INDEPENDENT ANALYSIS

Two Systems, One Drought

Virginia's Groundwater Ceiling, Its Rivers, and the Water the Energy Buildout Actually Uses

An Independent Volume in the Virginia Data Center Series

WATER

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Disclosure

In July 2026 the author was named to the advisory board of "Data Centers and the Southern Energy Buildout: Implications for Electricity Costs, Energy Transition, and Energy Justice," a 2026–2029 study at Emory University funded by the Alfred P. Sloan Foundation and covering Georgia, Tennessee, and Virginia, for which he receives a token honorarium. This report was prepared independently and entirely from public sources and is not a product of, or funded by, that project. Unlike earlier volumes in this series, the research for this volume was conducted after that appointment. The Sloan Foundation and Emory University reviewed no part of this volume, supplied no data to it, and had no advance sight of its findings.

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Introduction: The Columns Nobody Adds

Virginia runs two water systems, and they fail in opposite ways.

East of the fall line the Coastal Plain aquifer fails slowly, invisibly, and close to permanently. Eighty years of cumulative withdrawal have drawn the Potomac aquifer down roughly two hundred feet at the major pumping centers. The clays between the sand layers compact as the water leaves, and compacted clay does not spring back. The storage is not depleted; it is destroyed. Water that entered the system before the last glaciation is being pumped out on a schedule measured in decades and replaced on a schedule measured in centuries.

West and north, and along every river in the Commonwealth, surface water fails fast, visibly, and recoverably. Gauges drop, reservoirs draw down, task forces convene, restrictions go into effect, and then it rains and the restrictions lift. In July 2026 the James River rose above its conservation triggers and Richmond and five surrounding counties lifted voluntary restrictions within a fortnight of the worst readings of the year.[1] Nothing comparable happens to a confined aquifer.

The Commonwealth is currently solving a problem in the first system by adding load to the second. The Department of Environmental Quality's SJ 25 study, delivered to the Secretary of Natural and Historic Resources in December 2025 and released to the public in late July 2026, found that no location it tested east of Interstate 95 could support a three-million-gallon-per-day groundwater withdrawal, and that the best passing volume anywhere in the coastal plain was 360,000 gallons per day at a site chosen because it was the best case.[2] The agency's recommended response is to move users onto alternative sources, which in eastern Virginia means rivers.[3] It issued that guidance during the second driest water year in the Commonwealth's recorded history.[4]

Meanwhile the energy buildout's actual water demand does not run mostly through cooling towers at data centers. It runs through the power plants that serve them, and those plants draw from rivers and estuaries, not from the aquifer. Groundwater supplied about 0.01 percent of Virginia's power generation withdrawals in 2024.[5] Off-site water use, primarily for thermoelectric generation, accounts for roughly three-quarters of the total operational water footprint of American data centers.[6] The buildout's water demand and the coastal plain's water migration are converging on the same rivers, in the same decade, during the same drought.

No state mechanism sums the two columns.

That is the subject of this volume. It is a claim about institutional design rather than about scarcity, and it needs to be stated carefully, because the strong version is false. Virginia has instruments. The Ground Water Management Act carries a hard numerical ceiling that governs the sum of all lawful withdrawals in a management area. The Code expressly authorizes DEQ to consider surface water availability when it evaluates a groundwater application, and since September 2024 the Virginia Water Protection regulation has carried a mirror provision running the other direction.[7] There is an entire dormant statutory regime, Chapter 24 of Title 62.1, that would let the State Water Control Board declare a Surface Water Management Area with a permit trigger and a domestic-use priority, and the surface water regulation the state actually uses opens by subordinating itself to that chapter.[8]

The accurate claim is narrower and harder to answer. Virginia possesses the authority to evaluate the two regimes against one another and does not exercise it. It has never declared a Surface Water Management Area. It produces no forecast that reconciles groundwater demand against surface water demand as a single number. Its two permitting programs run on separate applications, separate technical evaluations, and separate staff, and a locality moving from one source to the other files twice and is scored twice, never once. The 2020 State Water Resources Plan, the closest thing to an integrating document, describes itself as compiling what the two programs separately report.[9] The next one is not due until roughly 2031.

Three things follow, and this volume takes them in order.

The migration is real, it is expensive, and it is already under way. Caroline County holds a permit to draw nine million gallons a day from the Rappahannock. New Kent has an application pending on the Pamunkey. James City County's groundwater permit expires in February 2027, and eleven of the fourteen largest negotiated groundwater permits in eastern Virginia expire in 2026 or 2027.[10] The identified capital cost of the projects now in motion or contemplated exceeds a billion dollars before a single private well conversion is counted.

The rescue does not arrive in time to change those decisions. The Hampton Roads Sanitation District's SWIFT program is the largest managed aquifer recharge effort on the East Coast and its first full-scale plant begins phased start-up this fall. DEQ will credit measured recharge benefits in permitting decisions, and is already conditioning at least one permit term on SWIFT's progress. What it will not do is model projected benefits into the fifty-year simulations its permitting machinery runs on, and it says a credible model needs about a decade of full-scale operating data.[11] The two SWIFT facilities nearest the most constrained region are the last two in HRSD's own published schedule.

And the coupling runs both directions. SWIFT's benefit depends on uninterrupted electricity. The generation whose cooling water is the buildout's real water story depends on rivers that the migration is now also claiming. Each system has acquired a claim on the other, and the instrument that would price that claim is the one Virginia has and does not use.

Two cautions before the detail. This volume is not an argument that Virginia is running out of water. The Commonwealth has substantial surface water, and the 2026 drought will end. It is an argument about sequencing and accounting: that a state pushing users from a capped regime into an uncapped one during a record dry year, without any mechanism that scores the transfer, is making a decision it has not admitted to making. Second, the numbers here are drawn from the state's own record — DEQ's reports and bulletins, the Virginia Administrative Code, USGS compilations, county capital plans, and permit documents. Where this volume departs from something the author has previously published, it says so.

1. Two Systems, Two Failure Modes

The confined aquifer

The Virginia Coastal Plain aquifer system begins at the fall line, which runs a short distance west of Interstate 95; DEQ treats the interstate as its approximate western edge. It is a wedge of sediment thickening eastward from there, built of alternating sand and clay layers, and one unit within it dominates. The Potomac aquifer, the deepest and largest, accounts for 70 percent of reported and estimated withdrawals in the Eastern Virginia Groundwater Management Area. On the Eastern Shore, where the Potomac carries saline water, the shallower Yorktown-Eastover system supplies 95 percent of withdrawals.[12] Total withdrawal across the Eastern Virginia GWMA runs about 96.3 million gallons per day.[13]

Three properties make this system fail differently from a river.

Recharge is geologically slow. The confined portions of the Potomac aquifer are separated from the surface by clay confining units. Water enters at the outcrop near the fall line and moves eastward at rates USGS measures in single-digit feet per year — about ten feet per year in southeastern Virginia, four feet per year farther north.[14] The water being pumped from a well in James City County today entered the system long before anyone was there to pump it.

Withdrawal has reversed the natural flow direction. Two paper mills built the modern hydrology of eastern Virginia. Withdrawals at Franklin and West Point, each drawing tens of millions of gallons a day across the twentieth century, pulled inland water levels below sea level and inverted the regional gradient. Water that once discharged outward toward the rivers and the Bay now flows inward and downward toward the pumping centers.[15] The measurable consequences are land subsidence and locally rising chloride concentrations, which is what saltwater intrusion looks like before it reaches a wellhead.

And the storage loss is physical, not merely a matter of levels. This is the property that separates the two systems, and it is worth stating precisely because it is easy to overstate. When head drops in a confined aquifer, the clay layers between the sands consolidate. That consolidation is largely inelastic: the pore space collapses and does not reopen when pressure returns. USGS documented compaction rates of up to 3.7 millimetres per year in the Virginia Coastal Plain.[16] The surface expression is subsidence, and the subsidence is doing measurable work on the coastline. USGS Circular 1392 reaches two nested conclusions: land subsidence causes more than half of the observed relative sea-level rise in the southern Chesapeake Bay region, and aquifer-system compaction causes more than half of the land subsidence.[17]

That second finding is the one this volume relies on, and it needs a correction to the record. A previously published sidebar under this author's byline compressed the two conclusions into one and reported that groundwater withdrawal accounts for more than half of relative sea-level rise.[18] It does not. Against USGS's own figures of 3.9 millimetres per year of relative sea-level rise and 2.1 millimetres per year of subsidence, compaction's share of sea-level rise works out to roughly a quarter to a third; HRSD's own materials state about 25 percent. The corrected claim is the more useful one anyway. What matters here is not the coastline arithmetic but the mechanism: the

aquifer is not simply low, it is being permanently reduced in capacity, and the evidence for that is a shoreline sinking at a rate you can measure.

A distinction the volume will hold to. Three different quantities get conflated in discussions of aquifer recovery, and conflating them produces bad analysis in both directions.

Head, the water level, recovers. It recovers quickly and sometimes dramatically. When the Franklin mill cut its withdrawal in 2010, water levels at the pumping center rebounded 107 feet within a few years.[19]

Storage, the physical capacity to hold water, does not recover where compaction has occurred. Whether repressurization produces any elastic rebound that returns usable storage is an open question that can only be answered by direct measurement, and the instrument for measuring it — an extensometer with collocated observation wells at the James River injection site — was still under construction as of DEQ's July 2026 report.[20]

Residence time, the pace at which water actually moves through the system, does not change at all. It is a property of the sediment.

A statement that "the aquifer has only had bad years" is therefore wrong as stated, and this volume does not make it. Levels have had good years. The system's capacity has not.

Rivers and reservoirs

Surface water fails on a weather timescale. The failure is visible, it is measured continuously at gauges, and it reverses.

The 2026 record demonstrates both halves. In late April, one hundred percent of Virginia stood in drought, with 85.91 percent of the Commonwealth in severe drought and 8.08 percent in extreme drought.[21] By late May the extreme category had grown to 36.12 percent.[22] Approximately sixty of the state's 201 stream gauges were setting provisional record daily lows.[23] Goose Creek near Huddleston, the indicator gauge for the Roanoke region, sat at the 0.44 percentile.[24]

Then it rained. Between mid-July and July 30, severe drought coverage fell by thirteen percentage points and extreme drought by four, and ten percent of the Commonwealth left drought conditions entirely.[25] On August 4 the City of Richmond and Chesterfield, Goochland, Hanover, Henrico, and Powhatan counties lifted their voluntary conservation advisories, on the basis that James River flows had risen above the conservation triggers in Richmond's James River Regional Flow Management Plan.[26]

Two features of that August 4 lift deserve attention, because both are easy to misread. It was not a drought de-escalation. The Drought Monitoring Task Force's advisory of record as of that date still carried the Middle James region at drought warning, and DEQ had published no post-meeting advisory.[27] The localities exited a flow-based conservation trigger, which is a separate instrument keyed to river conditions rather than to the state's drought classification. A river can rise above a management threshold while the region it runs through remains in a declared drought.

The second feature is the contrast with what the groundwater indicators were doing at the same moment. DEQ's July 31 bulletin recorded that reservoirs were within normal ranges except at Smith Mountain Lake and John Kerr, that streamflow had improved in the eastern and western regions, and that groundwater levels "continue to decline across Virginia."[28] In May, twenty of twenty-four groundwater indicator wells had recorded seven-day levels below the tenth percentile, and twelve stood at the zero percentile — provisional record lows.[29] The Governor's July 16 statement put it plainly: "The long-term outlook for groundwater levels remains a concern and will take a prolonged period of additional rainfall to recover."[30]

Two systems, one drought, and two entirely different recovery curves running simultaneously in the same state.

Why this is not merely an observation

The two failure modes have opposite policy implications, and the divergence is the reason the regulatory design in Section 2 matters.

If a resource fails fast and recovers fast, the right instrument is a trigger: a threshold, a restriction, a lifting mechanism. Virginia has built exactly that for surface water, and on the evidence of August 2026 it works about as designed.

If a resource fails slowly and does not recover, a trigger is close to useless, because by the time it fires the loss has already been taken. The right instrument is a ceiling applied in advance to the cumulative sum of everything drawing on the resource. Virginia has built exactly that for groundwater, and it is the 80 percent drawdown criterion described in the next section.

The problem is not that either instrument is badly designed. The problem is what happens at the boundary between them, when a user constrained by the ceiling walks across the line and becomes subject only to the trigger.

2. Two Regimes, One Gap

The groundwater ceiling

The Ground Water Management Act of 1992 governs withdrawals inside a declared Groundwater Management Area. Virginia has two: the Eastern Virginia GWMA, covering roughly everything east of Interstate 95, and the Eastern Shore GWMA covering Accomack and Northampton counties. Inside those areas, any withdrawal of 300,000 gallons or more in any single month requires a permit — roughly the demand of a thirty-house subdivision.[31]

The permit turns on a technical evaluation, and the operative criterion is numerical. Under 9VAC25-610-110 D 3 h, DEQ must demonstrate to its satisfaction that

> "the stabilized effects from the proposed withdrawal in combination with the stabilized combined effects of all existing lawful withdrawals will not lower water levels, in any confined aquifer that the withdrawal impacts, below a point that represents 80% of the distance between the land surface and the top of the aquifer."[32]

Three features of that sentence do the work.

It sums. The test is applied to the proposed withdrawal *in combination with all existing lawful withdrawals*, which includes withdrawals that were never permitted because they predate the management area. A cumulative test that only counted permits would be trivially gameable; this one is not.

It is numerical. Eighty percent of the distance from land surface to the top of the aquifer is a specific elevation at a specific location, computed by model. There is no balancing test, and there is no variance from the criterion itself.

And it looks fifty years out. DEQ's evaluations are run through the Virginia Coastal Plain groundwater flow model, where "stabilized effects" means the conditions the model predicts fifty years in the future. The output is an area of impact — the extent within which the model predicts at least one foot of drawdown — and a determination whether the criterion is breached anywhere inside it.[33]

Two further provisions matter for what follows. Applications for human consumption receive the highest priority when available groundwater cannot satisfy everyone seeking it.[34] And a public water supply's renewed permit cannot be set below the portion of its previously permitted withdrawal that supported human consumption during twelve consecutive months of the prior term.[35] That is a floor, and it is the strongest protection in either regime.

It is also narrower than it looks, and the narrowness has not been widely absorbed. "Human consumption" covers water used for survival and health: drinking, bathing, cooking, dishwashing, hygiene. Municipal systems also serve commercial and industrial customers, and DEQ has indicated that customer-class information would be needed to determine how much of a utility's draw qualifies for the protected floor.[36] A public water supply is not automatically protected in full. It is protected up to the share of its water that goes to people rather than to processes — a number that, for most Virginia utilities, has never been publicly calculated.

There is one more provision that has attracted almost no attention and that this volume treats as significant. Section 62.1-263 of the Code directs that in evaluating a groundwater application, DEQ may consider surface water availability, and 9VAC25-610-110 G carries the same authority in the regulation.[37] The cross-regime question is not unauthorized. It is simply not asked systematically.

The surface water regime

Surface water withdrawals run through the Virginia Water Protection permit program, which also serves as Virginia's Clean Water Act Section 401 certification. The trigger volumes are set out at 9VAC25-210-310 A 11: more than 10,000 gallons per day from nontidal waters, or more than two million gallons per day from tidal waters, for non-agricultural uses. Agricultural thresholds sit at one million gallons per month nontidal and sixty million gallons per month tidal.[38] That tidal agricultural figure equals two million gallons per day in a thirty-day month and is within eight percent of it in any other, so on tidal waters the agricultural and non-agricultural triggers are effectively the same. That undercuts the common assumption that agriculture enjoys a categorically softer threshold. On nontidal waters the agricultural threshold is roughly three and a third times higher.

The cumulative-effects provision reads differently from its groundwater counterpart. Under 9VAC25-210-370 B 3, DEQ must consider

> "the combined effect on the hydrologic regime of the surface water within an affected stream reach due to consumptive water uses associated with: (a) all existing permitted withdrawals; (b) the total amount of withdrawals excluded from VWP permit requirements; and (c) any other existing lawful withdrawals."[39]

The enumeration is comparable to the groundwater test. The operative differences are three, and only the third is usually noticed.

The verb is *consider*. There is no numerical criterion the sum must satisfy. Instream flow conditions are developed case by case during permit drafting, and the regulation describes them permissively: conditions "may include, but are not limited to" volume and rate limits, safe yield, and conservation requirements.[40] No statewide safe-yield figure exists for the James, the Rappahannock, the York, the Pamunkey, the Chickahominy, or the Potomac against which a new application is quantitatively tested.

The geography is a *stream reach*, not a basin or a management area. The groundwater test asks whether a withdrawal breaches a ceiling anywhere within an area of impact that DEQ's own modeling puts at sixty-six to ninety-one miles.[41] The surface test asks about the reach the withdrawal affects.

And the quantity counted is *consumptive use*, not withdrawal. This is the difference that matters most for the argument in Section 7, and it is almost never stated. Virginia's thermoelectric fleet withdrew about 5,320 million gallons per day in 2015 and consumed 50.6 million, a consumption rate of 0.95 percent, because once-through cooling returns nearly all of what it takes to the source at a slightly higher temperature.[42] Under a cumulative-effects provision denominated in

consumptive use, the largest water withdrawer in the Commonwealth by an order of magnitude enters the calculation at roughly one percent of its apparent size. That is not an oversight; it is arguably the hydrologically correct measure. But it means the surface regime's cumulative test is structurally incapable of registering the thing most readers assume it registers.

