



2024

ANNUAL REPORT



WEST VIRGINIA GEOLOGICAL & ECONOMIC SURVEY

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Cover Photo

A view of Seneca Creek during mapping field work of the Onego quadrangle in Pendleton County in October 2023.



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EXECUTIVE SUMMARY

Jessica Moore, Director and State Geologist

Dear Reader,

Thank you for your interest in the West Virginia Geological and Economic Survey's (WVGES) activities during Fiscal Year 2024. I am pleased to present this report, which includes details of new and continuing research across our Coal, Oil and Gas, and Geoscience programs. Each program's work contributes to the overall mission of the agency, which is as follows:

The West Virginia Geological and Economic Survey conducts long-term and project-specific, independent and unbiased analysis of the geology of the state and provides scientific expertise, information, and education to all of West Virginia's stakeholders regarding the coal, natural gas, petroleum, non-fuel resources, environmental concerns, karst, and geologic hazards of the state.

Given the breadth and depth of the mission to which WVGES geoscientists are assigned, it's essential to identify and maintain strong partnerships with both public and private institutions. The power of these partnerships cannot be overstated. In FY 24, our partnerships resulted in acquisition of high-resolution geophysical data and prospecting for critical minerals via the U.S. Geological Survey's Earth Mapping Resources Initiative; public education on the safe and secure geologic storage of carbon dioxide via the Department of Energy's Central Appalachian Partnership for Carbon Storage; characterization of flooded mine pools for geothermal applications in conjunction with the WV Office of Energy and Marshall University, and many more success stories that are detailed in this report.

I hope you enjoy the report and invite you to visit us anytime at <https://www.wvgs.wvnet.edu> or from 8:00 a.m. to 4:30 p.m. at our headquarters in the historic Mont Chateau lodge in Morgantown, West Virginia.



Jessica Moore, WVGES Director and State Geologist (right), meets with U.S. Senator Shelley Moore Capito (left) in Washington, D.C.

Coalbed Mapping Project

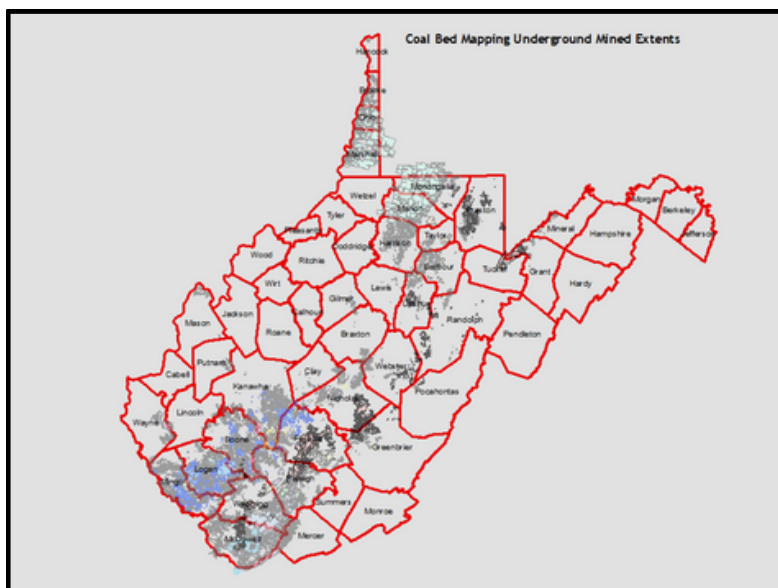
The Coal Bed Mapping Project (CBMP) is a Geographic Information System (GIS) database of West Virginia's mined and remaining coal. The database provides a snapshot of all known mining and available data in the Mountain State's coal measures.

CBMP is composed of 86 mineable coal seams and splits which are continually updated based on new mining acquired from the following: West Virginia Office of Miners Health Safety and Training (WVMHS&T), the West Virginia Department of Environmental Protection, the West Virginia Department of Tax and Revenue, Property Tax Division and the Office Of Surface Mining Reclamation and Enforcement (Pittsburgh, PA) or newly acquired mine maps from industry and private donations.

CBMP utilizes an Oracle database of coal elevations and thicknesses with nearly 200,000 points, over 38,000 of which are detailed drill holes. During FY 24, CBMP added 163 new drillers logs, 6 geologist cores, 59 surface sections and over 4600 underground mine data points to the database. This data is collected throughout the year and entered as it becomes available. In FY 24, CBMP received a group of data in an area of McDowell County which was previously a data void. This new data will allow WVGES geologists to evaluate and re-correlate problem areas to improve the overall model.

The State Tax Department utilizes CBMP to accurately and equitably value mineral properties for tax assessment. Shape files of mine map location, mining type, coal thickness, coal elevation and partings, mined and remaining areas, and overburden are created from CBMP for easy online public access. Data sets are free and available to everyone on the WVGES website at:

<https://www.wvgs.wvnet.edu/www/coal/cbmp/coalims.html>



Underground Mine Mapping Project

New and legacy mine maps are collected from various sources including governmental, industry and private collections. If a newly acquired paper map is of better quality than existing data, it is scanned and added to the dataset and then the paper map is archived. A new aperture card scanner was purchased in FY 24 which allows greatly improved rescans of archived aperture cards. Currently, rescans are only done to satisfy specific service requests. However in the future, all aperture cards of substandard quality currently in our database will be rescanned.

CBMP added only 16 new mine maps in FY 24. The low number of maps is a function of staffing issues and retirements at our sister agencies who were not able to send new data. These issues will be resolved in FY25.

Several thousand new locations from archival Bureau of Mines coal analyses were added to the database requiring extensive review and vetting of location data.

As always CBMP strives to improve the accuracy of our data model. As more data is added, previously scanned images are replaced with clearer images, thickness and elevation data is incorporated into the data model, and new mine maps are made available. This information, creates a better understanding of the depositional environment and interrelationships associated with WV's coal seams.

Mine Information Database System (MIDS)

Mine Information Database System (MIDS) houses publicly accessible information collected from mine maps including mine name, company name, location, map year and various other information compiled from maps in our system.

The database contains 49,967 documents representing 91,796 mines. Many maps are variations of an existing map with slightly different mined areas, seams or data points. These maps are recorded along with any new mining or data points are recorded in CBMP.

WVGES encourages mine map submissions and remarks from the public to improve our database. If you have a mine map that you would like to donate, know of an archive that could be accessed or if you see an error in our database, please contact us a info@wvgs.wvnet.edu.

All maps in our database are accessible at:

