Commonwealth of Virginia

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

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David L. Bulova
Secretary of Natural and Historic Resources

Michael S. Rolband, PE, PWD, PWS Emeritus
Director

EASTERN VIRGINIA GROUNDWATER MANAGEMENT ADVISORY COMMITTEE

Bank of America Building – 3rd Floor Multipurpose Meeting Room
1111 East Main Street, Richmond, VA 23219

April 8, 2026
10:00 am

MEETING MINUTES

Committee Members Present	
John Aulbach – Aqua Virginia	Whitney Katchmark – Hampton Roads Planning District Commission
Cathy Binder – King George Service Authority	Robert Pickett – VA Association of Soil & Water Conservation Districts
Tom Dunlap – James River Association	Doug Powell – James City County Service Authority
Jason Early – Stantec	Jonathan Rak – Virginia Department of Environmental Quality
Dan Holloway – Hampton Roads Sanitation District (HRSD)	Paul Retel – City of Suffolk & Western Tidewater Water Authority
David Jurgens – City of Chesapeake Utilities	Andrea W. Wortzel – Mission H2O

Committee Members' Alternates or Designees Present	
Anthony Creech (Alternate for Dr. Karen Shelton) – Virginia Department of Health (VDH)	Ivy Ozmon (Alternate for Whitney Katchmark) – Hampton Roads Planning District Commission
Katelyn Jordan (Designee for Jake Tabor) – Virginia Farm Bureau Federation	Jenny Reitz (Alternate for Dan Holloway) – HRSD
Joe Hunt (Designee for Dana Adkins)-Chickahominy Tribe	Shannon Varner (Alternate for Andrea W. Wortzel) – Mission H2O

The following committee members were absent from the meeting: Mark Bennett – USGS; Ethan Betterton – Virginia Chamber of Commerce; Bob Carteris – City of Norfolk; Rita Chandler –

Accomack-Northampton Planning District Commission; Andrew Clark – Home Builders Association of Virgina; Mike Gerel – Chesapeake Bay Foundation; Joey Hiner – Southeast Rural Community Assistance Project, Inc. (SERCAP); Davids Jurgens – City of Chesapeake Utilities; Eric Lassalle – Smithfield Foods, Inc.; Dr. Kevin McGuire – VA Water Resources Center; John O'Dell - Virginia Well Drillers Association; and Robert Wayland Citizen-at-Large.

Technical Support Staff Present	
Brendan Brogan - DEQ	Caitlin Kelly – DEQ
Brandon Bull – DEQ	Preston Kirby - VDH
Todd Beach- DEQ	Kati McCall- DEQ
Robert Byles - DEQ	Andrew Noyes – DEQ
Brian Campbell – DEQ	James Peel - DEQ
Weedon Cloe – DEQ	Eric Seavey - DEQ
Justin Chen – DEQ	Sadeya Tashnia - DEQ
Allison Dorsey -DEQ	Dallin Walker-DEQ
Morgan Emanuel – DEQ	Jacob Whitlock-DEQ
Eden Harper-DEQ	Ben Wojcicki - DEQ
Sam Jasinski – DEQ	

Interested Parties	
Glenda Booth – Tauxemont Community Association	Alan Lemon -Aquaveo
Stephanie Collins – Troutman Pepper Locke	Kamryn Peffley – International Paper
Dan Hamilton – King George Service Authority	Chris Pomeroy – City of Suffolk & Wester Tidewater Water Authority
Lauren Hines-Acost – Bay Journal	Todd Wood - Aquaveo
Katelyn Jordan – Virginia Farm Bureau	

Meeting Notes

Welcome and Introductions:

Mr. Weedon Cloe, Manager of the DEQ Office of Water Supply, welcomed members to the third meeting of the Eastern Virginia Groundwater Management Advisory Committee (EVGMAC) for the state fiscal year (FY2026). He thanked everyone for attending and went over some housekeeping items, including location of facilities and emergency evacuation procedures. Mr. Cloe went over the planned meeting agenda outline. The committee then approved both the tentative agenda and the previous meeting's minutes as presented.

ACTION ITEM: DEQ staff will finalize the meeting minutes and post them as "Final" to Town Hall.

Updates to the work plan to consider effect of groundwater recharge and potential relationship to groundwater withdrawals:

Mr. Cloe introduced Mr. Jonathan Rak, DEQ Deputy Director, who gave an update on the workplan to consider effects of groundwater recharge and potential relationship to groundwater withdrawals. DEQ intended to convene the EVGMAC virtually earlier in the year to cover the Senate Joint Resolution No. 25- Groundwater Supply East of Interstate 95 Report and Recommendations (SJ25). DEQ prepared and submitted the report to the Secretary of Natural and Historic Resources in December 2025, however the change in administration has delayed the release of the full report. DEQ will be sharing a presentation focusing on the technical analysis in the report, however the report will not contain any recommendations as these have not yet been finalized. Mission H2O has submitted comments and ideas to DEQ that will be incorporated into the workplan, and any comments or ideas from other committee members are welcome.

2024-2025 Annual Simulation of Reported Use and Total Permitted Use; Virginia Coastal Plain and Eastern Shore

Mr. Cloe introduced Mr. Todd Wood, an engineer with Aquaveo. Aquaveo is a consulting firm that conducts groundwater modeling and technical evaluations to support groundwater withdrawal permitting on behalf of DEQ.

Mr. Wood gave an outline of what his presentation would cover; general information regarding what the models are and how they are used, reported use vs. total permitted use, critical cells, and the results of the annual updates. The results are broken into four categories, reported use and total use for the coastal plain, and reported use and total permitted use from the eastern shore. The presentation provided by Mr. Wood is included as Attachment 1 to these minutes.

Mr. Wood began by showing a map displaying the area that the models cover. The coastal plain model covers 771,840 cells, with each cell being 1 sq mile. The Eastern Shore model covers 1,736,040 cells, with each cell being 1,000 ft. Both models are developed by the USGS to simulate groundwater levels and predict changes based on different potential scenarios. Mr. Wood then shared a chart showing a timeline of updates and recalibrations to the model over the years. Next Mr. Wood explained that a critical cell is a model cell where the computed water level is below the critical surface. Critical surface is defined as 80% from the ground surface down to the top of the aquifer. A red critical cell occurs when the water level drops below the top of the aquifer.

Mr. Wood shared how much water was withdrawn from the Coastal Plain in 2024, based on the reported use model. Mr. Wood shared a graph showing the long-term trends tracking withdraws from the aquifer by Maryland, North Carolina, and Virginia. The majority of the withdrawals have come from Virginia. Looking at a more recent sample size shows that over the last three years water use has steadily declined. Mr. Wood then shared a graph comparing the top users (WestRock and International Paper), with the remaining groundwater initiative facilities. Overall water withdrawals have stabilized with a slight downward trend over the last few years. Total reported use was then broken down by aquifer, with the Potomac aquifer accounting for approximately 88% of total withdrawals. Overall, the relative trends are similar, with the relative use dropping over the last year.

A committee member asked how private, nonpermitted withdrawals are considered in the numbers. Mr. Wood explained that anything that was included in the model is reflected in the numbersas Aquaveo has changed its workflow over the last few years. Previously they checked all nonpermitted wells, however they now focus on what is in DEQ's system. If wells had been put in the model previously, that data will be updated, however.

Mr. Wood then shared a color-coded map breaking down usage by county into average reported use from 2020-2024 and use allocated to the model. A committee member asked if the model includes an estimate of domestic use. The model does include domestic use, however that has not been updated recently. The model shows all users within an area. That includes permitted, as well as reported non-permitted agriculture.

Mr. Wood showed a map showing the simulated potentiometric water levels of the Potomac aquifer and the critical cells that exist in the latest reported use model, including which critical cells have also dropped below the top of the aquifer. Mr. Wood then moved to a map showing the 2024 reported use values versus the 2023 reported use for the Potomac aquifer, which showed facilities are overall using less water in 2024. A map for the same data for the Piney Point aquifer showed one area in the northern area of the aquifer that increased water withdrawals.

Mr. Wood then moved to discussing how much is permitted to be withdrawn from the coastal plain in 2025. He shared a graph breaking down the total permitted use across 2015, 2024 and 2025 by different withdrawal sources, including Virginia Coastal Plain Groundwater Initiative (VACPGWI), permitted and non-permitted within Groundwater Management Areas, and reported use from Maryland and North Carolina. VACPGWI Average Withdrawal increased from 2024 to 2025. He then moved on to a chart displaying total permitted use broken down use broken down use for each city/county in the 5-year average reported use, the 2025 total permitted us, and what percentage of the total permitted use was reported as being used. Changes made by the Groundwater Initiative have led to rising water levels. The number of critical cells, both normal and critical cells below the top of the aquifer, have decreased significantly from 2015 to 2025. However, from 2024 to 2025 the number of critical cells has increased.

One committee member asked a question regarding the appearance of critical cells in the King George area. In 2015, there were no critical cells, however in 2025 critical cells had appeared. The answer is that the Groundwater Management Area was expanded in 2014. Many of the facilities in that area were not permitted yet in 2015. Another committee member asked what caused the appearance of critical cells below the top of the aquifer. Mr. Wood explained that this was due to a change in the way that tiered withdrawals had been simulated, which had been updated to be more realistic. A committee member then asked how the model is validated, and how far out can they be predicted. Aquaveo spent a year calibrating the model, and each time they do an analysis they pull USGS water levels and make sure that the value at the wells reasonably match what the model is simulating. It is hard to know how far ahead the model can be predicted. A report can be found on DEQ's website detailing recalibrations done to the modeling in 2019. https://www.deq.virginia.gov/home/showpublisheddocument/27220/638701940153300000

Mr. Wood then moved to covering the Virginia Beach aquifer, and again shared maps comparing the 2015 Total Permitted Simulation and the 2025 Total Permitted Simulation. The changes in this aquifer have been less drastic. This is due to the fact that the Virginia Beach aquifer does not see as much usage. There are critical cells in the aquifer, and while the number of cells have decreased from 2015 to 2025, there was very little change from 2024 to 2025. Mr. Wood shared the same data set for the Aquia aquifer. The aquifer has seen a significant decrease in critical cells from 2015 to 2025, however there was not a significant decrease from 2024 to 2025. The Piney Point aquifer showed similar trends, with a significant decrease from 2015 to 2025, but a much less pronounced decrease from 2024 to 2025. There were no critical cells in the Yorktown aquifer in 2024 reported use or 2025 total permitted use.

Lastly, Mr. Wood shared maps showing the changes to water levels in the different aquifers. The Potomac aquifer water levels in the Total Permitted simulations have gone down over the last few years. Mr. Wood stressed that this represents the absolute worst-case scenario, where every facility permitted to pump is pumping to the absolute limit of what is allowed. It does not represent the actual water levels in the aquifer. The Aquia aquifer and Piney Point aquifer both also show decreases overall, however there was a small pocket in the Piney Point aquifer where water levels increased, while in other pockets it decreased, leading to an overall decrease.

Mr. Wood paused for questions. One committee member asked if and how data centers have been factored into the predictive models. Data centers would be included in the model up to what they are permitted for. Another committee member clarified that predictive models are based on what is currently permitted, not on what permits might be issued in the future. Another member mentioned that a large number of critical cells are located in the center of the coastal plain, and that there is another grouping right along the fault line and if DEQ has different strategies for managing permits in the two areas. Strategies will be based on where critical cells are located and the availability in the area.

A committee member asked for clarification on changes to the tier system in the model. The change was made to reflect what is actually contained in permits with regard to tiered reductions in withdrawals for the top 14 permitted withdrawals. Previous iterations of the model anticipated reductions in withdrawals extending beyond the permit terms, but that are not included in permits. The permitted withdrawal model scenario now reflects actual permit conditions and requirements with regard to tiered reductions in withdrawals. .

Another committee member asked if Maryland and North Carolina are doing any kind of Groundwater Initiative programs to help regional groundwater management. DEQ is working to ensure realistic boundary conditions for the Virginia Coastal Plain GW flow model, and plans to include this in the larger discussion with USGS and Aquaveo about model maintenance in the short to medium term.

Mr. Wood then shifted his presentation to focusing on how much was withdrawn from the Eastern Shore. Mr. Wood shared a graph showing the trends in Reported Use in the Eastern Shore. The majority of the withdrawals come from Virginia, however there are some coming from Maryland as well. Reported use has been relatively consistent since 2022. Over the last 10 years there was a steady increase until 2022, at which time usage stabilized. Mr. Wood then shared a graph breaking down the Eastern Shore Reported Use broken down by aquifer. Unlike the Coastal Plain model, there is no single aquifer that dominates usage.

The next slides Mr. Wood shared showed the 2024 Reported Use simulation for the water levels in the different aquifers, as well as a map showing the difference in water levels from 2023 to 2024.

Lastly, Mr. Wood discussed how much is permitted to be withdrawn from the Eastern Shore in 2025. Mr. Wood began by sharing a table comparing the 2024 Total Permitted to the 2025 Total Permitted, with there being a slight increase in the overall total amount from 2024 to 2025. Next Mr. Wood shared what percentage of the 2025 overall Total Permitted amount had actually been reported in 2024. Overall, approximately 63.9% of the Total Permitted amount was reported. Mr. Wood shared the 2025 Total Permitted simulated water-level results in Accomack and Northampton Counties. There were no critical cells in either the 2024 Reported Use or the 2025 Total Permitted simulations. Mr. Wood shared plots for the Upper, Middle and Lower Yorktown-Eastover 2025 minus 2024 Total Permitted water levels.

Mr. Wood finished his presentation with maps showing the 2025 Total Permitted simulation's chloride concentrations and the chloride concentrations in the Total Permitted simulation versus the Reported Use simulation. This is something that Aquaveo looks at in the Eastern Shore only, as chloride is more heavily concentrated in seawater.

Mr. Wood then took questions from the committee. One committee member asked if the model has changed to reflect injections. DEQ staff explained that no, the model does not reflect injections as there was further study needed. Another committee member asked if critical cells along the fault line are checked to see if they would be critical cells even without withdrawals. Analysis was done in 2022 to determine which cells would still be critical, even with zero pumping, and those cells were excluded from the model, so those cells would not affect permits. A committee member asked what assumptions are baked into the model to recognize that there are "unknown unknowns." Aquaveo uses as much available data as possible and are constantly updating and reviewing the models to ensure as much accuracy as possible.

ACTION ITEM: The department will post the Presentation on the DEQ Website.

Senate Joint Resolution No. 25 – Groundwater Supply East of Interstate 95 Report.

Mr. Cloe introduced Mr. Brian Campbell, Groundwater Characterization and Monitoring Manager with DEQ, who presented on Senate Joint Resolution No. 25. Mr. Campbell began by acknowledging the many different individuals who worked on the report, including staff from DEQ Water Resources Division, DEQ's Policy Division, staff from the U.S. Geological Survey (USGS), and staff at Aquaveo, LLC. He then gave an outline of what his presentation would cover.

Mr. Campbell gave an overview of the Virginia Coastal Plain aquifer system and groundwater supply. He shared a map outlining the Eastern Virginia Groundwater Management Area (GWMA), the Eastern Shore GWMA, the Chesapeake Bay Impact Crater, and the two model domains. Mr. Campbell then covered the groundwater withdrawals in the Eastern Virginia GWMA by source aquifer and by use. Overall, a total of 96.3 million gallons a day are withdrawn. The Potomac aquifer is the largest and deepest, accounting for approximately 70% of total withdrawals. The main uses of the aquifer are; industrial (35%), private domestic (35% and growing) and public water supply (27%).

Mr. Campbell paused for questions from committee members. One committee member asked for clarification on what qualifies as "private domestic." Mr. Campbell explained that it refers to any household wells. The withdrawals from these wells are not reported to DEQ, as they are typically below the reporting threshold. DEQ gathers data about these wells from USGS estimates. A follow-up question was asked regarding if there was a distinction between residential drinking water and wells used for other domestic purposes. DEQ does not have that depth of resolution, and that data is not tracked. Further refinement is always possible, but this is the best estimate DEQ has at the moment. Another committee member asked when the USGS estimates were published. Mr. Campbell stated that they were published last year, and however he noted that the current model uses data from a previous estimate, and that the newest data has not yet been incorporated into the model. However, the number of withdrawals has not changed drastically. A separate committee member asked for clarification of what constitutes a public water supply. DEQ staff explained that it the use of the water that determines the classification of the data. Another member asked if the model simulates domestic withdrawals at different rates by county. DEQ explained that it is estimated on a county-by-county basis. A committee member asked about the difference in MGD withdrawals between the preceding presentation and Mr. Campbell's. Mr. Campbell explained that the difference was a result of a different time period being covered, and differences in the private domestic data. Another committee member asked how DEQ determines where private domestic withdrawal is coming from. Mr. Campbell explained that it relies on USGS estimates based on population census data. The USGS method takes VDH data and data from DEQ that documents the location and depth of private wells and cross-references those against the groundwater flow model for aquifer information.

Mr. Campbell moved on to discussing the historical context for the Eastern Virginia GWMA. He began by sharing a map showing the historic groundwater level declines from pre-development through the early 2000s in the Potomac aquifer. Major industrial withdrawals led to groundwater levels declining below sea level, altering flow patterns to flow inward and downward, and increased the potential for land subsidence and regional saltwater intrusion. Mr. Campbell focused on the area around Franklin, because the area tells the clearest story about what happened in the aquifer. In the 1940's the water levels of the Potomac aquifer rose seven (7) feet above the land surface. The Franklin Paper Mill began operations in 1938. The mill began reporting its withdrawals in 1982, with an average withdrawal of 30-35 MGD until 2010 when the mill closed.

A part of the mill reopened in 2012, with withdrawals of around 15 MGD, and has since continued in that range. Data from two wells near the mill show a decline of around seven (7) to eight (8) feet per year during the 1950s and 1960s. Had the decline continued at that rate, the water level would have reached the top of the Potomac aquifer by around 1990. However, the Groundwater Acts of 1973 and 1992 helped to stabilize water levels until the mill closed. Water levels rebounded significantly when the plant closed. Mr. Campbell noted that the closing of the mill was driven by economic concerns, not increased regulation.

Mr. Campbell then shared two maps comparing critical cells in the Virginia Coastal Plain and the Eastern Shore. One map showed 50-year simulations in 2015, prior to the negotiation of reductions in permitted withdrawals under the Virginia Coastal Plain Groundwater Initiative. The other map showed 50-year simulations in 2017 after the negotiated reductions. The maps show that there was not a large reduction in reported use critical cells, but there was in total permitted use critical cells.

Mr. Campbell then moved to discussing an analysis of observed groundwater-level data. He first shared a hydrograph showing USGS observation wells throughout Eastern Virginia. A review of the hydrographs showed that around the 2010 closure of Franklin Mill, well level decreases near the mill began to reverse. DEQ used these observation wells to map out locations to determine the travel time and distance of the rebound. A pressure front propagated through the middle zone of the Potomac aquifer at a rate of roughly 270,000 feet per year. This rate was compared to the USGS estimated bulk groundwater flow rates that had been calculated as up to 10 feet per year. This shows that the pressure signal travels faster than the actual water molecules in the aquifer. Mr. Campbell shared a graph showing a year-over-year trend in the water levels. After 2010, groundwater levels across the Potomac aquifer broadly rose and stabilized for about a decade. By around 2021, rising trends stalled and began to reverse. Levels throughout the Potomac aquifer are projected to resume declining in the next 5 to 10 years. DEQ has not determined the cause of this yet. As you move farther away from the mill the rebound takes longer to arrive and has less effect when it does.