Beyond 370 B 3 there is a second and stronger provision that is frequently overlooked. Section 370 D 3 conditions permit issuance on a finding that the withdrawal will not cause significant impairment "individually or in combination" with other activities.[43] That is an issuance criterion rather than a factor to weigh. It has not, on the public record, been used to deny a large withdrawal on cumulative grounds.

Grandfathering

The cumulative test in either regime can only sum what it can enumerate, and on the surface side the enumeration has a large hole in it.

Section 9VAC25-210-310 A 1 excludes any surface water withdrawal in existence on July 1, 1989. Section A 3 excludes unpermitted withdrawals begun between July 1, 1989 and July 25, 2007 that filed under the water withdrawal reporting regulation, up to the largest twelve-consecutive-month withdrawal in the ten years before that date.[44] The consequence, in DEQ's own words for calendar year 2024: "Of the top 20 largest reported withdrawals in 2024, 14 are from facilities that are unpermitted."[45]

The list is not marginal. Fairfax Water's two treatment plants drew 94.6 million gallons a day at Corbalis and 69.4 at Griffith in 2024, which the author sums to 164.0 across the utility. Both are unpermitted.[46] AdvanSix's Hopewell plant drew 96.4 in the same year, the City of Norfolk's Western Branch Reservoir 57.2, and Virginia Beach 33.7 through the Lake Gaston pipeline. None of those is permitted either.[47] Across the Commonwealth, DEQ reports that "In 2024, unpermitted withdrawals represented approximately 78% of the total reported withdrawals in Virginia when excluding power generation," and that "81% (916.16 MGD) of 2024 reported surface water withdrawals were associated with unpermitted facilities."[48] Roughly one gallon in five of non-power surface withdrawal moves through a Virginia Water Protection permit.

Those figures come from the Annual Water Resources Report DEQ published in December 2025, and their provenance is worth a sentence of its own. Section 62.1-44.40 of the Code requires the State Water Control Board to submit that report to the Governor and the General Assembly on or before October 1 each year. The December 2025 edition is roughly three months late, and it does not appear in the legislature's reports-to-the-General-Assembly series at all. It is posted on DEQ's website. The most current public accounting of who withdraws Virginia's water, and under what authority, was not filed with the body that requires it.[49]

Two qualifications keep this from being overstated, and they cut in opposite directions.

The 1989-to-2007 cohort is capped. Under 9VAC25-210-310 A 3 a, the largest twelve-consecutive-month withdrawal in the ten years before July 25, 2007 "shall constitute a limit on the withdrawal that is excluded from permit requirements," and any increase above it requires a permit application.[50] Those withdrawals are excluded from permitting but not from limitation.

The pre-1989 cohort is not. Withdrawals in existence on July 1, 1989 are excluded outright, and the only reporting-and-consideration obligation attached to that exclusion — the requirement to supply DEQ a maximum annual figure that "shall not constitute a limit" but "shall be considered when evaluating applications for new withdrawal permits" — applies by its terms to temporary withdrawal systems where the purpose is agriculture.[51] It does not reach the large municipal and industrial withdrawals that dominate the top-20 list. Fairfax Water, the City of Norfolk and Virginia Beach are pre-1989 systems. Their volume is neither capped nor subject to that provision.

The instrument Virginia has and does not use

The claim that no mechanism exists to sum demand across the two regimes is false as stated, and the volume is stronger for saying so.

Chapter 24 of Title 62.1 of the Code, sections 62.1-242 through 62.1-253, establishes a Surface Water Management Area regime. Within a declared area, the State Water Control Board may require permits for withdrawals, with a trigger volume of 300,000 gallons per month — the same threshold the Ground Water Management Act uses. The chapter provides a locality petition right, a multi-user permit criterion, and a statutory priority for domestic use.[52] It is, in structure, the surface water counterpart to the groundwater regime this volume has just described.

The Virginia Water Protection regulation is aware of it. Section 9VAC25-210-370 B opens by subordinating itself to Chapter 24 — the provision this volume quoted above operates subject to that regime.[53]

Virginia has never declared a Surface Water Management Area.

Set alongside the cross-regime authorities at § 62.1-263 and 9VAC25-610-110 G on the groundwater side, and their mirror at 9VAC25-210-315 on the surface side since September 2024, the picture is not one of a state that lacks tools.[54] It is one of a state holding a full set of instruments it has never carried through to a declaration while its two permitting programs proceed on separate tracks.

What is genuinely absent is smaller and more specific:

- **No integrated forecast.** The 2020 State Water Resources Plan compiles separately submitted groundwater and surface water information and projects a 450 million gallon per day demand increase to 2040, split 77 percent surface and 23 percent ground. That is a breakdown of parallel supply sources, not a reconciled demand model. The next plan follows regional plans due in October 2029 and will not appear before roughly 2031.[55]
- **No single application.** A locality moving off groundwater onto a river files two applications, on two regulatory tracks, evaluated by two program divisions against two different kinds of test.
- **No scoring of the transfer.** Nothing requires DEQ, when it constrains a groundwater permit and directs the applicant toward alternative sources, to establish that the receiving river can bear the load, or to record the transfer anywhere that a later analyst could add up.

That last item is the specific gap this volume is about. It is not a gap in authority. It is a gap in practice, and the difference matters, because a gap in practice can be closed without legislation.

The asymmetry, stated generally

The two regimes ask questions of different kinds, and this is the structural reason the surface side has never developed a cumulative number.

The groundwater regime asks a question about a **stock**: how much is in the aquifer, how far has the level fallen, what is the sum of everything drawing on it. Stock questions aggregate naturally, because every withdrawal draws on the same pool. Summation is the obvious operation.

The surface regime asks a question about a **flow at a point**: what is passing this gauge, what does this reach need, is this withdrawal impairing this stretch of river. Flow-at-a-point questions do not aggregate, because each point is a different question with a different answer.

A regulator can be equally diligent in both regimes and still produce a hard ceiling in one and a case-by-case judgment in the other. That is not a drafting failure. It is a consequence of what each resource is, and it means the pressure created by a rigorous groundwater rule lands on a regime that is structurally disinclined to count.

The better your groundwater ceiling, the more traffic it sends across a boundary nobody is scoring.

3. What the Record Already Showed

Four droughts, and a fifth thing that is not a drought

The U.S. Geological Survey recognises four major statewide droughts in Virginia since the early 1900s: 1930–32, 1938–42, 1962–71, and 1980–82.[56] Everything since — 1999, 2002, 2007–08, 2010–12, 2023, 2024, and the event now under way — layers on top of that framework rather than displacing it.

The drought of record is **1930–32**, and the point is worth making because the attribution is frequently misplaced onto the 1960s. USGS: "The drought of 1930-32 was one of the most severe droughts recorded in the State. Recurrence intervals ranged from 30 years to greater than 80 years." Elsewhere the agency is blunter: it "was the worst drought in Virginia in at least 100 years."[57] DEQ's own 2003 Drought Assessment and Response Plan names it "the drought of record (1930-1932)" in terms.[58] The driest twelve-month periods ran about half of normal precipitation. Woodstock recorded twenty-one days at or above 100°F in the summer of 1930, and the 109° reading of July 20 remains Virginia's official high. Some 300,000 acres of Virginia forest burned that year, about thirty times the current annual average.[59]

The 1962–71 event has a legitimate claim to a different superlative. It produced the largest cumulative streamflow deficit of the four, because it ran for the better part of a decade.[60] Duration rather than depth.

The 2002 drought is the one modern Virginia water policy is actually built around. On August 30, 2002, Governor Warner declared a drought emergency across the majority of the Commonwealth by Executive Order #33, requiring the elimination of some non-essential water uses. DEQ's account of the peak is worth quoting at length because nothing since has approached it:

> "The intensity of these drought impacts peaked in late August 2002. Wildfire indices were at levels previously unrecorded in Virginia, the vast majority of Virginia agricultural counties had applied for Federal drought disaster designation, streamflows reached period of record lows, and thousands of individual private wells failed."[61]

And on the near-failures:

> "During the third week of August several public water supply systems across the Commonwealth were on the brink of failure. Several large municipal systems, such as Charlottesville and Portsmouth, had less than sixty days of water supply capacity remaining in reservoirs. Several smaller rural systems that rely primarily on withdrawals from free-flowing streams, such as the towns of Farmville and Orange, had at most a few days of water supply available and were forced to severely curtail usage."[62]

The Rapidan River fell to 0.45 cubic feet per second.[63] Carvins Cove Reservoir hit its lowest measured level that October. And DEQ was explicit that even this did not reach the severity of 1930–32.

One fact from that history governs everything in Section 4. **No drought emergency has been declared in Virginia since 2002.** DEQ states it directly: watch declarations issue for various

regions nearly every year, warnings less often, "A Drought Emergency declaration has not been issued since the 2002 drought."[64] Twenty-three years of restraint, which is a fact about institutional behaviour as much as about weather.

The other chronology

Running alongside the drought record is a second sequence, and it does not oscillate.

1939. The Virginia Geological Survey begins documenting pressure declines around the Franklin pumping center. The warning predates the Second World War.

1973. The General Assembly passes Virginia's first Groundwater Act, expressly because Coastal Plain levels are falling.

1992. The legislature replaces it with the Ground Water Management Act, having concluded the first statute did not stop the decline.

2009. A USGS model shows roughly 200 feet of drawdown at the major pumping centers since large-scale pumping began.[65]

2013. USGS Circular 1392 establishes that aquifer-system compaction causes more than half of the land subsidence in the southern Chesapeake, and that subsidence causes more than half of relative sea-level rise there.[66]

2014–2017. DEQ reduces the combined permitted maximum of its fourteen largest groundwater users from 146.5 million gallons per day to 73.6 million.[67] The Commonwealth had promised roughly twice the water the aquifer could bear, and spent three years unwinding the promise.

2016. JLARC, the legislature's own watchdog, reports that eastern Virginia lacks sufficient groundwater to accommodate any major new permit request.[68] That is the SJ 25 conclusion, arrived at ten years earlier by a different body.

2018. HRSD begins injecting purified wastewater into the Potomac aquifer. Utilities do not spend on that scale replenishing a resource in good condition.

2019. The James City Service Authority's groundwater permit is cut from 8.83 million gallons a day to six, with a further reduction scheduled for 2027.[69]

2026. SJ 25, six months late, puts a number on it: the best remaining site in the coastal plain can spare 360,000 gallons a day, and it is on the lower Northern Neck, far from anywhere that wants it.

The asymmetry, in the record

Set the two sequences side by side and the structural claim of Section 1 stops being theoretical.

The surface record oscillates. Severe drought in 1930, 1962, 1977, 2002, 2026; recovery in the intervening years; a wet 2003 immediately following the emergency of 2002. Each event is severe, each passes.

The groundwater record does not oscillate in the same way. USGS's longest Virginia well record, an Arlington County observation well with data to 1931, shows the well essentially dry in 1931 and low again in the droughts of 1942, 1955, 1966, and 1982 — a stair-step of fresh minima keyed to each dry period.[70] Levels do recover between events, sometimes substantially. What does not recover is the storage the compaction has taken, and the sinking coastline is the receipt.

The Franklin closure is the cleanest demonstration available of both halves. When International Paper cut its Franklin withdrawal by 89 percent in 2010 — a reduction DEQ characterises as 29 million gallons per day — water levels at the pumping center rebounded 107 feet, briefly returning to levels last seen in the early 1960s.[71] That is head recovering, fast and dramatically. But the mill resumed operations in 2012, and DEQ records the post-2013 withdrawal averaging 42 percent of the pre-2010 rate, rising to 47 percent by 2024.[72] The regional gains held roughly stable from about 2015 to 2021 and have since plateaued and begun to reverse. DEQ now expects the Potomac aquifer to enter general decline within five to ten years under current conditions.[73]

A previously published account under this author's byline described the Franklin mill as having "stopped pumping 29 million gallons a day."[74] It did not stop. It cut hard, and then came partway back, and the coming-back is precisely why the rebound was temporary. That distinction is load-bearing for Section 6, because the same mechanism governs whether SWIFT's gains persist.

4. The Second Driest Year

The ranking

Governor Spanberger's office, July 16, 2026:

> "All areas of the Commonwealth continue to experience record historic drought conditions… Rain is approximately 7.8 inches below normal on average throughout the Commonwealth. This represents the second driest water year on record."[75]

The water year began October 1, 2025. Virginia recorded its fifth driest January-through-June on record since 1895, at 16.18 inches, a deficit of 5.15 inches for that period alone.[76] The Roanoke region had received 57 percent of its normal rainfall.[77]

Regional deficits as of DEQ's July 31 bulletin ranged from 5.3 inches at Norfolk to 9.4 inches at Danville. Richmond, by that date, was described as having normal year-to-date precipitation.[78] That is a change from the beginning of July, when DEQ's water supply planner Andrew Noyes told VPM News that the Richmond area still sat at a nine-inch deficit for the water year, and that the shortfall deepened westward: "For a lot of the James River watershed moving west of here, that deficit goes up to around 13 inches."[79] Both figures are accurate on their dates, and the movement between them over four weeks is itself the point of Section 1.

The measurements

DEQ's water-year percent-of-normal figures by drought evaluation region, as of late May, show the spread across the Commonwealth: Roanoke at 54.89 percent, Middle James 57.49, Eastern Shore 58.33, Northern Coastal Plain 58.97, Chowan 61.15 — all at emergency status on the precipitation indicator — against Northern Virginia at 78.04 and Shenandoah at 81.69.[80]

U.S. Drought Monitor coverage of Virginia moved as follows: on April 28, 100 percent of the Commonwealth in drought, 6.02 percent moderate, 85.91 severe, 8.08 extreme. On May 28, still 100 percent, with extreme drought at its peak extent of 36.12 percent. On June 23, 100 percent, extreme down to 25.53. By July 29, ten percent of the state was out of drought entirely, with 42 percent moderate, 21 severe, and 8 extreme.[81]

Streamflow at the indicator gauges in late May: Goose Creek near Huddleston at the 0.44 percentile, the Meherrin near Lawrenceville at 1.19, the Mattaponi at Beulahville at 1.71, Reed Creek at Graham Forge at 2.11, the Chickahominy near Providence Forge at 4.07.[82] DEQ's April report noted approximately sixty of 201 stream gauges setting provisional record daily lows.[83]

Groundwater told a different story throughout. In May, twenty of twenty-four indicator wells recorded seven-day average levels below the tenth percentile, and twelve of those stood at the zero percentile — provisional record lows — across the York-James, Southeast Virginia, Northern Coastal Plain, Northern Virginia, Shenandoah, Upper James, Roanoke and Big Sandy regions. In June, nineteen of twenty-four remained below the tenth percentile.[84] DEQ's July 31 assessment recorded improvement in eastern and western streamflow while groundwater levels "continue to decline across Virginia."[85]

Reservoirs held statewide except in the Roanoke basin. Smith Mountain Lake stood 5.5 feet below normal at the July 16 news conference; John Kerr 4.45 feet.[86]

The institutional response

The Drought Monitoring Task Force moved to weekly meetings, rather than its normal biweekly cadence, "given the severity of conditions."[87] It recommended a drought emergency for the Roanoke Drought Evaluation Region on July 7. On July 16 the Governor held a news conference at Smith Mountain Lake, endorsed voluntary conservation, and declined to issue an emergency declaration: "As governor, I do not want to put an executive order in place. I do not want us to need mandatory practices to conserve water. But we are constantly in that reevaluation phase of when do we hit true, true emergency where we do need to take that extra step."[88]

DEQ's corrected bulletin of July 31 escalated Shenandoah, Upper James and York-James from watch to warning, and de-escalated Big Sandy from warning to watch. The result placed **all thirteen drought evaluation regions on an active advisory** — one emergency, ten warnings, two watches.[89]

On July 30, State Senators Richard H. Stuart (R, 25th District) and Russet W. Perry (D, 31st District) wrote to the Governor asking that the General Assembly be called into special session over water.[90] As of the date of this report the Governor's office has not responded and no session has been called, scheduled, or declined.

The distinction between a drought advisory and a locality's own conservation trigger became visible on August 4, when Richmond and five surrounding counties lifted voluntary restrictions on the basis of James River flows rising above the thresholds in Richmond's James River Regional Flow Management Plan.[91] Middle James remained at drought warning. Two mechanisms, two answers, same week.

What the drought is doing to agriculture

The sector taking measurable losses in 2026 is not the one this series usually covers.

USDA Farm Service Agency drought disaster designations began with twenty-four Virginia localities on April 14 and another twenty-four on May 22. By mid-July, more than seventy-five Virginia localities carried a designation.[92] Virginia has ninety-five counties and thirty-eight independent cities; seventy-five localities is a majority of the Commonwealth's county-equivalents. A further USDA action on July 9 designated fifteen counties as natural disaster areas.[93]

DEQ's June task force report recorded the Department of Forestry reporting "an abnormal number and acreage of wildfires for June," and drought stress in pines producing elevated rates of injury from Southern Pine Beetle. Producers reported reduced first-cutting hay yields and delayed corn and soybean crops statewide.[94]

Twenty-nine community water systems across Caroline, Fauquier, Louisa, Orange, Powhatan and Shenandoah counties operated under mandatory conservation as of DEQ's June 25 bulletin.[95] Every one of those is a rural or small-town system.