<https://www.wvgs.wvnet.edu/www/mids/main.php>

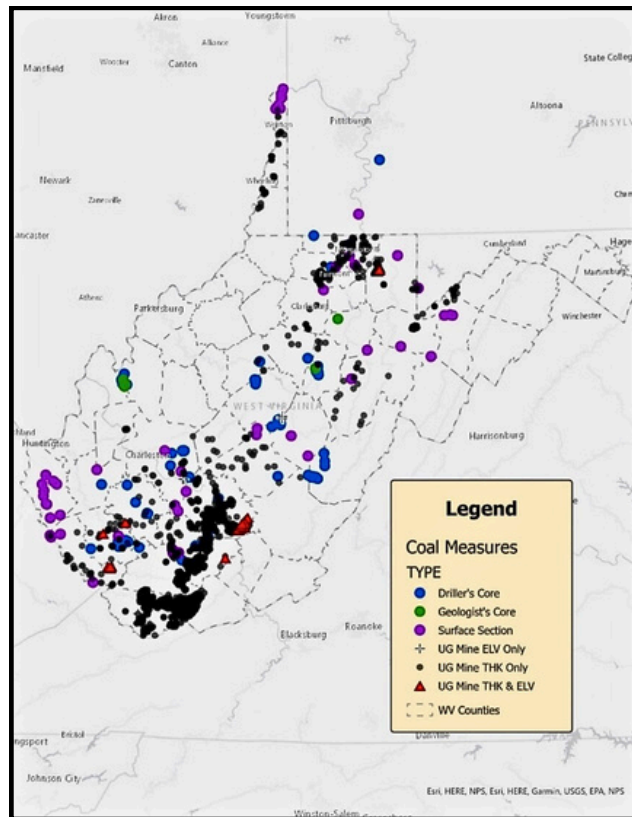


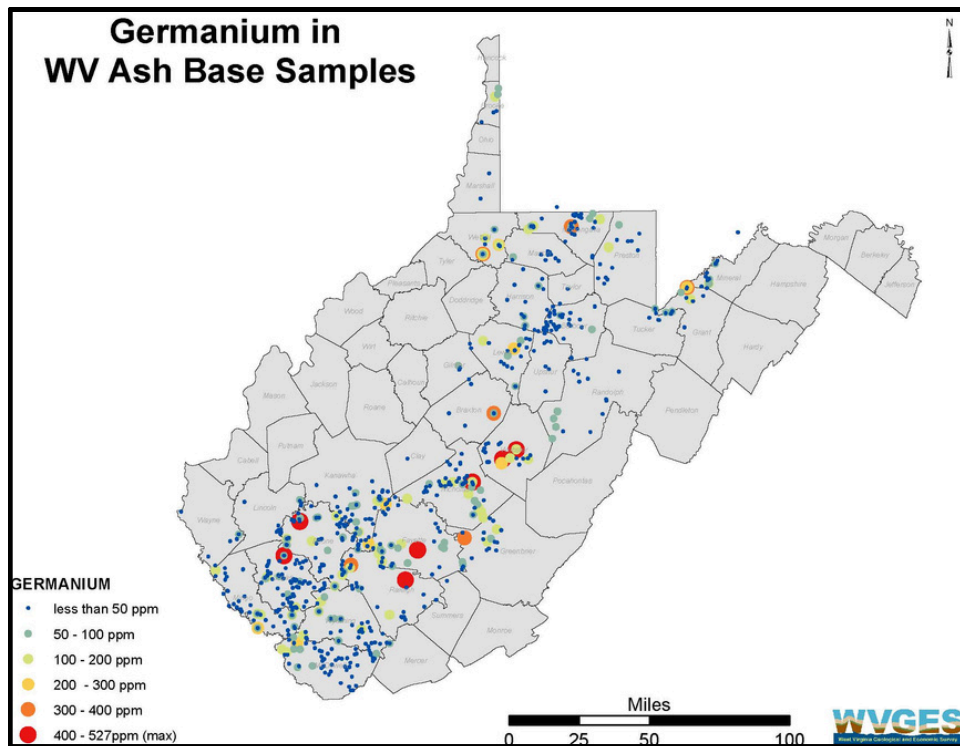
Figure 1. New datapoints added in FY 24 by type of data.

Coal Chemistry Database

The WVGES Coal Chemistry Database contains coal analyses, assays of accessory minerals and critical mineral data, including Rare Earth Elements (REE's), and many other types of information for all mined and unmined coal seams in WV. Included in this data set is a large archive of physical coal samples, many of which have been reanalyzed for recent critical mineral projects.

In FY24, time was spent correcting location errors associated with point IDs for Proximate Analysis data in the Coal Chemistry Database. Several thousand points were identified as problematic and were researched and corrected with accurate modern location information. Forms were created to display and/or enter data, but an outward facing webpage is forthcoming and anticipated to be available in FY 25.

The physical coal sample archives are comprised of over 10,000 physical samples primarily of non-confidential laboratory analyses collected from many decades of field work and industry donations of every mined coal seam in WV and are available to the academia, industry, and the public for further analyses. These samples are currently being rebottled and inventoried as described in the Data Preservation Project section (Page 8).

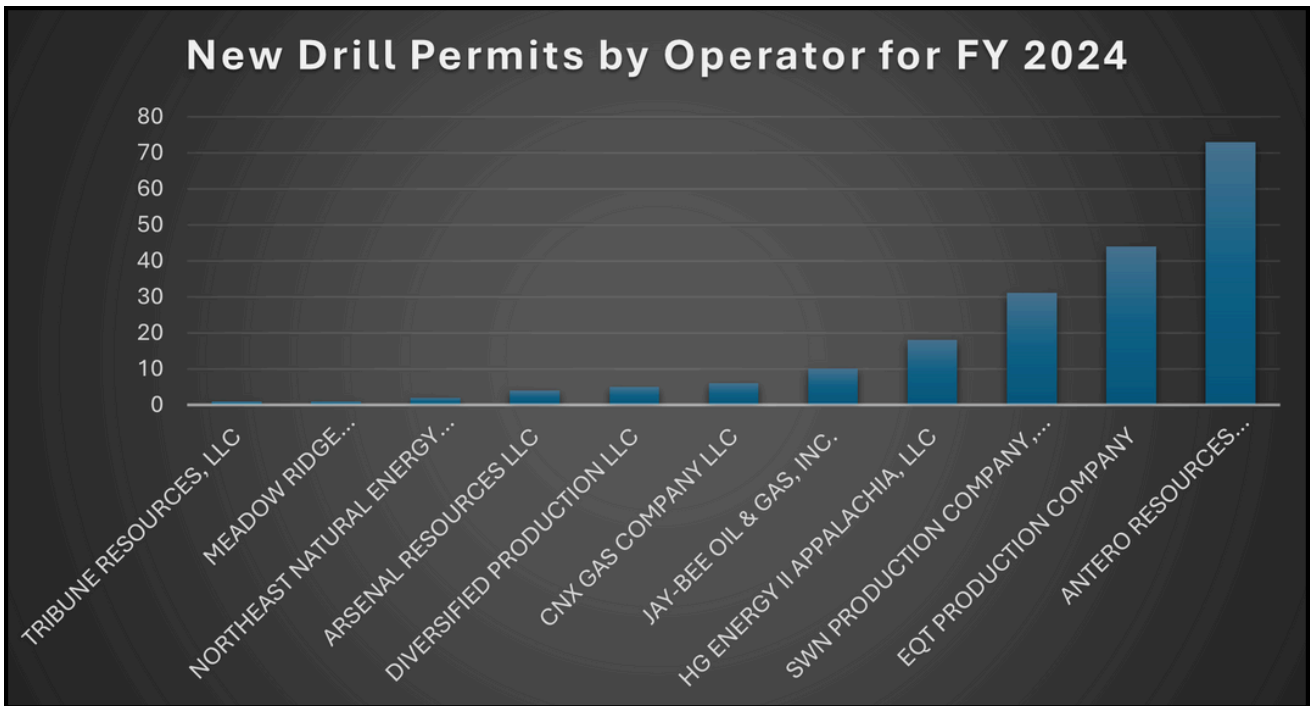


This map was created using critical mineral data that is accessible here: <https://www.wvgs.wvnet.edu/www/datastat/te/index.htm>