Mr. Campbell discussed the implications of these observations for Managed Aquifer Recharge (MAR). Within the Potomac aquifer, pressure effects may travel tens of thousands of times faster than the typical flow of groundwater molecules. Injections into the aquifer may yield a regional increase in groundwater levels with only local migration of the injected water itself. However, regional groundwater-level gains may be sensitive to disruption and could prove transient if injections were suspended for any reason. This finding complicates the forecasting of groundwater levels that could result from MAR projects, such as the Sustainable Water Initiative for Tomorrow (SWIFT).

Mr. Campbell next highlighted the difference between hydraulic effects and the flow of actual water. He explained that hydraulic equilibrium provides a baseline idea of the pressure effects of a withdrawal. You start withdrawing water, and the normal expected reaction is hydraulic drawdown. However, if you start by injecting water before withdrawing it, you get water pushing into the aquifer system. That causes a local build-up of hydraulic pressure. At a later time, if you stop injecting you are left with a static plume. The local hydraulic pressure will decline as it diffuses. There is still a post-injection plume, but the hydraulic buildup will have returned to equilibrium. If the water that was injected is then withdrawn, you will see the same hydraulic effects as you would if no injection had taken place. This is the concern about the difference between hydraulic effects and the actual water: just because the water is injected does not mean the effects are durable.

Mr. Campbell then paused for questions. A member asked Mr. Campbell to expand on the importance of hydraulic pressure. Mr. Campbell explained that hydraulic pressure is what raises the water level. In a confined aquifer, if you drill a well down into the aquifer, the pressure will cause the water to rise into the well. Another member asked what the volume of the paper mill withdrawal was before it was reduced. Before the closure it was a withdrawal of about 30-35 MGD, and resumed at roughly 15 MGD. Another member asked if the hydraulic figures were based on the assumption of a single injection, which is correct. Mr. Campbell explained that the longer the injection goes, the longer the benefits will exist. Another member noted that it is possible that data from 1980 through 2005 from monitoring wells near a well that was both injected into and withdrawn from may exist, however DEQ staff have not reviewed it. Another member asked in the models reflect both pressure changes and water volume changes, and if so, do they propagate in a similar way. DEQ staff explained that it would track the volume and pressure changes, but travel times of particles would be separate.

Mr. Campbell turned to discussing model-based analyses. For the regional groundwater budget DEQ subdivided the aquifer system into eight (8) groundwater budget regions, modified from pre-existing drought evaluation regions. USGS used ZONEBUDGET software and DEQ/Aquaveo "reported use" simulations to compute a comprehensive groundwater budget (inflows and outflows) for each region over the modeled historical period 1890-2023 and future period 2024-2073, with a focus on 2000 (after the 1992 Groundwater Management Act but before the closure of the Franklin Mill) and 2023 (representing the current day). The result was that in confined VCP aquifer system, groundwater generally flows inward from perimeter regions and downward from overlying hydrogeologic units to Potomac aquifer.

Mr. Campbell shared a diagram displaying the model storage rates in the Potomac aquifer. The diagram compared the storage rates of seven (7) groundwater budget regions, with each region showing the values in 2000 and 2003. In almost every region, a decrease in 2000 changed to an increase in 2023. The only exception was the Northern Neck region, which showed a change from a larger decrease in 2000 to a smaller decrease in 2023.

Mr. Campbell explained that the model cannot account for "what-if" scenarios, things such as population growth or where industries will use groundwater in the future. To address this, DEQ staff conducted a model with a hypothetical withdrawal of 3 MGD at each of nine (9) different locations. None of the locations passed the criteria for permitting. The maximum-passing amount varied regionally, in Northumberland County it was 360,000 gallons a day, while in the western region of the state it was less than 30,000 gallons a day. Only the best-case scenario would support a large withdrawal.

Mr. Campbell paused for questions from committee members. One member asked if the increase in 2023 was solely attributable to the decrease from the Franklin Mill. Mr. Campbell explained that it was attributable to overall reductions, including the groundwater initiative. Mr. Campbell also noted that while there is an ongoing storage increase in the Potomac aquifer, a portion of that is occurring because of the induced downward flows from overlying aquifers, meaning that some of the benefit is coming at the expense of the overlying aquifer. Another member asked for clarification on the water levels in the Potomac aquifer. Mr. Campbell explained water levels were stable, with some areas of increase, but that every year the rate of increase is slowing. A committee member asked if any analysis had been done to see if any of the water levels were below the critical surface level. DEQ staff have not done that analysis. DEQ is working with USGS this year to produce new water level maps.

DEQ staff updated and expanded USGS report on Virginia Coastal Plain groundwater quality and compared the reports data set with more recent data from 2007 to 2024. This demonstrated that overall regional groundwater quality has been stable since 2007 and supported USGS's previous findings that groundwater quality has largely been stable since the early 20th century. The analysis also identified locally increasing chloride concentrations trends consistent with previous findings. DEQ staff analyzed data from every time period in the data set. The increasing concentration trends were found mainly in the Potomac and the Yorktown-Easteover aquifers, and mainly near known withdrawal sites. Groundwater withdrawals can induce a rise in salinity. DEQ is expanding its chloride monitoring network.

Mr. Campbell covered the key technical findings of the report. Major industrial withdrawals have caused inland groundwater levels to decline below sea level, inducing inward and downward flows. A sharp decrease in a major industrial withdrawal, plus special management efforts reduced the groundwater deficit to near zero in the overall Potomac aquifer, with some regional variation. Groundwater levels in the Potomac aquifer rose and broadly stabilized until about 2021, when rising trends stalled and began to reverse. MAR has the potential to increase regional groundwater levels; however, these gains could dissipate rapidly if injections were to cease. The Virginia Coastal Plain has limited capacity for new significant withdrawals, and chloride concentrations in the aquifer system have increased locally in parts of both Eastern Virginia and the Eastern Shore.

The Groundwater Management Act of 1992 and its implementation show that regulation has positive effects on groundwater supply, however these effects are currently insufficient for long-term sustainability. The final SJ 25 report will offer recommendations on how to improve the Act's effectiveness.

At the close of his presentation Mr. Campbell asked for any final questions. A committee member asked for clarification on the conclusion that industrial withdrawals had caused inland groundwaters levels to decline. Mr. Campbell explained that industrial withdrawals were an order of magnitude higher than all other withdrawals for the majority of the twentieth century. The member followed up by noting that beneficial impact of reducing the International Paper withdrawal, while it being instructive of the benefits of SWIFT, is different than actively injecting. Mr. Campbell again noted that the current model does not simulate injections, so DEQ does not know how the aquifer will behave under the new stress regime of injections. The rebound of the mill closure is the best analog, but without actual data to inform the models it is difficult to say what the effects will look like.

New Business – Updates and/or Topics of Interest from Committee Members: Mr. Cloe went around the room and asked if there were any questions, updates, or topics of interest from the Committee members.

- B. Cameron Webb, MD, JD, has been appointed as the State Health Commissioner by the new administration.
- VDH has compiled a private wells dashboard that provides permitting information on private wells that goes back to 2020. This dashboard is in final development to be released to the public at a future date.
- A committee member mentioned that Virginia Institute of Marine Science will be conducting modeling work over the next two years of surface water, and the impact on aquatic organisms and the salinity of the James River and the York River.
- A committee member recommended that the committee meet in person when working on the workplan.
- A committee member raised the possibility of having an additional meeting, or possibly a longer meeting to ensure the committee has enough time to address the different items in the workplan.
- A committee member mentioned that the presentation brings up complex concepts, including how short-lived hydraulic effects can be. Right now, the withdrawal permitting program is entirely based on a technical analysis. How will that be reconciled with the reality that there is going to be a new boundary condition that is larger than any individual withdrawal.
- Committee members noted that they are working on regional water supply plans, and having more insight into how injections are affecting trends would be helpful.
- DEQ staff noted that the groundwater flow model can be used to simulate injections as negative withdrawals, but that it is unknown how well the resulting predictions would fit the actual response of the aquifer system to future injections.

Next Committee Meeting:

The next committee meeting is currently planned for mid-June 2026. Committee members discussed having a longer meeting to allow members to focus on the workplan.

Public Input Forum

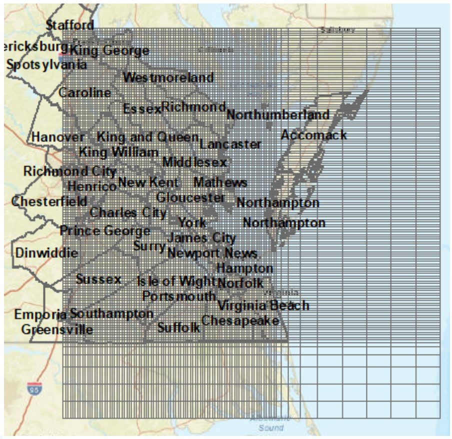
Mr. Cloe opened the floor for public input. No questions or comments were offered.

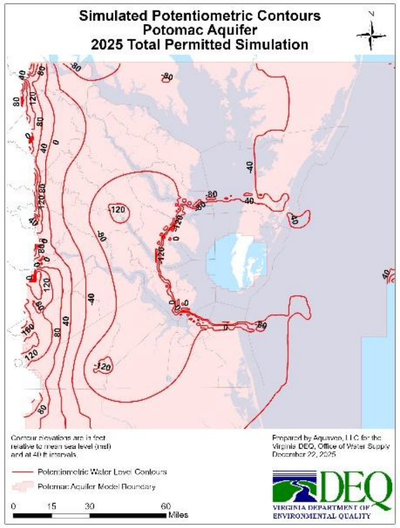
Adjournment:

Mr. Cloe noted that all relevant material from meetings, including the meeting agenda, would be posted on Townhall. Mr. Cloe thanked all the members of the committee, the interested public, and closed the meeting. The meeting was adjourned at approximately 12:39 p.m.

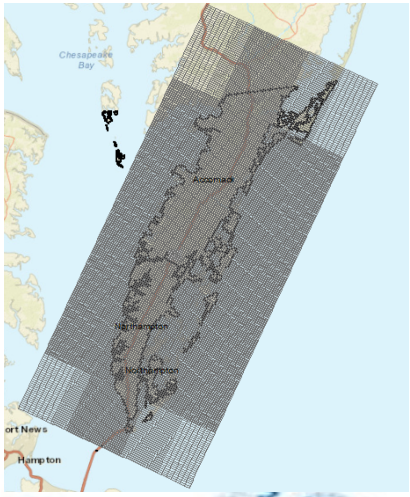
2024-2025 Annual Simulation of Reported Use and Total Permitted Groundwater Levels

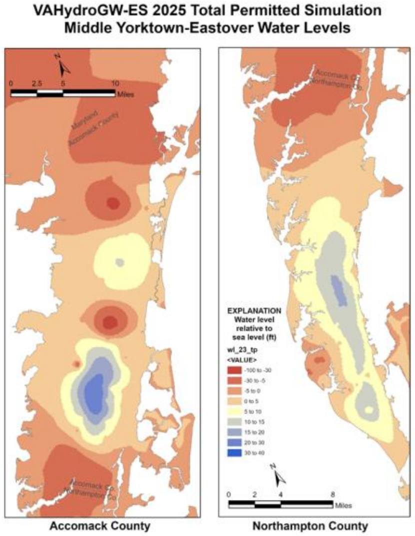
VAHydroGW-VCPM





VAHydroGW-ES





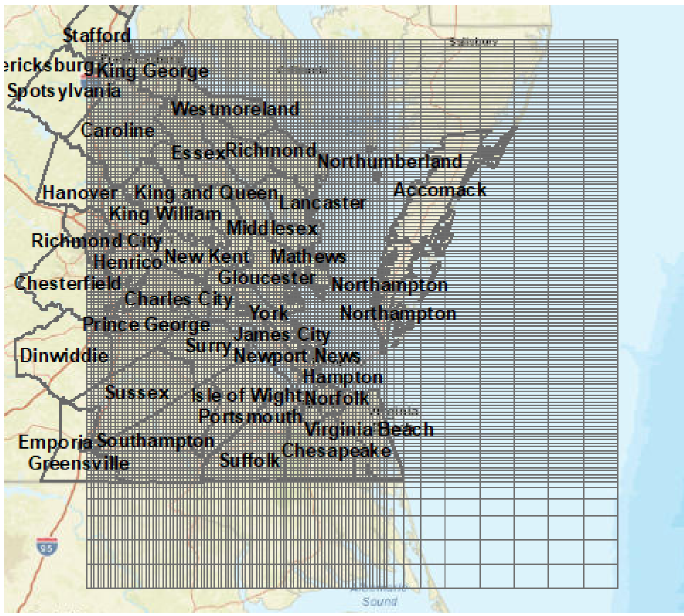
Outline

- General Information on Models
- Reported Use vs Total Permitted
- Critical Cell definition
- 2025 Results
  - Coastal Plain (VAHydroGW-VCPM)
    - 2024 Reported Use
    - 2025 Total Permitted
  - Eastern Shore (VAHydroGW-ES)
    - 2024 Reported Use
    - 2025 Total Permitted

AQUAVEO
Water Modeling Solutions

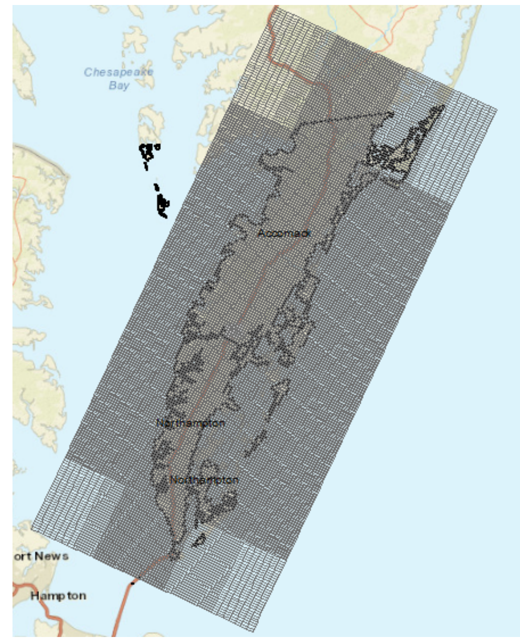
General Information on Models

- VAHydroGW-VCPM
  - Coastal Plain



  - 771,840 cells
  - Cells are 1 sq mi

- VAHydroGW-ES
  - Eastern Shore

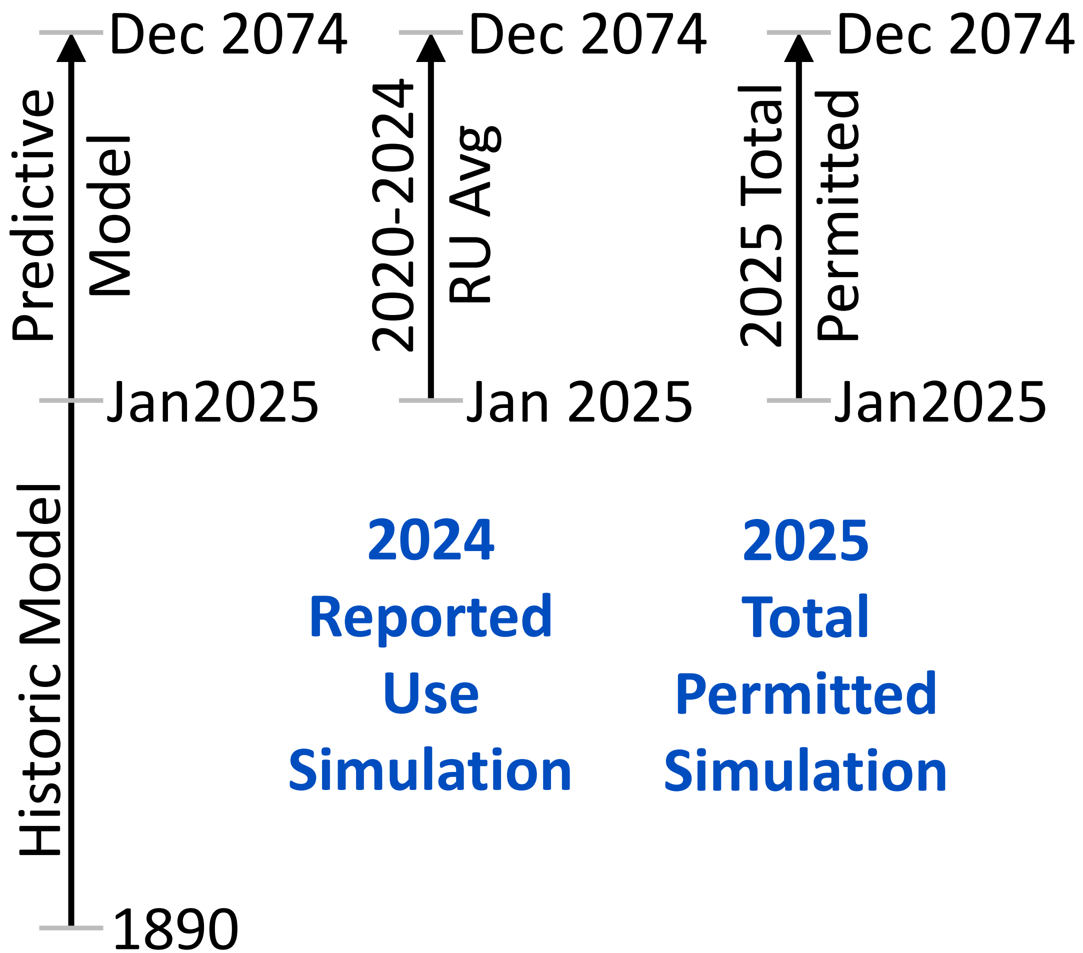


  - 1,736,040 cells
  - Cells are 1,000 ft

- Both developed by the USGS to simulate groundwater levels
  - Used to predict changes based on different scenarios

