approximately 200 feet of eroded streambank was restored on Mill Creek/Meadow River in Greenbrier County. This restoration resulted in a reduction of an estimated 64 tons of sediment annually.

Sediment

In construction assistance, the WVCA reviewed one sediment and erosion control plan for construction sites less than one acre in size in Monroe County; facilitating the conservation of an estimated zero tons of soil. Plans are reviewed for the appropriate best management practices to prevent sedimentation of the state's waters and underground aquifers.

The WVCA provided technical stormwater management assistance to one construction project by providing recommendations for BMPs to alleviate problem areas. BMPs recommended were rain gardens, overflow, plant materials, bio swales, stream restoration structures, downspouts, outlet/outfall protection, porous pavers, tree planting, subsurface basin, and detention ponds.

Additionally, a total of six hundred linear feet of severely eroding streambanks were restored saving one hundred sixty-three tons of sediment from entering the streams and underground aquifers each year. Twenty-one watershed associations throughout the state were provided technical and educational outreach support for sediment and construction related issues.

Nutrient Management Plans

A nutrient management plan is a written site-specific plan which describes how the major plant nutrients (nitrogen, phosphorus, and potassium) are to be managed annually. The goal of nutrient management planning is to minimize adverse environmental effects, primarily upon water quality, and avoid unnecessary nutrient applications above the point where long run net farm financial returns are optimized. The plan will address the most critical farm nutrient problems through measures to manage fertilizers and animal manures to reduce runoff, erosion, and nutrient loss.

# Nutrient Management Plans	# N Managed	#P Managed	Acres
1	27,653.76	36,408.33	571.2
1	34,412.61	11,898.77	384
1	19,820	1,300	153.2
1	25,283.81	47,407.14	568.3
1	21,801	29,817	550.8
1	11990	21000	350.2
1	3350	6375	108.6
1	6490	7991	60.1
1	27,653.76	36,408.33	571.2
1	34,412.61	11,898.77	384
1	25,452	7,570	195.1
1	17,695	1,360	149.9
1	3,960	80	33
1	13,380	7,560	91
1	21,268.64	35,354.16	335.4
1	24,173.73	37,731.42	327.4
1	3,138	2,295	50
1	3,138	2,295	44.16
1	2,535	1,854	49.4
1	2,099	1,535	22.3
1	3,138	2,295	42.75
1	2,777	2,031	29.5
1	3,138	2,295	33.34
1	3,138	2,295	54.17
1	3,138	2,295	33
1	1,883	1,377	20
1	1188	869	12.62
1	1,185	1,622	28.5

The Agriculture Enhancement Program (AgEP)

West Virginia Agricultural Enhancement Program's (AgEP) mission is to assist the agriculture cooperators of West Virginia Conservation Districts with the voluntary implementation of best management practices (BMPs) on agricultural lands to conserve and improve land and water quality. The program offers technical and financial assistance as an incentive to implement suggested BMPs.

Practices Completed in FY20		Practices Completed in FY 21	
Practice	**Unit Totals**	**Practice**	**Unit Totals**
Cover Crop	21.93 Acres	**Cover Crop**	170.89 Acres
Critical Area Planting	2.5 Acres	**Exclusion Fence**	60,342 Feet
Exclusion Fencing	39,048 Feet	**Frost Seeding**	3,115.92 Acres
Frost Seeding	2,352.47 Acres	**Heavy Use Protection Area**	133,383 Feet
Heavy Use Protection Area	108,708 Feet	**Invasive Species Management***	1,455.73 acres
Invasive Species Management	761.56 Acres	**Lime**	18,383 Tons/ 9,124.48 Acres
Lime	21,115.67 Tons/ 9,781.66 Acres	**Litter Transfer**	200 Tons
Litter Transfer	45.5 Tons	**Nutrient Management**	1,362 Acres
Nutrient Management	1,127.51 Acres	**Pasture Division Fence**	117,869 Feet
Pasture Division Fence	113,111 Feet	**Pasture Seeding**	1,163.10 Acres
Pasture Fence/Watering System Combo	12,647 Feet	**Pollinations**	10,890.25 Sq. Ft.
Pasture Seeding	1,249.22 acres	**Pond Clean Out**	8 Cleanouts
Pollinations	10,890 Sq. Ft.	**Roof Runoff Management**	1 Applications
Pond Cleanout	8 Clean Outs	**Urban Agriculture**	71 Applications
Urban Agriculture	19 Applications	**Warm Season Annual Seeding**	196.67 Acres
Watering System	46 components/systems	**Water System**	56 components/ systems
Winter Grazing	2 acres		
**ISM acres include brush acres.*		**ISM acres include brush acres.*	

Educational Activities Specific to Groundwater

The West Virginia Soil **Tunnel Trailer, or for a better understanding, “a look at life below the soil”. This mo**bile classroom illustrates living soil and expresses the negative impacts pollution present to groundwater and soil.

Greenbrier Valley Conservation District held a Water Quality Field Day on November 4, 2019 for agricultural producers within the Indian Creek

watershed. The field day was held at the WVU Willow Bend Farm. Approximately 50 producers attended and participated in presentations and field activities that covered topics including conservation practice implementation, economics of conservation practices, animal health and fellow agricultural producer testimonials. Sponsoring agencies and organizations for the field day included WVCA, GVCD, NRCS and The Conservation Fund.

Eastern Panhandle Conservation District held their 2021 Watershed Group Gathering virtually on June 8, 2021. Sessions included Watershed Highlights from local groups, Natural Systems Protections, Wetlands and Healthy Watersheds and Hazard Mitigation Planning. With approximately 50 in attendance, it was an unconventional yet successful event.

Eastern Panhandle Conservation District held a Forestry Workshop on September 28, 2019 in Berkeley County. Topics included forest management plans, invasive species management, forest pests, timber harvesting, creating wildlife habitat and streamside tree buffers. Approximately 65 attendees participated in classroom style instruction as well as field practicums.

Stormwater Management

Conservation Specialists serve as direct service providers or help coordinate assistance from other sources to watershed organizations and landowners. WVCA supports statewide efforts to address nonpoint pollution with education and outreach, coordination and implementation of projects addressing runoff, erosion and sediment control, stormwater management, nutrient and pest management, stream cleanup, riparian demonstrations, stream bank stabilization, pre and post project monitoring, watershed assessments, agriculture BMP selection and installation, the availability and types of conservation programs, financial assistance, and water quality improvements.

NPS Projects
WVCA Conservation Specialist Functions as 319 Watershed Project Managers

WVCA's Conservation Specialists (CS) support volunteer watershed associations, educate citizens on non-point source pollution issues, identify local stakeholders, partners and funding sources, and take the lead for Project Teams (PTs) consisting of community stakeholders to place projects on the ground. Watershed Project Proposal funds are used to install specific projects designed to remedy or decrease contributions to the impairment of the priority watershed in which the projects are installed.

WVCA Conservation Specialists (CS) support volunteer watershed associations, educate citizens on non-point source pollution issues, identify local stakeholders, partners and funding sources, and take the lead for projects.
Sleepy Creek §319 Watershed Project – Morgan County

The goal of the Sleepy Watershed Project is to reduce fecal coliform loads within the watershed from failing septic systems.

- 3 septic systems repaired
- 6 septic systems pumped
- Outreach and Education

Sleepy Creek CBIG Watershed Project – Morgan County
The goal of the Sleepy Creek CBIG Watershed Project is to reduce fecal coliform, nitrogen, phosphorous and sediment loads within the watershed from stormwater runoff from urban and agricultural land uses.

- Riparian buffer plantings
- Outreach and education
- Porous paver installation
- Water quality monitoring

Elks Run §319 Watershed Project – Jefferson County
The goal of the Elks Run Watershed Project is to reduce fecal coliform and sediment loads within the watershed from failing septic systems and stormwater runoff from urban and agricultural land uses.

- Water quality monitoring
- Pet waste campaign
- Riparian tree plantings
- Outreach and education
- Rain garden design for future implementation
- Cover crops planted
- 15 septic systems pumped

Back creek protection §319 watershed project
The goal of the Back Creek Protection Watershed Project is to promote land conservation and reduce sediment loads within the watershed from eroding streambanks.

- Outreach and education
- Placement of 96.38 acres into conservation easement
- Restoration and stabilization of approximately 900 feet of streambank on Back Creek

Indian Creek §319 Watershed Project – Monroe County

- 1 septic system repaired
- 1 septic system pumped
- 19,318 feet of exclusion fence installed
- 33,168 feet of pasture division fence installed

Potts Creek and Sweet Springs Creek CBIG Watershed Projects – Monroe County

- 10,427 feet of exclusion fence installed
- 9,409 feet of pasture division fence installed
- 12 livestock alternative water systems installed

Second Creek §319 Watershed Project – Monroe and Greenbrier Counties

- 1,065 feet of exclusion fence installed
- 1,122 feet of pasture division fence installed

Spring Creek §319 Watershed Project –Greenbrier County

- 1,102 feet of pasture division fence installed

WVCA is a full partner in the Chesapeake Bay Program. Chesapeake Bay efforts include:

The West Virginia Chesapeake Bay Program is an effort by the West Virginia Conservation Agency, West Virginia Department of Environmental Protection, West Virginia Department of Agriculture and several other state, federal and local partners to implement the Chesapeake Bay Total Maximum Daily Load (TMDL). The Chesapeake Bay TMDL is a comprehensive "pollution diet" to restore the health of the Bay and all of its tributaries by setting limits for nitrogen, phosphorous and sediment pollution. The TMDL is the largest clean-up ever initiated by EPA, encompassing a 63,000 square mile watershed. It is designed to ensure that all pollution control measures needed to fully restore the Bay and its tidal rivers are in place by 2025. Each jurisdiction has developed a Watershed Implementation Plan (WIP) that details how the pollution allocations will be met.

West Virginia is currently in Phase 3 of its WIP which outlines how the 2025 goals will be met. The WIP outlines in detail how pollution reduction strategies will be undertaken in each major load sector: Wastewater, Developed Lands, Agriculture, Forest, and Other. Reducing nitrogen, phosphorous and sediment in local creeks and river will mean healthier water resources to better sustain tourism, fishing, drinking water supplies, wildlife habitat and other uses.

Agricultural BMP Implementation

Chesapeake Bay Implementation Grant (CBIG) funds have been allocated to assist agricultural producers with the installation of cover crops, stream exclusion fencing, alternative watering systems, riparian buffer establishment, heavy use area protection, divisional fencing and poultry litter transfer. With the assistance of these funds, WVCA and Conservation Districts have helped the state reduce nutrient and sediment loads by implementing Best Management Practices (BMPs).

A total of 9,074 acres of cover crops were planted during this time. Cover crops improve water quality by reducing soil erosion and nutrient runoff. Some examples of cover crops are clover, barley, rye and triticale. Often, when producers harvest their cash crops (corn, soy beans, etc.), the fields lay bare in the winter. By establishing a cover crop during the winter months, the soil is held in place as opposed to being washed away during heavy rain events.

Additionally, 12,716.7 tons of poultry litter were transferred out the watershed. The Potomac Valley is rich with poultry production and therefore, has a surplus of litter. Transferring this litter prevents excess nutrients from entering streams.

Producers installed 35,886 feet of divisional fencing, 12,716.7 feet of stream exclusion fencing and 18 alternative watering systems. These fencing practices, in combination with water systems, allows producers to implement grazing plans for livestock. This improves the quality and quantity of forages which provides more vegetation to filter surface water of excessive nutrients and sediment.

Nutrient Management

Nutrient management is the implementation of a site-specific combination of nutrient source(s), rate, timing and placement into a strategic plan to optimize agronomic and environmentally efficient utilization of nitrogen and phosphorous. WVCA works closely with the West Virginia Department of Agriculture to promote NMP adoption by certifying staff to write plans, employing summer inters to assist obtaining soil and manure samples.

During this timeframe, 6,926.1 acres were sampled for nutrient management

plans. **Stormwater Management**

A permeable paver project was installed at the Jefferson County Fairgrounds. This project consisted of 4 infiltration trenches and 23,809 square feet of pavers. Educational signage was installed to explain how the system functions and the importance of the load reductions that are provided.

An additional permeable paver project was installed at The Inn at Boydville. This project installed 5,000 square feet of pavers in a parking area and replaced trees that were removed for paver installation. Educational signage also accompanied this project.

Water Quality Workshops

CREP-
A virtual CREP training was held for WV partners in the fall of 2020. Approximately 75 were in attendance. The training was also recorded for future use.

NPS Project Photos-

Sleepy Creek Restoration

Reforestation in the Elks Run Watershed

Back Creek Stream Restoration and Tree Planting

Back Creek Forestry Workshop

Indian Creek Water Quality Field Day November 4, 2019

Stream and Pond Exclusion Fence – Indian Creek Watershed

Pasture Division Fence – Indian Creek Watershed

Septic Repair Projects – Indian Creek Watershed

V. DEPARTMENT OF HEALTH AND HUMAN RESOURCES
Office of Environmental Health Services

Well Head Protection Program

As of June 30, 2021, the Wellhead Protection (WHP) program continues to work with the 554-groundwater community, non-community transient and transient public water supply systems on developing WHP programs.

In West Virginia, the Source Water Assessment and Protection (SWAP) Program encompasses both the wellhead “groundwater” protection and surface water protection efforts. Implementation of the wellhead protection program began in the early 1990’s, as part of West Virginia groundwater protection strategy. This protection strategy was extended to surface water sources with the 1996 Safe Drinking Water Act Amendments. The Act requires states to develop and implement a SWAP program designed to evaluate the vulnerability of public drinking water systems to possible sources of contamination and encourages states to work with these systems in developing protection and management plans. The Source Water Protection Plan (SWPP) was enacted by WV Senate Bill 373 during the 2014 WV Legislative Session and revision of the 64CSR3, Public Water Supply System regulations to include requirements for utility water systems to update their existing or file a new comprehensive SWPP for surface water and surface water influenced groundwater (SWIG) systems. There are 141 surface and SWIG public water systems that have submitted an updated SWPP in 2019. The Public Water Supply System regulations (64CSR3) were revised in 2019 to allow the PWS to submit the required 3-year update for the SWPP on a staggered basis.

The WHP program targets groundwater water systems for protection on a county or local basis. In many communities, ground water is the only source of drinking water. Once groundwater is contaminated it is very expensive to treat or replace.

The WHP program includes public participation, source delineations, the potential contaminant survey, contingency planning and management directives complementing the SWAP program. WHP program is the practice of assessing the quality of our water resources and implementing programs that reduce pollutants and chemical contaminants which could potentially negatively impact these resources. Protecting water resources from contaminants also can eliminate the need for supplementary treatment procedures, and can delay the cost of new infrastructure and related increases in water rates. It is our hope that this work accomplished in West Virginia and across the United States will be a valuable tool to a public water supply/community and will help in planning and building future capacity for economic growth.

The West Virginia Bureau for Public Health (WVBPH) Office of Environmental Health Services (OEHS) staff continues to complete WHP studies for new public water supply systems and helps revise existing plans within the state by prioritizing efforts, program resources, education and outreach efforts in developing and implementing protection measures. Implementation of the WHP builds on other environmental assessment and protection programs and requires integrated linkage and cooperation of the WV Department of Environmental Protection (DEP). Moving to a voluntary protection plan phase will require a multifaceted approach that will require continued financial support within West Virginia. OEHS relies on participation and involvement of federal, state, local agencies, industry, agriculture, environmental groups, public water supplies, and the public at many levels to protect the surface and groundwater of the state and the health of the people of West Virginia. Implementation of the WHP builds on other environmental assessment programs and requires an integrated linkage and cooperation with many associated entities. Follow up assistance and a continuing source of funding for activities will likely be required for sustainability. The WHP program maximizes the use of existing information, requires integration with existing state and federal programs and the use of a Geographic Information System (GIS) to map delineations and assessments.

Program Milestones and Future Priorities

During this reporting cycle, the WHP programs continued to pursue the following:

Building Partnerships-Inter-agency cooperation and other alliances:

- Continue to participate and build voluntary protection efforts by prioritizing efforts, program resources, education and outreach efforts in developing and implementing voluntary protection measures not only to the local water systems but also to local governments, councils, planners, and other stakeholders.

- Provide funding for the WVDEP's Underground Injection Control (UIC) Class 5 program to locate UIC Class 5 wells in source water protection and sensitive hydrological areas within West Virginia. This work also includes assisting the DEP to identify underground and aboveground storage tanks in the SWAP/WHP area.

- Continue participation and provide funding for the Potomac Drinking Water Source Protection Partnership (DWSPP). This partnership is composed of water utilities and the various governmental agencies responsible for drinking water protection in the Potomac River Basin.

- Continue participation with the Ohio River Valley Water Sanitation Commission (ORSANCO) work group on source water protection. This work group is composed of water utilities and the various governmental agencies responsible for drinking water protection in the Ohio River basin.

- Continue a working relationship between the federal *Safe Drinking Water Act* (SDWA) and the *Clean Water Act* (CWA) programs within the state to provide the most accurate and representative assessment of source waters, based on available data which the state believes best reflects the quality of the resources.

- Continue to work with the West Virginia Rural Water Association (WVRWA), to identify local SWAP and WHP areas within the state.

- Continue to use hydrogeologic information provided from the United States Geological Survey (USGS) to help define WHP delineation areas.

Public Outreach/Educational Activities:

- OEHS Staff provides help in developing a protection program, and assessing potential sources of contamination.

- The WVBPH website (http://www.wvdhhr.org/oehs/eed/swap/) continues to provide information on the SWAP/WHP programs (educational materials, posters and brochures) and guide municipalities, water suppliers, or other groups through developing a local SWAP program. In addition, a link is available to a website that provides copies of the initial SWAP/WHP susceptibility assessment reports for the community water systems.

- WVBPH Source Water Protection GIS website disseminates relevant source water information to public water supplies, state agencies, federal agencies and local governments to further source water protection**.** https://oehsportal.wvdhhr.org/wvswap/index.html

- Installation of protection signage along the perimeter of wellhead protection areas. PWSs can use the signs for municipality and non-highway use.

Other Actions for Protection of Sources of Drinking Water

- Continue to evaluate new public water supply water wells or intakes to assure they are located in areas where contamination threats are minimal.

Permits for new public water wells now require an initial survey for potential sources of contamination within 2000 feet of proposed well location with site-specific information used when available.

- Continue to use the Alternative Monitoring Strategy Program (AMSP), which determines future monitoring frequency reductions, is dependent on having a SWAP/WHP program in place, which requires consistent revisions and updates.

- Continue to participate in the development of regulations and design standards for water supply wells, private water wells and monitoring wells for the prevention of groundwater contamination.

- Continue to evaluate public water supply wells to determine whether groundwater sources are under the direct influence of surface water (GWUDI) and/or SWIG.

- Continue to support the efforts of the WVDEP - Division of Water and Waste Management's (DWWM) and the USGS with groundwater water quality studies. This program has strived to benchmark raw water quality data for West Virginia aquifers. West Virginia is trying to identify the impacts of various land uses on water quality. This information will help West Virginia avoid future contamination events.

- Continue to implement the revised regulations and design standards for private water wells, approved April 2, 2008, for the protection of groundwater.

Ground Water Data Collection and Management:
The WHP program acquires a variety of data, including locations and characteristics of public water supply sources, point of entry, potential contaminant sources, and description of watersheds, hydrogeologic settings, and aquifer parameters. This data continues to be collected through field data collection activities, contractor services, as well as programs within federal, state, and local agencies.

Future Program Needs

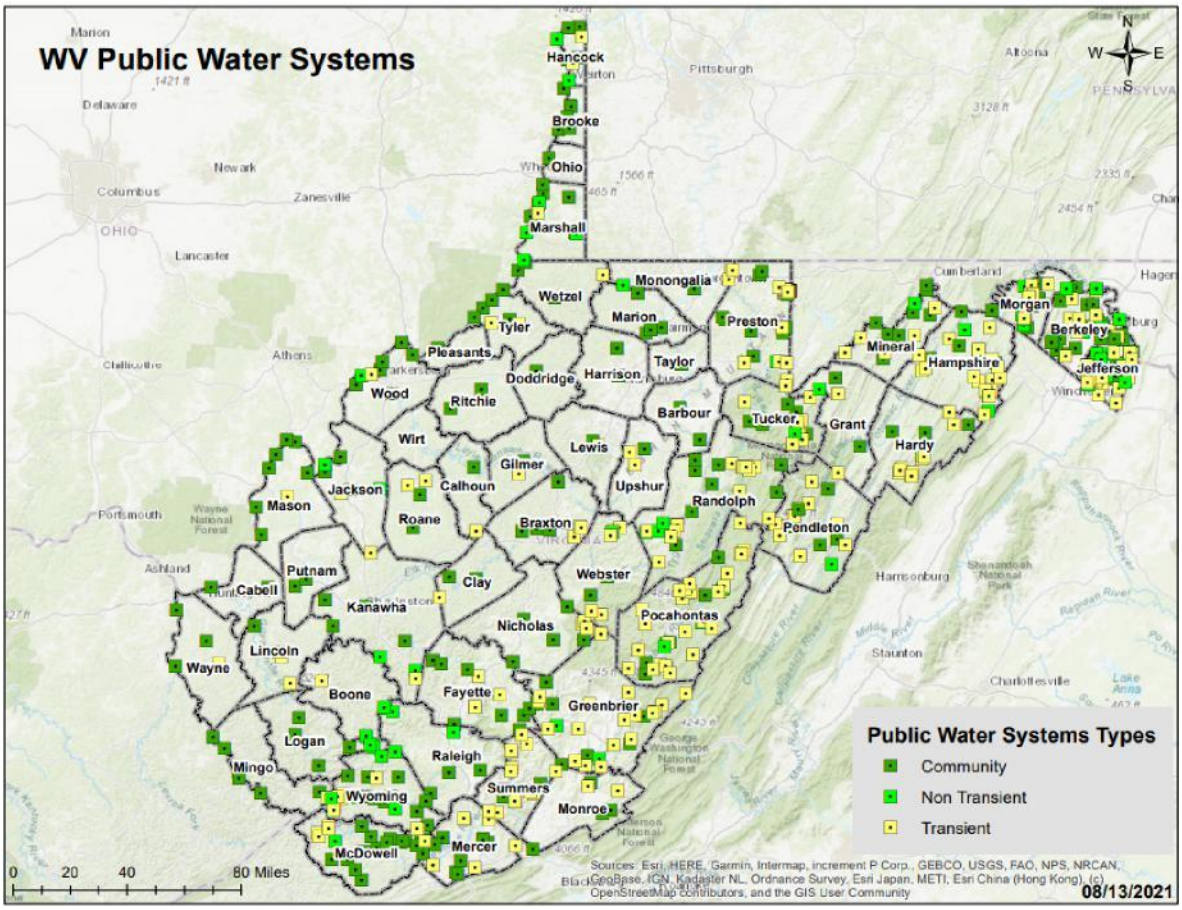
OEHS to date has hired additional staff and spent a significant amount of time in developing the WHP programs, creating a GIS program for the storage and display of geologic/hydrologic and regulatory site data, delineations, and existing significant contaminant source inventories. Potential future WHP program needs are as follows:

- Source water education materials designed to identify, assess, prioritize, and address local source water protection and contamination prevention needs.

- Pollution prevention technical assistance to small businesses located within wellhead protection areas to balance brownfield redevelopment with local water protection/restoration efforts.

- Continued groundwater quality monitoring to support activities mandated by the Safe Drinking Water Act and the Clean Water Act.

- Funding to continue to sustain a grant program for PWSs that utilize groundwater to assist and focus appropriate source water protection efforts, increase resistance and provide security to source water protection areas and new water facilities.


WV Public Water Systems
Hancock
Brooke
Ohio
Marshall
Wetzel
Monongalia
Marion
Preston
Tyler
Pleasants
Taylor
Doddridge
Harrison
Wood
Ritchie
Barbour
Tucker
Grant
Hardy
Wirt
Lewis
Gilmer
Upshur
Randolph
Jackson
Calhoun
Mason
Roane
Braxton
Pendleton
Putnam
Clay
Webster
Cabell
Kanawha
Nicholas
Pocahontas
Lincoln
Wayne
Boone
Fayette
Greenbrier
Logan
Raleigh
Mingo
Summers
Wyoming
Monroe
McDowell
Mercer
Morgan
Berkeley
Jefferson
Mineral
Hampshire
Public Water Systems Types
Community
Non Transient
Transient
0 20 40 80 Miles
08/13/2021

VI. UNITED STATES GEOLOGICAL SURVEY

SUMMARY OF GROUNDWATER QUALITY IN WEST VIRGINIA

West Virginia Department of Environmental Protection Cooperative

Projects Fiscal Year 2020 and 2021
Introduction

The USGS and the WVDEP had 5 active groundwater cooperative projects during Federal Fiscal Years 2020 and 2021. These projects were designed to provide the WVDEP with hydrologic and geologic data and included interpretative projects with respect to groundwater quality and hydrogeologic assessments to support the mission and activities of the WVDEP, and to fulfill requirements of the West Virginia Groundwater Protection Act.

Projects include: 1) a statewide groundwater level network operated by the USGS in cooperation with the WVDEP used for assessment of groundwater storage and drought prediction and monitoring for West Virginia; 2) a statewide borehole logging project operated cooperatively by the USGS and the WVDEP to provide critical information related to groundwater flow processes of the state's fractured-bedrock aquifers; 3) a project to assess groundwater used by rural residential homeowners in areas of current and past coal mining and oil and gas development to assess the quality of groundwater available to rural homeowners that are dependent on these water sources, a project which is part of a long-term on going ambient groundwater quality project operated by the USGS in cooperation with the WVDEP and the WVDHHR; 4) an assessment of the hydrogeologic framework of complex fractured-rock and karst limestone aquifers in Monroe County: and 5) a survey of the occurrence of per- and polyfluoroalkyl substances (PFAS) in public drinking water supplies throughout West Virginia. Additionally, The USGS is working with WVDHHR on assessment of public-water supply wells in surface-water-influenced alluvial aquifers along the Ohio River.

Background

The USGS has a long history of cooperative data collection, monitoring efforts, and hydrologic studies with the WVDEP and other state, federal, county, and local agencies to provide critical data on surface- and groundwater quality, streamflow discharge, groundwater levels, aquatic health, and to better understand complex groundwater flow processes. These topics have been assessed by long-term data-collection networks and interpretative scientific studies. These data-collection efforts, long-term networks, and hydrologic assessments help to provide information that the WVDEP requires to fulfill its mission. Some of the projects date back to the inception of the WVDEP. Summary descriptions of on-going projects follows, with associated maps and tables of sites monitored or assessed.