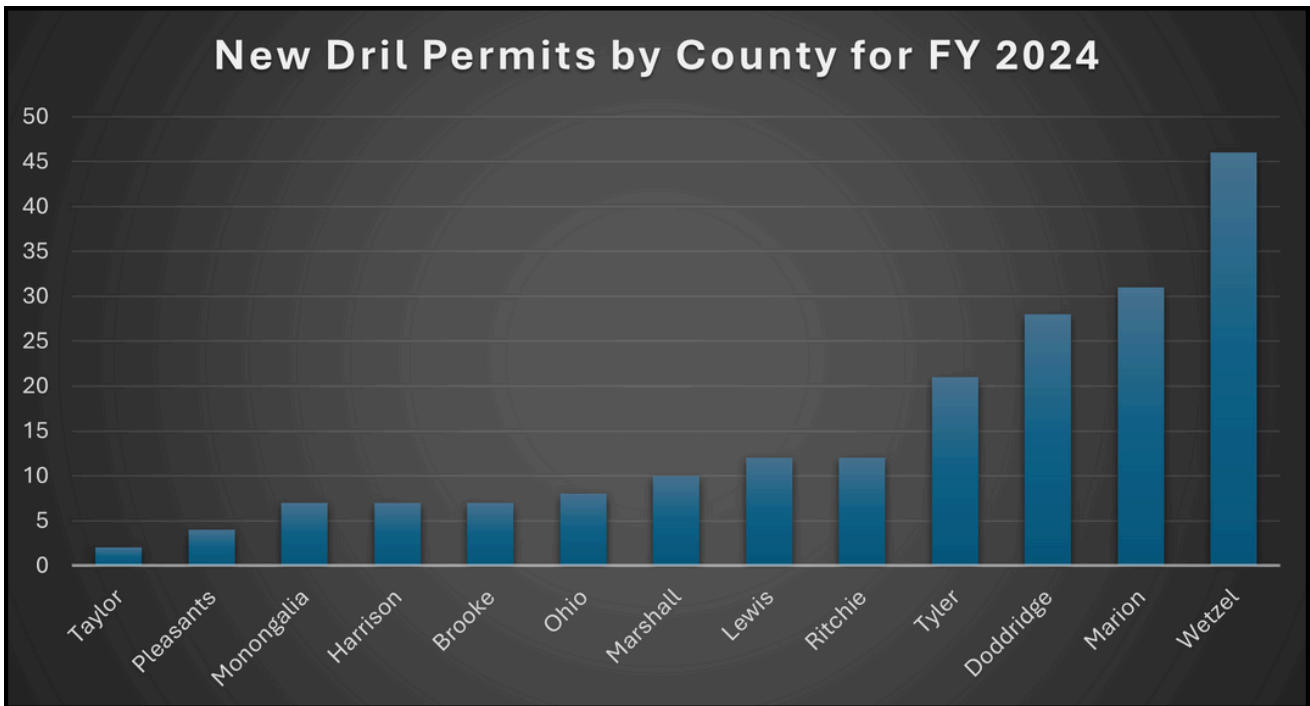
Oil and Gas

Oil and Gas drilling permits decreased by 16% in FY 2024. The number of permitted wells in FY 2023 was 232, but in FY 2024 that number dropped to 195. In 2024, Wetzel County had the most well permits at 46, with Antero leading all operators with 73 permits. The decrease in well permits coincides with a drop in the number of wells drilled in the state, but the average lateral length for Marcellus wells increased to nearly 13,000' last year and has doubled since 2015. There were only two new Utica permits in FY 2024, and the remaining 193 new permits were Marcellus. Only 11 operators had new permits issued in FY 2024, and out of those only five of those operators had more than 10 permits issued. Tug Hill, which was an active operator in the state for many years, was officially acquired by EQT and did not drill or permit any new wells in FY 2024. A total of 201 wells were plugged in WV in FY 2024, while in FY 2023 a total of 225 were plugged.

The OIL & GAS PROGRAM is responsible for research into current oil and gas trends, fields, and the evaluation of specific horizons using data such as well logs, cores, and associated samples. Managing physical samples as well as database curation allows requests from researchers, industry professionals, and governments to be easily accommodated. Historical documents and legacy samples are of new interest as scientific advances are made.



New drilling permits by county for FY 2024. Wetzel had the most with 46 new permits.



New drilling permits by operator for FY 2024. Antero Resources had the most with 73.

Geothermal Test

West Virginia University continues to investigate utilization of deep geothermal resources for the energy demands of its Evansdale Campus. The campus was designed to run on electricity and steam produced from waste coal and generated at the WVU Physical Plant on Beechurst Avenue. The plant, slated to close in 2027, now supplies only steam to both WVU campuses and the university is actively researching ways to offset the energy load of its facilities. Following a feasibility study conducted in 2019 to characterize the geothermal potential of a local low-temperature anomaly, WVU received funding from the U.S. Department of Energy's Geothermal Technologies Office to drill a deep stratigraphic test well to a proposed total depth of 15,000 feet. The well is located at the Morgantown Industrial Park and was drilled by Northeast Natural Energy beginning in May of 2023. In FY 2024, the well continued to be evaluated by the operator. A completion report was filed with the DEP in March of 2024, and the well was reported to have reached a total of 10,535' in the Rose Hill Formation. A temperature log was run after drilling and indicated that the well had a higher-than-normal temperature gradient for the region.

Grant Work

National Geological and Geophysical Data Preservation Program Grant (NGGDPP)

The U.S. Geological Survey NGGDPP program requires and evaluates submitted proposals each year and, if approved, provides funding to rescue and preserve at-risk scientific data while also making those data publicly available in modern formats. WVGES has successfully been awarded funding multiple times. One completed project and two ongoing projects. One project began in May 2023 and will run until May 2025 and another overlapping two-year project that began in May 2024.

The activities undertaken by WVGES within this NGGDPP project will allow for better organization of the collections, improved curation, and provide easier retrieval for current and future study. Increasing access to available samples and data will allow for further research by the following: U.S. Geological Survey (USGS), WVGES, state entities, and surrounding states in need of physical geological samples. This access will allow our partners in both, academia and private industries to better characterize the resources of the country.

Completed Project (ending in April 2024)

WVGES capitalized on changes in the usage of funds permitted in the NGGDPP program announcement in FY22. Support for infrastructure improvements was added and WVGES requested funds to build a storage facility for the state's core, cuttings, and geological samples collection. In addition to the storage facility, funds were requested to curate crushed coal samples that were in deteriorating conditions. Finally, a proposal to continue photographing cores through the coal measures that have been utilized for critical minerals research. The WVGES's proposal was funded in full, and work began in May 2022.

Storage space for physical material at both the WVGES headquarters and existing offsite locations was inadequate. The amount of core material donated or requested has continued to increase. As oil, gas, and coal companies downsize their operations in Appalachia, elimination of sample storage space is often one of the first cost-saving measures adopted. Many of these companies have longstanding relationships with the state geological surveys in the Appalachian basin and frequently offer to donate sample material rather than see it disposed of and/or destroyed. Acquisition of high-quality core material via either mechanism is extremely advantageous for the WVGES. However, identification and maintenance of storage space is untenable.

A new 30' x 40' building was constructed on deeded parcel space at the WVGES office in Morgantown. The building, cement slab, and site preparation were completed in the period of performance and the Survey has been consistently moving material into the building after construction was completed. One challenge of this project was the change in construction costs from when quotes were solicited to when the project was awarded, and construction completed. Overall, WVGES incurred costs well above the quoted materials and activity. While all goals of the project were achieved the increased costs required the Survey to increase its contribution significantly.

With the completion of the building the WVGES has significantly expanded the amount of available space for physical samples. Material that includes both oil and gas cores as well as coal exploration cores, these cores have been transferred to the new facility. However, much work on the new building remains. The building currently lacks electricity and shelving to fully utilize the space. The Survey is currently using pallets to store core and cuttings. Ideally the facility will be fully equipped, and the space maximized.

WVGES has a decades-long history of curating samples collected from coal mining operations and the Survey's coal sample repository holds over 10,500 samples. Additionally, as coal mines close, the subsurface locations where the samples were collected are inaccessible; mines are either flooded post-closure, abandoned and permanently sealed, or are designed to collapse as the longwall mining proceeds through the seam. Therefore, these materials form a representative sample set that cannot be replicated. The Survey began the process of preserving these samples in plastic containers that will securely store the geological samples and provide a more easily accessible collection. In this period of performance, a workflow and workstations were set up and the first 750 samples were transferred to permanent containers and storage. Additionally, two more cores were photographed which extended through the coal

measures and have been used in critical minerals research.