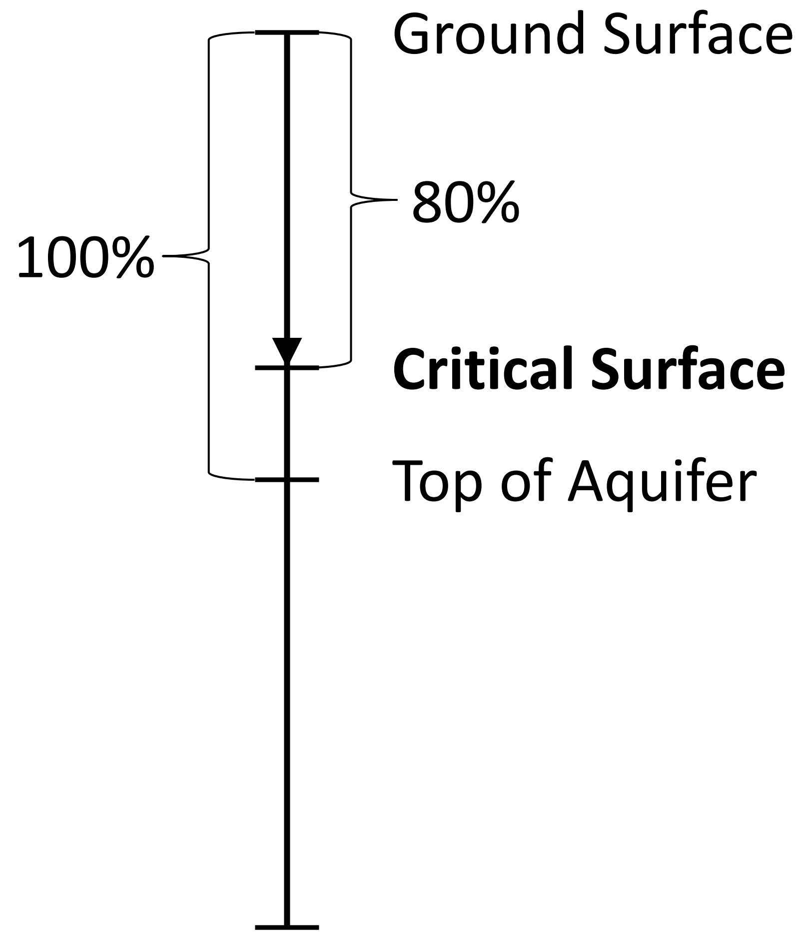
VCPM Groundwater Simulations

- VCPM Adaptation
  - 2013 Updated and adapted for DEQ use
    - 2003 -2012 data
    - RU and TP created
  - 2015-16 RU and TP updated
  - 2016 Addition of SUB package
  - 2016-17 RU and TP updated
  - 2017-18 RU and TP updated
  - 2018-19 RU and TP updated
  - **2019 Recalibration**
  - **2024-25 RU and TP updated**
  - ***2024-2025 Annual Report***



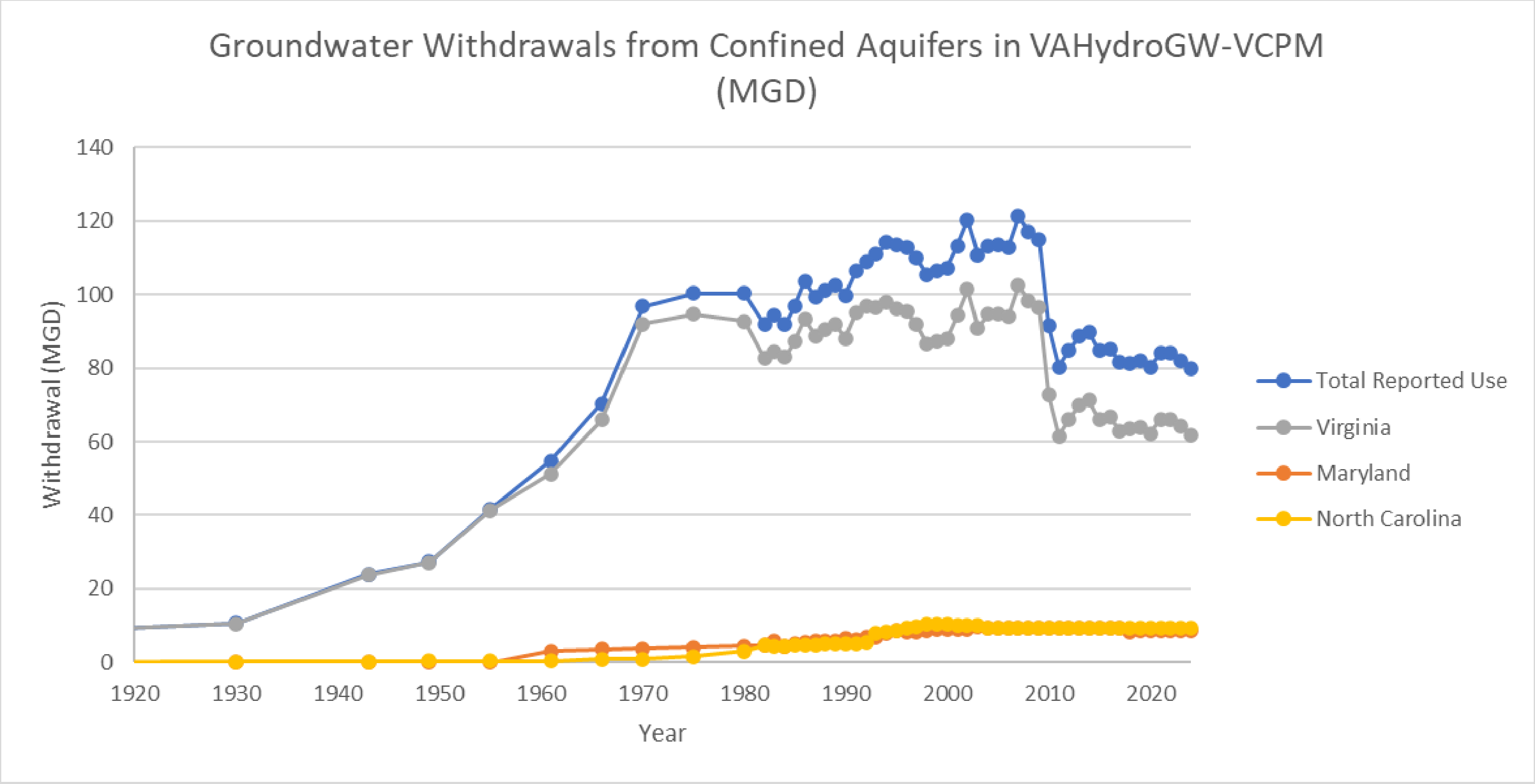
Critical Cell

- Critical Surface = 80% from the surface to the top of the aquifer
- **Critical cell is a model cell where the computed water level is below the critical surface**

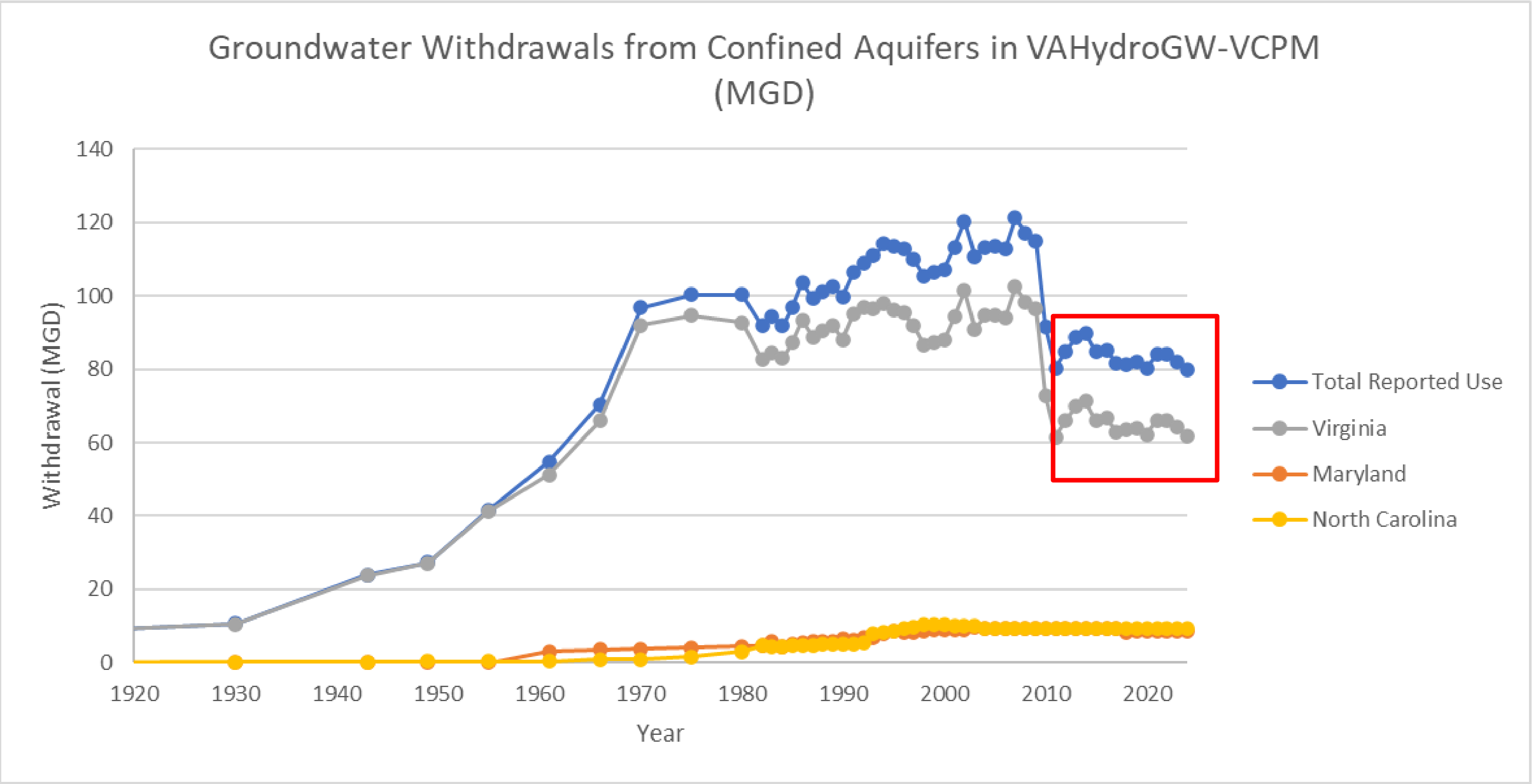


How much was withdrawn from the Coastal Plain in 2024?