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Statewide Groundwater-Level Network

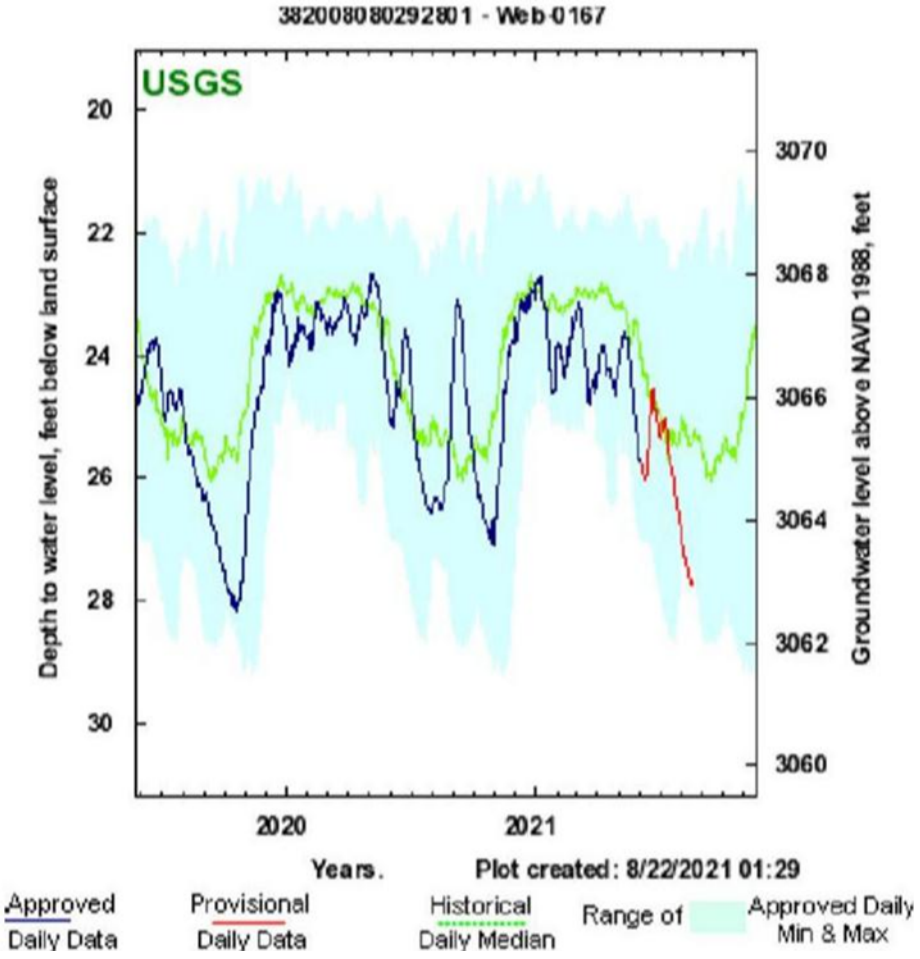
The statewide groundwater level network is comprised of 19 wells (Table 1) with at least 2 wells in each of West Virginia's six major climatological zones, and provides state, federal, and local water-resource managers data on the current condition of groundwater levels throughout the State of West Virginia. The data are commonly used to assess current conditions of groundwater storage, to predict the onset of a drought, and in times of drought to assess the severity of the drought with respect to groundwater storage. In many states the data are used by regulatory agencies to issue drought proclamations, and to serve as the basis for issuing voluntary or mandatory water conservation orders. During the last major drought, the data from the network were used to assess the magnitude of the drought with respect to groundwater levels statewide. At that time the statistical analysis of the data had to be computed manually, but at present the data is all automated and easily accessed in a USGS online database titled "Groundwater Watch" (https://groundwaterwatch.usgs.gov/NetMapT1L2.asp?ncd=rtn&sc=54).

Table 1. List of wells that comprise the Statewide Groundwater-Level Monitoring Network. The USGS operates the network, which is funded by the USGS and the WVDEP Division of Water and Waste Management as part of a long-term cooperative project.

USGS Station Number	USGS Well Number	Location of Well
372322081241501	Mcd-0204	McDowell County
373839081255201	Wyo-0148	Wyoming County
380653080155301	Poc-0256	Pocahontas County
381447081393101	Kan-0946	Kanawha County
382008080292801	Web-0167	Webster County
382205082304501	Way-0144	Wayne County
385849079563901	Bar-0136	Barbour County
390333078370801	Hrd-0301	Hardy County
391020080244101	Har-0165	Harrison County
391308081064201	Rit-0116	Ritchie County
391920078032201	Ber-0840	Berkeley County
392200078532001	Min-0173	Mineral County
392725077582401	Ber-0445	Berkeley County
392757077501001	Jef-0797	Jefferson County
393814079484601	Mng-0585	Monongalia County
401216080362703	Brk-0066	Brooke County
401216080362703	Jef-0526	Jefferson County
373234080320101	Mnr-0162	Monroe County
401216080362703	Way-0110	Wayne County

Graphs in figures 1 A & B, retrieved from the USGS Groundwater Watch website, illustrate how the statistical data for long-term water levels can be used to assess current groundwater levels across the State of West Virginia, and in turn how the data may be used to predict the onset of drought and assess the magnitude of a drought.

Figure 2A shows long-term groundwater levels for the past 2 years in context with longterm statistical trends (maximum, minimum, and median daily water levels). Likewise, figure 2B shows daily water levels in context with statistical percentile classes. For example, the orange boxes in figure 2B show the 10th to 24th percentiles of water levels, and the brown boxes show historical groundwater levels less than the 10th percentile, both of which may be used to assess the onset and magnitude of drought conditions.



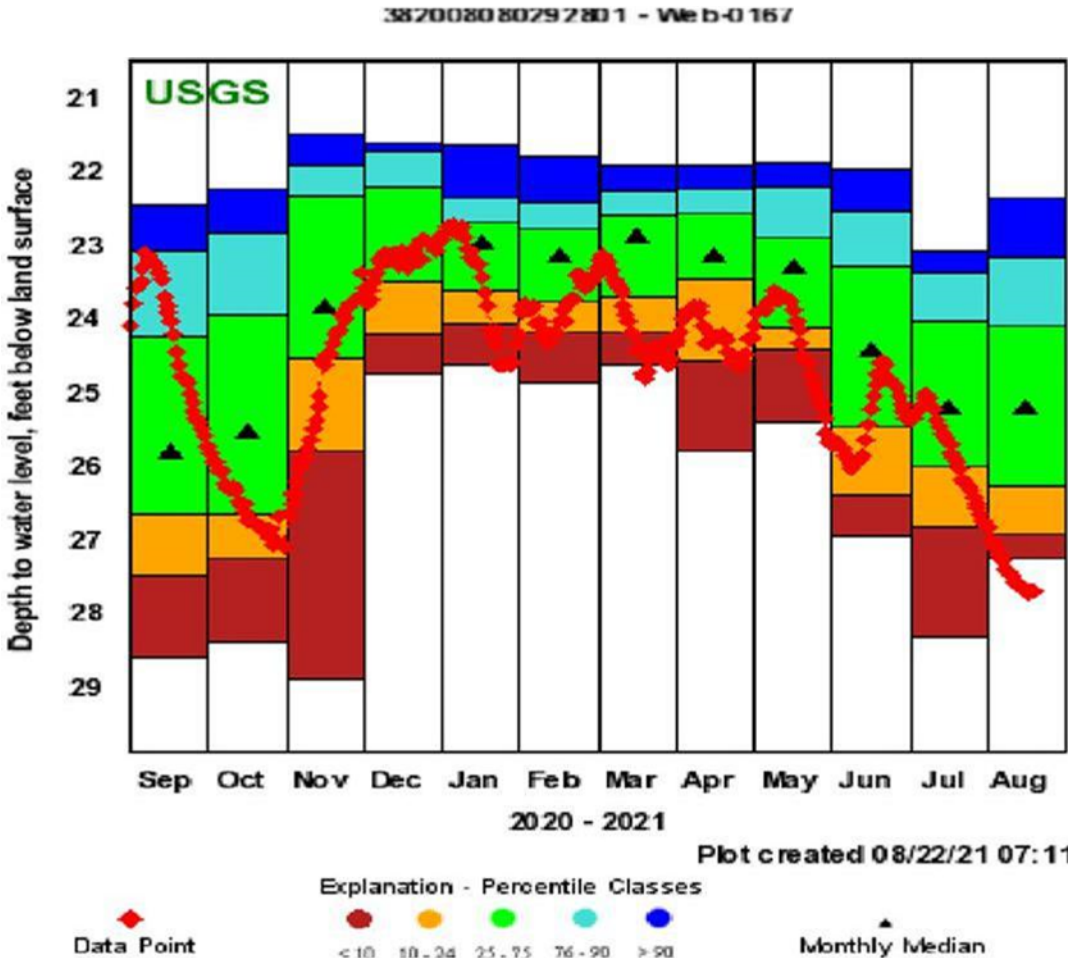


Figure 1. Graphs showing A) daily groundwater levels and B) statistical water-level trends for the Pocahontas County monitoring well with respect to long-term data.

West Virginia Aquifer Characterization and Borehole Geophysics Program

The West Virginia Water Resources Protection Act required the WVDEP to develop a plan to characterize the groundwater aquifers within the state. The West Virginia Water Resources Management Plan of 2013 identified fractured-rock aquifers in the state as an area where more information was needed to fulfill the requirements of the Act. To address these data and information gaps, the WVDEP and USGS cooperatively developed the WV Borehole Geophysics program with the purpose of collecting and analyzing data that will fulfill the requirements of the Act.

The objectives of the program are to collect borehole geophysical data within the state and use this information to calculate and understand the distribution of aquifer properties for a wide variety of fractured-rock aquifers. To complete these objectives, personnel from the USGS and WVDEP have been collecting geophysical data from groundwater wells in West Virginia since 2015. Table 2 lists the types of borehole geophysical tools employed for the study and the types of assessments that are derived

from each geophysical tool. The USGS has invested approximately $300,000 in the equipment and vehicles required for the project, and the tools purchased were specifically selected for characterization of the state's fractured rock aquifers.

Table 2. Table listing the types of borehole geophysical tools employed for the logging project and the types of data provided by the respective tool.

Borehole Geophysical Tool	Types of data available from the tool
Downhole camera	Provides a downhole video of the borehole
3-arm caliper tool	Measures diameter of the borehole and used to assess locations of fractures within a well
EM induction tool	Measures formation conductivity and used to assess borehole lithology, and differentiate saline zones
Multi-parameter electrical tool	Measures a wide range of formation and fluid properties such as fluid resistivity, formation resistivity, water temperature, formation gamma radiation, spontaneous potential and other properties and used to assess fresh and saline water zones and differentiate formation lithology
Acoustic televiewer	Uses acoustic waves to produce an image of the borehole and used to determine fracture properties
Optical televiewer	Provides a 360-degree image of the borehole and used to determine fracture properties
EM flowmeter	Measures the flow of water in the borehole and used to assess water bearing fractures
Full wave sonic porosity	Uses sound waves to determine formation and fracture porosity.

As of August of 2021, data have been collected at 126 groundwater wells in West Virginia (Fig. 2) with 100 wells logged from 2015 to the present. Twenty-six wells were logged for previous USGS projects dating before the current cooperative geophysics program. Federal fiscal year 2019 was scheduled to be the last year of data collection and two additional fiscal years (2020 and 2021) were scheduled for analysis and report writing. Due to the Covid-19 pandemic, and the large mobilization effort to sample all public water systems in West Virginia for PFAS compounds, a one-year no cost extension was greed to between the USGS and the WVDEP. The final interpretive report summarizing findings of the study will be written in federal fiscal year 2022 with final approval of the report planned to be completed by September 20th, 2022.

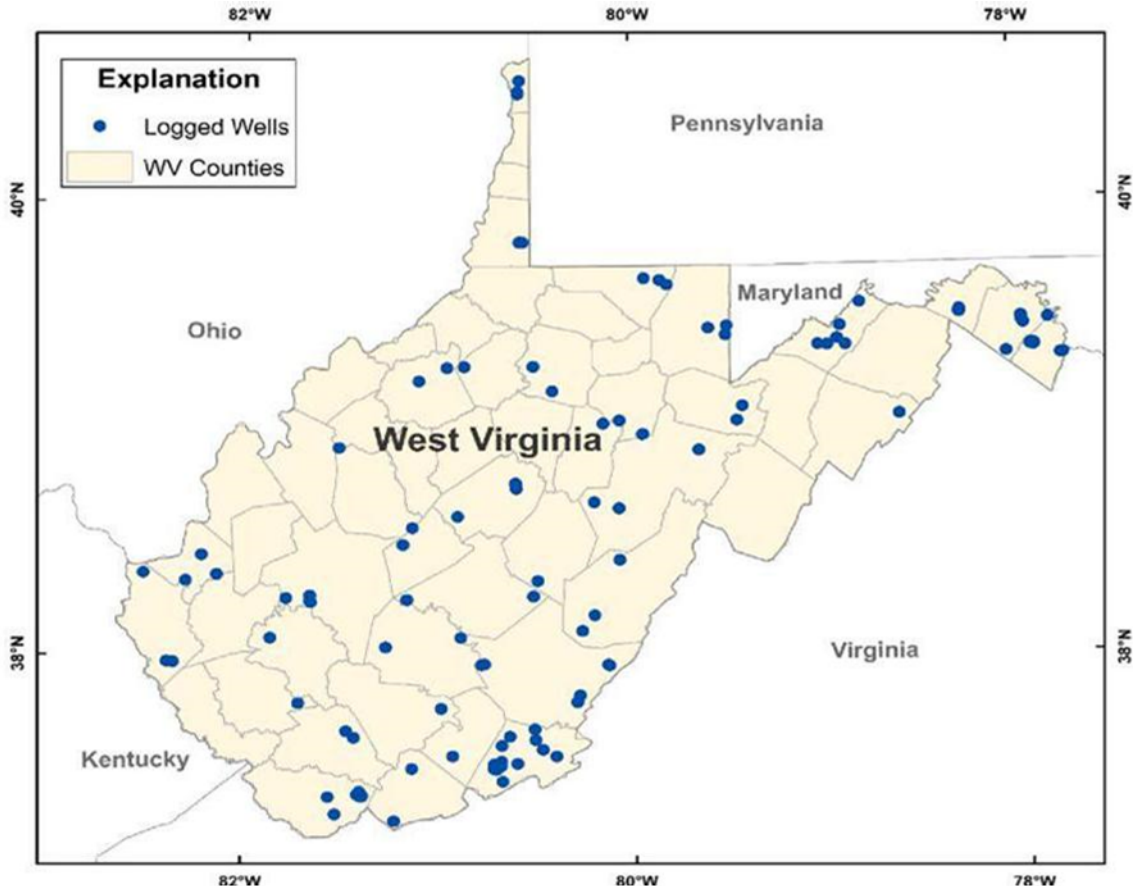


Figure 2. Map showing locations of wells logged as part of the Statewide Borehole Geophysics Program and previous USGS projects through August 2019.

Assessment of Drinking Water Quality in Rural Areas with Active or Legacy Coal Mining or Oil and Gas Development

This project consists of two primary objectives: 1) to assess groundwater quality in a 7-county area in West Virginia's southern coalfields and determine the quality of water available to rural residential homeowners in areas of past or current coal mining, and 2) to assess groundwater quality in an area of current intense Marcellus Shale "wet gas" development. In addition to examining relations among groundwater quality with respect to coal mining and shale gas production, this study provides a benchmark of current conditions for future comparisons. A tertiary but equally important objective is to collect groundwater-quality data in areas of the state that have been under represented in previous studies.

This project is currently on-going and is scheduled to be completed in FY 2022. A report summarizing the groundwater quality of southern West Virginia's coal mining region, Groundwater Quality and Geochemistry of West Virginia's Southern Coal Fields, was released in 2020. The report for the Marcellus Shale "wet gas" study has been through the peer review process and will be submitted for editorial review in September of 2021, with final publication of the report planned for the Winter or Spring of 2022.

Monroe County Groundwater Resource Assessment and Monitoring Project

A countywide assessment of the groundwater resources in Monroe County was initiated in October of 2017 and all field data collection activities have been completed. Major objectives of the project include 1) development of a hydrogeologic framework for Monroe County including sinkhole mapping and fracture trace and lineament analysis, 2) determining directions of groundwater flow by development of a countywide water table (potentiometric surface) map and by conducting tracer tests with fluorescent dyes, 3) water budget assessment and analysis of the availability of groundwater resources in the County by interpreting soil water budget recharge estimates and correlating those estimates with similar recharge estimates made for key index stream gaging stations, 4) assessing groundwater flow velocities and potential for contaminant transport by conducting two groundwater tracer tests using fluorescent tracers, and 5) characterizing fracture, bedding plane, and lithologic controls on groundwater flow by collecting borehole geophysical data for as many unused wells as can practically be located within the county.

All field activities were completed by the end of December 2019. Data analysis and report writing was conducted in 2020 and 2021 and writing of the initial draft of the interpretive report is scheduled to be completed in 2021. The Covid-19 pandemic resulted in a year long delay in final data analysis and writing and review of the interpretive report summarizing the results of the study. This delay was a result of field staff inability to travel during the pandemic to complete the geologic mapping portion of the project, which is needed to properly interpret the hydrogeologic data collected for the study. At the time of writing of this project status update, all geologic mapping activities have been completed and are being used for further interpretation of the hydrogeologic data collected for the study. A report summarizing the findings of the study is currently being written and is scheduled to be approved for publication in the Summer of 2022.

Susceptibility of Surface-Water-Influenced Groundwater Supplies in the Ohio River Alluvial Aquifer

Surface-water-influenced groundwater (SWIG) systems include any underground public-water supply (PWS) which is heavily influenced by the quality and quantity of surface water in the immediate area of a well. Despite the fact that alluvial aquifers have a relatively small footprint in comparison to other aquifers in West Virginia, these sand and gravel aquifers are the primary water supply for numerous large communities along the Ohio River (Wheeling, Parkersburg, Point Pleasant, etc.). Protection of PWSs requires an understanding of aquifer interactions with the Ohio River and tributary streams that contribute to the chemistry of groundwater from pumping wells.

To address questions concerning SWIG systems in the Ohio River alluvial aquifer, the USGS and WVDHHR have developed a project to understand the spatial differences in aquifer susceptibility to contamination and surface water infiltration. The purpose is to characterize the ground water-quality, determine recharge sources, and estimate age of groundwater in the Ohio River alluvial aquifer in the State of West Virginia. The results of this study will be used to identify field locations for further investigations into the heterogeneities controlling riverbank filtration.

Several groundwater wells from PWSs along the Ohio River have already been sampled this year as part of the USGS National Water Quality Assessment Project. At least 10 additional groundwater wells, and 4 surface water sites, are scheduled to be sampled this winter. The analyte list (Table 4) supplies the necessary water-quality data to characterize groundwater quality, determine groundwater age, identify source water contributions to PWSs, and assess PWS susceptibility to surface contamination. This project began in July of 2019 and reports and products for this study are scheduled to be completed by the end of 2021.

Per- and Polyfluoroalkyl Substances in West Virginia's Public Source Water

Per- and polyfluoroalkyl substances (PFAS) are industrial compounds used in lubricants, fire-fighting foams, and non-stick materials. PFAS compounds have been detected in West Virginia’s groundwater and surface waters. West Virginia Senate Concurrent Resolution 46 (2019) directed the West Virginia Department of Environmental Protection and the West Virginia Department of Health and Human Services to “purpose and initiate a public source-water supply study plan to sample perfluoroalkyl and polyfluoroalkyl substances for all community water systems in West Virginia, including schools and daycares that operate treatment systems regulated by the West Virginia Department of Health and Human Resources.”

WVDEP and WVDHHR entered into a cooperative agreement with the USGS Virginia and West Virginia Water Science Center to address the requirements of the resolution and by April of 2021 the USGS had sampled 279 sites across the state (Fig. 3). Results from these samples are being transmitted to the Virginia and West Virginia Water Science Center from analytical labs and results are being reviewed to ensure they meet all quality-assurance standards. Where PFAS were found in exceedance of applicable standards, the public-water supply operators and the WVDHHR were notified as soon as possible. Results are scheduled to be published as a USGS data release in September 2021. A scientific report presenting significant findings of the study is in preparation and is planned for publication in mid-2022.

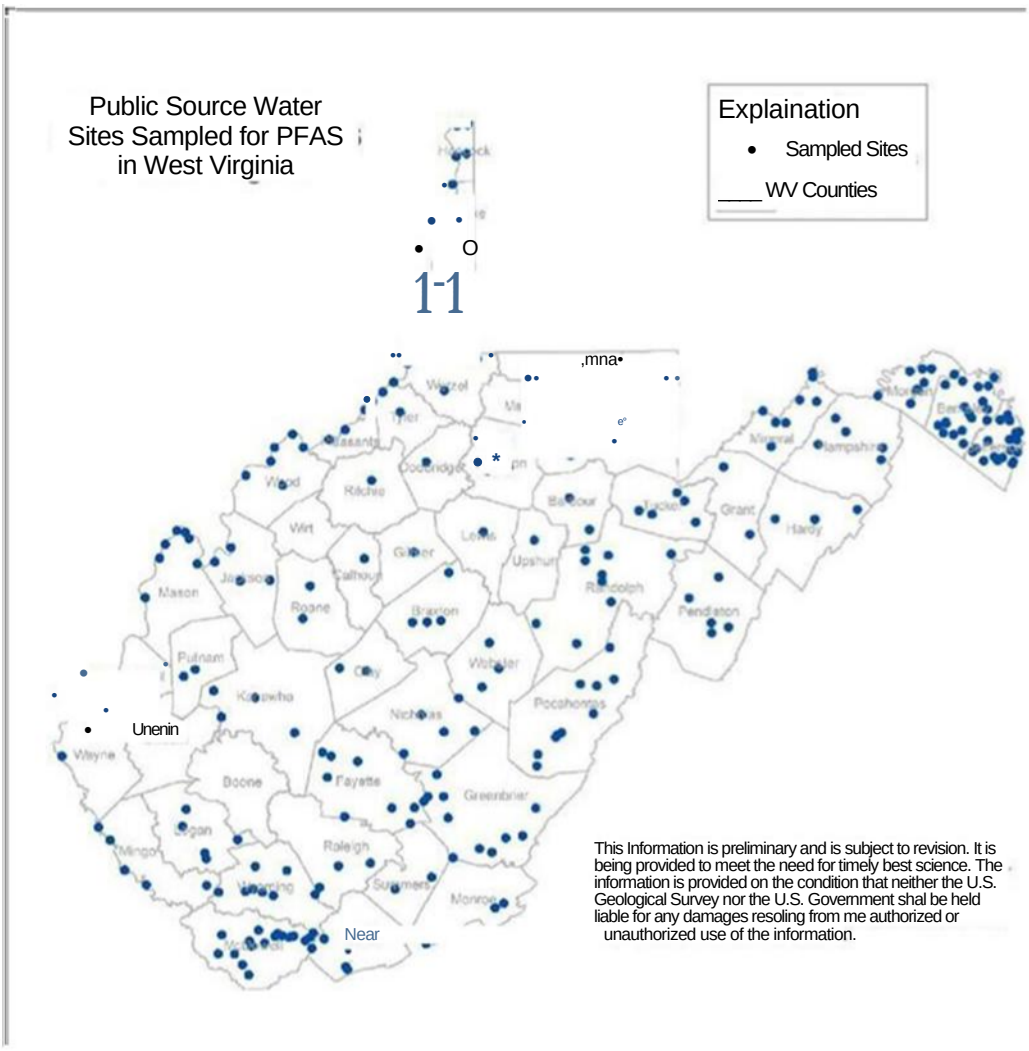


Figure 3. Map showing locations of Public source water sites sampled for PFAS in West Virginia by the USGS in cooperation with the WVDEP and WVDHHR.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Office of Oil and Gas

The Office of Oil and Gas (OOG) regulates West Virginia's oil and natural gas industry. Protection of groundwater is of utmost importance and is achieved through the permitting, inspection and enforcement of exploration, production, plugging and injection activities of the industry. Over 62,000 active wells are maintained by the OOG. Regulations aimed at protecting groundwater have been in existence since 1929. Additional regulations have been added in subsequent years to further aid in the protection of groundwater. The OOG believes that groundwater protection is maximized by conforming to these existing regulations and practices. The following is a summary of selected regulatory functions and activities the OOG conducts in protecting groundwater.

Fresh Water Casing and Drilling Practices- 35 CSR 4-11.3; 35 CSR 8-9.2

For conventional wells, operators must set freshwater casing at least 30 ft. below the deepest fresh water horizon and circulate cement to surface prior to drilling into any oil, gas or salt water bearing strata. With the passage of W. Va. Code § 226A, the Horizontal Well Act, in December 2011, and its corresponding legislative rule, 35CSR8, going into effect in July 2013, at least 300 ft. of freshwater casing must be run and cemented to surface on applicable horizontal wells, known as H6A wells. The freshwater casing may be extended deeper to cover known aquifers or to cover a coal seam prior to drilling below sea level (elevation) and must always be cemented to surface. The operator must also employ practices and procedures necessary to minimize damage or disturbance to strata including groundwater until casing has been set.

Plugging Methodology – 35 CSR 4-13, W. Va. Code § 22-6-24, 35 CSR 8 – 19, 35 CSR 8 - 20

During plugging and abandonment operations of a well, the operator is required to separate oil, gas and water-bearing strata with 100 ft. cement plugs to completely seal the borehole and prevent communication with other zones, including groundwater.

Water Supply Testing- 35 CSR 4-19 and 35 CSR 8-15

For conventional wells, operators are required to notify landowners within 1,000 ft. of a proposed drill site for a well. At the request of the landowner, the operator shall sample and analyze water from any wells or springs within this 1,000 ft. radius. If no requests are made, then the operator shall choose an existing well or spring from within the 1,000 ft. to sample and analyze. Operators are required to move out to 2,000 ft. if there are no wells or springs within 1,000 ft. Sampling parameters include, but are not limited to pH, iron, chlorides, total dissolved solids and detergents (MBAS). Results are to be submitted to the landowner as well as the OOG. Results are kept on file for groundwater quality purposes should a problem ever arise. The operator shall sample

and analyze water from any existing water wells or developed springs within 1500 ft. from the center of the proposed pad for all wells permitted under W. Va. Code § 22-6A. Under 35 CSR 8-15.3. b, the Chief can require the operator to sample and analyze out to 2000 feet. parameters include, but are not limited to: total petroleum hydrocarbons (GRO, DRO, ORO), BTEX, chloride, sodium, total dissolved solids (TDS), aluminum, arsenic, barium, iron, manganese, pH, calcium, sulfate, detergents (MBAS), dissolved methane, dissolved ethane, dissolved butane, dissolved propane, and bacteria (total coliform).

Underground Injection Control Program – 35 CSR 4-7

The OOG administers the Underground Injection Control (UIC) Program for Class 2 and 3 injection wells. Class 2 wells include brine disposal and secondary recovery gas and water injection wells. Class 3 wells include solution mining wells. The current active inventory of Class 2 and 3 wells consists of approximately 27 private and 11 commercial brine disposal wells, 480 secondary recovery wells and 13 solution mining wells. The primary focus of this program is the protection of groundwater from injection operations.

During the permitting process, operators are required to sample and analyze all water wells, springs and surface water bodies within at least a quarter-mile radius of the injection well or facility. Solution mining permits further require that groundwater be sampled, analyzed and charted on a quarterly basis. To ensure well integrity, mechanical integrity tests (MITs) are required to be conducted on every injection well by the operator at least once during the 5-year permit term to ensure that injected fluid is not migrating into any Underground Source of Drinking Water (USDW). Operators are required to submit reports monthly of daily activity for each injection well.

Abandoned Well – 35 CSR 6

Abandoned wells are the most problematic regulatory area relating to groundwater, especially for wells drilled 75 to 100 years ago when technology and concern for groundwater protection were not as advanced as today. These wells, which are found throughout the state, now pose potential and actual threats to groundwater quality, as aquifers penetrated by these wells are typically not cased to protect them from contaminants within the borehole of the well. Some of the typical contaminants that may affect groundwater quality include hydrocarbons, chlorides and metals. The OOG works with both industry and the federal government to locate, prioritize and plug or produce abandoned wells. The OOG has a priority ranking of abandoned wells and those that pose a significant and/or immediate threat to human health or the environment are scheduled for evaluation first.

Annual Inspection – 35 CSR 4-11.6

Operators are required to visually inspect all their unplugged wells on an annual basis. Any significant leakage or well integrity failure is to be reported to the OOG and measures should be taken to remedy the problem. Operators are required to submit certification to the OOG that the inspections have been conducted.

General Water Pollution Control Permit, GP-WV-1-88, GP-WV-1-07

The primary function of the land application general permit, GP-WV-1-88, is the prevention of pollution to the waters of the state relating to the handling and disposing of drilling wastes. Operators applying for a conventional well work permit involving the use of a pit for holding wastes generated during well work must also register this site and indicate the method for treating and disposing of the pit contents. If land application is the chosen method of disposal, a groundwater protection plan (GPP), must be filed as part of the permit packet. Generally, most pit contents (excluding those generated from an H6A well) may be land applied after proper treatment and aeration procedures.

Another general permit, GP-WV-1-07, allows for produced water from certain coalbed methane wells to be applied directly to the ground. To qualify for coverage under this permit, candidate wells must meet strict water quality criteria. Analyses of surface water, and in some cases, groundwater, must be presented to OOG on a semi-annual basis for review.