Ongoing Data Preservation Projects

Project 1 (May 2023-May 2025)

WVGES began a two-year project in May 2023 that addresses several needs to preserve and make accessible geological data. Overall, six total subprojects will be undertaken by Survey personnel. Two of these (critical mineral sample preservation and core photography) are continuations to the ongoing projects described above. These continuations will allow for a larger percentage of holdings to be preserved and accessible.

In addition to the continuing projects, work has commenced on multiple fronts to transfer data from legacy formats to modern formats as well as acquire new data from legacy geological samples. There is an existing “Mine Information Database System” (MIDS) maintained by the WVGES that contains information about specific mines in WV. This system contains information such as location, company name, mine name, permit number, and targeted coal bed. Additionally, many entries in this system have mine map images with associated coal thickness, elevation data and other important geologic notes. Details on many of these images are illegible because they were originally scanned at low resolution from microfilm. Funds have been requested by the WVGES to purchase an aperture card/microfilm scanner to produce high resolution images of these aperture cards. There are over 40,000 aperture cards in the Survey’s collection. WVGES proposes to scan selected images and record the data from select aperture cards.

The WVGES curates both physical samples and digital data associated with those samples. To make the collections of both more publicly accessible, a database of available samples and data will be constructed along with an interactive online map service for users to access inventory and data. Data is publicly available and comes from a wide variety of sources including expensive sample analysis conducted by industry partners.

A digital framework of a comprehensive inventory and modern database of legacy coal samples and chemistry data was previously established by the Survey. This effort modernized a portion of a substantial coal chemistry database containing greater than 40,000 analyses and over 10,000 physical samples. The majority of which were collected from exploratory drilling, active underground mining operations, or other field work. In this portion, the WVGES focused on major and trace element geochemical data. This database was previously compiled in numerous tabular and document files, in unsupported formats, and was not linked to information on sample availability. A comprehensive modernization of this data was conducted using an Oracle cross-linked table-based interface focusing on major and trace element geochemistry. This current project will continue to modernize the database including additional data and analyses not previously included (proximate and ultimate analysis). WVGES will also create a web-based interface where this data can be searched by different variables. Completion of this work would mark the first time much of this data and associated files would be available to the public via the WVGES website.

Two hundred distinct samples will be sent to the USGS Geochemical Laboratory for new analyses to further understanding of critical mineral resources in the rocks of WV. These sample results will be completely new analyses that will add to a growing dataset of critical mineral potential in the state. These analyses will be publicly available and added to the national critical mineral datasets.

Project 2 (May 2024-May 2026)

Building upon Project 1, WVGES began a two-year project in May 2024 that will continue several activities described above. In addition to this, work began on another project to return the ability to acquire analytical data with new scientific equipment. Overall, five total subprojects will be undertaken by WVGES personnel. Three of these (critical mineral sample preservation, core photography, critical mineral geochemical analysis) are continuations to the ongoing projects described above. These ongoing and new projects will allow for a larger percentage of holdings to be preserved and more accessibility as well as increase data available for geoscience research.

The process of transferring crushed rock samples to more permanent containers and storage will be continued. At the conclusion of this project, WVGES will have 30% of the collection catalogued. Also, core photography of six more cores will be undertaken. These include cores through the Marcellus and Utica intervals, which are the two current major gas and NGL producing targets in the state. Two other cores are being examined for possible carbon sequestration and/or underground storage.

The major task in this project is to acquire a new portable x-ray fluorescence (pXRF) machine. WVGES previously had a device, but it became inoperable and too expensive to service. Scientific equipment of this type is very expensive. In this project, a new pXRF machine will be acquired to analyze samples for critical minerals analysis.

Another 200 distinct samples will be sent to the USGS Geochemical Laboratory for new comprehensive analyses of critical mineral resources in WV rocks. Samples used in this project will be taken from samples acquired during geologic mapping, oil and gas exploration, and other activities. Cores and well cuttings will be utilized for this research. These sample results will be completely new analyses that will add to a growing dataset of critical mineral potential in the state.

Critical Minerals, as defined by Federal Executive Order 13817, include 31 elements, oxides or mineral compounds used in modern technological applications including renewable energy sources, communications devices, household products, and defense tools. A majority of the critical minerals come from non-domestic sources, which has significant economic and security implications for the country.

Carbon Capture Utilization Storage (CCUS)

Current Projects Funded by U.S. Department of Energy

Midwest Regional Carbon Initiative (MRCI)

- Collaborative effort between Battelle Memorial Institute and multiple states to identify CCUS reservoirs for carbon storage and CO2 flooding.
- Project ends at the end of FY 2024

21st Century Power Plant (21 CCP)

- 21st Century Power Plant that would incorporate carbon capture and storage to cut/eliminate CO2 emissions.
- Working with the Battelle Memorial Institute, PA Geological Survey, and private companies to identify potential CO2 sequestration targets in WV and PA
- Project will finish in FY 2025

Central Appalachian Partnership (CAP)

- Regional mapping across WV and PA for CCUS potential
- Project in cooperation with the Pennsylvania Geological Survey
- Mapping will include potential reservoirs and confining layers
- Began in January 2024

Pending Projects

CarbonSAFE-Tri-State Carbon Capture and Storage Hub

- Mapping in northern WV for CCUS potential
- Project in cooperation with Southern States Energy Board, Tenaska, Projeo, West Virginia University, and Ohio State University
- WVGES focus on community outreach

Regional Initiative for Technical Assistance Partnerships (RITAP)

- Detailed mapping of CCUS opportunities on state-owned properties
- Project in cooperation with Battelle Memorial Institute and state geological surveys
- Will be performed in coordination with the WV Department of Natural Resources (DNR)

Geoscience and Mapping Program

WVGES continues the task of new geologic mapping in West Virginia annually. The resulting maps and associated data serve as products to understand the geology of the state more fully at the surface and in more detail than in the past. The Survey has been producing geologic maps since the Survey was created. Currently maps are produced at 1:24,000 scale in conjunction with the U.S. Geological Survey's (USGS) STATEMAP Program. This program is a part of the National Cooperative Geologic Mapping Program and partial funding is secured through the National Geologic Mapping Act. The program is a partnership between the USGS, the Association of State Geologists, and State Geological Surveys. Funding is a 1:1 match between WVGES and the USGS. Expansion of the program is continued by the WVGES in West Virginia to generate coverage of more areas within the state. The Survey has two ongoing active mapping grants with mapping being conducted in multiple areas in the state.



TOP LEFT: WVGES geologist examining a Devonian aged rock outcrop during field work on the Cresaptown quadrangle.

TOP RIGHT: WVGES geologists on a field trip led by the Germany Valley Karst Society.

BOTTOM LEFT: WVGES geologist taking bedding plane measurements during field work on the Onego quadrangle.

BOTTOM RIGHT: WVGES geologist examining an Avis Limestone outcrop during field work on the Rupert quadrangle.

STATEMAP

Active Projects

Grant 1

WVGES utilized a change to the STATEMAP program announcement allowing for proposed projects over a two-year timeframe rather than the previous one-year period of performance. Notification of partial funding was received in April 2022 to proceed with mapping in three different areas of the state with a two-year project beginning September 2022 that will run through September 2024. Work began on five full and seven partial 1:24,000 quadrangles (Figure 2) in Greenbrier, Marshall, Mercer, Preston, and Summers counties. Full quadrangles included in this series are Brandonville, Bruceton Mills, Dawson, Majorsville, and Moundsville. Portions of the Alderson, Forest Hill, Fort Spring, Greenville, Peterstown, and Narrows quadrangles in Greenbrier, Mercer, and Summers counties are also included. Maps will be completed and delivered in FY25. Additional funding was requested to improve previously published geologic maps by edge-matching, digital database updates, addressing geologically difficult problem areas via focused field work, and using newly available LiDAR imagery. Under the U.S. Geoframework Initiative, the Survey is working to build seamless, edge-matched 1:24,000 geology organized by 1:100,000 sheets. This includes the WV portion of the Cumberland and Front Royal 100k map areas. WVGES is working to convert geologic map databases to the newly required U.S. Geological Survey's Geologic Map Schema (GeMS) digital map database format. This database format has many complexities and will be mandatory for all future map submissions to the U.S. Geological Survey. Furthermore, the WVGES is working with surrounding states to develop a draft cooperative interstate surficial mapping framework for creating seamless Appalachian surficial geology map databases across state lines. A draft cooperative report of best practices for Appalachian surficial mapping is included in this project.

