

# DATA CENTERS AND WATER USE IN THE POTOMAC RIVER BASIN

*How future growth could affect water supply in the nation's capital*

The Potomac basin is home to the largest concentration of data centers in the world to date. The rapid development of artificial intelligence (AI) and cloud services is driving unprecedented growth in the region, particularly in Northern Virginia and Maryland. While much of the public discussion has focused on electricity demand of data centers, these facilities can also use substantial amounts of water for cooling. The Potomac River provides 75% of the water supply for the region's three primary utilities (Fairfax Water, WSSC Water, and the Washington Aqueduct) supplying 5 million people. Furthermore, it is the sole source of drinking water for Washington, D.C., and Arlington County, supporting over 1 million residents and critical federal services in the National Capital. As part of the 2025 Washington Metropolitan Area (WMA) Water Supply and Demand Study, ICPRB evaluated current and projected direct, on-site consumptive water use by data centers in the Potomac River basin. The analysis distinguishes between data centers located upstream of the WMA drinking water intakes, where consumptive use directly affects available river flows upstream of WMA intakes, and those located within the WMA.

**Data centers in the region are heavily clustered.** Predominantly located within Loudoun County, rapid development is now occurring in Prince William County. New developments are also emerging in Frederick, Maryland, within the Monocacy watershed, alongside other scattered sites throughout the Potomac basin. These facilities are served by public water suppliers and, to date, hold no direct withdrawal permits.

**Current impact is modest but variable.** Despite the high concentration of data centers in the basin, currently, average consumptive water use remains relatively small within the WMA and is negligible upstream. Upstream data center consumptive use is currently less than 0.1 million gallons per day (MGD) on average and about 0.3 MGD at peak. Within the WMA, average consumptive use in 2025 is approximately 4 MGD, with peak-day use of about 15 MGD. These relatively modest current values reflect regional climate conditions that allow many facilities (about 40%) to exclusively rely on air cooling while many utilize a hybrid approach taking advantage of "free cooling" during the winter months.

**The challenge of peak demand.** Of significant note is the substantial surge in demand in the summer. Monthly use in summer can be close to three times the average annual demand while peak daily use can be as much as 10 times. This volatility coincides with the time of year when competing demands, such as outdoor water use, are at their highest, and river flows are lowest. While data centers account for only 1% of total withdrawals in the WMA, they represent 9% of annual consumptive use and up to 12% of consumptive use in summer. On a basin-wide scale, data centers currently account for 0.3% of withdrawals and 3% of total consumptive use.

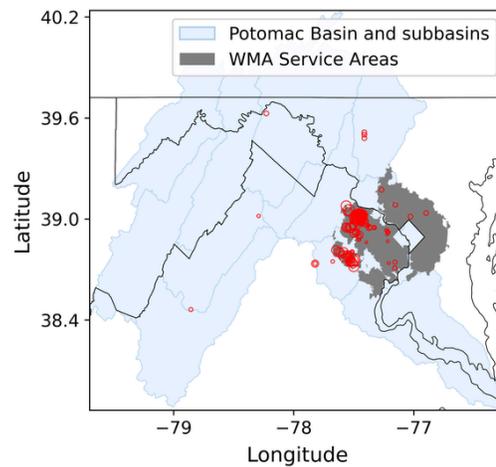


Figure 1. Distribution of Data Centers by Power Demand in the Potomac Basin. Red circles represent data center locations, sized by their relative power demand.

## FAQS

**How do data centers use water?** Data centers primarily use water for cooling IT equipment to maintain safe operating temperatures. While this study focuses on direct, on-site consumption, data centers also have an "indirect" water footprint (often referred to as Scope 2 and 3) through the water required to generate the electricity they consume and the water used in the lifecycle of their hardware.

**How many data centers are in the Potomac basin?** The count depends on whether facilities are defined as individual buildings or as campuses. This study accounted for over 290 individual buildings in the basin. Because counts vary depending on the definition used, more informative metrics for scale are total power demand (estimated at about 5,400 MW) and total floor space (estimated at 56 million square feet) currently operating within the basin.