Spill Prevention and SPCC Plans -- 35 CSR 1, 35 CSR 8 - 18

To prevent discharged oil from reaching waters of the state, all operators are to have adequate containment or diversionary structures in place at each well or facility. Operators are also required to have a Spill Prevention Control Countermeasure (SPCC) Plan for these facilities. This requirement was devised as a result of the passage of the Clean Water Act (CWA) to protect waters of the state from discharged oil.

For horizontal wells permitted under W. Va. Code § 22-6A-1, operators must further ensure that all site equipment is positioned and used in a manner that will prevent spills into waters of the state. Provisions also exist that describe the use of pad liners, containment structures, catchment basins, and bulk chemical storage on site.

Miscellaneous

To prevent discharged oil from reaching waters of the state, all operators are to have adequate containment or diversionary structures in place at each well or facility. Operators are also required to have a Spill Prevention Control Countermeasure (SPCC) Plan for these facilities. This requirement was devised as a result of the passage of the Clean Water Act (CWA) to protect waters of the state from discharged oil.

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VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Office of Waste Management

Solid Waste Permitting Unit (SWPU)

The SWPU regulates solid waste facilities under the Solid Waste Management Rule, 33CSR1. This includes the review of applications for various permitting activities for new and existing facilities such as permit issuance, renewal, or closure. The SWPU reviews applications to accept special waste, to alter groundwater monitoring systems, and reviews statistical groundwater monitoring reports, conducts construction quality assurance and quality control inspections, and compliance assistance to waste generators.

Description	Permitted Facilities
Active Municipal Solid Waste Landfills (Class A & B)	18
Closed Municipal Solid Waste Landfills (Class A & B)	28
Active Construction/Demolition Waste Facilities (Class D and D-1)	21
Yard Waste Composting Facilities	1
Transfer Stations	17
Waste Tire Facilities	1
Registered Recycling Facilities (Class E)	187
Incinerator	1
Mixed Waste Processing Facilities	0
Industrial Landfills (Class F)	42

Some landfills are currently allowed to accept drill cuttings and associated drilling waste for proper disposal. Those facilities had to obtain modifications to their permits, which require that the leachate from the cells holding this waste be monitored separately from rest of the landfills waste through dedicated monitoring wells and that the leachate emanating therefrom be treated by publicly owned treatment works (POTWs).

Oil and other chemicals, primarily from vehicles, and leachate can contaminate stormwater flowing from solid waste facilities. Plans form structures and procedures for managing stormwater are a part of the detailed plans reviewed by the SWPU. Proper design, construction, and management prevent contaminated stormwater from infiltrating into the ground water.

In an effort to protect groundwater, the Solid Waste Management Rule requires an impermeable liner system for solid waste municipal solid waste landfills. This multiple layer liner system includes a leak detection zone that will alert the facility should there be a failure in the liner. If contamination has been detected by routine detection monitoring, the landfill may be required to begin corrective action to clean up the groundwater.

Permitted landfills must sample groundwater-monitoring wells twice each year and perform statistical tests to determine whether groundwater has been contaminated. The statistical reports are reviewed by the SWPU and the Office of Environmental Enforcement (OEE) takes any necessary enforcement action.

Groundwater monitoring wells must sometimes be replaced because they have caved in, gone dry, or are located where the disposal area is expanding. The SWPU reviews well replacement plans to ensure that the new wells are properly placed to detect potential groundwater contamination as soon as possible.

Groundwater monitoring reports are submitted to the SWPU on paper. The Integrated Regulatory Information Support system (IRIS) which is being developed by WVDEP, will accept groundwater-monitoring data electronically and provide an interface to statistical and mapping software that will allow the SWPU to check statistical calculations.

The proper management of waste reduces the likelihood of groundwater contamination by reducing the amount and controlling the types of contaminants in leachate. This is achieved by special waste requests which are reviewed by the SWPU and either approved or denied for disposal.

The SWPU is responsible for ensuring that facilities are properly designed by reviewing plans and granting permit modifications for expansion. During construction at these facilities, the SWPU conducts quality assurance/quality control (QA/QC) inspections to assure that facilities are built according to specifications and accepted industry practices.

Through the Landfill Closure Assistance Program (LCAP), the WVDEP is currently monitoring the 33 closed solid waste landfills in West Virginia. Under this program, the emphasis is on the capping of these facilities to minimize groundwater impact. Active solid waste landfill facilities have an on-going program to identify and address any groundwater releases. The LCAP Program utilizes consultants who follow the procedures outlined in 33CSR1 to sample, analyze, and identify groundwater and any associated problems. The SWPU has assisted LCAP by providing geological assistance on program priorities.

Hazardous Waste Permitting Section

The Hazardous Waste Permitting Unit (Permits) was established by Chapter 22, Article 18 of the West Virginia Code and the rules promulgated there under. Legislative Rule, Title 33, Series 20, known as the Hazardous Waste Management System (HWMS), are the regulations promulgated to regulate the storage, treatment, and disposal of hazardous wastes generated and managed in West Virginia. The HWMS has incorporated by reference the Code of Federal Regulations (CFR) promulgated under the Resource Conservation and Recovery Act (RCRA) amendments of 1984. All provisions of 40CFR264 Subpart F and 40CFR265 Subpart F, which pertain to groundwater protection and any releases from a Solid Waste Management Unit (SWMU), have been incorporated by reference in their entirety.

Permits and the State of West Virginia coordinate this regulatory effort with the EPA. In general, as a summary of the relationship between the two agencies, West Virginia has authorization to assume the lead role in the groundwater protection and monitoring at the permitted units in West Virginia while EPA has the lead for implementing corrective action activities.

Groundwater Protection Goal and Priorities

The goal of Permits is to identify all permitted sites with groundwater contamination or potential for groundwater contamination due to a release, remediate the site, and return the site to its original condition.

The priority objectives are as follows:

- Identify all sites with contaminated groundwater or potential for groundwater contamination.

- Define the contaminants, source, and extent of contamination.

All RCRA facilities will have chosen remedies and remediation, and construction completion by 2020, with contamination under engineering control and stabilized to prevent additional contamination to groundwater and eliminate further migration of contaminated groundwater.

Mechanisms to Regulate and Protect Groundwater at Permitted Units

The Groundwater monitoring regulations in 40 CFR Part 264/265, Subpart F, is one part of an overall strategy to reduce the likelihood of environmental contamination resulting from hazardous waste treatment, storage, disposal and any SWMU under the Corrective Action Program. This strategy includes restrictions on disposal of untreated hazardous waste, unit-specific standards for land-based hazardous waste management

units, and monitoring groundwater below these units. The land disposal restrictions program requires the treatment of hazardous wastes before disposal to reduce the mobility or toxicity of hazardous constituents. The unit-specific standards for land-based hazardous waste management units seek to prevent the release of hazardous waste to the environment.

Groundwater monitoring is the final link in this strategy to prevent environmental contamination. Owners and operators of all land-based units must institute a groundwater program that is able to detect and characterize any releases of hazardous waste or hazardous constituents to the groundwater underlying the facility. Should the other elements of the strategy fail, groundwater monitoring will detect the release so it can be remedied.

The regulations in Subpart F of Part 264/265 are general requirements, establishing performance-based standards that state what a successful groundwater monitoring program must accomplish; they do not dictate specific technical standards. Each facility's groundwater monitoring program is unique because no two Treatment, Storage, or Disposal Facilities (TSDF) are the same. Individual groundwater monitoring programs are based on site-specific conditions, including the underlying geology and hydrology, contaminants in the groundwater, as well as the properties of wastes managed on site.

Regulatory authority is available to require the owner and operator of a TSDF to remediate releases of hazardous waste or hazardous constituents to the environment. All permitted facilities must comply with Part 264, Subpart F, for releases from SWMUs. There are three stages to the Part 264, Subpart F, groundwater monitoring and follow-up activities:

- Detection monitoring - to detect if a release has occurred
- Compliance monitoring - to determine if regulatory standards have been exceeded once a release has occurred
- Corrective action - to remediate a release to the groundwater

Section 264.97 sets out the basic requirements that apply to all groundwater monitoring programs under Part 264, Subpart F. The specific requirements that apply to each of the three phases of groundwater monitoring are found in section 264.98, 264.99, and 264.100.

The general requirements for groundwater monitoring programs at permitted facilities are found in Subpart 264.97. These general requirements apply to all three phases of groundwater monitoring: detection monitoring, compliance monitoring, and corrective action. A groundwater monitoring program established pursuant to Part 264, Subpart F, must have a sufficient number of monitoring wells, installed at appropriate locations and depths, to yield water samples that:

- Represent the background conditions of the site
- Represent the quality of groundwater passing the point of compliance
- Detect any contamination of the uppermost aquifer at the point of compliance

The goal of a detection monitoring program is to detect and characterize any release of hazardous constituents from a regulated unit into the uppermost aquifer. The detection monitoring system must be installed at the point of compliance and adhere to the task requirements applicable to all groundwater monitoring systems. The owner and operator must monitor for certain indicator parameters and any other specific waste constituents or reaction products that would provide a reliable indication of the presence of hazardous constituents in groundwater at the point of compliance.

Once it is established that a release has occurred, the owner and operator must institute a compliance-monitoring program. The goal of the compliance-monitoring program is to ensure that the amount of hazardous constituents released into the uppermost aquifer does not exceed acceptable levels. Once those levels are exceeded, the owner and operator must initiate corrective action. The compliance-monitoring program establishes routine monitoring (at least semiannually).

The goal of the Subpart F corrective action program is to bring regulated units and/or SWMU back into compliance with the required standards at the point of compliance. The Subpart F corrective action program seeks to accomplish this goal by requiring that the owner and operator either remove the hazardous constituents or treat them in place. Examples of corrective measures include excavation, stabilization, solidification, and source control. The owner and operator must also conduct corrective action to remove or treat in place any hazardous constituents that exceed the required standards between the point of compliance and the down gradient property boundary, and beyond the facility boundary where necessary to protect human health and the environment.

Mechanisms for Corrective Action

The Hazardous and Solid Waste Act of 1984 (HSWA) required corrective action for all releases of hazardous waste or constituents from any SWMU at a facility seeking a permit regardless of when the waste was placed in the unit. A SWMU is any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. This definition includes any area at a facility where solid wastes have been routinely and systematically released. This authority is applied to any facility seeking a permit, including operating permit, post-closure permits, and permits-by-rule after November 8, 1984.

Under HSWA, Congress also gave EPA the authority to issue orders requiring cleanups at interim status facilities. For interim status TSDF's that were already in operation when the applicable RCRA standards were established, and that are operating under the standards in 40 CFR Part 265 until they receive a permit Under 3008(h), as added by HSWA, the EPA can issue an administrative order or file a civil action whenever it determines, on the basis of any information, that there is or has been a release of hazardous waste into the environment from the facility. This applies to facilities that are currently operating under interim status, that formerly operated under interim status, or that should have obtained interim status. It also applies to any release of hazardous waste or constituents from the facility. In addition to requiring cleanup, EPA has the authority under 3008(h) to revoke or suspend interim status. Finally, as with 3004(v), EPA may use 3008(h) to require corrective action beyond the facility boundary and to require proof of financial assurance for cleanup.

One of the keys to understanding the RCRA corrective action program is knowing when a facility becomes subject to the corrective action. A facility can enter the corrective action program in one of primarily four ways. Facilities can enter the corrective action program under statutory authorities, by enforcement orders, by volunteering to perform cleanups, or after detecting statistically significant increases of contamination according to the groundwater monitoring requirements in 40CFR264, Subpart F.

In the past, EPA has used the corrective action process to evaluate and document the nature and extent of contamination, identify the physical and geographic characteristics of the facility, and identify, develop, and implement appropriate corrective measures. The conditions at contaminated sites vary significantly, making it difficult to adhere to one rigid process. Consequently, the corrective action process is designed to be flexible.

The original corrective action process of investigation and remedy selection and implementation comprise several activities. These activities are not always undertaken as a linear progression toward final facility cleanup but can be implemented flexibly to most effectively meet site-specific corrective action needs. These activities are:

- RCRA Facility Assessment (RFA) - identifies potential or actual releases from SWMUs

- Interim/Stabilization Measures - implements measures to achieve high-priority, short-term remediation needs RCRA Facility Investigation (RFI) - compiles information to fully characterize the release

- Corrective Measures Study (CMS) - identifies appropriate measures to address the release

Once the implementing agency has selected a remedy, the facility enters the corrective measures implementation (CMI) phase of corrective action. During the CMI, the owner and operator of the facility implement the chosen remedy. This phase includes design, construction, maintenance, and monitoring of the chosen remedy, all of which are performed by the facility owner and operator with agency oversight.

A remedy may be implemented through a phased approach and phases could consist of any logically connected set of actions performed sequentially over time or concurrently at different parts of a site.

Facilities with On-going Corrective Action

The following chart lists the West Virginia facilities that are currently performing corrective actions. It lists the facility, if the facility has human health (HH) and groundwater (GW) under control, and where each facility stands with its cleanup status.

This chart is periodically updated and can be viewed on the Internet at:

https://www.epa.gov/hwcorrectiveactionsites

- Additional information can be seen about site history and project detail if you go to the Web site and click on the facility name.

West Virginia
RCRA Baseline Facilities
EPA Region 3

Facility fact sheets and the Environmental Indicator forms are Adobe Acrobat PDF files.

For additional facility information, go to the following links:
- Click on the facility name to view the facility fact sheet
- Click on the "YES" to view the facility's completed Environmental Indicator form
- Click on the location name to view a map of the area

Cleanup Initiated	**Complete Without Controls**
Remedy Selected	**Complete With Controls**
Construction Complete	

Facility Name	EPA ID#	Location	Environmental Indicators		Cleanup Status
			HE	GW	
AEP Kanawha River Plant (Appalachian Power)	WVD980554588	Glasgow	YES	YES	Done
Airco Welding Products	WVD980554760	Chester	YES	YES	Done
Alliant Techsystems Operations LLC	WV0170023691	Rocket Center	YES	YES	Done
Appalachian Timber Services LLC	WVD063461958	Sutton	YES	YES	Done
Union Carbide Corporation (UCC) – Institute Operations (formerly Bayer Cropscience LP, Rhone Polenc, Aventis)	WVD005005509	Institute	YES	YES	Done
Covestro (formerly Bayer Polymers LLC,Miles)	WVD056866312	New Martinsville	YES	YES	Done
Beazer East-Colliers (Koppers-Colliers)	WVD980707178	Colliers	YES	YES	Done
SI Group USA (USAA), LLC - South Plant (formerly Addivant USA LLC, GE Specialty Chemicals)	WVD061776977	Morgantown	YES	YES	
SI Group USA (USAA), LLC - North Plant (formerly Addivant USA LLC, GE Specialty Chemicals)	WVD980552384	Morgantown	YES	YES	
Solvay Group (Cytec Industries, Inc.)	WVD004341491	Willow Island	YES	YES	
Chemours Belle Plant (formerly Dupont)	WVD005012851	Belle	YES	YES	
Chemours Company FC LLC - Potomac River Works (formerly DuPont)	WVD041952714	Martinsburg	YES	YES	Done

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Cleanup Initiated	**Complete Without Controls**
Remedy Selected	**Complete With Controls**
Construction Complete	

Facility Name	EPA ID#	Location	Environmental Indicators		Cleanup Status
			HE	GW	
Chemours Company FC LLC (formerly Dupont - Washington Works)	WVD045875291	Washington	YES	YES	
Solutia Nitro Site (formerly Flexsys,Solutia Inc., Monsanto)	WVD039990965	Nitro	YES	YES	
FMC Corporation Hydrogen Peroxide Division	WVD005005079	South Charleston	YES	YES	Done
Huntington Alloys Corporation	WVD076826015	Huntington	YES	IN	
MPM Silicanes (formerly GE Silicones)	WVD004325353	Friendly	YES	YES	
Sabic Innovative Plastics (GE Plastics, GE Chemicals)	WVD088911854	Washington	YES	YES	
Safety Kleen Corp	WVD000737387	POCA	YES	YES	Done
Rubbermaid Commercial Products LLC (formerly General Motors)	WVD044145209	Martinsburg	YES	YES	Done
Rubbermaid Commercial Products LLC (formerly General Motors)	WVD044145209	Martinsburg	YES	YES	Done
Great Lakes Chemicals Corp (FMC)	WVD005005087	Nitro	YES	YES	
TRC Spent Cathode Storage Pile (	WVD988766127	Ravenswood	YES	YES	
Koppers-Follansbee (Beazer East)	WVD004336749	Follansbee	YES	YES	
Koppers - Green Spring (CSXT)	WVD003080959	Green Spring	YES	YES	

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RCRA Baseline Facilities
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Remedy Selected	**Complete With Controls**
Construction Complete	

Facility Name	EPA ID#	Location	Environmental Indicators		Cleanup Status
			HE	GW	
Miller Springs Remediation Management – Glenn Springs Holdings	WVD005010277	Belle	YES	YES	Done
West Lake Chemical (formerly Eagle Natrium LLC, PPG Industries)	WVD004336343	New Martinsville	YES	YES	Done
Constellium Rolled Products Inc. (Century Alum., Ravenswood)	WVD009233297	Ravenswood	YES	YES	Done
Union Carbide Corporation (UCC) -Dow (–Private Trucking Operations)	WVD000739722	Nitro	YES	YES	Done
Shell Lubricants – Ergon Refinery (formerly Quaker State-Congo)	WVD057634776	Newell	YES	YES	Done
SMR Technologies (BF Goodrich)	WVD980555395	Fenwick	YES	YES	Done
St. Marys Refining Company (formerly Quaker State)	WVD004337135	St. Marys	YES	YES	Done
Union Carbide Corporation (UCC) - South Charleston Plant (	WVD005005483	South Charleston	YES	YES	
Union Carbide Corporation (UCC) – Technology Park	WVD060682291	South Charleston	YES	YES	Done
West Virginia Department of Environmental Protection (WVDEP Emergency Response Center)	WVR000502815	Elk View	YES	IN	Just added to the "beyond 2020 CA Universe"

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RCRA Baseline Facilities
EPA Region 3

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Cleanup Initiated	**Complete Without Controls**
Remedy Selected	**Complete With Controls**
Construction Complete	

Cleveland-Cliffs Weirton LLC (formerly Arcelormittal Weirton, Weirton Steel)	WVD000068908	Weirton	YES	YES	
Follansbee Plant (aka: Trimodal Terminal; 6Twelve Properties; formerly Wheeling - Pittsburgh Steel)	WVD004319539	Follansbee	YES	IN	
Flint Group Pigments (formerly XSYS Print Solutions LLC, BASF - Huntington)	WVD000068601	Huntington	YES	YES	

DEFINITIONS

HE - Current Human Exposures Under Control Environmental Indicator (CA725)

GW - Migration of Contaminated Groundwater Under Control Environmental Indicator (CA750)

YES - The Environmental Indicator has been met

IN - More information is needed

Cleanup Started - Initiation of a facility-wide investigation and cleanup.

Cleanup Initiated - Initiation of a facility-wide investigation and cleanup

Remedy Selected - The regulator has selected final cleanup objectives to address contamination and exposures.

Construction Complete - All components of the final remedy are in place and operating as designed.

Complete without Controls - Final cleanup objectives are met for all media, and no further activity or controls are necessary.

Complete with Controls - Final cleanup objectives are met but on-going operation, maintenance and/or monitoring of controls are necessary to ensure protection of human health and the environment.

Groundwater Data Collection and Management

Most groundwater data is collected by facilities or environmental firms on the facilities' behalf. Occasionally samples are collected by DWWM personnel for the purpose of comparison. Regardless of who is collecting groundwater samples, sampling methodology and analytical testing procedures must comply with the protocols prescribed by the appendices to 40CF261. All samples must be analyzed by laboratories certified by the DWWM.

Permits do not have a database for the management of groundwater data. Currently, facility groundwater data is submitted in paper form and reviewed by hazardous waste personnel assigned to the facility. In the future groundwater data will be submitted electronically. The electronic data will be stored, managed and shared among the divisions of WVDEP and other agencies with groundwater certification. The electronic data will be available to the public as well. In the future the data will be submitted by e-permitting system.

Program Consideration and Needs

There are difficulties inherent with trying to clean areas to pristine levels where industry has been associated with business activities for decades. There are economic and technical obstacles that need to be considered in areas that will probably never be utilized for drinking water. However, that must be balanced with the ideal that our groundwater is a valuable resource not to be taken for granted. There are many who have a stake in the decisions on how best to manage the environment. In the future, policy and decision making must be addressed by administration in a manner that each operating unit is clear as to the direction and in the manner these issues are to be decided.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Water Use Section

The Water Use Section operates under the authority of the 2008 Water Resources Protection and Management Act (W.Va. Code §22-26*).* The Section's formative publication, the West Virginia Water Resources Management Plan, provides a comprehensive review of the state's waters and was adopted by the Legislature in 2014. The Water Use Section has continued to implement the provisions and recommendations of both the Act and Plan with several ongoing programs, projects, and studies relevant to the state's groundwater resources.

Water Use Section - Current Groundwater Related Programs and Projects:

- Large Quantity Water User Survey
- GIS Internet Based Water Information Tools
- Geophysical Well Logging - Groundwater Aquifer Study
- Mine Pool Study – Location, Quantity, Quality and

Sustainability **Water Use Section – Large Quantity Users (LQU) Survey:**

Any entity that withdraws more than 300,000 gallons in 30 days from state water resources (including groundwater) is considered a Large Quantity User (LQU) under the Water Resources Protection and Management Act. These LQUs use the WV DEP Electronic Submission System to report their withdrawals annually to the Water Use Section. The Section has been collecting LQU information since 2010 and monitoring trends in water use. We share water withdrawal information with the State Legislature and research partners including universities and the U.S. Geological Survey.

In general, total water use has been on a slight decline, due primarily to the decrease in water used by thermoelectric operations, the largest water use sector overall. Groundwater withdrawals remain relatively consistent, comprising less than 10% of the total water use in West Virginia. Public water supply is the single largest user of groundwater (comprising 29% of all PWS withdrawals in 2020). Groundwater use is concentrated in the alluvial aquifers along the Ohio River, southern coalfields, and karst aquifer systems of eastern WV.

Table 1. Total water withdrawals (WD) from the 2019 and 2020 WVDEP LQU database.

2019			2020	
Water Use Sector	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**
Agriculture/Aquaculture	11,366,372,753	1.75%	9,568,490,855	1.66%
Chemical	133,655,672,743	20.55%	90,396,328,476	15.70%
Industrial	19,958,107,366	3.07%	39,694,594,742	6.89%
Mining	13,260,094,521	2.04%	9,929,772,782	1.72%
Oil & Gas	4,548,804,221	0.70%	2,923,297,711	0.51%
Petroleum	301,407,497 301,407,497	0.05%	296,017,675	0.05%
Public Water Supply	68,377,376,711	10.51%	57,305,088,314	9.95%
Recreation	1,170,135,868	0.18%	1,218,229,705	0.21%
Thermoelectric	396,571,231,051	60.98%	363,483,322,266	63.13%
Timber	1,075,306,386	0.17%	957,057,719	0.17%
TOTAL	**650,284,509,117**			

Table 2. Groundwater withdrawals (GW WD) from the 2019 and 2020 WVDEP LQU database.

2019			2020	
Water Use Sector	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**
Agriculture/Aquaculture	2,596,905,000	22.85%	1,491,415,920	15.59%
Chemical	879,993,644	6.64%	16,992,815,706	18.80%

2019			2020	
Water Use Sector	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**	**Groundwater Withdrawn (gallons)**	**% of Groundwater Withdrawn (gallons)**
Industrial	716,266,451	3.59%	1,426,663,047	3.59%
Mining	7,028,926,340	53.01%	1,430,282,975	14.40%
Oil & Gas	213,463,133	4.69%	9,676,465	0.33%
Petroleum	300,884,597	99.83%	0	0.00%
Public Water Supply	13,217,209,922	19.33%	16,774,293,796	29.27%
Recreation	333,665,589	28.52%	324,854,103	26.67%
Thermoelectric	407,861,920	0.10%	3,450,841,919	0.08%
Timber	8,609,912	0.80%	0	0.00%
Petroleum	300,884,597	99.83%	0	0.00%
TOTAL	**33,703,786,508**		**41,900,843,931**	

Water Use Section – GIS Internet Based Water Information Tools:

In cooperation with the TAGIS group, the Water Use Section maintains a suite of internet-based tools that display water resources management data in a Geographic Information System (GIS). The Water Resources Management Mapping Tool acts as a clearinghouse for all manner of data relevant to groundwater management, including LQU withdrawals, watershed delineations, karst, monitoring wells, springs, mine pools, NPDES, geology, and more. Link: http://tagis.dep.wv.gov/WVWaterPlan/

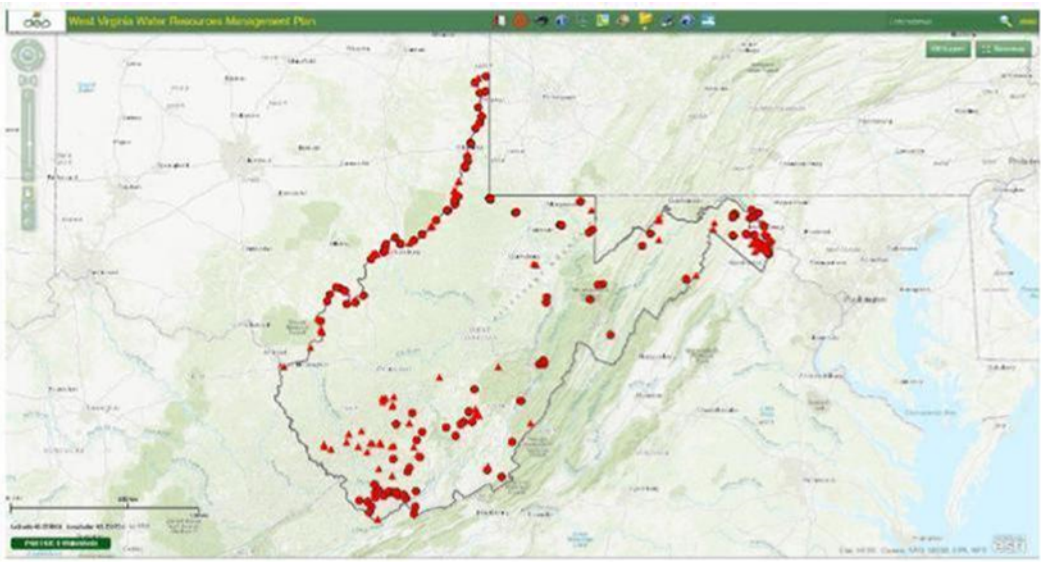


Figure 1. WV's groundwater based LQUs from the Water Resources Mapping Tool.