Grant 2

A notification of partial funding was received in April 2023 to proceed with mapping in three different areas of the state with a two-year project beginning September 2023 that will run through September 2025. WVGES will be mapping Mineral, Pendleton, Greenbrier, and Fayette counties. This includes three full quadrangles (Onego, Rainelle, and Rupert) and two partial quadrangles (Cresaptown and Cumberland). In addition to the new mapping compilations of the Frederick and Morgantown 100k map areas, a compilation of six quadrangles in Mercer County will be completed. These compilations, along with those described above, will increase the area where seamless 1:24,000 scale geology is available to users. An inventory of 2D and 3D GIS formatted mapping available in WV will be started.

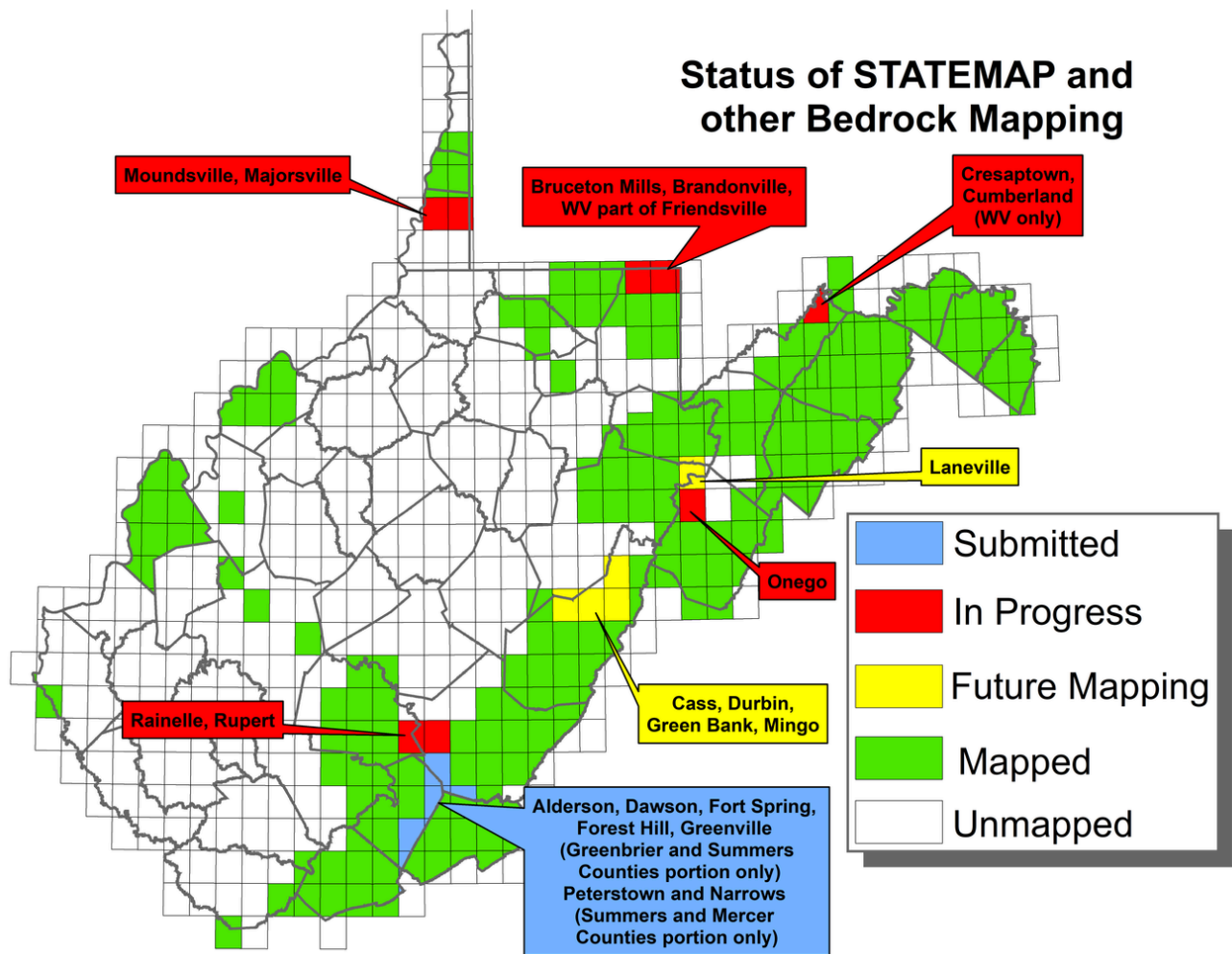


Figure 2

Proposed Projects

The program announcement from the STATEMAP program was released in September 2023 and the annual meeting of the STATEMAP Advisory Committee, a group of industry, academia, and government professionals, was held both in-person and virtually in December 2023. WVGES personnel presented proposed mapping areas in WV. A two-year project was submitted with a notice of funding received to complete 1:24,000 mapping of five full quadrangles (Mingo, Cass, Green Bank, Durbin, and Laneville) in Pocahontas, Randolph, and Pendleton counties. This work will begin in September 2024. In addition to the new mapping, WVGES will continue modernizing existing mapping GIS and databases.

Outreach and Geoscience Education

Museum

In December 2023, the museum received the skull of a giant ground sloth (*Megalonyx* sp.) on loan until December 2024, with the possibility of a loan renewal. The skull was found in Putnam County, West Virginia and is fondly referred to as “Skully.” Skully has brought many visitors and has been an asset for geoscience education concerning the geology of WV and fossils that can be found in the state. Additionally, a large collection of fossils and minerals were donated to us by the family of the late Robert Peck. The donation is of a significant size that will require some time to process. The museum loaned a few specimens to the Morgantown History Museum.

Groups continue to visit the museum, including school groups, scouts, and Master Naturalists, as well as the occasional tourist or local who stops in to visit the survey’s facilities. The Draw Jeff Contest (a *Megalonyx jeffersonii*, WV’s state fossil) was held for a second year for K-12 students across the state. The entries were divided into elementary, middle, and high school age groups with one winner from each. The winners received a gift certificate to the museum’s store and a personalized tour of the museum. In addition to this we hosted groups from WV Department of Natural Resources (WVDNR), Rock Cave Elementary School, Glenville State University School of Surveyors, Living Oaks Academy, Mont Chateau Estates, West Virginia Academy, and North Elementary School this past year.



LEFT: WVGES geologist showing off the *Megalonyx jeffersonii* exhibit during a student museum tour.
RIGHT: WVGES geologist, Beth Rhenberg, with Draw Jeff contest winner, Reagan Wease, of Chesapeake Elementary School.

State Park Visiting Geologist Program

This program is hosted by each state park in conjunction with several WVGES geologists who enjoy assisting in public education and spending time in nature. For each visit scheduled there is a presentation as well as an accompanying nature walk led by the visiting geologist. These programs sometimes take place in one day or are spread out over a two-day period.

A total of six programs were held at the following state parks: Cacapon Resort State Park, Canaan Valley State Park, Tygart Lake State Park, Kanawha State Forest, Blackwater Falls State Park, and Watoga State Park.

Outreach

Survey staff ran the Dr. Bob Behling Memorial Geology Field Trip for the West Virginia Science Teachers Association's annual conference in October 2023. Survey staff also attended the West Virginia Science and Engineering Fair in March of 2024 to help promote geoscience education as well as showcase future potential career opportunities. Students of all ages were able to learn about what the WVGES has to offer.