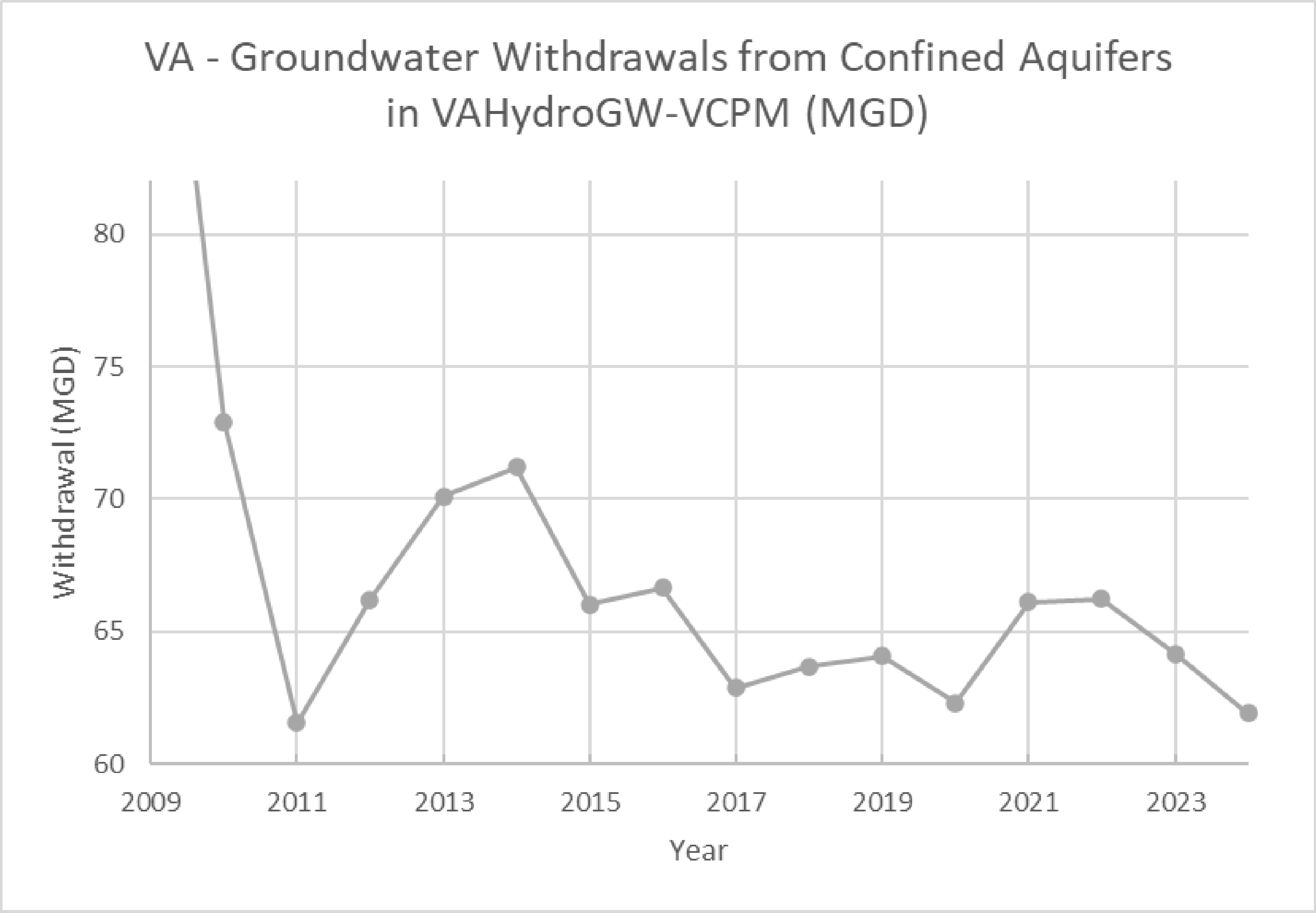
VCPM – Reported Use



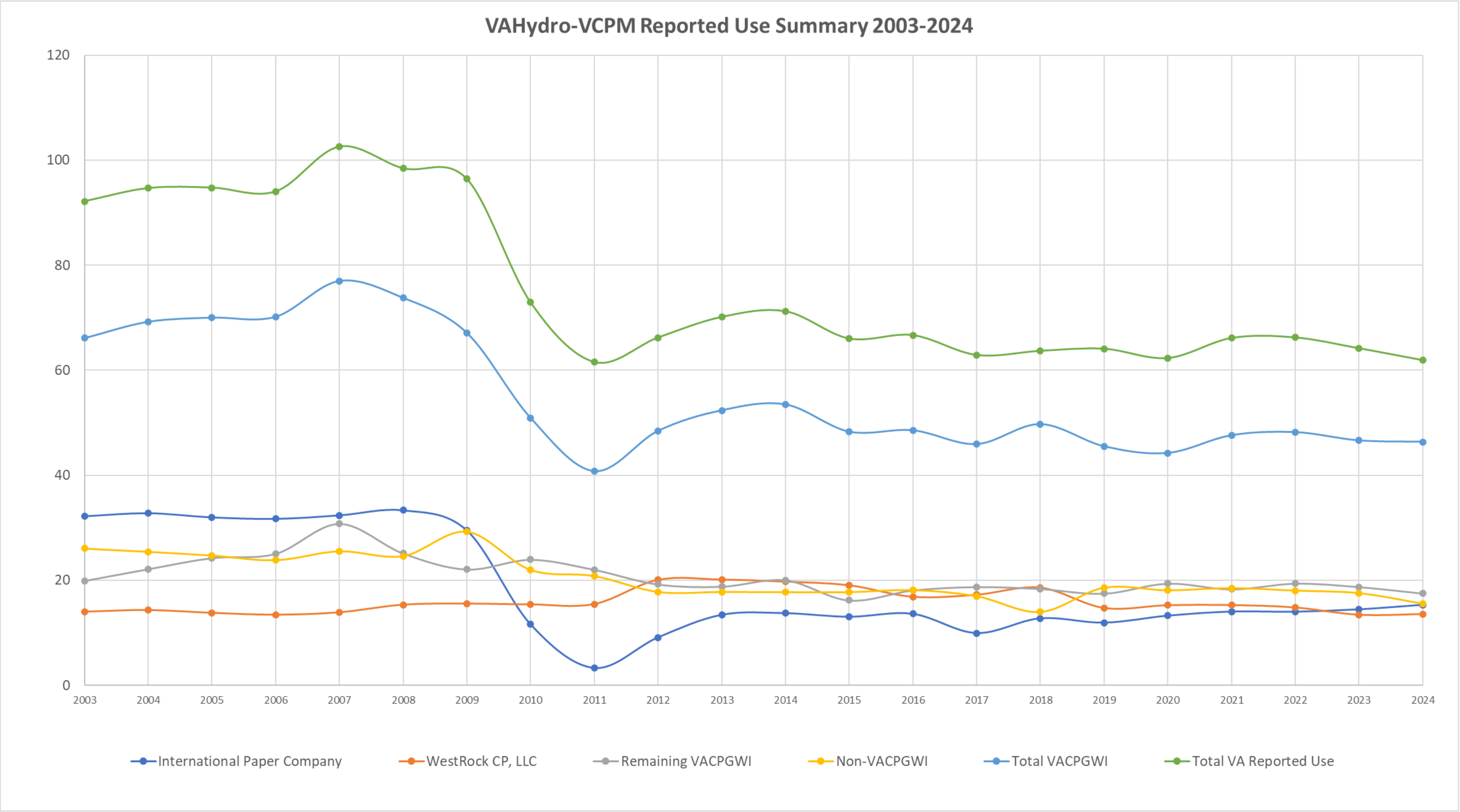
VCPM – Reported Use



VCPM – Reported Use

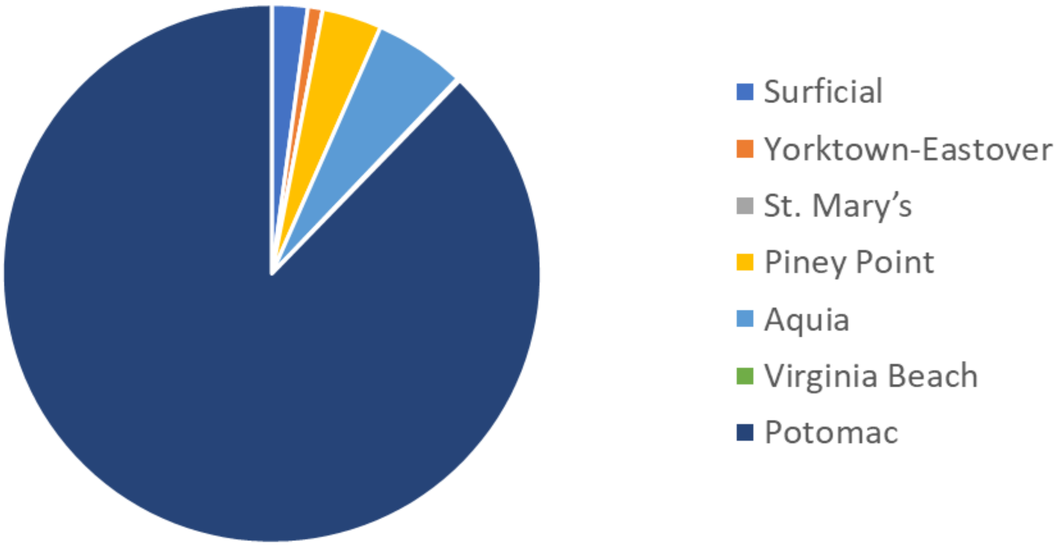


VCPM – Reported Use

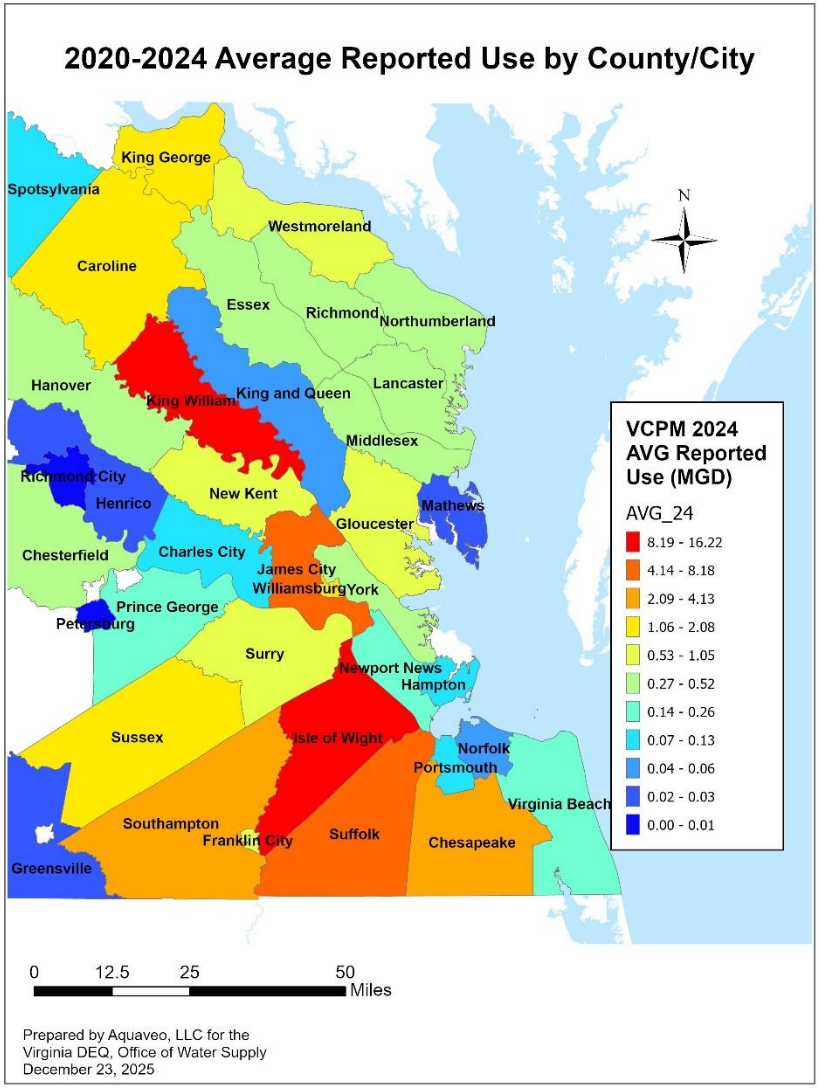


VCPM – Reported Use

Aquifer	2023 VA Reported Use (MGD)	2024 VA Reported Use (MGD)	2020-2024 VA Reported Use (MGD)	Use Allocated to Model (%)
Surficial	1.20	1.34	1.37	2.1%
Yorktown-Eastover	0.53	0.37	0.57	0.9%
St. Mary’s	0.00	0.00	0.00	0.0%
Piney Point	2.16	2.23	2.29	3.6%
Aquia	3.55	3.75	3.53	5.5%
Virginia Beach	0.07	0.07	0.10	0.2%
Potomac	56.28	53.74	56.15	87.7%
TOTAL	**63.80**	**61.51**	**64.01**	**100.0%**



VCPM – Reported Use



City/County	2020-2024 Average Reported Use Allocated to Model (MGD)	Use Allocated to Model (%)
Caroline	1.07	1.66%
Charles City	0.06	0.10%
Chesapeake	4.10	6.37%
Chesterfield	0.41	0.64%
Essex	0.45	0.70%
Franklin City	0.85	1.32%
Gloucester	0.62	0.96%
Greensville	0.01	0.02%
Hampton	0.11	0.17%
Hanover	0.45	0.70%
Henrico	0.01	0.02%
Isle of Wight	16.22	25.21%
James City	4.98	7.74%
King and Queen	0.03	0.05%
King George	1.29	2.00%
King William	16.14	25.08%
Lancaster	0.45	0.70%
Mathews	0.02	0.02%
Middlesex	0.30	0.46%
New Kent	1.04	1.62%
Newport News	0.19	0.30%
Norfolk	0.04	0.06%
Northumberland	0.33	0.51%
Petersburg	0.00	0.01%
Portsmouth	0.11	0.17%
Prince George	0.25	0.39%
Richmond	0.32	0.49%
Richmond City	0.00	0.00%
Southampton	3.11	4.83%
Spotsylvania	0.06	0.10%
Suffolk	7.16	11.12%
Surry	0.59	0.92%
Sussex	1.12	1.74%
Virginia Beach	0.14	0.22%
Westmoreland	0.90	1.40%
Williamsburg	1.05	1.63%
York	0.37	0.58%
TOTAL:	64.36	100.00%

VCPM – Reported Use

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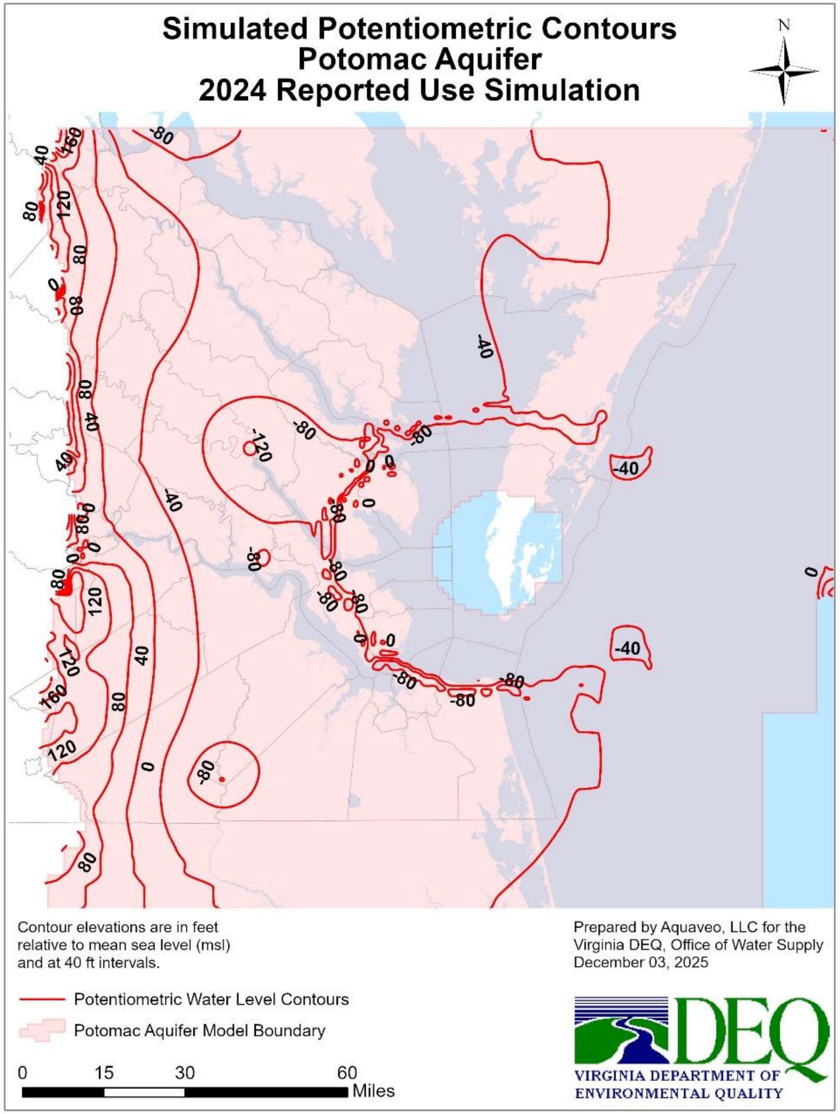
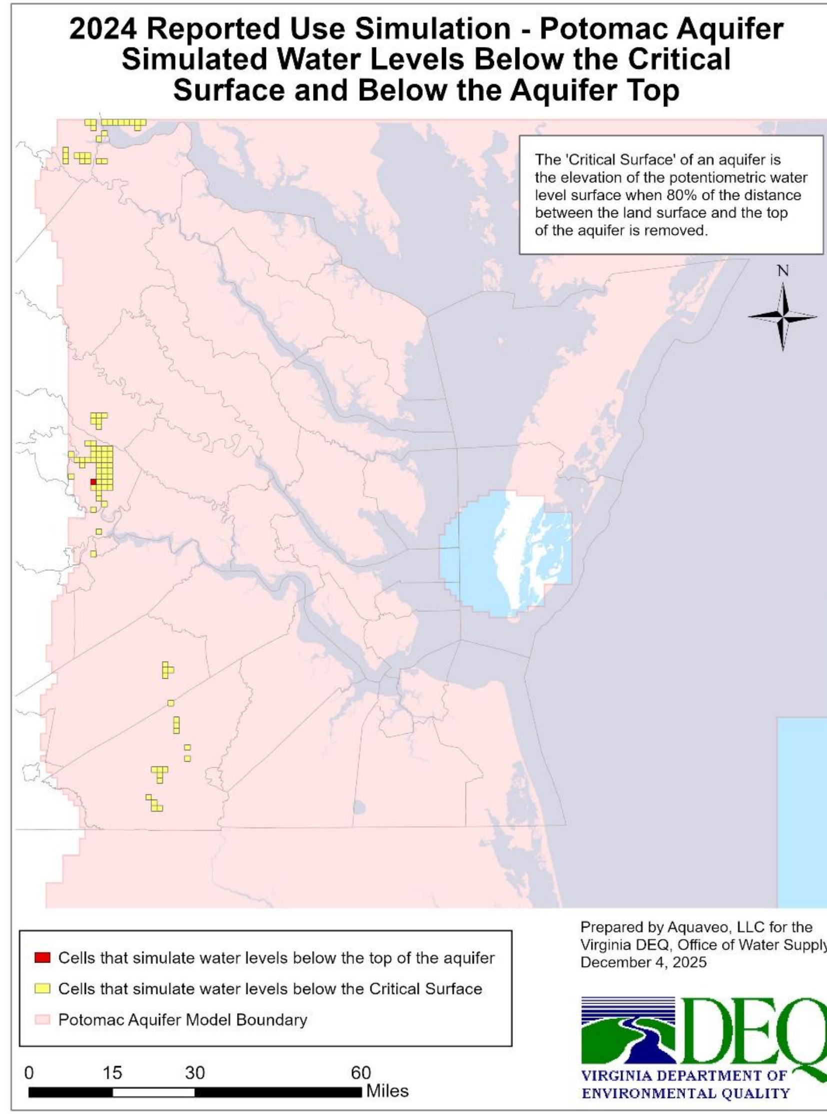
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY





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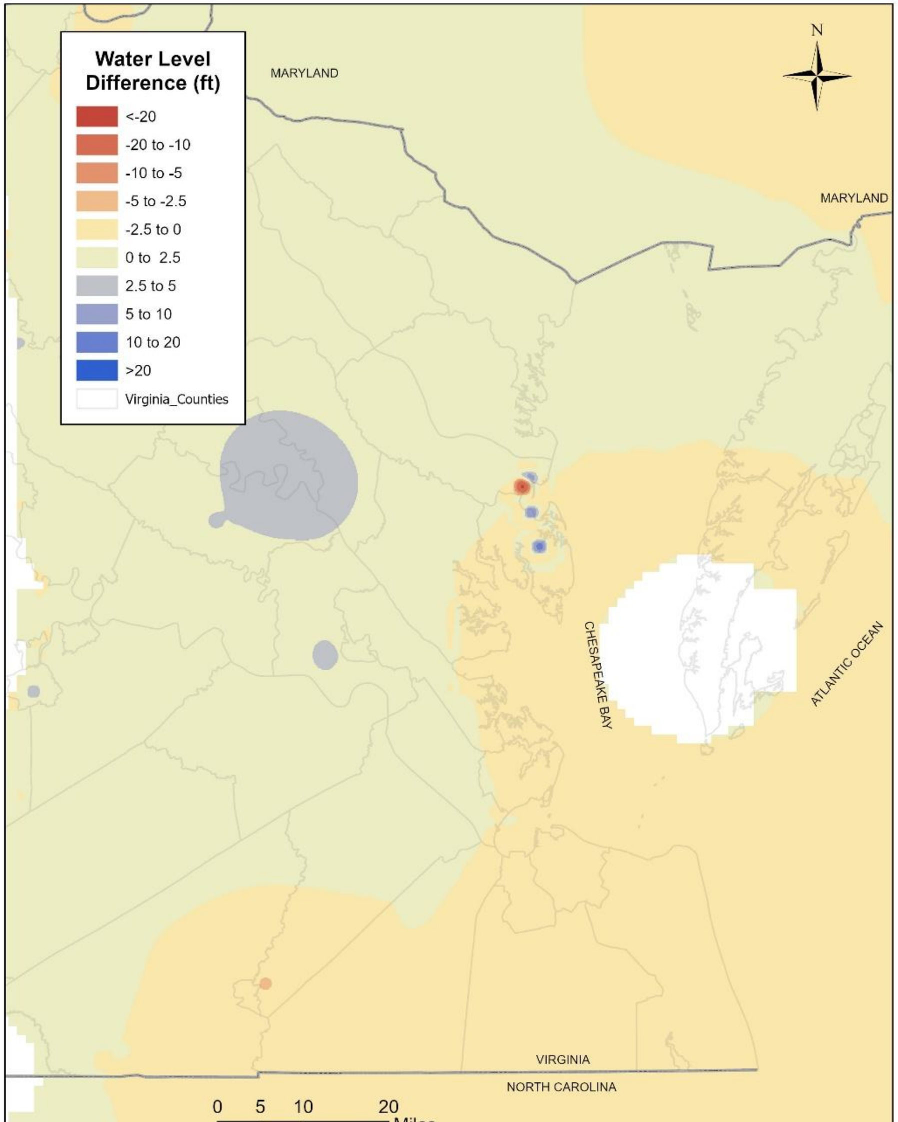
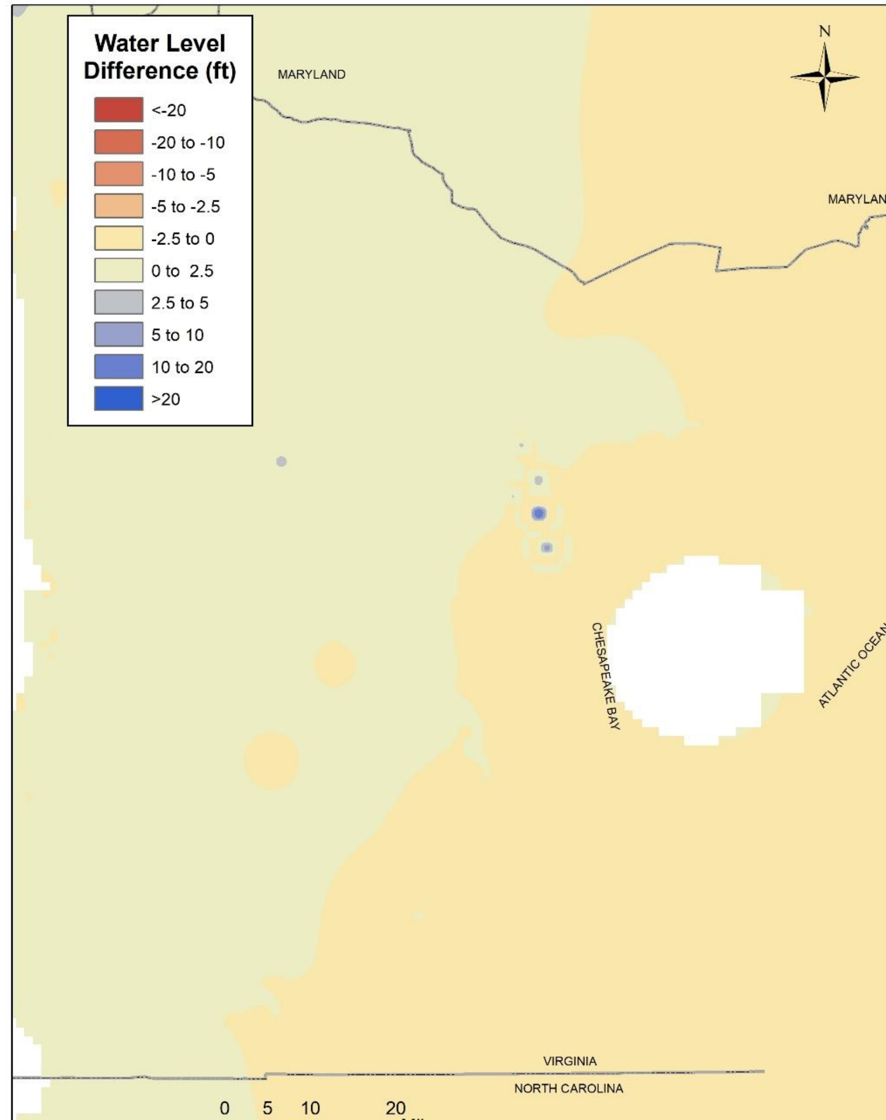
DEQ Virginia Department of Environmental Quality

