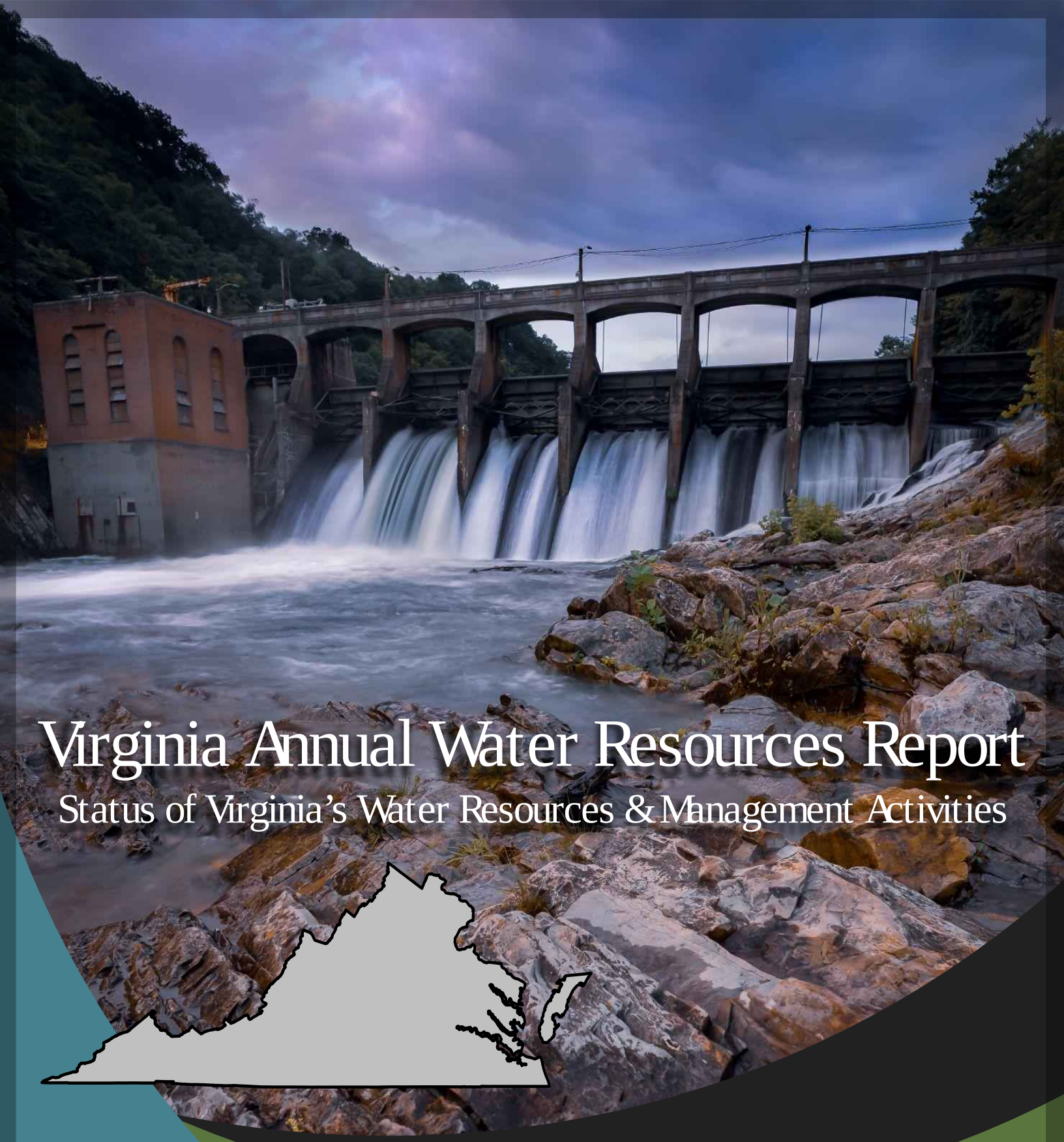

# Virginia Annual Water Resources Report

## Status of Virginia's Water Resources & Management Activities



Virginia Department of Environmental Quality

Commonwealth of Virginia

October 2024

DEQ
Virginia Department of Environmental Quality

Annual Water Resources Report cover photo by Trevor Lawson, 2021.

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## Acronyms

BGD: Billion Gallons per Day
BGY: Billion Gallons per Year
BSE: Virginia Tech Biological Systems Engineering
CIA: Cumulative Impact Analysis
DEQ: Virginia Department of Environmental Quality
DWR: Virginia Department of Wildlife Resources
ENSO: El Niño–Southern Oscillation
EPA: Environmental Protection Agency
FERC: Federal Energy Regulatory Commission
GPD: Gallons per Day
GW: Groundwater
GCMP: Groundwater Characterization and Monitoring Program
GWMA: Groundwater Management Area
HRSD: Hampton Roads Sanitation District
ICPRB: Interstate Commission on the Potomac River Basin
IFIM: Instream Flow Incremental Method
JPA: Joint Permit Application
MGD: Million Gallons per Day
NPDES: National Pollutant Discharge Elimination System
NWIS: USGS National Water Information System
ORM: Office of Regulatory Management
OWS: Office of Water Supply
PDC: Planning District Commission
PEEP: Permitting Evaluation and Enhancement Platform
PWS: Public Water Supply
RAP: Regulatory Advisory Panel
SW: Surface Water
SWCB or Board: State Water Control Board
SWIFT: Sustainable Water Initiative for Tomorrow
SWIP: Surface Water Investigations Program
UIC: Underground Injection Control
USACE: United States Army Corps of Engineers
USDA: United States Department of Agriculture
USGS: United States Geological Survey
VDH: Virginia Department of Health
VGIN: Virginia Geographic Information Network
VMRC: Virginia Marine Resources Commission
VWP: Virginia Water Protection (Permit Program)
WSP: Water Supply Plan
WSPA: Water Supply Planning & Analysis
WTP: Water Treatment Plant
WUDR: USGS Water Use Data and Research Program
WWTP: Waste Water Treatment Plant

# Executive Summary

The Virginia Annual Water Resources Report (Annual Report) is submitted in October of each year to the Governor and the Virginia General Assembly in accordance with § 62.1-44.40 of the Code of Virginia. The Annual Report focuses on water quantity and supply, summarizing reported water withdrawals for the 2023 calendar year, identifying water withdrawal trends, and providing an update on the Commonwealth's water resources management activities. Where applicable, the Annual Report also serves as a status report on activities associated with the State Water Resources Plan between five year updates. The 2020 State Water Resources Plan was released in January 2022 after completing an extensive public comment and stakeholder outreach process.

Water quality issues are addressed in the most recent biennial Water Quality Assessment Integrated Report, published by the Virginia Department of Environmental Quality (DEQ).

Chapter 1 provides an overview of water resource management activities and outcomes during 2023. This chapter discusses several DEQ programs including Water Supply Planning and Analysis, Water Withdrawal Reporting, Water Withdrawal Permitting and Compliance, Groundwater Withdrawal Permitting, Surface Water Withdrawal Permitting, Groundwater Characterization and Monitoring, Surface Water Investigations, and Drought Assessment and Response.

Chapter 2 provides a brief overview on how withdrawals are reported to DEQ, summarizes 2023 reported water withdrawals at the statewide level for all water use types, and compares 2023 reported withdrawals to average use over the past five years.

Chapter 3 provides an overview of water withdrawal reporting for the year 2023, as well as comparisons to reporting in recent years, for each of the following water withdrawal use categories: public water supply, commercial, manufacturing, power generation, mining, agriculture, and irrigation.

Chapter 4 identifies new, continuing, and future priorities, challenges, or other topics of specific interest for DEQ. These include updates on new legislative or regulatory actions, programmatic goals and achievements, and other items.

In addition to the main chapters, the report includes several appendices that provide: the top 20 largest reported withdrawals in 2023 (Appendix 1), withdrawals within individual localities in 2023 (Appendix 2), an overview of Virginia's water resources and climatic conditions (Appendix 3), and some additional information on water transfers (Appendix 4).

**Water Withdrawal Permitting;**

In calendar year 2023, DEQ issued 91 groundwater withdrawal permits and 15 surface water withdrawal permits.

DEQ manages groundwater withdrawal permits within the Eastern Virginia Groundwater Management Area and Eastern Shore Groundwater Management Area as well as surface water withdrawal permits statewide. A significant focus of this administration and the DEQ Director is improving permit processing timelines. DEQ's agency-wide Permitting Enhancement and Evaluation Platform (PEEP) is operational and is intended to improve efficiency and transparency throughout permitting processes and will be particularly beneficial in identifying critical path improvements for complex individual permit issuance processes. In preparation to integrate effectively into the PEEP process, DEQ's water quantity management programs addressed a number of issues including: incorporating program data and data management into the DEQ enterprise system, working to bring on new hires to fill vacancies, and accelerating new hire training.

DEQ has greatly reduced the backlog of groundwater withdrawal and surface water withdrawal permit applications received prior to the initiation of PEEP, with 16 groundwater and 5 surface water applications remaining as of July 1, 2024. In calendar year 2023, DEQ issued 91 groundwater withdrawal permits and 15 surface water withdrawal permits. Review of water withdrawal applications requires extensive interagency coordination and a technical evaluation process, both of which contribute to longer permit processing timelines than is typical in other DEQ permit programs. Vacancy rates within the permit program remain a consistent challenge. DEQ continues to work to fill these vacancies through continuous recruitment strategies.

**Summary of 2023 Water Withdrawal Reporting and Trends (excluding power generation):**

Surface Water: Reported withdrawals increased by 2.1% compared to the five-year average.

Groundwater: Reported withdrawals decreased by 5.4% compared to the five-year average.

In calendar year 2023, 1,174 facilities reported water withdrawals to DEQ. Total reported withdrawals in 2023 were approximately 5.26 billion gallons per day (BGD), including the cooling water withdrawals at nuclear and fossil fuel power generation facilities, which make up 76% of this total. The 2023 total reported withdrawal is 6.1% less than the five-year average of 5.61 BGD, which is primarily due to a reduction in reported power generation withdrawals.

Excluding power generation, 2023 reported withdrawals totaled 1.26 BGD, a 1.3% increase compared to the five-year average. The increase in reported use over the last five years is largely driven by increased withdrawals from public water supply facilities. Reported use for many categories dropped in 2020 due to economic and social impacts from the COVID-19 pandemic. Though total reported withdrawals excluding power generation dropped in 2020, total volume has remained above pre-pandemic levels since 2021.

In 2023, public water supply withdrawals increased by 3.9% to 822.7 million gallons per day (MGD). Though reported public water supply withdrawals increased in 2023 compared to the five-year average, withdrawals remained mostly consistent from 2022 to 2023. Despite successes in reducing per capita water use, reported public water supply withdrawals have steadily increased over the last ten years as Virginia's population continues to grow in the urban and suburban areas served by public water supplies. Reported increases in withdrawals in 2023 were also reported in irrigation and commercial categories, which were 3.4% and 9.9% higher than the five-year average. Increased surface water withdrawals for irrigation were driven by drought conditions throughout the growing season, leading to additional irrigation demands. Increased commercial

withdrawals were driven by numerous commercial facilities reporting increased demands higher than their five-year average.

**Surface Water:** Total reported surface water withdrawals excluding power generation increased by 2.1% compared to the five-year average and surface water withdrawals accounted for approximately 89% of total reported withdrawals in 2023. Public water supply remains the largest non-power use type for surface water withdrawals with 763 MGD reported in 2023. Surface water withdrawals for public water supply increased by 4.0% compared to the five-year average. Approximately 76% (857.9 MGD) of 2023 reported surface water withdrawals were associated with unpermitted facilities. Unpermitted surface water use is primarily from facilities that are exempt from permitting requirements.

**Groundwater:** Total reported groundwater withdrawals excluding power generation decreased by 5.4% compared to the five-year average in 2023, and accounted for approximately 11% of total withdrawals with 133 MGD reported. Manufacturing and industrial use has historically maintained the largest categorical total for reported groundwater withdrawals. Public water supply surpassed manufacturing for the largest total reported groundwater withdrawals by category. In 2023, public water supply withdrawals reported 59.7 MGD, a 3.1% increase compared to the five-year average. Manufacturing withdrawals were comparable and decreased slightly with 56.1 MGD reported, a 2.9% decrease compared to the five-year average. Approximately 49% of reported groundwater withdrawals by volume were associated with unpermitted groundwater wells. Reported unpermitted groundwater use is primarily from public water supply or manufacturing facilities located outside of current groundwater management areas (GWMAs).

**Water Resources Priorities and Challenges:**

The following section summarizes several of the water resource management priorities, challenges, or other topics of specific interest that are discussed in more detail in Chapter 4. These include updates on new legislative or regulatory actions, programmatic goals and achievements, and other items.

**The Permitting Enhancement and Evaluation Platform (PEEP):** This platform provides online public facing resources to communicate and track the critical steps to obtain permitting approvals from DEQ. Surface water withdrawal permits became viewable in PEEP on July 1, 2023, and groundwater permits became viewable on April 1, 2024.

**Addressing Unreported Water Use:** DEQ staff conduct compliance activities annually to identify users who meet the threshold for annual withdrawal reporting as well as to contact users who have previously reported but have failed to do so consistently. In addition, DEQ works to address known gaps in withdrawal reporting data through projects like the ongoing partnership between DEQ and contracted USGS staff in 2022-2023 to evaluate and improve estimates of domestic use that fall below the reporting threshold. This work progressed in 2023, and is projected to be completed and published in 2024.

**Eastern Virginia Groundwater Management Area:** One of the long-term water resource management challenges in Virginia is the historic over-allocation of groundwater from the Coastal Plain aquifer system in the Eastern Virginia Groundwater Management Area (GWMA), particularly from the Potomac Aquifer. The Hampton Roads Sanitation District's (HRSD) Sustainable Water Initiative for Tomorrow Project (SWIFT) proposes to inject treated drinking-quality water into the Potomac aquifer by constructing injection wells at sites across the Hampton Roads area.

**Eastern Shore Groundwater Management Area:** A new Eastern Shore groundwater model, building upon the 2019 USGS and DEQ study, is nearing completion and expected to debut during the fall of 2024. This new model will include the updated hydrogeologic information and the results of a detailed review of water use, including better characterization of surficial aquifer use. The new model will also incorporate the new framework and water use data including domestic use estimates.

**Amendments to the Local and Regional Water Supply Planning Regulation (9VAC25-780):** The Local and Regional Water Supply Planning Regulation (9VAC25-780) was recently amended to comply with legislative mandates created by the 2020 General Assembly Session (2020 Va. Acts Ch. 1105) and the 2022 General Assembly Session (2022 Va. Acts Ch. 331). These mandates required regional planning areas to be designated based primarily on river basins to promote cross-jurisdictional coordinated water resources planning, required providing a mechanism for a locality to request reassignment, and required each regional planning area to identify water supply risks and strategies to address such risks. A Regulatory Advisory Panel (RAP) met throughout 2021 and 2022, the resulting amendments were presented to the SWCB in June of 2022, a public comment period was initiated and concluded in July of 2023, and final amendments were subsequently approved by the SWCB in November of 2023. The final regulation will be published this fall.

**Evaluating Tidal Fresh Surface Water Withdrawals:** Groundwater limitations in the Coastal Plain region continue to motivate applications for the construction of tidal fresh surface water withdrawal intakes in the James, York and Rappahannock river basins. These same limitations have also motivated applications for reuse of wastewater treatment plant return flows, which effectively increase the consumptive losses associated with existing withdrawals. A future need is the development of new modeling techniques and the application of updated water quality models for use in evaluating these potential projects.

**Program Funding:** The FY 2022-2023 budget provided significant funding for the continuance of the multi-year DEQ/USGS project to install new monitoring facilities within the Virginia Coastal Plain. This significant investment addresses existing monitoring gaps and will ensure DEQ is able to evaluate trends in land subsidence, aquifer recovery, groundwater levels, and to continue collecting data for making sound management decisions. DEQ's responsibilities and authorities in terms of managing water supply are complex and increasingly rely on extensive and regular data collection and the development and ongoing maintenance of evaluation models. Continued financial investment is necessary to allow for proactive and responsive management to ensure that these resources can be put to beneficial uses that foster Virginia's prosperity.

# 1 2023 Water Resources Management Updates

Citizens of the Commonwealth of Virginia enjoy access to over 100,000 miles of non-tidal streams and rivers, 248 publicly-owned lakes, 236,000 acres of tidal and coastal wetlands, 808,000 acres of freshwater wetlands, 120 miles of Atlantic Ocean coastline, and more than 2,300 square miles of estuaries. However, an increasing population and a growing economy can present challenges for managing water resources despite the relative bounty Virginia enjoys. Virginia benefits from a robust economy and an increasing population drawn by the many opportunities available. The state's water resources are shared across a variety of beneficial uses, including in-stream uses such as recreation, navigation, habitat for wildlife, and the aesthetic value of rivers and streams, as well as off-stream uses such as supplying drinking water, agricultural, commercial, or industrial facilities. Increasing demands coupled with limited resource availability and competition for water highlight the importance of active management of Virginia's water resources. This means placing a greater emphasis on collaboration with state and local governments, planning partners, and permittees to find cost-effective solutions that conserve the Commonwealth's water resources and ensure their ability to support all beneficial uses into the future, particularly during periods of drought.

DEQ's mission is "to protect and enhance the environment of Virginia in order to promote the health and well-being of the Commonwealth's citizens, residents, and visitors." State law determines how this mission is to be fulfilled with respect to water resources. More information on the statutes and regulations related to water resources management can be found on the DEQ website. The following sections briefly discuss the various DEQ programs involved in water resources planning and management (Water Supply Planning and Analysis, Water Withdrawal Reporting, Water Withdrawal Permitting and Compliance, Groundwater Withdrawal Permitting, Surface Water Withdrawal Permitting, Groundwater Characterization and Monitoring, Surface Water Investigations, and Drought Assessment and Response) as well as updates on the work done by each program in 2023.

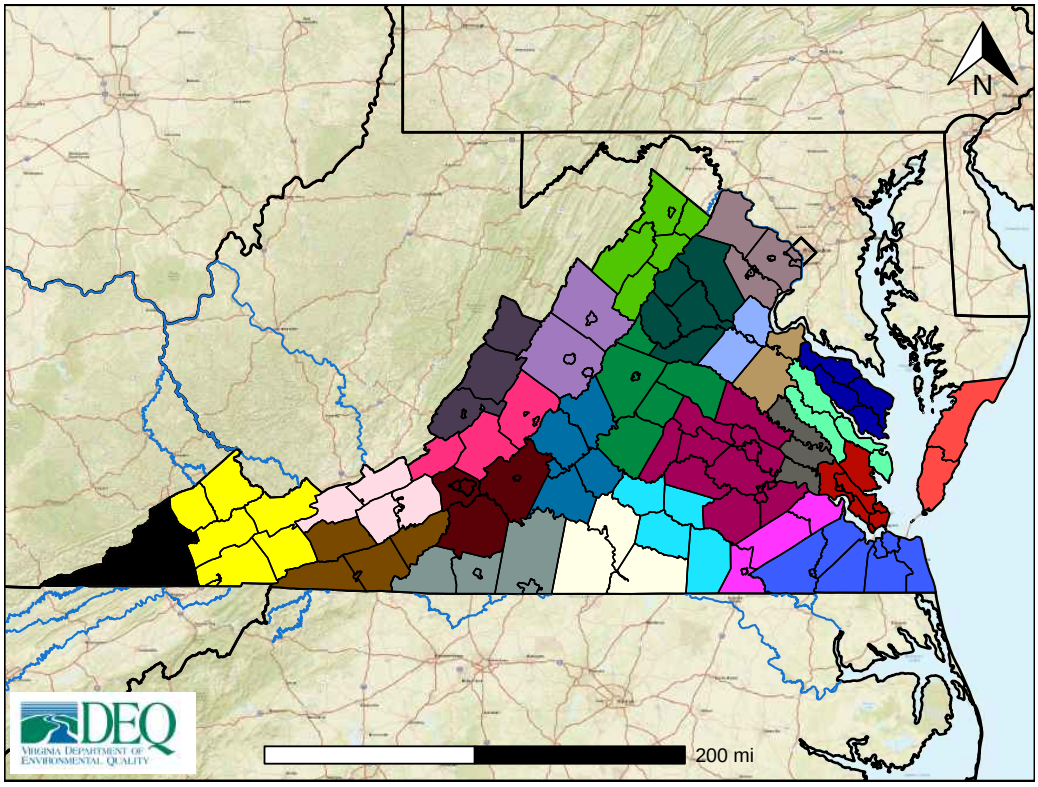
## 1.1 Water Supply Planning and Analysis

In response to the 2001-2002 drought, during which some water utilities and localities were unable to meet the demands as streamflows decreased to record levels, the Virginia General Assembly enacted a statute (Chapter 3.2 of the Code of Virginia) that required the development of a comprehensive water supply planning program requiring periodic development of local, regional, and state water supply plans. Water supply plans were to include information on environmental resources, existing and anticipated water sources, existing and projected water use and demand, the potential for water supply deficits, and proposals for new sources of water to address deficits if necessary. The Local and Regional Water Supply Planning Regulation (9VAC25-780) was adopted in 2005 in accordance with section 62.1-44.38:1.A of the Code of Virginia. Localities and regional partnerships were required to submit their initial water supply plans to DEQ no later than November 2011.

Following submission, staff reviewed a total of 48 water supply plans, of which 10 were local plans and 38 were regional plans. DEQ submitted final compliance determinations to all planning partners in late 2013. In 2018, all 323 localities in Virginia reviewed their water supply plans and addressed compliance conditions, in accordance with the required five-year review and submissions deadline.