This matters to the argument beyond sympathy. Agriculture withdrew 51.7 million gallons per day for irrigation and 27.0 for livestock in the most recent complete USGS compilation for Virginia.[96] Those numbers look small beside public supply at 697 and thermoelectric at 5,320. But irrigation and livestock water is consumed at rates on the order of 70 to 90 percent — the water leaves as evapotranspiration and does not return to the reach. Applied to the metric the surface regime actually uses, Virginia agriculture's consumptive draw is on the order of 55 to 71 million gallons per day, against the entire thermoelectric fleet's 50.6.[97]

On the measure written into the state's own surface water cumulative-effects test, agriculture is the same order of magnitude as every power plant in Virginia combined. Agriculture also holds no priority ranking on the surface side, has no reissuance floor comparable to the one protecting public water supplies, and — unlike public supply — is not named anywhere in the Ground Water Management Act's priority provisions.

The 2017 precedent is instructive about who absorbs a reduction when one arrives. When DEQ cut the fourteen largest groundwater permits from 146.5 to 73.6 million gallons per day, it did so to permittees. When Georgia suspended new withdrawal permits in the Lower Flint basin — an action covering surface water and the Floridan aquifer together, and the closest thing in the Southeast to the integrated instrument this volume describes — it was applied to agriculture, has stood for more than a decade, and has never been extended to industrial load.[98] Any Virginia move toward an integrated cumulative ceiling should be read with that sequence in view.

5. The Migration and Its Price

Caroline County

Caroline holds a Virginia Water Protection permit, VWPP No. 20-0514, issued by DEQ in November 2025, authorising withdrawal of up to nine million gallons per day from the south bank of the Rappahannock River.[99] The original application sought 13.9 MGD and included an industrial cooling component; the county withdrew that component and reduced the request. The Virginia Marine Resources Commission approved the in-water intake structure by an 8–0 vote on June 23, 2026.[100] Of 209 public comments received, 206 opposed the project, three were neutral, and none were in favour.[101]

The infrastructure is an intake, a raw water pump station, and roughly thirty-five miles of raw water line to a treatment plant near Carmel Church, serving Caroline County and the towns of Bowling Green and Port Royal.

Cost figures have circulated at "at least $200 million," attributed to county officials. The primary engineering source is more precise and slightly lower. The Caroline County Water Master Plan puts the Rappahannock Water Supply Project at $156,280,000 in the scenario including the county's Transit Oriented Development, or $135,730,000 excluding it, with phased facility upgrades of $33.9 million each in 2037 and 2047. Both figures are stated "in 2016 dollars," and the plan itself specifies that a preliminary engineering report is still owed before the estimates can be refined.[102] Escalated to mid-2020s water construction costs, $200 million sits comfortably within — arguably below — the county's own envelope. The county's adopted FY27 budget carries the Rappahannock River Project line at $0.00 in both FY26 and FY27. The project is programmed, not appropriated.[103]

The Rappahannock Tribe filed an appeal of the DEQ permit in January 2026; the Mattaponi Tribe followed. Landowners are separately contesting the county's use of eminent domain over roughly eleven acres at the intake site.[104]

The constraint driving all of it is in SJ 25. DEQ's centroid test for the Northwest Coastal Plain, sited in Caroline County, returned a maximum passing groundwater withdrawal of 60,000 gallons per day.[105] Caroline is effectively foreclosed from the aquifer for growth of any kind.

New Kent County

New Kent has a joint permit application pending with the Norfolk District of the Army Corps of Engineers, NAO-2014-02045, and the Virginia Marine Resources Commission, 2026-0568, re-noticed in May 2026. It seeks an eight-million-gallon-per-day raw water intake on the Pamunkey River at Northbury Farm, with a pump station, 4,700 feet of raw water pipeline, and a water treatment plant, "to provide a reliable public water supply for New Kent County to satisfy the projected water demands for the next 50 years and avert reliance on groundwater."[106]

This is a re-permit rather than a first permit. The Corps notice records that a permit was issued to New Kent in 2017 for the same work at a different intake location, and that relocating the intake required a new authorisation.[107] Two approvals remain outstanding: Endangered Species Act

Section 7 consultation, which the Corps has determined is required, and Coastal Zone Management concurrence, which the applicant has not submitted.[108]

Permanent impacts as stated in the notice: 0.017 acre of subaqueous bottom, 0.01 acre of stream channel, conversion of 0.18 acre of palustrine forested wetlands and 0.02 acre of palustrine scrub-shrub wetlands to emergent wetlands.[109]

The cost is $150 million, and the figure requires three qualifications. It appears in the county's FY2026-2027 Recommended Budget capital improvement plan as $5 million in FY29-30, $5 million in FY30-31, and $140 million in the "beyond" column — a sum of two columns rather than a single line item. Its scope is construction only: intake, transmission pipelines, treatment plant. Design at $5.7 million, land and easements at $2.5 million, environmental studies at $250,000 and cultural resources surveys at $450,000 are separate lines, taking the programmed total to roughly $164.6 million, and that excludes local distribution build-out entirely. And the CIP itself labels the number a "Budget placeholder," noting that "the actual construction costs will not be known until we have completed the design." The FY26-27 recommended budget column carries $0.[110]

The driver is a state-ordered reduction in groundwater withdrawal by 2038. The county's own CIP codes the justification as "Mandated — Mandating Agency: DEQ (State)," while conceding in the narrative that "the project is not specifically mandated" and that the alternative supply is needed because DEQ continues to restrict groundwater as the county grows.[111] That tension — a project the county calls mandated and simultaneously not mandated — is an accurate description of what regulatory pressure without a formal directive looks like from the receiving end.

Western Tidewater

The Western Tidewater Water Authority, jointly held by Suffolk and Isle of Wight County, held a groundwater permit for 8.30 million gallons per day at the time of the 2009 Norfolk water agreement.[112] In 2017 DEQ's reduction brought it to 4.2 million gallons per day, having initially sought a target in the 3.5 to 3.9 range.[113] The present figure is commonly reported as 6.6 million gallons per day.

That figure needs unpacking, because it is not a flat allocation. HRPDC's March 2021 planning update states that its supply projections include the authority's groundwater permit "but does not include the tiers built into the permit," and enumerates them: Tier 1 of 2.4 MGD, a temporary increase for the period the Robert G. House treatment plant is offline for rehabilitation; Tier 2 of 2.4 MGD, conditioned on completion of the Suffolk Route 10 transmission main extension; and Tier 3 of 1 MGD, conditioned on the Route 460 main.[114] The base is 4.2. The 6.6 figure is the base plus the first conditional tier. Describing the authority as permitted for 6.6 million gallons a day overstates its unconditional entitlement.

The characterisation of the 2017 action as a "halving" also requires care. DEQ proposed 4.2 from a base of 8.3, which is very nearly a halving. The 6.6 figure that is now cited as the settled outcome has no order or permit document behind it on the public record; it is attributed to the attorney who negotiated the Norfolk agreement, speaking to a reporter in 2024.[115] A renewal application,

GWI000305, was received by DEQ on July 24, 2026 with a target completion date of April 5, 2027.[116]

The Norfolk agreement itself allocates the authority fifteen million gallons per day of Norfolk surface water through 2048, at an estimated cost across the forty-year term of roughly $300 million. Fifteen years in, most of that surface water remains unused, because the authority still meets demand largely from groundwater.[117] A locality can hold a surface water contract and continue pumping until the groundwater permit forces the switch. The contract is a hedge; the permit is the trigger.

James City County

The James City Service Authority is the most fully documented case in the Commonwealth, and it is the one where the 2027 timing binds hardest.

Its groundwater withdrawal permit, GW0043401, expires February 6, 2027. The permit's structure is tiered: an annual Tier I limit of six million gallons per day, with conditional tiers rising to 8.4 million. The authority distributes about five million gallons on an average day.[118] The permit was cut from 8.83 million gallons per day in 2019, with a further reduction scheduled for 2027 — the reduction now due for adjudication.[119]

February 2027 is not a cutoff for pumping. Under 9VAC25-610-96, a timely renewal application keeps the existing permit in effect where DEQ has not completed its decision through no fault of the applicant.[120] What binds is the draft permit, which the authority's general manager told his board on July 28, 2026 that he expects from DEQ by the end of this year. He characterised SJ 25's implications as showing "really limited, limited growth potential" for additional groundwater withdrawal.[121]

DEQ's York-James centroid test, sited in James City County, modelled a hypothetical three-million-gallon-per-day Potomac withdrawal and found it failed. The maximum passing volume was 120,000 gallons per day, and the one-foot drawdown contour from that hypothetical extended 91 miles — the largest area of impact among the nine sites tested.[122]

Two cautions on that number, both of which the author has previously placed on the record and both of which hold. The test used a regional midpoint rather than the authority's actual well field; it modelled one new withdrawal added to a baseline in which existing permit holders were assumed to pump their permitted amounts; and it did not decide the renewal application, which requires its own technical evaluation.[123] Separately, the general manager cited 130,000 gallons per day in the July 28 meeting where the report's table says 120,000.[124]

The renewal turns on a number nobody has published. The reissuance floor at 9VAC25-610-110 F 2 protects the portion of the permitted withdrawal that supported human consumption. Municipal systems also serve commercial and industrial customers, and DEQ has said customer-class information would be needed to determine how much qualifies.[125] How much groundwater the authority is claiming as its protected human-consumption baseline is the single most consequential unpublished figure in the eastern Virginia water record.

Hanover and Henrico

Two further projects belong in the accounting, though neither is a groundwater-to-surface migration in the strict sense.

Hanover County buys wholesale from Richmond and operates the Doswell treatment plant on the Pamunkey. Its comprehensive plan describes county groundwater as restricted in both quantity and quality and not viable for long-term use. Following the January 2025 Richmond regional water crisis, the county's twenty-five-year master plan alternatives contemplate expanding a Pamunkey River plant along with Doswell to add twenty million gallons per day of permanent capacity and eliminate the Richmond dependency. The cost range presented to the board was $424 million to $543 million over a ten-to-twenty-year implementation. The board separately approved $4 million in short-term reliability improvements.[126] This is an alternative under study, not a funded project, and the range should always travel with the figure.

Henrico County's Cobbs Creek Reservoir is complete. The $280 million project impounds 14.8 billion gallons in Cumberland County, and DEQ approved an increase of 47 million gallons per day in raw water withdrawal from the James in exchange for it. Phase III was substantially complete in November 2024.[127] Henrico is already surface-dependent, so this is capacity expansion rather than migration. It belongs in the register because it reshapes regional wholesale economics and is being examined as a regional source in the wake of the Richmond crisis.

The price list

Project	Capacity	Cost	Confidence
Caroline — Rappahannock intake	9.0 MGD permitted	~$200M (county estimate; $135.7–156.3M in 2016 dollars per Master Plan)	Medium
New Kent — Pamunkey intake + WTP	8.0 MGD requested	$150M construction placeholder; ~$164.6M programmed	Medium
Henrico — Cobbs Creek Reservoir	47 MGD safe yield	$280M	High (as-built)
Hanover — Pamunkey expansion	+20 MGD	$424–543M	Low (unfunded alternative)
Western Tidewater — Norfolk contract	15 MGD allocation	~$300M over 40 years	Medium

The three intake, reservoir and treatment projects plus Hanover's midpoint total roughly **$1.11 billion**. Adding the Western Tidewater contract's forty-year lifetime cost brings the figure to approximately **$1.41 billion**, though that sum mixes capital with long-term operating commitment and should be labelled when used.[128]

Neither figure includes SWIFT, the Sussex megasite, local distribution build-out, or the private well conversions that follow if the aquifer decline resumes on DEQ's forecast.

Who is paying it

The aggregate obscures the distribution, and the distribution is the finding.

Caroline County's population is approximately 30,900, and it is one of the few Virginia localities the Census classifies as entirely rural. A $200 million water project against that population is roughly **$6,475 per resident**, and against nine million gallons per day of permitted capacity, roughly **$22.2 million per MGD**.

Henrico County's population is approximately 334,400. Cobbs Creek at $280 million is roughly **$837 per resident**, and against 47 million gallons per day of safe yield, roughly **$5.96 million per MGD**.

Caroline's residents are carrying about **7.7 times** Henrico's per-capita burden, for water that costs about **3.7 times** as much per unit delivered.[129]

Set that against Section 2's grandfathering figures. Fairfax Water drew 164.0 million gallons a day from the Potomac and the Occoquan across two treatment plants in 2024, both legally unpermitted, at no permit cost and outside any cumulative evaluation. DEQ publishes no combined figure for the utility; the total is the author's sum of its two plant entries.[130] A county of thirty thousand people is financing a nine-MGD intake and a thirty-five-mile pipeline, under appeal from two tribes and in litigation with its own landowners, because the aquifer beneath it will yield 60,000 gallons a day. A water authority serving over two million draws some 2,700 times that from a river, and was never required to ask.

That is not a claim that Fairfax Water is doing anything improper. It holds an exclusion the regulation grants it. It is a claim about what the grandfathering provision distributes, and in which direction.

What is not in the price list

Three categories of cost sit outside every figure above.

Private wells. DEQ reports that lawful unpermitted withdrawals, chiefly private drinking water wells, make up as much as 40 percent of total groundwater withdrawal volume in eastern Virginia; private domestic wells specifically account for 33.3 of the 96.3 million gallons per day withdrawn in the Eastern Virginia GWMA, or 34.6 percent.[131] They are growing with population at a projected 200,000 to 300,000 additional gallons per day each year through 2050.[132] They are unpermitted, unmetered, and invisible to DEQ except by estimate. Their owners have no standing in any permitting proceeding described in this section, no ratepayer representation, and no monitoring. In 2002, thousands of them failed.[133] When the next aquifer decline arrives, the response available to a private well owner is to deepen the well or haul water, and neither appears in any capital plan.

There is one protection, and it is worth knowing because it is not widely used. Under 9VAC25-610-110 D 3 g, a permit applicant must commit to mitigation for wells within the area of impact, with a rebuttable presumption of causation and a low-cost dispute process, as enforceable permit conditions.[134] Given that DEQ's own modelling puts areas of impact at sixty-six to ninety-one miles, the population inside that radius of any major coastal-plain withdrawal is substantial.

Agriculture. No irrigation or livestock operation in the Commonwealth appears in any project above, and none holds a priority ranking on the surface side.

Local distribution. Every figure in the price list is trunk infrastructure. Getting the water to houses is separately budgeted, separately financed, and in the rural localities carrying the highest per-capita burden, separately unfunded.

6. SWIFT and the Unanswered Question

What it is

The Sustainable Water Initiative for Tomorrow is the Hampton Roads Sanitation District's programme to inject purified wastewater into the Potomac aquifer. HRSD is a political subdivision of the Commonwealth created in 1940, the fourteenth largest wastewater utility in the country, with 225 million gallons per day of combined treatment capacity serving twenty cities and counties — roughly 1.9 million people, about a fifth of Virginia's population, across some 5,000 square miles.[135]

Injection is permitted not by Virginia but by the U.S. Environmental Protection Agency's Region 3, under the federal Underground Injection Control programme; Virginia does not hold delegated UIC authority. Independent oversight runs through the Potomac Aquifer Recharge Oversight Committee, established at §§ 62.1-271 through 62.1-275 of the Code, with technical support from a monitoring laboratory jointly directed by Virginia Tech and Old Dominion University.[136]

One technical fact is frequently reported wrongly and matters for the energy discussion below. **SWIFT is not reverse osmosis.** HRSD piloted an RO train and rejected it, on aquifer-compatibility grounds rather than cost:

> "Early piloting of a reverse osmosis (RO) treatment train generated a final water product that differed significantly from the chemistry of the native groundwater. The resulting low ionic strength of the RO-treated water relative to the groundwater presents a considerable concern for successful injection operations. This incompatibility posed a high potential for permanent disruption and dispersal of clay particles, clogging pores within the aquifer and reducing aquifer permeability and ultimately injection well capacity."[137]

The selected process is coagulation, flocculation and sedimentation, then ozone, biofiltration, granular activated carbon, and ultraviolet disinfection — what HRSD terms carbon-based advanced water treatment. It uses roughly half the energy of an RO scheme.

Injection depth has been reported as "more than a thousand feet." That describes the bottom of the well rather than the injection interval. The Research Center well is about 1,400 feet deep with eleven screened segments between 500 and 1,400 feet below land surface; the James River wells run about 1,200 feet, interacting with the Potomac starting at approximately 400 feet.[138]

The capacity number

Four different figures circulate, all of them HRSD's, and they describe different things.

Figure	What it is
120 MGD	The volume in HRSD's original modelling scenario
100 MGD	The five-facility ultimate programme target
50 MGD	Phase 1 design capacity, two facilities
41 MGD	HRSD's own expected recharge from those two facilities

Figure	What it is
32 MGD	HRSD's commitment as stated to the State Water Commission, August 2026: 65% of design capacity at both funded plants, achieved 2032

The gap between the third and fourth is HRSD's uptime assumption: "The conservative estimate is that the SWIFT project will be able to recharge at least 65% of the influent flow to the wastewater facilities."[139] DEQ's SJ 25 report uses approximately 50 million gallons per day for the two sites.[140]

The fifth figure is the newest and it is lower. On August 20, 2026, counsel for the water-user coalition Mission H2O told the Virginia State Water Commission that HRSD is "committed to recharging at least 65% of that capacity, or ten MGD" at James River, with the ten-MGD annual average achieved in 2027, and at least 65 percent of Nansemond's 34 MGD, or 22 MGD, by 2032 — "so by 2032, at least 32 million gallons of recharge will occur on a daily basis."[141] That is HRSD's own commitment, restated in a legislative forum by a party representing its beneficiaries, and it supersedes the 41.