TAGIS and the Water Use Section also maintain a Water Withdrawal Guidance Tool. Developed in 2009, this tool helps direct potential water withdrawals towards only those surface waters with sufficient flow. The Section is currently investigating improvements to this tool, including the incorporation of groundwater resources, stream ecology, and higher spatial resolutions. Link: https://tagis.dep.wv.gov/wwts/

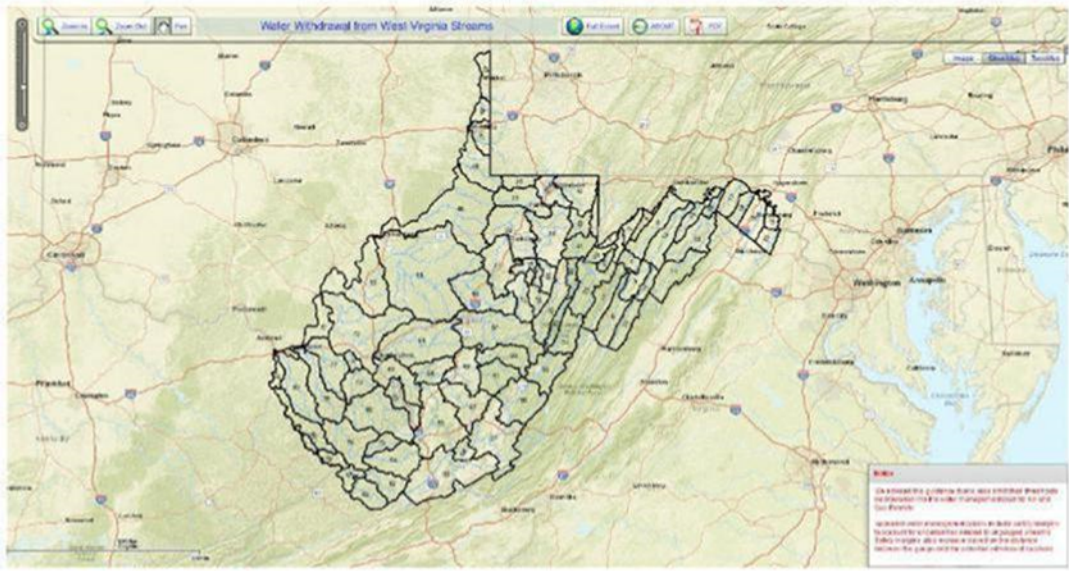


Figure 2. The 86 hydrologic zones of the Water Withdrawal Guidance Tool. Water Use Section – Geophysical Groundwater Well Logging:

The Water Use Section and the United States Geological Survey (USGS) have continued a collaborative five-year project to assess geophysical and hydrologic

properties of groundwater wells throughout West Virginia. The data from this project will be used to characterize the aquifers within the State through a better understanding of the bedding planes, joints, faults, and other fractures through which most of our groundwater flows or is stored. This research will increase knowledge of the depth and location of these water bearing fractures throughout the state.

Fieldwork for the project was completed September 2019 with over 120 well logs completed with geological and hydrological data. At the conclusion of the fieldwork the Water Use Section and USGS will collaborate on the final report and data models, expected in spring 2022.

Figure 3. Location of USGS-WVDEP borehole geophysics well logs 2014-2018. Water Use Section – Mine Pool Study

The Water Use Section has been involved in many projects to determine quantity and quality of water within Abandoned Underground Coal Mine Aquifers (AUCMA), also known as Mine Pools. Several municipalities and PSDs in southern West Virginia obtain their water supply from groundwater in mine pools. In 2012 we collaborated with the WV Geological and Economic Survey to map the extent of potential mine pools. Since then, the WV DEP has worked with the U.S. Geological Survey to obtain data from more than 770 water samples from 294 mines. A final report summarizing mine pool water quality and hydrogeology was provided in 2020. Future research could focus on sustainable yield of this water resource and inter-basin flow resulting from mine pools that transcend surface watershed boundaries.

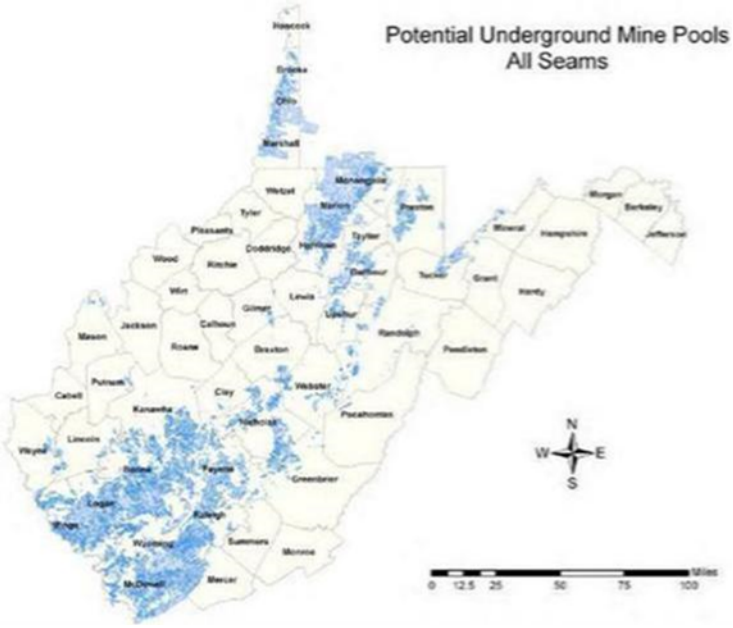


Figure 4. WVGES-WVDEP estimated extent of Abandoned Underground Coal Mine Aquifers.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Groundwater Program

Groundwater Quality Standard and Variances –

WV Code of State Rules Title 47 Series 57

47 C.S.R. 57 established procedures for facilities to petition the Secretary for a variance from groundwater protection standards for an individual source or for a class of sources. If the Secretary agrees that a variance is appropriate, the rulemaking procedures will be initiated in accordance with Chapter 29 Article 3 of the W. Va. Code. The Secretary may deny a variance; however, only the Legislature may grant a variance.

Variances may be granted by the Legislature to allow groundwater quality standards to be exceeded for a single source or class of sources, which by their nature cannot be conducted in compliance with the requirements of W. Va. Code 22-12-5. The benefits of granting the variance must outweigh the benefit of complying with existing groundwater quality standards and demonstrate that there is no technologically feasible alternative available. The request must also show that granting the variance is more in the public interest than adherence to existing groundwater quality standards.

During this reporting period, there have been no new requests for any groundwater quality standard variances. Nine current variance well facilities/sites were inspected during this period for compliance and status. Several remedial action plans were submitted per regulation by variance well owners and reviewed to determine variance well compliance status.

Groundwater Protection Regulations - WV Code of State Rules Title 47 Series 58

The Groundwater Protection Rule, 47 C.S.R. 58, requires Groundwater Protection Plans (GPPs) from facilities that have the potential to affect groundwater. GPPs are pollution prevention documents that cover all processes and materials at a facility that may reasonably be expected to influence groundwater quality. The facility must make an inventory of all potentially contaminating processes and materials and have structures and practices in place to prevent groundwater contamination from these processes and materials. Groundwater protection practices include, at a minimum, quarterly inspections and maintenance by facility personnel and spill cleanup procedures. The Groundwater Protection Rule sets out instructions for how to prepare and implement GPPs.

GPPs for 1026 West Virginia facilities were received by the Groundwater Program during this reporting period. Of these, 1019 were approved and sent to the Permits Section, or facility, where appropriate. The remaining were mailed letters identifying deficiencies in their GPP’s that need addressed. Inspectors visited 503 facilities during the reporting period to check on the efficacy of the applicable GPPs.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management
Groundwater Program
Monitoring Well Driller Certification/Recertification Program
WV Code of State Rules Title 47 Series 59

The Monitoring Well Driller Program (MWDP) instructs and certifies monitoring well drillers in the design, construction, alteration, and abandonment of monitoring wells and boreholes. This program, authorized by 47 CSR 59 Monitoring Well Regulations, was established to ensure industry, well owners, and the regulatory community that all monitoring wells and boreholes are to be installed and abandoned by knowledgeable drillers.

The WVDEP is responsible for the certification of monitoring well drillers. This is now accomplished by online testing as of January 1, 2020 at the West Virginia Online Learning website, www.onlinelearning.wv.gov. Drillers seeking certification contact the Groundwater Program, and a monitoring well testing verification form is sent to them to determine eligibility to take the monitoring well certification test. If the driller is found to have the qualifications for certification, an Online Learning application is set up and Online Learning then sends an email with passwords and information on how to access the test online. The certification process can now be completed online from the driller's home or office. It is no longer necessary to drive long distance to take the test.

As of June 30, 2021, the Monitoring Well Driller Program has certified six hundred sixty-eight (668) Applicants. There are currently two hundred fourteen (214) active monitoring well drillers, and four hundred fifty-four (454) are inactive, 25 of which were certified during this reporting period.

The monitoring well driller certification information is available on the Internet at http://www.wvdhhr.org/bph/monwell/. This site provides information on testing requirements, testing dates, an application for the testing and training and the required address verification form. The recertification of the monitoring well drillers is handled directly by the Monitoring Well Driller Program. Recertification requires a fee and the completion of an address verification form.

Many years ago to track the driller certification and recertification process, the WVDEP's Information Technology Office developed a module to the Environmental Resource Information System (ERIS). ERIS is a client/server system of Windows programs, which allows WVDEP offices to track and manage a wide variety of environmental information. However applicants / drillers cannot view their application status.

ERIS contains a listing of drillers who are currently certified and those whose certification has expired. This module is capable of generating and tracking certification and recertification correspondences, invoices for fees, certification card, and address verification forms. Reports can be generated from this module containing drillers' addresses, initial certification date, certification date, certification expiration date, driller registration numbers, and fee invoicing information.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Groundwater Program

Monitoring Well Installation and Abandonment
WV Code of State Rules Title 47 Series 60

Concerns from the drilling industry, the desire to protect well owners, and an overwhelming need by groundwater regulatory agencies for quality control of data from monitoring wells led to the enactment of 47 CSR 60, *Monitoring Well Design Standards,* in May 1996. This rule established the minimum acceptable documentation and standards for the design, installation, completion, and abandonment of monitoring wells, boreholes, and geoprobe locations. This rule does not eliminate nor supersede the more stringent aspects of well design criteria as established by federal programs such as RCRA or CERCLA but only stipulates that, at a minimum, monitoring wells must be constructed and abandoned in accordance with 47 CSR 60.

As is the case of any rule, there are unforeseen circumstances that require alternatives and exceptions when compliance with the rule is unfeasible or unnecessary. The alternatives and/or exceptions are handled through written variance requests on an individual basis.

The rule has resulted in the need for both electronic and paper files to document the installation, completion, and abandonment and groundwater monitoring wells, boreholes, and geoprobe locations. The electronic submission software became available as of 2003, with a format that consists of drop-down menus areas for written comments.

During this reporting period the following monitoring well installation and abandonment documentation forms were received and reviewed:

Year	Completion Forms	Abandonment Forms	Modification Forms	Comments	Total
2019 July to Dec	142	184	15	11 records returned for corrections; 3 not Re-submitted	341
2020 Jan to June	137	197	0	13 records returned for corrections	334
2020 July to Dec	210	121	0	67 records returned for corrections	331
2021 Jan to June	177	164	4	25 records returned for corrections	345

Year	Completion Forms	Abandonment Forms	Modification Forms	Comments	Total
Total from July 2019 till June 2021	666	666	19	116 records total returned for corrections	1351

All forms are reviewed for completeness and correct information. The major deficiencies noted are casing and screen depths that are out of order and data that was reported after the 60-day required reporting period.

Underground Injection Control (UIC) Program
WV Code of State Rules Title 47 Series 13

The SDWA of 1974 established the UIC program to ensure that fluids injected underground will not endanger drinking water sources. Applying the UIC regulations (47CSR13) promulgated under the authority of Chapter 22, Article 11 of the state code, the DWWM's UIC program mainly regulates the subsurface emplacement of effluents into or above underground sources of drinking water by permitting the siting, construction, operation, and abandonment of Class 5 shallow injection wells.

In addition to Class 5 injection wells, the DWWM's UIC program has begun drafting guidance documents and rules for the permitting process of Class 6 CO2 underground sequestration wells.

The Class 5 category includes thirty-two (32) types of injection wells ranging from high-tech aquifer remediation wells to low-tech septic systems. UIC permits for Class 5 wells fall into four broad categories:

Industrial/Commercial

This includes groundwater remediation re-injection wells, where contaminated groundwater is pumped out, treated to meet groundwater quality standards, then returned to the underground. It also includes various industrial/commercial facilities that dispose of certain types of wastewater into subsurface distribution systems, including facilities that inject sanitary waste from restrooms co-mingled with other wastewater constituents into a septic tank and leachfield system.

Stormwater

Disposal of stormwater into a drilled well or directed into a naturally occurring sinkhole may be permitted if it can be reasonably demonstrated that no underground sources of drinking water will be adversely impacted.

Septic permits.

These class 5 wells typically dispose of solely sanitary waste into a septic tank and leachfield system (solely sanitary waste not co-mingled with any other fluid).

UIC permit applications are promptly processed and no current backlog of applications exist. Currently, the only bottle neck in the permitting process comes from the occasional lack of information submitted by applicants, resulting in placing the application on hold pending information submittal. Keeping permittees mailing addresses up to date on is often a challenging task, as many permittees fail to keep the WV DEP apprised of contact or address changes, making it difficult to track fee invoices and required reports.

The UIC/Groundwater Program is currently in contract with Enfotech. Each program is working to develop specific components, forms, data, and details of processes needed. This information is then sent to the team analyst/project coordinator who synthesizes the requests from each program and sends it on to Enfotech. The team coordinator and Groundwater Program manager correspond on a regular basis with Enfotech and attend monthly team meetings to discuss each component. Information regarding the ePermitting system can be found at the DEP website: https://apps.dep.wv.gov/eplogin.cfm

The Groundwater Program works to prevent groundwater contamination by requiring the submission of GPPs, Annual Permit Reports, and Grease Trap Inspection Reports. Every applicant applying for a UIC Permit is required to submit a completed GPP to the WVDEP. The GPP is a plan of action for the facility detailing how to handle and store pollutants responsibly onsite, prevent spills and clean up promptly to protect groundwater.

One of the greatest challenges faced by the UIC program continues to be the effect of permitting stormwater disposal in karst and other environmentally sensitive areas. Over the years the UIC program has worked closely with officials to develop BMPs to prevent potential contamination from entering the subsurface to the greatest extent possible. This has included the development of emergency response plans in case of fuel spills or other accidents. UIC storm water permits protect groundwater by requiring adequate monitoring, sampling of injected fluids and the routine cleaning and maintenance of the potential pollutant sources.

Groundwater Programs Internships

During college break, 2021, the Groundwater Program offered internships to engineering and geology students. The contribution of each is provided below; primarily the interns worked on the proposed edits for the West Virginia Underground Injection Control Rule 47-13 and forms with related instructions to be used in the upcoming electronic permitting system.

Ashley McClung was an engineering intern at the West Virginia Department of Environmental Protection. This summer, she worked in the Groundwater/UIC program within the Division of Water and Waste Management. To help protect groundwater, she helped review and write permits, respond to public comments, and help worked on the new website for permit applications and writing permits.

She reviewed stormwater and sewage permit applications and entered them into the current Eris database. She used the ERIS system to write the permits. Working with permits helped her understand the process, then she helped create guidelines for the new permitting system.

The new website customized by EnfoTech will allow paperless applications to be submitted to the Groundwater Program. Ashley began her work by creating step-by-step guides to explain to EnfoTech what is needed in the UIC applications for stormwater and sewage permits. This guide includes a timeline of the permitting process and details of what both applicants and staff need from this website to maximize efficiency of the process. This will reduce the number of separate documents needed from the applicant to just one application online. She also included information about what is needed for the permit writer to draft permits in a quicker way online. This electronic system will allow for more convenient processes for both the applicant and the state.

UIC permits help protect groundwater by utilizing regulations that minimize contamination of pollutants in water that is injected into the ground. The applications include a groundwater protection plan that asks questions such as what types of material or activities are to be conducted that could contaminate the groundwater. It also includes information to inform the applicant that employees at their company must be trained on their responsibility to ensure groundwater protection. Protecting groundwater is important to ensure the safety of its use for drinking and other purposes.

Ryan McNeal is a Geology student at Marshall University and interned with the Groundwater Program. He focused on several aspects of underground studies that may affect the UIC Program. He analyzed the areas around coal-fired power plants in West Virginia to determine locations where it may and may not be appropriate for installation of Class 6 Wells, which are for the capture of and the sequestration of carbon dioxide in deep rock formations. Ryan used well logs from the West Virginia Geological and Economic Survey to interpret the subsurface geology around coal-fired power plants and constructed stratigraphic columns. The stratigraphic columns may be used to identify target formations for carbon sequestration, confining units, and to examine the lateral continuity of the stratigraphic intervals below the surface. Ryan gathered his findings in a report for the Program, and his research may be used in an application to the USEPA, should the Agency seek primary enforcement authority over Class 6 wells. Next, Ryan researched geothermal energy in West Virginia to understand regions of the state capable of harnessing geothermal energy, deep or shallow. Ryan also created a map for DWWM environmental inspectors to use while planning inspections. Ryan's work has been done to help West Virginia seek primacy for Class 6 injection wells, help inspectors prioritize sites to inspect, and help the Program staff better understand geothermal energy.

WVU Engineering student and intern for the DWWM, Michael Farha, has written the program description for the Class 6 Underground Injection Control (UIC) primacy application. The program description provides an overview of the scope, structure, coverage, and processes of the State's Class 6 UIC program. Class 6 being wells used for geologic sequestration of carbon dioxide. Primacy, if granted by the EPA, will give West Virginia primary enforcement authority over Class 6 wells. Michael has also developed Standard Operating Procedures for both enforcement and inspection of Class 6 facilities. Additionally, he identified forms (templates, reports, and notices) required for the Class 6 UIC program and created an outline of Class 6 permit application requirements and the expertise required to review information submitted in accordance with those requirements.

UIC Industrial/Commercial & Stormwater Permitting

The growing infrastructure and economy of West Virginia is a pleasant sight. However, without abundant resources of clean groundwater, there will be no economic growth, no industrial base, and no preservation of the quality of life that is the foundation of our culture. Limiting and controlling underground injection ensures that groundwater and underground sources of drinking water will remain viable for future use. Once groundwater becomes contaminated, it is very difficult to remove the pollution. The cost of groundwater remediation can be enormous, with no certain outcome of how effective the final results will be. The pollutants could remain in an area, making the water unusable for a period of many years or decades. After a period of time, the contamination in the groundwater may spread to the surface water through its natural outlets. An exception to this is contamination in areas underlain by limestone, which may contain numerous voids ranging in size from small fissures to large caverns. This area is referred to as karst terrain. In these areas, ground water may travel very rapidly, even flowing under mountains, carrying contamination that could swiftly spread into sources of drinking water.

UIC industrial permits require that constituents of the waste stream are identified, and each permit stipulates that the appropriate EPA-approved testing method is used in the analysis of the injected fluids. Discharge limits are set to ensure that all injected fluids meet WVDEP groundwater quality standards, maximum contaminant levels (MCLs) established by the EPA, health advisory limits, or other risk-based limits as appropriate. Improvements to the UIC industrial permit also include greater regulatory control over sampling, reporting schedules, construction details regarding the subsurface distribution system, and how the subsurface distribution system is to be properly closed. These requirements in UIC permits insure the greatest degree of protection to human health and the environment.

The permitting of UIC wells provides for minimum standards and technical requirements for the proper siting, construction, operation, monitoring, and abandonment of injection wells. When UIC permit applications are received and reviewed, they are accepted, accepted with modifications, or denied. Upon acceptance, an individual permit is issued in draft form and placed in public notice for a - thirty-day comment period. If no significant comments are received, a final permit is issued thirty days after the end of the comment period. Public hearings are held if necessary. Significant improvements to UIC industrial/commercial permits continue to be made by close scrutiny of each application in regard to injection well design and maintenance, potential toxicity of proposed injectates, fate and transport of the injectate, site hydrogeology, and a careful attention to monitoring the sites discharge reports on an ongoing basis. Four (4) UIC Industrial/commercial permits and sixteen (16) UIC Stormwater permits have been issued during this reporting period.

UIC Sewage Permitting

UIC staff works closely with the county health departments and the Office of Environmental Health to promote a healthy environment. If a UIC permit is needed for a facility, UIC staff assists applicants in the completion of the UIC permit application process. All sewage tanks involved with sewage systems, with the exception of holding tanks and receptacles, privy vaults and self-contained excreta disposal facilities, must be registered with WVDEP. The WVDEP has a program that offers the county health departments the option of processing the registration fees under a contract and receiving a portion of the money back to the county. UIC staff also participates and interacts with the State Sewage Advisory Board, which makes recommendations to the Bureau of Public Health (BPH) on technical and procedural issues relating to West Virginia's Sewage Disposal Program, mediates unresolved issues between the sewage industry and regulatory agencies and makes recommendations in other areas of policy modification or development as so directed by the Commissioner of the BPH.

Most all non-residential facilities injecting fluids into the subsurface fall under the regulation of the UIC Program. This includes small business injecting fluids into the subsurface through a septic tank and leachfield system, or other such subsurface waste disposal system. This includes any place other than a private residential home, even if the waste stream is comprised of solely sanitary waste, provided the system has the capacity to serve twenty or more persons per day. Residential dwellings are exempt from UIC regulations with the exception of residential multiple dwellings. Examples of residential multiple dwellings include: garage apartments not connected to the residence, mobile homes, trailer parks, apartment complexes, campgrounds, etc.; or two or more single family residences sharing a common septic system. The Groundwater Program also works with Health department sanitarians to ensure the proper siting of septic systems and to insure there is a minimum distance of fifty feet from a drinking water supply to the septic tank and a minimum distance of 100 feet from the leach field. This is verified by a site inspection to make sure compliance with distance regulations are met before signing the sewage permit for septic system installation.

Annual reports and grease trap inspection reports are required every year to the WVDEP by January 31st. The annual report requires monthly sight and odor checks for any evidence of sewage outside of the septic system. If sewage is detected outside of the septic system, the facility is required to contact the local sanitarian or the WVDEP to investigate the cause of sewage outside the system. The annual report also requires either a sludge depth measurement within the septic tank, which shall be logged on the report, or for the requirement for the septic tank(s) to be pumped out. Pumping receipts are requested to accompany annual reports for verification that the septic tank has been pumped. If the sludge depth measurement within the septic tank calculates to 33% full or the septic tank(s) have not been pumped in the last 5 years, whichever one occurs first, the septic tank shall be pumped out at that time. This process prevents the over- accumulation of sewage to embody the septic tank and reduces the chance of back-up into the facility or solids to escape the tank and enter the leach field.

Grease trap inspection reports require the tracking and logging whenever the grease trap is cleaned. The grease trap is required to be cleaned when the layer of fats, oils and grease (FOG) reach a level of 25% of trap capacity. Only facilities generating FOG are required to have grease traps/interceptors and thus provide grease trap inspection reports. Such facilities for example are schools, care facilities that provide meals and convenient stores.

UIC regulations require completed groundwater protection plans (GPPs) for each UIC permit and or other facilities that don't require a UIC permit but discharge Class 5 waste underground. An example of a facility needing a GPP that doesn't meet the criteria for a UIC permit would be an auto-repair garage with an on-site sewage disposal system that serves less than twenty people in a day, has floor drains in the garage bays, and the drains lead to oil water separators that do not discharge but are regularly pumped out. The GPP assists the permittee in understanding potential harm to groundwater resources based on their operations and how to reduce harmful impact to groundwater from sewage discharge. In the GPP, permittees describe the types of wastes that are disposed to the underground and into their leachfield and how they plan to keep fats, oils and grease out of the system where operations are cooking or washing dishes.

Eleven (11) new UIC sewage permits were issued during this reporting period. Two (2) UIC sewage permits were modified, Forty-one (41) UIC sewage permits were renewed and four (4) UIC sewage permits were transferred during this reporting period.

Enforcement

Although the major enforcement steps are outlined in 47CSR13, "Underground Injection Control" and 47CSR58 "Groundwater Protection Rule", DWWM will often inform ally deal with problems on an individual basis to achieve a quick solution based on charact eristics unique to the situation with a success rate of nearly 100 %. When an informal enforcement does not result in a satisfactory outcome, DWWM has other enforcement tools at its disposal. Currently, two Environmental Resources Specialists conduct all Groundwater / UIC inspections and UIC enforcement actions. Duties include making sure facility owners and operators are in compliance with all applicable rules and regulations. High priority wells statewide are found due to the number of individual drinking water wells. During this reporting period, the USEPA streamlined and modernized UIC reporting to a web-based system (UIC Data Application) which the Groundwater/UIC program utilizes.

Inspections

Groundwater/UIC inspections are conducted at businesses and industrial facilities such as factories, mills, quarries, electric power generating facilities, and sites not serviced by public sewage disposal plants such as non-residential/multiple dwellings i.e. trailer parks, campgrounds, schools and apartment complexes. Inspections are conducted based on a statewide strategic geographic plan developed during this reporting period which involves a bi-weekly rotation of county groupings. On occasion, county sanitarians in selected watersheds are contacted for areas that are not serviced by a public sewage disposal plant. Inspections may focus on wellhead-protected areas.

In addition to routine UIC inspections of permitted facilities, suspected Class 5 UIC wells are inventoried and inspected to determine proper classification. Information on suspected wells comes from the Class 5 UIC inventory and database, complaints, request for permits, referrals from other agencies, or discovered upon routine inspections. During inspections, which are sometimes multimedia with other programs or agencies, a Groundwater/UIC inspection form is completed on site. The owner/operator is verbally informed of the status of any UIC well observed during an inspection. If the facility has a Class 5 UI C well that is not permitted, the owner/operator is given the option to apply and obtain a permit for the well or a closure plan will be implemented. If there are other environmental concerns the owner / operator is given guidelines to obtain compliance. BMPs are reviewed with the facility owner/operator for groundwater protection. BMP implementation not only helps protect the environment, it also enables the facility to operate more efficiently by reducing the amount of waste generated. The Groundwater/UIC inspector collects global positioning system (GPS) locational data on underground storage tanks (USTs) and aboveground storage tanks (ASTs) for the Bureau of Public Health for wellhead protected areas and for the Tank Program at DWWM. A Review of a facility's Groundwater Protection Plan (GPP) or collection of information for the facility to obtain a GPP is also done during an inspection.

As part of the inspection process, GPS and other data is tracked and databases updated. Other programs or agencies may be notified if environmental concerns exist that may fall under another purview.

During the reporting period from July 1, 2019 through June 30, 2021:

- Four hundred ninety-eight (498) Groundwater/UIC inspections were conducted, and GPS coordinates recorded for inspections conducted

- Fifty-four (54) Motor Vehicle Waste Disposal Wells (MVWDWs) were discovered and plugged with cement Ninety-four (94) Motor Vehicle Waste Disposal Wells (MVWDWs) were discovered and verified connected to PSD systems

- Two hundred forty-five (245) GPPs were reviewed

- Eighty-eight (88) verbal enforcements actions were given to owner/operators of facilities with follow-ups to ensure compliance
.
- A total of two (2) written Notice of Violation were issued to bring the facilities into compliance

- Collected data on three hundred ninety-eight (398) Above Ground Storage Tanks (ASTs) and thirty-four (34) Underground Storage Tanks (USTs)

- In an inspection initiative that was started in 2020 to inspect campgrounds across the state to determine UIC compliance, a total of eighty-one (81) campgrounds were inspected during this reporting period

- Sixteen (16) larger, more complex industrial sites were given multimedia inspections

- Two (2) Geothermal well sites were inspected with one geothermal well at each site

- Twenty-three (23) groundwater monitoring well sites were inspected at facilities where ongoing remediation was occurring

Rule Authorizations

In addition to issuing UIC permits, rule authorizations for the injection of fluids into the subsurface are granted for situations where coverage under a UIC permit is not needed. Typically, these rule authorizations, issued for one year, permit the injection of subsurface releasing compounds (SRC) used in the remediation of contaminated soil and groundwater. Other Rule Authorizations may be issued for use of approved septic systems in process of obtaining a class 5 UIC sewage permit. Rule Authorizations may also be issued for the use of approved septic systems where it is uncertain as to whether or not these systems serve more than twenty people.

The most common application of SRC is in remediation of hydrocarbon-contaminated waters where oxygen releasing compounds, sometimes mixed with a microbial agent, is injected into the shallow subsurface. The addition of oxygen is often necessary to enhance the natural chemical and biological processes that break down hydrocarbons and certain other compounds *in situ*. In many situations, there is no need for the addition of other microbial agents, as the native bacteria in the soil are sufficient for bioremediation purposes as long as there is sufficient oxygen to fuel this process. In other situations, active bioremediation is enhanced by the addition of sulfate, magnesium, and ferric compounds, compressed air, or the addition of electron acceptors or donors. Other sites are treated with injections of food grade molasses, lecithin, or other nutrients may be used.

Oxygen releasing compounds are being pumped into several injection points at a facility in Institute in an effort to clean up carbon tetrachloride, chloroform, and fluorocarbons.

In addition to remediating hydrocarbons, other SRCs may be used to remediate chlorinated hydrocarbons, metals, and chlorinated biphenyls using hydrogen releasing compounds or other reducing agents. Twenty-eight (28) Rule Authorizations have been issued during this reporting period.