**Can water reuse be a solution?** The use of reclaimed water can be an effective way to reduce demand for potable supply. However, it does not eliminate consumptive loss. For evaporative cooling, reclaimed water is largely lost rather than returned to the river system, reducing return flows. If the reclaimed water is sourced upstream of the Washington Metropolitan Area (WMA) intakes, this reduction in return flow can affect both water supply availability and downstream environmental flow targets.

**What about water quality?** Data centers in the region typically discharge to municipal sewers for treatment. However, as some facilities move toward individual withdrawals and direct discharges, potential cumulative impacts related to increased temperature, salinity, minerals, and other contaminants of concern in their wastewater may require further study. In addition, as consumptive use increases, reductions in streamflow may increase the concentration of discharged contaminants as well as other pollutants in the receiving waters.

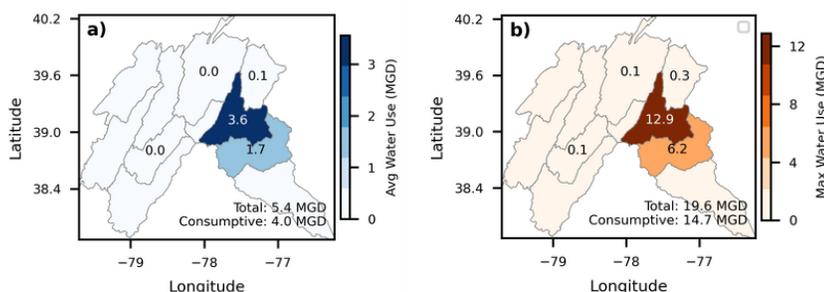


Figure 2. Average and peak data center water use by sub-basin, showing facility clusters (black dots) and regional consumption intensity (shading).

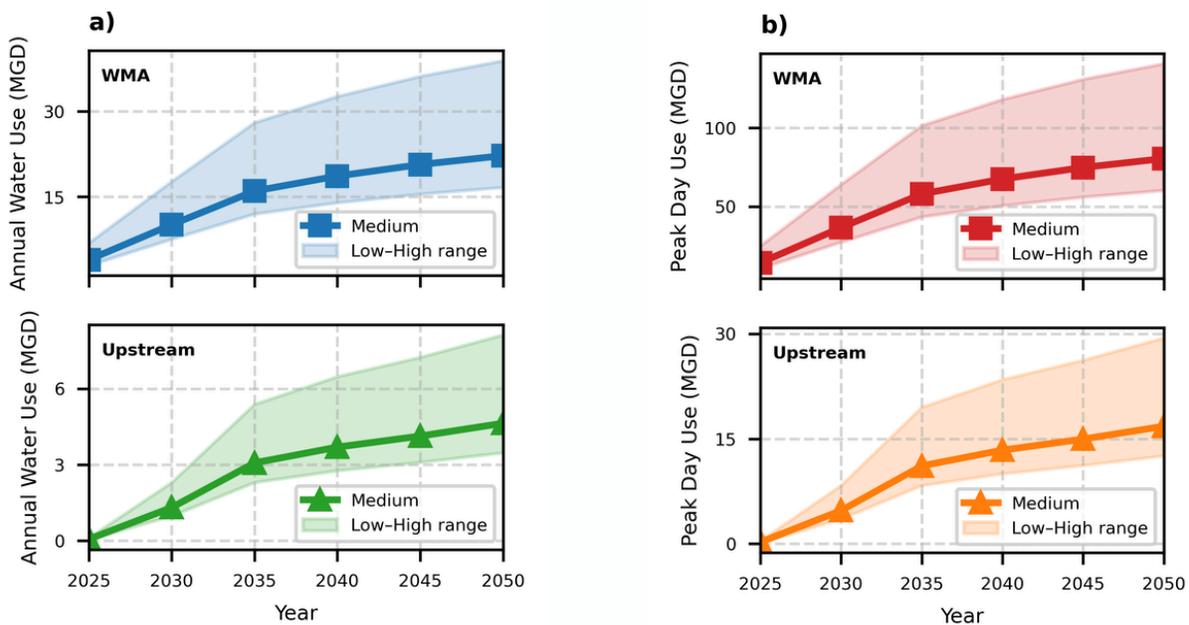


Figure 3. Projected annual and peak data center water use (2025–2050) the WMA and upstream Potomac basin (medium scenario).