Pete Sullivan from the Appalachian Geological Society contacted the survey to assist with the creation and implementation of kiosks along Corridor H at a truck stop near Moorefield, WV, for Lost River State Park, and around the grounds of Mont Chateau. The kiosks along Corridor H have been completed and installed.



WVGES geologists with the new interpretive geologic kiosk at a roadcut on Corridor H near Moorefield

Museum Visitor Statistics

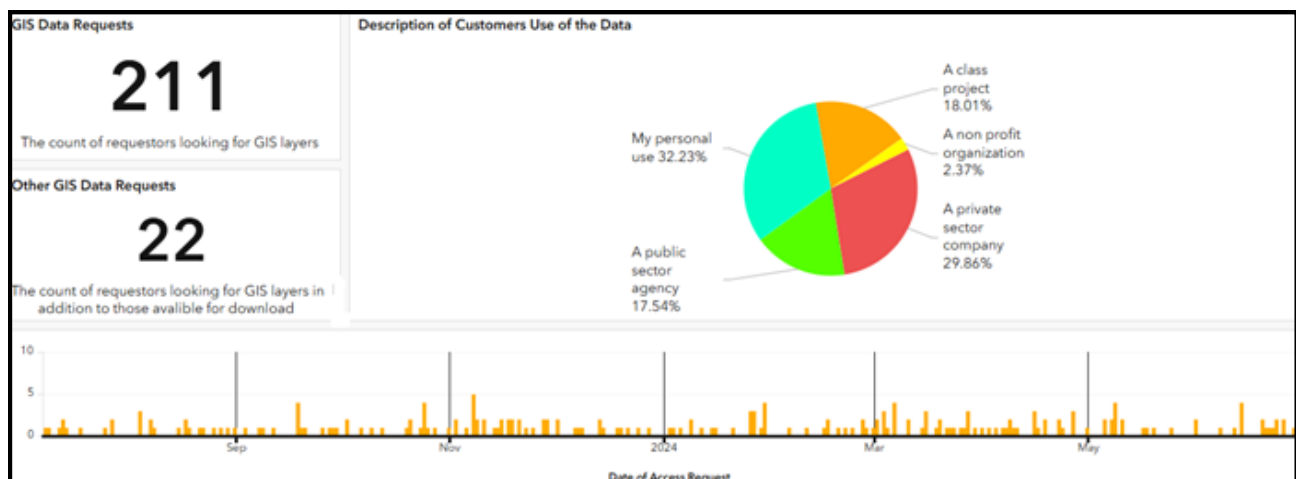
- 426 visitors
- 77% in-state visitors
- 23% out-of-state visitors

Information Services

Applications

The interactive Geologic Map of West Virginia was updated and is currently available and can be accessed on our website. Based on the 1:250,000 scale State Geologic Map-1, originally published in 1968, this updated spatial database (modeled in the USGS-Geologic Map Schema (GEMS)) correctly represents the original paper map. For the first time, users can explore and download spatial files featuring: Rock Units in Geologic Ages, Igneous Intrusions, Faults, Anticlines and Synclines, and Contact and Boundary Lines.

The online self-service WV Geologic Data Explorer and Download Access Request Form streamlines customers' ability to research and obtain spatial data available for the various and numerous geologic publications provided by the WVGES. For this reporting period the cloud-based data repository and application has automatically serviced 211+ data access requests while simultaneously logging customer information and usage descriptions of the data.



The automated coal seam and coal mining spatial data request form and cloud-based data delivery access was expanded. For the current reporting period 167 service requests were processed.



Updates

- All oil & gas wells in West Virginia, including Marcellus Formation and Utica Shale Plays data updated
- West Virginia Underground and Surface Mining interactive mapping layers updated
- Expansion of the Coal Bed Mapping Project data holdings incorporated
- Recently published geologic mapping projects were integrated into the data explorer application
- And others, see <http://ims.wvgs.wvnet.edu>

Hardware and Software Support for Office and Field Activities

- Installation of a Dell PowerEdge R6515 Server, upgrade of enterprise database applications, and migration of data which will facilitate the digital storage of, and public access to, records processed through various data preservation projects performed with the USGS.
- Expanded the enterprise level geologic database based on the national USGS GeMS data model providing a comprehensive dataset of all previous geologic mapping projects in one location.
- Organized the latest release of state-wide 1-meter high-resolution LiDAR imagery for use on desktop workstations and mobile mapping devices to allow direct observation to identify previously hidden landforms.
- Continued to advance processing capabilities for extremely large, high-resolution imagery (LiDAR) datasets.
- Enhanced equipment to support staff who are virtually attending meetings, workshops, and conferences, including the Geologic Mapping Forum, Digital Mapping Techniques, and corresponding workshops with other state and federal geologic mappers and GIS professionals.
- Assisted mappers to apply new techniques, hardware, and methods to collect and utilize digital data in the field.



LEFT: Calymene trilobite found in the Dolly Ridge Formation during field work off of Route 33

RIGHT: Tabulate coral fossils from the Devonian Mahatango Formation discovered near the Patterson's Creek exit on Corridor H



The West Virginia GIS Office of GIS Coordination, is located at the West Virginia Geological & Economic Survey. The mission of the WV Office of GIS Coordination is to serve the public good by working with state agencies, West Virginia's GIS community, and regional and federal partners to provide and promote cooperative leadership, support, and innovative solutions using geospatial technology. The Office was established by Executive Order 4-93 to provide coordination and technical support in the development and operation of geographic information systems (GIS) for the state's spatial data infrastructure. The WV GIS Tech Center supports key statewide GIS services for the state. This is coordinated through the WV GIS Tech Center, WV Geological and Economic Survey and all other State Agencies.



ABOVE: Taryn Moser, WV State GIS Coordinator

It's been a busy first year for the GIS Coordinator, along with interacting with many West Virginians across the state, time was spent listening and learning what the GIS community needs on all levels, from local government to legislation. The WV GIS Coordinator, Taryn Moser, has been working with GIS in the Mountain State for over 20 years and utilizes her professional experiences to enhance and advocate for this program. Collaboration is needed for all geospatial data and technologies to work efficiently on state-wide programs such as Imagery & Lidar. These are two large projects that can be accomplished with the collaboration of state agencies, the state itself, and local governments. These programs are utilized daily by many people and organizations throughout the state. The Parcel Viewer (<https://www.mapwv.gov/parcel/>) is used every day by citizens and decision makers for WV.

The Steering Committee has been reestablished as part of [Executive Order 4-93](#), and was re-activated by the GIS Policy Council in 2008 with a newly formalized membership of GIS representatives from WV state agencies, local government, academia, federal and private sectors, and a representative from the WV Association of Geospatial Professionals. The State GIS Steering Committee, chaired by the WV GIS Coordinator, works in collaboration with the GIS Policy Council and WV's GIS user community to provide active leadership in enhancing the state's use of geospatial technology.

Upcoming Projects

- Planning Funding from State Agencies for Imagery & Lidar Programs Statewide
- Modernizing WV-Code 7-2-6
- Reinstating GIS Policy Board
- Work with ESRI & Procurement for a State Master Agreement for Licensing, Trainings

WV GIS Technical Center



The West Virginia GIS Technical Center, located in the Department of Geology and Geography, West Virginia University, provides focus, direction, statewide coordination, and leadership to users of geographic information systems (GIS), digital mapping and remote sensing within the state of West Virginia. The Center was established by Executive Order 4-93 to provide coordination and technical support in the development and operation of geographic information systems (GIS) for the state's spatial data infrastructure. Listed below are key statewide GIS services the Center provides for West Virginia, coordinated through the WV Office of GIS Coordination, WV Geological and Economic Survey.