Groundwater Program Remediation Activities

Since 1991, the remediation section of the Groundwater Program has worked on more than five hundred (500) sites. There are approximately fifty-two (52) active remediation projects which were active during this reporting period. This includes those remediation sites that have been issued Rule Authorizations for the injection of subsurface releasing compounds for groundwater remediation.

These sites vary between equipment yards, above-ground releases (such as from truck wrecks), petroleum bulk terminals and refineries, railyards, and manufacturing plants. Some of the sites are active facilities, but many are physically abandoned (as opposed to legally abandoned) and are nothing more than empty lots or fields. Most of the contamination is some type of hydrocarbon, usually diesel fuel or fuel oil; however, other sites have benzene, chloride, metals or chlorinated solvent contamination.

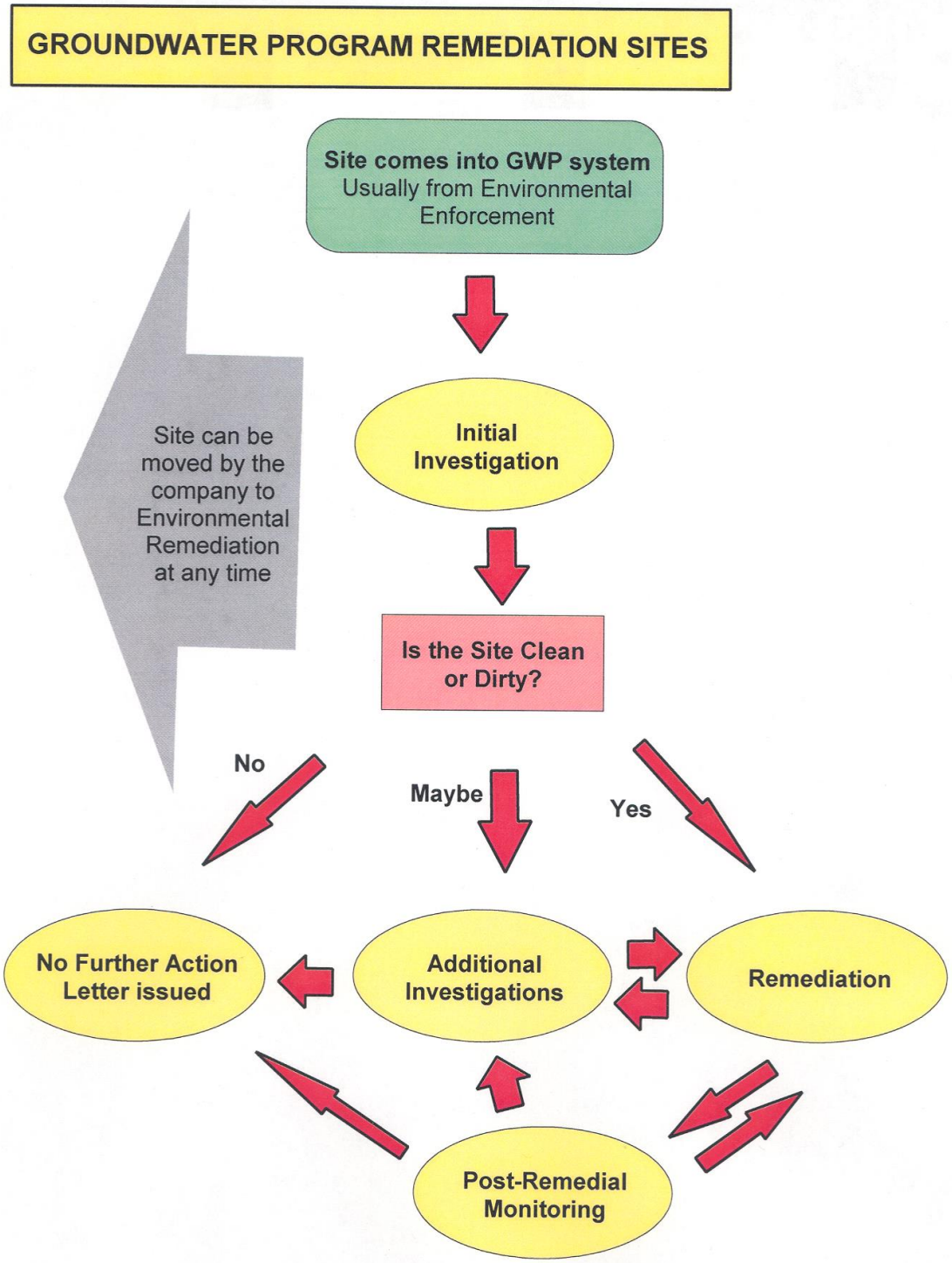
The Groundwater Program is the lead state agency at many of these locations. At other sites, the Groundwater Program advises other DEP programs regarding remediation efforts. In general, the Groundwater Program handles those sites with groundwater and soil contamination that do not fit under some other regulatory authority. Compliance with the remedial strategies suggested by the Groundwater Program depends a great deal on the responsible party's completion of the work.

During this reporting period, five No Further Action letters have been provided by the Groundwater Program to those sites where the contamination has been successfully remediated. The Groundwater Program has also provided advice to numerous other sites and has referred sites to other WVDEP groups. As of the end of June 2021, twenty-one sites are active with on-going investigation or remediation, as well as numerous projects of a more temporary nature that the Groundwater Program is called upon to assist others involved in remediation efforts.

The following table shows Groundwater Program remediation projects that were active between July 1, 2019 and June 30, 2021.

County	Facility	Watershed	Contaminant(s)	Comments
Berkeley	Al's Auto 2904 Charles Town Road Kearneysville WV	Potomac River Drains	Petroleum Hydrocarbons, Volatile Organic Compounds	Continuing remediation, gauging, recovery, and monitoring.
Raleigh	B & M Oil Co 150 Poplar Court, Whitesville	Lower New	Petroleum Hydrocarbons	Continuing gauging, recovery, and monitoring.
Monongalia	Brock Oil Brock Resources Inc 3479 Earl Core Road, Morgantown	Monongahela	Petroleum Hydrocarbons, Volatile Organic Compounds	Continuing remediation, gauging, recovery, and monitoring.
Kanawha	Chevron Phytoremediation Cabin Creek	Lower Kanawha	Petroleum Hydrocarbons	Continuing remediation, and monitoring.
Taylor	CSX Grafton Railyard Engine House Shop Former Roundhouse Area, Grafton	Tygart Valley	Solvents	Continuing remediation, gauging, recovery, and monitoring.
Taylor	CSX Grafton Railyard Locomotive Shop, Grafton	Tygart Valley	Diesel Fuel	Continuing remediation, gauging, recovery, and monitoring.
Mineral	CSX Keyser Railyard, Keyser	North Branch Potomac	Solvents	Continuing remediation, gauging, recovery, and monitoring.
Jefferson	former Family Quality Cleaners 96 Patrick Henry Way Charles Town	Shenandoah Jefferson	Solvents	Continuing gauging, recovery, and monitoring
Mercer	Little General #2225 1000 Oakvale Road, Princeton	Upper New	gasoline	Continuing remediation, gauging, recovery, and monitoring.
Lincoln	Little General #4075 403 Midway Road, Alum Creek	Coal	Petroleum Hydrocarbons	Remediation, gauging, recovery, and monitoring.

County	Facility	Watershed	Contaminant(s)	Comments
Wayne	Marathon Petroleum Terminal 227	Lower Ohio	Petroleum Hydrocarbons	Continuing remediation, gauging, recovery, and monitoring.
Jefferson	McHenny property, 4936 Kearneysville Pike, Shepherdstown	Potomac	heating oil	Continuing gauging, recovery, and monitoring.
Mercer	Norfolk Southern Bluefield Railyard, Bluefield	Upper New	Diesel Range Organic Compounds	Continuing remediation, gauging, recovery, and monitoring.
Kanawha	Norfolk Southern Dickinson Railyard, Dickinson	Upper Kanawha	Petroleum Hydrocarbons	Continuing remediation, gauging, recovery, and monitoring.
Wyoming	Norfolk Southern Mullens Railyard, Mullens	Lower Guyandotte	Diesel Range Organic Compounds	Continuing remediation, gauging, recovery, and monitoring.
Grant	Petersburg Oil bulk plant	South Branch Potomac	Petroleum Hydrocarbons	Site characterization report completed.
Summers	R. T. Rogers Bulk Terminal 300 Grace St. Hinton	Lower New	Petroleum Hydrocarbons	Corrective Action Plan to be completed
Berkeley	Veterans Administration Hospital Martinsburg	Potomac River Drains	Solvents	Continuing remediation, gauging, recovery, and monitoring.
Grant	VEPCO Mount Storm Power Plant, Mount Storm	North Branch Potomac	Diesel Range Organic Compounds	Continuing remediation, gauging, recovery, and monitoring.
Wood	WV ANG Army Aviation Support Facility 387 Aviation Drive, Williamstown	Middle Ohio South	Petroleum Hydrocarbons	Awaiting final inspection
Harrison	Wholesale Tire, 361 Armory Road Clarksburg	West Fork	Volatile, Semi-Volatile organic compounds, metals	Corrective Action Plan to be completed

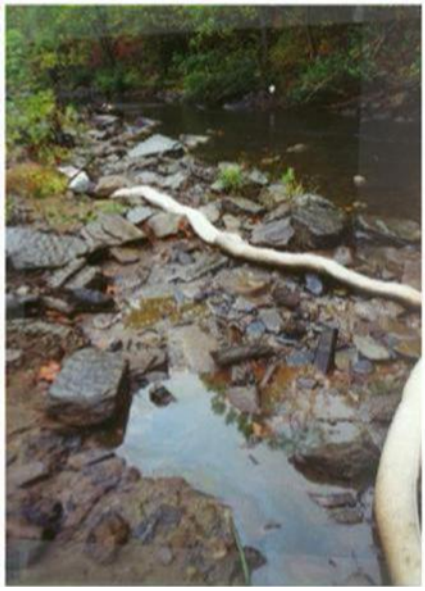

GROUNDWATER PROGRAM REMEDIATION SITES
Site comes into GWP system
Usually from Environmental Enforcement
Initial Investigation
Is the Site Clean or Dirty?
No
Maybe
Yes
Site can be moved by the company to Environmental Remediation at any time
No Further Action Letter issued
Additional Investigations
Remediation
Post-Remedial Monitoring

Above, a Geoprobe unit injects oxygen release compounds at a bio-remediation site. Below, a high vacuum pump truck extracts hydrocarbons.

Groundwater Sampling

Employing air sparging at a groundwater cleanup site

Employing bio-venting at groundwater cleanup site



Hydrocarbon sheen on a stream with absorbent pads being used to keep the contamination from entering the stream.

A sinkhole filled with trash - a direct conduit for contamination to enter groundwater in Karst areas.

Groundwater Program E-Permitting System Online Portal and Database Purpose:

The E-permitting system and online portal will be implemented for easy submission, review and approval of applications and reports required by the Groundwater Protection Act and Water Pollution Control Act. Also, the filing of real-time onsite inspections, a fee account history the permittee may view at any time, and transparency of records for the public to access are features of the system. The following overview will explain the need for a comprehensive data management system, and that is due to the varying duties, forms, reports, and applications that the Program deals with.

Overview of Groundwater Programs:

The Groundwater Program protects West Virginia's groundwater by requiring and approving groundwater protection plans for industrial activities that pose a threat to groundwater. The Program implements the Groundwater Standards and once a leak or spill of pollutant causing materials occurs asks the industry to sample and analyze the groundwater for pollutants. Program staff review the analytical reports, provide remediation guidelines and follow up on the cause of the spill or leak at sites such as rail yards, factories, and refineries.

Groundwater regulations require industries to maintain groundwater standards unless a legislated variance is provided. Coal-fired power plants have variances for their fly-ash ponds and coal pile areas and our staff reviews

The Groundwater Program administers the Underground Injection Control Program for Class 1, 4 and 5 well types. There are no Class 1 or 4 wells in West Virginia at this time, however, should such a well be discovered or requested, the Program would work with the operator to permit the well, bring it in to compliance, or close it out, as the rules require. Class 5 wells are common to our state. These are for injection of nonhazardous wastes into or above underground sources of drinking water. Many of our citizens' source of drinking water is from wells and springs, therefore these shallow Class 5 sites pose a risk that the Program staff must constantly monitor. These types of wells include improved sinkholes or drilled wells for stormwater runoff that can pick up pollution as it streams across parking lots, lawns, and industrial sites. Large scale, on-site sewage disposal systems make up the bulk of the Class 5 well inventory and these sites include campgrounds, multi-dwellings, doctor and dentist offices, stores, and restaurants.

The Groundwater Program collects fees that go into the Groundwater Protection Fund. The fees are assessed to permit holders, monitoring well drillers, mining operations, pesticide registrants, and septic tanks installs, most of which are either permitted or regulated by programs other than the Groundwater Program. The Groundwater Protection Fund supports the West Virginia Department of Agriculture's effort to regulate pesticides and to monitor groundwater for pesticide residues that can threaten groundwater quality. DoA enforces fee payment. Very importantly, the fund is used for financial agreements with parties doing work that support groundwater protection efforts. Program staff monitor the agreements, recommend payments, and require timely reports of activities. The

Groundwater Program issues and renews certifications for monitoring well drillers and maintains the records of constructed, modified, and abandoned wells.

Current Working Environment:

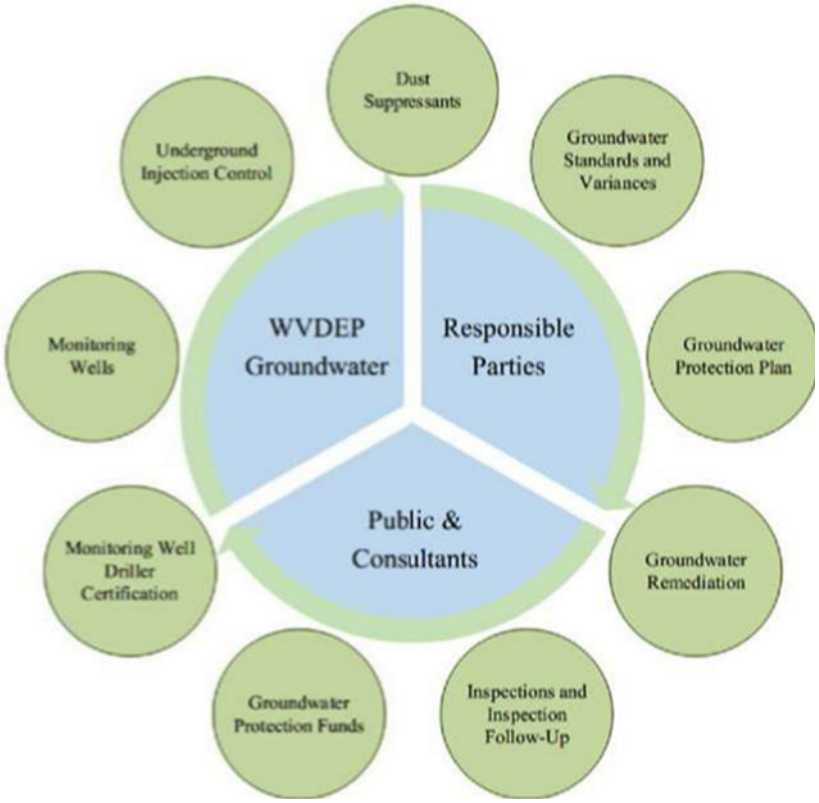
Currently, most groundwater related applications and reports are handled with hard copies and sent through the US Mail, which leads to slow processing and approvals. In addition, staff are tied up on the phones answering queries from responsible parties wanting to know the status of their applications and reports. Each step of the permitting process and report review is time-consuming as letters must be written and messages sent out to applicants who are unable to view any of the information due to the lack of an on-line system.

The Groundwater team's goal is to have all applications and reporting obligations available on a one-stop on-line portal, configured so that the submitter can view the information.

Proposed Groundwater Data Management System:

The state's Groundwater Protection Act requires an efficient data management system be developed. In fact, it says, "to develop, as soon as practical, a central groundwater data management system for the purpose of providing information needed to manage the state's groundwater program" (§22-12-6 (a) 2). In addition, The Groundwater Protection Rule (47CSR58 4.9.g) suggests "Data Management - The director may at his discretion require submittal of any or all groundwater monitoring data collected in association with a regulated activity and may further specify an electronic format in which the data is to be submitted."

The Groundwater Program has taken efforts toward developing an online portal for submitting permit applications, driller certification requests, reports, remedial actions, groundwater protection plans, and for paying groundwater protection funds (Figure). In addition, we aim to develop a back end or database where all information-flow will be stored in a secured system.



Benefits to Diverse Groundwater Programs:

There are nine primary duties the team performs: dust suppressant reviews, groundwater standard implementation and variance monitoring, groundwater protection plan approvals, groundwater remediation oversight monitoring well data maintenance, monitoring well driller certification, groundwater protection fee collection and financial agreement monitoring, underground injection control permitting, and inspections and follow-up.

To accomplish all its goals, staff works with the WV Department of Agriculture, USGS, WV Bureau for Public Health, EPA, County Health Departments, universities, and of course the citizens of the state.

When the online portal is implemented, we foresee efficiency, transparency, and the accumulation of information previously accessible to the Agency in antidotal form only.

Current Status of Online Portal:

The contract was awarded to EnfoTech & Consulting Inc. to customize an off-the-shelf online portal for different sections of WVDEP. Our Program is one of the participants in the contract. We officially kicked off the project in February 2020 and have a two-year timeline for completion. The process has been split into six Sprints. Dust Suppressants topic is about to go live in Sprint #1. We have already submitted the documents and templates for the Sprint #2 which includes groundwater protection plans, monitoring well records, and monitoring well driller certification. Currently, we are preparing notes, flowcharts, forms, environmental interest tabs, picklists, etc. for the rest of the programs.

Presently, the Groundwater Program is working ahead of schedule and our aim to have many of our interests go live by November 2022.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Non-Point Source Program

In 2020 West Virginia's NPS Program provided technical and financial support to more than 100 programs and projects ranging from general administration to outreach, planning, monitoring and a wide variety of implementation. Most of the projects focus on priority areas identified within our watershed based plans (WBPs), but other partners and stakeholders implement projects in non-priority areas using their required matching funds, or by taking advantage of periodic *additional grant opportunities* (AGOs). *Table 1* provides a summary.

Table 1. §319 Program status.

FFY	NPPF	WPF	AGOs	Total	Complete	%
2016	5	8	12	25	19	76.0%
2017	5	10	9	24	8	33.3%
2018	3	9	12	24	4	16.7%
2019	4	8	6	18	0	0.0%
2020	4	9	0	13	0	0.0%
Totals	**21**	**44**	**39**	**104**	**31**	**29.8%**

NPPF: Nonpoint Program Funds
WPF: Wateshed Project Funds
AGOs: Additional Grant Opportunities

The percent complete was less than previous years especially for grant years nearing the end of their performance period. This is directly attributed to the challenges brought on by the Covid-19 pandemic. A one-year extension was granted by USEPA for fiscal year 2016 and West Virginia has requested the same for 2017. In addition, further discussion on the many challenges brought on by the *Covid pandemic*.

Implementation

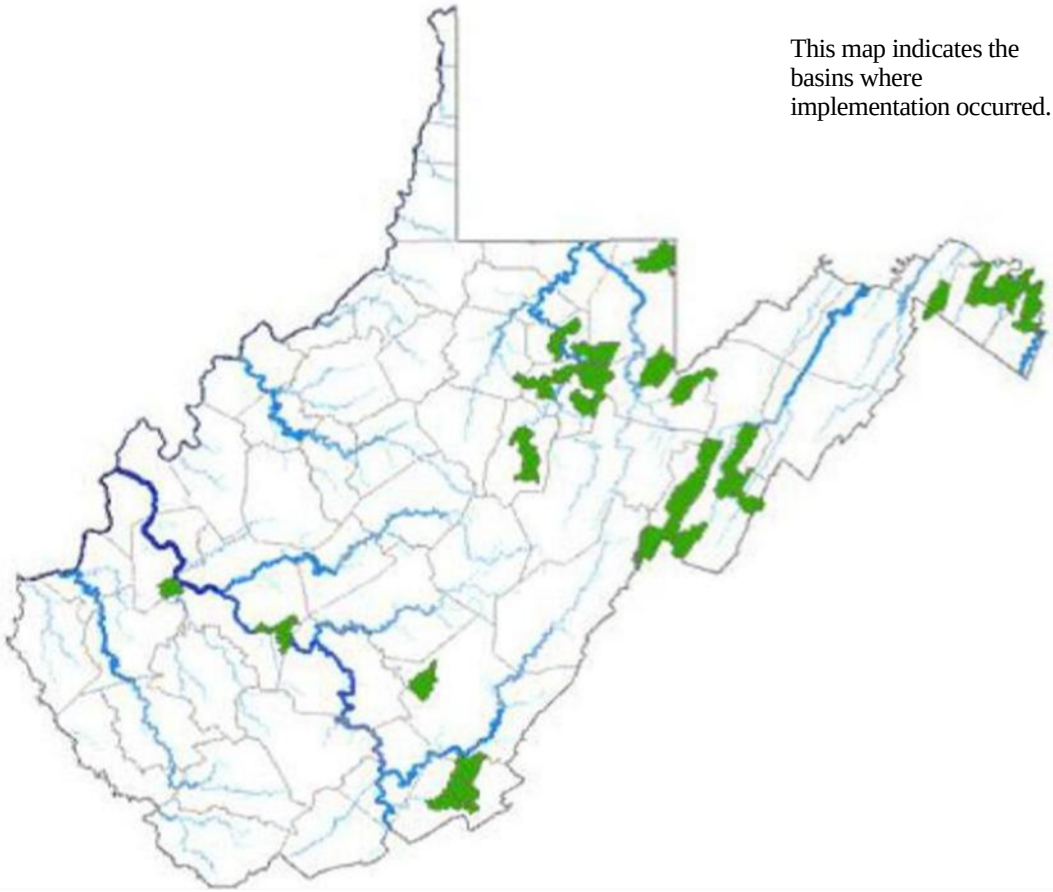
Best management practices (BMPs)

BMP implementation and NPS pollutant reduction are the major goals of our watershed projects. The efforts of our dedicated staff, partners and local stakeholders have made significant impacts in restoring and protecting our watersheds impacted and threatened by NPS pollution. In 2020 BMP implementation occurred in 30 different Hydrologic Unit Code 12 watersheds. BMP implementation is represented graphically and compared using a log(n) calculation in *Figure 1*. Additional details are provided in *Appendix 1.* WV Conservation Agency (WVCA) significantly contributions through their statewide Agriculture Enhancement (AgE) Program. Although not funded with §319, AgE provides match and often is a vehicle for additional BMPs in project watersheds.

Figure 1. §319 and AgE BMP implementation.

Units

iu (individual units)
ac (acres)
ft (feet)
sqft (square feet)
syst (systems)



This map indicates the basins where implementation occurred.

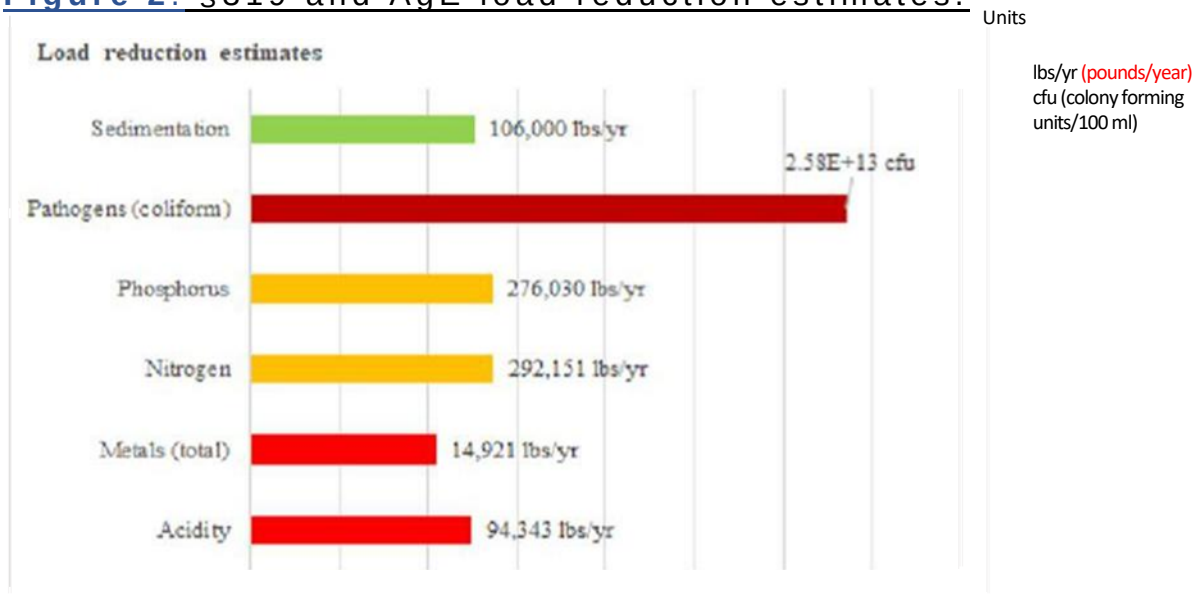
Typically, outreach is reported in GRTS but has not been a focus of past annual reports. However, this pandemic year brought outreach to the forefront. WVDEP's WIB, WVCA, WV Rivers Coalition (WVRC) and many others performed above and beyond taking full-advantage of multiple virtual formats reaching more participants than ever before.

Pollutant load reductions

In West Virginia bacteria and pollutants associated with acid mine drainage (AMD) are the two largest contributors of nonpoint sources accounting for approximately 70 percent of the impairments. Most of the bacteria loads come from agriculture and failing septic, whereas the AMD pollutants (acidity and heavy metals etc.) are associated with abandoned mining. In addition to the West Virginia priorities, USEPA's National §319 Program promotes the reduction of nutrients and sediment, which are the leading causes of NPS impairment nationwide. Although nutrients and sediment are not our primary focus, we exceeded our 2014 Management Plan goals. WV's *NPS Management Plan* was revised in 2019 and will not be discussed in this report since it is too early in the five-year cycle to accurately judge progress. An update will be provided in the 2021 annual report.

Load reductions are represented graphically and compared using a log(n) calculation in *Figure 2*. Additional details are provided in *Appendix 2*. Most §319 projects do not require nutrient load reductions; however, due to WVCA's AgE Program contributions nutrient reductions and sediment reductions are significant statewide.

Figure 2. §319 and AgE load reduction estimates.



Chesapeake Bay Program

Nitrogen and phosphorus reductions are needed for restoration of the Chesapeake Bay (CB) watershed. Despite the pandemic, West Virginia's Chesapeake Bay Tributary Team continued to implement wastewater and nonpoint source strategies from the *Phase 3 Watershed Implementation Plan* (WIP3) and is generally on-track to meet West Virginia's

portion of the CB TMDL by 2025. These strategies, such as riparian forest buffers and Green Infrastructure practices, were chosen to help achieve local benefits while reducing nitrogen and phosphorus loads. CB partners produce and share a quarterly e-newsletter, found *here*, to document projects and encourage others in similar actions.

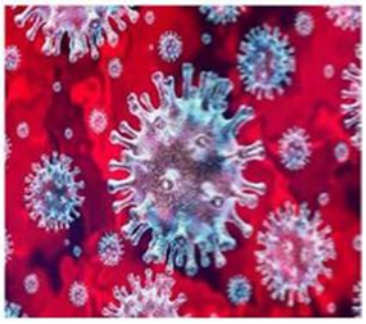
Table 2 shows historic, recent and WIP3 loads of total nitrogen and total phosphorus. Implementation during the 2020 progress year (July 2019-June 2020) appears to have rebounded from the effects of heavy rain events in fall 2018 (progress year 2019). Modeled progress is still dampened due to the expiration of some practices once they reach their modeled lifespan. CB partners are renewing efforts to verify and maintain these older practices to keep them active in the model.