Note what moved and what did not. The percentage is unchanged; the base changed. Forty-one came from applying 65 percent to *influent flow* at two plants; thirty-two comes from applying it to *design capacity*. The distinction is not cosmetic, and the next subsection shows why it is now a contractual question rather than an engineering one. **The operationally relevant number for 2027 is ten.**

The programme's own materials have not kept pace with the revision, and the discrepancy is worth noting because the reach claim rides on it. HRSD's programme overview page still describes modelling "the effect of adding 120 million gallons of purified water daily into the Potomac Aquifer" and concludes that the aquifer could then "support all existing permits for groundwater use, with capacity to allow future withdrawals practically anywhere within the Eastern Virginia Groundwater Management Area." A second HRSD page describes "the addition of 50 million gallons of SWIFT Water each day" and retains the same geographic claim, that the injections would "positively impact nearly the entire Potomac aquifer, as far north as Maryland and south beyond the North Carolina border."[142] The modelled volume was reduced by 58 percent and the stated geographic reach did not move. Anyone citing HRSD's reach claim should specify which version.

The covenant

Everything above treats 65 percent as an engineering assumption. Since February 2026 it has been a contractual floor, and the instrument that made it one is the most consequential SWIFT document in the public record. It is also among the least examined: it appears not in HRSD's minutes but inside the Commission's **agenda packet** for February 24, 2026, whose corresponding minutes carry blank attachment pages.[143]

DEQ Water Quality Improvement Fund Contract #440-S-23-06 is a grant and operations agreement between the Commonwealth and HRSD covering the James River facility. The

Commonwealth pays **$331,384,307**, financing "seventy-five percent (75%) of the cost of the Eligible Project." In exchange, Article V § 5.0:

> "the Grantee's facility shall meet the SWIFT utilization requirement of 50% injection of total influent flow measured in million gallons per day (MGD), on an annual average basis during the first full calendar year of operation after CTO issuance… Starting in the second calendar year of operation and for the duration of the grant agreement, the facility shall meet the SWIFT utilization requirement of 65% injection of total influent flow measured in MGD, up to the 16 MGD capacity of the SWIFT facility."[144]

The load-bearing term is the baseline. Section 1(i): "'Influent Flow' means total flow, **as measured by the influent flow meter**, into the James River Sewage Treatment Plant." The obligation is a percentage of what arrives at the plant, not of what SWIFT produces and not of what SWIFT could produce. Against the plant's roughly 15.9 MGD of average daily flow that is about eight million gallons a day in year one and about ten thereafter — arithmetic which is this volume's, not the document's. The "up to 16 MGD" clause caps the obligation; it does not set a target, and it does not bind at current flows.

The obligation has teeth. Article VIII caps monetary assessments at **$26,577,021 annually** and **$531,540,420 over the life of the agreement**, assessed "for each one percent of underutilization" once the injection rate "falls 5% or more below the required utilization rate." Beyond money, § 8.4 lets DEQ sue in the Circuit Court of the City of Richmond for injunction or mandamus "or to recover part or all of the grant funds," and HRSD pre-concedes that any failure "constitutes irreparable harm to the Commonwealth for which the Director or Department lacks an adequate remedy at law." Section 9.13 terminates the agreement twenty years after execution — from February 2026, not from the Certificate to Operate, which puts the end near February 2046 and gives roughly nineteen years of post-CTO obligation.

Two things follow, and they cut in opposite directions.

The contingency argument above is weaker than it was. This volume argues that SWIFT's gains decay whenever injection stops, and that a locality building permitted withdrawal on SWIFT-supplied head underwrites HRSD's ratepayer base indefinitely. That remains true as hydrogeology. But the covenant makes a quiet commercial retreat expensive in a way it was not before. HRSD cannot scale back the James River injection to save operating cost without exposing a $331 million grant and up to $26.6 million a year in assessments. The excuse clause at § 1(f) is drawn tightly enough to confirm the point: it forgives fires, strikes, acts of God, and — "only with respect to the SWIFT utilization requirement" — a directive to reduce or cease injection issued by DEQ, the Department of Health, EPA, or another governmental authority. A regulator can stop the pumps without penalty. A business decision cannot.

And it forecloses the arrangement everyone eventually proposes. The recurring idea in this space is that a large industrial user, a data center being the usual example, could take reclaimed water from a treatment plant for cooling. Reclaimed water requires no groundwater withdrawal permit, so the arrangement would reduce recharge while triggering no groundwater review — a gap SJ 25 does not reach, since SJ 25 governs withdrawals rather than diversions of recharge. The covenant closes it arithmetically. Because the obligation is measured against

influent, every gallon diverted to a customer reduces the numerator and leaves the denominator where it was. Each sale is a gallon of shortfall against the 65 percent floor. HRSD's own precedent points the same way: its one municipal-industrial reuse agreement, 0.5 MGD to a refinery beside the York River plant signed in December 2000, sold the water **at cost**, to recover the sidestream treatment investment and nothing more.[145]

The covenant is itself a finding, and it sits oddly beside everything in the next subsection. Virginia has bound a $331 million grant to a 65-percent-of-influent injection floor for twenty years, with exposure running past half a billion dollars, at the same moment its environmental agency tells the General Assembly that it cannot model the recharge at all and can credit only measured benefits in permitting. **The Commonwealth is contractually certain about the injection and evidentially uncertain about its effect.**

The facilities, and where they are

Facility	Locality	Capacity	Status	Timing
SWIFT Research Center	Suffolk	1.0 MGD demonstration	Operating since May 2018; passed one billion gallons injected October 2025	—
James River TP SWIFT	Newport News	16 design; 10 expected	Construction, phased start-up	Start-up late autumn 2026; 10 MGD annual average in 2027
Nansemond TP SWIFT	Suffolk	34 design; 22 expected at 65%	Design and construction	Start-up 2029; injections from 2030, 22 MGD by 2032
VIP SWIFT	Norfolk	Not published	Preliminary engineering	Early-to-mid 2030s
York River TP SWIFT	York County	Not published	Not started	~2029–2035
Williamsburg TP SWIFT	James City County	Not published	Not started	~2036–2040; programme closeout 2040–41

Two facilities frequently listed as part of the programme are not. Boat Harbor is being decommissioned, its flow diverted by force main to Nansemond in a 55-million-gallon-per-day pump station conversion. Army Base does not appear in HRSD's programme schedule at all.[146]

The schedule above comes from HRSD's published programme summary, which carries a data date of March 31, 2023. It is what the district currently serves, but it should be treated as the last published plan rather than a live commitment. What is not ambiguous in that document is the ordering: York River and Williamsburg are last, and the programme's terminal dates run to 2040 and 2041.

The reach question, and what it actually shows

An intuitive objection to SWIFT runs that recharge will be local while drawdown is regional, so the programme relieves less than its headline capacity suggests. The field evidence does not support that objection, and DEQ says so.

The demonstration is the Franklin closure. When the mill cut its withdrawal by 89 percent in 2010, DEQ examined 92 observation wells across the regional Potomac aquifer, identified 55 hydrographs carrying a detectable arrival signal, and regressed elapsed time against distance:

> "The estimated lateral propagation rate was about 5 days per mile (0.2 miles per day). The subset of results from the middle zone of the Potomac aquifer was cleaner, with a good correlation ($R^2 = 0.931$) and an estimated lateral propagation rate of 7.3 days per mile (0.14 miles per day)."[147]
>
> "the last well to detect the signal, on day 386, was the Gloucester Landfill observation well… 54 miles from the Franklin Mill wellfield."[148]

DEQ separately reports, on the basis of a groundwater-level trend analysis rather than the arrival-signal regression, that the Franklin reduction produced a general upward shift across a wide area of the coastal plain, "possibly as far as Westmoreland County along the Potomac River." Beyond the wells in the regression, the arrival signal itself could not be reliably distinguished.[149]

DEQ characterises that reduction as of "the same order of magnitude" as planned SWIFT injections.[150] A second and independent line points the same way: SJ 25's own permitting model produces areas of impact of sixty-six to ninety-one miles for hypothetical three-MGD withdrawals.[151] Pressure effects in this aquifer are regional at a fifty-to-ninety-mile scale. Recharge at Nansemond and the James River will register at West Point, at Franklin, and in James City County.

The mismatches that do exist are different from the intuitive one, and worse for SWIFT's usefulness as a rescue.

Pressure travels; water does not. DEQ elevates this to a formal Key Point, repeated three times in the report:

> "In the Potomac aquifer, hydraulic pressure effects travel tens of thousands of times faster than the typical flow of groundwater molecules through sediments. Injections of water into the aquifer may yield a regional increase in groundwater levels with only local migration of the injected water molecules. However, regional water-level gains may dissipate rapidly when the injections cease."[152]

Groundwater moves about ten feet per year in southeastern Virginia against a pressure-wave rate of 740 feet per day. HRSD's own James River modelling is consistent: SWIFT water takes one to two weeks to move fifty feet and eight months or more to travel four hundred.[153] What a locality thirty miles away receives is a higher potentiometric surface — it pumps against less head and sits further from the 80 percent critical surface — while the molecules it pumps remain the native groundwater it always pumped. Whether that counts as new supply for permitting purposes is a legal and accounting question rather than a hydrogeologic one, and the Eastern Virginia

Groundwater Management Advisory Committee has it open as Module 4 of the work plan it adopted in June 2026.[154] The cleanest available formulation of the problem appears in the discussion following the HRSD and planning district presentations to that committee, recorded in the minutes without attribution to a speaker: "The transmission mechanism is the aquifer."[155]

The gains are contingent on injection never stopping. DEQ again:

> "if the injections were suspended for any reason—technical, economic, or political—the groundwater-level benefits could prove transient, as has been observed since the initial gains that resulted from the 2010 Franklin Mill closure."[156]

And in the accounting discussion: "If injections decrease or pause, withdrawals that are offset by the injections may need to be curtailed."[157]

The Franklin analogy is exact and it is not favourable. Those gains decayed because the mill came back at 42 percent of its former rate. SWIFT's gains would decay for any equivalent reason. This is not a capital asset that buys permanent headroom; it is a perpetual operating obligation whose benefit dissipates on roughly the timescale it accrued. A locality that builds permitted withdrawal on top of SWIFT-supplied head is underwriting HRSD's ratepayer base, its grid reliability, and its political durability indefinitely.

That framing needs one qualification it did not need before February 2026. At James River the operating obligation is now contractual rather than voluntary, secured against a $331 million grant and enforceable by injunction for twenty years. The hydrogeology is unchanged — the head still dissipates when the pumps stop — but the probability of a quiet commercial scaling-back at that one plant is materially lower than the general argument assumes. Nansemond, the VIP, York River and Williamsburg carry no equivalent instrument that this volume could locate.

The schedule is the real geographic mismatch. Both funded facilities sit on the south side of the James and the lower Peninsula. The two that would inject nearest the York-James region — Williamsburg, in James City County itself, and York River — are last in HRSD's published sequence. Meanwhile York-James is where DEQ's model found the least room in the Commonwealth, and where the James City Service Authority's permit renews in February 2027.

And no independent analysis exists. No non-HRSD, non-DEQ modelling or peer-reviewed work testing whether SWIFT's distribution of recharge matches the distribution of drawdown could be located for this volume. HRSD has its own modelling, which DEQ describes as attempts to use the existing flow model and immediately discounts. DEQ has the Franklin analogy, which is inference rather than a SWIFT model. The oversight committee is a monitoring and water-quality body. EVGMAC's Module 2 is scoping the question and has not answered it; DEQ's policy advisor told the committee in June that staff "has looked at the available information on MARs and has not identified a lot of useful information."[158] The analysis has not been published because DEQ's position is that it cannot yet be done credibly.

What DEQ will and will not do

The distinction here is finer than most summaries allow, including one previously published under this author's byline, and getting it right changes the conclusion.

DEQ will not model projected SWIFT benefits into its long-range forecasts. Its reasoning, at SJ 25 § 2.6.1:

> "the current model was not designed or optimized to simulate the regional effects of aquifer-replenishment operations. Calibrating a new model for this purpose would typically require at least 10 years of high-quality observational data collected during full-scale injection operations. Without this data set, there can be little confidence in predicting the aquifer system's response to an unprecedented stress condition."[159]

That matters because the permitting machinery runs on fifty-year simulations. The report says as much: these uncertainties "complicate and may preclude the assumptions that are necessary for modeling and prediction of groundwater levels 50 years in the future."[160]

Four reasons underlie the ten-year figure. The flow model was calibrated against a century of withdrawal and injection is the opposite sign of stress. Compaction is asymmetric, so the model cannot assume the reverse of what it learned — and the instrument for measuring any rebound, an extensometer with collocated wells at the James River site, was still under construction when the report was written.[161] A single propagation cycle across the region takes more than a year, so distinguishing a SWIFT signal from seasonal variation and concurrent withdrawal changes requires many cycles. And the confounders are at a maximum right now, with the worst drought since 2002 running concurrently with eleven of the fourteen largest permits being renegotiated.

But the same passage ends with a sentence that is routinely dropped from summaries of it:

> "In the meantime, as the initial effects of SWIFT injections are monitored, any measured benefits can be considered in permitting decisions."[162]

Measured benefits count. Projected benefits do not. That is a narrower position than "DEQ will not credit SWIFT," and the difference is not academic: DEQ has indicated to the James City Service Authority a likely fifteen-year permit term with reductions deferred to roughly year fourteen, contingent on SWIFT's progress.[163] The agency is already conditioning a permit on the programme while telling the legislature it cannot yet simulate it. Both things are true, and the door that stands open is the measured-benefit door.

This volume therefore does not claim a permitting freeze from 2027 to 2037. The accurate statement is that no locality can bank a *projected* benefit in a renewal decided in 2027, and that the measured benefit available by then will be whatever one facility, in phased start-up since the previous autumn, has actually delivered. DEQ is building the measuring apparatus now: nineteen state observation wells, the first two bracketing the James River facility north and south, and a perimeter of nine real-time stations to monitor the aquifer's response.[164] Its recommendation asks for $45,000 a year for that monitoring.

Forty-five thousand dollars a year, to measure the performance of a programme whose two recharge plants alone cost more than thirty thousand times that.

What it costs

The programme's public cost figure requires an upward correction, including to a figure this author has previously published.

The figures move, and they are almost all HRSD's own. Presented to the Virginia State Water Commission in December 2023, the two SWIFT facilities came to **$579 million for James River and $971 million for Nansemond**, or $1.55 billion, with the Research Center a further $26 million, inside a four-project bundle totalling **$2,162 million** — the remainder being the Boat Harbor and Chesapeake-Elizabeth offline projects at $456 million and $185 million, which are diversion and decommissioning work rather than recharge.[165]

HRSD's Commission record of February 24, 2026 revises all three headline numbers upward or outward. The programme total is stated as **$2.4 billion**. Nansemond is **$952 million**. James River is published not as a point estimate but as a **range, "$500 to $600 million."**[166] A widening is not a revision to a lower number, and it should not be converted into one; the honest reading is that HRSD's own confidence in the James River figure fell between 2023 and 2026. Press reporting in October 2025 described the expansion as a **$2.8 billion** programme, and EPA's October 2024 news release put "initial SWIFT Program costs" at **$2.9 billion**.[167]

Five figures therefore circulate for the cost of this programme, as five circulate for its capacity. **Use approximately $1.5 to $1.6 billion for the two recharge plants and $2.4 billion for the programme, sourced to HRSD's own board record.** The EPA and press totals are programme-cost figures and should be labelled as such; roughly $641 million of the 2023 bundle bought diversion and decommissioning, not recharge, and a further tranche is grant support rather than sewer bills.

A previously published column under this author's byline described SWIFT as costing "something on the order of a billion dollars," citing HRSD's own overview page, which still carries that older framing.[168] The figure is low by roughly half for the recharge facilities alone.

Financing runs through HRSD wastewater fees paid by ratepayers across twenty localities, a $1.3 billion federal WIFIA loan, and Virginia Water Quality Improvement Fund grants — of the $2,162 million bundle, $1,950 million was grant-eligible with roughly $1,269 million in expected support.[169] The James River share of that support is now documented precisely: $331,384,307, or 75 percent of eligible cost, against the injection covenant described above. HRSD has begun looking for a way to shift part of the continuing burden, proposing to the advisory committee in June 2026 that "development of a framework for groundwater trading could set the stage for offsetting a portion of SWIFT's annual O&M Costs to reflect the shared groundwater supply benefits of the program."[170] That is the natural institutional response to a benefit that evaporates when the pumps stop, and by August 2026 it had become the central legislative fight described below.

One cost comparison entered the public record for the first time on August 20, 2026. Asked by Senator Bill DeSteph what the alternatives cost, DEQ's director gave figures HRSD had commissioned from an engineering consultant — a levelized cost per thousand gallons over a 25-year amortization period:

Source	Levelized cost per 1,000 gallons, 25-year amortization
Reuse from a wastewater plant	$3.32
SWIFT	$4.98
Desalination	$6.96

Delegate Keith Hodges read all three figures back into the record, which is useful confirmation for numbers taken from a hearing rather than a document.[171] They are order-of-magnitude figures and they exclude piping, distribution and power, as the director was careful to say. They are also the only published comparison of Virginia's three engineered water-supply alternatives against one another.