- **State GIS Clearinghouse:** Serves critical spatial data to state users via the State GIS Clearinghouse. The Center currently provides nearly 200 TB of storage space in a virtualized environment configured to maximize availability and access. The system must have a large capacity to allow for downloading large datasets, such as such as LiDAR-derived digital elevation data, high spatial resolution aerial imagery, and base maps.
- **GIS Data Development:** Plays a crucial role in not only serving critical spatial data to state users but in updating and integrating local geospatial data within state and national geospatial databases. These data layers are utilized by state agencies, communities, and the public for applications that include emergency response, risk assessments, economic development, energy resource exploitation and management, transportation, natural resources, community planning, tax assessments, real estate appraisals, health studies, and election management. For example, the Center updates statewide mapping data layers (tax parcels, E-911 addresses, political and public boundaries, aerial imagery, elevation data, etc.) that support the various critical infrastructure sectors like broadband, water, sewer, transportation, and flood mitigation.
- **State GIS Services Support:** Provides hosting and e-government services that support operational map layers for 13 state agencies that include mineral parcel, hazard, historical, transportation, and voting geospatial data needed by state users. In addition, key GIS support and hosting services are provided for local governmental offices that include E-911 (addresses), county assessor (tax parcel), and county clerk (elections and boundaries). The most popular web map services supporting the state's geospatial data infrastructure are tax parcels, E-911 addresses, leaf-off imagery, and boundaries. This past year statewide web map services via www.mapwv.gov increased by 10% to 3.3 million visits.
- **State Base Layer Map Services:** Provides a publicly accessible gateway to essential base map layers and geoprocessing services (e.g., aerial imagery, elevation, address geocoding) utilized by many organizations in the state for their mapping activities. This includes redacting privacy information from select mapping files for state residents in accordance with Daniel's Law privacy requests.

WV GIS Technical Center



- **State Outreach Support:** Provides the West Virginia Geospatial Community with advisory, training, and outreach services that advance the state’s spatial data infrastructure. The Technical Center responds to an estimated 12 calls per week from the public and clients regarding GIS data and applications.

STATEWIDE GIS SERVICES	BASE MAP LAYERS	AGENCY MAP LAYERS
<ul style="list-style-type: none"> • State GIS Data Clearinghouse • State GIS Data Development • State GIS Services Support • State Base Map Services • State Data Privacy Requests • State Outreach Support 	<ul style="list-style-type: none"> • Addresses & Locator services • Aerial Imagery • Boundaries – Election, Legal, Public Lands, Tax District • Building Footprints • Elevation • Tax Parcels (Surface) 	<ul style="list-style-type: none"> • Archaeological & Historical • Delinquent Properties • Hazards Flood & Landslides • Highway Plans Archival • Hunting & Fishing • Mineral parcels • Trails • Voter Points & Polling Sites

Past and Future Accomplishments: During this reporting cycle, the Center partnered with other stakeholders in developing the WV Flood Resiliency Framework (www.WVFRF.org), a virtual hub of risk assessment, visualization, planning, and training resources for building community flood resiliency in West Virginia. In the future, the Center plans on modernizing the State GIS Clearinghouse.

Funding: Financial support is primarily from the Mineral Lands Mapping Program, funded by the state legislature starting in 1996, to provide critical spatial data to the state. The Center does not receive any funding support from West Virginia University.

Property Tax Division

The State Tax Department is implementing an electronic data submission process for mined coal as part of a comprehensive e-filing process in the Property Tax Division. The new system includes electronic documents, maps, and plats of coal properties and interests as part of the submission. This system is designed to streamline our operations and enhance efficiency. The conversion is not simply about processing electric submittals and validating locations, it's about renovating our coal filing system. Instead of the current scanning and georeferencing of surface and underground mine maps and maps for quarries and reserve coal locations the new system is intended to expedite the intake of electric submittals and validate geospatial data.

Implementing commonly used secure documents such as Geo PDF (ESRI-based files) and GeoTIFF (Computer Aided Design) as a standard for incoming map-related documents as part of the tax submittals will enhance the workflow of the Reserve Coal Valuation Model and the Coal Mapping Program, making our operations better structured and more reliable. The systems will facilitate the processing and preservation of location-based coal maps to identify and locate unmapped coal ownership properties using this dataset while enhancing our data accuracy. The new system simplifies the storage and georeferencing process needed to obtain better quality from paper map submittals, reducing the risk of data loss or distortion. The creation of coal thickness contours and quality contours will provide a more detailed and accurate picture of the coal reserves, amplifying the value of our data. The GIS Section implemented the system to support internal GIS applications to facilitate and ensure data quality across the coal assessment process.

Geospatial data submittals, like all digital information, face preservation challenges. It's crucial that we maintain strict standards and procedures to ensure the quality and integrity of this data, including coordination of reference systems and cartographic representation standards according to the WV State Code, topology, and commercial vector data formats.

The West Virginia Property Tax Division curates and maintains several layers of data , including the Cadastral layer, which encompasses the WV statewide surface, statewide mineral, and oil and gas well locations. From this comprehensive dataset remaining coal reserves, market interest, and natural resource production can be estimated. To promote state-wide collaboration this valuable information is shared with other state agencies, including but not limited to West Virginia GES, WV GIS Technical Center, West Virginia Department of Environmental Protection, and the West Virginia Division of Forestry.

Facility Maintenance

- Updates and installation of two large-scale exhibits for Natural History Museum
- Updates to building entrances and exits; door, lighting, and emergency fixture repairs.
- Installation of electrical in newly constructed Core Storage building.
- Updates and repairs to the public restrooms in both main buildings.
- Updates to building entrance and landscaping
- Upgrades and repairs to ceiling light fixtures.

Presentations and Publications

Presentations

State Geologist, Jessica Moore FY 2024 Presentations

Midwest Regional Carbon Initiative Partners Meeting, Morgantown, WV. October 2023. WV CCS Policy Updates: [Presentations from the 2023 Partners and Stakeholders Meeting | Midwest Regional Carbon Initiative](#)

Geological Society of America (GSA) Connects, Pittsburgh PA, October 2023: *Honoring the Life and Work of Dr. Israel Charles White: Founding Father of Appalachian Basin Geology and the Geological Society of America*

WV Public Energy Authority, Charleston, WV. January 2024. *Earth Materials for Advanced Energy Systems in West Virginia*. Livestream link: [West Virginia Public Energy Authority - West Virginia Department of Commerce : West Virginia Department of Commerce](#)

U.S. Departments of Energy and Interior, invited workshop to discuss the CarbonBASE initiative, Reston, VA, February 2024: *Characterization of Conventional and Unconventional Resources: Reducing Data Scarcity and Uncertainty*

U.S. Energy Information Administration (virtual), May 2024: *Advanced Energy Systems in Appalachia*

Global CCS Institute D.C. Forum, May 2024, Washington, D.C. Panelist, *State Regulatory Update*



LEFT: Jessica Moore, WVGES Director and State Geologist (right), at the Global CCS Institute D.C. Forum
 RIGHT: WVGES staff geologists attend the Geological Society of America (GSA) annual meeting in Pittsburgh

WVGES Staff FY 2024 Presentations

Poster Presentation at the Geological Society of America (GSA) Connects 2023 Meeting in Pittsburgh, Pennsylvania in October 2023: *A Study Exploring the Mine Pool Pumped Storage Potential of West Virginia Coal Mines*

The Geological Society of America's (GSA) Annual Meeting in Pittsburgh, October 2023: *The Stony Gap Existential Crisis: Problems with Using Channel Sandstones to Define Formation Contacts.* T107. *Appalachian Paleozoic Stratigraphy and Tectonics: A Special Session to Honor the Career of Richard (Rick) Diecchio*

Abstract link: <https://gsa.confex.com/gsa/2023AM/webprogram/Paper390162.html>

Midwest Regional Carbon Initiative (MRCI) Annual Meeting
 October 2023: *Interactive ArcGIS Tool, Metadata and Inventory*