RU Simulations – Potomac

2024 minus 2023

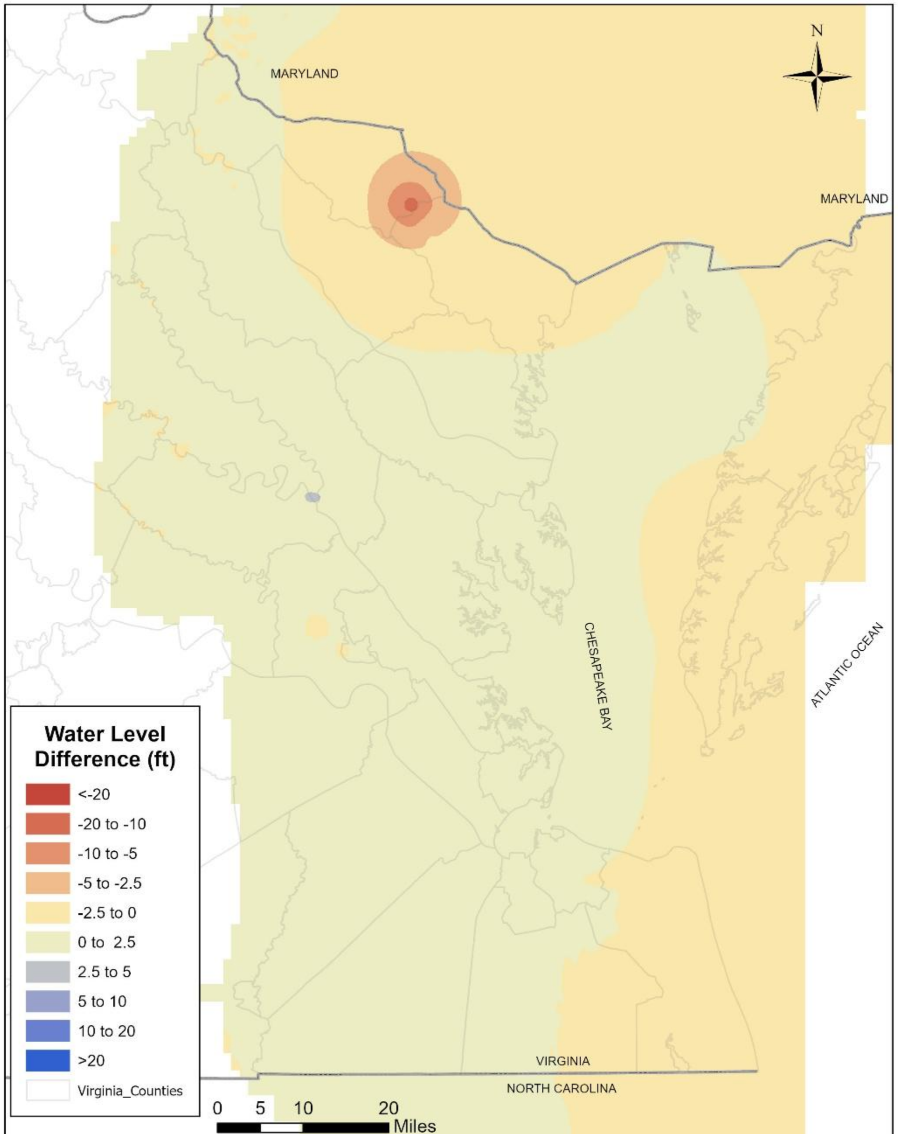


2023 minus 2022

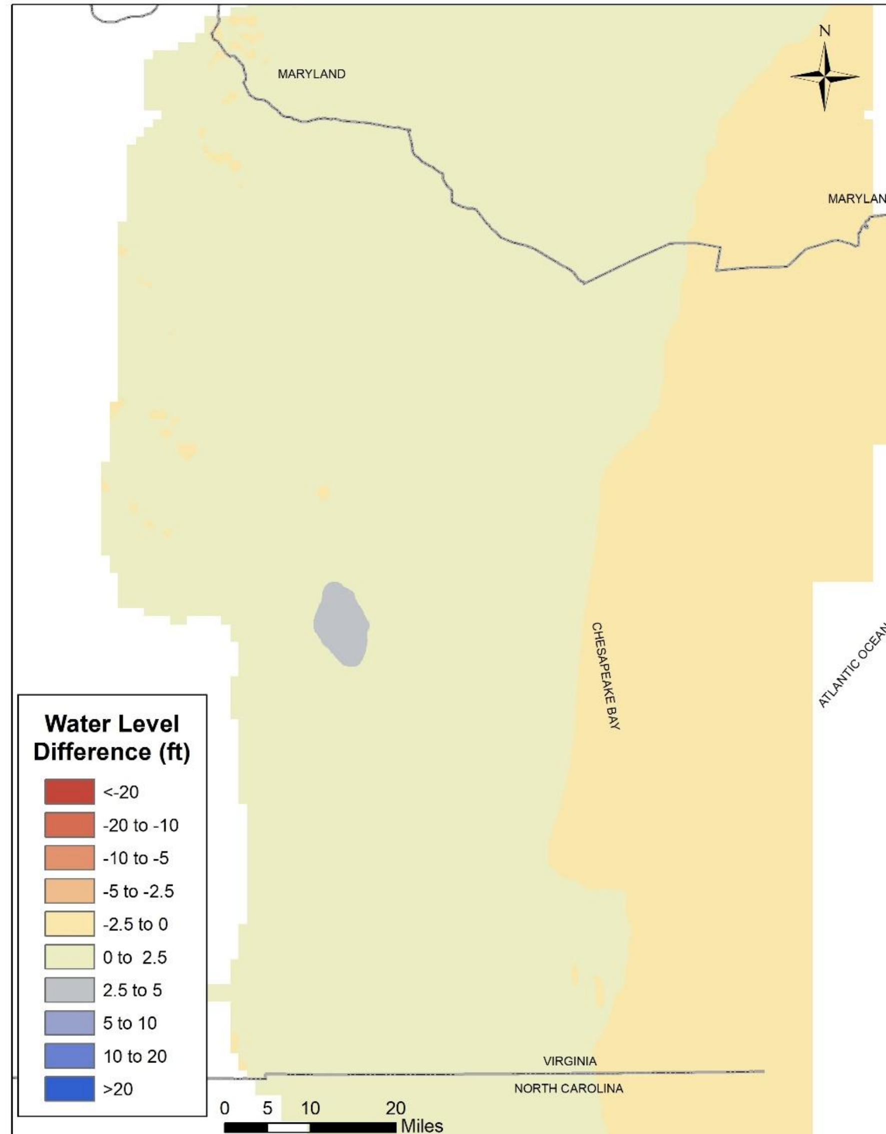


RU Simulations – Piney Point

2024 minus 2023



2023 minus 2022



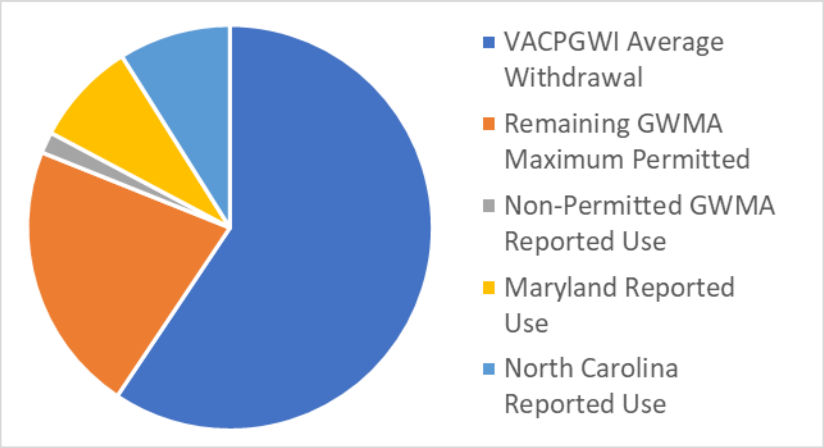
How much is **permitted** to be withdrawn from the Coastal Plain in 2025?

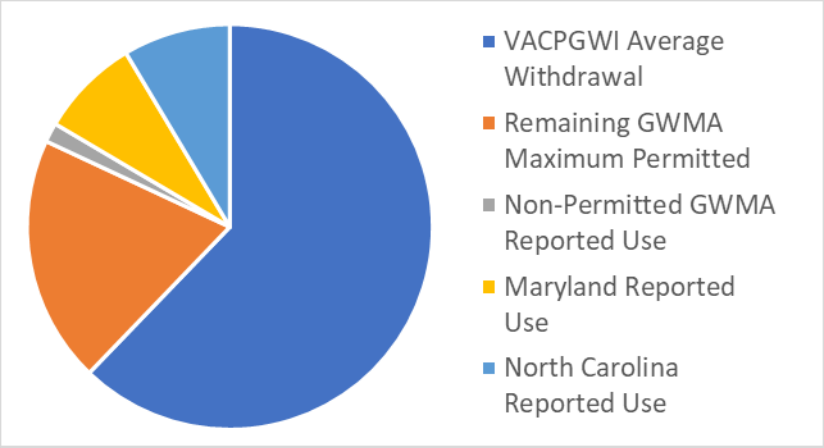
VCPM – Total Permitted

Withdrawal Source	2015 Total Permitted (MGD)	Use Allocated to Model (%)
VACPGWI Withdrawals	119.2	70.57%
Remaining GWMA Maximum Permitted	26.2	15.51%
Non-Permitted GWMA Reported Use	5.4	3.20%
Maryland Reported Use	8.8	5.21%
North Carolina Reported Use	9.3	5.51%
TOTAL	**168.9**	**100.00%**

Withdrawal Source	2024 Total Permitted (MGD)	Use Allocated to Model (%)
VACPGWI Average Withdrawal	61.8	59.39%
Remaining GWMA Maximum Permitted	22.5	21.67%
Non-Permitted GWMA Reported Use	1.8	1.69%
Maryland Reported Use	8.6	8.30%
North Carolina Reported Use	9.3	8.94%
TOTAL	**104.0**	**100.00%**

Withdrawal Source	2025 Total Permitted (MGD)	Use Allocated to Model (%)
VACPGWI Average Withdrawal	67.6	62.2%
Remaining GWMA Maximum Permitted	21.5	19.8%
Non-Permitted GWMA Reported Use	1.7	1.5%
Maryland Reported Use	8.6	7.9%
North Carolina Reported Use	9.3	8.6%
TOTAL	**108.6**	**100.0%**

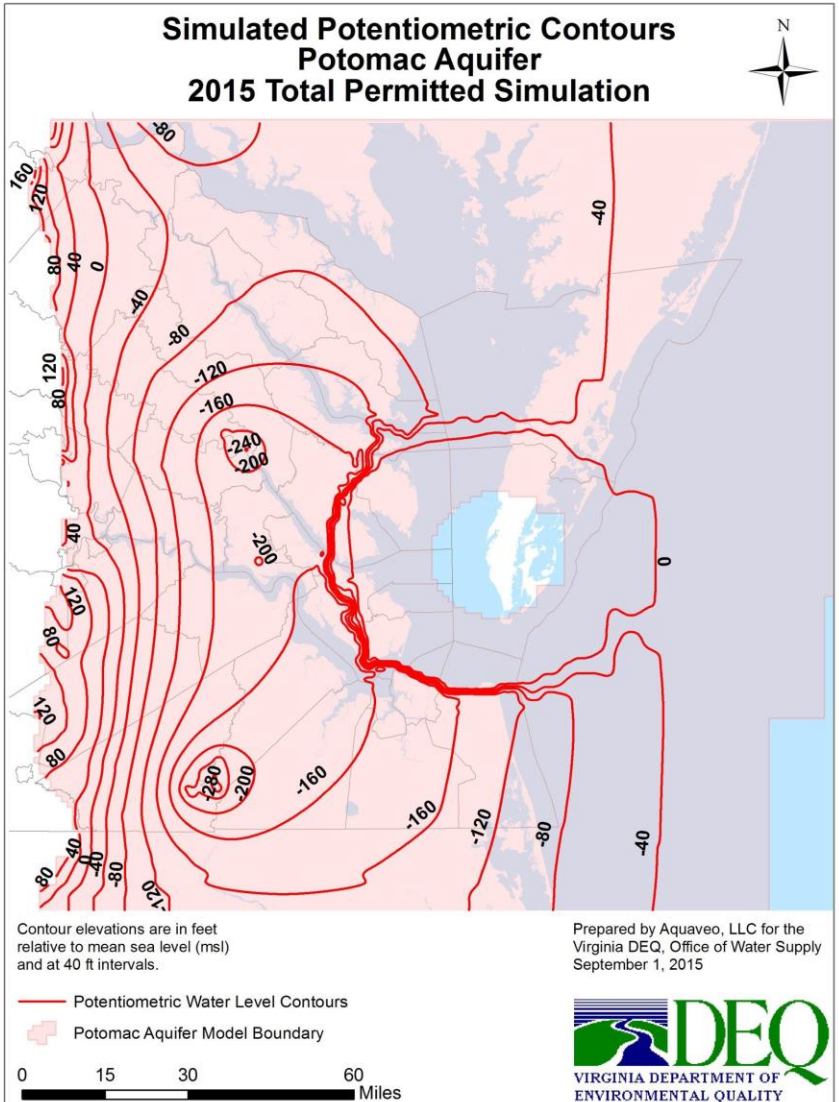


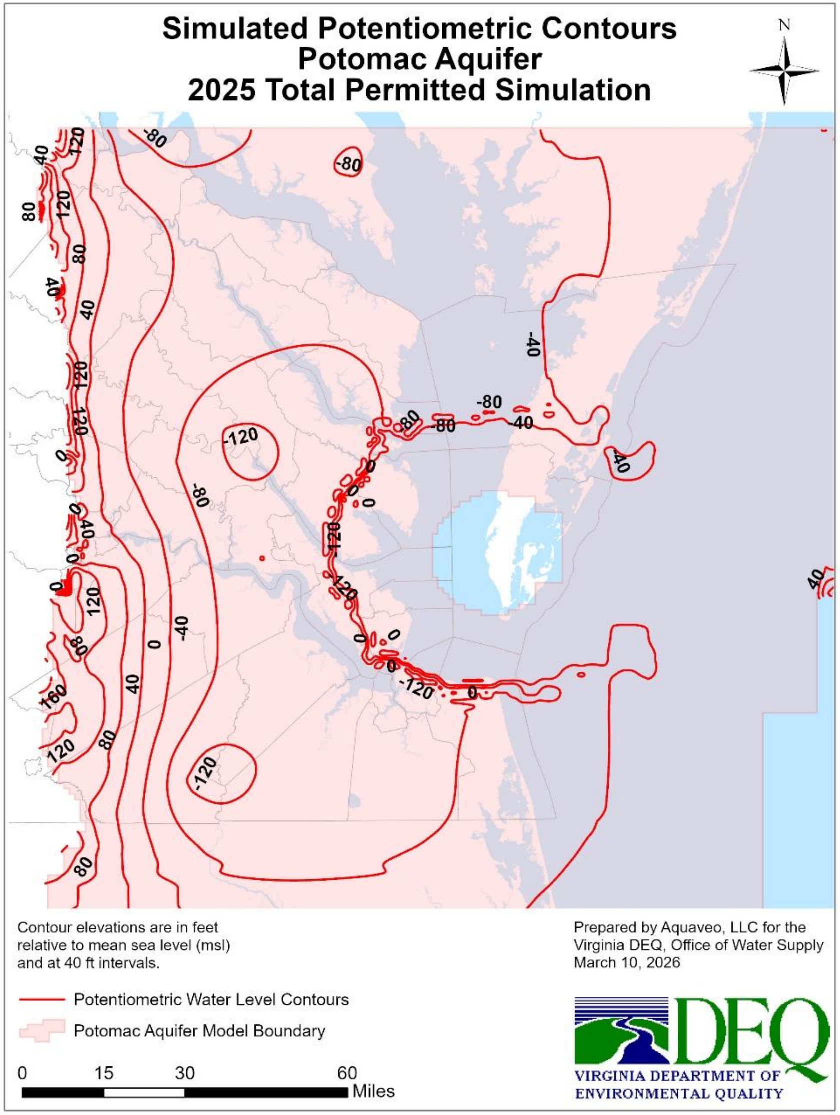


VCPM – Total Permitted

City/County	2020-2024 Average Reported Use (MGD)	2025 Total Permitted (MGD)	RU/TP
Caroline	1.07	1.47	72.5%
Charles City	0.06	0.17	36.5%
Chesapeake	4.10	6.31	65.0%
Chesterfield	0.41	0.55	74.6%
Essex	0.45	0.62	72.5%
Franklin City	0.85	1.60	53.1%
Gloucester	0.62	0.76	81.2%
Greensville	0.01	0.00	908.3%
Hampton	0.11	0.32	34.0%
Hanover	0.45	0.64	70.0%
Henrico	0.01	0.02	77.5%
Isle of Wight	16.22	19.02	85.3%
James City	4.98	8.75	56.9%
King and Queen	0.03	0.09	38.7%
King George	1.29	1.84	70.1%
King William	16.14	18.12	89.0%
Lancaster	0.45	0.58	77.1%
Mathews	0.02	0.02	63.4%
Middlesex	0.30	0.51	58.4%
New Kent	1.04	2.33	44.8%
Newport News	0.19	3.20	6.0%
Norfolk	0.04	2.58	1.5%
Northumberland	0.33	0.53	61.6%
Portsmouth	0.11	0.22	50.3%
Prince George	0.25	0.45	55.1%
Richmond City	0.00	0.00	N/A
Richmond	0.32	0.35	89.6%
Southampton	3.11	5.35	58.0%
Spotsylvania	0.06	0.02	314.3%
Suffolk	7.16	13.29	53.8%
Surry	0.59	0.86	68.9%
Sussex	1.12	2.07	54.2%
Virginia Beach	0.14	0.24	61.2%
Westmoreland	0.90	1.49	60.5%
Williamsburg	1.05	1.28	82.0%
York	0.37	0.62	60.0%
TOTAL	**64.35**	**96.3**	**66.8%**

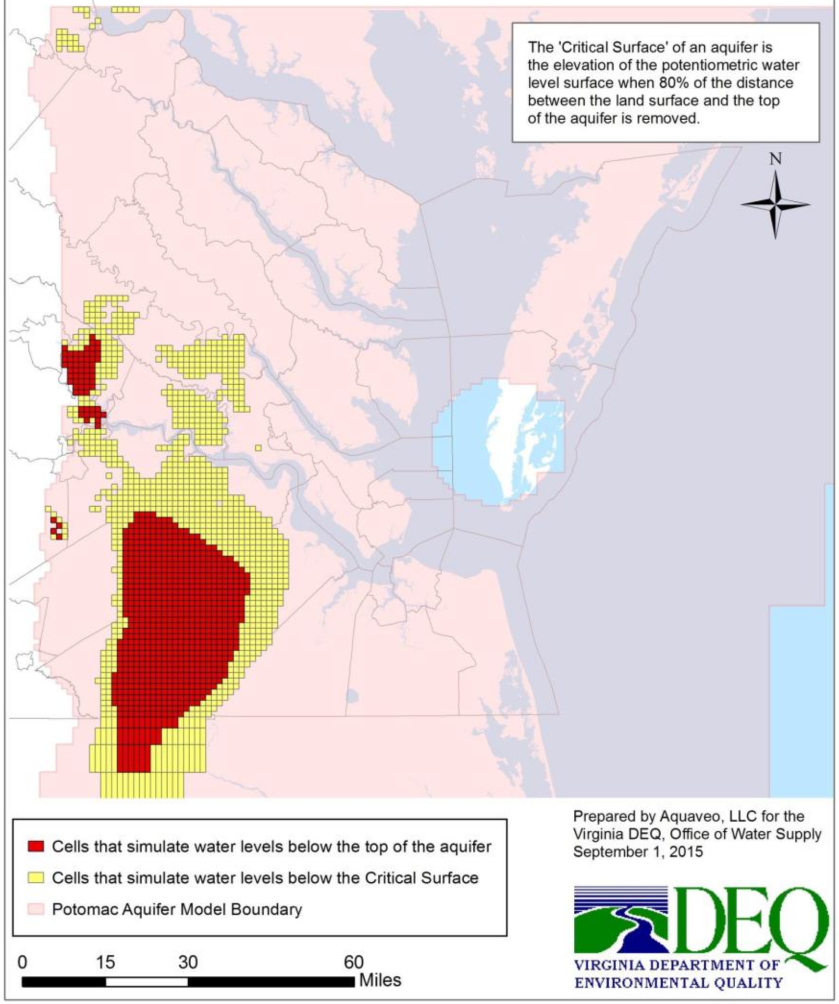
VCPM – Total Permitted





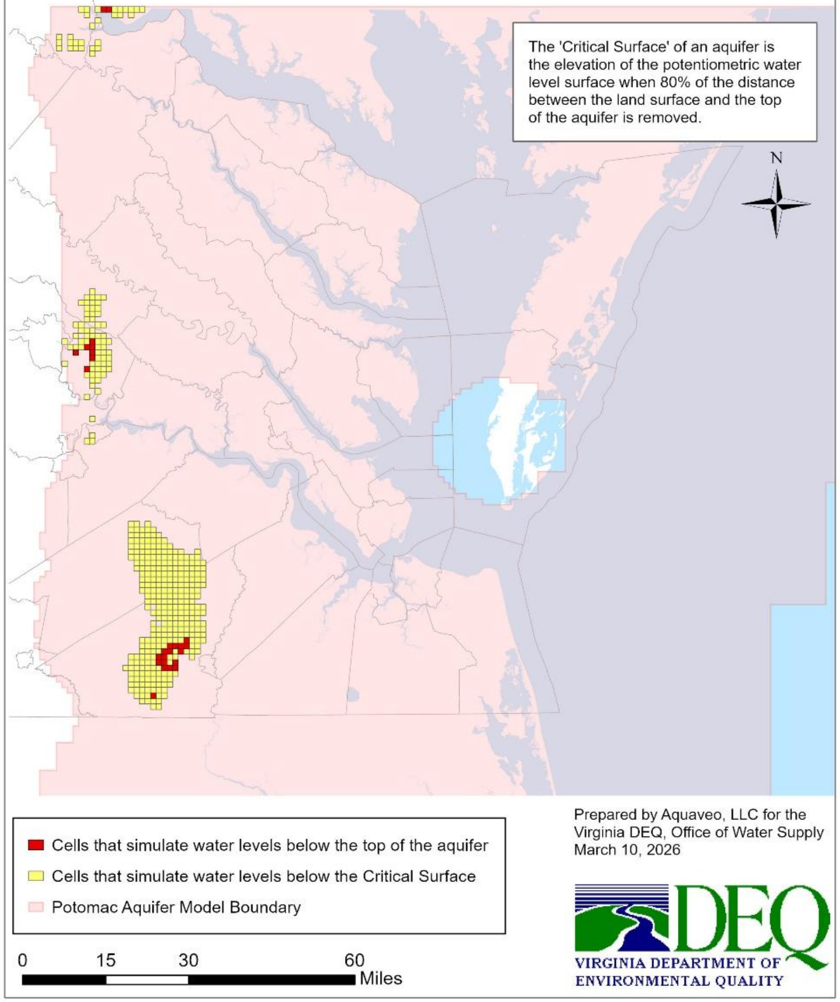
VCPM – Total Permitted

2015 Total Permitted Simulation - Potomac Aquifer Simulated Water Levels Below the Critical Surface and Below the Aquifer Top