Legislation enacted following the 2020 General Assembly Session (2020 Va. Acts Ch. 1105) required the State Water Control Board (SWCB) to adopt regulations designating regional planning areas based primarily on river basins, to encourage the development of cross-jurisdictional water supply projects, and to estimate the risk that each locality and region in the Commonwealth could experience due to water supply shortfalls. This law also directs localities to participate in cross-jurisdictional, coordinated water resource planning, and to develop a single water supply plan for each regional planning area. A Regulatory Advisory Panel (RAP) made up of a variety of stakeholders advised DEQ in the development of proposed amendments for SWCB consideration through the collaborative approach of regulatory negotiation and consensus during a series of meetings in 2021 and 2022. Proposed regional planning areas were developed, as shown in Figure 1, which is a change from the local and regional planning areas documented in 2011 water supply plan

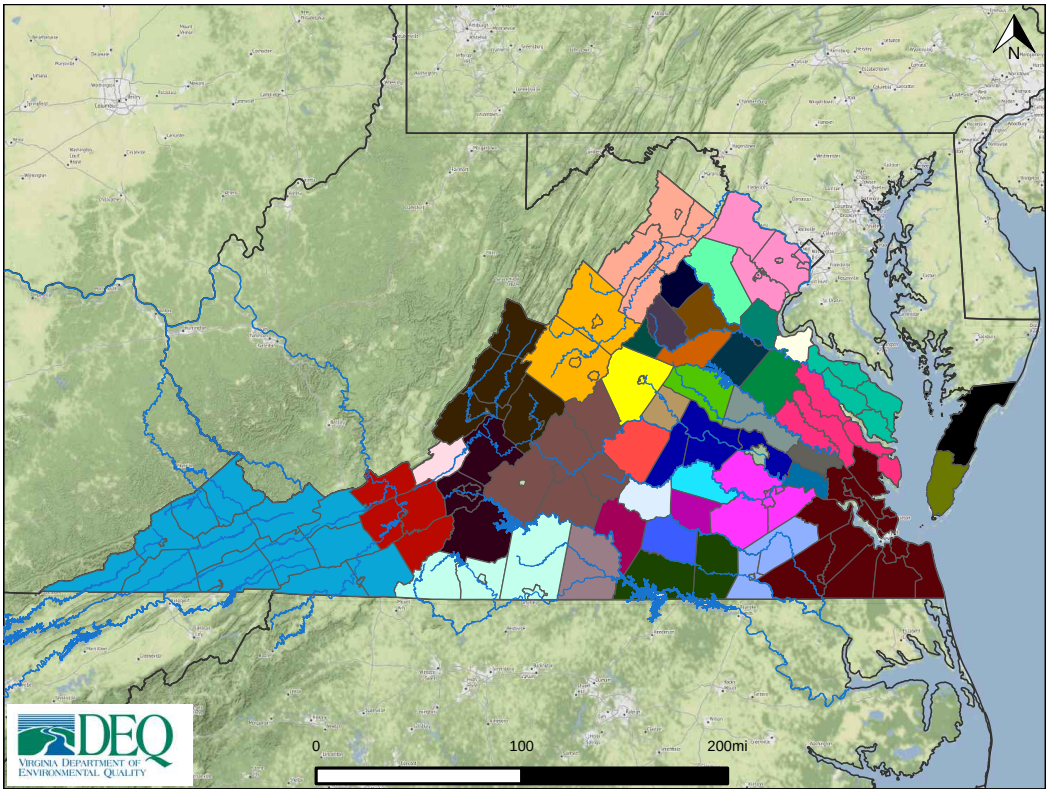
Figure 1: New Water Supply Planning Regions




**Proposed Water Supply Regions**

- Big Sandy Upper Tennessee 1
- Big Sandy Upper Tennessee 2
- Chowan 1
- Chowan 2
- Eastern Shore
- Middle James 1
- Middle James 2
- Middle James 3
- New River 1
- New River 2
- Northern Coastal Plain 1
- Northern Coastal Plain 2
- Northern Coastal Plain 3
- Northern Piedmont 1
- Northern Piedmont 2
- Northern Virginia
- Roanoke 1
- Roanoke 2
- Roanoke 3
- Shenandoah 1
- Shenandoah 2
- Southeast Virginia
- Upper James 1
- Upper James 2
- York James 1
- York James 2

Figure 2: Previous Water Supply Planning Programs according to 2011 Water Supply Plans




- Accomack County + Towns Regional WSP
- Albemarle County, City of Charlottesville, Town of Scottsville Regional Water Supply Plan
- Amelia County Water Supply Plan (LOCAL PLAN)
- Appomattox River Water Authority (ARWA) + Hopewell Regional WSP
- Buckingham County & Town of Dillwyn Regional Plan
- Caroline County & the Town of Bowling Green Regional WSP
- Charles City County (LOCAL PLAN)
- Charlotte County Regional WSP
- Craig County−Town of New Castle Regional WSP
- Culpeper County + Town Regional WSP
- Cumberland, Goochland, Henrico, and Powhatan Counties Water Supply Plans
- Fauquier County Regional Water Supply Plan
- Fluvanna County + Town of Columbia Regional WSP
- Greene County + Stanardsville Regional WSP
- Greensville, Sussex, Emporia Regional Water Supply Plan
- Halifax County and Towns
- Hampton Roads Planning District Commission (HRPDC) Regional WSP
- Hanover County & Town of Ashland Regional
- King George County WSP (LOCAL PLAN)
- Lake Country Regional WSP
- Louisa County and Towns
- Lunenburg County + Towns Regional WSP
- Madison County + Town Regional WSP
- Middle Peninsula Regional Water Supply Plan
- New Kent County WSP (LOCAL)
- New River Valley WSP
- Northampton County + Towns Regional WSP
- Northern Neck Regional WSP
- Northern Shenandoah Regional WSP
- Northern Virginia Regional Water Supply Plan
- Nottoway County and Towns
- Orange County Regional Water Supply Plan
- Prince Edward County and Town of Farmville Water Supply Plan
- Rappahannock County + Town of Washington WSP
- Region 2000 Regional Water Supply Plan
- Richmond, City of (LOCAL PLAN)
- Roanoke Valley Alleghany Regional Commission Regional WSP
- Southwest VA Regional Water Supply Plan
- Spotsylvania County and City of Fredericksburg Regional Water Supply Plan
- Stafford County Water Supply Plan (LOCAL PLAN)
- Upper James River Basin WSP
- Upper Shenandoah Regional WSP
- West Piedmont Planning District Commission Regional Water Supply Plan

submissions (Figure 2). In the Spring of 2023, the draft regulation was approved, and a public comment period was initiated in May of 2023. The public comment period ended on July 21, 2023, following which DEQ reviewed and incorporated comments into the draft of the final regulation in the Fall of 2023. Final amendments were approved by the SWCB on November 30, 2023, and the final regulation will be published this fall.

Once final, the amended Local and Regional Water Supply Planning Regulation will substantially impact the process and requirements for the next plan submission cycle. DEQ is in the process of developing a guidance document to address how this action may impact the planning process. More information on the program and the new process will be provided as it becomes available, and can be found on the DEQ website.

### 1.1.1 Virginia State Water Resources Plan

The water supply plans and other water use reporting and source data collected by DEQ form the basis of the Virginia State Water Resources Plan (State Plan). The first iteration of the State Plan was published in October 2015. It includes the results of a cumulative impact analysis (CIA) conducted using data from local and regional water supply plans and water withdrawal data submitted by individual users under the Water Withdrawal Reporting Regulation.[1] In general, the goal and intent of the State Plan is to use the locally sourced data to conduct analysis that localities can use to inform future planning efforts and permit applications for future water withdrawal projects.

Using updated information submitted in the 2018 water supply plan five year review cycle, DEQ developed the 2020 State Plan. The 2020 State Plan includes updated demand and source information, improved discharge data, and enhanced CIA modeling, including new metrics and scenarios, such as the first ever climate change CIA scenarios. Analysis was also conducted at a more localized scale with detailed summaries for each of the 20 minor basins on existing sources, demand projections, water use trends, and modeling results.[2]

### 1.1.2 VAHydro to myDEQ Transition

Data used in the State Plan such as locality provided demand and source data, annual withdrawal reporting, and withdrawal permit reporting was collected via VAHydro, a web-based, interactive platform that provided the basis for more efficient data collection and analysis. VAHydro was designed to link modules pertaining to water withdrawal permitting, water supply planning, water withdrawal reporting, groundwater well registration, and drought monitoring/modeling of both surface water and groundwater. Due to the software VAHydro was based on going out of support, as of April 1, 2024, DEQ has transitioned from VAHydro into the Comprehensive Environmental Data System (CEDS). Like VAHydro, CEDS provides links between withdrawal reporting, permitting, and well registrations, and now can also provide links to other permitting programs such as the Virginia Pollutant Discharge Elimination System (VPDES). Water users can use the myDEQ Portal to access their facilities and water use data stored in CEDS.

Work is still being done on the new system to transition some of the functionality offered by VAHydro. Primarily, the water supply planning module is in queue for future transition. DEQ is maintaining copies of water supply plans and associated data outside of CEDS until this project is completed, and this information is available upon request. Additionally, ongoing development with another software called Tableau will allow myDEQ Portal users to view historic reporting data submitted to VAHydro and/or CEDS.

[1] 9VAC25-200.

[2] The nine major river basins within Virginia are further divided into 20 minor basins to provide a higher resolution, more localized scope for analysis. Minor basins are generally delineated around significant tributaries to the major river (for instance, Shenandoah Minor Basin is a tributary to the Potomac-Shenandoah Major Basin), or by physical characteristics of the area geography. For instance, the James River Basin is subdivided by the Upper James, Middle James, and Lower James minor basins, which are located in the Ridge and Valley, Piedmont, and Coastal Plain geographical regions of Virginia respectively.

### 1.1.3 Modeling and Analysis

DEQ staff in the Water Supply Planning and Analysis program perform a number of highly technical functions to serve other DEQ programs. This includes maintaining and utilizing an operational surface water model to conduct CIA for individual surface water withdrawal permit projects as well as basin-wide analyses and water supply planning simulations such as those presented in the State Plan. DEQ modelers routinely update the VAHydro surface water model both internally and in collaboration with partners ranging from the United States Geological Survey (USGS), Virginia Tech Department of Biological Systems Engineering (BSE), and the Chesapeake Bay Program. Through a variety of grant and program funded projects, partner organizations publish the results of work that serves to advance the state of the science, informing water resources management in professional peer-reviewed journal papers to ensure methodological documentation and scientific integrity.

In September of 2023, a technical paper was published in Agricultural Water Management *Quantification of unreported water use for supplemental crop irrigation in humid climates using publicly available agricultural data* summarizing the results of a two-year project completed in 2022 funded by a USGS WUDR grant. This project was completed in cooperation with the Virginia Tech BSE Department and DEQ, and helped to improve estimates of water used for irrigation at the county level using USDA Agricultural Census data and DEQ water withdrawal reporting data. This project and the resulting publication provide critical insights for localities, as historically one of the major challenges localities had when preparing water supply plans was collecting information on water use from agricultural water users.

DEQ is finalizing the next generation operational model platform in Hydrologic Simulation Program-Python (HSP2). The transition from Hydrologic Simulation Program–FORTAN (HSPF) to HSP2 provides increased model speed and the ability to efficiently handle sub-daily timesteps, improved turnaround time for permit model technical evaluations, improved debugging and quality assurance abilities, and facilitates dynamic updates and future model maintenance through an active, supportive community of Python users. The Virginia Tech BSE Department continued to provide analytical support to DEQ for the translation of the VAHydro model into the new HSP2 framework in 2023. Program benefits resulting from this collaboration include an updated VAHydro model that now includes simulated meteorology from 1984-2023 in the new HSP2 system, expanding the simulation of historical drought conditions beyond the previous limit of 2014. The HSP2 model implementation was not fully completed in 2023 as expected due to substantial modeling needed to assist in processing a backlog of groundwater and surface water withdrawal permit applications throughout the year. However, significant progress was made in converting DEQ model actions into Python, culminating with their inclusion in the first official release of HSP2 on the Python package index (PyPI).

A method of assessment of available water for major basins is in development as of 2023, considering minimum simulated drought storage and cumulative consumptive use. This new methodology enables more accurate assessment of future water storage needed and areas where water for instream flows could be considered to be below minimum recommended values. This method, once completed, is intended to support and be presented through the next iteration of the State Water Resources and Supply Plan. Program plans for 2024 include calculating the available water assessment for all watersheds using the 2023 available water assessment methodology and developing an updated methodology for assessing locations and time periods where errors in meteorological inputs result in uncertainty in low-flow simulations.

## 1.2 Water Withdrawal Reporting

The Water Withdrawal Reporting Regulation requires the annual reporting of monthly water withdrawals (surface water and groundwater) of volumes greater than an average of 10,000 gallons per day (GPD) during any month, or one million gallons per month for crop irrigation. The regulation allows the submission of metered and estimated water withdrawal information. DEQ offers electronic reporting that allows reporters to enter withdrawal data on a monthly basis; mail in reporting is also accepted. DEQ maintains withdrawal data as far back as 1982 and categorizes water withdrawals by water use types: agriculture, commercial, irrigation, manufacturing and industrial, mining, fossil fuel power, hydropower, nuclear power, and public water supply. The database also categorizes withdrawals by water source (groundwater, surface water, or

transfer) and source sub-type (reservoir, spring, stream, or well). Analyses of the reported 2023 data are provided in Chapters 2 and 3, and in Appendix 1 and Appendix 2.

Annual water withdrawal reporting is one of the most important data sources for DEQ. Reporting of water withdrawals allows for informed modeling and planning decisions related to the Commonwealth's future water demands and availability. Reported water withdrawals are linked into the surface water model, which enables staff to prepare up-to-date and accurate water budgets and conduct CIA in support of permit decisions and water supply planning efforts. Withdrawal data is also used by other programs within DEQ, other agencies, and the public. The effectiveness of the Commonwealth's water resource management depends on the comprehensiveness and accuracy of this self-reported withdrawal information.

Each year DEQ works to increase the number and quality of withdrawal reports. This includes reaching out to facilities to ensure continued reporting, especially as points of contact change or leave the company.

## 1.3 Water Withdrawal Permitting and Compliance

This program administers the permitting and related compliance and reporting activities required by statutes aimed at the management and protection of groundwater and surface water resources. Under the Ground Water Management Act of 1992,[3] Virginia manages groundwater through a permit program regulating the withdrawal of groundwater in certain areas designated as Groundwater Management Areas (GWMAs). Currently, there are two GWMAs in the state. The Eastern Virginia GWMA generally comprises areas east of Interstate 95 and west of the Chesapeake Bay and Atlantic Ocean coast. The Eastern Shore GWMA includes Accomack and Northampton counties. Any person or entity located within a declared GWMA must obtain a groundwater withdrawal permit to withdraw 300,000 gallons or more of groundwater in any one month.

Projects involving surface water withdrawals from state waters and related permanent structures are permitted under the Virginia Water Protection (VWP) Permit Program Regulation as provided by Article 2.2 of the State Water Control Law.[4] DEQ issues VWP individual permits for such withdrawals through use of the Joint Permit Application (JPA) process.

A significant focus of this administration and the DEQ Director is improving permit processing timelines. DEQ's agency-wide Permitting Enhancement and Evaluation Platform (PEEP) is operational and is intended to improve efficiency and transparency throughout permitting processes and will be particularly beneficial in identifying critical path improvements for complex individual permit issuance processes. In preparation to integrate effectively into the PEEP process, DEQ's water quantity management programs addressed a number of issues including: incorporating program data and data management into the DEQ enterprise system, working to bring on new hires to fill vacancies, and accelerating new hire training.

DEQ has greatly reduced the backlog of groundwater withdrawal and surface water withdrawal permit applications received prior to the initiation of PEEP, with 16 groundwater and 5 surface water applications remaining as of July 1, 2024. In calendar year 2023, DEQ issued 91 groundwater withdrawal permits and 15 surface water withdrawal permits. Review of water withdrawal applications requires extensive interagency coordination and a technical evaluation process, both of which contribute to longer permit processing timelines than is typical in other DEQ permit programs. Vacancy rates within the permit program remain a consistent challenge. DEQ continues to work to fill these vacancies through continuous recruitment strategies.

## 1.4 Groundwater Withdrawal Permitting

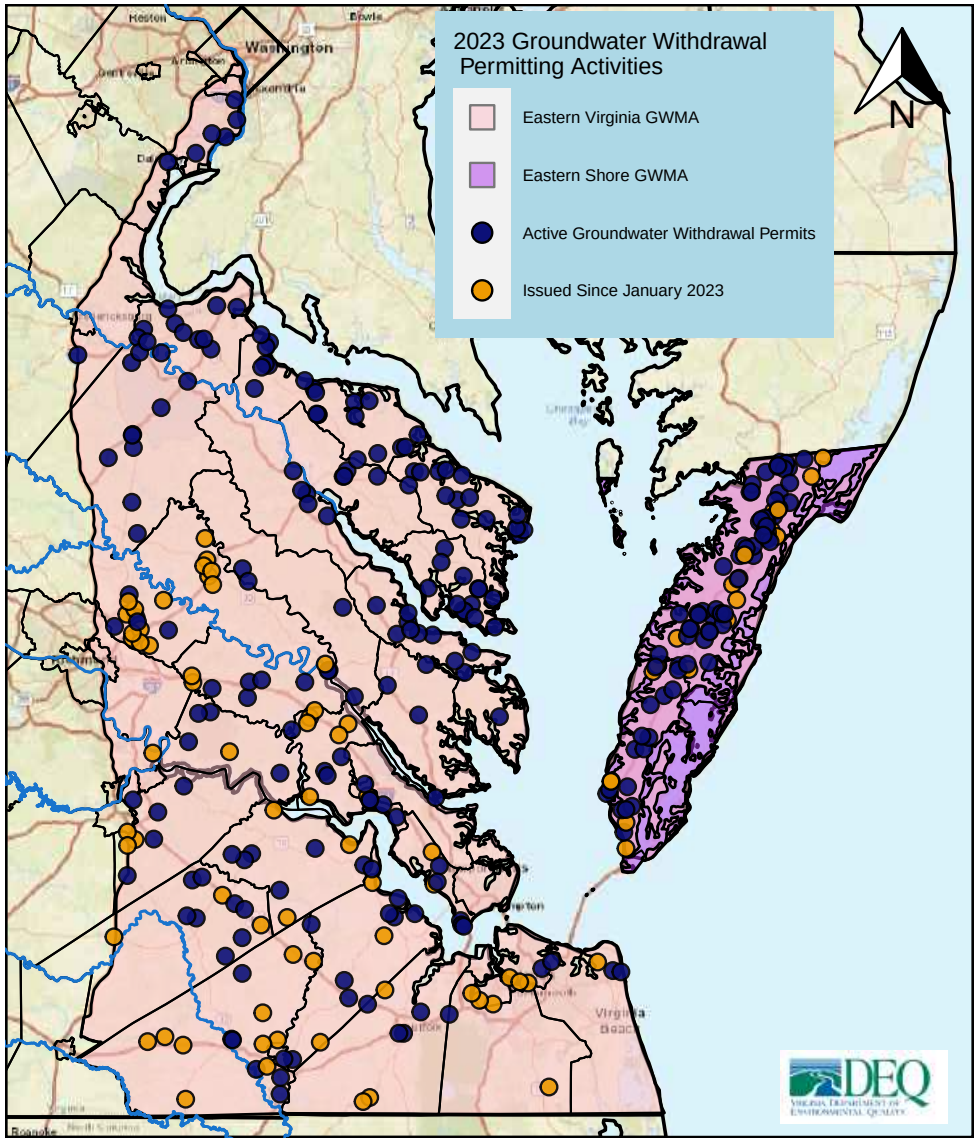
Groundwater withdrawal permit applications for new or expanded withdrawals in a GWMA are evaluated to determine impacts of the proposed permit on the groundwater resource. The evaluation determines the area of impact, the potential for a proposed withdrawal to cause salt water intrusion, and assesses the impact

[3] § 62.1-254 et seq. of the Code of Virginia.
[4] §§ 62.1-44.15:20 through 62.1-44.15:23.1 of the Code of Virginia.

of the combined drawdown from all existing lawful withdrawals. Existing lawful withdrawals include those permits issued under historic use conditions and current new or expanded use permits, as well as users that withdraw less than 300,000 gallons per month.

As of July 1, 2024, DEQ administers a total of 345 groundwater withdrawal permits. Currently permits are authorized to withdraw a combined total of approximately 41.8 BGY, which equates to an annual average withdrawal rate of 115 MGD. Figure 3 provides a spatial overview of groundwater withdrawal permitting activities in Virginia. A complete list of all active groundwater permits is available upon request.

Figure 3: 2023 Groundwater Withdrawal Permitting Activities



## 1.5 Surface Water Withdrawal Permitting

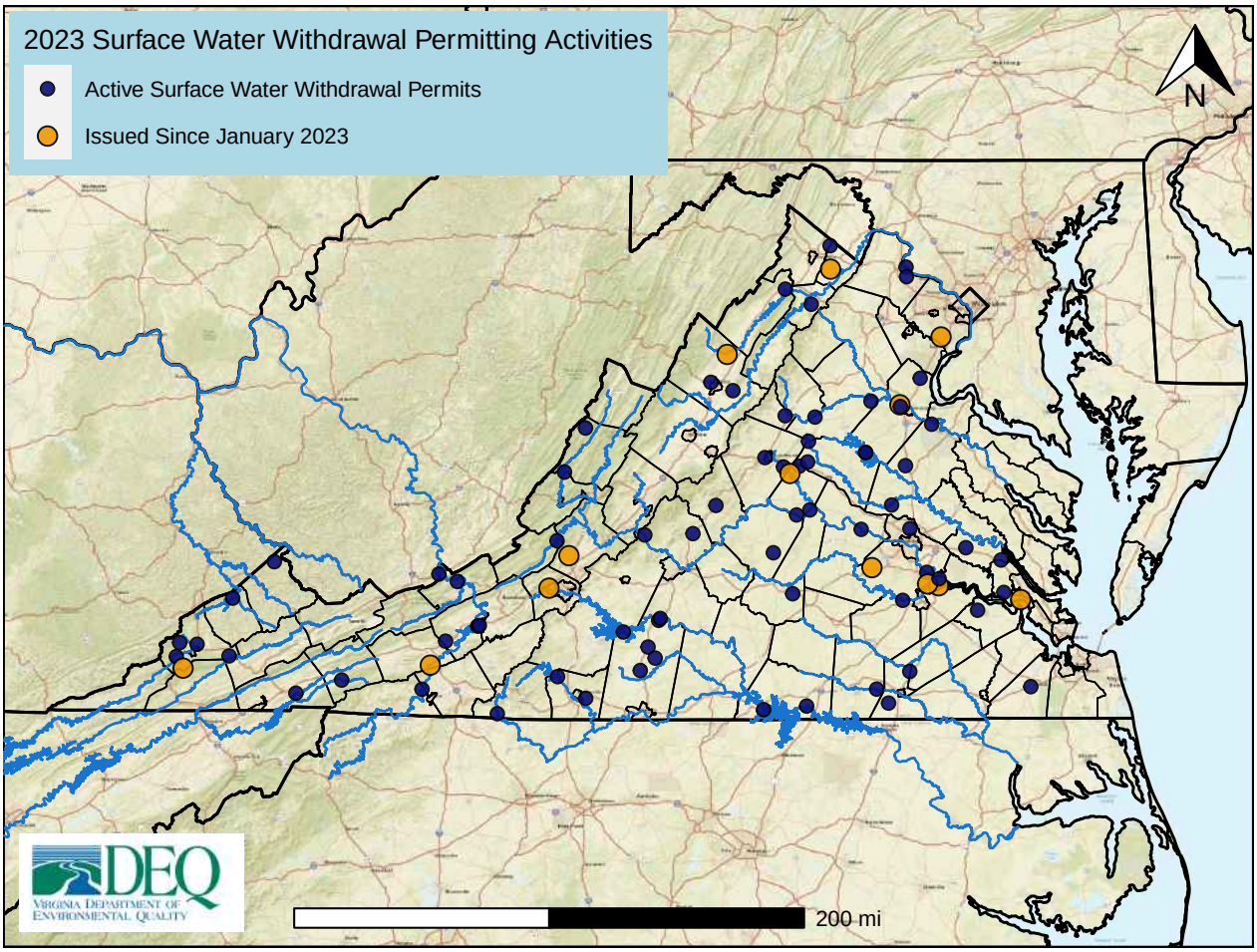
Application for a surface water withdrawal permit is made through the submittal of a JPA to DEQ, the Virginia Marine Resources Commission (VMRC), and the U.S. Army Corps of Engineers (USACE). DEQ's evaluation of surface water withdrawal permit applications includes an in-depth analysis of the applicant's water demand and a CIA of the project to determine potential impacts on existing in-stream and off-stream beneficial uses. To conduct these analyses, DEQ uses an operational hydrologic model to determine the cumulative impacts to aquatic life, water quality, recreation, and downstream water availability for existing intakes.

Each new or re-issuance permit application is modeled to evaluate any potential impact to beneficial uses downstream of the withdrawal site. Staff use the output of this analysis to inform the permit determination and to develop appropriate limits on withdrawal volumes and minimum in-stream flow conditions if a permit is issued. Figure 4 illustrates Virginia Water Protection (VWP) surface water withdrawal permitting activities, including permits issued in 2023. Currently, DEQ administers 98 VWP permits for surface water withdrawals. In calendar year 2023, DEQ issued 15 surface water withdrawal permits.

An ongoing effort for the Water Withdrawal Permitting program is processing VWP permit applications for a large number of hydroelectric power facilities that are or will be applying for Federal Energy Regulatory Commission (FERC) relicensure as their 30 year licenses expire. Any applicant for a federal license or permit to conduct an activity that may result in a discharge to navigable waters must apply for a Section 401 Certification. A Section 401 Certification is a statement from the state that there is reasonable assurance that the facility will comply with the Clean Water Act and any state established water quality standards. The DEQ VWP Permit Program serves as the Commonwealth's Section 401 Certification for FERC licenses as established by the VWP Regulation.[5] Ten of the twenty two regulated hydroelectric facilities in Virginia are currently undergoing or will be initiating the re-licensing process with FERC and DEQ within the next four years, resulting in an increase in VWP permit applications overall. The VWP permitting process for these facilities will incorporate current scientific framework and regulatory requirements, which are more robust than those in place during the original Section 401 Certification issuance processes. Previous certifications generally required only a minimum release from the facility downstream. Once issued, current VWP permits provide enhanced data collection, in-stream flow management during droughts or low flow events, and better protections for in-stream beneficial uses, especially in regions where multiple hydroelectric facilities are located on the same river.

[5] 9VAC25-210-340.

Figure 4: 2023 Surface Water Withdrawal Permitting Activities




## 1.6 Groundwater Characterization and Monitoring

Since 2022, the Groundwater Characterization and Monitoring Program (GCMP) has been organized into two teams. The Groundwater Characterization Team consists of two geologists who focus on groundwater conditions in the hard-rock provinces of Virginia and three geologists who work primarily in the Coastal Plain's two Groundwater Management Areas (Eastern Virginia and Eastern Shore). A separate Groundwater Monitoring Team of six groundwater geologists focuses on the operation and maintenance of the State Observation Well Network, the collection and management of groundwater-level data, and the collection of ambient groundwater quality data. Both teams operate under the general supervision and direction of a Program Manager, who also manages the program's interactions with other DEQ programs and cooperating external partners.

Starting in Fiscal Year 2022, significant funding was provided to the GCMP for a multi-year effort to include three phased projects. The first phase of project execution was to construct an extensometer in the vicinity of the West Point Paper Mill. Extensometers monitor changes in aquifer thickness that can occur in response to changing pressures within the aquifer system. Changes in aquifer pressure are typically associated with groundwater withdrawals, natural recharge, surface loading from tidal influences, and groundwater injection (which will be occurring at several locations within the HRSD). In 2022, DEQ geologists assisted in selecting the location for the extensometer site at HRSD's West Point Operation Center. Subsurface installation was completed in 2023, and final instrumentation is expected in 2024. This new installation will complete the

Eastern Virginia network of four extensometers to measure changes in aquifer levels and surrounding land subsidence.