Both funded facilities have slipped. James River moved from a stated April 2026 completion to phased start-up in late autumn 2026 with ten MGD of recharge expected in 2027, roughly a year to eighteen months. Nansemond moved about six months. The "full buildout by 2032" framing that appears in secondary sources is not supported by HRSD's own schedule, which extends to 2040–41.[172] The district is separately re-engineering for PFAS after the federal maximum contaminant level tightened, moving toward ion exchange — an addition absent from the original train, with cost, schedule and energy implications that have not been quantified.

The energy footprint, stated honestly

HRSD publishes no energy data for any SWIFT facility. No kilowatt-hour, kWh-per-million-gallon, megawatt or annual electricity figure appears in the programme pages, project pages, the Research Center's quarterly reports, the district's climate planning study, its capital improvement index, or its testimony to the State Water Commission. Every figure below is an analogue drawn from the literature and should be read as one.

Peer-reviewed work on American potable reuse systems puts carbon-based ozone and biological activated carbon trains — the SWIFT configuration — at 0.30 kWh per cubic metre, against 0.84 for RO-based full advanced treatment.[173] Converting correctly, one kWh per cubic metre is 3,785 kWh per million gallons, so the SWIFT-type train runs about 1,135 kWh per million gallons of treatment before injection pumping.

Taking treatment plus injection at roughly 1,600 to 2,200 kWh per million gallons, the programme's continuous electrical load works out to about **2.1 to 2.9 megawatts at 32 MGD**, the two funded plants' expected recharge, and **6.7 to 9.2 megawatts at a hundred**. At the ten MGD available in 2027 it is well under a megawatt. Excluded from that: the Boat Harbor diversion, a 55-MGD pump station and five miles of force main whose load is a direct consequence of the programme's architecture and appears in no treatment-intensity figure.

Those numbers are small, and this volume says so. Even at full buildout SWIFT is a single-digit-megawatt load, on the order of a tenth to a twentieth of one large data center campus. It is not a material addition to Virginia's generation requirement, and any argument that leans on its size is an argument a utility analyst will dismantle in a paragraph.

What survives is narrower. Virginia's largest water-supply intervention is an electricity consumer whose benefit is contingent on uninterrupted operation. The Commonwealth is being asked to price a water solution whose durability depends on the grid, in the same decade it is being asked to build generation whose cooling depends on rivers. Each system has acquired a claim on the other. That is a statement about coupling rather than about magnitude, and it is the one the evidence supports.

The question nobody has answered

If SWIFT works as designed it will create recovered capacity in a shared aquifer, paid for by the ratepayers of one region. The claimants for that capacity are not compatible with one another.

Utilities across eastern Virginia have absorbed permit reductions since 2017 and would like them back. The aquifer itself has a claim, since the injections were justified partly as a defence against subsidence and saltwater intrusion, which is Norfolk's problem before it is anyone else's. New industrial applicants — data centers among them — will eventually argue that a replenished aquifer has room for them. Nobody has established an order of precedence, and the water arrives before the argument is settled.[174]

DEQ gestures at this without resolving it, recommending that before the General Assembly authorises any groundwater trading, it should first settle how groundwater rights are allocated and whether parties who pay for recharge deserve compensation. Those questions are live in Hampton Roads now, whether or not anyone calls it trading. The regional planning district has put the risk plainly: "we might end up with a General Assembly Session where someone tries to allocate water from the SWIFT Recharge efforts to specific users through legislation."[175]

That session is now in view, and the argument opened on August 20, 2026. The State Water Commission took the SJ 25 report at a four-hour meeting, heard DEQ, the Mission H2O water-user coalition and the Chesapeake Bay Foundation in turn, and closed with the chair directing DEQ to return in October with one to three prioritized bills and Senator Scott Surovell asking the commission to vet legislative and budget language before session. Three things surfaced there that this subsection had left as prospective.

The precedence question was named by the agency as a defect in its own authority. Recommendation one asks the legislature to clarify how the statutory human-consumption preference is to be operated. Director Mike Rolband's reason is the mechanism this volume describes at Section 2: "how we do that is very difficult as we permit things on a first come, first served basis. So we won't know, say an industrial user comes in, and then next month, after we issue the permit, a human consumption need comes in."[176] The preference exists. What does not exist is any instrument that lets the agency hold a place in the queue for it.

The coalition split on trading is now explicit and it runs where the money runs. Mission H2O — municipal, industrial and agricultural users, represented by counsel at Troutman Pepper Locke — accepts the report's findings and disputes only its timeline, arguing that trading is worth exploring precisely because it could fund the recharge network. The Chesapeake Bay Foundation's Jay Ford opposed it categorically, reading SJ 25's own sentence back to the commission: "given the diminished capacity of the aquifer, it is advisable to reduce permit allocations to actual use upon

renewal rather than allowing entities to withdraw more than their original allocation." His objection was ownership. "The second it goes into the ground, that is a public resource for the state of Virginia," and once trading opens, "it's impossible to pull it back."[177] DEQ took neither side and asked for guardrails if the legislature goes there.

And the data center entered the argument as a payer rather than a claimant. Senator DeSteph, working through arithmetic aloud, equated the two paper mills' roughly 29 MGD to "about 100 data centers of use" and proposed that data centers be required to fund SWIFT-equivalent injection as a condition of siting — solving the mills' withdrawal and their own at once. His numbers do not survive inspection: he states a per-facility figure of "300,000 gallons a year" where his own division requires per-day, and his capital estimates move between $500,000 and $750,000 a plant inside thirty seconds. Rolband declined to endorse the arithmetic and objected only on power and piping cost, saying the concept "is trending in a very good direction."[178]

Two hard facts came out of that exchange. Asked directly, Rolband confirmed that east of Interstate 95 there are **eleven data centers and none of them use groundwater** — "there's 11 that are on surface water and municipal, new municipal water." And DEQ was asked, on the record, to cost the proposal out.

The order of precedence, in other words, is no longer unestablished because nobody has raised it. It is unestablished because three incompatible answers were put to a legislative commission on the same morning: reduce allocations to actual use, create a market, or let the largest new industrial users buy their way in by financing the recharge. The water still arrives before the argument is settled. What has changed is that the argument has started.

The demand-side arithmetic

The advisory committee's June 2026 minutes contain the clearest public statement that this collision is no longer prospective. The regional planning district's water resources director presented two lost projects:

> "Example from Hampton Roads Alliance/Project 1: An emerging technology company (manufacturing magnets) was looking for a site that would support 10,000 metric tons of annual capacity, create 700 high paying technical jobs, and invest $1.8 B into the selected community. The project required 1,400,000+ GPD of industrial water availability. This volume of water was not available in this area so the company went looking elsewhere. Example from Hampton Roads Alliance/Project 2: A company was looking to identify a site to support the expansion of its data center capacity. They required 10 MGD of water on a closed loop system. An appropriate site was not available in the area so they went elsewhere."[179]

The committee also heard that the Virginia Economic Development Partnership had identified more than a dozen opportunities New Kent County could not pursue because the water requirements could not be met.

A single data center inquiry at ten million gallons a day is, on HRSD's own August 2026 commitment, the James River facility's entire expected 2027 recharge. One prospect that went elsewhere would have consumed the whole of Virginia's first year of aquifer replenishment. It is

also, on the record above, a project describing itself as closed-loop — a phrase carrying weight it cannot bear, and one the Commonwealth has just written into law. That is the subject of the next section.

Where this leaves the migration

If SWIFT delivers on HRSD's own expectations, regional heads stabilise and then rise across the southern and central coastal plain within a year or two of each facility coming online. DEQ's projection that the analysed wells enter general decline within five to ten years is averted. But the renewals now in front of the agency will be decided on measured benefit from one plant in its first months of operation, which is close to nothing, and the two facilities nearest the tightest region arrive in the late 2030s. The localities that build river intakes in 2028 do not un-build them in 2038. A rescue that arrives after the infrastructure decision has been financed does not reverse it.

If SWIFT slips, or PFAS re-engineering forces a derating, or the three unfunded facilities are deferred, then recharge lands nearer 10 to 22 million gallons per day against roughly 96 million of daily withdrawal across the management area. Gains decay during any interruption. And the measured-benefit door narrows toward nothing, because DEQ's condition is not the passage of ten years but ten years of high-quality data collected during full-scale operation. Intermittent operation does not start that clock. The 65 percent assumption is the one variable that has firmed rather than softened since this volume was first published, and only at James River, and only because a grant agreement put money behind it.

Either way, the decisions that determine eastern Virginia's water infrastructure for the next half-century are being made in the eighteen months beginning now, and the rescue is not a variable in them.

7. The Water the Buildout Actually Uses

Withdrawal is not consumption, and the distinction governs everything

Virginia's thermoelectric generating fleet withdrew approximately **5,320 million gallons per day** in 2015, about 79 percent of all water withdrawn in the Commonwealth including saline.[180] The two nuclear stations alone account for roughly 67.5 percent of all reported withdrawals in Virginia in 2023, North Anna at 1,869.7 million gallons per day and Surry at 1,683.6.[181]

Those figures are accurate, they come from the General Assembly's own reporting, and quoted without their companion they are badly misleading.

The same USGS compilation records Virginia thermoelectric **consumption** at **50.6 million gallons per day** — a consumption rate of **0.95 percent**.[182] Ninety-nine percent of what the fleet withdraws returns to the source. Dominion's own disclosure states the mechanism: "The majority of water withdrawn at facilities with once-through cooling is discharged back to the source."[183] Once-through cooling passes river or estuary water through a condenser and returns it a few degrees warmer. It has real ecological consequences — thermal loading, entrainment, impingement — and those are regulated under a different programme. What it does not do is remove water from the basin.

Two further facts complete the correction. **45.1 percent of Virginia's thermoelectric withdrawal is saline**, drawn from brackish tidal water at Surry and the retired Yorktown station.[184] Saline withdrawal does not compete with freshwater users. And the two nuclear stations do not share a cooling design: **Surry is once-through on the tidal James; North Anna is closed-cycle**, circulating through Lake Anna and a three-lagoon waste heat treatment facility.[185] Any account that describes both as once-through is wrong, and North Anna is the larger of the two.

So the honest statement of Virginia's thermoelectric water position is this. The withdrawal figures are enormous and largely reversible. Nearly half is saline. Consumptive loss across the entire fleet is about 50 million gallons a day, which is roughly half the Eastern Virginia Groundwater Management Area's total withdrawal from all sources.

What that does to the seventy-five percent

The most-cited figure in data center water analysis is Siddik, Shehabi and Marston's finding that "roughly three-fourths of US data centers' operational water footprint is from indirect water dependencies" — that is, through the electricity they consume rather than through the buildings themselves.[186] The paper is sound and the finding is national. Applying it to Virginia without adjustment produces a wrong answer, and this volume declines to do so.

Siddik's national figure is 7.1 cubic metres of water per megawatt-hour of data center consumption, and the paper is explicit that this "masks the large spatial variation (range 1.8–105.9 m^3)" across watersheds, and that the Southeast "consumes one-quarter of the electricity used by the industry but only one-fifth of the indirect water since data centers in this region source their electricity from less water-intensive sources."[187]

Virginia's own arithmetic sits below the bottom of that range. Consumption of 50.6 million gallons per day against net generation of 61,100 gigawatt-hours works out to approximately **1.14 cubic metres per megawatt-hour** — lower than the 1.8 that anchors Siddik's stated minimum.[188] The reason is exactly the fleet composition described above: once-through nuclear on brackish water, closed-cycle nuclear on a reservoir, and, increasingly, air-cooled gas.

Recomputing the indirect share with Virginia's figure and Siddik's own direct-use factor puts the indirect pathway at roughly **39 percent** of a Virginia data center's operational water footprint rather than 75. The indirect pathway remains material. It is not the dominant term it is nationally, and a volume that claimed otherwise would be corrected in its first hostile reading.

The marginal megawatt-hour

There is a second and more serious problem with the naive version of the argument, and it should be conceded plainly.

Fleet averages describe the existing fleet. New load is served by new generation, and new Virginia generation is not once-through nuclear. Combined-cycle gas with a wet cooling tower withdraws about 253 gallons per megawatt-hour and consumes 198. The same plant with an air-cooled condenser withdraws about four gallons and consumes two.[189]

Virginia already operates both. Dominion's Brunswick County station, at 1,358 megawatts, uses a seventy-two-cell air-cooled condenser — the largest single ACC in the United States at commissioning — saving more than eight million gallons a day against a water-cooled equivalent. Greensville County, at 1,588 megawatts, uses an eighty-cell ACC with thermal energy storage.[190] That is **2,946 megawatts of Virginia generation already running on dry cooling**, and it is an existence proof that cuts against the simple version of this volume's own argument: the marginal megawatt-hour serving a new data center may carry a water intensity two to three orders of magnitude below the fleet average.

Nor is thermoelectric generation the only thing being built. Solar, offshore wind and storage carry effectively no cooling water requirement, and Virginia's load sits inside PJM, which means the generation serving a Loudoun campus is not necessarily in Virginia at all. A water analysis that treats every new megawatt as a proportional claim on the James is not doing arithmetic.

What survives, and why it still matters

Strip out the overreach and three findings remain. They are narrower than the headline version and they are defensible.

First, the water the fleet does consume comes from rivers, essentially none of it from the aquifer. Groundwater supplied about 0.01 percent of Virginia's power generation withdrawals in 2024 by DEQ's reckoning, and 0.071 percent in the 2015 USGS compilation.[191] Whatever the buildout's generation water requirement turns out to be, it lands on the same surface water that eastern Virginia's localities are now migrating toward. The two demands converge on one resource. That is the collision this volume is about, and it does not depend on the indirect share being three-quarters.

Second, the surface regime's cumulative test is denominated in consumptive use. Section 2 established that 9VAC25-210-370 B 3 requires consideration of combined effects "due to consumptive water uses." Against Virginia's own numbers, the largest withdrawer in the Commonwealth enters that calculation at 0.95 percent of its apparent size. This is arguably the hydrologically correct measure. It is also the mechanism by which the thermoelectric fleet is very nearly invisible to the only cumulative provision the surface regime has, and it is the reason no amount of tightening that provision would reach the generation question.

Third, the state has just legislated the cooling tradeoff at the facility, and only at the facility. The 2026 budget, at Item 366 of the enacted appropriation act, directs DEQ to amend the water supply planning regulation by July 1, 2027 to establish criteria for identifying "Cooling Water Scarcity Areas," with particular focus on the Eastern Virginia Groundwater Management Area. The operative requirement, as enacted:

> "In the Eastern Virginia Groundwater Management Area, a new data center that submits a complete application for a Department of Environmental Quality air permit after January 1, 2027, shall demonstrate to the satisfaction of the department that it has minimized the use of any type of water for cooling purposes and demonstrate the use of best available water-efficient technologies, including air cooling, closed-loop systems, recycled water, stormwater reuse, non-potable reclaimed water, or other technologies approved by the department. A data center shall only use direct evaporative cooling in conjunction with one of the department's approved primary technologies. The department, by October 15, 2026, shall conduct a study and provide a plan on the retrofitting of existing data centers in the Eastern Virginia Groundwater Management Area to use air cooling systems, 100 percent recycled water and/or stormwater for cooling, or use a closed loop system."[192]

The enacted text differs materially from the conference report version that circulates in secondary accounts of the 2026 session, and the difference matters. The conference report set out three permitted technologies as alternatives — air cooling, fully recycled or storm water, or a closed loop system. The enacted provision replaced that menu with a performance standard: the applicant must satisfy DEQ that it has minimised water use for cooling and demonstrated best available water-efficient technologies, from a non-exclusive list that DEQ may add to. It also added a sentence absent from the conference report restricting direct evaporative cooling to use in conjunction with an approved primary technology. Anyone citing the three-technology menu is citing language that did not become law.

Four dates matter: the retrofit study is due **October 15, 2026**; the requirement binds new air permit applications from **January 1, 2027**; the regulation is due **July 1, 2027**; and the parallel obligation in any designated Cooling Water Scarcity Area applies **prior to July 1, 2032**, running before that date rather than commencing on it.

The mandate does what it can reach. It can require a data center to use dry cooling on its own heat load. It cannot reach the combined-cycle plant supplying that data center, which is permitted in a different proceeding, before a different body, under a different statute, and whose cooling water is drawn under a regime that counts consumption rather than withdrawal. That is the regulatory seam, and it is precisely where the two systems meet without anyone summing them.

"Closed loop"

One phrase in that budget language deserves scrutiny it has not received.

The enacted sentence on evaporative cooling cuts two ways. It permits direct evaporative cooling only "in conjunction with one of the department's approved primary technologies," naming a mechanism the conference report did not. Against the conference report's three alternatives, it admits evaporative cooling where none was listed; against the recycled-water alternative, which an evaporative system could already have satisfied, it restricts it. The sentence is new either way, and DEQ will settle what it permits.

What remains open is what the words mean. "Closed-loop systems" is not a defined term in the appropriation act, and it is broader than the engineering term "closed-cycle." A wet recirculating cooling tower is a closed loop in the sense that the working fluid circulates; it also evaporates a substantial fraction of its throughput and requires continuous make-up water and blowdown. A true no-loss liquid loop is a different machine entirely. "Approved primary technologies" is likewise undefined, as is the standard by which DEQ will judge that an applicant has "minimized" water use "to the satisfaction of the department." Each of those is a discretionary judgment with no published criteria until the regulation lands in July 2027, eighteen months after the first applications are due.