Geological Society of America (GSA) Annual Meeting
 October 2023
Evolution of Upper Devonian Marginal Marine Sandstone Lithofacies in the Appalachian Basin: Implications for Basin Evolution, Lithostratigraphy and Carbon Storage Potential

American Association of Petroleum Geologists (AAPG) Carbon Capture, Utilization, and Storage (CCUS) Conference
 March 2024
 Poster Title: *Generating a Regional Data Inventory to Accelerate CCUS Deployment in the Midwestern and Eastern United States*

Geological Society of America (GSA) Connects 2023 Meeting. October 2023: *The Development of a Statewide Coal Mapping Database for West Virginia: Lessons and Triumphs.*

Governors Energy Summit. October 2023

Publications

OF2201 Bedrock Geologic Map of the Greenbrier and Summers County Areas of the Alderson and Fort Spring 7.5' Quadrangles, West Virginia: D.L. Spurgeon, J.W. Perkins, S.E. El-Ashkar; Digital Cartography by S.E. Gooding, 2023, 1:24,000 scale, 10 p, 42" x 60", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

OF2202 Bedrock Geologic Map of the Dawson 7.5' Quadrangle, Greenbrier and Summers Counties, West Virginia: S.E. El-Ashkar, D.L. Spurgeon, J.W. Perkins, P.J. Hunt, H.E. Sphar, C. Davidson, J.K. Tudek, P.A. Dinterman; Digital Cartography by S.E. Gooding, 2023, 1:24,000 scale, 16 p, 42" x 42", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

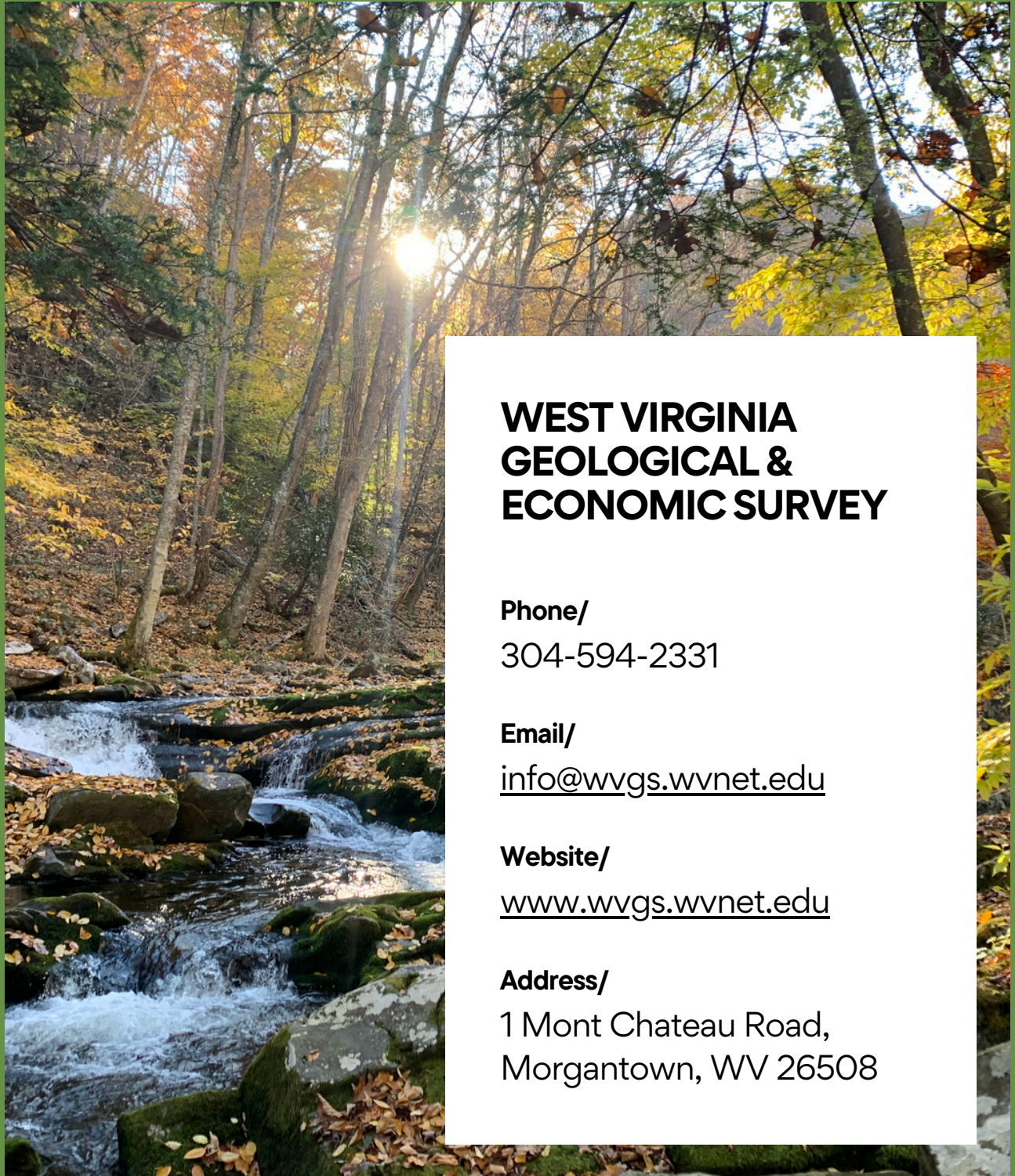
OF2203 Bedrock Geologic Map of the Summers and Mercer County Areas of the Forest Hill, Greenville, Peterstown, and Narrows 7.5' Quadrangles, West Virginia: J.W. Perkins, S.E. El-Ashkar, D.L. Spurgeon, P.A. Dinterman, H.E. Sphar, R.E. Carte, Jr.; Digital Cartography by S.E. Gooding, 2023, 1:24,000 scale, 12 p, 50" x 42", full color map shows geology and structure, strike/dip. Map layout includes legend, cross sections and stratigraphic column. Text in booklet. Files for GIS available.

RI-37 Regional Investigation of Rare Earth Element-Enriched Underclay Deposits in the Central and Eastern United States: an Earth Mapping Resources Initiative (Earth MRI) Geochemical Reconnaissance Study: J. Moore, H. Hanna, B. Royce, G. Daft, Jr., W. Andrews, C. Eble, S. Brown, 2024, 31 p, 15 f, 1 table, 964 p Appendix. The U.S. Geological Survey's (USGS) Earth Mapping Resources Initiative (Earth MRI) works to identify mineralized areas or deposits across the United States that may host critical minerals to be utilized as a domestic resource. Aluminum-rich clays associated with coal horizons in Pennsylvanian-age strata occur throughout the Appalachian Plateau Province, the Central Appalachian Basin, and the Illinois Basin and have the potential to be low-grade, large-volume, critical mineral feedstocks. Understanding of the distribution of metals in varying lithologies and stratigraphic positions is limited by data density and a lack of modern geochemical data. Led by the West Virginia Geological and Economic Survey and including the participation of eight state geological surveys, a multi-year, regional reconnaissance study collected over one thousand stratigraphic and spatially representative underclay samples in the Appalachian and Illinois Basins. The samples were collected from both core and outcrops and were analyzed by the USGS and are presented in this peer-reviewed report. The full publication is being freely distributed on the WVGES web site:

https://www.wvgs.wvnet.edu/wvges2/publications/PubCat_FreeDownloadablePublications.aspx

Equal Employment Opportunity

The agency has undertaken major initiatives to achieve pay equity among similarly classified and experienced professionals regardless of race, religion, gender, sexual orientation, national origin, age, or disability. WVGES will continue to devote a serious and sustained effort to educate the community through outreach programs. By increasing knowledge and awareness of the Geosciences through the agency's presence within these programs, the goal is to reach a greater diversity of people, thereby creating a greater diversity in the candidates who wish to fill vacant positions. As a state agency internally and externally, disseminating the affirmative action policy and plan is important for the success of the Survey.



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