The second phase of project execution is to install up to approximately 20 climate response network (CRN) wells in the hard-rock provinces of Virginia. These wells are intended to measure hydrostatic pressures within the shallow portions of fractured-rock aquifer systems for the purpose of evaluating the relation between long-term climatic trends and groundwater levels. The third and final stage of project execution will be to install up to approximately 19 chloride monitoring wells in the Coastal Plain. In 2023, DEQ geologists oversaw the installation of six CRN wells and continued securing the necessary access for the remaining CRN wells and chloride monitoring wells.

The GCMP provided technical support to groundwater withdrawal permittees and new applicants in multiple localities, including Caroline, Essex, Isle of Wight, King and Queen, King George, King William, Lancaster, Middlesex, Sussex, and Westmoreland counties, and on the Eastern Shore. DEQ geologists collected hydrogeological data and provided on-site support and quality control for permittees' contractors. Through detailed evaluation of borehole geophysical logs and drill cuttings, DEQ geologists determined the aquifer depths and characteristics at each well location. These determinations helped to ensure that production wells were constructed in accordance with groundwater withdrawal permit conditions, with their screens and pumps correctly placed within the permitted aquifers. Notably, DEQ geologists participated in the design, drilling, and construction of a new State Observation Well, SOW 253A, at the Lake Kilby Water Treatment Facility in the City of Suffolk, as required by a special condition of the City of Portsmouth's groundwater withdrawal permit for that facility. SOW 253A was equipped for continuous monitoring of groundwater level and conductivity, and it began transmitting groundwater-level data to the U.S. Geological Survey in near-real time (available via National Water Information System, https://waterdata.usgs.gov/va/nwis/current/?type=gw). The GCMP also provided technical support to HRSD's Sustainable Water Initiative for Tomorrow (SWIFT) project team during drilling and construction of managed aquifer recharge (MAR) injection wells and monitoring wells at the James River Treatment Plant in Newport News.

Staff also conducted groundwater resource investigations in the Piedmont, Blue Ridge, and Valley and Ridge physiographic provinces to better understand the complexities associated with the flow and storage of groundwater in fractured-rock aquifers. During the 2023 calendar year, borehole geophysical investigations took place in Augusta, Culpeper, Fauquier, Nelson, Pittsylvania, Powhatan, Rockbridge, and Spotsylvania counties. Typically, data from borehole logging are used to describe local hydrogeologic conditions in the vicinity of the wellbore. Borehole log data from multiple wells can also be used to describe aquifer systems at a more regional scale. In 2023, staff continued an effort to archive historic borehole geophysical log data collected by DEQ. Logs will be stored in the U.S. Geological Survey's borehole geophysical log database, available for public access at the following link: https://webapps.usgs.gov/geologlocator/#!/.

Also in 2023, staff completed a regional inventory and analysis of Virginia springs. The statewide spring database, compiled over several years, represents the most comprehensive database of its kind, including physical characteristics, field measurements, and chemistry data on over 1,600 springs throughout the state. DEQ released a peer-reviewed report, "Springs of Virginia," that analyzes relationships between spring characteristics and geological factors such as lithology, proximity to major geologic structures, and position relative to a major watershed. The author presented the results of the analysis at the 2023 Virginia Geological Research Symposium in Charlottesville. The report is available on the program's website (https://www.deq.virginia.gov/our-programs/water/water-quantity/groundwater-characterization-program). The accompanying dataset is available through DEQ's Environmental Data Hub: https://geohub-vadeq.hub.arcgis.com/maps/f3b910d2a65e4d2e93ff7b43ac5e542a/about.

The GCMP continued quarterly groundwater-level monitoring across the network of State Observation Wells. DEQ geologists also continued to evaluate the integrity of existing groundwater monitoring wells to ensure that measured groundwater levels remained representative of hydraulic conditions in the aquifer. More than half of the 294 State Observation Wells in the network exceed 30 years of age and will require repair, maintenance, or abandonment and replacement. Over time, monitoring wells can lose connection to the

aquifer through sediment infill, mineral encrustation, or growth of bacterial mats. Staff maintained and updated a priority list of wells to help guide the evaluation and maintenance efforts, as resources allow. As a result of this evaluation, three compromised wells were permanently abandoned in 2023 and four additional wells were slated for abandonment in 2024.

The GCMP's Ambient Groundwater Quality Monitoring Program focused primarily on the collection of groundwater samples from locations designated as "trend wells." These wells were selected for regular sampling to monitor for saltwater "upconing," the transient upwelling of saline groundwater that can occur in response to the local removal of fresh groundwater by supply wells, and for the more regional phenomenon of lateral saltwater intrusion in the Coastal Plain aquifer system. In 2023, the list of regularly sampled trend stations was expanded to include three recently installed wells, including SOW 253A (see above). In addition, DEQ geologists collected discrete or "spot" samples at various wells of interest, including a recently installed cluster of State Observation Wells in Southampton County. Planned spot sampling in 2024 will include newly installed CRN wells. Ambient groundwater quality sampling data are available through the national Water Quality Portal (https://www.waterqualitydata.us/).

In 2023, the GCMP also participated in a one-time effort, funded by Virginia's General Assembly, to sample groundwater for per- and polyfluoroalkyl substances (PFAS). DEQ engaged the U.S. Geological Survey in a joint effort to collect groundwater samples for PFAS analyses, in addition to the usual analyses, at selected trend wells and spot wells in the Coastal Plain aquifer system. The overall results indicated that PFAS were not present in the confined aquifer system at the selected well locations.

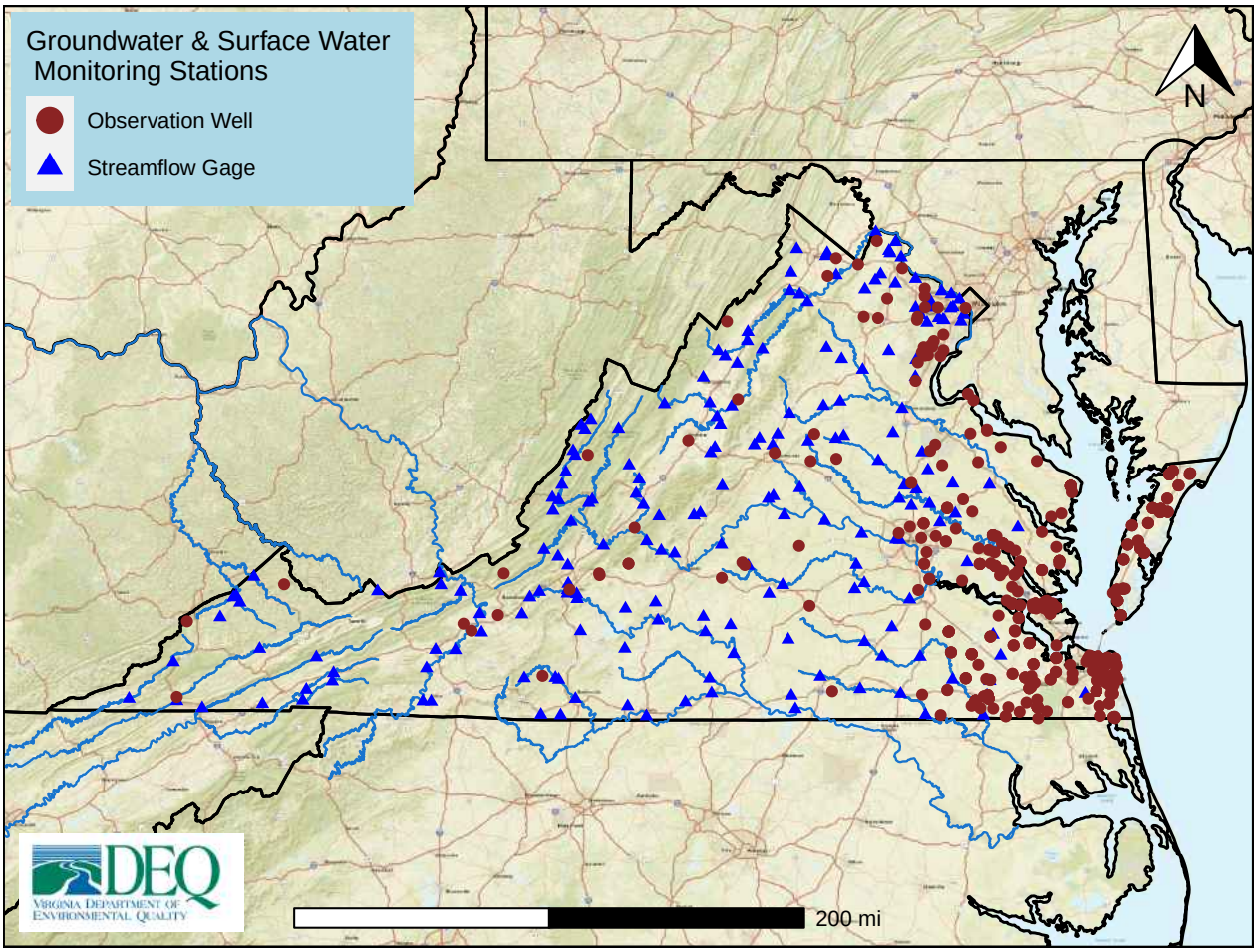
## 1.7 Surface Water Investigations

DEQ's Surface Water Investigations Program (SWIP) and the USGS National Streamflow Information Program are the primary entities responsible for collecting surface hydrologic data in Virginia. Their collaboration provides a comprehensive picture of real-time and historical hydrologic conditions in the Commonwealth. The SWIP mission is the systematic collection of reliable hydrologic data concerning the quantity of surface water in the Commonwealth, using the same standards and procedures as the USGS. Virginia is currently the only state partnering with the USGS on the collection of real-time streamflow data where state-collected data are incorporated directly into the USGS database. Data accuracy, attained through use of state-of-the-art equipment and personnel training in USGS methods, is the key to maintaining this unique partnership.

SWIP field personnel collected and processed data from the network of 78 surface water discharge monitoring stations on a six to eight week schedule, or more frequently in times of drought or flood. Monitoring often occurs in extreme conditions such as low and high water, and involves the servicing of sensitive equipment, maintaining permanent gauging stations, and measuring streamflow ("discharge"). The data obtained from each surface water discharge monitoring station is continually measured and uploaded into the USGS National Water Information System (NWIS) database where it is accessible by citizens, localities, and state and federal agencies for water supply planning, emergency management response planning, water withdrawal permitting, and natural resource management purposes. Development of and access to these data are essential for the successful planning and management of the Commonwealth's water resources.

Figure 5 provides a spatial overview of active surface water and groundwater monitoring stations in Virginia.

Figure 5: Groundwater and Surface Water Monitoring Stations




## 1.8 Drought Assessment and Response

Since the adoption of the Virginia Drought Assessment and Response Plan in 2003, drought watch declarations have been issued for various regions nearly every year with drought warning declarations occurring less frequently. A Drought Emergency declaration has not been issued since the 2002 drought.

Moderate to severe drought conditions existed across much of the Commonwealth throughout 2023. Drought evaluation regions are shown in Figure 6. Drought watches were issued in April for the Chowan, Eastern Shore, Northern Coastal Plain, Southeast Virginia, and York-James evaluation regions. Watch conditions persisted through May with improved conditions resulting in the drought watch advisories being lifted for the Chowan, Northern Coastal Plain, Southeast Virginia, and York-James regions. Throughout late spring, dry conditions continued to develop within the Shenandoah, Northern Virginia, Northern Coastal Plain, and Northern Piedmont regions with drought watch being issued in June of 2023. El Niño–Southern Oscillation (ENSO)-neutral conditions transitioned to El Nino throughout the late spring and summer months, with significant precipitation occurring across most regions of Virginia during mid-July. As a result of improved conditions, drought watches were lifted for all regions except the Eastern Shore and Shenandoah.

Throughout June, July, and August, drought conditions improved across the majority of Virginia with significant precipitation events providing beneficial additions to surface water systems. Significant drought conditions persisted within the Shenandoah Valley, specifically as continued declines of surface water and

groundwater levels were observed throughout August. A drought warning advisory was issued for the Shenandoah at the end of August 2023 in response to increased reported impacts to agriculture, public water suppliers, and observed surface and groundwater indicators below the 5th percentile.

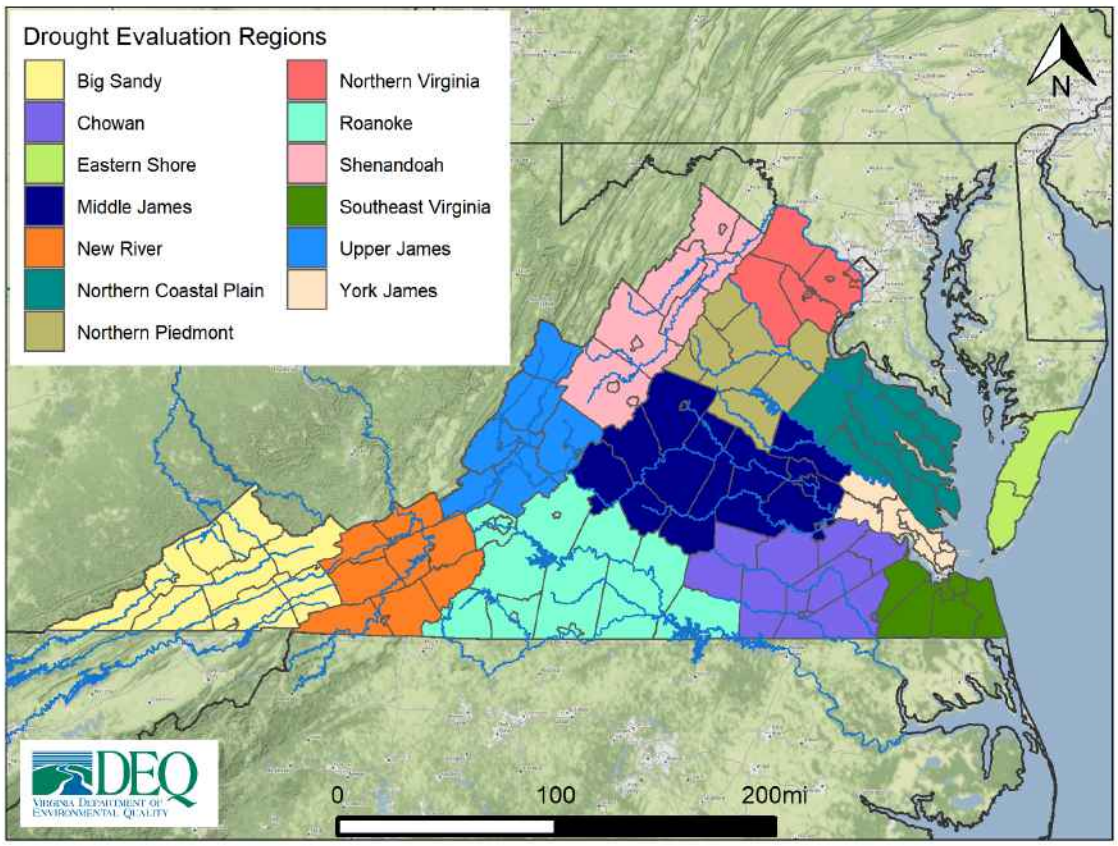
Declines of drought indicators were observed throughout September and October with severe hydrologic drought present throughout the Shenandoah. Drought watches were issued for the Northern Virginia and York-James drought evaluation regions. DEQ provided coordination and technical support on drought conditions and impacts to various stakeholder groups including the Northern Shenandoah Valley Regional Commission, Town of Strasburg, and other water users across the Commonwealth. The Virginia Department of Agriculture and Consumer Services reported extensive impacts to agricultural producers due to drought conditions to the Drought Monitoring Task force with federal disaster relief program information provided in DMTF reports.

Extensive hydrologic drought conditions persisted throughout the fall within the Shenandoah Valley with near record and record low observations recorded for some surface and groundwater monitoring stations in the region. Additional drought evaluation regions were included within the existing drought watch in November, including the Northern Piedmont, Roanoke, Upper James, and Middle James. During late November Lake Moomaw's available conservation storage was less than 17% remaining, while inflow to the reservoir continued to be significantly below the release flow. DEQ and the USACE continuously monitored reservoir levels and met with stakeholders and partner agencies to develop and implement a reduced minimum release from Gathright Dam to support the recovery of the lake to more normal storage levels. In December of 2023, with less than 2% of conservation storage remaining, DEQ, the Department of Wildlife Resources (DWR), and USACE, coordinated and implemented the 100 cfs release modification. The 100 cfs release aided in providing adequate water supply to manufacturing and public water supply facilities downstream of Lake Moomaw including Westrock and the Town of Covington. The release was agreed to be maintained until April 1, 2024, or when conservation storage recovered fully.

At the end of 2023, significant drought remained present with drought warning advisory continuing for the Shenandoah region. Drought watch advisories were present for the Big Sandy, Eastern Shore, Middle James, Northern Piedmont, Northern Virginia, Roanoke, Upper James, and York-James evaluation regions. Winter precipitation events provided significant recovery of drought indicators across the Commonwealth with all drought advisories lifted at the end of February 2024. In March of 2024, Lake Moomaw reached full conservation storage and continued normal operational procedures.

DEQ provides a drought indicator map that is updated daily and can be viewed online at Current Drought Conditions in Virginia.

Figure 6: Drought Evaluation Regions



# 2 Summary of 2023 Water Withdrawal Reporting

Chapter 2 provides a brief overview on how withdrawals are reported to DEQ, summarizes 2023 reported water withdrawals at the statewide level for all water use types, and compares 2023 reported withdrawals to the average use over the past five years. Also covered in this chapter are withdrawals categorized by source type (groundwater and surface water), as well as how withdrawals vary across the state.

## 2.1 Background on Water Withdrawal Reporting in Virginia

Most facilities report withdrawals to DEQ through the Annual Water Withdrawal Reporting program, and withdrawals can be reported online or by mail. Facilities that report water withdrawals in compliance with surface water and groundwater withdrawal permits are also included in this report.

A total of 1,174 facilities reported water withdrawals to DEQ for the calendar year 2023, which is similar to the number of facilities reporting in recent years. Some annual variation in the number of facilities reporting is expected as facilities cease or start operation. Facilities that fail to report to the Annual Water Withdrawal Reporting program also contribute to this variation. DEQ staff prioritize compliance contacts to such facilities on an annual basis using criteria such as the relative size of withdrawal to the source and the potential for in-stream or off-stream beneficial uses of the source or sources to be impacted by withdrawals in the area. Compliance for facilities with withdrawal permits is managed by the Withdrawal Permitting and Compliance program; permitted facilities that fail to report are addressed through compliance and enforcement processes in accordance with current guidance.

Water withdrawals reported to DEQ are categorized as coming from either a surface water source such as a stream (including rivers), reservoir, or spring, or a groundwater source such as a well or dug pond that intersects the groundwater table. Water withdrawn in the Commonwealth may be used by the withdrawing entity or locality, or it may be "transferred" to another entity or locality. While some water transfers are reported to DEQ, they are not included in the withdrawal data presented in this chapter since the water is accounted for when it is initially withdrawn from the source. More information on water transfers reported to DEQ can be found in Appendix 4.

Water withdrawals are further categorized into use types according to how the water is used. Use type categories include: Agriculture, Commercial, Fossil Power, Irrigation, Manufacturing, Mining, Nuclear Power, and Public Water Supply. Specifics of what each of the use type categories includes can be found in Chapter 3, Sections 3.3 - 3.9.

DEQ staff continuously strive to improve the accuracy of reported withdrawal amounts and classification of data through a proactive data quality assurance/quality control process. Improvements in previously published data sets occur due to identification and correction of errors. As such, minor changes may be noted when comparing current data to prior publications of this report.

## 2.2 Consumptive Use

Although some portion of a withdrawal is generally returned to the source, facilities are required to report "gross" withdrawals to DEQ. In other words, the withdrawal totals in this report do not account for water returned back to a source through discharges or other means. The proportion of a withdrawal that is not returned to a source, for example water that infiltrates into the ground via irrigation or discharge into septic systems, or is lost to treatment processes or leaks, is considered "consumptive use."

DEQ accounts for the consumptive use of a facility when evaluating a permit application. However, because consumptive use can vary significantly across use-types and even across facilities within the same use type, it is not practical to account for consumptive use in this report. Figure 7 provides ranges of consumptive use across use-types, and shows how these varying consumptive use rates would affect how a surface water withdrawal impacts flow in a stream.[6] Agriculture and irrigation have very high consumptive use as the water applied to those uses does not generally return to a stream in a manner that can be readily measured. Consumptive use for public water supply varies seasonally with higher consumptive use during the summer when irrigation increases and minimal consumptive use during the winter. Consumptive use for industrial facilities varies based on the specific water use, but most industrial facilities have low consumptive use. Power generation facilities that use water for once-through cooling systems return almost all water to the source.

Consumptive use also varies by source; while groundwater withdrawals from confined aquifers may be returned to surface water streams via discharges, they are not returned to the source aquifer so they are considered entirely consumptive in terms of their impact on the aquifer.

For more information on this subject, see the recent publication produced by DEQ and Virginia Tech which provides a review of consumptive use values across use types and discusses methodologies for estimating consumptive use.[7]

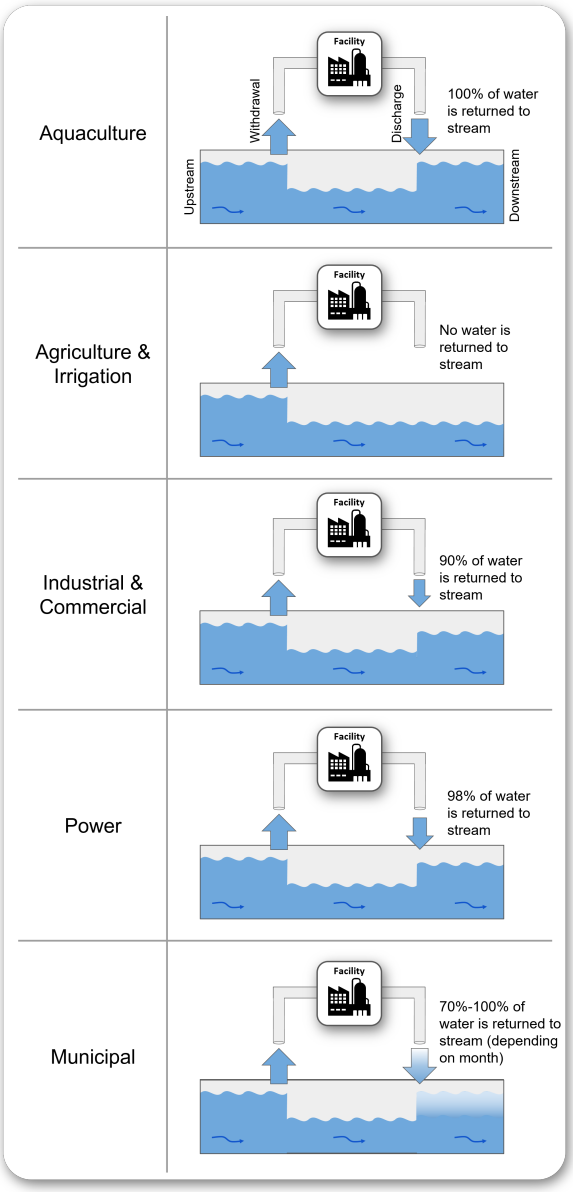



Figure 7: Impact of Consumptive Use Across Use-Types on a Source Stream

[6] 2020 Virginia State Water Resources Plan (Section 4.2.6.1 Estimating Consumptive Use Factors).

[7] McCarthy, M., Brogan, C., Shortridge, J., Burgholzer, R., Kleiner, J., and Scott, D., 2022, *Estimating Facility-Level Monthly Water Consumption of Commercial, Industrial, Municipal, and Thermoelectric Users in Virginia*: Journal of the American Water Resources Association, https://doi.org/10.1111/1752-1688.13037.

## 2.3 2023 Reported Withdrawals

A summary of water withdrawals reported to DEQ from 2019-2023 is represented in Table 1. Total reported withdrawals in 2023 were approximately 5.26 billion gallons per day (BGD), including the cooling water withdrawals at nuclear and fossil fuel power generation facilities, which make up 76% of this total. The total reported withdrawal is a 6.1% decrease from the five-year average of 5.61 BGD. The decrease is primarily due to a reduction in surface water withdrawals reported for power generation. Because withdrawals associated with power generation are around 3.5 times greater than all other reported withdrawals, and are also largely non-consumptive, this report generally discusses withdrawals with power generation excluded. This lessens the likelihood that trends in reported use for other use categories are being obscured.