And the older menu survives in one place that matters. The retrofit study provision — the sentence governing what DEQ must propose for the data centers already operating in the management area — still directs the agency to plan for facilities "to use air cooling systems, 100 percent recycled water and/or stormwater for cooling, or use a closed loop system." The undefined term therefore governs the retrofit question in its original either/or form.

The record already contains a case that tests it. The site inquiry described in Section 6 required, in the advisory committee's own minutes, "10 MGD of water on a closed loop system."[193] Ten million gallons a day is not a rounding error in a closed system. Whatever that applicant meant by the phrase, it was not a design with no continuing water requirement.

DEQ has until July 1, 2027 to define these terms in regulation, and until October 15, 2026 to take a position on the retrofit question. If "closed loop" is read there to include wet recirculating towers, the retrofit plan will accommodate the evaporative consumption the new-facility provision was written to constrain, in the management area SJ 25 identifies as having no room. The October study is the first place the agency has to answer.

The coupling, stated precisely

Direct water use at Virginia data centers is modest and runs mostly through public systems already permitted and reported. Indirect use through generation is smaller as a share than the national literature implies, because Virginia's fleet is unusually low-consumption, and the marginal unit of new generation is lower still.

None of that dissolves the problem. The water the generation fleet does consume is surface water, drawn from the same rivers that a dozen coastal-plain localities are now spending upward of a billion dollars to reach. The instrument that would evaluate those two claims together exists in

the Code and has never been carried through to a declaration. And the Commonwealth's one legislative response to date regulates the cooling tower at the data center while leaving the cooling tower at the power plant to a different proceeding, on a metric that renders it nearly invisible.

The columns are still not being added. They are simply smaller than the loudest version of the argument suggests, and they are being kept in separate books by a state that has the authority to keep them in one.

8. Who Pays

Who is protected

The Ground Water Management Act contains the strongest protection either regime offers, and it protects one class of user for one purpose.

Applications for human consumption receive the highest priority when available groundwater cannot serve everyone seeking it.[194] A public water supply's renewed permit cannot fall below the portion of its previously permitted withdrawal that supported human consumption during twelve consecutive months of the prior term.[195] Together these mean a municipal utility cannot be reduced below what its customers need to live.

The protection stops there, and the boundary is not where most readers assume.

Human consumption means drinking, bathing, cooking, dishwashing, hygiene — survival and health. It does not mean every gallon a public system delivers. Municipal utilities serve commercial and industrial customers alongside households, and DEQ has stated that customer-class information would be needed to determine how much of a given utility's draw qualifies for the floor.[196] No Virginia utility has published that calculation. The single most consequential number in the 2027 permit renewals is one that does not currently exist in public.

On the surface side there is no priority ranking at all. The Virginia Water Protection programme has no equivalent of the human-consumption preference and no reissuance floor. A locality that migrates from groundwater to a river trades a regime with a statutory protection for one without.[197]

The 2003 Drought Assessment and Response Plan gives DEQ authority to require industrial water users to reduce withdrawals to protect essential uses, but only after a gubernatorial emergency declaration. That authority has not been exercised since it was created, because no such declaration has issued since 2002.[198]

Who pays

Ratepayers, and not evenly.

Section 5 gave the aggregate: roughly $1.11 billion across three intake, reservoir and treatment projects plus one unfunded alternative, or about $1.41 billion including a forty-year contract commitment. The per-capita distribution is the finding the aggregate conceals.

Locality	Population	Project	Cost	Per resident	Per MGD
Caroline County	~30,900	Rappahannock intake, 9.0 MGD	~$200M	~$6,475	~$22.2M
Henrico County	~334,400	Cobbs Creek Reservoir, 47 MGD	$280M	~$837	~$5.96M

Caroline's residents carry roughly **7.7 times** Henrico's per-capita burden for water that costs roughly **3.7 times** as much per unit of capacity delivered.[199] Caroline is classified as entirely rural. The disparity is structural rather than incidental: a small population cannot spread the fixed cost of an intake, a pump station and thirty-five miles of transmission main, and the cost of that infrastructure does not scale down with the number of people who will drink from it.

Two further asymmetries compound it. Rural systems have fewer connections across which to amortise debt service, so the rate impact per household exceeds even the per-capita figure. And the localities under mandatory conservation in 2026 — twenty-nine community systems across Caroline, Fauquier, Louisa, Orange, Powhatan and Shenandoah — are without exception the small and rural ones.[200]

Set that beside the grandfathering figures from Section 2. Fairfax Water withdrew 164.0 million gallons a day across two treatment plants in 2024, both legally unpermitted under the pre-1989 exclusion, at no permit cost and outside any cumulative evaluation. The total is the author's sum of DEQ's two plant entries.[201] Caroline County is financing a nine-MGD intake under appeal from two tribes and in litigation with its own landowners, because DEQ's model says the aquifer beneath it will yield sixty thousand gallons a day.

Fairfax Water is doing nothing improper; it holds an exclusion the regulation grants. The observation is about what the exclusion distributes. The oldest and largest withdrawals were exempted, and the newest and smallest are paying to build alternatives.

Who is invisible

Private wells. DEQ reports that lawful unpermitted withdrawals, chiefly private drinking water wells, "make up as much as 40% of total groundwater withdrawal volume in the eastern portion of Virginia," with private domestic wells specifically accounting for 33.3 of the 96.3 million gallons per day withdrawn in the Eastern Virginia Groundwater Management Area — 34.6 percent.[202] They grow with population at a projected 200,000 to 300,000 additional gallons per day annually through 2050.[203]

These households have no standing in any proceeding described in this volume. They are not ratepayers of the utilities whose permits are being adjudicated, so they have no rate case. They hold no permit, so they receive no notice. They are not metered, so their consumption enters DEQ's accounting only by estimate. In 2002, thousands of them failed.[204] When the next decline arrives, a private well owner's options are to deepen the well or to haul water, and neither appears in any capital plan in Section 5.

One protection exists and is underused. Under 9VAC25-610-110 D 3 g, a permit applicant must commit to mitigating impacts on wells within the area of impact, with a rebuttable presumption that the permitted withdrawal caused the impairment and a low-cost dispute resolution process, both as enforceable permit conditions.[205] Given that DEQ's own modelling puts areas of impact at sixty-six to ninety-one miles, the population within that radius of any major coastal-plain withdrawal is large. The presumption runs in the well owner's favour. Very little in the public record suggests it is being invoked.

A 2024 addition to the Code, § 62.1-262.2, is sometimes described as a protection for residential wells near large withdrawals. It is not one, on two counts. Its geographic scope is limited on the face of the statute to the portion of the Eastern Virginia Groundwater Management Area **north of the Occoquan River**, which excludes every locality discussed in Section 5. And it operates as a permit-expiration provision for systems that already hold a groundwater withdrawal permit, rather than as a drawdown protection for unpermitted domestic wells. The households this section is about received nothing from it.[206]

Agriculture. Section 4 gave the consumption arithmetic: irrigation and livestock withdraw 78.7 million gallons a day in Virginia and consume most of it, putting agricultural consumptive use on the order of 55 to 71 million gallons a day against the entire thermoelectric fleet's 50.6.[207] On the metric the surface regime's cumulative provision actually uses, Virginia agriculture is the same order of magnitude as every power plant in the Commonwealth.

Agriculture holds no priority ranking on the surface side and no reissuance floor. It is not exempt from the Ground Water Management Act — neither § 62.1-259 nor 9VAC25-610-50 lists agriculture among their exclusions, a point frequently assumed the other way.[208] Its surface water permit-exclusion thresholds are higher than the non-agricultural triggers on nontidal waters by roughly three and a third times. On tidal waters they are effectively the same: sixty million gallons per month for agriculture against two million gallons per day for everyone else, which coincide exactly in a thirty-day month and differ by less than eight percent in any other.[209]

Which is to say: farms sit inside the binding cumulative test without any of the protections that test's beneficiaries enjoy. In 2026 they are the sector with measurable losses on the record — seventy-five-plus localities under federal disaster designation, reduced hay yields, delayed row crops, beetle damage in drought-stressed pine.[210] DEQ's centroid ceiling for Caroline County, sixty thousand gallons a day, is approximately one centre-pivot irrigating twenty-five acres.

Tribal nations and hosting landowners. The Rappahannock Tribe and the Mattaponi Tribe have both filed appeals against the Caroline permit. Landowners are in eminent domain litigation over the intake parcel. Two hundred six of two hundred nine public comments opposed the project.[211] The pipelines, intakes and wetland conversions that Section 5 prices are being hosted by rural landowners along thirty-five miles of the Rappahannock and along the Pamunkey, and the hosting is not compensated in any of the per-capita figures above.

The pattern

The costs of the migration fall on the localities with the fewest residents to spread them across, the least capacity to finance them, and the least representation in the proceedings that produced them. The oldest and largest surface withdrawals are exempt from the evaluation the new ones must pass. The population most exposed to an aquifer decline has no seat in any room where the aquifer is discussed.

None of that is an accident of anyone's bad faith. It is what a set of individually reasonable rules produces when nobody sums them.

9. Limits and Open Questions

What this volume does not establish

It does not establish that Virginia is running short of water. The Commonwealth has substantial surface water and the 2026 drought will end. The argument is about accounting and sequencing.

It does not establish that any particular locality's project is unwise. Caroline and New Kent face a real constraint and are responding to it within the options available to them.

It does not establish that DEQ has acted improperly. The agency commissioned the study, published a blunt finding, and has been explicit about what it can and cannot model. The gap this volume identifies is between authority and practice, and it is a gap the agency alone may not be able to close.

It does not establish the magnitude of the buildout's incremental water demand. Section 7 shows why the national indirect-share figure overstates the Virginia case and why marginal generation is far less water-intensive than the fleet average. A defensible estimate would require load forecasts matched to specific generating units and cooling technologies, and this volume does not attempt one.

What would have to be true for the central argument to be wrong

Stating this is a discipline, not a courtesy. The argument would fail if:

DEQ is in fact conducting cross-regime evaluation and simply not documenting it publicly. The authorities at § 62.1-263 and 9VAC25-610-110 G exist. If DEQ routinely weighs surface availability when it constrains a groundwater permit, the practice gap is smaller than described. A records request covering the technical evaluations behind the 2017 reductions and the pending 2026–27 renewals would settle it.

The migration does not in fact materialise at scale. If Caroline's appeals succeed, New Kent's federal permit stalls on the Endangered Species Act consultation, and the remaining localities meet demand through conservation and reuse instead, the surface water load this volume anticipates does not arrive.

SWIFT delivers measured benefit fast enough to be credited in the 2027 renewals. DEQ has left that door open. If the James River facility performs above expectation in its first year and DEQ credits it materially in the James City County permit, the decade-long gap described in Section 6 closes considerably.

The receiving rivers turn out to have ample headroom. No statewide safe-yield figure exists for the James, the Rappahannock, the York or the Pamunkey. This volume treats that absence as a problem. It is possible that a competent basin analysis would show the incremental municipal withdrawals are immaterial against mean flows, in which case the accounting gap is real but the consequence is not.

Each of those is testable, and three of the four will be substantially resolved within eighteen months.

Open data gaps

The human-consumption baseline. No Virginia public water supply has published the share of its withdrawal that qualifies for the reissuance floor. This is the number that determines the outcome of every 2027 renewal.

Whether a VWP permittee has ever been curtailed under a permit's own instream flow condition. No public record surfaced across three passes for this volume. The only curtailments identified in the recent record are two release modifications at Lake Moomaw, in December 2023 and again in December 2024, each a joint action of DEQ, the Department of Wildlife Resources and the Corps of Engineers. Both were operating decisions rather than permit invocations, and the second ran until March 2025.[212] This absence is load-bearing for Section 2 and deserves a records request.

The Annual Water Resources Report and the reports series. The December 2025 edition, carrying calendar year 2024 data, supplies the figures used in Section 2. It does not appear in the General Assembly's reports series, and § 62.1-44.40 required its submission by October 1, 2025. Why the Commonwealth's annual accounting of who withdraws its water was posted to an agency website three months late rather than filed with the legislature is not explained in the document.

Private well registration data. New wells in groundwater management areas have been registered since September 2016 with location, depth, static level, yield and driller's log.[213] That dataset has not been analysed and would materially improve any estimate of the population exposed to an aquifer decline.

SWIFT energy consumption. HRSD publishes none. Every figure in Section 6 is a literature analogue.

Per-connection cost in the migrating localities. Section 8 gives per-capita and per-MGD figures. Per-connection figures, which are what actually appear on a bill, require connection counts this volume did not obtain.

Points on which this volume corrects the author's prior published work

Four, stated in the text where they occur and collected here.

USGS Circular 1392 establishes that aquifer-system compaction causes more than half of land subsidence, and that subsidence causes more than half of relative sea-level rise in the southern Chesapeake. A previously published sidebar compressed these into a claim that groundwater withdrawal causes more than half of relative sea-level rise. It does not; the figure is roughly a quarter to a third.[214]

The Franklin mill did not stop pumping. It cut by 89 percent in 2010 and resumed in 2012, averaging 42 percent of its pre-2010 rate thereafter and reaching 47 percent by 2024. The resumption is why the rebound decayed.[215]

SWIFT's cost is approximately $1.5 to $1.6 billion for the two funded recharge facilities, within a programme HRSD's own board record now states at $2.4 billion, not "on the order of a billion dollars." HRSD's overview page carries the older figure.[216]

And DEQ's position on SWIFT is that projected benefits cannot enter a fifty-year simulation while measured benefits can be considered in permitting decisions. "For planning purposes, the rescue does not exist yet" is a fair gloss for a column and too coarse for this volume, particularly since DEQ is already conditioning a permit term on the programme's progress.[217]

10. What to Watch in 2027

Ten items, in the order they fall due.

October 15, 2026 — DEQ's data center cooling retrofit study. The budget requires a study and a plan for retrofitting existing Eastern Virginia GWMA data centers to air cooling, fully recycled or storm water, or closed loop. It is the first document in which the agency must take a position on what "closed loop" means, and that definition determines whether the 2027 mandate reaches evaporative cooling or accommodates it.

End of 2026 — the James City County draft permit. The authority's general manager expects a draft from DEQ by year's end, against a permit expiring February 6, 2027. Five things should be public before it issues: the volume requested in the renewal application, the authority's protected human-consumption calculation, DEQ's technical evaluation and model assumptions, the Alternative Source Development Assessment required by the current permit, and any measured SWIFT benefit included in the review.

October 2026 — the State Water Commission returns to SJ 25. The commission took the report on August 20, 2026 and directed DEQ to come back with one to three prioritized bills; Senator Surovell asked that legislative and budget language be vetted at commission level before session, noting that Senate rules exempt commission-approved legislation from bill limits. This is where the 2027 groundwater legislation will be shaped, and it is a more informative meeting to watch than the session itself.

Late autumn 2026 into 2027 — the James River SWIFT facility. Phased start-up, with ten million gallons per day of recharge expected as an annual average in 2027, now underwritten by a grant covenant rather than an operating assumption. The first measured benefit DEQ can credit anywhere will come from this plant, and the amount available by the time the 2027 renewals are decided is the practical test of the measured-benefit door.

January 1, 2027 — the Eastern GWMA cooling requirement binds. New data centers submitting a complete DEQ air permit application after this date must demonstrate to DEQ's satisfaction that they have minimised water use for cooling and use best available water-efficient technologies, and may use direct evaporative cooling only in conjunction with an approved primary technology.

The 2027 General Assembly session — SJ 25's twelve recommendations. Two reach directly into land use: the recommendation that DEQ be authorised to deny a groundwater permit where surface water or recycled water is reasonably available, and Recommendation 5, which would require comprehensive plans in groundwater management areas to limit planned growth to available water where no other supply is feasible. The first would formalise the migration this volume describes. The second would move the water question ahead of every rezoning and special use permit in a management area — and DEQ's stated reason for wanting it is exposure rather than planning doctrine. Rolband told the commission in August that without it the agency is caught: "it's a taking if we deny that permit when they were granted by the local government the authority to build something."[218] An agency is asking the legislature to constrain local land use because state permitting cannot absorb its consequences. Set that beside a Governor who has

described data center siting as "a local choice" and the collision is on the calendar rather than in prospect. Whether the session acts is, as much as anything, a test of how seriously the legislature treats science it commissioned itself.

The 2027 session, second front — groundwater trading. Recommendation 11 is written with deliberate skepticism and does not tell the legislature to authorise trading. The August hearing showed why that restraint matters: the water-user coalition wants trading explored as the way to finance additional recharge, the Chesapeake Bay Foundation opposes it as the privatisation of a public resource, and a sitting senator has proposed that new industrial users fund SWIFT-equivalent injection as a condition of siting. All three answers were put to the same commission on the same morning. Any of them would settle the precedence question this volume argues is unsettled, and they settle it in incompatible directions.

2026–2027 — eleven of the fourteen largest negotiated groundwater permits expire. The renewals will be decided under the current regulation regardless of what the session does, and they will set eastern Virginia's allocation for a term of years.

July 1, 2027 — the Cooling Water Scarcity Area regulation. DEQ must amend the water supply planning regulation to establish the designation criteria. This is the first time the Commonwealth will define a water-scarcity geography by reference to evaporative cooling load.