**Future conditions could change substantially.** Over 100 million square feet of additional data center development is currently planned across the region in coming years, much of it in the form of hyperscale facilities with dense server configurations. These facilities may rely more heavily on water-based cooling, which can be more energy-efficient and cost-effective than air cooling, particularly in warmer conditions. Conversely, technological innovation could reduce the water intensity of data center cooling in coming years, though the pace and scale of adoption remain uncertain. Under baseline assumptions, data center water use within the WMA is projected to increase to approximately 22 MGD on average and over 80 MGD at peak by 2050. Upstream consumptive use is projected to reach about 5 MGD annually and about 17 MGD at peak, with even higher values possible under more water-intensive cooling scenarios. Should this growth materialize, the cumulative impact of data center growth could lead to regional water supply reliability challenges especially during low-flow periods.

## METHODOLOGY

**Current data center water use.** The study's methodology is grounded in observed data derived from aggregated utility records. Current demand was established using utility-reported average and peak water use in the Loudoun Water and Prince William Water service areas, which was then linked to facility power capacities identified through a database developed by the Virginia Joint Legislative Audit and Review Commission (JLARC), using Virginia Department of Environmental Quality (VADEQ) air permits, which are publicly available on the VADEQ website. Water use for areas without direct reporting was estimated based on the established relationship between power demand and water use, expressed through a water use intensity factor, defined as water use per power demand (WUP), analogous to the commonly used Water Use Efficiency metric. Nominal site-level water use intensity values can range between 100-1,600 gallons/day/MW on average, depending on cooling technology, and can reach up to 8,500 gallons/day/MW at peak for facilities using evaporative cooling. The estimated regional average WUP for all existing data centers in the basin is 800 gallons/day/MW with an assumed consumptive-use factor of 75%.

**Future data center water demand.** Future water demand was projected by combining regional energy forecasts with various cooling technology scenarios. The study utilized PJM Interconnection load forecasts through 2050, which project a 35% load increase for Allegheny Power Service area (Maryland, West Virginia, Pennsylvania) and a 135% increase for Dominion's service area (Virginia). These forecasts identify data centers as the primary driver of regional power growth.

Water Use Intensity scenarios were developed to account for **uncertainty in future cooling methods**. These scenarios (low, medium, and high) were constructed by varying the assumed share of water-cooled versus air-cooled facilities. The final water demand projections were derived by applying these different intensity scenarios to the projected power growth, providing a range of outcomes.

*The Interstate Commission on the Potomac River Basin (ICPRB) is an interstate compact commission established by Congress in 1940. Its mission is to protect and enhance the waters and related resources of the Potomac River basin through science, regional cooperation, and education. Represented by appointed commissioners, the ICPRB includes the District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia, and the federal government.*

*ICPRB's Section for Cooperative Water Supply Operations on the Potomac (CO-OP) provides technical and managerial support to the three major WMA suppliers (Fairfax Water, WSSC Water, and the Washington Aqueduct) under the Water Supply Coordination Agreement of 1982.*

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## RECOMMENDATIONS

As data center development expands in the region, improved transparency in water use (at a daily scale), energy consumption, and cooling technologies will be essential for accurately assessing and planning for future water demand.

Data centers in the Potomac Basin are typically supplied by public water utilities rather than self-supplied and therefore do not fall under existing consumptive use regulations and mitigation requirements. Updating policies to address low-flow mitigation for large utility-supplied facilities could help address their cumulative impacts on water availability during droughts.

Strategic planning and technology choices can improve long-term water supply resilience. Potential approaches include siting facilities near downstream reclaimed-water sources and adopting cooling technologies that reduce freshwater demand. However, lower-water cooling approaches often increase energy use, and the environmental impacts of alternative "water-free" technologies should be carefully evaluated to avoid unintended consequences.

While future data center growth and its associated water demands remain uncertain, it could place significant pressure on regional water supplies, potentially requiring substantial infrastructure investment to maintain system reliability.