Excluding power generation, reported withdrawals totaled 1.26 BGD, which represents a 1.3% increase compared to the five-year average (2019-2023). The 2023 total excluding power generation is comparable to 2022, although slightly lower. The increase in reported use over the last five years is largely driven by increased withdrawals from public water supply facilities. Despite successes in reducing per capita water use, reported public water supply withdrawals have steadily increased over the last fifteen years as Virginia's population continues to grow in the urban and suburban areas served by water utilities. Reported use for many categories dropped in 2020 due to economic and social impacts from the COVID-19 pandemic. Though total reported withdrawals excluding power generation dropped in 2020, total volume has remained above pre-pandemic levels since 2021. A detailed discussion of reported withdrawals for each of the use types in Table 1 is provided in Chapter 3.

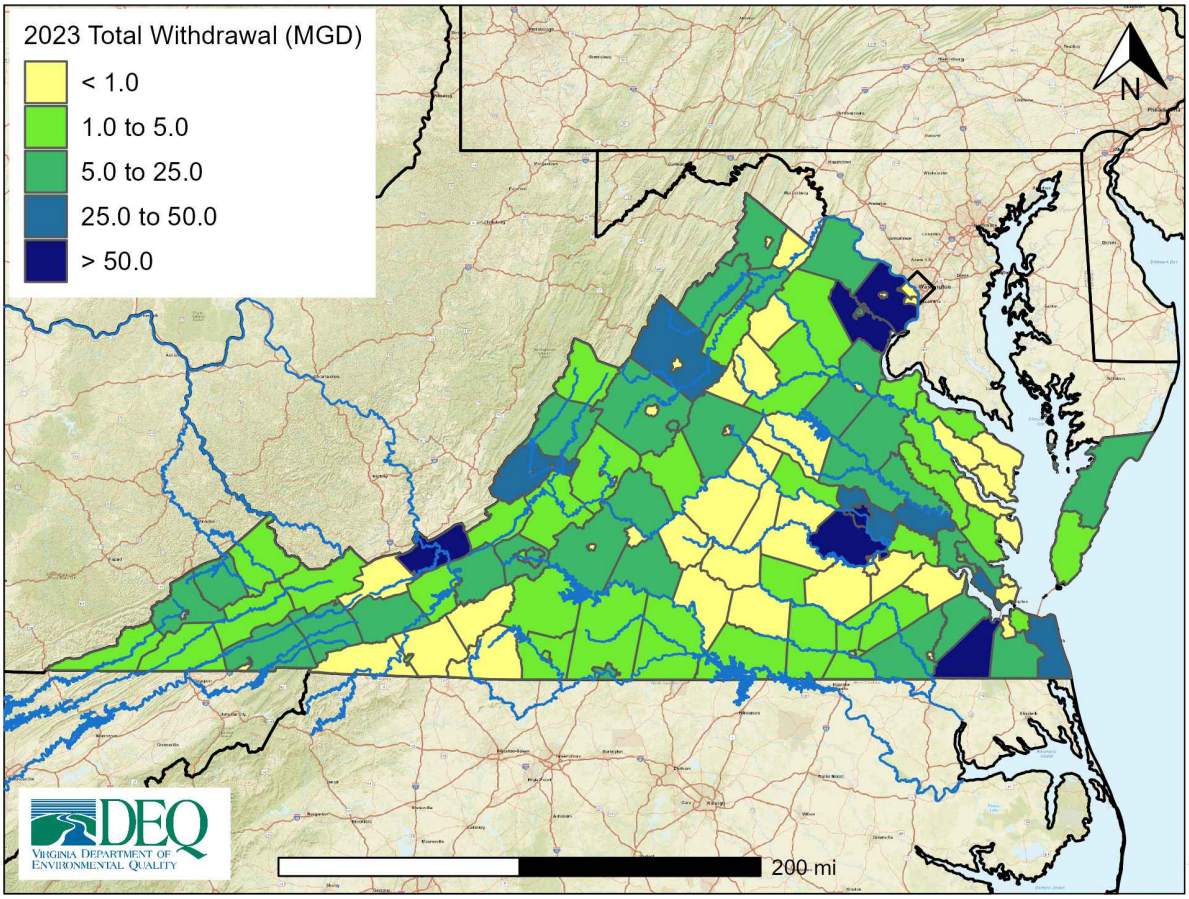
Table 1: Summary of Virginia Water Withdrawals by Use Category and Source Type 2019 - 2023 (MGD)

| Category | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| **Groundwater** | | | | | | | |
| Agriculture | 1.22 | 1.33 | 1.30 | 1.43 | 1.30 | 1.32 | -1.5 |
| Commercial | 4.52 | 3.64 | 4.11 | 4.02 | 4.27 | 4.11 | 3.9 |
| Irrigation | 2.01 | 1.93 | 1.89 | 1.75 | 1.45 | 1.81 | -19.9 |
| Manufacturing | 57.76 | 58.00 | 59.67 | 57.47 | 56.11 | 57.80 | -2.9 |
| Mining | 17.57 | 19.69 | 20.72 | 19.34 | 10.04 | 17.47 | -42.5 |
| Public Water Supply | 55.13 | 55.82 | 59.75 | 59.14 | 59.67 | 57.90 | 3.1 |
| Fossil Power | 0.07 | 0.07 | 0.06 | 0.07 | 0.08 | 0.07 | 14.3 |
| Nuclear Power | 0.37 | 0.36 | 0.37 | 0.29 | 0.38 | 0.35 | 8.6 |
| **Surface Water** | | | | | | | |
| Agriculture | 30.98 | 29.73 | 28.58 | 26.92 | 25.28 | 28.30 | -10.7 |
| Commercial | 9.94 | 6.38 | 8.82 | 7.79 | 9.60 | 8.51 | 12.8 |
| Irrigation | 20.59 | 16.21 | 21.64 | 19.17 | 20.78 | 19.68 | 5.6 |
| Manufacturing | 293.49 | 301.92 | 309.55 | 303.17 | 298.19 | 301.26 | -1.0 |
| Mining | 13.74 | 15.62 | 12.91 | 10.99 | 11.32 | 12.92 | -12.4 |
| Public Water Supply | 727.44 | 671.65 | 744.07 | 764.02 | 763.08 | 734.05 | 4.0 |
| Fossil Power | 752.18 | 635.84 | 732.32 | 751.66 | 449.84 | 664.37 | -32.3 |
| Nuclear Power | 3739.35 | 3863.89 | 3656.36 | 3678.73 | 3552.99 | 3698.26 | -3.9 |
| **Total (GW + SW)** | | | | | | | |
| Agriculture | 32.20 | 31.06 | 29.88 | 28.35 | 26.59 | 29.62 | -10.2 |
| Commercial | 14.46 | 10.02 | 12.94 | 11.81 | 13.87 | 12.62 | 9.9 |
| Irrigation | 22.59 | 18.15 | 23.54 | 20.92 | 22.23 | 21.49 | 3.4 |
| Manufacturing | 351.25 | 359.92 | 369.22 | 360.64 | 354.30 | 359.07 | -1.3 |
| Mining | 31.31 | 35.31 | 33.63 | 30.33 | 21.36 | 30.39 | -29.7 |
| Public Water Supply | 782.56 | 727.47 | 803.82 | 823.16 | 822.75 | 791.95 | 3.9 |
| Fossil Power | 752.25 | 635.91 | 732.38 | 751.73 | 449.92 | 664.44 | -32.3 |
| Nuclear Power | 3739.73 | 3864.26 | 3656.73 | 3679.03 | 3553.37 | 3698.62 | -3.9 |
| **Total - without power** | | | | | | | |
| Total Groundwater | 138.21 | 140.42 | 147.45 | 143.15 | 132.86 | 140.42 | -5.4 |
| Total Surface Water | 1096.17 | 1041.51 | 1125.58 | 1132.07 | 1128.24 | 1104.71 | 2.1 |
| **Total (Gw + Sw)** | **1234.38** | **1181.93** | **1273.03** | **1275.22** | **1261.10** | **1245.13** | **1.3** |
| **Total - power only** | | | | | | | |
| Total Groundwater | 0.44 | 0.43 | 0.44 | 0.36 | 0.45 | 0.42 | 7.1 |
| Total Surface Water | 4491.53 | 4499.73 | 4388.68 | 4430.39 | 4002.83 | 4362.63 | -8.2 |
| **Total (Gw + Sw)** | **4491.97** | **4500.17** | **4389.12** | **4430.75** | **4003.28** | **4363.06** | **-8.2** |
| **Total All Categories** | | | | | | | |
| **Total (Gw + Sw)** | **5726.36** | **5682.11** | **5662.15** | **5705.98** | **5264.39** | **5608.20** | **-6.1** |

## 2.4 2023 Reported Water Withdrawals by Locality

Demand for water varies considerably across Virginia. Figure 8 shows the total 2023 reported withdrawals excluding power generation within each locality. The largest withdrawals were reported across major population centers, including Northern Virginia, the greater Richmond area, and the Tidewater area. Localities with significant industrial and mining facilities such as Giles County can influence overall demands.

Figure 8: 2023 Total Reported Water Withdrawals By Locality Excluding Power Generation




Excluding power generation, the City of Hopewell has the highest total 2023 reported water use resulting from industrial facilities that withdraw from the tidal James River. The City of Suffolk, which contains two public water supply reservoirs operated by the City of Norfolk, as well as the counties of Chesterfield, Fairfax, and Prince William make up the remainder of the top 5 localities. The City of Suffolk, Fairfax County, and Prince William County's withdrawals are primarily for providing public water supply to the large urban/suburban regions. Chesterfield has significant users in manufacturing as well as public water supply.

2023 reported withdrawals for each locality can be found in Table 21 located in Appendix 2.

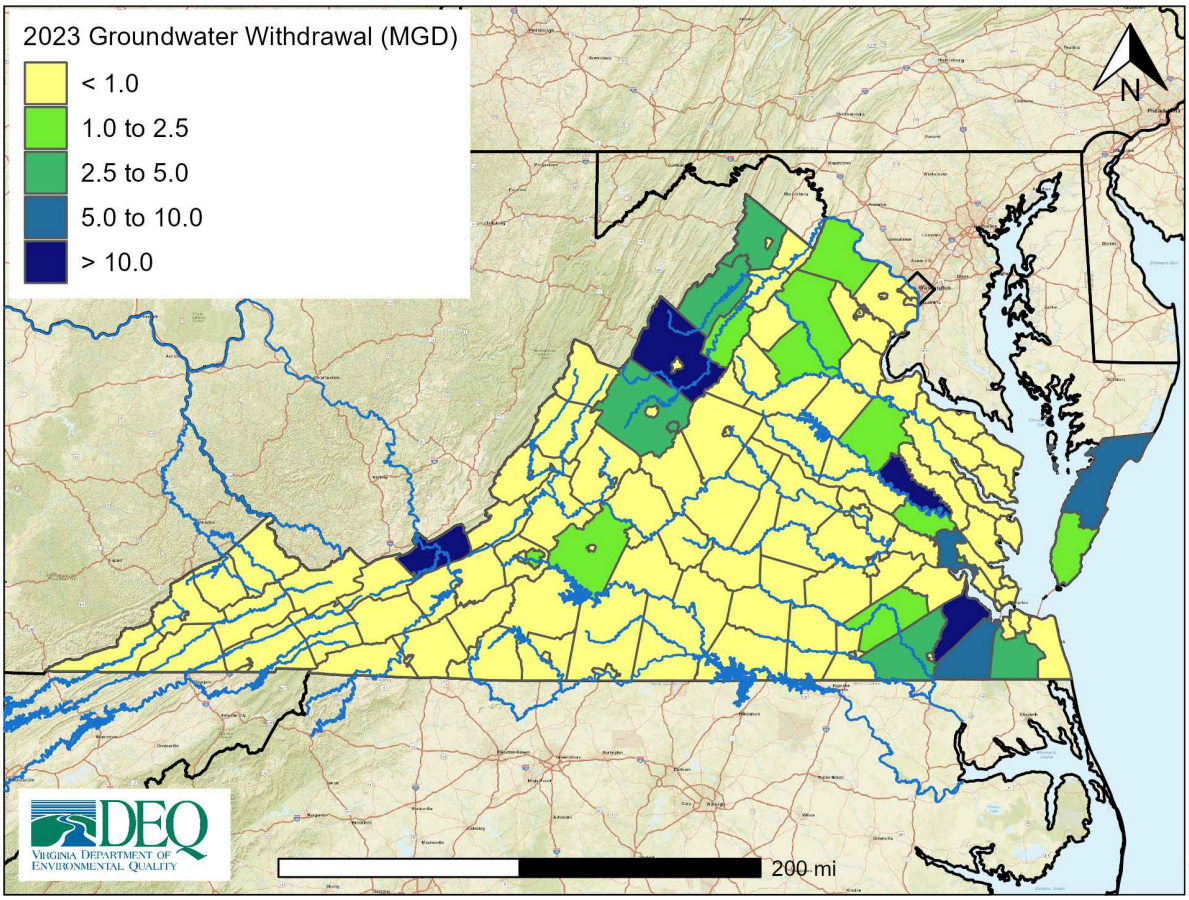
## 2.5 2023 Reported Water Withdrawals by Source Type

When comparing reported withdrawals based on the type of source (surface water or groundwater), there are several historic trends that continued in 2023. Surface water sources (streams, reservoirs, and springs) continued to supply the vast majority of water needs in Virginia, including for nuclear power facilities, large industrial facilities, and large public water suppliers that serve the major population centers of Virginia. In 2023, surface water sources comprised 89% of total reported withdrawals when excluding power generation, which is consistent with the average proportion over the last five years. Groundwater use is most prevalent in the Coastal Plain areas east of Interstate 95 and on the Eastern Shore where confined aquifers provide reliable and high quality water to areas with limited access to fresh surface water. Groundwater also supplies most rural public water supplies and small self-supplied facilities across use-types for which the relative affordability and accessibility of groundwater is crucial. The following section covers 2023 reported withdrawals categorized by groundwater and surface water in more detail.

**Groundwater:** As indicated in Table 1, 2023 reported withdrawals from groundwater sources excluding power generation totaled 133 MGD, which is a decrease of 5.4% when compared to the five-year average. There was a slight drop in use of groundwater in the irrigation, manufacturing, and agriculture categories. Mining had the largest impact on this overall decrease, decreasing by 42.5% in 2023 compared to the five-year average. The commercial and public water supply categories reported increases in withdrawals compared to the five-year averages for 2023, although both stayed very consistent with 2022. Public water supply facilities reported 59.7 MGD in withdrawals from groundwater sources, a 3.1% increase from the five-year average. Overall, groundwater use for public water supply has shown an increasing trend over the last five years. This trend is likely to continue to the extent that groundwater remains the most practical source for portions of the Commonwealth that are experiencing population growth, such as the Tidewater region, and along the I-95 corridor.

Cumulative reported groundwater withdrawals within each locality are shown in Figure 9. For most localities in Virginia, reported groundwater use remains below 1 MGD. The largest reported groundwater withdrawals in 2023 continued to be from industrial facilities located in Isle of Wight and King William counties. Due to decreases in mining use, Rockingham County surpassed Giles County in groundwater withdrawals. Significant groundwater withdrawals are also evident in the Tidewater region where many public water suppliers, including the cities of Suffolk, Norfolk, as well as James City County, use groundwater as their primary source or as a supplement to surface water. Groundwater use in areas such as the Eastern Shore and the Shenandoah Valley is relatively higher than other parts of the state due to several factors, including the limited availability of surface water, a higher relative concentration of reporting agricultural facilities, and the presence of one or more industrial facilities that rely on groundwater as their primary source.

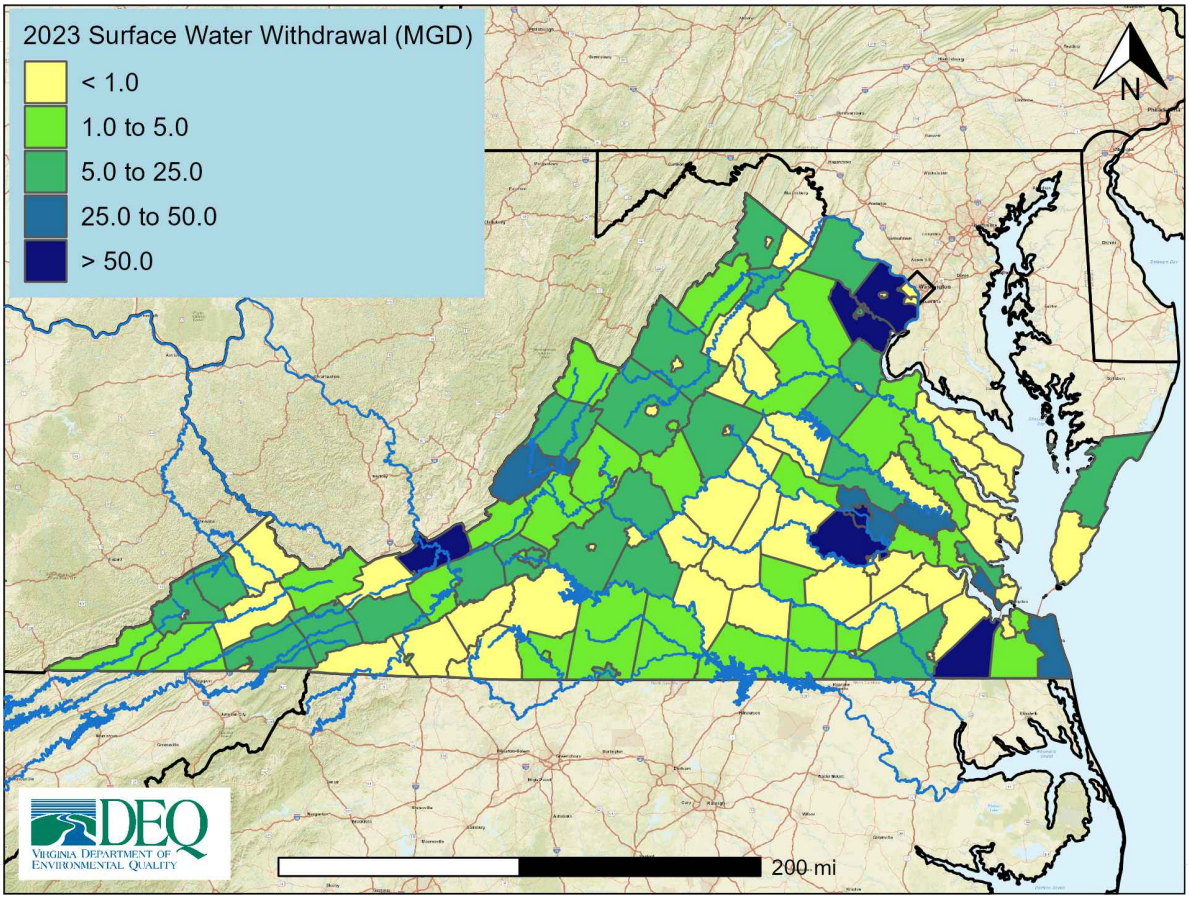
Figure 9: 2023 Groundwater Withdrawals by Locality



**Surface Water:** Total reported surface water withdrawals in 2023 decreased by 6.1% compared to the five-year average, which is a result of a 32.3% reduction in withdrawals for fossil power, as well as a 3.9% reduction in withdrawals for nuclear power. However, when excluding power generation, reported surface water withdrawals for 2023 totaled 1128 MGD, an increase of 2.1% compared to the five-year average. Public water supply withdrawals for surface water continue to increase consistently due to population growth in the metropolitan areas primarily served by surface water. Reported surface water withdrawals for agriculture and mining decreased by approximately 11% and 12% respectively compared to the average, while commercial increased by 13%.

Cumulative reported surface water withdrawals within each locality are shown in Figure 10. Surface water withdrawals were distributed widely across the state and were greatest around cities and counties with dense population centers and significant manufacturing water uses. The largest reported surface water withdrawals occurred within the City of Hopewell, Chesterfield County, and Fairfax County, driven by public water supply facilities in Fairfax County and Chesterfield County, as well as manufacturing facilities in the City of Hopewell and Chesterfield County. In addition, agriculture and irrigation use of surface water is spread throughout Virginia, although focused in more rural counties.

Figure 10: 2023 Surface Water Withdrawals by Locality



## 2.6 2023 Permitted and Unpermitted (Excluded) Withdrawals

Unpermitted withdrawals make up a large portion of the total reported withdrawals within Virginia. Table 2 compares reported withdrawals from users that hold a VWP surface water withdrawal or groundwater withdrawal permit and reported withdrawals from unpermitted facilities.[8] Unpermitted surface water withdrawals include withdrawals that are excluded from VWP permitting requirements pursuant to §62.1-44.15:22 of the Code of Virginia or 9VAC25-210-310, based on exclusions related to the size, age, and purpose of the withdrawal. Unpermitted groundwater withdrawals are those not required to obtain a groundwater withdrawal permit under the Ground Water Management Act of 1992. These include withdrawals located outside of a groundwater management area, those that withdraw less than 300,000 gallons in any month, and those that are otherwise excluded pursuant to 9VAC25-610-50.

In 2023, unpermitted withdrawals represented approximately 73% of the total reported withdrawals in Virginia when excluding power generation. The majority of unpermitted withdrawals come from surface water sources, with 76% of reported surface water withdrawals associated with unpermitted facilities. About half of reported groundwater withdrawals (51%) are from users operating under a Groundwater Withdrawal Permit. Of the top 20 largest reported withdrawals in 2023, 12 are from facilities that are unpermitted (see Table 20).

Table 2: 2023 Permitted and Unpermitted (Excluded) By Use Type Withdrawals (MGD)

| | **Annual Withdrawal Amount** | | **% of Total** | |
|---|---|---|---|---|
| **Use Type** | **Unpermitted** | **Permitted** | **Unpermitted** | **Permitted** |
| **Groundwater** | | | | |
| Agriculture | 0.24 | 1.06 | 0.18 | 0.80 |
| Commercial | 2.33 | 1.94 | 1.75 | 1.46 |
| Irrigation | 0.26 | 1.20 | 0.19 | 0.90 |
| Manufacturing | 19.91 | 36.20 | 14.99 | 27.25 |
| Mining | 10.04 | 0.00 | 7.56 | 0.00 |
| Public Water Supply | 31.96 | 27.71 | 24.06 | 20.86 |
| **Total Groundwater** | **64.74** | **68.12** | **48.73** | **51.27** |
| **Surface Water** | | | | |
| Agriculture | 24.93 | 0.36 | 2.21 | 0.03 |
| Commercial | 8.19 | 1.41 | 0.73 | 0.12 |
| Irrigation | 20.53 | 0.24 | 1.82 | 0.02 |
| Manufacturing | 287.79 | 10.39 | 25.51 | 0.92 |
| Mining | 11.26 | 0.06 | 1.00 | 0.01 |
| Public Water Supply | 505.21 | 257.87 | 44.78 | 22.86 |
| **Total Surface Water** | **857.91** | **270.33** | **76.04** | **23.96** |

The largest unpermitted groundwater withdrawals are for manufacturing/industrial facilities, mining facilities, and public water supply facilities located outside of the groundwater management areas. Withdrawals for public water supply were the largest contributor to total groundwater withdrawals. In 2023, 24.1% of the total reported groundwater withdrawals were associated with unpermitted public water supply facilities located outside groundwater management areas. Note that groundwater withdrawals for domestic and private well use are not included in the reported use totals, as such use falls below the reporting threshold and is not required to be reported to DEQ.

As with groundwater, unpermitted surface water withdrawals in 2023 were dominated by withdrawals associated with public water supply and manufacturing facilities. Withdrawals from unpermitted public water

[8] Currently unpermitted facilities that have applied for withdrawal permits, and whose applications are currently under review, are counted as permitted withdrawals for the purpose of this table.

supply facilities made up 66.2% of the total reported public water supply surface water withdrawal volume in 2023, while unpermitted manufacturing facilities made up 96.5% of the total reported manufacturing surface water volume. Unpermitted withdrawals, whether groundwater or surface water, continue to present a significant challenge for management of the resource. More information on measures DEQ is taking to better evaluate the impacts from unpermitted users is provided in Chapter 4 of this report.

Unreported unpermitted withdrawals are not represented in Table 2, however unreported withdrawals are of interest to DEQ. These withdrawals consist primarily of those that do not exceed the reporting thresholds for their use type as stated in 9VAC25-200-30. Trends in increased private groundwater well completion reports received by DEQ and VDH point to an increase in private groundwater well construction. Since 2016, 14,483 wells have been registered with DEQ through electronic submission; 2,655 wells were registered electronically with DEQ in 2023 alone. DEQ also receives well abandonment reports, either for wells that had been registered with DEQ or those constructed prior to 2016. DEQ has received 2,232 abandonment reports, accounting for 15.4% of registered wells. This means that, at most, 12,251 of these registered wells are currently active.