Undated, and the most consequential — whether Virginia declares a Surface Water Management Area. The authority in Chapter 24 of Title 62.1 has gone unused since the three proceedings opened under it in 1993 lapsed, long before any of the projects in Section 5 were conceived. It would place a permit trigger, a multi-user criterion and a domestic-use priority on a declared surface geography, and it is the instrument that would let the Commonwealth evaluate a groundwater constraint and a surface water application as one question. Nothing in the record suggests it is under consideration. Nothing in the record explains why not.

Two further items are live and undated. Senators Stuart and Perry's July 30 request for a special session on water has not been answered; it is one of two special-session requests pending before the Governor, the other concerning the proposed Dominion-NextEra merger. And the Caroline County permit appeals, along with New Kent's outstanding Endangered Species Act consultation and Coastal Zone Management concurrence, will determine whether the two flagship migration projects proceed on the schedule their counties have budgeted for.

The pattern across all of it is that the decisions arrive before the information does. The permits renew before SWIFT can be measured. The cooling mandate binds before "closed loop" is defined. The comprehensive plans that would ration growth to water are optional until a session that has not happened makes them otherwise. And the localities financing intakes are doing so against a state ceiling number published six months late, in the second driest year on record, without any instrument that adds their new river demand to the demand already there.

Endnotes

[1] City of Richmond Department of Public Utilities and Henrico County releases, August 4, 2026; Henrico County, "Henrico lifts request for voluntary water conservation," henrico.gov, August 4, 2026. The lift was made under Richmond's James River Regional Flow Management Plan, not under a DEQ drought advisory.

[2] Virginia Department of Environmental Quality, *Groundwater Supply East of Interstate 95: Report on Senate Joint Resolution No. 25 (2024)*, July 2026 (hereafter DEQ, SJ 25), Table 10 and § 2.5.3–2.5.4. https://www.deq.virginia.gov/home/showpublisheddocument/37496

[3] DEQ, SJ 25, Recommendation 2 (authority to deny a groundwater withdrawal permit where an alternative source is reasonably available).

[4] Office of Governor Abigail Spanberger, news release, July 16, 2026. https://www.governor.virginia.gov/newsroom/news-releases/2026/july-releases/name-1121395-en.html

[5] DEQ, SJ 25, § 2.5.2.

[6] Md Abu Bakar Siddik, Arman Shehabi and Landon Marston, "The environmental footprint of data centers in the United States," *Environmental Research Letters* 16, no. 6 (2021): 064017, § 3.1. https://doi.org/10.1088/1748-9326/abfba1

[7] Va. Code § 62.1-263; 9VAC25-610-110 G; 9VAC25-210-315 (eff. September 25, 2024).

[8] Va. Code §§ 62.1-242 through 62.1-253 (Chapter 24, Surface Water Management Areas); 9VAC25-220. The subordination clause appears at the opening of 9VAC25-210-370 B.

[9] Virginia DEQ, *Virginia State Water Resources Plan* (2020, released January 2022). https://www.deq.virginia.gov/water/water-quantity/water-supply-planning/virginia-water-resources-plan

[10] Eastern Virginia Groundwater Management Advisory Committee (EVGMAC), draft minutes, June 17, 2026, posted July 2, 2026. Virginia Regulatory Town Hall, https://townhall.virginia.gov/L/GetFile.cfm?File=meeting\53\43330\Minutes_DEQ_43330_v1.pdf. The minutes are not posted on DEQ's own site, which carries the meeting presentations only.

[11] DEQ, SJ 25, § 2.6.1.

[12] DEQ, SJ 25, § 2.1 and Table 5.

[13] DEQ, SJ 25, p. 29 (96.3 Mgal/day, Eastern Virginia GWMA).

[14] DEQ, SJ 25, § 2.2.4, citing McFarland (2013).

[15] DEQ, SJ 25, § 2.2; see also the discussion of the Franklin and West Point pumping centers at § 2.2.3.

[16] R.D. Eggleston and J. Pope, *Land Subsidence and Relative Sea-Level Rise in the Southern Chesapeake Bay Region*, U.S. Geological Survey Circular 1392 (2013). https://doi.org/10.3133/cir1392

[17] Eggleston and Pope, Circular 1392, "Major Conclusions," p. 20: "Land subsidence causes more than half of the observed relative sea-level rise. Aquifer-system compaction causes more than half of the land subsidence." Underlying figures at p. 18 (3.9 mm/yr relative sea-level rise; 2.1 mm/yr subsidence).

[18] Tommy N. Turner, "They were warned" (sidebar), *Williamsburg Watch*, July 27, 2026. The corrected attribution appears in the text above.

[19] DEQ, SJ 25, § 2.2.3.

[20] DEQ, SJ 25, § 2.6.1 and § 1.4.4.

[21] Virginia DEQ, Drought Monitoring Task Force report, April 28, 2026. https://www.deq.virginia.gov/home/showpublisheddocument/35813/639131624804770000

[22] Virginia DEQ, Drought Monitoring Task Force report, May 26, 2026. https://www.deq.virginia.gov/home/showpublisheddocument/36401

[23] DEQ, DMTF report, April 28, 2026.

[24] DEQ, DMTF report, May 26, 2026 (USGS gauge 02059500).

[25] WTVR CBS 6, "Virginia drought update," July 30, 2026, citing U.S. Drought Monitor.

[26] Henrico County release, August 4, 2026; WWBT, August 4, 2026.

[27] Virginia DEQ, "CORRECTED News Release: Drought Update," GovDelivery bulletin, July 31, 2026. https://content.govdelivery.com/accounts/VADEQ/bulletins/423012f. As of August 5, 2026 the DEQ drought page still described the August 4 task force meeting in the future tense.

[28] DEQ, July 31, 2026 bulletin.

[29] DEQ, DMTF report, May 26, 2026.

[30] Office of Governor Spanberger, July 16, 2026.

[31] Va. Code § 62.1-254 et seq.; 9VAC25-610-50.

[32] 9VAC25-610-110 D 3 h. The regulation further provides that compliance "will be determined at the points where the predicted one-foot drawdown contour is predicted for the proposed withdrawal."

[33] DEQ, SJ 25, § 1.6.3.

[34] 9VAC25-610-110 E 1.

[35] 9VAC25-610-110 F 2.

[36] DEQ, SJ 25, discussion of human consumption and customer class.

[37] Va. Code § 62.1-263; 9VAC25-610-110 G.

[38] 9VAC25-210-310 A 11 (non-agricultural); 9VAC25-210-310 A 4 (agricultural).

[39] 9VAC25-210-370 B 3.

[40] 9VAC25-210-370 B.

[41] DEQ, SJ 25, Table 10.

[42] C.A. Dieter et al., *Estimated Use of Water in the United States in 2015*, U.S. Geological Survey Circular 1441 (2018), Table 12 (Virginia). https://doi.org/10.3133/cir1441

[43] 9VAC25-210-370 D 3.

[44] 9VAC25-210-310 A 1 and A 3.

[45] Virginia Department of Environmental Quality, *Annual Water Resources Report*, December 2025 (calendar year 2024 data), § 2.6, p. 24. https://www.deq.virginia.gov/home/showpublisheddocument/32729/639026074417130000. The preceding edition states twelve of the top twenty rather than fourteen: DEQ, *Virginia Annual Water Resources Report* (October 2024), RD512, § 2.6, p. 23. https://rga.lis.virginia.gov/Published/2024/RD512/PDF

[46] DEQ, *Annual Water Resources Report*, December 2025, Appendix 1, Table 20, p. 52: Fairfax Water Corbalis WTP 94.6, Fairfax Water Griffith WTP 69.4, both marked unpermitted. Confirmed at Table 5, p. 32, of the same edition. The combined figure of 164.0 is the author's addition; DEQ reports the two plants separately and publishes no utility total.

[47] DEQ, *Annual Water Resources Report*, December 2025, Appendix 1, Table 20, p. 52: AdvanSix Resins and Chemicals Hopewell Plant 96.4, City of Norfolk Western Branch Reservoir 57.2, City of Virginia Beach Service Area 33.7, each marked unpermitted.

[48] DEQ, *Annual Water Resources Report*, December 2025, § 2.6, p. 24, for the 78 percent figure; Executive Summary, p. vii, and Table 2, p. 24, for "81% (916.16 MGD)." The preceding edition gives 73 percent and 76 percent (857.9 MGD) for calendar year 2023: RD512, § 2.6, p. 23, and Executive Summary, p. vii.

[49] Virginia Department of Environmental Quality, *Annual Water Resources Report: Status of Virginia's Water Resources & Management Activities*, December 2025 (calendar year 2024 data), pp. vii and 23. https://www.deq.virginia.gov/home/showpublisheddocument/32729/639026074417130000. Va. Code § 62.1-44.40 requires submission to the Governor and General Assembly on or before October 1 each year. The December 2025 edition does not appear in the General Assembly's reports series; it is posted on DEQ's website.

[50] 9VAC25-210-310 A 3 a.

[51] 9VAC25-210-310 A 1 b. The reporting-and-consideration sentence appears within the exclusion for temporary surface water withdrawal systems and applies, by its terms, "where the purpose of the withdrawal is for agriculture."

[52] Va. Code §§ 62.1-242 through 62.1-253; implementing regulation at 9VAC25-220. The trigger volume is at § 62.1-243 A (ii); the locality petition right at § 62.1-246 A; the multi-user criterion at § 62.1-248 B 1; the domestic-use priority at § 62.1-248 D. On the absence of any declaration: 9VAC25-220-40 B requires that a surface water management area be declared by regulation, and the Administrative Code retains even repealed area-designation chapters, so the absence of such a chapter is dispositive. Three proceedings were opened under the authority by notices published April 19, 1993, for the Shenandoah, the North River above its confluence with the Middle River, and the James River in the Richmond metropolitan area (VR 680-15-04 through 680-15-06, *Virginia Register of Regulations*, Vol. 9, Iss. 15, pp. 2235–2237). None reached a proposed regulation. The James River docket ran longest, and Senate Document 56 (2000) still described it as "in the process of being designated." The docket record is set out in *A Line Drawn on a Highway*, version 2.2, Appendix C (cite all versions: 10.5281/zenodo.22105181). Declared: never.

[53] 9VAC25-210-370 B, opening clause.

[54] 9VAC25-210-315 (eff. September 25, 2024).

[55] DEQ, *Virginia State Water Resources Plan* (2020); 9VAC25-780 (amended eff. October 9, 2024), regional plans due October 2029.

[56] U.S. Geological Survey, "Historic Drought Conditions in Virginia." https://va.water.usgs.gov/GLOBAL/histcond.htm

[57] USGS, "Historic Drought Conditions in Virginia"; USGS Virginia drought status, March 2002. https://va.water.usgs.gov/drought/index_mar8.htm

[58] Virginia DEQ, *Virginia Drought Assessment and Response Plan*, Drought Response Technical Advisory Committee, March 28, 2003. https://www.deq.virginia.gov/home/showpublisheddocument/5115/637490843054630000

[59] Patrick J. Michaels (then Virginia State Climatologist), *Washington Post*, September 2002, reprinted by Loudoun County History.

[60] USGS, "Historic Drought Conditions in Virginia."

[61] DEQ, *Drought Assessment and Response Plan* (2003).

[62] Ibid.

[63] USGS gauge 01667500, Rapidan River near Culpeper.

[64] DEQ, RD512, p. 12.

[65] U.S. Geological Survey, Scientific Investigations Report 2009-5039. https://doi.org/10.3133/sir20095039

[66] Eggleston and Pope, Circular 1392 (2013).

[67] DEQ, SJ 25, discussion of the 2014–2017 groundwater initiative.

[68] Joint Legislative Audit and Review Commission, *Effectiveness of Virginia's Water Resource Planning and Management* (2016). https://jlarc.virginia.gov/water-2016.asp

[69] Sarah Vogelsong, "In James City County, a water crisis by 2.83 million (gallon) cuts," *Virginia Mercury*, August 18, 2019.

[70] USGS Virginia drought status, March 2002 (Arlington County well 53V 1; Colonial Heights well 51G 1).

[71] DEQ, SJ 25, § 2.2.3 and § 2.2.4, p. 47.

[72] DEQ, SJ 25, p. 47. The 42 percent figure is the 2013–2024 average; the 2024 figure is 47 percent.

[73] DEQ, SJ 25, executive summary and § 2.3.

[74] Tommy N. Turner, "The state finally measured the water under James City County. The number is small.," *Williamsburg Watch*, July 27, 2026.

[75] Office of Governor Spanberger, July 16, 2026.

[76] National Integrated Drought Information System, Virginia state page, observed August 5, 2026. https://www.drought.gov/states/virginia

[77] WTKR News 3, July 16, 2026.

[78] DEQ, July 31, 2026 bulletin.

[79] Patrick Larsen et al., "Richmond region enacts voluntary water restrictions amid ongoing drought," VPM News, July 1, 2026. The nine-inch figure is VPM's reported summary of Noyes; the thirteen-inch sentence is a direct quotation.

[80] DEQ, DMTF report, May 26, 2026.

[81] DEQ, DMTF reports of April 28, May 26 and June 23, 2026; WTVR, July 30, 2026 (U.S. Drought Monitor data through July 28).

[82] DEQ, DMTF report, May 26, 2026.

[83] DEQ, DMTF report, April 28, 2026.

[84] DEQ, DMTF reports, May 26 and June 23, 2026.

[85] DEQ, July 31, 2026 bulletin.

[86] Office of Governor Spanberger, July 16, 2026; DEQ, DMTF report, May 26, 2026.

[87] WTKR News 3, July 16, 2026, quoting Virginia Department of Health Office of Drinking Water director Dwayne Roadcap.

[88] WTKR News 3, July 16, 2026.

[89] DEQ, July 31, 2026 bulletin.

[90] Letter of Senators Richard H. Stuart (R, 25th) and Russet W. Perry (D, 31st) to Governor Spanberger, July 30, 2026.

[91] Henrico County release, August 4, 2026.

[92] WTKR News 3, July 16, 2026, reporting remarks of Secretary of Agriculture and Forestry Katie Frazier; USDA Farm Service Agency designations of April 14 and May 22, 2026.

[93] USDA Farm Service Agency, "USDA designates 15 Virginia counties as natural disaster areas," July 9, 2026.

[94] DEQ, DMTF report, June 23, 2026.

[95] Virginia DEQ, news release, June 25, 2026. https://content.govdelivery.com/accounts/VADEQ/bulletins/41d8871

[96] Dieter et al., Circular 1441, Table 2A (Virginia): irrigation 51.7 Mgal/d, livestock 27.0 Mgal/d.

[97] Author's calculation applying consumptive fractions of 70–90 percent, standard for irrigation and livestock use, to the Circular 1441 Virginia figures. Thermoelectric consumption of 50.6 Mgal/d from Circular 1441, Table 12.

[98] Georgia Environmental Protection Division, Lower Flint River Basin withdrawal permit suspension (2012, modified December 18, 2024).

[99] Virginia DEQ, VWP Permit No. 20-0514, issued November 2025; DEQ approval announcement, December 10, 2025.

[100] Virginia Marine Resources Commission, decision of June 23, 2026.

[101] DEQ public comment summary, VWPP No. 20-0514.

[102] Caroline County, *Water Master Plan* (2020), ch. 8, Tables 8-2 and 8-3. https://co.caroline.va.us/documentcenter/view/4424

[103] Caroline County, *Adopted FY27 Budget*, adopted June 10, 2026, line 100-012210-3150-000-L42-000.

[104] Fredericksburg Free Press reporting, January and June 2026.

[105] DEQ, SJ 25, Table 10 (Northwest Coastal Plain centroid, Caroline County).

[106] U.S. Army Corps of Engineers, Norfolk District, Public Notice NAO-2014-02045 / VMRC 2026-0568, May 14, 2026. https://www.nao.usace.army.mil/Media/Public-Notices/Article/4484839

[107] Ibid.

[108] Ibid.

[109] Ibid.

[110] County of New Kent, *Fiscal Year 2026-2027 Recommended Budget — Capital Improvement Plan, Fiscal Years 2027 to 2031*, CIP Form-A, Public Utilities, Priority 3 (estimates by Arcadis US, Inc., prepared October 15, 2025). https://www.newkent-va.us/DocumentCenter/View/9015

[111] Ibid.

[112] Hampton Roads Planning District Commission, *Regional Water Supply Plan*, Section 1.

[113] HRPDC presentation, October 16, 2014; WVTF/RadioIQ, "East of I-95, Virginia begins to limit permitted groundwater users," August 9, 2017.

[114] HRPDC, "Updates to Water Supply Plan," March 2021.

[115] Stephen Faleski, "Dwindling groundwater precludes exiting Norfolk deal," *Smithfield Times*, October 8, 2024, quoting Chris Pomeroy.

[116] Virginia Permit Transparency, application GWI000305, received July 24, 2026. https://permits.virginia.gov/Permit/Details/163144

[117] *Smithfield Times*, October 8 and October 15, 2024.

[118] James City Service Authority, Groundwater Withdrawal Permit GW0043401. https://www.jamescitycountyva.gov/DocumentCenter/View/9952; JCSA Overview. https://www.jamescitycountyva.gov/DocumentCenter/View/32725

[119] Vogelsong, *Virginia Mercury*, August 18, 2019.

[120] 9VAC25-610-96 A.

[121] James City Service Authority board meeting, July 28, 2026, remarks of General Manager Douglas Powell. https://www.youtube.com/watch?v=90NG7_NW-Xc

[122] DEQ, SJ 25, Table 10 (York-James centroid, James City County).