All results are from the CAST 2019 model, available at: *http://cast.chesapeakebay.net*

Table 2. Progress towards reducing CB pollutants.

Pollutant	Category	2013 Progress (Baseline)	Progress 2019	Progress 2020	WV WIP3
Nitrogen	Agriculture	3.31	3.44	3.40	not specified
	Urban Runoff	1.20	1.19	1.20	
	Natural+ Deposition	2.60	2.58	2.57	
	Septic	0.34	0.35	0.35	
	Wastewater+ CSO	0.70	0.52	0.43	
	All Sources	**8.15**	**8.07**	**7.96**	**7.79**
Phosphorus	Agriculture	0.14	0.14	0.14	not specified
	Urban Runoff	0.06	0.06	0.06	
	Natural+ Deposition	0.22	0.21	0.21	
	Septic	0.00	0.00	0.00	
	Wastewater+ CSO	0.14	0.04	0.04	
	All Sources	**0.56**	**0.45**	**0.44**	**0.40**

WV's progress toward reducing CB pollutants; units: million lbs/yr.



Covid challenges: The Covid pandemic was an experience unlike any other. It affected every aspect of our lives and was an ever present danger/concern. Each of us have personal stories to share but the focus of this section is the impacts on §319 program and project management. Having to shift locations to a environment and not being able to interact in-person, or on-site had dramatic impacts, but Covid's impact on supply chains, ordering time, volunteer labor and more slowed multiple levels of program/project performance. USEPA provided an extension for fiscal year 2016 and 2017, which were the two most vulnerable federal fiscal years of impact. Additional details are provided in the annual report.

More in the 2020 annual report

Additional information from watershed projects, successes and watershed plan updates from the past year are available in the annual report at: https://dep.wv.gov/WWE/Programs/nonptsource/ NPSReports/ Pages/319Report.aspx. Appendix 1 and 2 provide a summary of 2020 implementation results.

The groundwater connection

Although §319 projects do not specifically target groundwater resources there are connections simply due to the nature of most treatment. These projects improve surface water conditions and reduce the cost of drinking water treatment long-term in communities most impacted by nonpoint source pollution.

Appendix 1. §319 projects and AgE BMPs

Basin	BMP	Amount	Unit	Date
Little Sandy Creek	AMD treatment system	1	Syst	Sep-20
Little Sandy Creek	Anoxic limestone drain	1,406	Sqft	Nov-20
Little Sandy Creek	Catch basin	435	Sqft	Nov-20
Little Sandy Creek	Constructed wetland	2,363	Sqft	Nov-20
Little Sandy Creek	Limestone leachbed	2,194	Sqft	Nov-20
Little Sandy Creek	Limestone leachbed	3,544	Sqft	Nov-20
Little Sandy Creek	AMD treatment system	1	Syst	Nov-20
Browns Creek-Coal River	Onsite wastewater system	5	IU	Nov-20
Browns Creek-Coal River	Onsite wastewater system	1	IU	Apr- 20
Upper Indian Creek	Onsite wastewater system	1	IU	Sep-20
Burnside Branch	Fence	2,594	Ft	Sep-20
Burnside Branch	Fence	10,653	Ft	Sep-20
Hughes Creek- Kanawha River	Natural stream restoration	400	Ft	Jul-20
Lower Second Creek	Fence	2,187	ft	Sep-20
Lower Second Creek	Fence	33,889	ft	Sep-20
Mill Creek-Meadow River	Streambank protection	120	ft	Sep-20
Tenmile Creek	AMD treatment system	1	IU	Sep- 20
Tenmile Creek	Limestone channel	550	Sqft	Sep- 21
Tenmile Creek	Catch basin	4,000	Sqft	Sep-20
Statewide (WVCA)	Outreach	19,943	IU	Sep-20

Basin	BMP	Amount	Unit	Date
Elks Run (WV Rivers)	Outreach	1,772	IU	Sep-20
Statewide (WVDEP)	Outreach	1,322	IU	Sep-20
Tilhance Creek	Conservation easements	62	Ac	Sep-20
Warm Springs Hollow	Conservation easements	34	Ac	Sep-20
Elks Run	Onsite wastewater pumpout	22	IU	Sep-20
Statewide	Nutrient management	4,298	Ac	Nov-20
Elks Run	Outreach	1,952	IU	Jun-20
Tuscarora Creek	Outreach	164	IU	Jun-20
WVDEP Statewide	Outreach	4,037	IU	Dec-20
WVCA Statewide	Outreach	19,923	IU	Dec-20
WIB calendar	Outreach	2,710	IU	Dec-20

BMP totals	Amount	Unit	Legend
AMD treatment systems	3	Syst	Syst - systems
Anoxic limestone drain	1,406	Sqft	Sqft – Square Feet
Limestone leachbed	6,330	Sqft	Ft - feet
Limestone channel	550	Sqft	Ac -acres
Catch basin	4,435	Sqft	IU - Individual Units
Constructed wetland	2,363	Sqft	
Fence	49,323	Ft	
Nutrient management	4,298	Ac	
Natural channel restoration	400	Ft	
Streambank protection	120	Ft	
Onsite wastewater	29	IU	
Conservation easements	96	Ac	
Outreach	26,076	IU	

Appendix 2. §319 projects and AgE load reductions

Basin	Pollutant	Reduction	Unit	Date
Little Sandy Creek	Acidity	75,152	Lbs/yr	Nov-20
Little Sandy Creek	Acidity	32,543	Lbs/yr	Nov-20
Tenmile Creek	Acidity	19,191	Lbs/yr	Dec-20
Little Sandy Creek	Metals (Al)	8,846	Lbs/yr	Nov-20
Little Sandy Creek	Metals (Al)	3,385	Lbs/yr	Nov-20
Tenmile Creek	Metals (Al)	2,026	Lbs/yr	Dec-20
Little Sandy Creek	Metals (Fe)	143	Lbs/yr	Nov-20
Little Sandy Creek	Metals (Fe)	521	Lbs/yr	Nov-20
Burnside Branch	Nitrogen	1,826	Lbs/yr	Sep-20
Burnside Branch	Nitrogen	1,325	Lbs/yr	Sep-20
Lower Second Creek	Nitrogen	1,775	Lbs/yr	Sep-20
Browns Creek-Coal River	Pathogens (coliform)	8.20E+10	CFU	Nov-20

Basin	Pollutant	Reduction	Unit	Date
Browns Creek-Coal River	Pathogens (coliform)	2.30E+13	CFU	Apr-20
Burnside Branch	Pathogens (coliform)	9.6E+11	CFU	Sep-20
Burnside Branch	Pathogens (coliform)	6.9E+11	CFU	Sep-20
Upper Indian Creek	Pathogens (coliform)	1.64E+10	CFU	Sep-20
Lower Second Creek	Pathogens (coliform)	9.3E+11	CFU	Sep-20
Mill Creek-Meadow River	Pathogens (coliform)	1.74E+09	CFU	Sep-20
Elks Run	Pathogens (coliform)	9.12E+10	CFU	Jun-20
Burnside Branch	Phosphorus	415	Lbs/yr	Sep-20
Burnside Branch	Phosphorus	301	Lbs/yr	Sep-20
Lower Second Creek	Phosphorus	403	Lbs/yr	Sep-20
Hughes Creek-Kanawha River	Sedimentation	30,000	Lbs/yr	Jul-20
Mill Creek-Meadow River	Sedimentation	76,000	Lbs/yr	Sep-20
AgE (statewide)	Nitrogen	287,225	Lbs/yr	Nov-20
AgE (statewide)	Phosphorus	274,911	Lbs/yr	Nov-20

Pollutant	LR	AgE	Totals	Unit	Legend
Acidity	94,343		94,343	Lbs/yr	Lbs/yr (pounds/year) CFU (colony forming units) AgE (Ag Enhancement Program)
Metals (total)	14,921		14,921	Lbs/yr	
Nitrogen	4,926	287,225	292,151	Lbs/yr	
Phosphorus	1,119	274,911	276,030	Lbs/yr	
Pathogens (coliform)	2.58E+13		2.58E+13	CFU	
Sedimentation	106,000		106,000	Lbs/yr	

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Watershed Assessment Branch

The Watershed Assessment Branch (WAB) was created in March 2002 from the joining of two existing programs, the Watershed Assessment Section (WAS) and the Total Maximum Daily Load (TMDL) Section. The WAB consists of biologists, environmental specialists, and analysts whose primary focus is to measure and assess the physical, chemical, and biological integrity of WV's streams, rivers, and lakes. Although this water quality information is used for a myriad of purposes, a major effort is placed on the preparation of The West Virginia Integrated Water Quality Monitoring and Assessment Report (IR) http://www.dep.wv.gov/WWE/watershed/IR/Pages/303d_305b.aspx . This report, required by U.S. EPA every 2 years, combines the 303(d) list of impaired waterbodies with the 305(b) assessment, a report that focuses on the overall quality of West Virginia's waters.

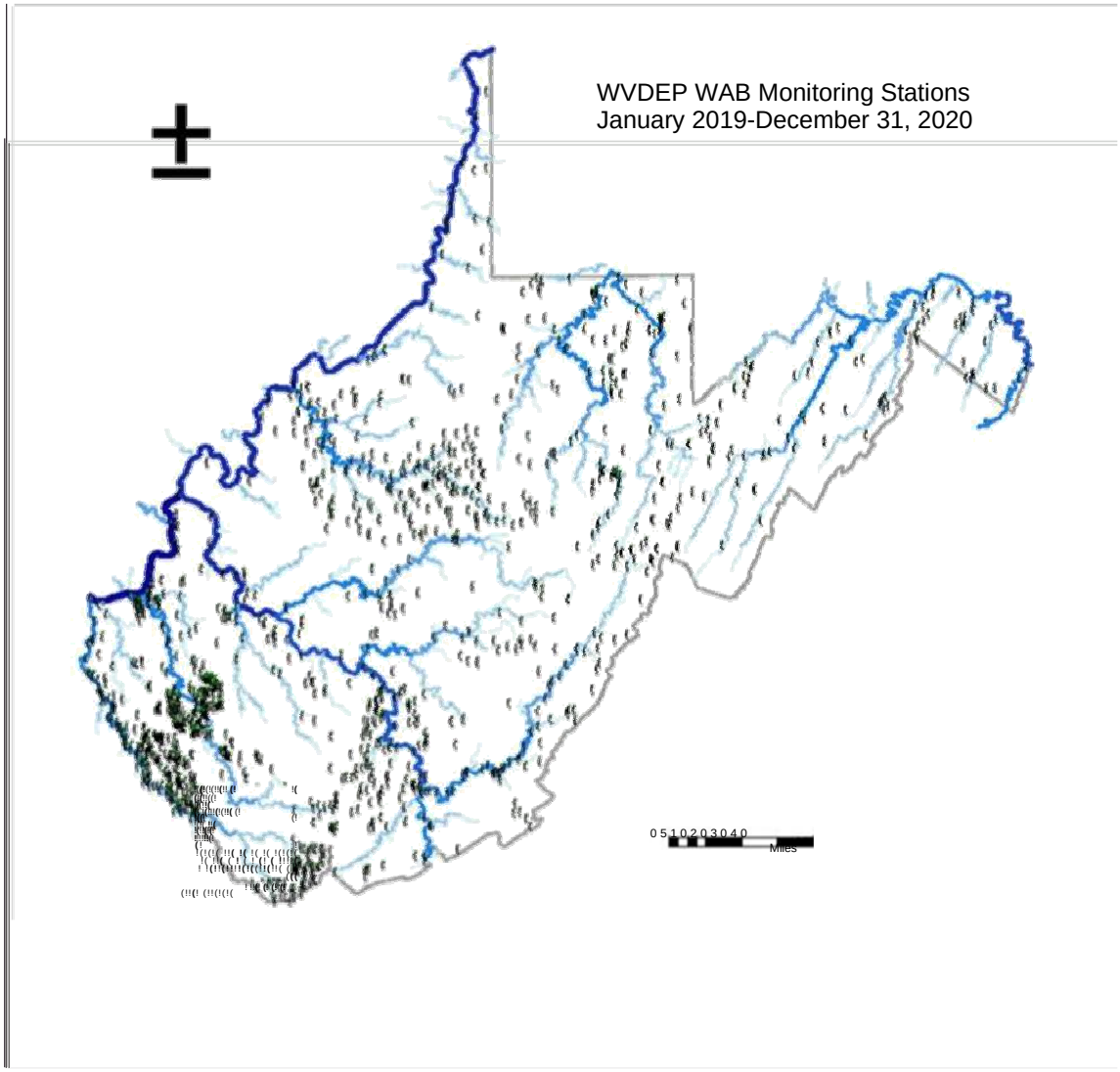
The WAB utilizes a specific combination of physical, chemical, and biological variables to help assess the health of streams and lakes in WV. These measures also help identify potential stressors and how they may be affecting the aquatic life communities of these waterbodies.

The WAB uses a variety of programs to assess and monitor WV's waterbodies. These include a stratified probabilistic monitoring design or "random" sampling design; a targeted sampling design; a long-term or "ambient" site network (mainly in WV's largest streams and rivers); a continuous monitoring design using deployable water quality meters (dataloggers); and a thorough pre-TMDL development monitoring effort – all designed to meet the objective of assessing the water quality of waterbodies throughout WV. In 2007, WAB 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 stream types with different stressors.

In 2012, the LiTMuS program was expanded to include research to monitor water quality, biology, and flow changes over time at several minimally impacted streams in WV. This research is a collaborative effort with the United States Environmental Protection Agency (US EPA) Global Change Assessment group, along with other states and US EPA offices from various regions, to develop Regional Monitoring Networks (RMNs) that can detect small, progressive changes in stream aquatic life communities that may be associated with climate change. Two major components of this study are the collection of temperature and stream discharge data, each being significantly related to groundwater. It is predicted that groundwater will help buffer streams from increases in air temperatures, at least in the near future. Furthermore, it is believed that streams with more groundwater contribution during base flow will be less sensitive to temperature increases. The WAB has established five RMN monitoring stations on five different WV streams, all with exceptional water quality, that are being monitored for temperature, discharge, and aquatic life status as part of this collaborative study.

In general, assessments are performed on a watershed basis. To better manage the state's water resources, West Virginia has been divided into 32 watersheds, or hydrologic regions. Each watershed is assessed every five years, according to the state's Watershed Management Framework. The targeted and pre-TMDL sampling programs are based on this five-year rotating basin schedule, whereas the Ambient, Probabilistic and LiTMuS programs collect data statewide annually.

From January 1, 2019 through December 31, 2020, WAB personnel conducted assessments that resulted in the collection of 8,136 water quality samples from 1,895 sites on 1,227 distinct streams/rivers, 20 lakes, and 72 wetlands. These sites are shown below.



The WAB measures a variety of physicochemical parameters in waterbodies that are evaluated in the field or determined via laboratory analysis. Stream temperature, dissolved oxygen, pH, and specific conductance are collected at nearly every site visit. The more common lab parameters analyzed include alkalinity, acidity, hardness, aluminum, iron, manganese, selenium, basic ions and nutrients. Other parameters are collected when pollutants are determined to be potentially present. Thirty-nine (39) parameters are measured at sites monitored as part of our Probabilistic Monitoring Program, and 40 parameters are measured at our Ambient Sites.

Habitat evaluations are important to waterbody assessments because they reflect the physical conditions that support aquatic life communities. WAB utilizes U.S. EPA's Rapid Bioassessment Protocol (RBP) for measuring the quality of in-channel and riparian habitat in streams and rivers. Channel flow status is evaluated as part of the RBP protocol. During drought conditions, groundwater discharges are important for maintaining a healthy channel flow status, and therefore the water levels necessary to support aquatic life.

The physical and chemical properties of water, as well as habitat quality are important in the overall assessment of waterbody health. However, the biological monitoring of aquatic life communities such as benthic macroinvertebrates and fishes, provides WAB a more comprehensive evaluation of ecological integrity. This is especially true for benthic macroinvertebrates (animals without backbones that live on the bottom of streams such as insects, crayfish, snails, worms) because they are diverse in species, live in all stream sizes, have a wide range of tolerances to pollutants and stressors, and unlike a grab samples of water that represent an instant in time, reflect past water quality conditions. For example, water quality measures like dissolved oxygen are important, but, only provide information about the specific current environmental conditions. A sudden spill or periodic discharge of toxic substances, which flowed past an assessment site a week ago, for example, would likely be revealed in an impaired benthic macroinvertebrate community, but likely would not be detected in the analysis of a water sample.

The WAB tries to identify pollutants and their sources, both regulated and non-regulated, and the severity of impacts on streams in watersheds throughout the state. For instance, fecal coliform bacteria from open pipe discharges, failing septic systems, failing sewer lines, inappropriate animal waste management techniques, and "collect and dump" sewage treatment activities are major stressor on the groundwater and surface waters in West Virginia. By identifying streams with violations of the criteria for fecal coliform bacteria, WAB has identified sub-watersheds with groundwater that is likely impaired by fecal coliform bacteria. Since fecal coliform bacteria is usually filtered out by groundwater seeping through dirt, sand and rock, additional studies must be conducted to confirm the potential impairment of groundwater. However, in karst areas, where groundwater is not subjected to as much filtering, the presence of fecal coliform bacteria in streams is a clear indicator that groundwater pollution has occurred "upstream".

By identifying streams impacted by acid mine drainage, WAB has identified areas where the groundwater also is likely impaired. By helping identify these areas, WAB has made it possible to target remediation efforts lessening the negative effects on fish and benthic communities.

The WAB has developed and maintains the 303(d) list of impaired waters. These impaired waters have, in some cases, been linked to contaminated groundwater. TMDLs (Total Maximum Daily Load) are required by the federal CWA. In simple terms, a TMDL is a plan of action used to clean up 303(d) listed streams that are not meeting water quality standards. The plan includes pollution source identification and strategy development for contaminant source reduction or elimination. Originally, TMDLs were developed under the 1997 settlement of the lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands Conservancy, et. al. v. Browner, et. al.*, which sought state and federal aid to improve and maintain West Virginia's water quality. The lawsuit resulted in a consent decree between the plaintiffs and the EPA. The consent decree established a rigorous schedule for TMDL development, requiring the federal agency to develop over 500 TMDLs from West Virginia's 303(d) list of impaired streams by March 2006 (extended to September 30, 2009).

After settlement of the lawsuit in 1997 and the resulting consent decree, the EPA began developing TMDLs for West Virginia streams, with the DEP providing onsite logistical and technical support. However, beginning with the Upper Kanawha River watershed in 2001, WVDEP assumed the lead in developing TMDLs for state waters. In 2009, WVDEP completed TMDL development for all remaining streams listed in the 1997 consent decree.

We continue to develop TMDLs in-house with the assistance of contractors for water quality model development. Comprehensive TMDLs that have recently been approved include those for impaired waters in the Upper Guyandotte River, Big Sandy River, Lower Ohio River, and Twelvepole Creek watersheds. TMDL development is underway in the Lower Guyandotte River, Tug Fork River, and Little Kanawha River (excluding the Hughes River) watersheds.

In future years it is possible that additional cases of stream contamination documented on the 303(d) list will be traced back through groundwater to their original sources. WAB will then be able to suggest remediation and restoration activities to improve groundwater and surface water quality in West Virginia.

The WAB has recently increased its monitoring and assessment efforts of wetlands. In 2020, the WAB designed and started a probabilistic based wetland monitoring program – targeting approximately 50 wetlands for monitoring each year. These wetlands are chosen to be representative of statewide wetlands based on ecoregion and wetland type. WAB continues to coordinate and participate with other wetland monitoring activities in WV. Such monitoring activities include: 1) National Wetland Condition Assessment (USEPA), 2) Wetland Delineations, 3) support of the WVWRAP – West Virginia Wetland Rapid Assessment Protocol (WV DNR), & 4) communication with wetland alteration permitting agencies (WV DEP/WV DNR/US ACOE).

WAB staff participate in the Chesapeake Bay States PFAS Workgroup. This workgroup focuses on highlighting and discussing the different PFAS studies or efforts each of the states within the Chesapeake Bay watershed has worked or is planning to work. WVDEP and WVDHHR are funding USGS to conduct a statewide PFAS Study of all (`280) public surface and groundwater drinking water sources. The WAB has contributed to discussions and plans. The WAB also are involved in the development of an Ohio River PFAS study to start in 2021, led by Ohio River Valley Water Sanitation Commission (ORSANCO).

Currently, all assessment and monitoring data is stored and managed in a database called WABbase. WABbase is a custom, in-house designed database that utilizes Oracle as a back-end with multiple Microsoft Access front-ends. Currently, a portion of the data is entered manually. However, most certified laboratories have been submitting lab analyzed water quality results electronically. Additionally, WAB is in the process of resuming submitting surface water quality information to EPA's Water Quality Exchange (WQX) database via their Water Quality Portal.

WAB uses ArcGIS (ArcMap) to strategically plan the location of sampling sites, to identify the geologic and land use patterns upstream from the sampling sites, and to establish a list of potential waterbody stressors associated with both surface and underground activities and disturbances. WAB also uses this program to print maps showing the geographic distribution of violations in a watershed.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

State Water Pollution Control Revolving Fund (SRF)

The SRF program environmental goals are to reduce and/or eliminate water quality violations caused by sanitary wastewater and nonpoint sources in surface waters and groundwater. In FY2018 and FY2019 approximately $80 million dollars of assistance was expended from the SRF program to build and replace wastewater collection and treatment systems. In many of these projects, unsewered areas of West Virginia were provided with centralized or, in some cases, decentralized sewer systems that eliminated direct wastewater discharges and failing or marginally functional onsite septic systems. The failing systems and direct discharges contribute to polluting the groundwater in the state.

The majority of the funding continues to be used for actual construction while the remaining portion was used for planning, design, and administrative expenses related to the projects.

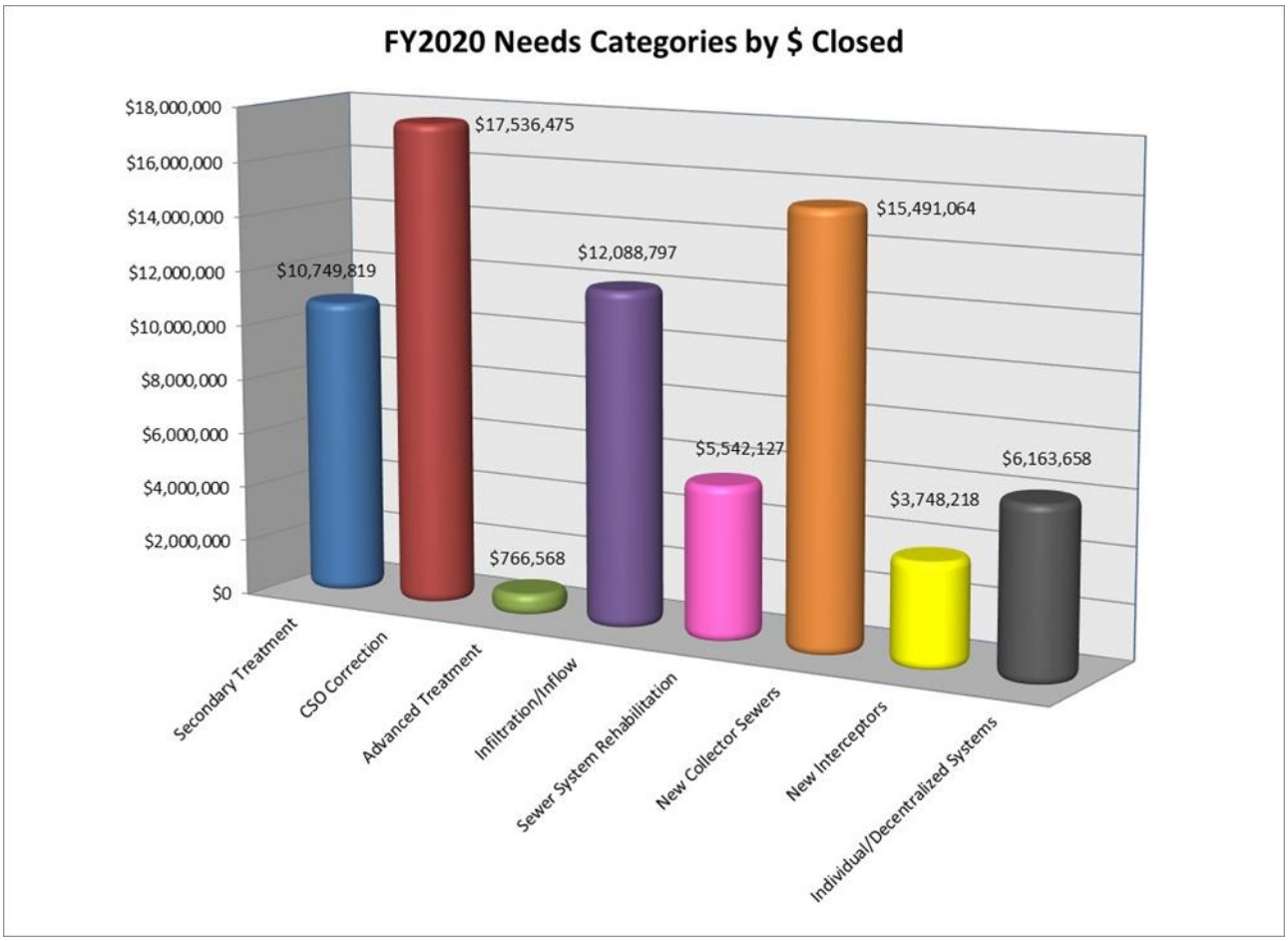
West Virginia's CWSRF program provides financial assistance to improve and maintain water quality throughout the State. The projects financed are vital in protecting and improving water quality in rivers, lakes, and streams throughout the State used for drinking water, recreation, cold water fisheries, warm water fisheries, wildlife use, industrial use, and agricultural use. In addition to the normal projects addressing wastewater issues, the CWSRF provided funding to projects to reduce stormwater impacts.