Though water withdrawal data is not collected with groundwater well completion reports, the increase in private well construction can be viewed as a metric for evaluating increasing unreported and unpermitted groundwater withdrawals. Unreported and unpermitted withdrawals also include users who may be withdrawing above the thresholds requiring reporting but are not in compliance with the regulation. Identification of such users is an ongoing effort for DEQ. More details on how DEQ continues to address this challenge can be found in Chapter 4.

# 3 Water Withdrawals By Use Category

Chapter 3 provides an overview of water withdrawal reporting for the year 2023, as well as comparisons to recent years reporting, for each water withdrawal use type. Water withdrawals reported annually to DEQ are grouped into the following categories:

- 3.3 Public Water Supply - includes water withdrawn and treated to produce water to supply municipal and non-municipal water systems that primarily provide residential use. Such systems may also supply commercial and industrial facilities located within their service area. Public water supply does not include private and domestic well withdrawals under 300,000 gallons per month, which are not required to be reported.
- 3.4 Agriculture - includes water withdrawn for raising livestock, fish farming/hatcheries, and general farm use, but does not include water used for crop irrigation.
- 3.5 Irrigation - includes water withdrawn to promote crop growth, including but not limited to tobacco, corn, soybeans, turf grass, and nursery products.
- 3.6 Commercial - includes water withdrawn for use by golf courses, local and federal installations, hotels, resorts, and correctional centers, among others.
- 3.7 Mining - includes water withdrawn for pit dewatering, excavation, processing, and removal of bulk products such as coal, rock, sand, and gravel.
- 3.8 Manufacturing - includes water withdrawn for use by industrial facilities that generally produce goods such as paper mills, food processors, pharmaceutical companies, furniture manufacturing, and concrete plants, among others.
- 3.9 Power Generation - includes water withdrawn for fossil fuel power and nuclear power. Withdrawals or diversions of water for hydroelectric power (hydropower) generation are nearly all non-consumptive and are exempt from the annual water withdrawal reporting requirements.

## 3.1 Water Use by Use Category At A Glance

Figure 11 compares the average total water withdrawals from 2019 to 2023 totals for each use-type category, excluding power generation (nuclear power and fossil fuel power). Figures 12 and 13 split this comparison by source type as well. In summary, total withdrawals from public water supplies increased, while mining, manufacturing, and agriculture decreased compared to the 5-year average. Commercial and irrigation stayed mostly consistent. This led to an increase in the portion of public water supply and a decrease in mining, with only slight changes in the other categories. The public water supply and manufacturing use-types continue to be the largest withdrawals in the state, when excluding power generation.

Figure 11: Groundwater + Surface Water Withdrawals, 2019-2023 Average and 2023 Total

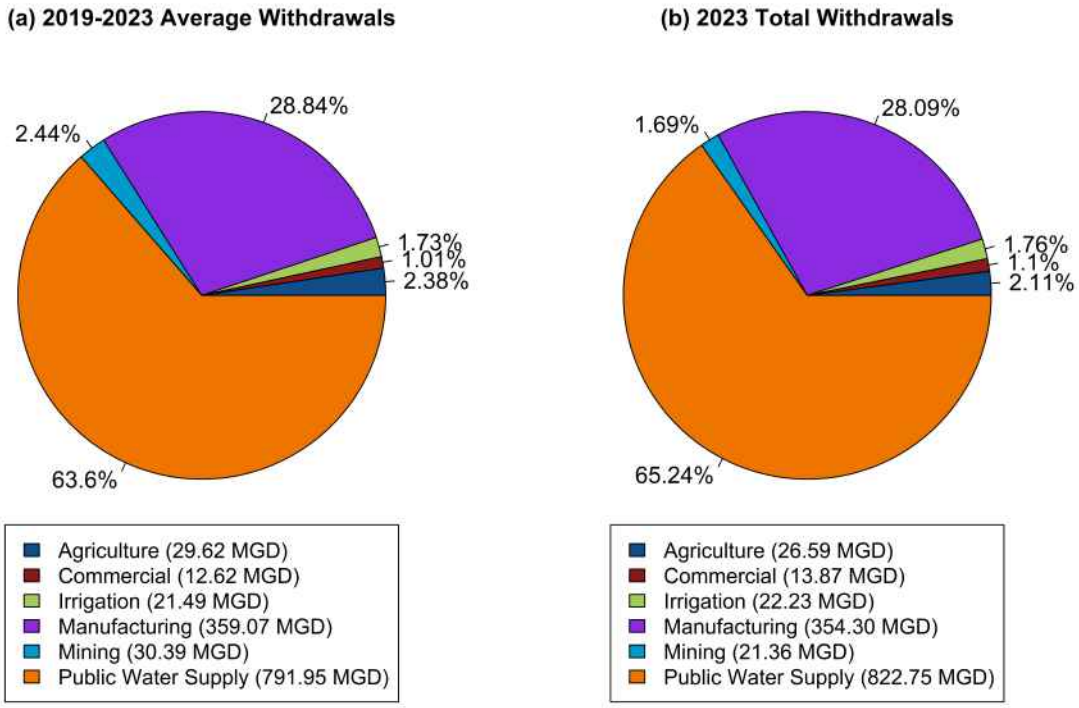


Figure 12: Groundwater Withdrawals, 2019-2023 Average and 2023 Total

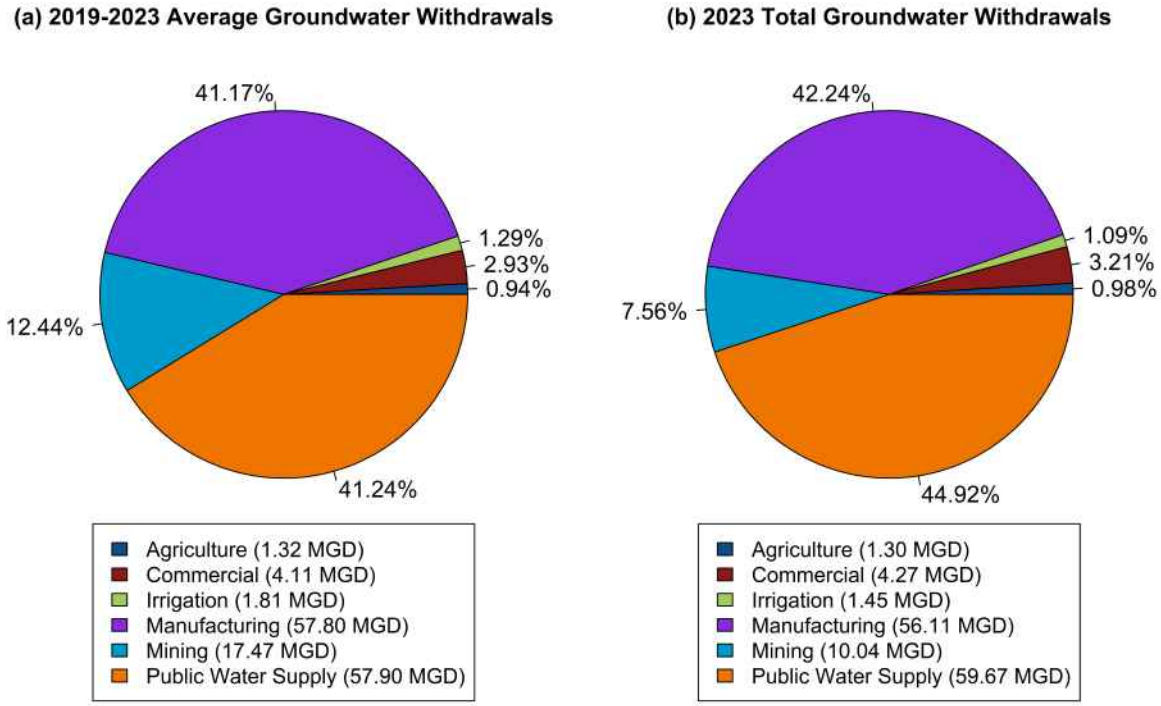
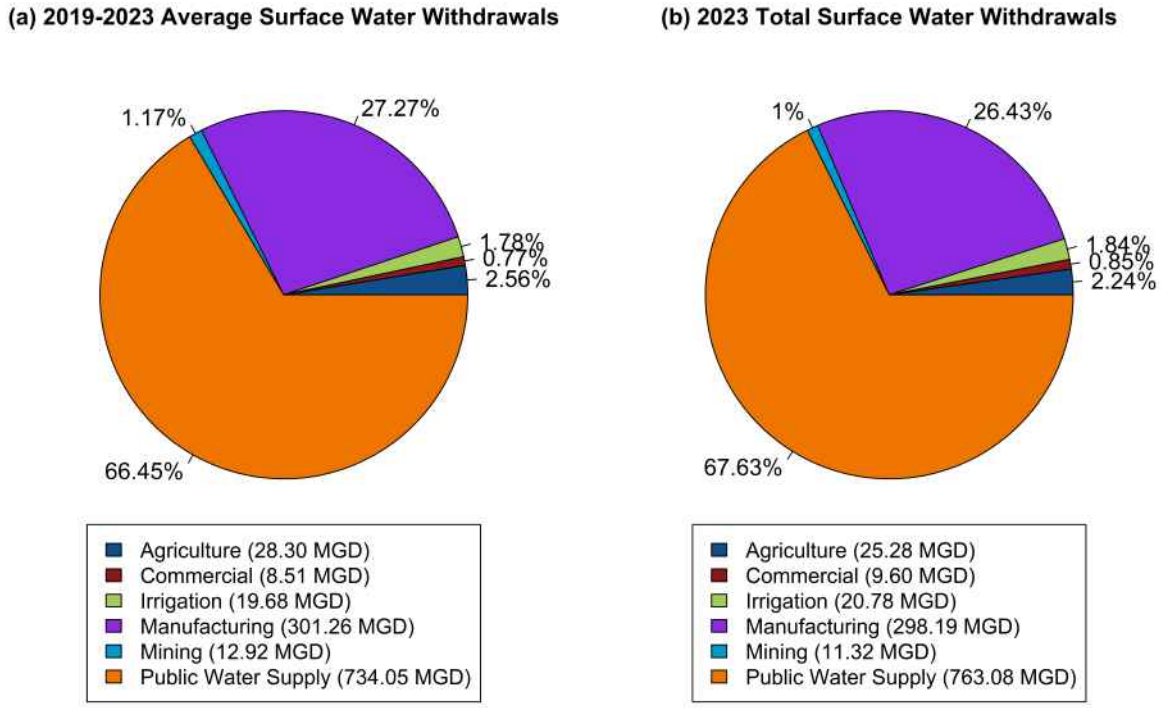



Figure 13: Surface Water Withdrawals, 2019-2023 Average and 2023 Total



## 3.2 Water Use Category Specific Section Overview

Each of the following sections includes the following for the relevant use-type category:

- A map depicting withdrawal point locations for each category, scaled by the magnitude of the 2023 reported annual withdrawal rate of individual measuring points (wells and surface water intakes)
- A table that lists reported withdrawals for the five-year period between 2019 and 2023 in terms of an annual average rate by source type (groundwater or surface water)
- A bar graph illustrating the reported quantity withdrawn for each source type (groundwater or surface water) between 2019 and 2023, as well as the withdrawal amounts relative to the five-year average
- A table listing facilities reporting the largest withdrawals for 2023, facility location, reported 2023 annual withdrawal rate, and the average annual withdrawal rate for the five-year period from 2019 to 2023

## 3.3 Public Water Supply

Water withdrawals for public water supply are primarily delivered to domestic users by both municipal and non-municipal community water systems; however, significant volumes are also delivered to commercial and industrial customers by water suppliers. Deliveries to specific users are generally not reported to DEQ; therefore, the reported withdrawals for public water supply do not differentiate between the categories of end users.

While most reporting public water systems are small systems that use groundwater (over 80%), the majority of the population in Virginia is served by large surface water systems with extensive service areas. The largest public water supply withdrawals are located within or near population centers such as the Washington D.C., Richmond, Hampton Roads, and Roanoke metropolitan areas. The largest public water supply purchases are located in the same areas, where water purveyors with large reservoirs or river withdrawals are able to supply both the population within their localities as well as, in some cases, neighboring localities. Smaller public water supply systems are spread throughout the state serving small towns or communities. Figure 14 shows spatial locations and size of water use of public water supply systems across the Commonwealth.

Figure 14: All 2023 Public Water Supply Water Withdrawals by Withdrawal Point Location

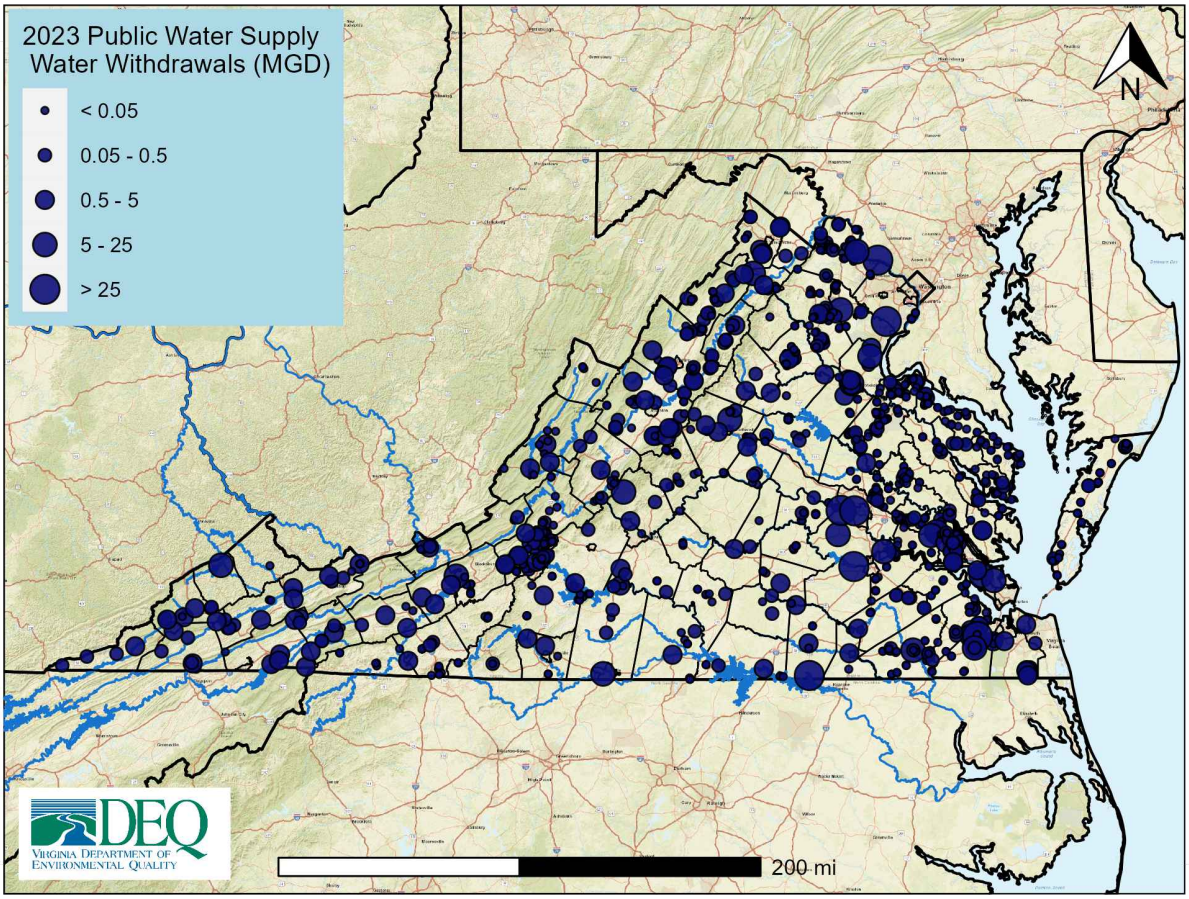


Table 3: 2019 - 2023 Public Water Supply Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 55.13 | 55.82 | 59.75 | 59.14 | 59.67 | 57.90 | 3.1 |
| Surface Water | 727.44 | 671.65 | 744.07 | 764.02 | 763.08 | 734.05 | 4.0 |
| **Total (GW + SW)** | **782.56** | **727.47** | **803.82** | **823.16** | **822.75** | **791.95** | **3.9** |

Water withdrawals for public water supply make up 65.2% of all non-power generation withdrawals in Virginia, so changes in this category can impact overall reported water use significantly. Reported 2023 water withdrawals for public water supply increased by 3.9% when compared to the five-year average (see Table 3). A 4.0% increase in reported surface water withdrawals for public water supply water is the major driver of overall increases in this category, as surface water supplied 92.7% of the total reported withdrawals for 2023 public water supply (see Figure 16). Reported groundwater withdrawals for public water supply increased by 3.1% compared to the five-year average.

There is an increasing trend in public water supply withdrawals reported over the last ten years (see Figure 15). Despite successes in reducing per capita water use, reported public water supply withdrawals have steadily increased over the last ten years as Virginia's population continues to grow in the urban and suburban areas served by public water supplies. Though reported public water supply withdrawals increased in 2023 compared to five-year average, withdrawals remained mostly consistent from 2022 to 2023. The decrease in 2020 public water supply use is an outlier largely attributed to temporary closures and other mitigation strategies due to the COVID-19 pandemic.

Tables 4 and 5 list the five public water supply facilities that reported the largest groundwater and surface water withdrawals in 2023 respectively. Table 6 displays information supplied by VDH regarding the number of public water supply systems by type and the total population served by all such systems.

Figure 15: 2014-2023 Public Water Supply Water Withdrawal Trend

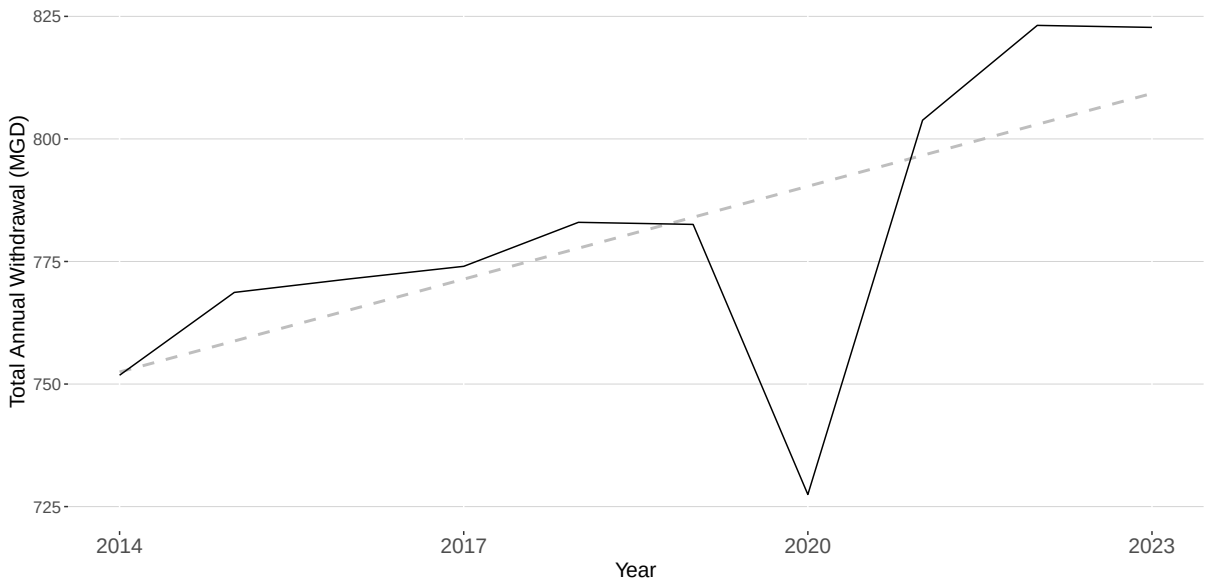


Table 4: Highest Reported Public Water Supply Groundwater Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| James City Service Authority Central System | James City County | GW | 5.2 | 5.2 |
| Western Tidewater Water Authority | City of Suffolk | GW | 3.6 | 3.9 |
| Northwest River/Western Branch Systems | City of Chesapeake | GW | 3.5 | 3.7 |
| Three Springs Service Area | Rockingham County | GW | 3.0 | 3.2 |
| Frederick County Sanitation Authority | Frederick County | GW | 2.3 | 2.9 |

Figure 16: 2019-2023 Public Water Supply Water Withdrawals by Source Type

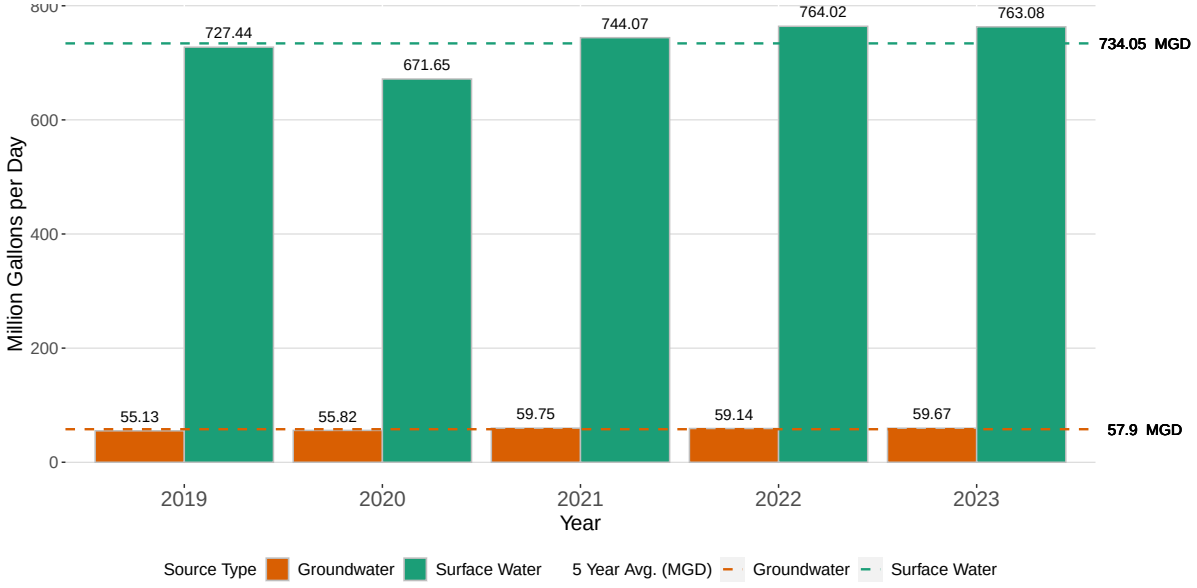


Table 5: Highest Reported Public Water Supply Surface Water Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Fairfax Water: Corbalis WTP | Fairfax County | SW | 85.7 | 86.2 |
| Fairfax Water: Griffith WTP | Prince William County | SW | 65.8 | 67.9 |
| City of Richmond WTP | City of Richmond | SW | 67.5 | 67.7 |
| City of Norfolk: Western Branch Reservoir | City of Suffolk | SW | 62.4 | 55.0 |
| Virginia Beach Service Area | Virginia Beach Service Area | SW | 32.1 | 38.5 |

Table 6: Number of Public Water Supply Systems and Population Served in 2023

| Category | Community Water Systems | Nontransient Noncommunity Water Systems | Transient Noncommunity Water Systems | Total |
|---|---|---|---|---|
| Number of Systems | 1,074 | 502 | 1,252 | 2,827 |
| Population Served | 7,312,108 | 278,499 | 196,500 | 7,787,107 |

## 3.4 Agriculture (Non-Irrigation)

Withdrawals for agriculture include non-irrigation withdrawals from livestock, poultry, and fish farms. Information concerning agricultural irrigation withdrawals is provided in the "Irrigation (Agricultural) Water Withdrawals" section 3.5 below. In total, withdrawals for non-irrigation agriculture make up 2.1% of all reported 2023 non-power generation withdrawals in Virginia. Figure 17 shows the spatial distribution of reported 2023 groundwater and surface water withdrawals for agricultural purposes statewide, with the highest number of withdrawals located on the Eastern Shore, within the Shenandoah Valley, and within the Virginia Coastal Plain. Table 7 provides the reported agriculture non-irrigation withdrawals in total as well as by source for the last five years. Overall, reported use in this category dropped by 10.2% compared to the five-year average, driven by reductions in surface water withdrawals. The majority of water withdrawn for agricultural use is obtained from surface water (see Figure 18), primarily via springs located in western Virginia that support fish farms and hatcheries, including those operated by the DWR. Reported 2023 surface water withdrawals for agriculture uses decreased by 10.7% compared to the five-year average. This continues the downward trend of surface water agricultural use.