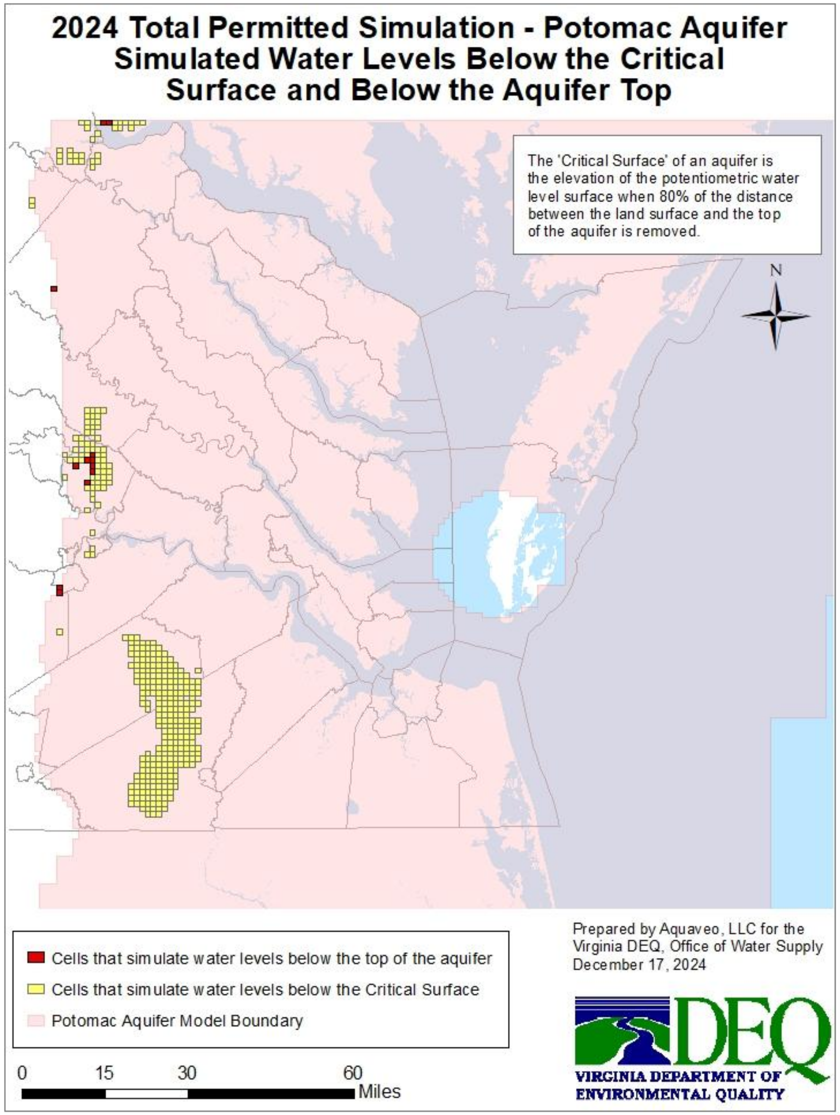
Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply September 1, 2015

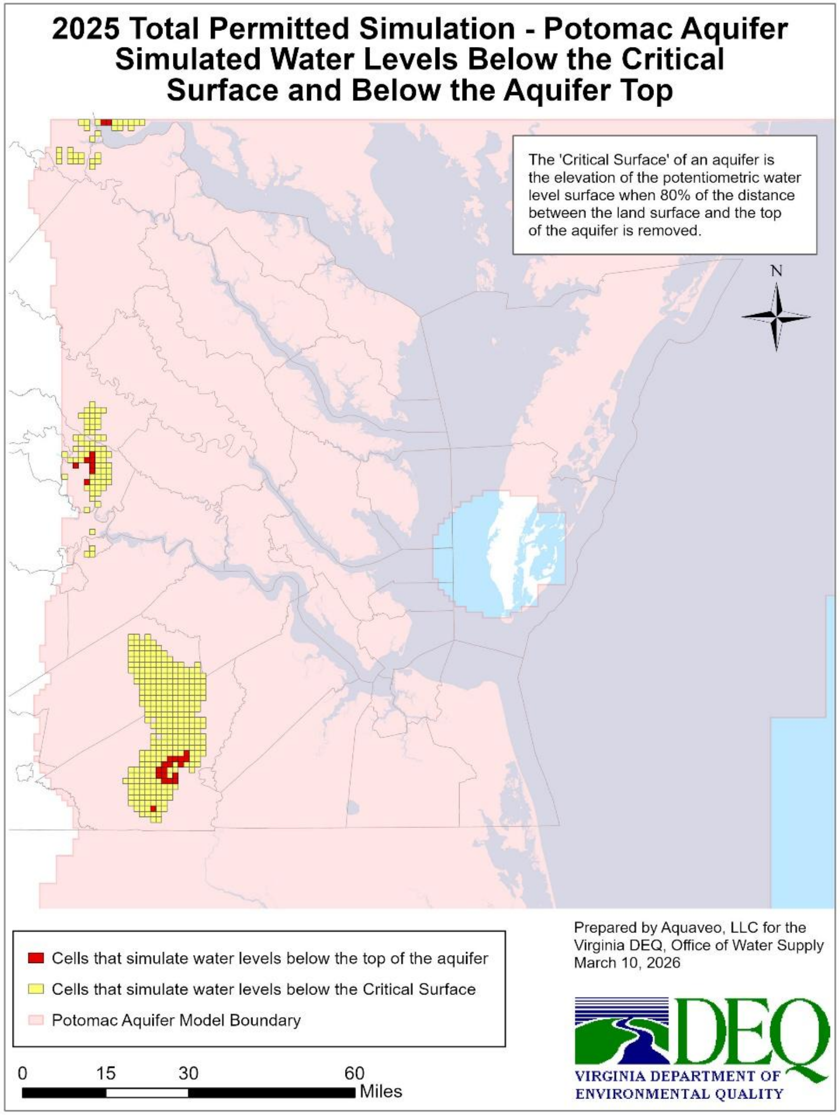
2025 Total Permitted Simulation - Potomac Aquifer Simulated Water Levels Below the Critical Surface and Below the Aquifer Top



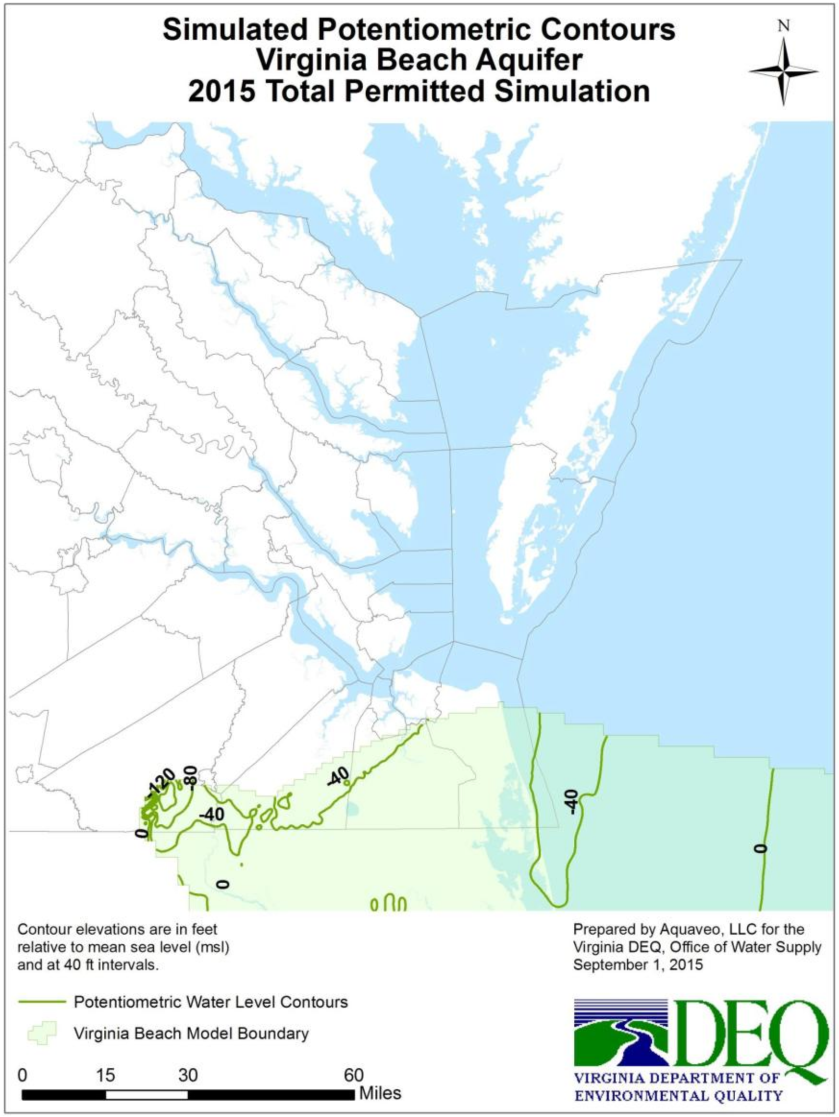
Prepared by Aquaveo, LLC for the Virginia DEQ, Office of Water Supply March 10, 2026

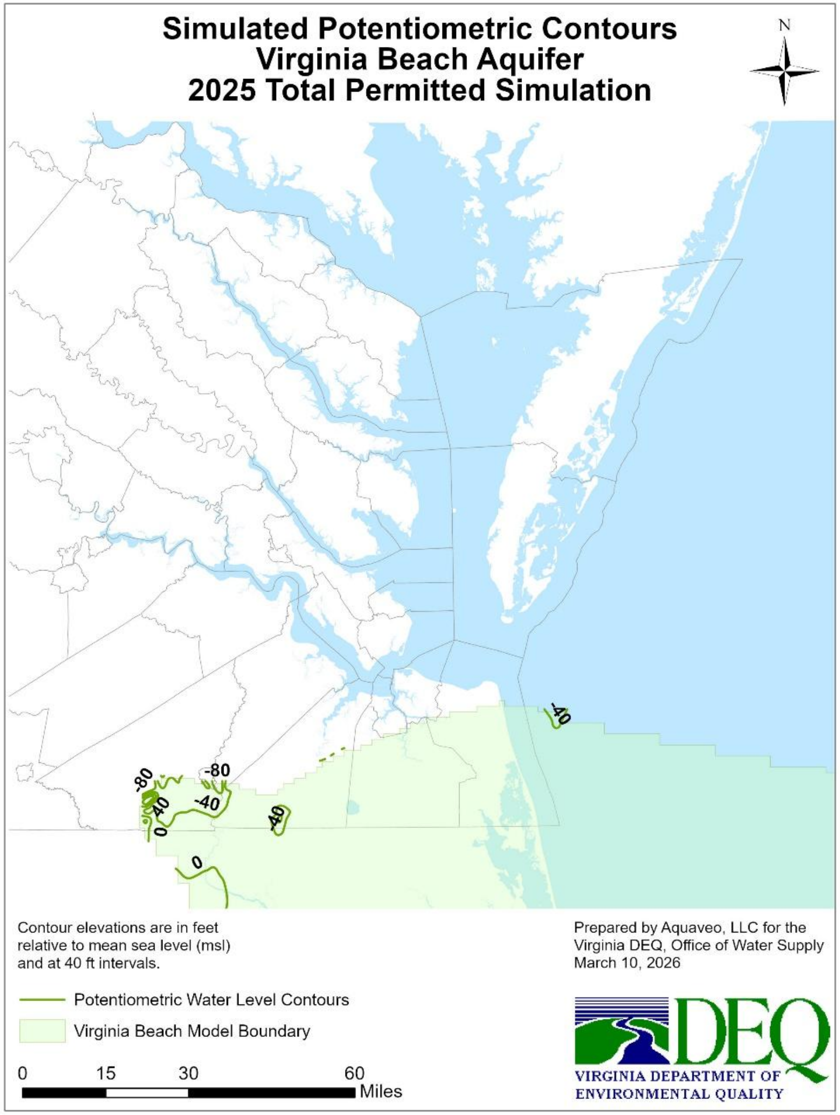
VCPM – Total Permitted





VCPM – Total Permitted





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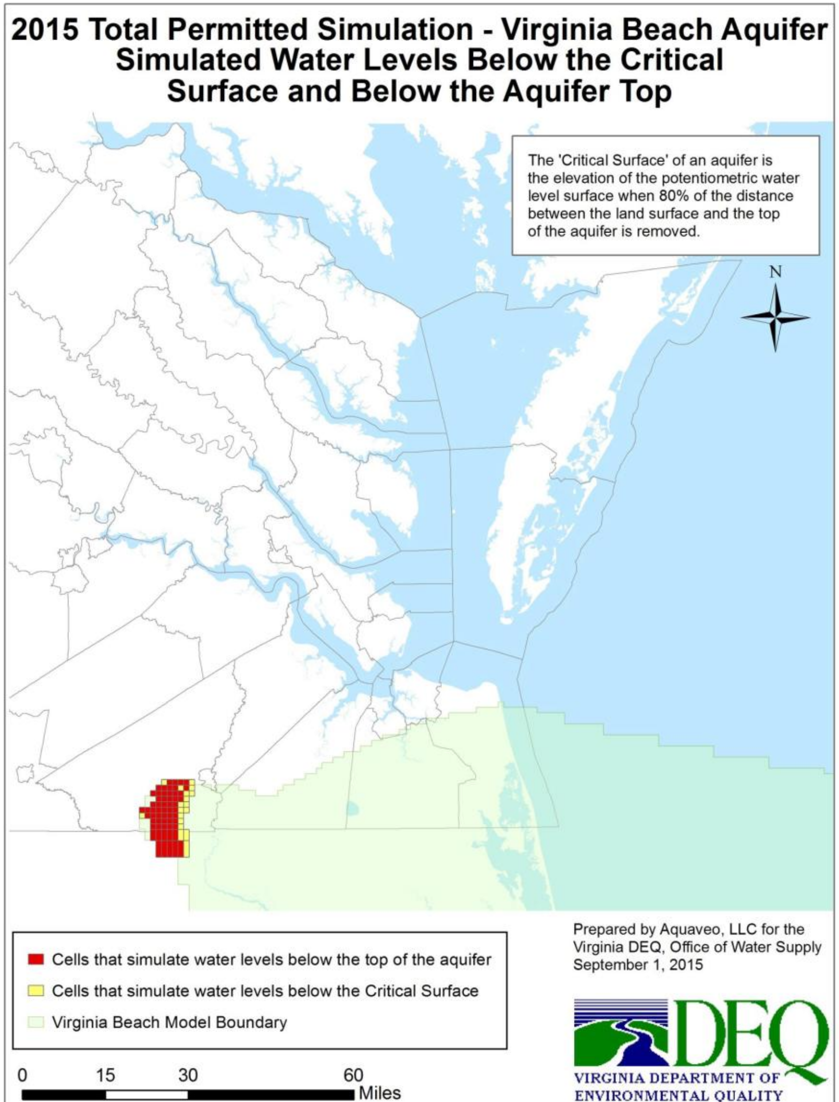
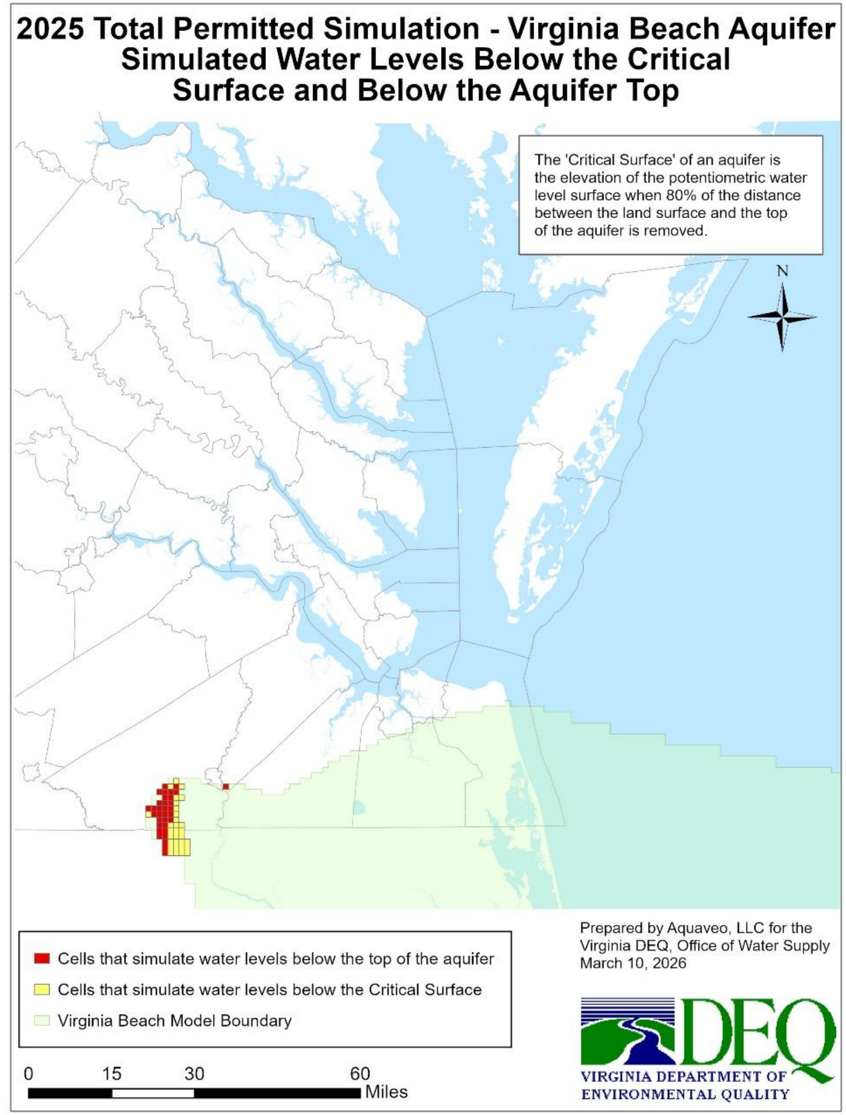
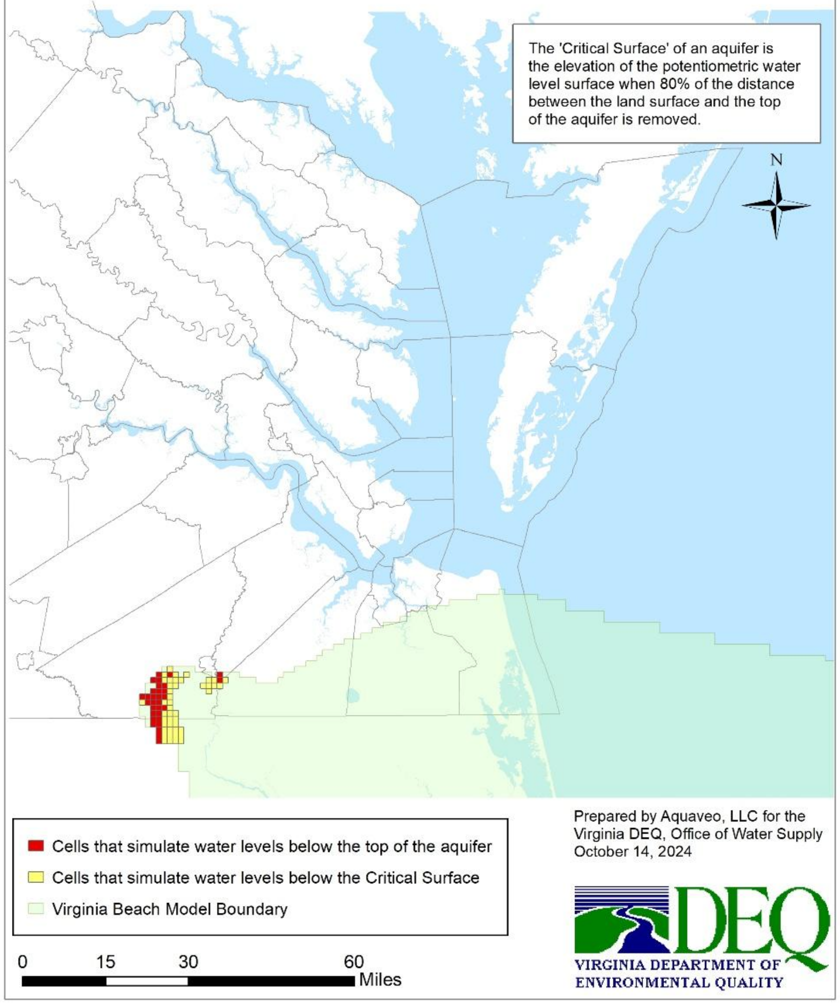
VCPM – Total Permitted