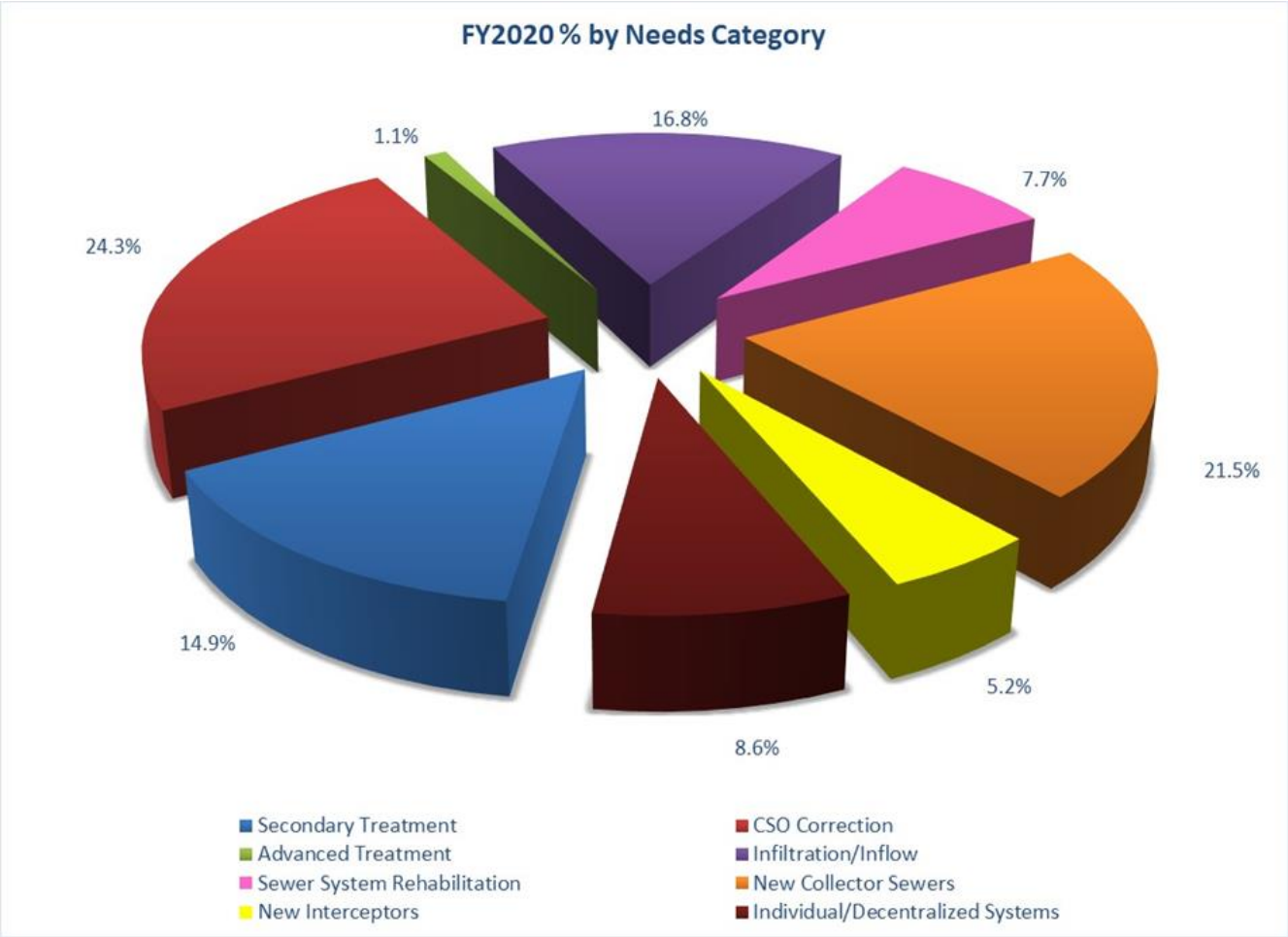
During FY 2020 and FY 2021, the CWSRF program contributed to the joint State/EPA mission of achieving clean and safe water by using the following goals:

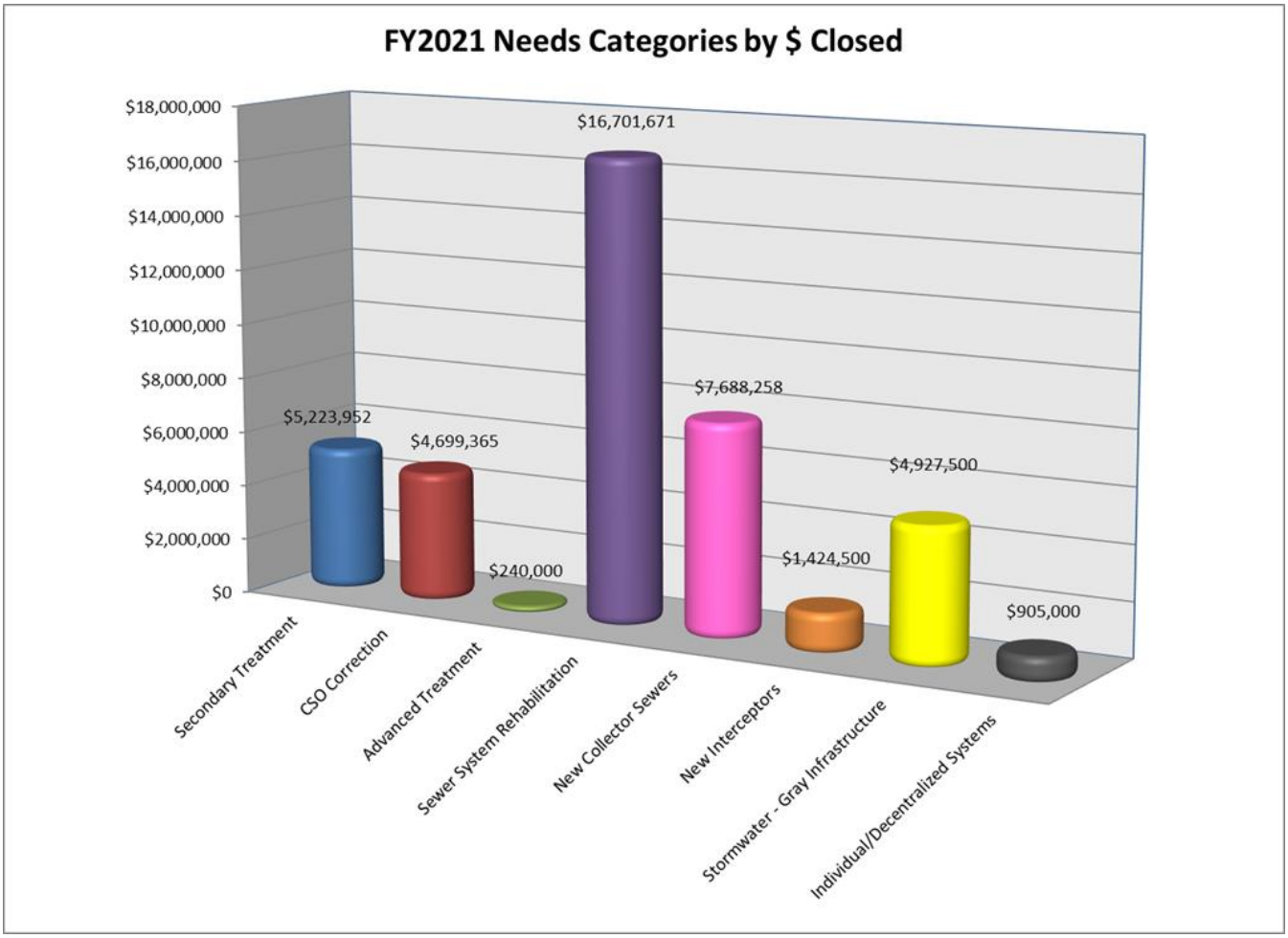
- Eliminate sewage overflows from combined sewer overflows (CSOs) and from separate sewer system overflows (SSOs),

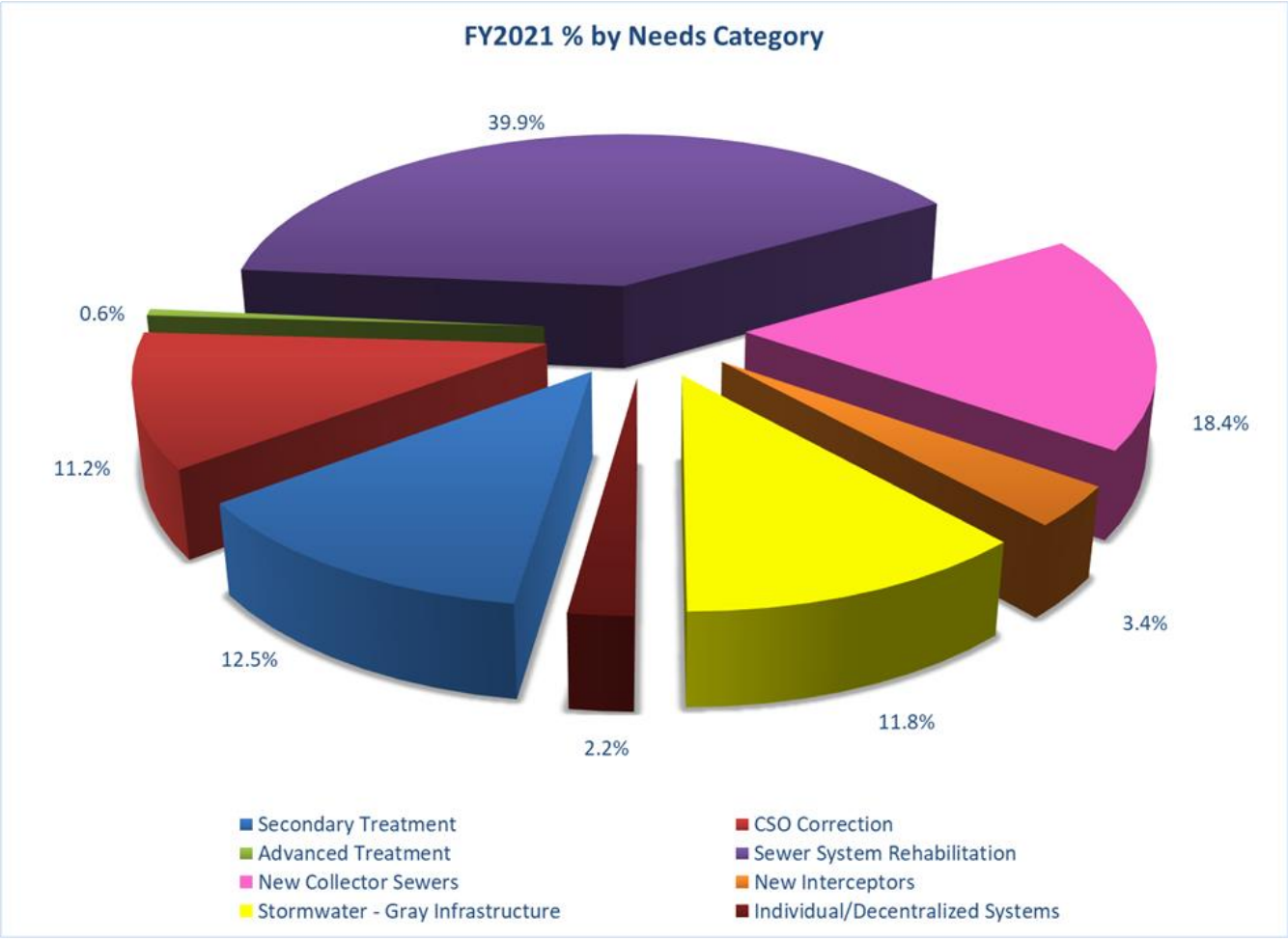
- Improve and protect designated uses of water bodies and achieve and maintain CWA compliance.

Loan and Principal Forgiveness dollars closed in FY20 were predominately in the CSO Correction category (24.3%) and New Collector Sewers category (21.5%), leaving the rest of the dollars to be spread over six other needs categories. Loan and Principal Forgiveness dollars closed in FY21 were predominately in the Sewer System Rehabilitation category (39.9%) and the New Collector Sewers category (18.4%), leaving the rest of the dollars spread over six other needs categories. (See graphs)


FY2020 Needs Categories by $ Closed
$18,000,000
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
$10,749,819
$17,536,475
$766,568
$12,088,797
$5,542,127
$15,491,064
$3,748,218
$6,163,658
Secondary Treatment
CSO Correction
Advanced Treatment
Infiltration/Inflow
Sewer System Rehabilitation
New Collector Sewers
New Interceptors
Individual/Decentralized Systems


FY2020 % by Needs Category
16.8%
1.1%
7.7%
24.3%
21.5%
14.9%
5.2%
8.6%
Secondary Treatment
CSO Correction
Advanced Treatment
Infiltration/Inflow
Sewer System Rehabilitation
New Collector Sewers
New Interceptors
Individual/Decentralized Systems


FY2021 Needs Categories by $ Closed
$18,000,000
$16,000,000
$14,000,000
$12,000,000
$10,000,000
$8,000,000
$6,000,000
$4,000,000
$2,000,000
$0
$5,223,952
$4,699,365
$240,000
$16,701,671
$7,688,258
$1,424,500
$4,927,500
$905,000
Secondary Treatment
CSO Correction
Advanced Treatment
Sewer System Rehabilitation
New Collector Sewers
New Interceptors
Stormwater - Gray Infrastructure
Individual/Decentralized Systems


FY2021 % by Needs Category
39.9%
18.4%
3.4%
11.8%
2.2%
12.5%
11.2%
0.6%
Secondary Treatment
CSO Correction
Advanced Treatment
Sewer System Rehabilitation
New Collector Sewers
New Interceptors
Stormwater - Gray Infrastructure
Individual/Decentralized Systems

Design standards for the SRF program are included in the Legislative Rules, Title 47 Series 31 and include restrictions on constructing sewer lines within 10 horizontal feet of a drinking water reservoir, 50 feet of any well or spring utilized for a public drinking water system, 50 feet of a private or individual homeowner's drinking water system, or within 10 feet of a homeowner's well. The enforcement of these regulations helps protect public and private water supplies.

The DEP's Agriculture Water Quality Loan Program is also administered through the SRF program. This program was established in 1997 and continues to offer loans to correct nonpoint source pollution. The program is set up as a cooperative effort between the WVDEP, WV Soil Conservation Agency (SCA), USDA Natural Resources Conservation Service (NRCS), local Soil Conservation Districts (SCD) and local banking institutions. As of June 30, 2021, more than $13 million had been loaned under this program for installation of best management practices. No new loans were made under this program during FY2020 and FY2021. This program is dependent on grant funds provided to the NRCS with a match provided by the CWSRF. The SRF will provide $150,000 as a set-aside for this program for FY2022.

A pilot program was started in 2000 called the Onsite Systems Loan Program. The purpose of this nonpoint source program is to eliminate existing health hazards and water quality problems due to direct sewage discharges from houses and malfunctioning septic tank systems. Many problems and barriers have prevented this program from being successful to date, but program revisions have been made to make it a more viable program. During the 2007 legislative session, the SRF statute was amended to allow other entities to act as an intermediary lender for this program. The WV Housing Development Fund and the SAFE Housing and Economic Development, Inc. (SHED) have entered into an agreement with the SRF to provide low interest loans to homeowners to correct failing onsite sewage systems. The program provided approximately 27 loans totaling more than $225,000 in FY 2020 and approximately 20 loans totaling more than $140,000 in FY2021 from this program and will provide $300,000 as a set-aside for this program for FY2022. To date over $3.4 million has been loaned under this program.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Environmental Enforcement

The Environmental Enforcement (EE) office is primarily responsible for inspection and enforcement of the state and federal solid waste, hazardous waste, underground and aboveground storage tank and water pollution control laws. EE's groundwater objective is to investigate all reports of contamination that fall within its jurisdiction and to refer all reports of contamination which are not under its jurisdiction to the appropriate authority.

The Compliance Monitoring Unit of the Environmental Enforcement Section of DEP has been assigned the responsibility to conduct Groundwater Sampling Inspections (GSI's) at various facilities throughout the State. Primarily, these facilities are active and inactive municipal and industrial landfill sites. The sites selected for sampling comes from requests from DEP's permitting staff, regional inspectors/supervisors and the discretion of the Compliance Monitoring unit.

The Department of Environmental Protection's Quality Assurance/Quality Control Plan and Standard Operating Procedures for Groundwater Sampling Revision No. 1 (effective August 5, 2009) is used by the Monitoring Unit as a guide when conducting GSI's.

Generally, all landfill sites will have a minimum of four (4) groundwater monitor wells. The number of wells per site will depend on the size of the landfill and could be as high as twenty (20) or more. Data collected from these wells depend upon whether it is an industrial or a municipal landfill. All municipal landfills generally have the same parameters (Phase I) as outlined in 33CSR Appendix I.

Collection of groundwater samples is accomplished by compressed air operated bladder pumps as well as bailers. All organics are collected by teflon bailers. All samples are collected, preserved and analyzed in accordance with 40 CFR. Groundwater samples are analyzed by State certified laboratories.

The Pre-Closure Program continues the review of industrial facilities that are in the process of ceasing operations. The review process allows EE to ensure that all known contamination is remediated. Sampling of all groundwater wells present at the sites is required as a part of this process. When any contaminated soil is identified at the facility, remediation is required under the Groundwater Protection Act.

Training that focuses on the complex interaction of groundwater, geology, and chemistry is included in the Core Training List for EE inspectors. Courses on the Core Training List are available to all inspection staff but are focused on newer inspectors in the training progression. These courses include classroom style training accompanied with ample practical (hands on) training exercises with a focus on sample collection and

preservation. This training program results in environmental inspectors that are both effective and safety conscious in their field work.

EE utilizes the WVDEP centralized database system that is accessible to all inspectors and other agency staff. WVDEP maintains files on groundwater complaints, investigations, Notice of Violations (NOV's), enforcement actions, spills, and monitoring well data for landfills and industrial sites in that system.

The Hazardous Waste Management Act, Underground Storage Tank (UST) Act and Aboveground Storage Tank Act are, in part, groundwater protection acts. The Hazardous Waste Management Act requires long term groundwater monitoring at permitted disposal sites. EE Inspectors conduct Operation and Maintenance inspections every three years at every hazardous waste land disposal facility in the State. These inspections involve evaluating the facility's groundwater monitoring methods and sampling protocols. Inspectors may split samples with the permit holder to conduct an independent analysis of the groundwater that has been sampled.

The UST Act and associated rule protect groundwater through imposing prevention and corrective action requirements. The UST program administers leak prevention activities and the leaking UST (LUST) program administers corrective action activities to ensure protection of the groundwater.

UST prevention activities include requirements for release detection, corrosion protection, overfill protection, and spill prevention at UST sites to ensure protection of the groundwater. West Virginia adopted the most recent Federal UST Rule on June 1, 2018. The modified rule provides additional protections for groundwater by requiring all new UST systems to have secondary containment, under dispenser containment, and additional testing of spill buckets, sumps and dispensers. Additionally, the rule requires all tank owners and operators to be trained concerning proper operation of their UST systems and requires them to perform monthly inspections of their UST systems and release prevention devices.

LUST corrective action activities include the oversight of cleanups of petroleum releases by responsible parties and enforces cleanups by recalcitrant parties to ensure protection of the groundwater. The LUST section may utilize limited federal funds to pay for cleanups at sites where the owner or operator is unknown, unwilling, or unable to respond, or at sites which require emergency action. Remediation of sites may prevent groundwater contamination and/or return contaminated groundwater to beneficial usage.

The Aboveground Storage Tank (AST) Act was promulgated in 2014 in response to the Freedom Industries spill. The AST Act focuses on tanks that present the highest threat to water resources by virtue of the tanks size, contents and location. Protection of groundwater as well as surface water through comprehensive tank regulation is the focus of this statute and rule. The AST Act and associated rule protect groundwater and surface water through imposing prevention and corrective action requirements. The AST program administers prevention activities and the leaking AST (LAST) program administers corrective action activities to ensure protection of the groundwater.

AST prevention activities include requirements for tank registration, release detection, corrosion protection, overfill protection and spill prevention at AST sites to ensure protection of the surface water and groundwater.

LAST corrective action activities include the oversight of cleanups of releases from regulated ASTs by responsible parties and enforces cleanups by recalcitrant parties to ensure protection of the groundwater. The LAST section may utilize funds to pay for cleanups at sites where the owner or operator is unknown, unwilling, or unable to respond, or which require emergency action. Remediation of sites may prevent groundwater contamination and/or return contaminated groundwater to beneficial usage.

Additionally, in fiscal years 2019 and 2020, EE personnel investigated 3,280 citizen complaints and approximately 1,300 reported spills. These spills and complaints included potential or actual impacts to groundwater.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Office of Abandoned Mine Lands and Reclamation

In reviewing surface mining legislation in the mid-1970s, Congress found that more than 1.5 million acres of land had been directly disturbed by coal mining and more than 11,500 miles of streams were polluted by sedimentation or acidity from surface or underground mines. In response to the problems associated with inadequate reclamation of coal mining sites, Congress enacted the Surface Mining Control and Reclamation Act of 1977 (SMCRA).

The two main purposes of SMCRA are (1) to establish a nationwide program to protect society and the environment from the adverse effects of surface mining operations while assuring that the coal supply essential to the nation's energy requirement is provided and (2) to promote the reclamation of mined areas left without adequate reclamation before SMCRA was passed. Title V of SMCRA deals with active mining, Title IV deals specifically with the problems associated with inadequate reclamation of abandoned mine lands (AML).

In Title IV, Congress established the Abandoned Mine Reclamation Fund to be used for the reclamation and restoration of areas affected by past mining. The fund is derived from a reclamation fee collected from coal mining operators on each ton of coal mined since SMCRA was enacted.

West Virginia received primacy of the AML program February 21, 1981, and the WVDEP was designated by the governor to operate this program with funding provided from the AML Reclamation Fund. The Office of Abandoned Mine Lands and Reclamation (AML&R) was established within the WVDEP.

The mission statement of the Office of AML&R is "to protect public health, safety, and property from past coal mining and enhance the environment through reclamation and restoration of land and water resources".

The program's vision statement is to, "efficiently and effectively use all available resources to achieve a long term benefit to public health, safety, property and general welfare while restoring the environment to pre-mining conditions.

AML&R Organizational Structure

AML&R is divided into groups: Administration & Financial, Realty, Planning, Design and In - House Design, Construction and Emergency. The state is divided into northern and southern regional offices. The responsibilities of those groups are:

1. *Administration & Financial* - This group performs the accounting function for the office. The group tracks expenditures as they relate to administrative and construction functions responsible for management of grants, budgets and financial administration of AML&R.

2. Realty **-** This group gains rights of entry from property owners so that exploration and construction can be conducted to address abandoned mine land problems. Also, the group's responsibility includes determining if before and after appraisals are necessary for the purposes of lien actions.

3. Planning **-** The Planning group identifies abandoned mine land problems, maintains the West Virginia Abandoned Mine Land Inventory, creates a description of each project, and develops a preferred alternative for correcting the problems. Each project requires the preparation of an environmental assessment to be in compliance with the National Environmental Policy Act (NEPA). Furthermore, the group oversees the Stream Restoration (AMD Set-Aside) section that is mandated to perform all program pre-construction, post-construction and compliance, and water monitoring functions. The group is also in charge of the treatment of Acid Mine Drainage resulting from pre-law mining activities.

4. Design & In - House Design **-** This group approves all consultant plans and specifications involving abandoned mine land projects. It also evaluates and selects a design consultant to perform all necessary preparation of plans and specifications for projects. This group also administers exploratory drilling, aerial mapping, surveying contracts, and prepares plan and specification on selected projects in-house.

5. Construction **-** The main task of the Construction group is contract administration and oversight of abandoned mine land construction projects. This includes site inspections during construction. The group conducts pre-bid and pre-construction conferences and performs final inspections.

6. Emergency **-** This group administers and conducts the Emergency Reclamation program. Emergency projects abate the sudden occurrence of health and safety hazards created by pre-law mining activities. A few examples include subsidence, mine fires, landslides, and blowouts.

AML Public Health and Safety Issues

SMCRA defined eligible sites under Title IV as those sites which were mined for coal and left in an inadequate state of reclamation prior to August 3, 1977, and for which there is no continuing reclamation responsibility under state or federal law. The definition of eligibility was extended in 1992 to include sites where surface coal mining occurred during the period between August 4, 1977 and the date on which the secretary of the U.S. Department of the Interior approved a regulatory program for the state in which the sites are located. The WV AML State Plan was approved January 23, 1981.

The expenditures of monies from the fund on lands and water eligible shall reflect the following priorities stated in Section 403 (a) in the Surface Mining Control and Reclamation Act Amendments of 2006:

1. (A) The protection of public health, safety, and property from extreme dangers of adverse effects of coal mining practices;

(B) the restoration of land and water resources and the environment that –

(i) have been degraded by the adverse effects of coal mining practices; and

(ii) are adjacent to a site that has been or will be remediated under subparagraph (A)

2. (A) The protection of public health and safety from adverse effects of coal mining practices;

(B) the restoration of land and water resources and the environment that -

(i) have been degraded by the adverse effects of coal mining practices; and

(ii) are adjacent to a site that has been or will be remediated under subparagraph (A); and

3. The restoration of land and water resources and the environment previously degraded by adverse effects of coal mining practices including measures for the conservation and development of soil, water (excluding channelization), woodland, fish and wildlife, recreation resources, and agricultural productivity.

The SMCRA Amendments of 2006 stated that any state or tribe may extend funds allocated to such state and tribe in any year through the grants for the purpose of protecting, repairing, replacing, constructing, or enhancing facilities related to water supply, including water distribution facilities and treatment plants, to replace water supplies adversely affected by coal mining practices.

The U.S. Office of Surface Mining (OSM) maintains an inventory of abandoned mine problems known as the Abandoned Mine Lands Inventory System (AMLIS). OSM maintains the system to provide information to meet the objectives of Title IV specified in Section 403(a).

When a problem area is entered into AMLIS along with the estimated cost of repairing the area, not including design, inspection, and program administration costs, the estimated cost is entered in the unfunded category. When a problem area on the inventory is funded, it is moved to the funded category. Later, when the actual construction is completed, the problem is again moved, this time to the completed category. In this manner, a complete history of the abandoned mine land problems are maintained in AMLIS. The total unfunded costs of all priorities in West Virginia as of August 25, 2021 is $1,789,802,470.57.

AML&R Accomplishments

AML&R has completed the problem areas (PA) and the associated problem types from July 1, 2020 through June 30, 2021. The PA and the problem type accomplishments have been entered into AMLIS and moved from the funded to completed category. The Problem Types, Completed Units and Completion Costs are shown below.

Problem Type	Completed Units	Completion Costs
Clogged Streams (Miles)	1.73	$372,833.15
Dangerous Highwalls (Feet)	5625	$1,235,887.55
Dangerous Impoundments (Count)	82	$2,371,688.61
Dangerous Piles & Embankments (Acres)	69.6	$5,506,162.75
Dangerous Slides (Acres)	10.85	$5,412,179.16
Gases: Hazardous/Explosive	1	$50,060.40
Hazardous Equipment & Facilities (Count)	5	$144,851.96
Hazardous Water Bodies (Count)	1.5	$49,339
Industrial/Residential Waste	1	$150,000
Polluted Water: Human Consumption (Count)	119	$4,462,329.26
Portals (Count)	118	$1,759,107.44
Subsidence (Acres)	4.25	$827,184.59
Surface Burning (Acres)	10	$1,686,939.79
Underground Mine Fires (Acres)	13.25	$2,986,406.1
Vertical Opening (Count)	3	$322,215.00
Gobs (Acres)	1.5	$133,824
Pits (Acres)	8	$20,000
Water Problems (Gallons)	321,110.3	$855,250.69
Total Cost		**$28,346,259.45**

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Land Restoration

The Division of Land Restoration's mission is to reclaim and remediate contaminated and disturbed land to a condition protective of public health and safety and suitable for productive reuse and economic development.

Office of Environmental Remediation

Through its various environmental cleanup programs outlined below, the Office of Environmental Remediation (OER) provides for clean, safe, and productive West Virginia communities by assessing and remediating environmental resources and restoring contaminated properties to beneficial use.

Voluntary Remediation Program - The Voluntary Remediation Program encourages voluntary cleanup and redevelopment of abandoned or under-utilized contaminated properties by providing certain environmental liability protections under West Virginia law to parties completing remediation under WVDEP oversight. During FY20 and FY21, the program:

- Accepted twenty-three (23) new applications for voluntary remediation projects.
- Issued thirty-two (32) Certificate of Completion for 1,062.54 remediated acres of land ready for reuse.

Cumulatively, 230 Certificate of Completion have been issued for 3,708 remediated acres of land since the inception of the program.

UECA-LUST Program - The Uniform Environmental Covenants Act–Leaking Underground Storage Tank (UECA-LUST) Program is an alternative remediation option for releases from underground storage tanks (USTs). Similar to the Voluntary Remediation Program, responsible parties may remediate LUST sites to risk-based standards utilizing engineering and institutional controls, such as covers, caps, and land use restrictions, in accordance with the Uniform Environmental Covenants Act. However, this program only addresses contaminants associated with the LUST release, rather than all contaminants associated with historic use of the site.

During FY20 and FY21, the program:

- Accepted five (5) LUST sites to participate in the program.
- Issued four (4) No Further Action letters to sites which successfully completed risk-based remediation.

Superfund Program - The West Virginia Department of Environmental Protection is a support regulatory agency for the U.S. Environmental Protection Agency at removal, pre-remedial, and remedial sites subject to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which requires meaningful state participation. The WVDEP Superfund Program represents state interests; ensures compliance with applicable state laws and regulations; provides oversight of data and data collection activities; and acts as a liaison between the U.S. EPA and the citizens of West Virginia, local officials, community representatives, property owners, industry, and nonprofit organizations. During FY20 and FY21, the program:

- Supported EPA's Remedial Program and led O&M efforts at ten (10) Superfund National Priorities List (NPL) sites.

- Assisted EPA Response Program On-Scene Coordinators with removal assessments and actions at eleven (11) sites.