Figure 17: All 2023 Agriculture (Non-Irrigation) Water Withdrawals by Withdrawal Point Location

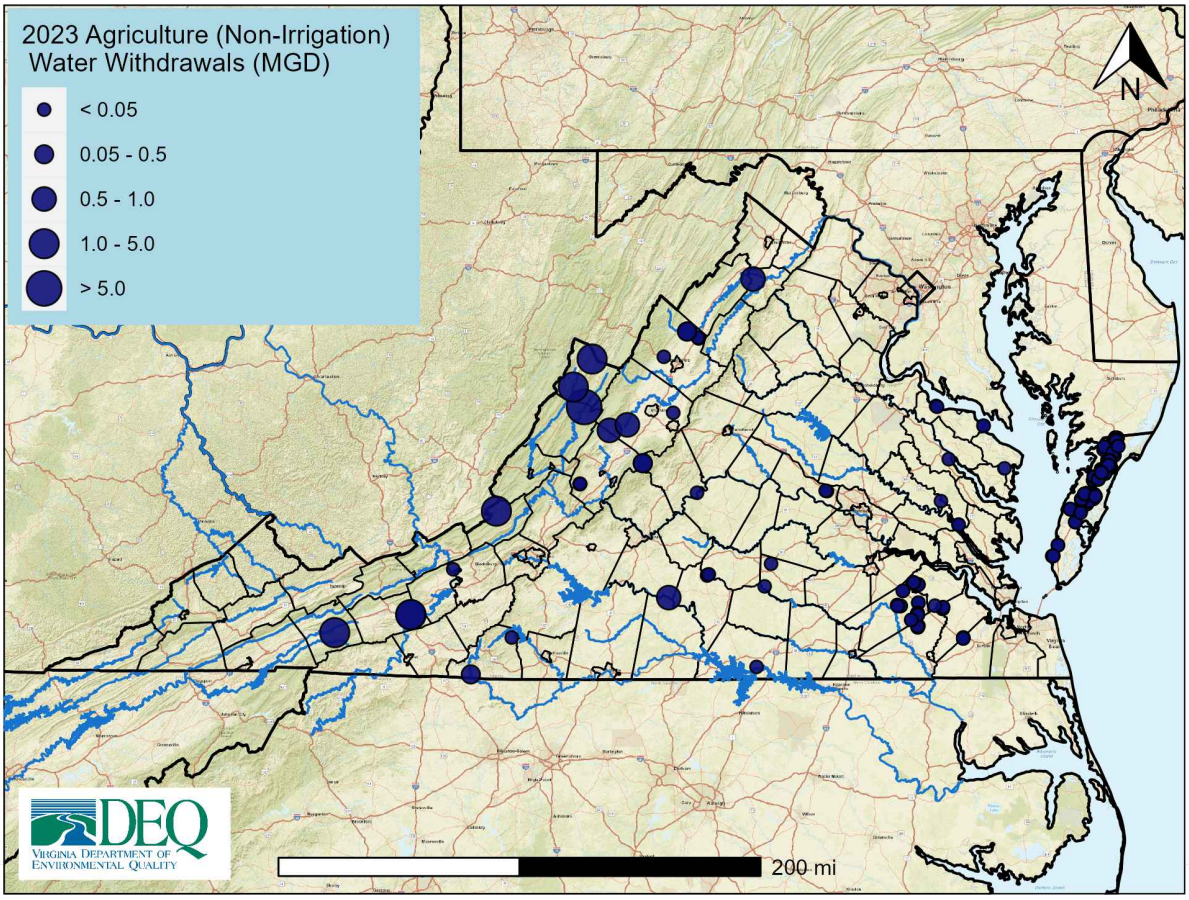
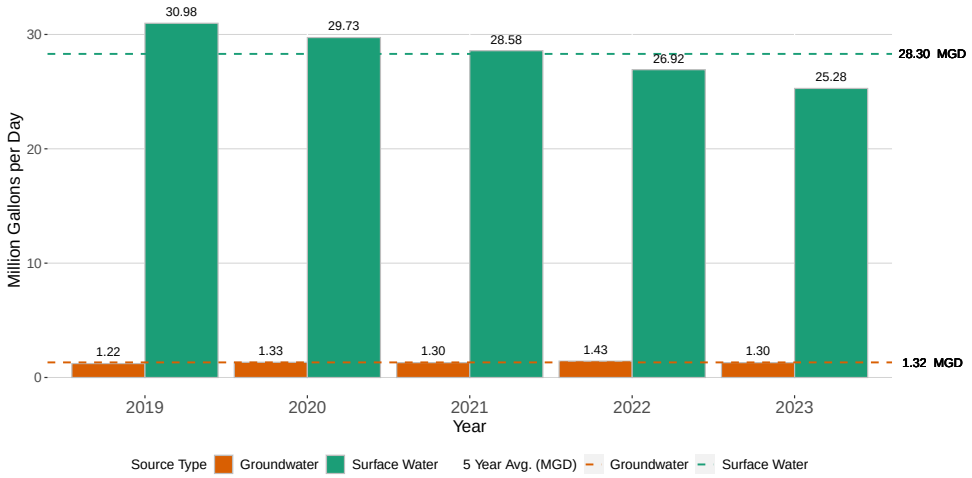


Table 7: 2019 - 2023 Agriculture Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 1.22 | 1.33 | 1.30 | 1.43 | 1.30 | 1.32 | -1.5 |
| Surface Water | 30.98 | 29.73 | 28.58 | 26.92 | 25.28 | 28.30 | -10.7 |
| **Total (GW + SW)** | **32.20** | **31.06** | **29.88** | **28.35** | **26.59** | **29.62** | **-10.2** |

Figure 18: 2019-2023 Agriculture Water Withdrawals by Source Type




Although surface water is the primary source by volume, the majority of farms reporting agriculture withdrawals make use of groundwater sources as well. Groundwater is generally used as a supplement for surface water during droughts or during high-flows where turbidity or water quality issues can create operational limitations for the use of surface water. Reported groundwater withdrawals decreased by 1.5% when compared to the five-year average, a decrease of approximately 20,000 gallons per day. Prior to 2023, reported groundwater withdrawals were increasing compared to the five-year average. Much of this increase was attributed to poultry facilities located on the Eastern Shore that started reporting in 2019 and 2020. Now that these facilities are more established, their groundwater withdrawals are less influential on this measure. There was a surge in use in 2022 from a series of hog farms in Sussex and Surry county that did not continue into 2023.

Table 8 lists the five facilities reporting the largest withdrawals for non-irrigation agriculture use in 2023, all of which are fish hatcheries. Note that most fish hatcheries typically have little to no consumptive use.

Table 8: Highest Reported Agriculture Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Coursey Springs Fish Cultural Station | Bath County | SW | 10.8 | 8.7 |
| Wytheville Fish Hatchery | Wythe County | SW/GW | 3.1 | 3.1 |
| Marion State Fish Hatchery | Smyth County | SW | 3.0 | 2.9 |
| Paint Bank Fish Cultural Station | Craig County | SW | 3.2 | 2.8 |
| Laurel Hill Trout Farm-South Monterey | Highland County | SW | 2.9 | 2.3 |

## 3.5 Irrigation (Agricultural)

Agricultural irrigation withdrawals are associated with farms irrigating crops such as corn, soybeans, sod, as well as nursery products. Water withdrawals from agricultural irrigation made up 1.8% of all non-power generation withdrawals in Virginia for 2023, totaling 22.23 MGD in reported withdrawals. Figure 19 illustrates the distribution of reported 2023 groundwater and surface water withdrawals for irrigation purposes statewide. As with previous years, most large-scale irrigation facilities are located in the Coastal Plain, the Eastern Shore, and Shenandoah Valley. Reported water withdrawals for irrigation in 2023 were 3.4% higher than the five-year average (Table 9). The increased withdrawals may be the result of a drier growing season in 2023 compared to average, leading to additional irrigation needs. Surface water continues to be the major water source type for irrigation, representing approximately 93.5% of 2023 total irrigation withdrawals (Figure 20).

The five facilities reporting the highest withdrawals for irrigation in 2023 are listed in Table 10.

Figure 19: All 2023 Irrigation (Agricultural) Water Withdrawals by Withdrawal Point Location

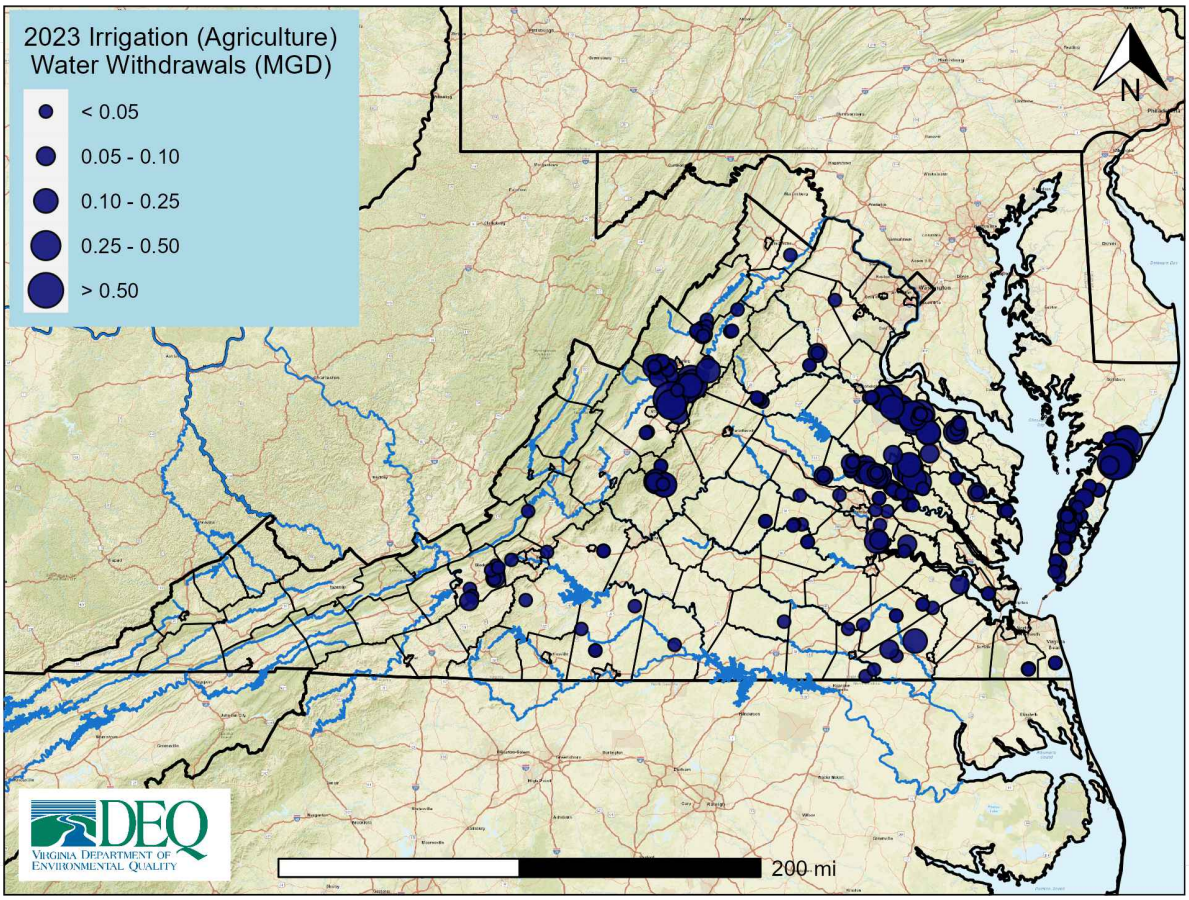


Table 9: 2019 - 2023 Irrigation Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 2.01 | 1.93 | 1.89 | 1.75 | 1.45 | 1.81 | -19.9 |
| Surface Water | 20.59 | 16.21 | 21.64 | 19.17 | 20.78 | 19.68 | 5.6 |
| **Total (GW + SW)** | **22.59** | **18.15** | **23.54** | **20.92** | **22.23** | **21.49** | **3.4** |

Figure 20: 2019-2023 Irrigation Water Withdrawals by Source Type

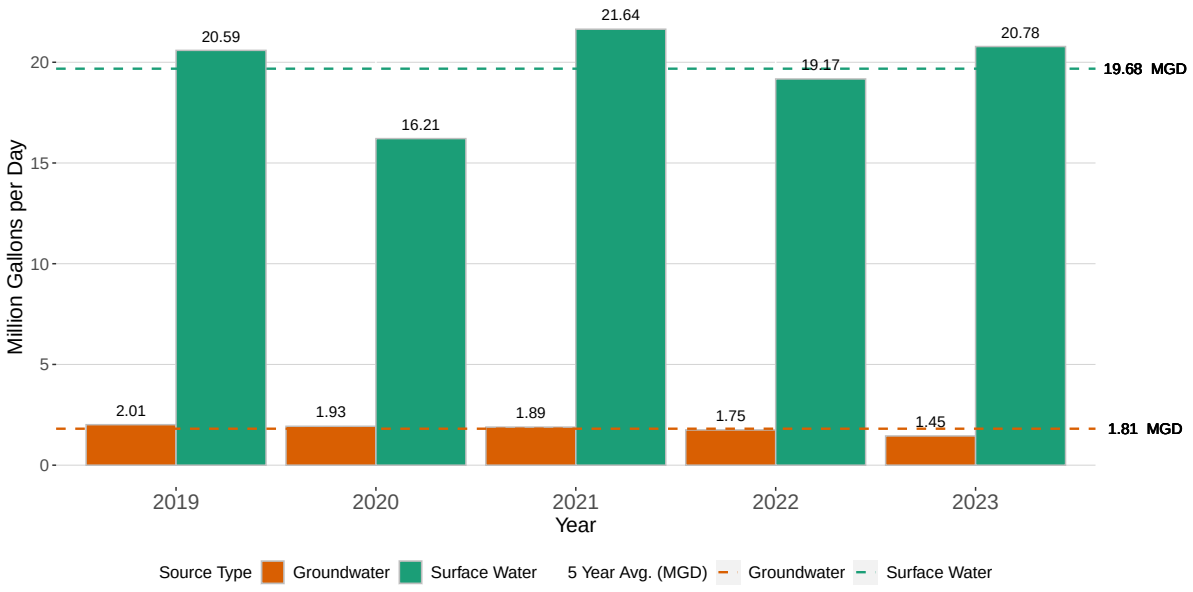



Table 10: Highest Reported Irrigation Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Arbuckle Farms | Accomack County | SW | 3.1 | 2.9 |
| Dublin Farms | Accomack County | SW | 2.1 | 2.1 |
| Glenwood | King and Queen County | SW | 1.3 | 1.2 |
| Cloverfield Farm | Essex County | SW | 0.9 | 1.0 |
| Saunders Brothers, Inc. | Nelson County | SW/GW | 1.0 | 0.9 |

## 3.6 Commercial

Commercial operations include golf courses, universities, hotels, resorts, and other similar entities. Water withdrawals from commercial activities make up 1.1% of all reported non-power generation withdrawals in Virginia. Figure 21 illustrates the distribution of reported 2023 groundwater and surface water withdrawals for commercial purposes, which are located predominantly near population centers. Reported commercial water withdrawals increased by 9.9% compared to the five-year average (Table 11), and continued to rely primarily on surface water sources (Figure 22). Withdrawals had fallen by almost 31% from 2019 to 2020, likely as a result of the COVID-19 pandemic. Reported commercial withdrawals have since increased but are still below the pre-pandemic volume of 14.5 MGD in 2019. The five facilities reporting the largest 2023 water withdrawals for commercial operations are listed in Table 12. 2023 withdrawal volumes for the top five users are mostly consistent with the five-year average, aside from the Port Tobacco At Weanack facility whose 2023 withdrawals increased 60% compared to the five-year average.

Figure 21: All 2023 Commercial Water Withdrawals by Withdrawal Point Location

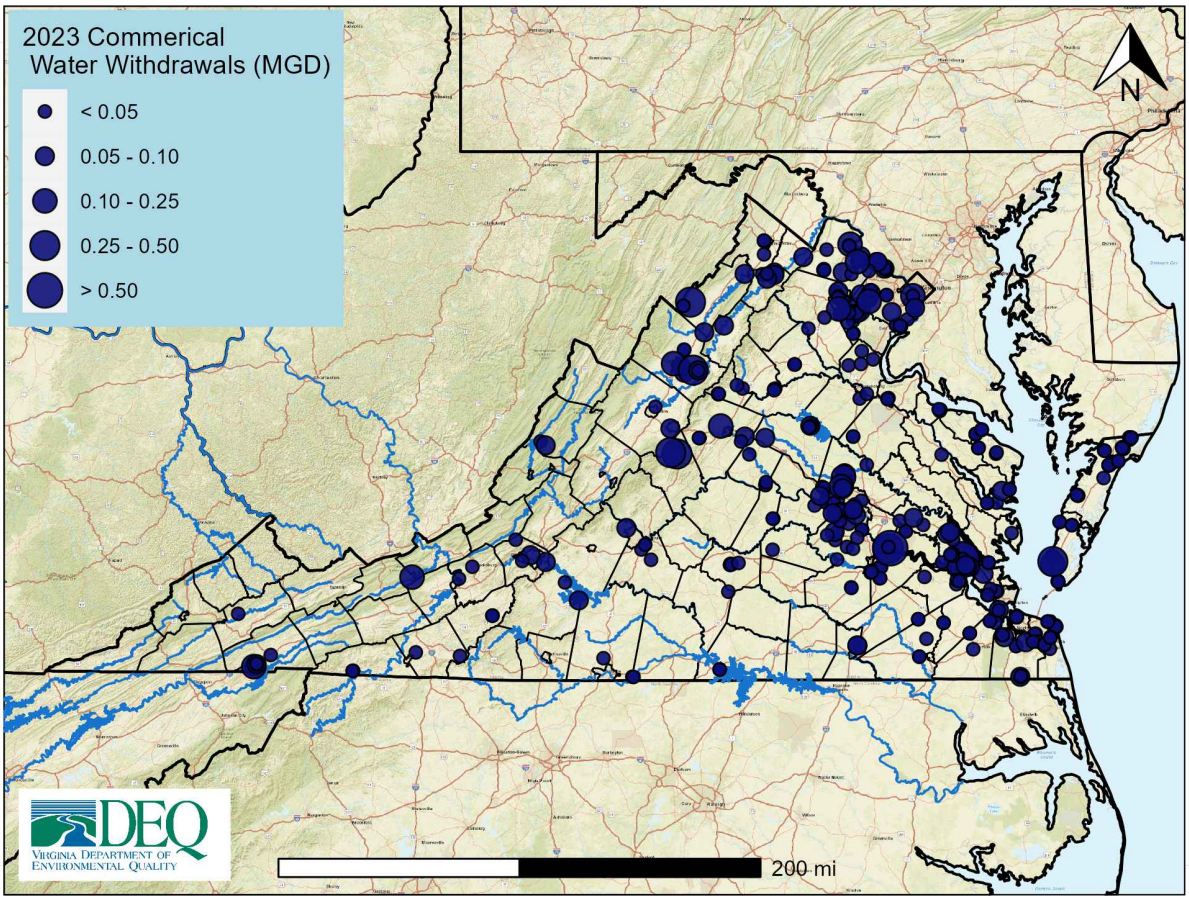


Table 11: 2019 - 2023 Commercial Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 4.52 | 3.64 | 4.11 | 4.02 | 4.27 | 4.11 | 3.9 |
| Surface Water | 9.94 | 6.38 | 8.82 | 7.79 | 9.60 | 8.51 | 12.8 |
| **Total (GW + SW)** | **14.46** | **10.02** | **12.94** | **11.81** | **13.87** | **12.62** | **9.9** |

Figure 22: 2019-2023 Commercial Water Withdrawals by Source Type

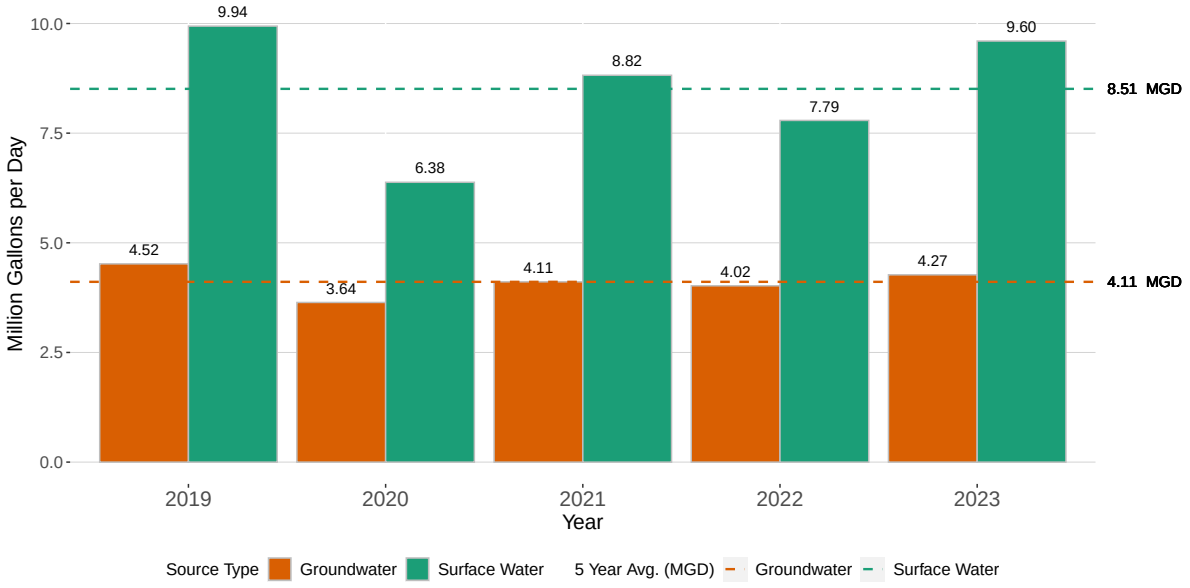



Table 12: Highest Reported Commercial Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Colonial Williamsburg | City of Williamsburg | GW | 1.0 | 1.0 |
| Port Tobacco At Weanack | Charles City County | SW | 0.5 | 0.8 |
| Lake Monacan-Stoney Creek (Wintergreen) | Nelson County | SW | 0.9 | 0.8 |
| Bryce Mountain Resort Inc | Shenandoah County | SW/GW | 0.3 | 0.4 |
| Bay Creek Resort & Club | Northampton County | SW | 0.5 | 0.4 |

## 3.7 Mining

The mining use category includes withdrawals for operations such as sand and gravel, stone, and coal mining. Reported water withdrawals from mining operations were approximately 1.7% of all non-power generation withdrawals in Virginia. Figure 23 illustrates the distribution of reported 2023 groundwater and surface water withdrawals for mining purposes statewide. The majority of stone and sand mining facilities are located along the Interstate 95 corridor. Additional stone and coal mining withdrawals are located in southwestern Virginia. Total reported water withdrawals for mining purposes in 2023 decreased by 29.7% as compared to the five-year average (Table 13). While several mines across Virginia reported a decrease in water use compared to 2022, the significant change this year can be attributed mostly to a large mining facility in Giles County that began ramping down operations in 2022. This decrease was seen from both groundwater and surface water usage. In 2023, the majority of reported withdrawals for mining continued to be from groundwater sources (Figure 24). This is largely due to the dewatering of the water table through wells that must be completed for many types of mining to prevent flooding. Such withdrawals are reported under groundwater withdrawals. The five facilities reporting the largest 2023 mining withdrawals are listed in Table 14.