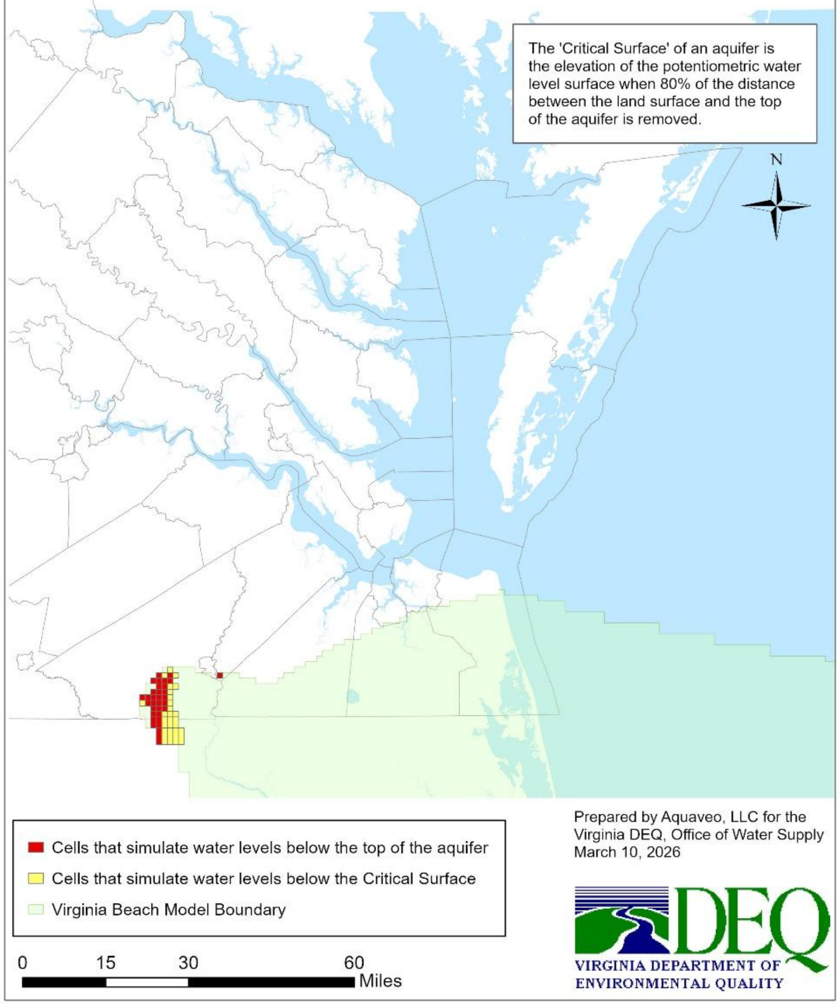


VCPM – Total Permitted

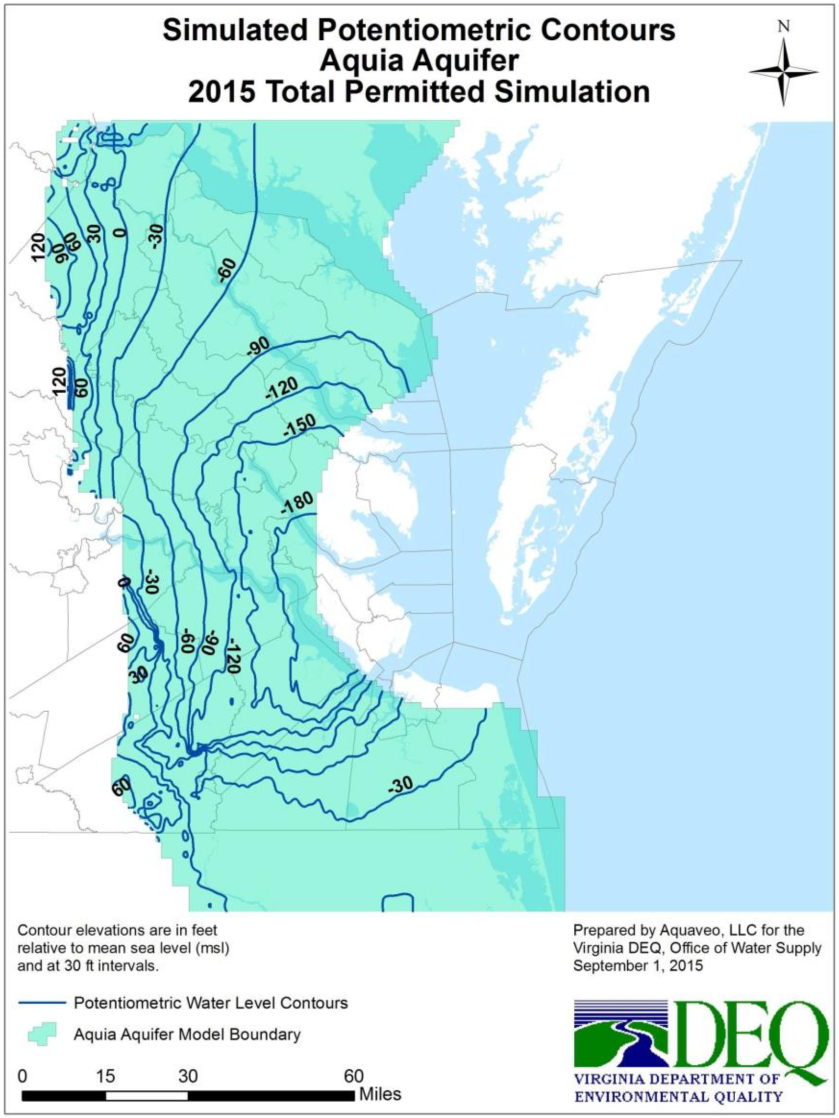
2024 Total Permitted Simulation - Virginia Beach Aquifer Simulated Water Levels Below the Critical Surface and Below the Aquifer Top

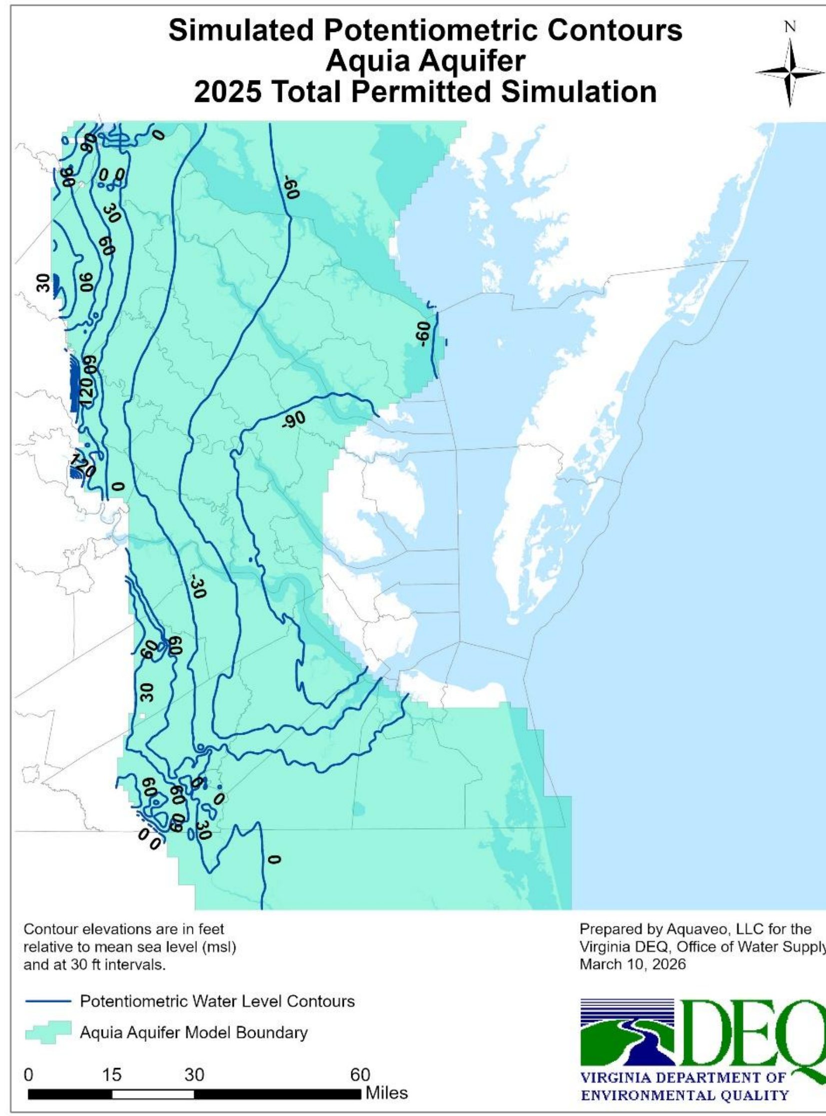


2025 Total Permitted Simulation - Virginia Beach Aquifer Simulated Water Levels Below the Critical Surface and Below the Aquifer Top



VCPM – Total Permitted





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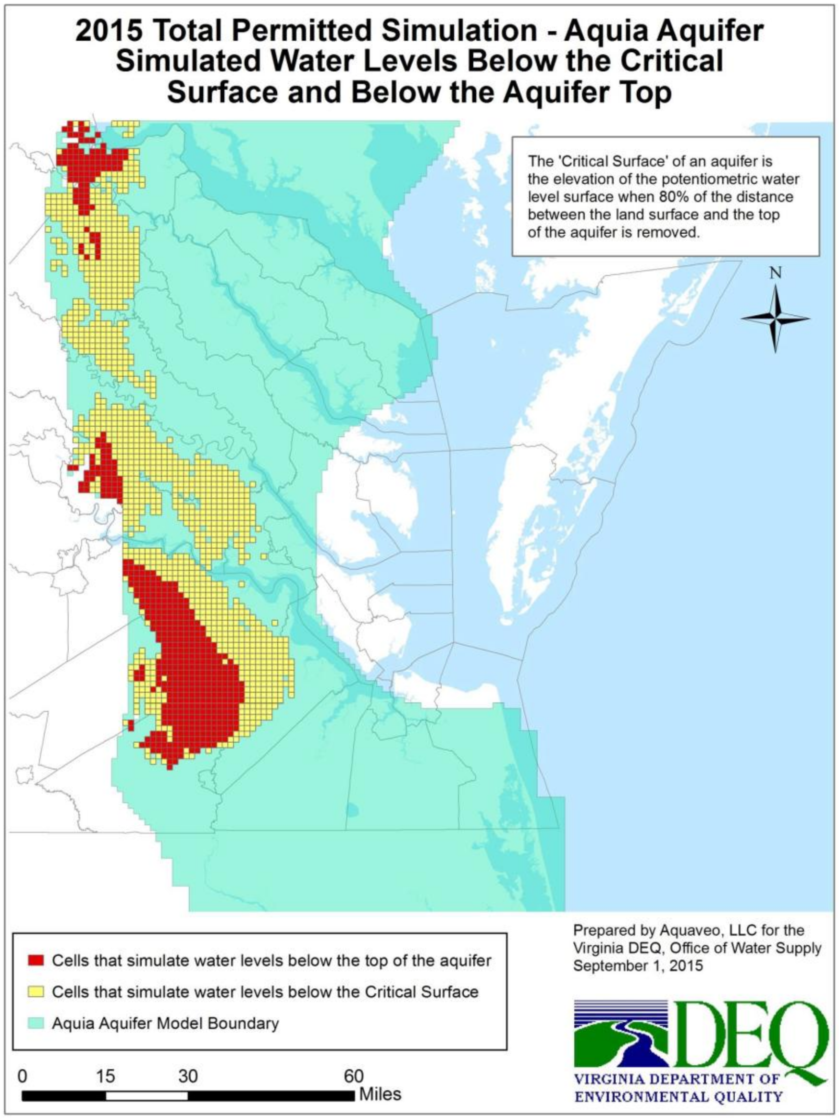
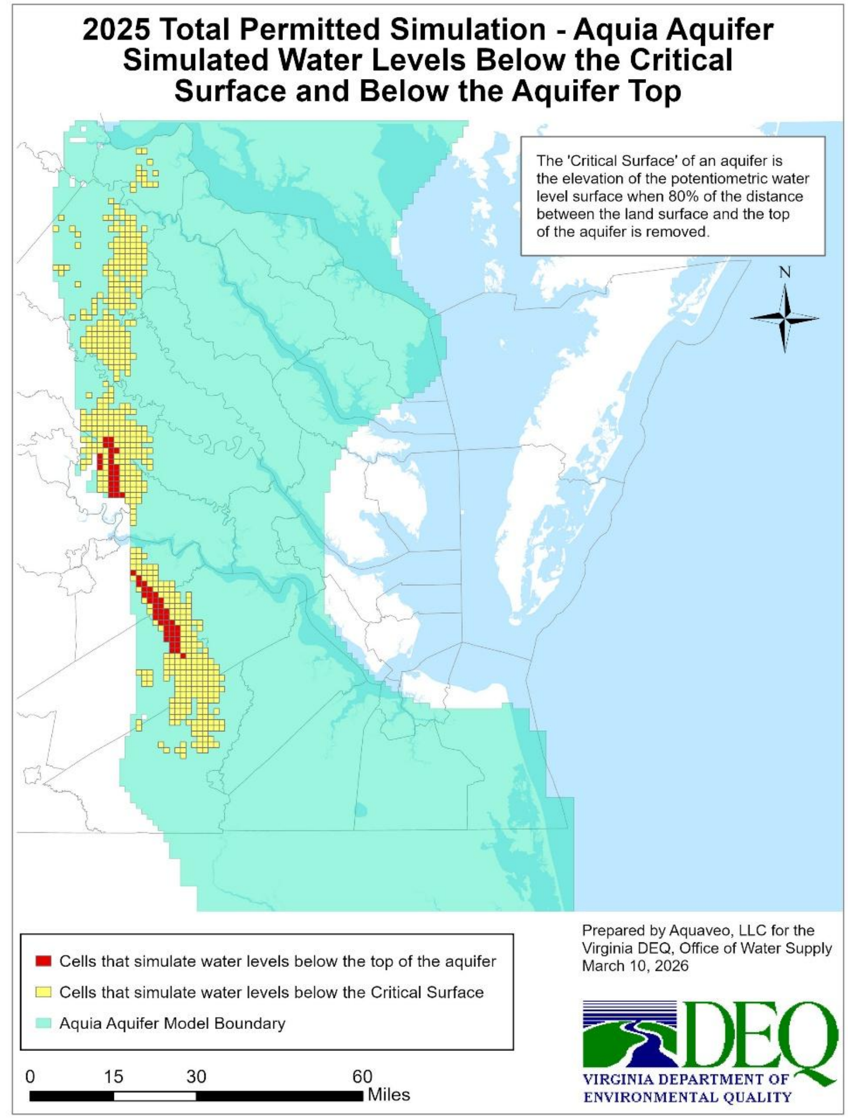
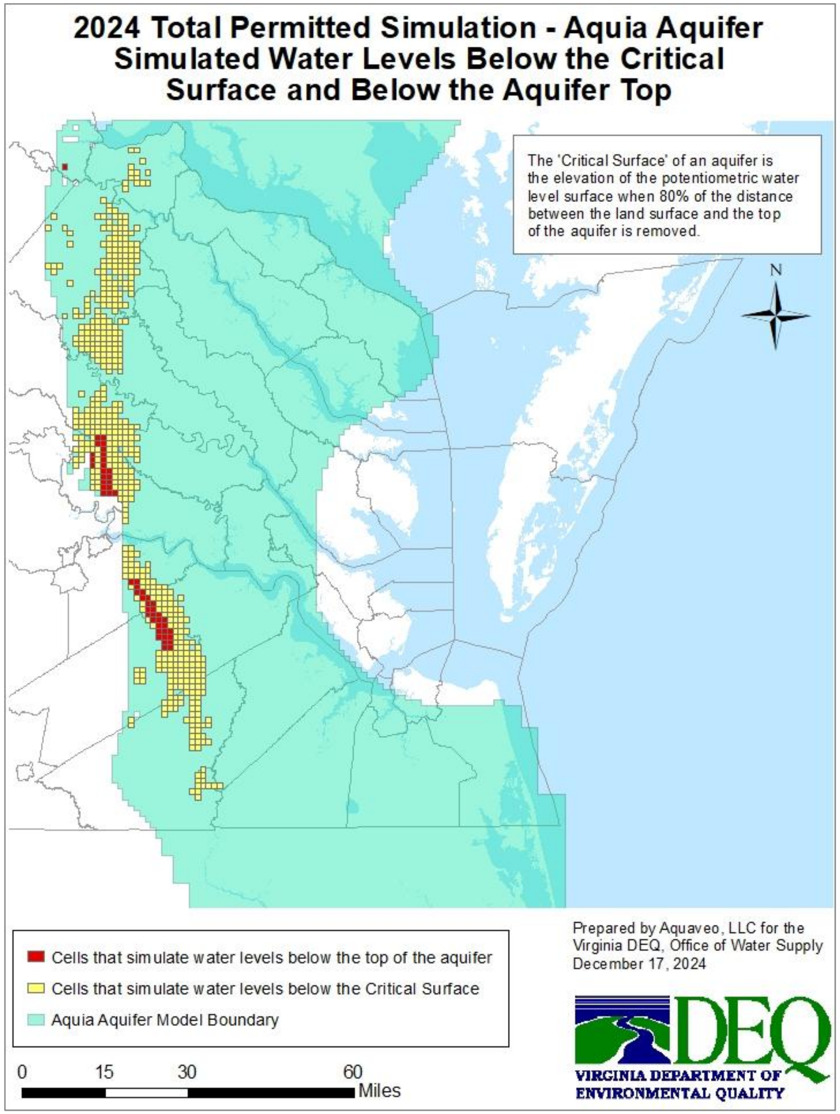
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