- Led or supported pre-remedial assessments for EPA's Site Assessment Program at eleven (11) sites.

- Took over lead agency role for continued assessment at one (1) CERCLA removal action site.

Federal Facilities Restoration Program – WVDEP serves as the lead regulatory agency at Department of Defense (DOD) restoration sites not on the Superfund NPL. The Federal Facilities Restoration Program oversees the investigation and cleanup of active, closing, and formerly used military installations at which hazardous substances and/or petroleum products were used, stored, or disposed of during past operations, as well as military munitions response sites known or suspected to contain unexploded ordnance, discarded military munitions, or munitions constituents. During FY20 and 21, the program:

- Collaborated with the U.S. Air Force, U.S. Army, U.S. Army Corps of Engineers, U.S. Army National Guard, and U.S. Navy, and the U. S. Department of Energy to actively assess and remediate nine (9) Formerly Use Defense Sites (FUDS), Military Munitions Response Program (MMRP) sites, and Installation Restoration (IR) sites, Legacy Sites, and PFOS/PFOA special assessment sites.

Long-Term Monitoring of Institutional Controls

Institutional controls are administrative and legal controls (such as restrictive covenants or city ordinances) that minimize the potential for human exposure or contamination and protect the integrity of the cleanup. WVDEP generally utilizes Land Use Covenants (LUCs)—also referred to as environmental covenants—as institutional controls on sites where removal and treatment of all contamination is not possible or practical. LUCs are legal instruments that impose activity and use limitations (AULs) where residual contamination is present on a property. AULs may include use or extraction of groundwater for any purpose, except for groundwater monitoring and/or remediation; any activity that may interfere with the groundwater monitoring and/or

remediation; any activity that may interfere with the monitoring well network; and construction of a building without a sub-slab vapor barrier and/or ventilation system adequate to prevent exposure to vapors in soil and groundwater. WVDEP continuously monitors and regularly inspects properties with recorded LUCs to protect citizens from coming in contact with contamination at a site. During FY20 and FY21, WVDEP received and processed 2,200 notifications of excavation from WV811 to monitor sites with established environmental controls that contain AULs and/or engineering controls.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION Office of Environmental Advocate

Rehabilitation Environmental Action Plan (REAP)

This was a strategic initiative signed into law by Governor Joe Manchin in 2005. The governor's bill combined elements of the WVDEP and the Division of Natural Resources into a more effective and streamlined system for the direction of environmental remediation programs. The REAP Program, housed within the Office of the Environmental Advocate, provides oversight of litter removal, statewide recycling, and open dump cleanups which protects West Virginia's surface and groundwater from contamination.

During the FY 2020 and 2021 period (July 1, 2019 - June 30, 2021), REAP has accomplished the following:

The REAP Program eliminated nearly 2,650 dumps from West Virginia's landscape, cleaned over 5,500 miles of roadway, and awarded over $3.5 million in grants for recycling and litter control initiatives. These actions contributed to the proper disposal of 6,487 tons of litter/waste across all programs. REAP was also responsible for the proper disposal of over 200,000 waste tires. Many of these tires were pulled from the 279 miles of rivers and streams that REAP cleaned during this time.

- REAP's Pollution Prevention Open Dump Program (PPOD) reclaimed 2,337 acres of land through the eradication of 2,033 dumps. PPOD removed 4,592 tons of litter/waste from the landscape while recycling 35 tons of scrap metal.

- REAP's Make It Shine Program coordinated the efforts of 3,989 volunteers. These volunteers worked to remove 181 tons of litter/waste from public lands and waters. The volunteers cleaned 37 miles of streams while also eradicating 126 dumps.

- REAP's Adopt-A-Highway Program had 13,589 volunteers in 1,955 active groups. They worked to remove 313 tons of litter from nearly 3,300 miles of roadway.

- The REAP Litter Control Grant Program, which provides grants to counties and municipalities for litter control and cleanup programs, funded 64 projects totaling $143,167.00.

- The REAP West Virginia Recycling Assistance Grant Program, which provides grants for recycling to public and private entities, awarded 48 grants totaling $3,210,809.85.

- The REAP Covered Electronic Device Grant Program, which offers grants to counties and municipalities wishing to implement electronic device recycling programs or e-cycling events, issued 21 grants totaling $220,826.00.
- The REAP West Virginia Public Employees Office Paper Collection Program collected over 374 tons of paper from state offices.
- The Youth Education and Outreach Program conducted 641 educational presentations regarding litter and recycling. Volunteers for this program cleaned 56 acres of parks, 18 miles of trails, and 107 miles of roadways.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Information Technology Support

Technical Applications and Geographical Information Systems (TAGIS) Unit

The TAGIS unit provides central support for all DEP units involved in groundwater activities in the form of geographical database creation and update, analysis, web-based services and applications, and software support.

TAGIS maintains the agency ArcGIS license server that provides access to advanced desktop GIS software. It also has developed automated processes for creating and updating geographical datasets critical for agency programs, including NPDES permits and outlets (which also include underground injection permits), voluntary remediation sites, oil and gas development permits, active mining operations, above ground storage tanks, and others. TAGIS also has developed or obtained a wide range of additional GIS data products related to stream networks, flow estimation, high resolution surface elevation data, soil data used for runoff analysis, public water sources and protection areas, toxics release inventory, and others. Additional work has extended the National Hydrology Dataset to allow stream network traversal in karst areas by linking sinking streams and emergent springs based on dye trace data and karst basin maps.

The TAGIS unit continues to expand the agency's web-based mapping capability, maintaining and developing a range of interactive mapping applications and ‘story maps’ that quickly bring together data resources from many organizations to a single place, which then can be shared with anyone via a simple web address. Over the last year, TAGIS has become increasingly involved with the use of UAVs to create detailed and accurate maps to support investigation and remediation of contaminated sites, as well as supporting reclamation of mine sites. TAGIS will soon take delivery of a multispectral camera to support mapping and monitoring wetlands.

VII. DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water and Waste Management

Groundwater Program

The Geochemistry of West Virginia's Water

Groundwater quality is affected by human activities and can be degraded as a result of industrial waste disposal, coal mining, oil and gas drilling, agricultural activities, domestic or municipal waste disposal, transportation, and rural development. While the overall quality of West Virginia's water resources are very good, there are many concerns to be addressed, more than the scope of this report will allow here. The Groundwater program is pursuing development of a Needs Assessment to begin a comprehensive database of groundwater quality. Three main concerns expressed by many are the increasing abundance of PFAS compounds and their toxicity, pharmaceuticals and endocrine disrupting chemicals in groundwater and hydraulic fracturing in oil and gas production.

Concerns

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that includes PFOA, PFOS, GenX, and many other chemicals. PFAS have been manufactured and used in a variety of industries around the globe, including in the United States since the 1940s. PFOA and PFOS have been the most extensively produced and studied of these chemicals. Both of these chemicals are very persistent in the environment and in the human body–meaning they don't break down and they can accumulate over time (bioaccumulation). There is evidence that exposure to PFAS can lead to a variety of adverse human health effects.

PFAS can be found in:

- **Food** packaged in PFAS-containing materials, processed with equipment that used PFAS, or grown in PFAS-contaminated soil or water.

- **Commercial household products**, including stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, personal care products, and fire-fighting foams (a major source of groundwater contamination at airports and military bases where firefighting training occurs).

- **Workplace**, including production facilities or industries (e.g., chrome plating, electronics manufacturing or oil recovery) that use PFAS.

- **Drinking water**, typically localized and associated with a specific facility (e.g., manufacturer, landfill, wastewater treatment plant, firefighter training facility).

- **Living organisms**, including fish, animals and humans, where PFAS have the ability to build up and persist over time.

Certain PFAS chemicals are no longer manufactured in the United States as a result of phase outs including the PFOA Stewardship Program in which eight major chemical manufacturers agreed to eliminate the use of PFOA and PFOA-related chemicals in their products and as emissions from their facilities. Although PFOA and PFOS are no longer manufactured in the United States, they are still produced internationally and can be imported into the United States in consumer goods such as carpet, leather and apparel, textiles, paper and packaging, coatings, rubber and plastics.

PFAS are found in a wide range of consumer products that people use daily such as cookware, pizza boxes, stain repellants, and many personal care products. Most people have been exposed to PFAS. Many of these PFAS bioaccumulate and can accumulate and stay in the human body for long periods of time. As a result, as people are exposed to PFAS from different sources over time, the level of PFAS in their bodies may increase to the point where they suffer from adverse health effects.

The most-studied PFAS chemicals are PFOA and PFOS. Studies indicate that PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals. Both chemicals have been shown to cause tumors in animals. The most consistent findings are increased cholesterol levels among exposed populations, with more limited findings related to:

- low infant birth weights,
- effects on the immune system,
- cancer (for PFOA),
- thyroid hormone disruption (for PFOS).
- effects on the immune system, Basic Information on PFAS
- cancer (for PFOA), and
- thyroid hormone disruption (for PFOS).

Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals that have been in use since the 1940s and are (or have been) found in many consumer

products like cookware, food packaging, and stain repellants. PFAS manufacturing and processing facilities, airports, and military installations that use firefighting foams are some of the main sources of PFAS. PFAS may be released into the air, soil, and water, including sources of drinking water. PFOA and PFOS are the most studied PFAS chemicals and have been voluntarily phased out by industry, though they are still persistent in the environment. There are many other PFAS, including GenX chemicals and PFBS in use throughout the world.

GenX is a trade name for a technology that is used to make high performance fluoropolymers (e.g., some nonstick coatings) without the use of perfluorooctanoic acid (PFOA). HFPO dimer acid and its ammonium salt are the major chemicals associated with the GenX technology. GenX chemicals have been found in surface water, groundwater, finished drinking water, rainwater, and air emissions in many areas.

Perfluorobutane sulfonic acid (PFBS) has been used as a replacement chemical for PFOS. PFBS has been identified in environmental media and consumer products, including surface water, wastewater, drinking water, dust, carpeting and carpet cleaners, and floor wax.

There are a variety of ways that people can be exposed to these chemicals at varying levels of exposure. For example, people can be exposed to low levels of PFAS through food, which can become contaminated through:

- Contaminated soil and water used to grow the food,
- Food packaging containing PFAS, and
- Equipment that used PFAS during food processing.

Exposure to PFAS chemicals can occur if the chemicals are released during normal use, biodegradation, or disposal of consumer products that contain PFAS. People may be exposed to PFAS used in commercially treated products to make them stain and water-repellent or nonstick. These goods include carpets, leather and apparel, textiles, paper and packaging materials, and non-stick cookware.

People who *work* at PFAS production facilities, or facilities that manufacture goods made with PFAS, may be exposed in certain occupational settings or through contaminated air.

Drinking water supplies in many communities have been contaminated by these chemicals. Such contamination is becoming increasingly common, especially in areas where industrial facilities produce or use PFAS in the manufacturing process, or near oil refineries, airfields or other locations at which PFAS were used for firefighting.

As these chemicals are ubiquitous and persistent in the environment, it is important that suppliers of drinking water test for the presence of these chemicals in the water supply. At present, many water treatment facilities are unable to remove these chemicals when detected and pass through the treatment system and into surface and groundwaters. Many of these compounds that passthrough treatment facilities are related to the use of medications and person care products and are linked to health problems associated with endocrine disruption. This is discussed more fully below.

Further research must be conducted to determine toxicity and how best to remediate water contaminated by these chemicals.

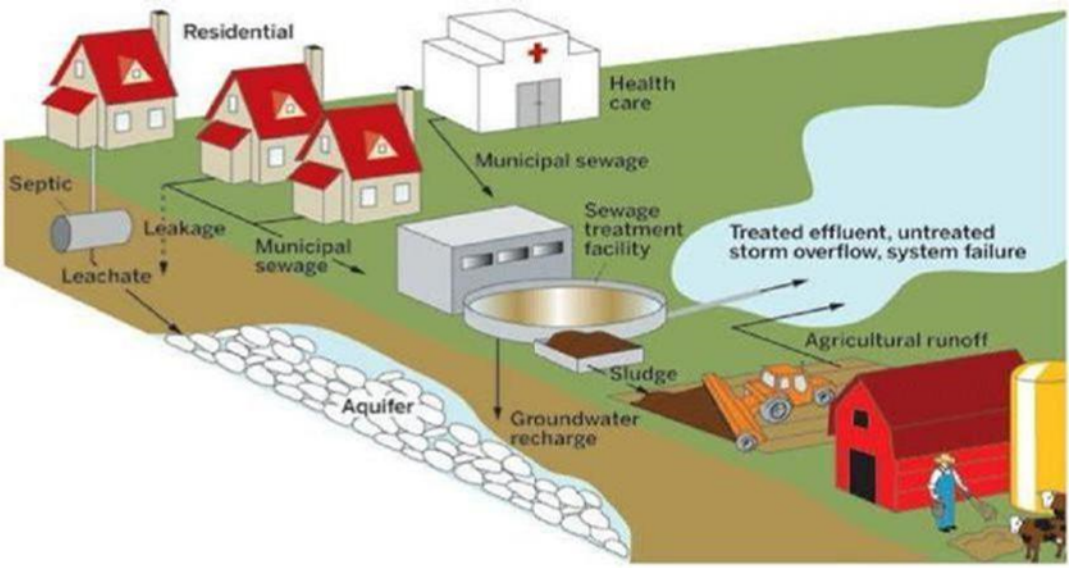
Pharmaceuticals and Endocrine Disrupting Chemicals in Groundwater

The presence of pharmaceuticals and endocrine disrupting chemicals in groundwater continues to be major concern as these chemicals are used in so many products consumed in everyday life. Endocrine disrupting chemicals are found in such products as antimicrobial soaps and disinfectants, flame retardants, plasticizers, linings in food containers (such as bisphenol A), food preservatives, shampoos, sunscreen, bug sprays, cosmetics, and many other personal care products. In addition to these products, pharmaceuticals and endocrine disrupting chemicals also enter drinking water supplies as they pass through septic tank and leach field systems, and water treatment plants. The source comes from many over-the-counter medications, veterinary drugs, prescription drugs such as cholesterol medications, natural and synthetic estrogens compounds, heart medications, steroids, and pain medications to name but a few.

The presence of pharmaceuticals and endocrine disrupting chemicals in groundwater has raised concerns regarding their effects on human health including the continued viability of antibiotic medications. Endocrine disruptors can mimic or partly mimic naturally occurring hormones in the body like estrogens (the female sex hormone), androgens (the male sex hormone), and thyroid hormones, potentially producing overstimulation. They also bind to a receptor within a cell and block the endogenous hormone from binding. The normal signal then fails to occur and the body fails to respond properly. Examples of chemicals that block or antagonize hormones are anti-estrogens and anti-androgens. Endocrine disruptors also interfere or block the way natural hormones or their receptors are made or controlled, for example, by altering their metabolism in the liver.

Because endocrine disrupting chemicals are found in such a wide variety of products; their presence appears to be ubiquitous in the environment. Bioassays of fish in the Potomac River and other bodies of water routinely find intersex characteristics in the fish sampled. One such mutation is the presence of eggs in the testes of male fish. Another concern is the presence of certain antibiotics in ground and surface waters. As many of these compounds are known endocrine disruptors, their presence even at low concentrations warrant additional scrutiny.

The practice of land applying biosolids from waste treatment facilities and livestock operations on agricultural areas must be reevaluated in light of recent research, as these biosolids have been shown to be laden with a wide variety of pharmaceuticals, endocrine disrupting chemicals, and especially, antibiotics. Agricultural industry uses some eighty percent of antibiotics manufactured. At this time, more study needs to be done in this area to determine the appropriate course of action needed to address this concern. Given the amount of pharmaceuticals and endocrine disrupting chemicals entering the environment, recent exemptions for the agricultural industry regarding regulation of land applying biosolids from waste treatment facilities and livestock operations must be perceived as a step in the wrong direction.



Pharmaceuticals and Personal Care Products in the Environment

Hydraulic Fracturing in Oil and Gas Production

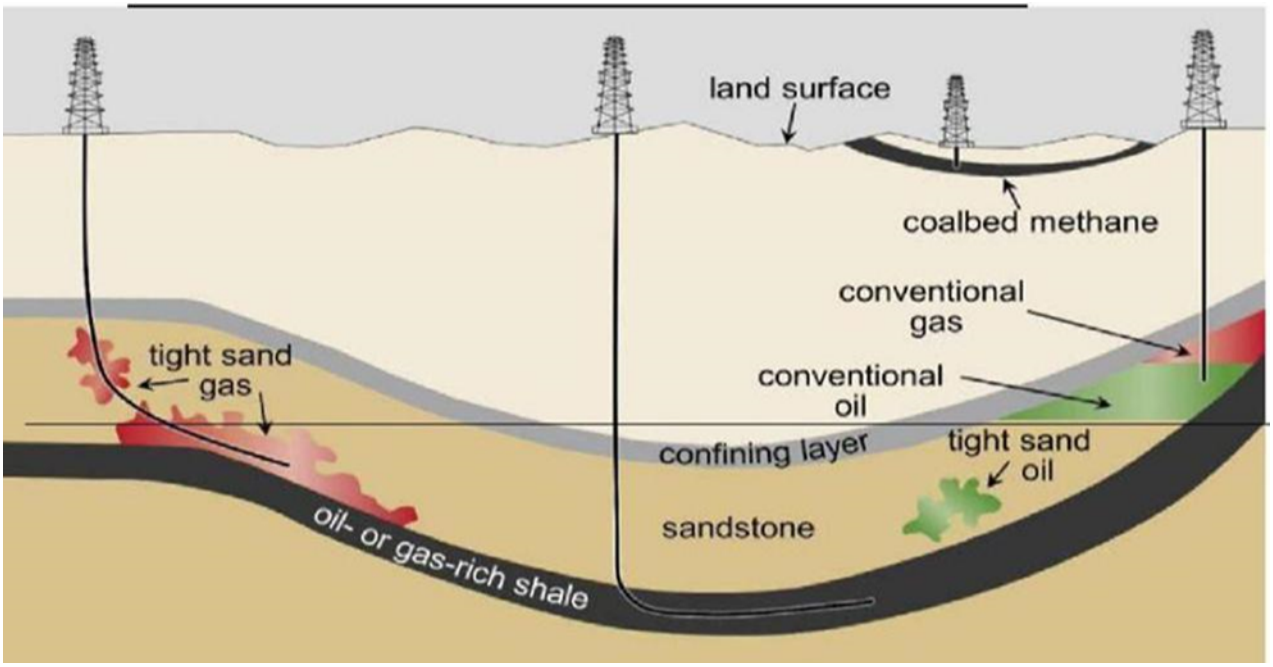
Hydraulic fracturing is a stimulation technique used to increase oil and gas production from underground rock formations. Hydraulic fracturing involves the injection of fluids under pressures great enough to fracture the oil and gas producing formations, primarily in tight geological formations such as the Marcellus Shale. The fluid generally consists of water, chemicals, and proppant (commonly sand). The proppant holds open the newly created fractures after the injection pressure is released. Oil and gas flows through the fractures and up the production well to the surface.

Hydraulic fracturing has been used since the late 1940s and, for the first 50 years, was mostly used in vertical wells in conventional formations. Hydraulic fracturing is still used in these settings, but the process has evolved; technological developments (including horizontal and directional drilling) have led to the use of hydraulic fracturing in unconventional hydrocarbon formations that could not otherwise be profitably produced.

Although proximity of hydraulic fracturing activities to a drinking water resource is not in itself sufficient for an impact to occur, it does increase the potential for impacts. Residents and drinking water resources in areas experiencing hydraulic fracturing activities are most likely to be affected by any potential impacts, should they occur. However, hydraulic fracturing can also affect drinking water resources outside the immediate vicinity of a hydraulically fractured well; a truck carrying wastewater could spill or a release of inadequately treated wastewater could have downstream effects.

Shown are conceptual illustrations of types of oil and gas wells. A vertical well is producing from a conventional oil and gas deposit (right). In this case, a gray confining layer serves to “trap” oil (green) or gas (red). Also shown are wells producing from unconventional formations: a vertical coalbed methane well (second from right); a horizontal well producing from a shale formation (center); and a well producing from a tight sand formation (left). Note: Figure not to scale. Modified from USGS

Schematic cross-section of general types of oil and gas resources and the orientations of production wells used in hydraulic fracturing.



Possible Impacts of Water Withdrawals for Hydraulic Fracturing on Water Quality

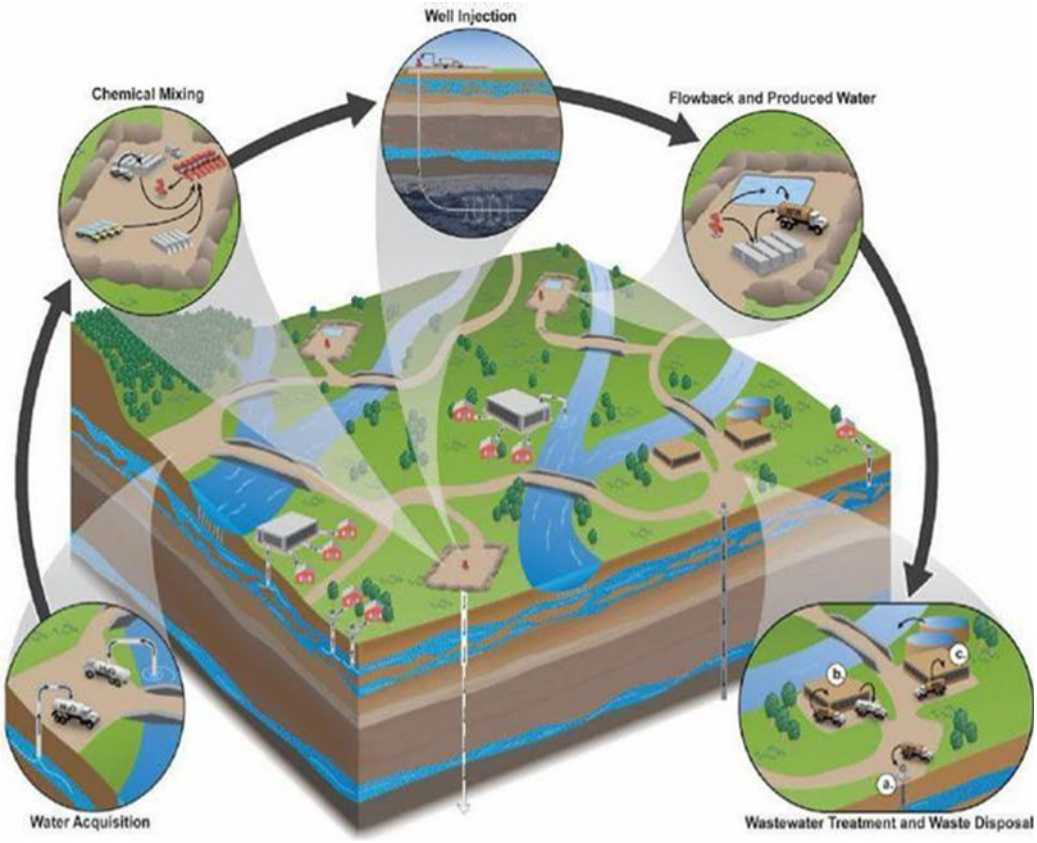
Water withdrawals for hydraulic fracturing, similar to all water withdrawals, have the potential to alter the quality of drinking water resources. Ground water withdrawals exceeding natural recharge rates decrease water storage in aquifers, potentially mobilizing contaminants or allowing the infiltration of lower quality water from the land surface or adjacent formations. Withdrawals could also decrease ground water discharge to streams, potentially affecting surface water quality. Areas with large amounts of sustained ground water pumping are most likely to experience impacts, particularly drought-prone regions with limited ground water recharge, although this is not a primary concern in West Virginia.

Surface water withdrawals also have the potential to affect water quality. Withdrawals may lower water levels and alter stream flow, potentially decreasing a stream's capacity to dilute contaminants. Case studies by the US EPA show that streams can be vulnerable to changes in water quality due to water withdrawals, particularly smaller streams and during periods of low flow. Management of the rate and timing of surface water withdrawals has been shown to help mitigate potential impacts of hydraulic fracturing withdrawals on water quality.

Chemical Mixing

Hydraulic fracturing fluids are developed to perform specific functions, including: create and extend fractures, transport proppant, and place proppant in the fractures. The fluid generally consists of three parts: (1) the base fluid, which is the largest constituent by volume and is typically water; (2) the additives, which can be a single chemical or a mixture of chemicals; and (3) the proppant. Additives are chosen to serve a specific purpose (e.g., adjust pH, increase viscosity, limit bacterial growth). Chemicals generally comprise a small percentage (typically 2% or less) of the overall injected fluid volume. Because over one million gallons of fluids are typically injected per well, thousands of gallons of chemicals can be potentially stored on-site and used during hydraulic fracturing activities.

On-site storage, mixing, and pumping of chemicals and hydraulic fracturing fluids have the potential to result in accidental releases, such as spills or leaks. Potential impacts to drinking water resources from spills of hydraulic fracturing fluids and chemicals depend on the characteristics of the spills, and the fate, transport, and the toxicity of chemicals spilled. Disposal of the brine associated with hydraulic fracturing has been a great concern to the public and to environmental professionals. Injection of the brine into Class 2 injection wells have often exceeded maximum contamination levels of toxicity for many of the constituents, including radioactive compounds.



The Stages of the Hydraulic Fracturing Water Cycle.
Shown here is a generalized landscape depicting the activities of the hydraulic fracturing water cycle and their relationship to each other, as well as their relationship to drinking water resources. Arrows depict the movement of water and chemicals. Specific activities in the "Wastewater Treatment and Waste Disposal" inset are (a)underground injection control (UIC) well disposal, (b) wastewater treatment and reuse, and (c) wastewater treatment and discharge at a centralized waste treatment (CWT) facility. Note: Figure not to scale

Identities and Volumes of Chemicals Used in Hydraulic Fracturing Fluids

There have been 1,076 chemicals identified that are used in hydraulic fracturing fluids. This is a cumulative list over multiple wells and years. These chemicals include acids, alcohols, aromatic hydrocarbons, bases, hydrocarbon mixtures, polysaccharides, and surfactants. According to the EPA's analysis of disclosures, the number of unique chemicals per well ranged from 4 to 28, with a median of 14 unique chemicals per well.

Analysis indicates that chemical use varies and that no single chemical is used at all well sites across the country, although several chemicals are widely used. Methanol, hydrotreated light petroleum distillates, and hydrochloric acid were reported as used in 65% or more of wells, according to disclosures analyzed by the EPA. Only 32 chemicals, excluding water, quartz, and sodium chloride, were used in more than 10% of wells according to the EPA's analysis.

Well Injection

Hydraulic fracturing fluids are injected into oil or gas wells under high pressures. The fluids flow through the well (commonly thousands of feet below the surface) into the production zone (i.e., the geologic formation being fractured) where the fluid injection pressures are sufficient to create fractures in the rock. There are two major subsurface mechanisms by which the injection of fluid and the creation and propagation of fractures can lead to contamination of drinking water resources: (1) the unintended movement of liquids or gases out of the production well or along the outside of the production well into a drinking water resource via deficiencies in the well's casing or cement, and (2) the unintended movement of liquids or gases from the production zone through subsurface geologic formations into a drinking water resource. Combinations of these two mechanisms are also possible.

Impacts to drinking water resources from subsurface liquid and gas movement may occur if casing or cement are inadequately designed, inadequately constructed or fail.

Appendix A

Regulatory Agencies with Groundwater Responsibility and Authority

Department of Agriculture
1900 Kanawha Blvd., E.
Charleston, WV 25305
(304) 558-3708

Department of Environmental Protection
601 57th Street, SE
Charleston, WV 25304

Office of Oil and Gas
(304) 926-0450
Division of Land Restoration
(304) 926-0455

Division of Water and Waste Management
(304) 926-0495
Office of Information Technology
(304) 926- 0499, Ext. 1615

Department of Health and Human Resources
350 Capital Street
Charleston, WV 25301

Office of Environmental Health Services
(304) 558-2981
Environmental Engineering Division
(304) 558-2981
Public Health Sanitation Division
(304) 558-2981