Figure 23: All 2023 Mining Water Withdrawals by Withdrawal Point Location

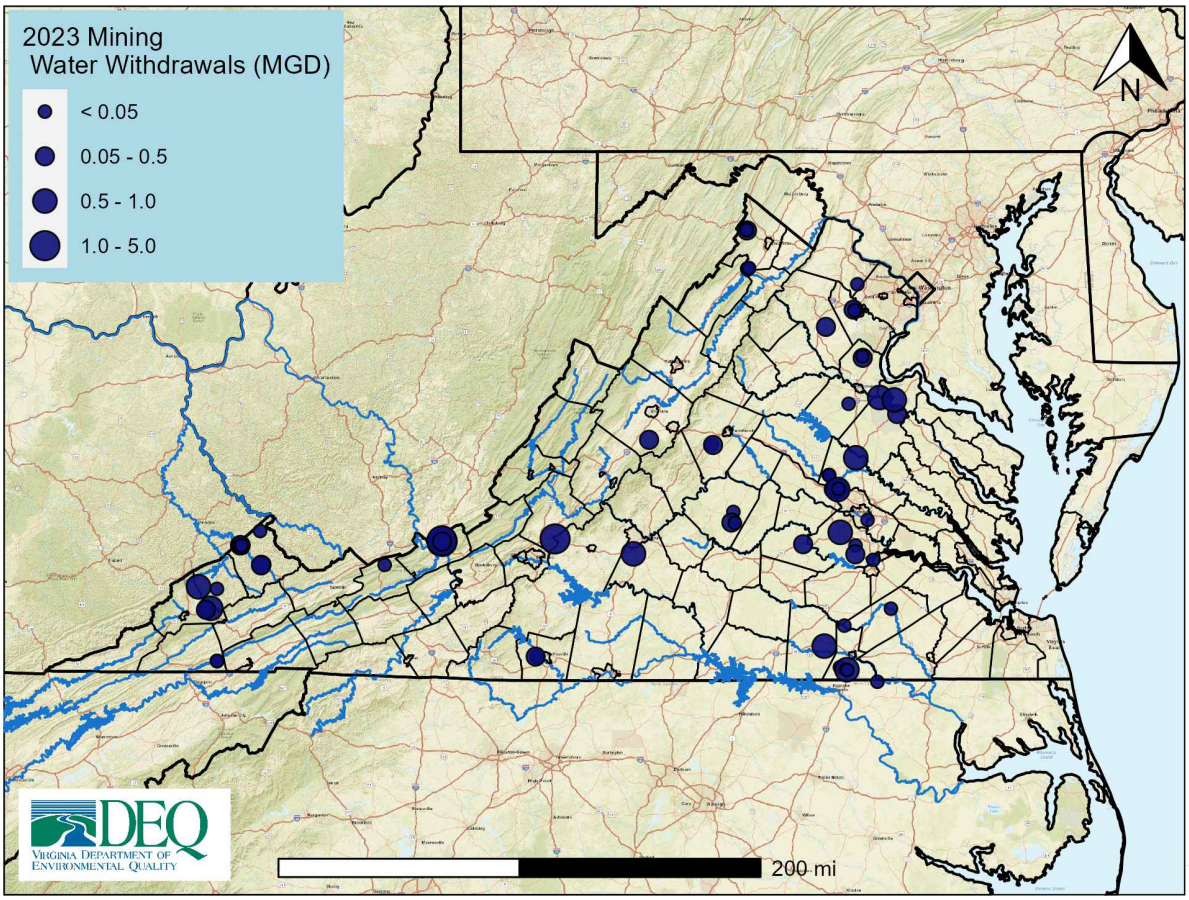


Table 13: 2019 - 2023 Mining Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 17.57 | 19.69 | 20.72 | 19.34 | 10.04 | 17.47 | -42.5 |
| Surface Water | 13.74 | 15.62 | 12.91 | 10.99 | 11.32 | 12.92 | -12.4 |
| **Total (GW + SW)** | **31.31** | **35.31** | **33.63** | **30.33** | **21.36** | **30.39** | **-29.7** |

Figure 24: 2019-2023 Mining Water Withdrawals by Source Type

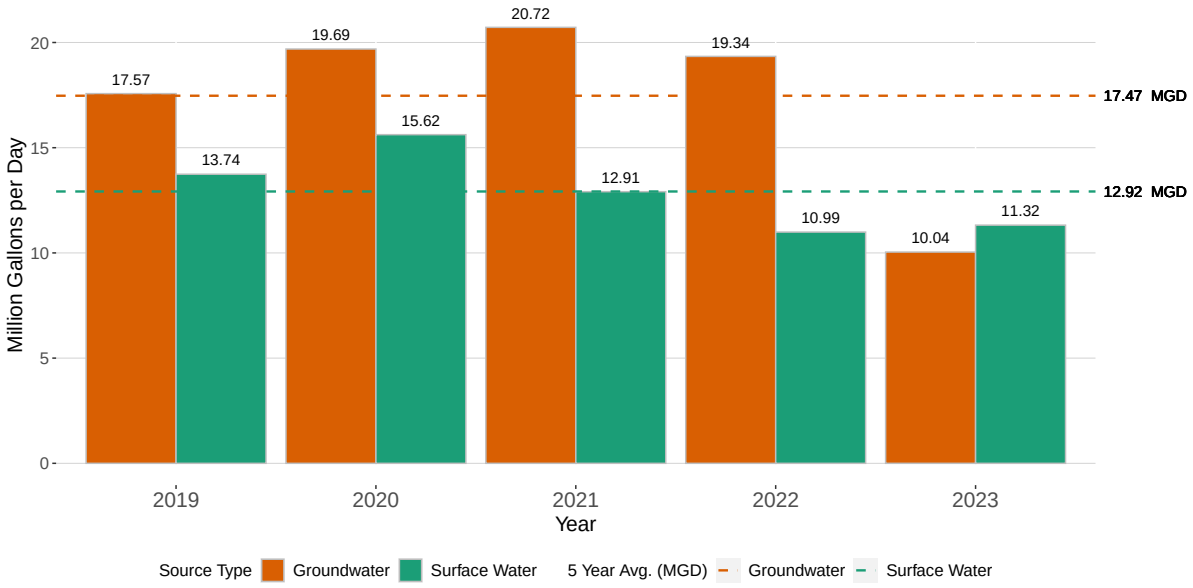


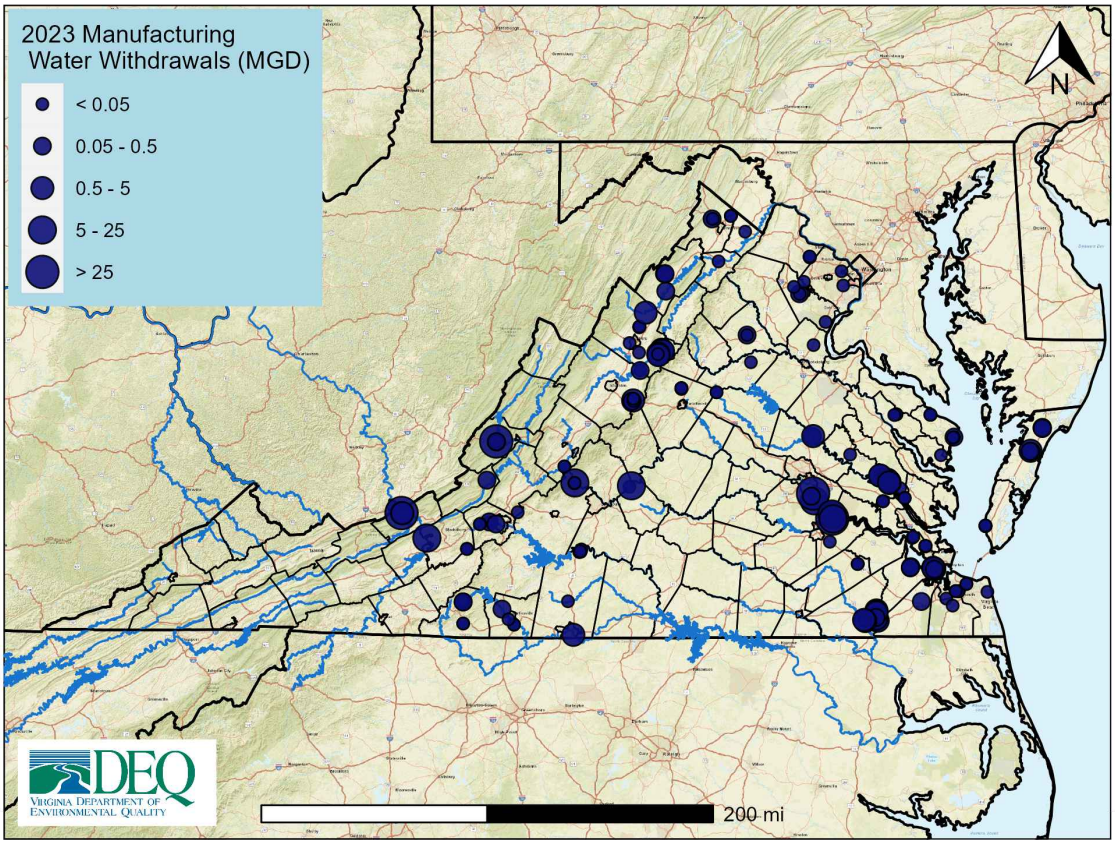

Table 14: Highest Reported Mining Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Lhoist North America - Kimballton Plant 2 | Giles County | SW/GW | 5.1 | 5.1 |
| Lhoist North America Kimballton Plant 1 | Giles County | GW | 10.9 | 3.9 |
| Hayfield Sand And Gravel | Caroline County | SW | 1.0 | 1.2 |
| Boxley Materials Company Blue Ridge Plant | Bedford County | GW | 1.6 | 1.1 |
| Royal Stone Quarry | Goochland County | SW/GW | 0.9 | 1.0 |

## 3.8 Manufacturing

The manufacturing use category includes industrial operations such as chemical and plastics manufacturing, paper mills, food processors, and other manufacturing related withdrawals. Water withdrawals from manufacturing users accounted for 28.1% of all reported non-power generation withdrawals in Virginia in 2023. Manufacturing water withdrawals are spread throughout much of Virginia (Figure 25) with facilities found in both rural and urban areas. The major determining factor for siting manufacturing facilities is access to sufficient quantity and quality of water, whether it be groundwater or surface water. Clusters of large-scale manufacturing withdrawals occur in the Middle James River Basin around the City of Richmond, as well as in the New and the Upper James river basins. Facilities located in the Coastal Plain generally rely on groundwater with wells constructed in the productive Potomac Aquifer or along productive fractures in the Western region of the State. All of the locations with large surface water withdrawals are situated on or near major rivers to facilitate water supply.

Figure 25: All 2023 Manufacturing Water Withdrawals by Withdrawal Point Location




Reported 2023 manufacturing withdrawals decreased by 1.3% compared to the five-year average, as shown in Table 15. Surface water is the predominate water source type for manufacturing, accounting for approximately 84.2% of reported withdrawals in 2023 (See Figure 26).

Table 16 lists the five facilities reporting the largest groundwater withdrawals associated with this category in 2023, and Table 17 lists the five facilities reporting the largest surface water withdrawals associated with this category in 2023.

Table 15: 2019 - 2023 Manufacturing and Industrial Water Withdrawals by Source Type (MGD)

| Source Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| Groundwater | 57.76 | 58.00 | 59.67 | 57.47 | 56.11 | 57.80 | -2.9 |
| Surface Water | 293.49 | 301.92 | 309.55 | 303.17 | 298.19 | 301.26 | -1.0 |
| **Total (GW + SW)** | **351.25** | **359.92** | **369.22** | **360.64** | **354.30** | **359.07** | **-1.3** |

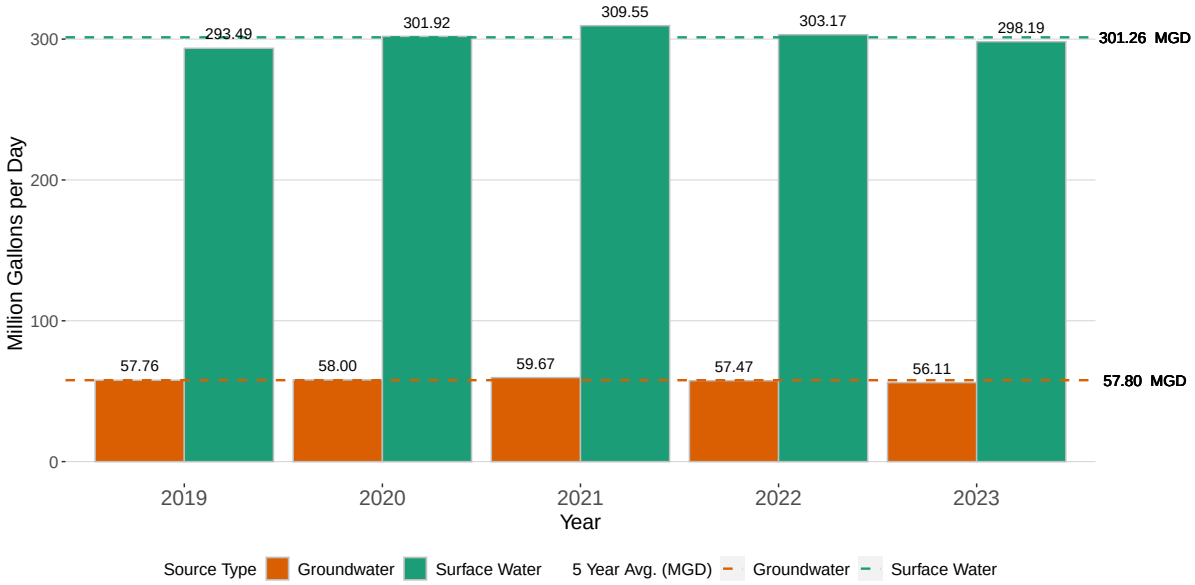
Table 16: Highest Reported Manufacturing and Industrial Groundwater Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| WestRock Virginia Corporation: West Point | King William County | GW | 16.1 | 15.1 |
| International Paper Franklin Mill | Isle of Wight County | GW | 13.9 | 14.4 |
| Merck & Co: Elkton Plant | Rockingham County | GW | 5.9 | 5.9 |
| Narrows Celco Plant | Giles County | GW | 5.5 | 5.1 |
| The LYCRA Company: Waynesboro Plant | City of Waynesboro | GW | 3.7 | 3.3 |

Table 17: Highest Reported Manufacturing and Industrial Surface Water Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| Advansix Resins And Chemicals: Hopewell Plant | City of Hopewell | SW | 101.9 | 103.0 |
| Narrows Celco Plant | Giles County | SW | 53.9 | 53.2 |
| WestRock Virginia Corporation: Covington Plant | Alleghany County | SW | 37.5 | 36.4 |
| Dupont E I De Nemours & Co: Spruance Plant | Chesterfield County | SW | 24.7 | 27.4 |
| U.S. Radford Ammunitions WTP 1 | Montgomery County | SW | 19.9 | 17.6 |

Figure 26: 2019-2023 Manufacturing Water Withdrawals by Source Type



## 3.9 Power Generation

The power generation use category includes water withdrawn for fossil fuel power and nuclear power. Withdrawals or diversions of water for hydroelectric power (hydropower) generation are nearly all non-consumptive and are exempt from the annual water withdrawal reporting requirements. As a result, a detailed description for hydropower is not included; however, a brief discussion of consumptive use of water is provided in Chapter 2.2.

The largest power generation facilities are located in central and eastern Virginia (see Figure 27), including two nuclear-power generating plants located in Louisa and Surry counties, which account for approximately 67.5% of total reported withdrawals in 2023, although most of the water withdrawn for these facilities is returned to the source after use for cooling. Total power generation withdrawals in 2023 decreased by 8.2% as compared to the five-year average (Table 18). Total power withdrawals decreased significantly from 4,430.75 MGD in 2022 to 4,003.28 MGD in 2023, the main driver of this decrease was a 40.2% drop in surface water withdrawals for fossil fuel power from 2022 to 2023. Groundwater withdrawals reported by power generation facilities in 2023 remain insignificant compared to surface water withdrawals, which is consistent with historical trends (Figure 28). The five power generation facilities with the highest reported withdrawals are listed in Table 19. Four of the five facilities reported a decrease in water usage as compared to the five-year average.

Figure 27: All 2023 Power Generation Water Withdrawals by Withdrawal Point Location

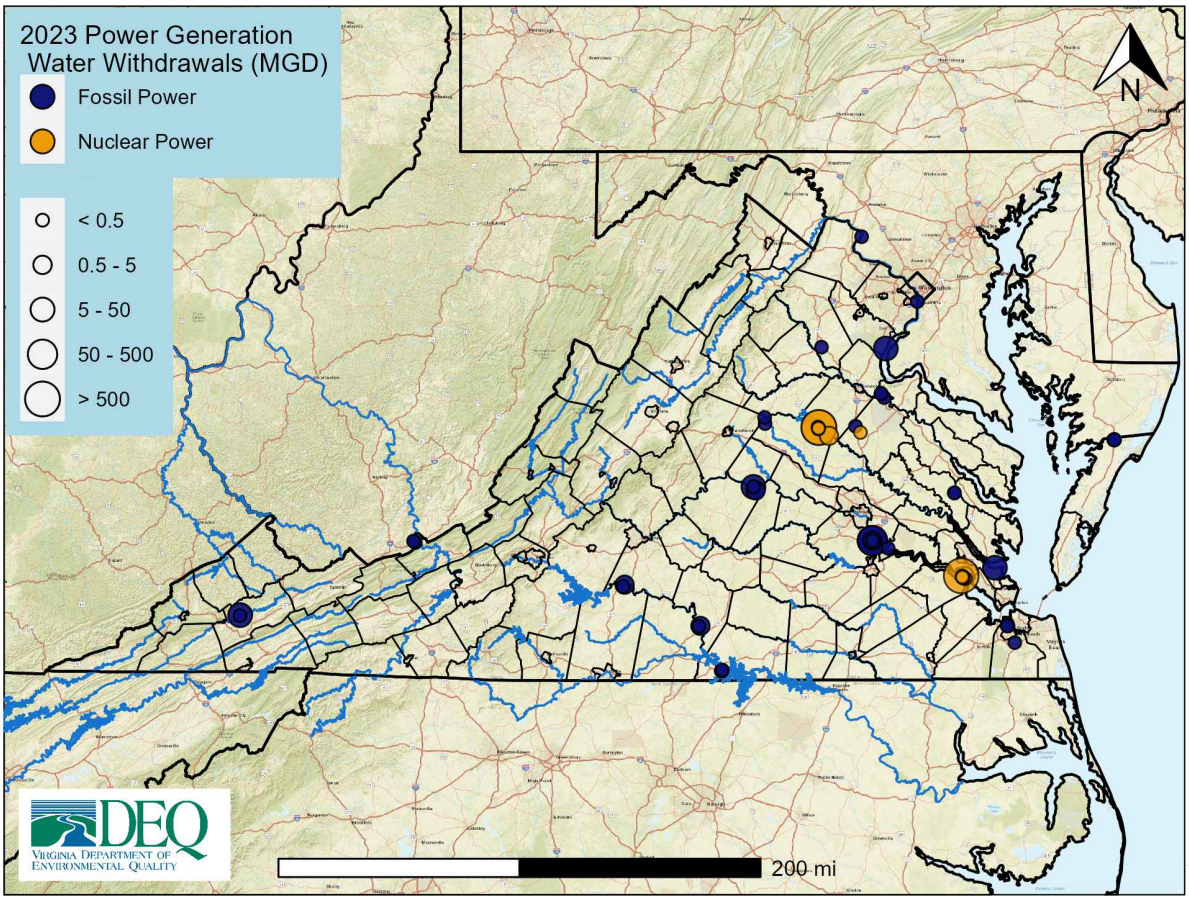


Table 18: 2019 - 2023 Power Generation Water Withdrawals by Source Type (MGD)

| Power Type | 2019 | 2020 | 2021 | 2022 | 2023 | 5 Year Avg. | % Change 2023 to Avg. |
|---|---|---|---|---|---|---|---|
| **Groundwater** | | | | | | | |
| Fossil Power | 0.07 | 0.07 | 0.06 | 0.07 | 0.08 | 0.07 | 14.3 |
| Nuclear Power | 0.37 | 0.36 | 0.37 | 0.29 | 0.38 | 0.35 | 8.6 |
| Total Groundwater | 0.44 | 0.43 | 0.44 | 0.36 | 0.45 | 0.42 | 7.1 |
| **Surface Water** | | | | | | | |
| Fossil Power | 752.18 | 635.84 | 732.32 | 751.66 | 449.84 | 664.37 | -32.3 |
| Nuclear Power | 3739.35 | 3863.89 | 3656.36 | 3678.73 | 3552.99 | 3698.26 | -3.9 |
| Total Surface Water | 4491.53 | 4499.73 | 4388.68 | 4430.39 | 4002.83 | 4362.63 | -8.2 |
| **Total (Gw + Sw)** | **4491.97** | **4500.17** | **4389.12** | **4430.75** | **4003.28** | **4363.06** | **-8.2** |

Figure 28: 2019-2023 Power Generation Water Withdrawals by Source Type

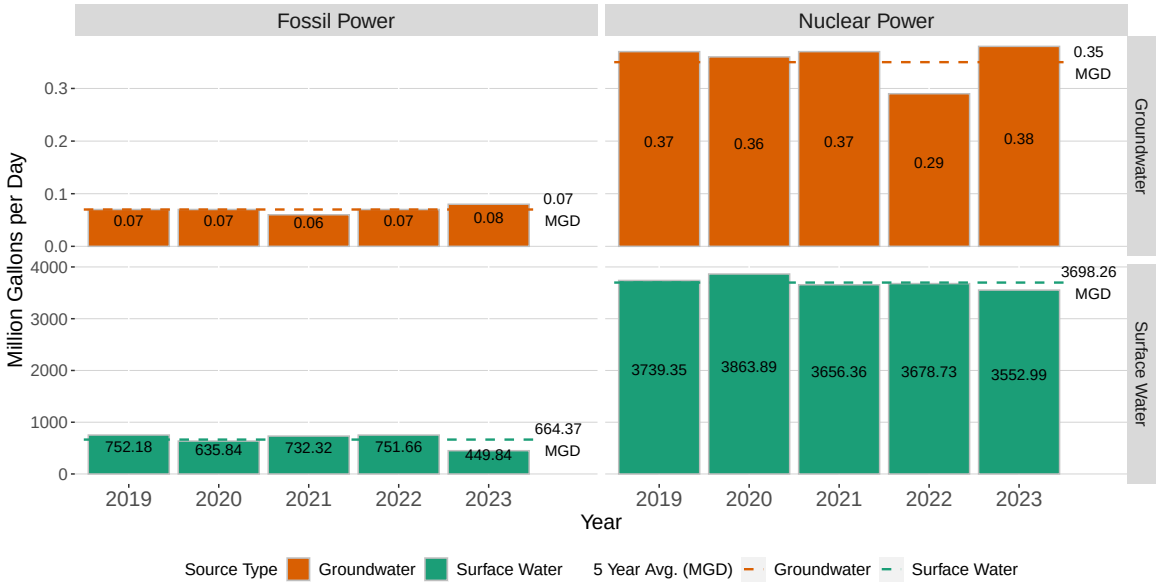



Table 19: Highest Reported Power Withdrawals in 2023 (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal |
|---|---|---|---|---|
| North Anna Nuclear Power Plant | Louisa County | SW/GW | 1854.1 | 1869.7 |
| Surry Power Station | Surry County | SW/GW | 1844.5 | 1683.6 |
| Chesterfield Power Station | Chesterfield County | SW | 464.1 | 389.6 |
| Yorktown Fossil Power Plant | York County | SW | 141.8 | 27.7 |
| Possum Point Power Station | Prince William County | SW | 42.7 | 18.6 |

# 4 Water Resource Priorities and Challenges

The following section identifies new, continuing, and future priorities, challenges, or other topics of specific interest in terms of water resources management at DEQ. These include updates on new legislative or regulatory actions, programmatic goals and achievements, and other items.

## 4.1 Permitting Enhancement and Evaluation Platform (PEEP)

DEQ has implemented a novel program called the Permitting Enhancement and Evaluation Platform (PEEP) that leverages technological improvements to foster transparency, collaboration, and efficiency in DEQ permit processes. The program includes public-facing online resources that convey and track the critical steps to obtain approvals from DEQ, including to the maximum extent practicable the steps needed from the applicant and other agencies. PEEP is a Critical Path Management (CPM) tool that assists permit writers, project managers, applicants and their agents, as well as the public, to understand the permit processes and steps needed to ensure timely decisions. PEEP increases transparency for external users and offers new ways for permit writers and managers to organize and monitor progress on applications. On July 1, 2023 Virginia Water Protection (VWP) surface water withdrawal permits became viewable in PEEP. Groundwater withdrawal permitting activities will be tracked in PEEP for all applications received after April 1, 2024.

## 4.2 Addressing Unreported Water Use

Another ongoing priority is evaluating and addressing unreported use below the regulatory threshold requiring withdrawal reporting (domestic or private well use for instance) and use above the regulatory threshold that is not currently being reported. DEQ staff conduct compliance activities annually to identify users who meet the threshold for annual withdrawal reporting as well as to contact users who have previously reported, but have failed to do so consistently. The extent of these contacts is highly dependent on available staff resources each year and must be balanced against other program responsibilities. In addition, DEQ works to address known gaps in this data.

As part of the ongoing partnership in characterizing the unreported groundwater usage within the Virginia Coastal plain, DEQ contracted with the USGS in 2022-2023 to evaluate and improve estimates of domestic use that fall below the reporting threshold. Work continued on this effort during 2023 and is expected to be completed and published in 2024. As Virginia's population continues to grow, it will be important to apply these estimates to better quantify water availability in the Virginia Coastal Plain aquifers.

## 4.3 Eastern Virginia Groundwater Management Area

HRSD's Sustainable Water Initiative for Tomorrow Project (SWIFT) pilot program is designed to recharge the confined Potomac aquifer system by routing highly treated wastewater through additional, advanced treatment and injecting this drinking-quality water into the aquifer. The SWIFT Research Center, located at HRSD's Nansemond Treatment Plant in Suffolk, is conducting pilot-scale injection of up to 1 million gallons per day (MGD) to investigate the effects on pressure in the Potomac and overlying aquifers.[9] The center currently collects data from observation wells and from an extensometer operated by USGS which measures changes in land elevation in response to the injection. These data are critical to evaluating model results and calibrating the model with respect to the simulation of the proposed injections.