[123] Tommy N. Turner, "The groundwater report is already at JCSA's door," *Williamsburg Watch*, July 29, 2026.

[124] Ibid.

[125] DEQ, SJ 25; 9VAC25-610-110 F 2.

[126] Hanover County 25-Year Master Plan alternatives, presented to the Board of Supervisors, 2026; VPM News reporting.

[127] Henrico County project record; DEQ withdrawal approval.

[128] Author's calculation from the figures in the table above. See also the accompanying data appendix, *VA_Water_Migration_Register_v0_3.xlsx*.

[129] Author's calculation. Populations: Caroline County approximately 30,900; Henrico County approximately 334,400 (U.S. Census Bureau estimates). Caroline's rural classification is from the 2020 Census Demographic and Housing Characteristics file.

[130] DEQ, *Annual Water Resources Report*, December 2025, Appendix 1, Table 20, p. 52: Corbalis WTP 94.6, Griffith WTP 69.4, summed by the author to 164.0. The corresponding calendar year 2023 entries are 86.2 and 67.9, summing to 154.1, at DEQ, *Virginia Annual Water Resources Report* (October 2024), RD512, Appendix 1, Table 20, p. 50.

[131] DEQ, SJ 25, p. 107 ("Lawful unpermitted withdrawals, such as private drinking water wells, make up as much as 40% of total groundwater withdrawal volume in the eastern portion of Virginia"); Table 5 (private domestic wells 33.3 of 96.3 Mgal/day).

[132] DEQ, SJ 25, p. 20.

[133] DEQ, *Drought Assessment and Response Plan* (2003).

[134] 9VAC25-610-110 D 3 g.

[135] HRSD General Manager Jay Bernas, presentation to the Virginia State Water Commission, December 15, 2023. https://dls.virginia.gov/commissions/swc/files/swift121523.pdf

[136] Va. Code §§ 62.1-271 through 62.1-275.

[137] Interstate Technology and Regulatory Council, *Managed Aquifer Recharge*, Case Study 5.1 (authored by HRSD Director of Water Quality Jamie Heisig-Mitchell).

[138] HRSD, SWIFT Research Center and James River Treatment Plant project documentation. DEQ's SJ 25 report states no injection depth.

[139] EVGMAC, draft minutes, June 17, 2026, p. 7.

[140] DEQ, SJ 25, § 2.6.1, p. 71.

[141] Virginia State Water Commission, meeting of August 20, 2026, testimony of Andrea Wortzel, Troutman Pepper Locke, on behalf of Mission H2O, at video time 3:03:15–3:03:55. Senate of Virginia broadcast archive, youtube.com/watch?v=WTkFJio-foo. Wortzel added, at 3:03:55, "I can say this with certainty given the drivers for the SWIFT project and the commitments that have been made as part of the funding process" — a reference, on the timing, to the grant covenant described below. Note that she frames the obligation as 65 percent of *capacity*; the covenant itself is written against *influent flow* up to the 16 MGD capacity. At the plant's present flows the two produce nearly the same number, and they diverge if influent moves.

[142] HRSD, "About SWIFT" and "The Potomac Aquifer: A Diminishing Resource," both observed August 2026. https://www.hrsd.com/swift/about and https://www.hrsd.com/swift/potomac-aquifer-diminishing-resource

[143] Hampton Roads Sanitation District, Commission Meeting Agenda, February 24, 2026, hrsd.com/sites/default/files/assets/Documents/pdfs/commission_agendas/2026/02-24-

2026CommissionMeetingAgenda.pdf. The contract is reproduced in full in the agenda packet; the corresponding minutes carry blank attachment pages. Reviewed for HRSD by AquaLaw PLC and approved 7–0.

[144] DEQ WQIF Contract #440-S-23-06, "WQIF Point Source Grant and Operations and Maintenance Agreement," Article V § 5.0; definition at § 1(i); penalty caps at § 8.2 and assessment trigger at § 8.2(b)(i); enforcement at § 8.4; Extraordinary Conditions at § 1(f); term at § 9.13. Exhibit I, which supplies the dollar formula for underutilization assessments, is referenced in the agreement but is not present in the retrieved packet. The 5 percent trigger is ambiguous as drafted: "falls 5% or more below the required utilization rate" admits both five percentage points and five percent relative, and the document does not resolve it.

[145] Aqua-Aerobic Systems, "York River Wastewater Treatment Plant, HRSD, Virginia," success story, aqua-aerobic.com/downloads/SuccessStory_YorkRiverHRSD-VA_SBR-Disk.pdf. The counterparty refinery stopped refining in 2010 and the system's current operating status could not be confirmed from HRSD's published record.

[146] HRSD, *SWIFT Program Summary Schedule (Level 1)*, data date March 31, 2023. https://www.hrsd.com/sites/default/files/assets/Documents/pdfs/SWIFT/HRSDSWIFTMasterSummaryScheduleLevel1.pdf

[147] DEQ, SJ 25, § 2.2.4, p. 48.

[148] DEQ, SJ 25, § 2.2.4, pp. 50–51.

[149] DEQ, SJ 25, § 2.2.4, pp. 50–51. The upward-shift finding derives from DEQ's groundwater-level trend analysis and is stated separately from the arrival-signal regression.

[150] DEQ, SJ 25, § 2.6.1.

[151] DEQ, SJ 25, Table 10.

[152] DEQ, SJ 25, Key Point #6, stated at § 2.2.4 and § 2.6.1.

[153] DEQ, SJ 25, § 2.2.4, citing McFarland (2013); HRSD James River modelling.

[154] EVGMAC, draft minutes, June 17, 2026 (Module 4, "Allocation of any new supplies created by the MAR efforts").

[155] EVGMAC, draft minutes, June 17, 2026.

[156] DEQ, SJ 25, § 2.6.1.

[157] DEQ, SJ 25, § 4.2.6.

[158] EVGMAC, draft minutes, June 17, 2026, remarks of policy advisor Jonathan Rak.

[159] DEQ, SJ 25, § 2.6.1, p. 71.

[160] Ibid.

[161] DEQ, SJ 25, § 2.6.1 and § 1.4.4.

[162] DEQ, SJ 25, § 2.6.1, p. 71 (final sentence of the passage).

[163] James City Service Authority board meeting, July 28, 2026.

[164] EVGMAC, draft minutes, June 17, 2026, remarks of DEQ Office of Water Supply manager Weedon Cloe, p. 4; DEQ, SJ 25, Recommendations 9 and 10.

[165] Bernas, presentation to the State Water Commission, December 15, 2023.

[166] HRSD Commission minutes, February 24, 2026. The James River figure is given as a range, "$500 to $600 million," and is not converted to a point estimate here.

[167] WHRO, October 20, 2025.

[168] Tommy N. Turner, "Hampton Roads spent a billion dollars refilling the aquifer. Nobody has decided who gets the water.," August 2026.

[169] Bernas, December 15, 2023; U.S. EPA WIFIA loan announcement, October 2024.

[170] EVGMAC, draft minutes, June 17, 2026.

[171] Virginia State Water Commission, August 20, 2026: Director Michael Rolband at video time 2:38:56–2:39:08, reporting an analysis HRSD commissioned from an engineering consultant; figures repeated by Delegate Keith Hodges at 2:39:29. The comparison excludes piping, distribution and power, which Rolband noted at 2:44:29–2:45:12.

[172] HRSD, *SWIFT Program Summary Schedule (Level 1)*; Bernas, December 15, 2023; HRSD project pages, observed August 2026.

[173] "Cost and energy intensity of U.S. potable water reuse systems," *Environmental Science: Water Research & Technology* (2021). https://doi.org/10.1039/D1EW00017A

[174] Turner, "Hampton Roads spent a billion dollars refilling the aquifer," August 2026, where this question was first put; DEQ, SJ 25, recommendations on groundwater trading.

[175] EVGMAC, draft minutes, June 17, 2026, remarks of HRPDC staff.

[176] Virginia State Water Commission, August 20, 2026, Director Michael Rolband at video time 2:18:47, on Recommendation 1. The same point recurs at 2:20:41 in the discussion of allocation rights.

[177] Ibid., Jay Ford, Chesapeake Bay Foundation, at 3:27:21 quoting SJ 25, and at 3:27:37 and 3:28:03. Mission H2O's position that its disagreement with DEQ concerns timeline rather than findings is at 3:00:39.

[178] Ibid., Senator Bill DeSteph at 2:40:31–2:43:49; the per-facility figure of "300,000 gallons a year" is at 2:41:42 and is quoted as spoken. Rolband's confirmation of eleven data centers east of Interstate 95, none on groundwater, is at 2:42:11; his response on the concept and its cost qualifications is at 2:43:49–2:45:12.

[179] EVGMAC, draft minutes, June 17, 2026, presentation of Whitney Katchmark, HRPDC.

[180] Dieter et al., Circular 1441, Tables 1, 2A and 12 (Virginia).

[181] DEQ, *Virginia Annual Water Resources Report* (October 2024), RD512, Table 19, p. 46, for the station figures. The 67.5 percent share is stated at § 3.9, p. 45, where DEQ attributes it to the two nuclear plants in Louisa and Surry counties as a share of total reported withdrawals in 2023, power generation included.

[182] Dieter et al., Circular 1441, Table 12 (Virginia): total withdrawals 5,320 Mgal/d; consumptive use 50.6 Mgal/d.

[183] Dominion Energy, *Water Security 2022 CDP Response*, p. 5. https://www.dominionenergy.com/-/media/content/about/coal-ash/pdfs/water-cdp.pdf

[184] Dieter et al., Circular 1441, Table 12 (Virginia): saline thermoelectric withdrawals 2,400 Mgal/d.

[185] Dominion Energy, *Water Security 2022 CDP Response*; VPDES Permit VA0052451 (North Anna).

[186] Siddik, Shehabi and Marston (2021), § 3.1.

[187] Ibid.

[188] Author's calculation from Circular 1441, Table 12 (Virginia): 50.6 Mgal/d consumptive use and 61,100 GWh net generation yield approximately 1.14 m^3/MWh.

[189] J. Macknick, R. Newmark, G. Heath and K.C. Hallett, "Operational water consumption and withdrawal factors for electricity generating technologies: a review of existing literature," *Environmental Research Letters* 7 (2012): 045802; NREL/TP-6A20-50900.

[190] Dominion Energy, *Water Security 2022 CDP Response*; Dominion station documentation for Brunswick County and Greensville County.

[191] DEQ, SJ 25, § 2.5.2 (2024 figure); Dieter et al., Circular 1441, Table 12 (2015 figure: 3.80 of 5,320 Mgal/d).

[192] Commonwealth of Virginia, 2026 Special Session I, House Bill 30, Chapter 1, Item 366 M (enacted text). https://budget.lis.virginia.gov/item/2026/2/HB30/Chapter/1/366/. The conference report version, which differs materially and is the one reproduced in most secondary accounts, is at https://budget.lis.virginia.gov/amendment/2026/2/HB30/Introduced/CR/366/7c/

[193] EVGMAC, draft minutes, June 17, 2026.

[194] 9VAC25-610-110 E 1.

[195] 9VAC25-610-110 F 2.

[196] DEQ, SJ 25; see also Turner, "The groundwater report is already at JCSA's door," July 29, 2026.

[197] 9VAC25-210 Part V contains no analogue to 9VAC25-610-110 E 1 or F 2.

[198] DEQ, *Drought Assessment and Response Plan* (2003); DEQ, RD512, p. 12.

[199] Author's calculation. See note 127.

[200] DEQ, news release, June 25, 2026.

[201] DEQ, *Annual Water Resources Report*, December 2025, Appendix 1, Table 20, p. 52. Summed by the author; see note 130.

[202] DEQ, SJ 25, p. 107 and Table 5.

[203] DEQ, SJ 25, p. 20.

[204] DEQ, *Drought Assessment and Response Plan* (2003).

[205] 9VAC25-610-110 D 3 g.

[206] Va. Code § 62.1-262.2 (2024). The provision's geographic limitation should be confirmed against the current text before it is relied upon.

[207] Dieter et al., Circular 1441, Table 2A (Virginia); author's calculation as at note 93.

[208] Va. Code § 62.1-259; 9VAC25-610-50. Neither enumerates an agricultural exclusion.

[209] 9VAC25-210-310 A 4 and A 11.

[210] DEQ, DMTF report, June 23, 2026; USDA Farm Service Agency designations, April, May and July 2026.

[211] DEQ public comment summary, VWPP No. 20-0514; Fredericksburg Free Press reporting, January–June 2026.

[212] DEQ, *Virginia Annual Water Resources Report* (October 2024), RD512, § 1.8, p. 13, on the December 2023 Gathright Dam release modification. DEQ, *Annual Water Resources Report*, December 2025, § 1.8, p. 13, on its recurrence in December 2024 and its continuation until March 2025.

[213] 9VAC25-610-42 (eff. September 2016).

[214] Eggleston and Pope, Circular 1392, p. 20; correcting Turner, "They were warned" (sidebar), July 27, 2026.

[215] DEQ, SJ 25, p. 47; correcting Turner, "The state finally measured the water under James City County," July 27, 2026.

[216] Bernas, December 15, 2023; correcting Turner, "Hampton Roads spent a billion dollars refilling the aquifer," August 2026.

[217] DEQ, SJ 25, § 2.6.1; James City Service Authority board meeting, July 28, 2026.

[218] Virginia State Water Commission, August 20, 2026, Director Michael Rolband at video time 2:19:19, on Recommendation 2. On the Governor's characterisation of data center siting as a local choice, see WJLA broadcast interview, August 13, 2026.

Deliverable Notes

Scope. This volume is an independent statewide analysis of Virginia's two water regimes and their intersection with the energy buildout. It is not a companion to, or a summary of, any single state document, though DEQ's SJ 25 report is its most frequently cited source. A separate companion analysis of that report, *The Aquifer Says No*, is available at doi.org/10.5281/zenodo.21556435.

Method. All figures derive from primary sources: the Virginia Administrative Code and Code of Virginia, DEQ reports and bulletins, U.S. Geological Survey compilations, county capital improvement plans and master plans, permit documents, federal public notices, and the minutes of the Eastern Virginia Groundwater Management Advisory Committee. News reporting is cited where it carries a quotation or a figure not otherwise available, and is identified as such.

Corrections to prior published work. Four claims in this volume correct statements previously published under the author's byline in the *Williamsburg Watch*. They are marked in the text at Sections 1, 3 and 6 and collected at Section 9. Corrections are stated openly rather than silently on the principle that a prior publication is a claim to be tested like any other.

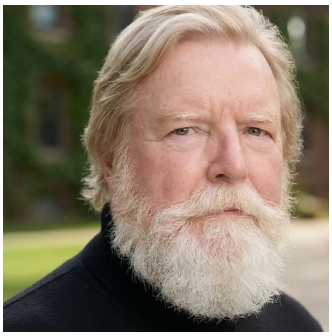
Verification. The research underlying this volume was assembled in seven topical memoranda and subjected to two independent verification passes and four adversarial reviews conducted from the perspectives of a utility policy analyst, an environmental litigator, an agricultural constituency researcher, and an academic referee.

Data appendix. A structured register of every project, cost, capacity, permit number, source and confidence rating discussed in Sections 5 and 6 accompanies this volume as *VA_Water_Migration_Register_v0_3.xlsx*.

Hearing citations. Quotations from the August 20, 2026 State Water Commission meeting are taken from the corrected caption track of the Senate of Virginia's broadcast and are cited to video time. Where a figure was repeated by a second speaker, that is noted. Nothing from that hearing is used here as the sole support for a load-bearing claim.

Currency. Evidence is current through August 21, 2026, with one exception: both editions of DEQ's *Annual Water Resources Report* were retrieved and read against the documents on August 26, 2026, and every figure in this volume drawn from either edition is current to that date. Four items were live and unresolved at that date: the Governor had not responded to the July 30 request for a special session; Exhibit I to the WQIF contract, which supplies the underutilization penalty formula, was not in the retrieved agenda packet; the operating status of the York River reclaimed water system was unconfirmed; and DEQ's data center cooling retrofit study, due October 15, 2026, had not issued.

About the Author



Tommy N. Turner is an independent researcher and writer who documents the local-government and energy dimensions of the data center build-out in Virginia. His series of jurisdiction-level case studies covers the counties and the fall-line corridor where Virginia's data center decisions have been made, refused, or contested, and the analytical volumes extend that work into the systems those decisions run on. Earlier volumes took the transmission network and the cost-allocation machinery, then generation. This one takes water. Like the rest of the series, it is assembled from primary records: Department of Environmental Quality groundwater and surface water withdrawal permits and the engineering reports filed with them, the agency's SJ 25 study to the General Assembly and the August 2026 State Water Commission record in which it was presented, both editions of the Commonwealth's Annual Water Resources Report, Hampton Roads Sanitation District commission agendas and the grant instruments inside them, United States Geological Survey investigations and groundwater atlases for the Coastal Plain, the Virginia Administrative Code and the Virginia Register, and county capital plans, drought plans, ordinances, and water authority records. He spent thirty years in corporate banking, banking technology and international consulting before this work, and holds an MBA from Emory. He writes opinion and analysis on Virginia public affairs for outlets including the Richmond Times-Dispatch, the Virginia Mercury, the Virginian-Pilot, the Roanoke Times, Cardinal News, and RTO Insider. The case studies and analytical volumes are published as open, citable living editions, revised as the record moves. He works from Williamsburg and Christiansburg, Virginia.

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