In 2022, DEQ geologists assisted in the selection of the location of an additional extensometer site at the HRSD West Point Operation Center. Installation began in April 2023 and has continued to date. The instrumentation shed was completed in 2023 with full build out of the facility, including the installation of instrumentation and equipment, projected to occur in summer of 2024. Once online, the West Point facility will complete a network of four extensometers in Eastern Virginia.

[9] https://www.hrsd.com/swift/about

The first full-scale SWIFT injection facility is currently under construction at HRSD's James River Treatment Plant in Newport News. The U.S. Environmental Protection Agency issued an Underground Injection Control (UIC) permit (VAS5B170028617), effective September 22, 2023, for a term of 10 years. The UIC permit authorizes HRSD to construct and operate 10 Class V aquifer recharge wells for the purpose of injecting wastewater treated at the James River Plant into the Potomac aquifer system, in accordance with the provisions of the permit. Once completed, this project may be capable of injecting up to 16 MGD to augment the Potomac aquifer. HRSD is projecting completion of the James River SWIFT facilities by 2026, with full-scale operations by 2030.

In 2023, DEQ and the USGS continued a cooperative effort to synthesize hydrogeologic information from recent subregional studies, groundwater withdrawal data, and water-level data from the statewide network of observation wells. In addition, DEQ and USGS began a preliminary characterization of the portion of Virginia's Coastal Plain located north of Fredericksburg. The study area includes portions of Stafford County, Prince William County, and Fairfax County located east of I-95, which are part of the Eastern Virginia Groundwater Management Area. The aim of these cooperative projects is to develop a comprehensive revision of the hydrogeologic framework, to support future updates to the analysis and modeling of groundwater flow in Virginia's Coastal Plain.

## 4.4 Eastern Shore Groundwater Management Area

In 2019, USGS published an update to the Hydrogeologic Framework of the Virginia Eastern Shore, a joint effort with DEQ.[10] This study was a substantial update to the prior hydrogeologic framework, which was published in 1994, and included significant improvements in the understanding of the saltwater-fresh water interface, and the location and effect of paleochannels (buried ancient river channels) on aquifer flow patterns and well yields. This work was made possible by data collected through the groundwater withdrawal permit program and the work of DEQ geologists. A new Eastern Shore groundwater model is nearing completion and is expected to be released in the fall of 2024. The new model will include the updated hydrogeologic information and the results of a detailed review of water use, including better characterization of surficial aquifer use. The new model also incorporates the new framework and water use data including domestic use estimates.

## 4.5 Evaluating Tidal Fresh Surface Water Withdrawals

Groundwater limitations in the Coastal Plain region continue to motivate applications for the construction of tidal fresh surface water withdrawal intakes in the James, York and Rappahannock river basins. These same limitations have also motivated applications for reuse of wastewater treatment plant return flows, which effectively increase the consumptive losses associated with existing withdrawals. The water quality in a tidal system is dynamic and the amount of available freshwater can improve or reduce local water quality during critical periods. Reducing freshwater inflows into a tidal system can shift the location further upstream where low salinity and high salinity water combine. Reducing freshwater inflows can also increase residence time in the estuary, which can increase the likelihood of negative water quality consequences like algal blooms, such as those seen in parts of the tidal James River. A future need is the development of new modeling techniques and the application of updated water quality models for use in these evaluations.

## 4.6 Program Funding

DEQ's responsibilities and authorities in terms of managing water supply are complex and increasingly rely on extensive and regular data collection, as well as the development and ongoing maintenance of evaluation models. Continued financial investment is necessary to allow for proactive and responsive management to ensure that these resources can be put to beneficial uses that foster Virginia's prosperity. Investment in the science and personnel that underpin data driven management decisions is necessary to maintain currency with

[10] McFarland, E.R., and Beach, T.A., 2019, Hydrogeologic framework of the Virginia Eastern Shore: U.S. Geological Survey Scientific Investigations Report 2019–5093, 26 p., 13 pl., https://doi.org/10.3133/sir20195093.

the changing world. The FY 2022-2023 budget provided significant funding for the continuance of the multi-year DEQ/USGS project to install new monitoring facilities within the Virginia Coastal Plain. These facilities include a borehole extensometer to measure land subsidence, climate response network wells for drought monitoring in areas west of Interstate 95, and chloride monitoring wells within the groundwater management areas to monitor the migration of saltwater that could put water supplies at risk. This significant investment addresses existing monitoring gaps and will ensure DEQ is able to evaluate trends in land subsidence, aquifer recovery, groundwater levels, and to continue collecting data for making sound management decisions.

## 4.7 Recent and Ongoing Legislative and Regulatory Actions

Over the past year, DEQ coordinated several regulatory actions related to water resources management in response to legislation passed by the General Assembly. A summary of each action and the current status is provided below:

- Legislation enacted following the 2020 General Assembly Session (2020 Va. Acts Ch. 1105) required the SWCB to adopt regulations designating regional planning areas based primarily on river basins, to encourage the development of cross-jurisdictional water supply projects, and to estimate the risk that each locality and region in the Commonwealth will experience water supply shortfalls. This law also directs localities to participate in cross-jurisdictional, coordinated water resource planning, and to develop a single water supply plan for each regional planning area. A Regulatory Advisory Panel (RAP) was formed and met six times during 2021-2022. Additional amendments were made following the 2022 General Assembly Session (2022 Va. Acts Ch. 331) that provide a mechanism for a locality to request, subject to approval by the Department, a change of its designated regional planning area to an adjoining planning area. Proposed regulatory amendments were developed and presented to the SWCB on June 22, 2022. Amendments were approved by the SWCB and a public comment period concluded on July 21, 2023. Final amendments were developed and approved by the SWCB on November 30, 2023, and will be published this fall.
- Legislation enacted following the 2021 General Assembly Special Session I (2021 Special Session I Va. Acts Ch. 100) will improve the efficiency and effectiveness of water use by requiring all applications for VWP permits for surface water withdrawals and Ground Water Withdrawal permits to include: 1) a water auditing plan, and 2) a leak detection and repair plan that satisfy the requirements in regulations to be adopted by the SWCB. These plans would also, once approved, be incorporated by reference as conditions in the permit. A RAP was formed and met four times. The proposed amendments were published in 2024 and a public comment period recently concluded.

# Appendix 1: Top 20 Reported Water Withdrawals in 2023 (Excluding Power Generation)

SW: Surface Water, GW: Groundwater, *Permitted Withdrawal, **Unpermitted Withdrawal

Table 20: Top 20 Reported Water Withdrawals in 2023 Excluding Power Generation (MGD)

| Facility | Locality | Type | 5 Year Avg. | 2023 Withdrawal | Category |
|---|---|---|---|---|---|
| AdvanSix Resins and Chemicals: Hopewell Plant** | City of Hopewell | SW | 101.9 | 103.0 | manufacturing |
| Fairfax Water: Corbalis WTP** | Fairfax County | SW | 85.7 | 86.2 | public water supply |
| Fairfax Water: Griffith WTP** | Prince William County | SW | 65.8 | 67.9 | public water supply |
| City of Richmond WTP* | City of Richmond | SW | 67.5 | 67.7 | public water supply |
| Celanese Acetate: Celco Plant** | Giles County | SW/GW | 59.4 | 58.3 | manufacturing |
| City of Norfolk: Western Branch Reservoir** | City of Suffolk | SW | 62.4 | 55.0 | public water supply |
| City of Virginia Beach Service Area** | City of Virginia Beach | SW | 32.1 | 38.5 | public water supply |
| Appomattox River Water Authority: Chesdin Reservoir WTP* | Chesterfield County | SW | 36.8 | 37.9 | public water supply |
| WestRock Virginia Corporation: Covington Plant** | Alleghany County | SW/GW | 38.0 | 36.9 | manufacturing |
| Henrico County WTP & Service Area* | Henrico County | SW | 26.0 | 28.5 | public water supply |
| Dupont E I De Nemours & Co: Spruance Plant** | Chesterfield County | SW/GW | 24.9 | 27.7 | manufacturing |
| City Of Newport News: Waterworks Lee Hall* | City of Newport News | SW/GW | 22.7 | 25.0 | public water supply |
| Virginia American Water: Hopewell District* | City of Hopewell | SW | 22.4 | 23.0 | public water supply |
| U.S. Radford Ammunitions WTP 1** | Montgomery County | SW | 19.9 | 17.6 | manufacturing |
| City of Newport News: Harwood's Mill WTP** | York County | SW | 18.1 | 16.3 | public water supply |
| City of Portsmouth: Lake Kilby WTP* | City of Suffolk | SW/GW | 16.5 | 15.7 | public water supply |
| City of Roanoke Service Area** | City of Roanoke | SW/GW | 13.8 | 15.4 | public water supply |
| WestRock CP LLC: West Point Mill Water System* | King William County | GW | 16.1 | 15.1 | manufacturing |
| AdvanSix Resins and Chemicals: Chesterfield Plant** | Chesterfield County | SW | 14.3 | 15.0 | manufacturing |
| International Paper: Franklin Mill* | Isle of Wight County | SW/GW | 16.2 | 14.4 | manufacturing |

# Appendix 2: Water Withdrawals Within Localities in 2023 (MGD) (Excluding Power Generation)

Table 21, shown below, lists the reported water withdrawals, both permitted and unpermitted, that occurred in 2023 within individual localities.

Table 21: Water Withdrawals Within Localities in 2023 (MGD)

| Locality | GW Withdrawal | SW Withdrawal | GW + SW Total | Percent of Total Withdrawal |
|---|---|---|---|---|
| City of Hopewell | 0.00 | 136.36 | 136.36 | 10.81 |
| Chesterfield County | 0.72 | 93.16 | 93.88 | 7.44 |
| City of Suffolk | 7.88 | 81.12 | 89.00 | 7.06 |
| Fairfax County | 0.23 | 86.86 | 87.09 | 6.91 |
| Prince William County | 0.38 | 69.74 | 70.13 | 5.56 |
| Giles County | 14.65 | 53.77 | 68.42 | 5.43 |
| City of Richmond | 0.03 | 67.86 | 67.89 | 5.38 |
| City of Virginia Beach | 0.13 | 38.64 | 38.77 | 3.07 |
| Alleghany County | 0.57 | 37.65 | 38.22 | 3.03 |
| City of Newport News | 0.15 | 33.21 | 33.36 | 2.65 |
| Henrico County | 0.01 | 28.86 | 28.87 | 2.29 |
| New Kent County | 1.12 | 26.65 | 27.77 | 2.20 |
| Rockingham County | 15.05 | 12.38 | 27.43 | 2.18 |
| Montgomery County | 0.12 | 24.84 | 24.96 | 1.98 |
| Bedford County | 1.14 | 18.36 | 19.50 | 1.55 |
| Loudoun County | 1.57 | 16.02 | 17.58 | 1.39 |
| Stafford County | 0.00 | 17.55 | 17.56 | 1.39 |
| York County | 0.40 | 16.32 | 16.71 | 1.33 |
| King William County | 15.85 | 0.77 | 16.62 | 1.32 |
| Isle of Wight County | 16.11 | 0.00 | 16.11 | 1.28 |
| Amherst County | 0.00 | 15.91 | 15.91 | 1.26 |
| City of Roanoke | 1.09 | 14.76 | 15.85 | 1.26 |
| City of Manassas | 0.29 | 13.30 | 13.59 | 1.08 |
| Spotsylvania County | 0.32 | 12.81 | 13.13 | 1.04 |
| Augusta County | 3.34 | 8.06 | 11.40 | 0.90 |
| Albemarle County | 0.19 | 10.73 | 10.91 | 0.87 |
| Accomack County | 5.23 | 5.61 | 10.84 | 0.86 |
| Frederick County | 3.36 | 6.69 | 10.05 | 0.80 |
| Bath County | 0.20 | 9.82 | 10.02 | 0.79 |
| Southampton County | 2.91 | 6.63 | 9.55 | 0.76 |
| James City County | 5.32 | 4.18 | 9.50 | 0.75 |
| Washington County | 0.14 | 9.32 | 9.46 | 0.75 |
| Warren County | 0.17 | 8.56 | 8.73 | 0.69 |
| City of Chesapeake | 4.08 | 4.19 | 8.27 | 0.66 |
| Wythe County | 0.06 | 8.20 | 8.25 | 0.65 |
| Wise County | 0.31 | 6.94 | 7.25 | 0.57 |
| Roanoke County | 0.87 | 5.76 | 6.63 | 0.53 |
| Campbell County | 0.08 | 6.24 | 6.32 | 0.50 |
| Smyth County | 0.76 | 5.44 | 6.20 | 0.49 |
| Hanover County | 0.44 | 5.74 | 6.18 | 0.49 |
| City of Waynesboro | 4.39 | 1.63 | 6.02 | 0.48 |
| Dickenson County | 0.05 | 5.66 | 5.71 | 0.45 |
| Shenandoah County | 3.02 | 2.59 | 5.60 | 0.44 |
| City of Danville | 0.00 | 5.23 | 5.23 | 0.41 |

| | | | | |
|---|---|---|---|---|
| Caroline County | 1.29 | 3.73 | 5.02 | 0.40 |
| Pulaski County | 0.00 | 4.76 | 4.76 | 0.38 |
| Tazewell County | 0.06 | 4.52 | 4.59 | 0.36 |
| Highland County | 0.05 | 4.21 | 4.26 | 0.34 |
| City of Salem | 0.99 | 3.14 | 4.13 | 0.33 |
| Henry County | 0.01 | 3.42 | 3.43 | 0.27 |
| Botetourt County | 0.71 | 2.38 | 3.09 | 0.24 |
| Fauquier County | 1.91 | 1.14 | 3.05 | 0.24 |
| Craig County | 0.08 | 2.90 | 2.97 | 0.24 |
| Culpeper County | 1.15 | 1.63 | 2.78 | 0.22 |
| City of Covington | 0.00 | 2.63 | 2.63 | 0.21 |
| Nelson County | 0.15 | 2.31 | 2.47 | 0.20 |
| King George County | 0.87 | 1.53 | 2.40 | 0.19 |
| City of Radford | 0.00 | 2.32 | 2.32 | 0.18 |
| City of Norfolk | 0.03 | 2.24 | 2.28 | 0.18 |
| Mecklenburg County | 0.10 | 2.04 | 2.13 | 0.17 |
| Charles City County | 0.08 | 2.02 | 2.10 | 0.17 |
| Goochland County | 0.12 | 1.96 | 2.08 | 0.16 |
| Lee County | 0.00 | 2.07 | 2.07 | 0.16 |
| City of Martinsville | 0.00 | 2.06 | 2.06 | 0.16 |
| Orange County | 0.06 | 1.99 | 2.05 | 0.16 |
| Page County | 1.20 | 0.80 | 2.00 | 0.16 |
| Essex County | 0.45 | 1.50 | 1.96 | 0.16 |
| Northampton County | 1.01 | 0.93 | 1.95 | 0.15 |
| Brunswick County | 0.02 | 1.82 | 1.83 | 0.15 |
| Greensville County | 0.09 | 1.64 | 1.73 | 0.14 |
| Rockbridge County | 0.27 | 1.40 | 1.67 | 0.13 |
| Pittsylvania County | 0.00 | 1.63 | 1.63 | 0.13 |
| Halifax County | 0.11 | 1.51 | 1.63 | 0.13 |
| Gloucester County | 0.66 | 0.95 | 1.60 | 0.13 |
| Westmoreland County | 0.91 | 0.59 | 1.50 | 0.12 |
| City of Galax | 0.00 | 1.49 | 1.49 | 0.12 |
| Scott County | 0.09 | 1.25 | 1.34 | 0.11 |
| Russell County | 0.41 | 0.90 | 1.31 | 0.10 |
| King and Queen County | 0.01 | 1.21 | 1.22 | 0.10 |
| Sussex County | 1.09 | 0.05 | 1.14 | 0.09 |
| Nottoway County | 0.04 | 1.07 | 1.10 | 0.09 |
| Franklin County | 0.18 | 0.91 | 1.09 | 0.09 |
| Buchanan County | 0.30 | 0.77 | 1.07 | 0.08 |
| City of Williamsburg | 1.05 | 0.00 | 1.05 | 0.08 |
| Prince Edward County | 0.06 | 0.90 | 0.96 | 0.08 |
| Fluvanna County | 0.17 | 0.77 | 0.94 | 0.07 |
| Louisa County | 0.38 | 0.54 | 0.92 | 0.07 |
| City of Franklin | 0.82 | 0.00 | 0.82 | 0.06 |
| Patrick County | 0.08 | 0.72 | 0.80 | 0.06 |
| City of Emporia | 0.00 | 0.80 | 0.80 | 0.06 |
| Greene County | 0.03 | 0.74 | 0.76 | 0.06 |
| Clarke County | 0.00 | 0.68 | 0.68 | 0.05 |
| Carroll County | 0.25 | 0.31 | 0.56 | 0.04 |
| City of Norton | 0.00 | 0.54 | 0.54 | 0.04 |
| Lancaster County | 0.44 | 0.09 | 0.53 | 0.04 |
| Lunenburg County | 0.00 | 0.48 | 0.48 | 0.04 |
| Amelia County | 0.12 | 0.31 | 0.43 | 0.03 |
| Buckingham County | 0.00 | 0.40 | 0.40 | 0.03 |

| | | | | |
|---|---|---|---|---|
| Middlesex County | 0.29 | 0.11 | 0.40 | 0.03 |
| Northumberland County | 0.33 | 0.02 | 0.35 | 0.03 |
| Surry County | 0.21 | 0.12 | 0.34 | 0.03 |
| Prince George County | 0.24 | 0.08 | 0.32 | 0.03 |
| Richmond County | 0.30 | 0.00 | 0.30 | 0.02 |
| Dinwiddie County | 0.04 | 0.21 | 0.25 | 0.02 |
| Floyd County | 0.13 | 0.10 | 0.23 | 0.02 |
| Charlotte County | 0.12 | 0.10 | 0.22 | 0.02 |
| Powhatan County | 0.10 | 0.08 | 0.18 | 0.01 |
| Bland County | 0.07 | 0.11 | 0.18 | 0.01 |
| Madison County | 0.04 | 0.12 | 0.16 | 0.01 |
| City of Harrisonburg | 0.00 | 0.15 | 0.15 | 0.01 |
| Arlington County | 0.02 | 0.13 | 0.15 | 0.01 |
| Grayson County | 0.09 | 0.05 | 0.14 | 0.01 |
| City of Portsmouth | 0.11 | 0.00 | 0.11 | 0.01 |
| City of Buena Vista | 0.05 | 0.00 | 0.05 | 0.00 |
| Rappahannock County | 0.04 | 0.00 | 0.04 | 0.00 |
| City of Fairfax | 0.01 | 0.02 | 0.03 | 0.00 |
| Cumberland County | 0.02 | 0.01 | 0.03 | 0.00 |
| City of Fredericksburg | 0.00 | 0.02 | 0.02 | 0.00 |
| City of Petersburg | 0.01 | 0.01 | 0.02 | 0.00 |
| Mathews County | 0.01 | 0.00 | 0.01 | 0.00 |
| Appomattox County | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Alexandria | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Hampton | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Lynchburg | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Bedford | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Bristol | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Charlottesville | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Clifton Forge | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Colonial Heights | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Falls Church | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Lexington | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Manassas Park | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Poquoson | 0.00 | 0.00 | 0.00 | 0.00 |
| City of South Boston | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Staunton | 0.00 | 0.00 | 0.00 | 0.00 |
| City of Winchester | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | **132.86** | **1128.24** | **1261.10** | **100.00** |

# Appendix 3: Water Resources Information and Climatic Conditions

**State Population**
(2020 census) - 8,644,727
(2023 Weldon Cooper Center Estimate[11]) - 8,729,032

**State Surface Area** - 42,775 square miles (39,490 square miles total land area, 3,285 square miles inland waters)

**Major River Basins (with Current Estimates of Annual Mean River Flow):**
Tennessee-Big Sandy (4,132 square miles, 3,225 MGD)
Albemarle Sound-Chowan River (4,252 square miles, 1,748 MGD)
James (10,236 square miles, 5,501 MGD)
New (3,068 square miles, 3,304 MGD)
Rappahannock (2,714 square miles, 1,100 MGD)
Roanoke (6,274 square miles, 5,120 MGD)
Shenandoah (3,041 square miles, 1,797 MGD)
Chesapeake Bay-Small Coastal (3,157 square miles, 97 MGD)
York (2,669 square miles, 1,060 MGD)

**Total Non-tidal River/Stream Miles** - 100,927 (This estimate represents mileage determined by the USGS National Hydrography Dataset)

**Publicly-Owned Lakes and Reservoirs**
There are 248 publicly-owned lakes in the Commonwealth:

| | | |
|---|---|---|
| Larger than 5,000 acres - | 5 | 109,838 acres |
| Smaller than 5,000 acres - | 243 | 52,392 acres |
| Total - | 248 | 162,230 acres |

Additionally, hundreds of small privately-owned lakes and ponds are distributed throughout the state.

**Freshwater Wetlands** - 808,000 acres

**Tidal and Coastal Wetlands** - 236,900 acres

**Estuary (excluding small coastal areas)** - 2,308 square miles

**Atlantic Ocean Coastline** - 120 miles

**Statewide Average Annual Rainfall** - 44.3 inches

**Average Freshwater Discharge of All Rivers** - approximately 22,850 MGD

**Average Freshwater Discharge into the Chesapeake Bay** - approximately 9,500 MGD

**Climatic Conditions:** Precipitation for the October 1, 2022 to 2023 water year was near-normal to above-normal throughout the New River, Roanoke, James River, Chowan, and Southeast Virginia drought evaluation regions. Precipitation over the water year was below normal for the Big Sandy, Eastern Shore, Shenandoah, Northern Coastal Plain, Northern Piedmont, and Northern Virginia regions. Streamflows for much of Virginia have remained within normal ranges throughout the water year, with below normal flows observed primarily throughout the summer and early fall months and focused within the Shenandoah Valley and Northern Virginia regions. Exceptionally low streamflows occurred within the Shenandoah drought evaluation region in late summer with observations below the 5th percentile of historic streamflows recorded. Groundwater levels in the Climate Response Network observation wells were below normal levels throughout spring, summer, and fall months for the Shenandoah, Northern Virginia, and Eastern Shore. Decreased and near record low groundwater levels were observed in late summer for many wells within the Shenandoah and Northern Virginia regions. On August 30, 2023, a drought warning declaration was announced for the Shenandoah drought evaluation region, with near record low surface water and groundwater indicators observed. In December of 2023, Lake Moomaw was observed to have less than 2% of conservation storage

[11] University of Virginia Weldon Cooper Center, Demographic Research Group. (2023). Virginia Population Estimates. Retrieved from https://demographics.coopercenter.org/virginia-population-estimates.

remaining. In coordination with DEQ, DWR, USACE, and downstream water users, a release modification from Gathright Dam was implemented to aid in reservoir recovery. The 100 cfs modification was successful in mitigating recovery of lost storage, and Lake Moomaw resumed normal operational procedures in March of 2024. The DEQ drought website includes the most up to date information related to drought and current conditions.

# Appendix 4: Water Transfers

**Water transfers** can be defined as water that has been withdrawn from surface or groundwater and transported via water pipelines, or other means of conveyance, to a different facility or service area. Water transfers generally represent water that is purchased, sold, or distributed to other water users or customers from a main supplier, although large water utilities may transfer water between sources and service areas they own. Transferred water data is reported to DEQ as a release (the point the water is sent from) or a delivery (the point where water is received). In some cases a transfer is reported from both sides of the transaction, but in others only one side reports the transfer.

In 2023, 412 water transfers were reported to the DEQ with approximately 1,156 MGD transferred on average each day. Transfers primarily occurred within regional water distribution systems that sold or purchased water from a larger primary source such as a reservoir. In general, withdrawals from a water source (groundwater or surface water) account for the largest portion of a locality's water use. Transferred water provides an additional supply connection that can be a primary water source or supplementary during drought or other conditions.

The largest water transfers occurred within the cites of Richmond, Norfolk, Virginia Beach, and Suffolk. The City of Richmond provides water supply to numerous customers, including Chesterfield, Hanover, and Henrico counties. The Hampton Roads region includes many of the reported water transfers with the cities of Norfolk and Virginia Beach as the primary provider and recipient. The City of Virginia Beach is primarily supplied by transferred water that originates from Lake Gaston, located in south central Virginia. The raw water is initially transferred to the City of Norfolk for processing, and finished water is transferred to the City of Virginia Beach. This system represents the greatest travel distance of any transfer in Virginia. Additionally, Northern Virginia localities are largely interconnected and supplied by water authorities in the region including Fairfax Water and Loudoun Water.

Currently, not all water transfers are consistently reported to the DEQ, in part because many systems lack the technology or resources to track and report water transfers. For example, there are localities that have reported water releases, but there are no corresponding records indicating the water has been received and used by another locality or entity. Some entities reportedly sell water but do not track where the water is sent. Improvements in the quality of reporting and methods DEQ uses to track the transfer of water, both within systems and between entities, are necessary to better understand the impact transfers have in Virginia.