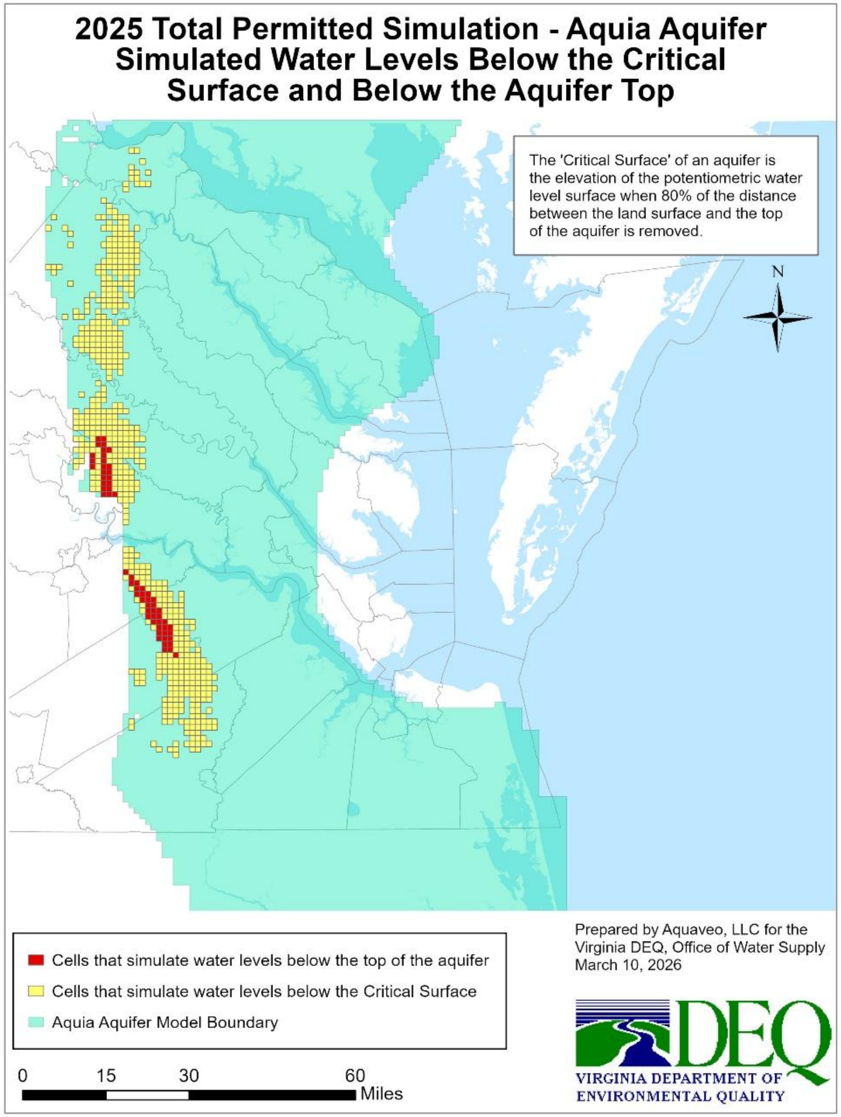
VCPM – Total Permitted



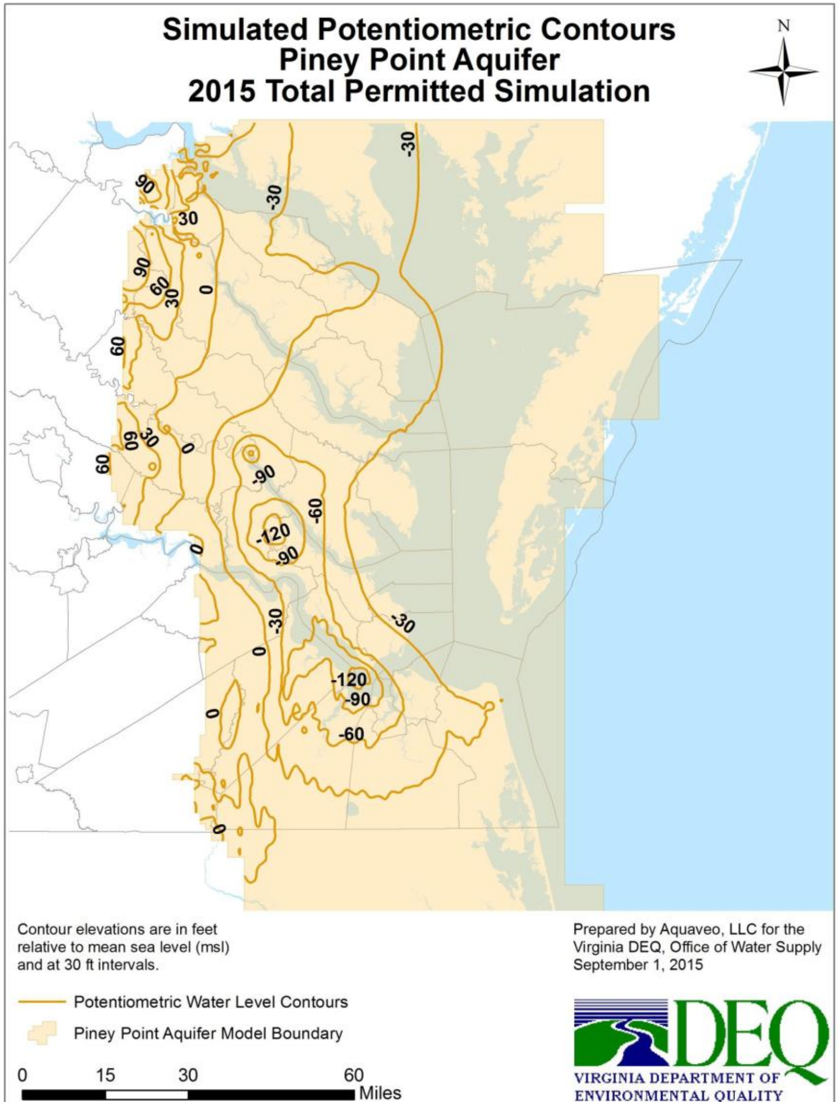


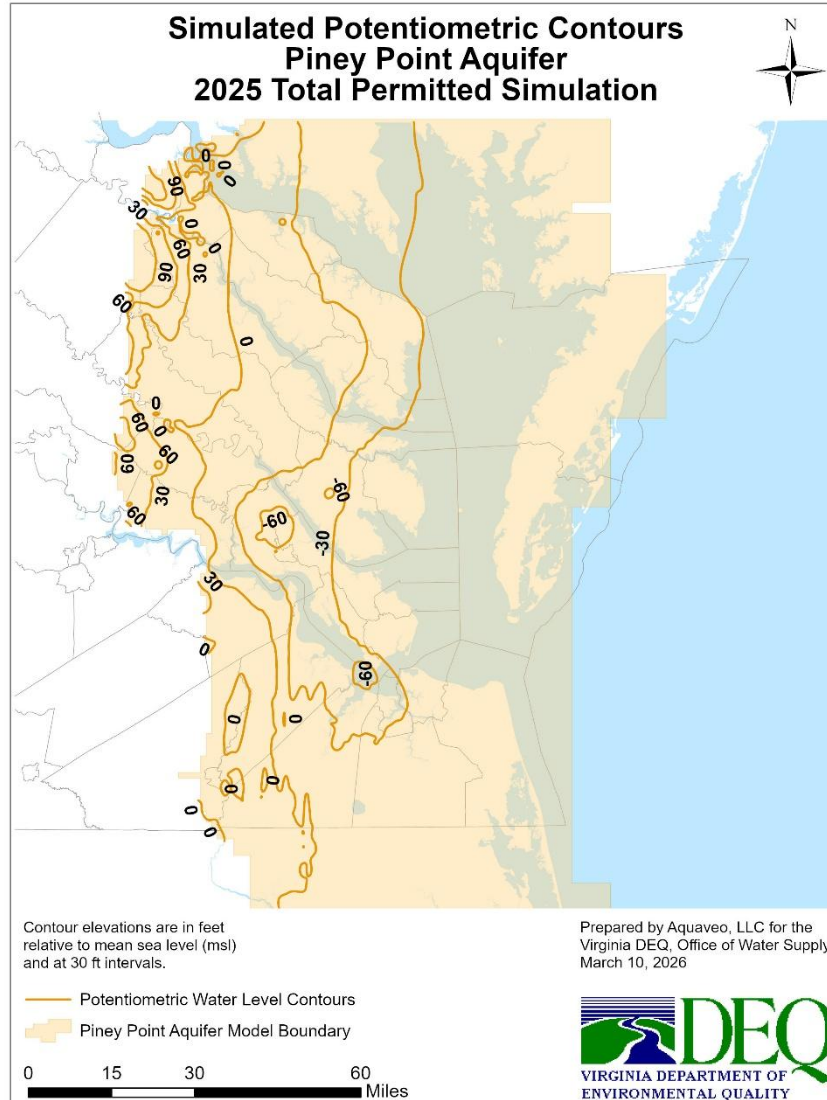
VCPM – Total Permitted





VCPM – Total Permitted





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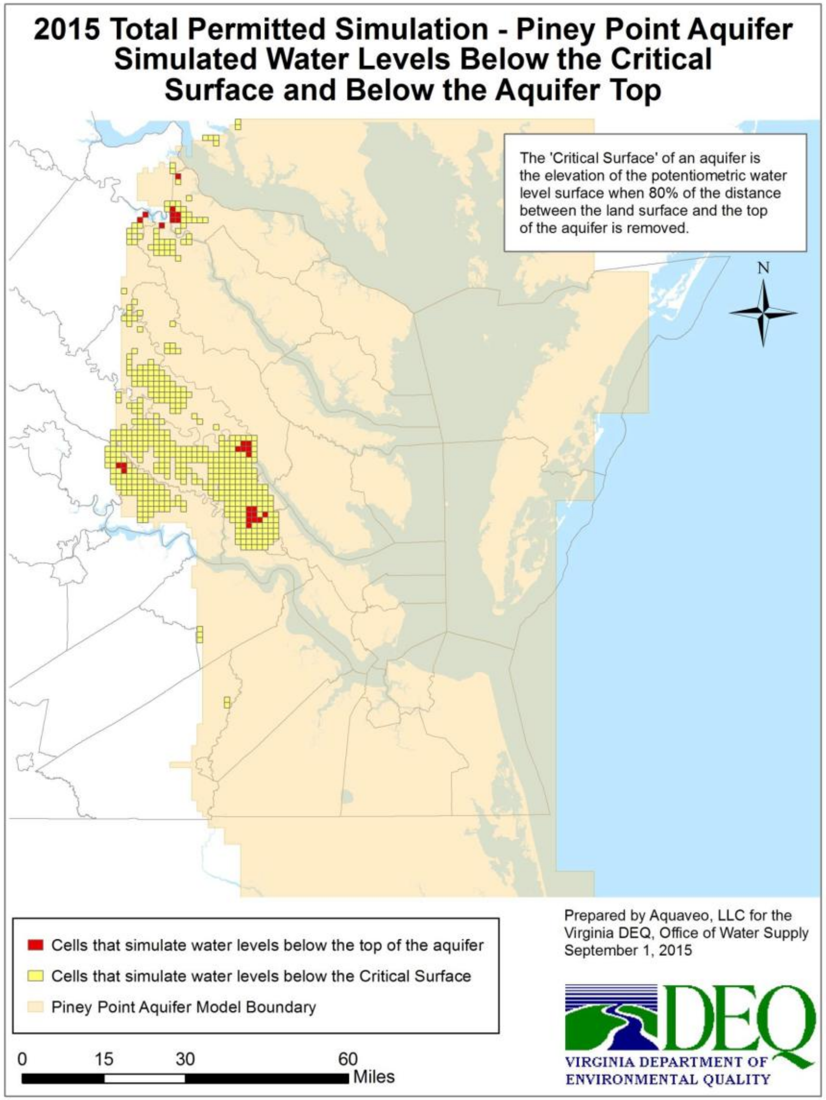
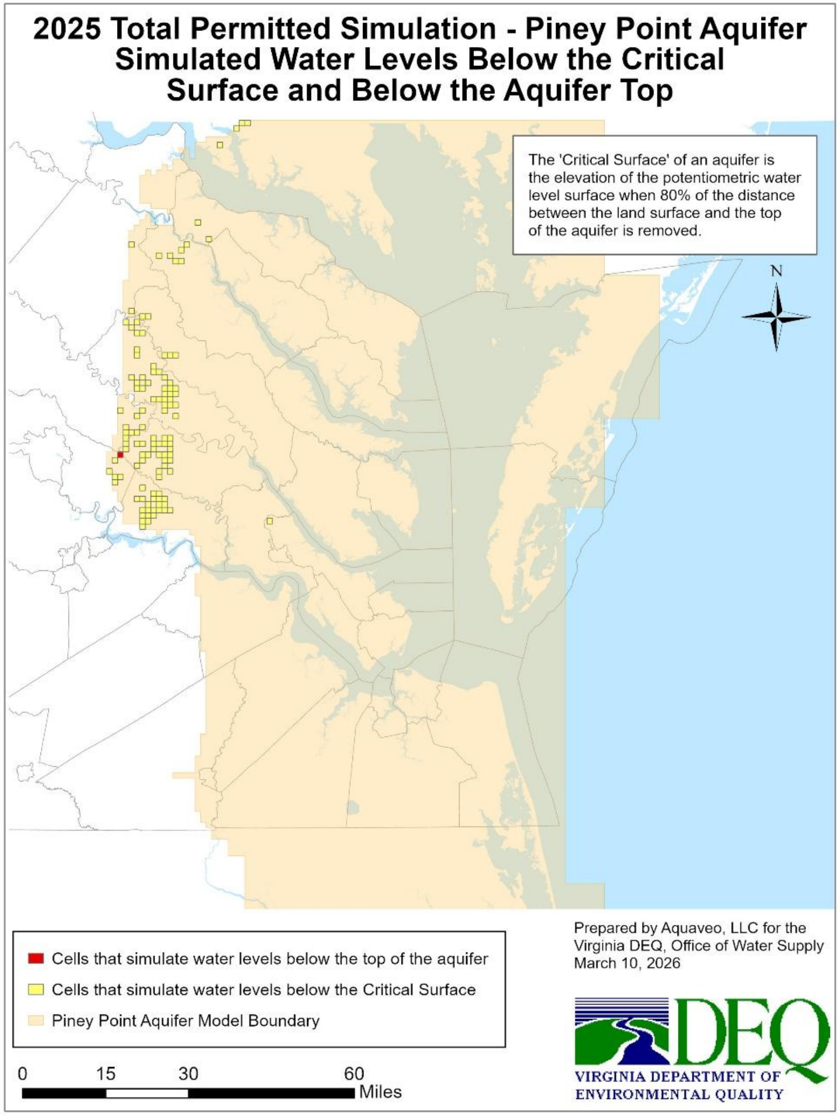
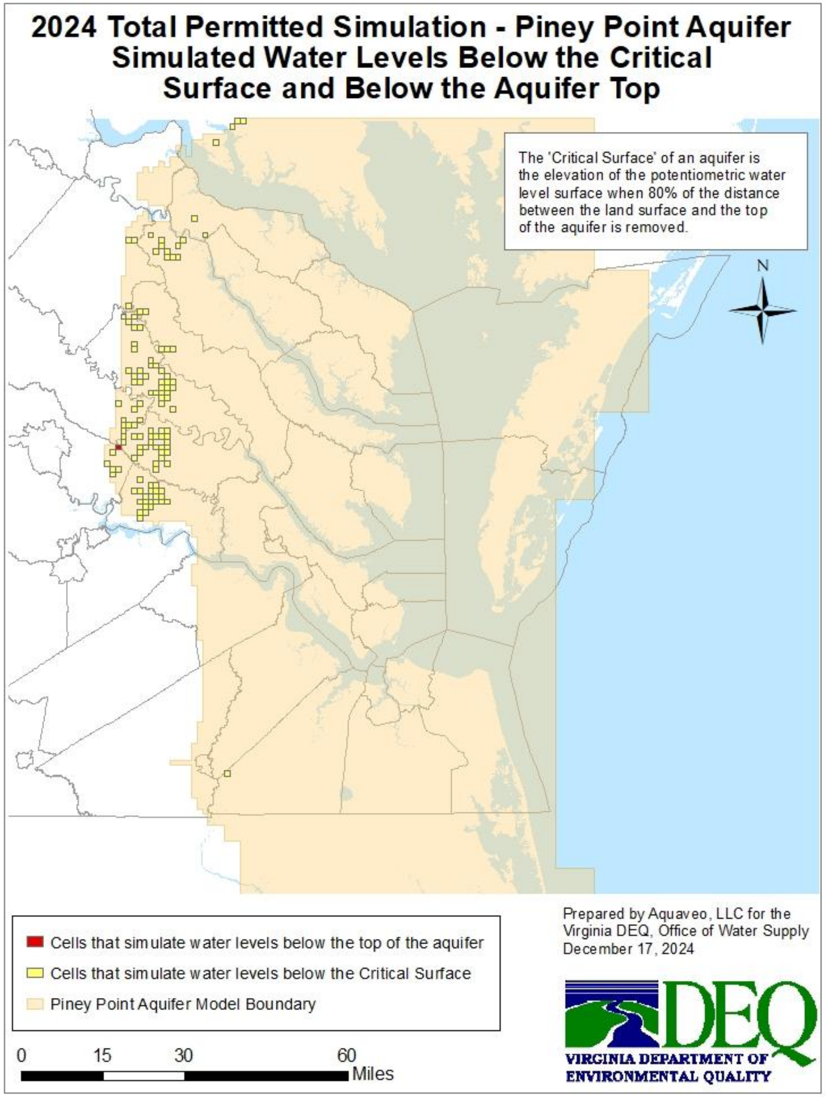
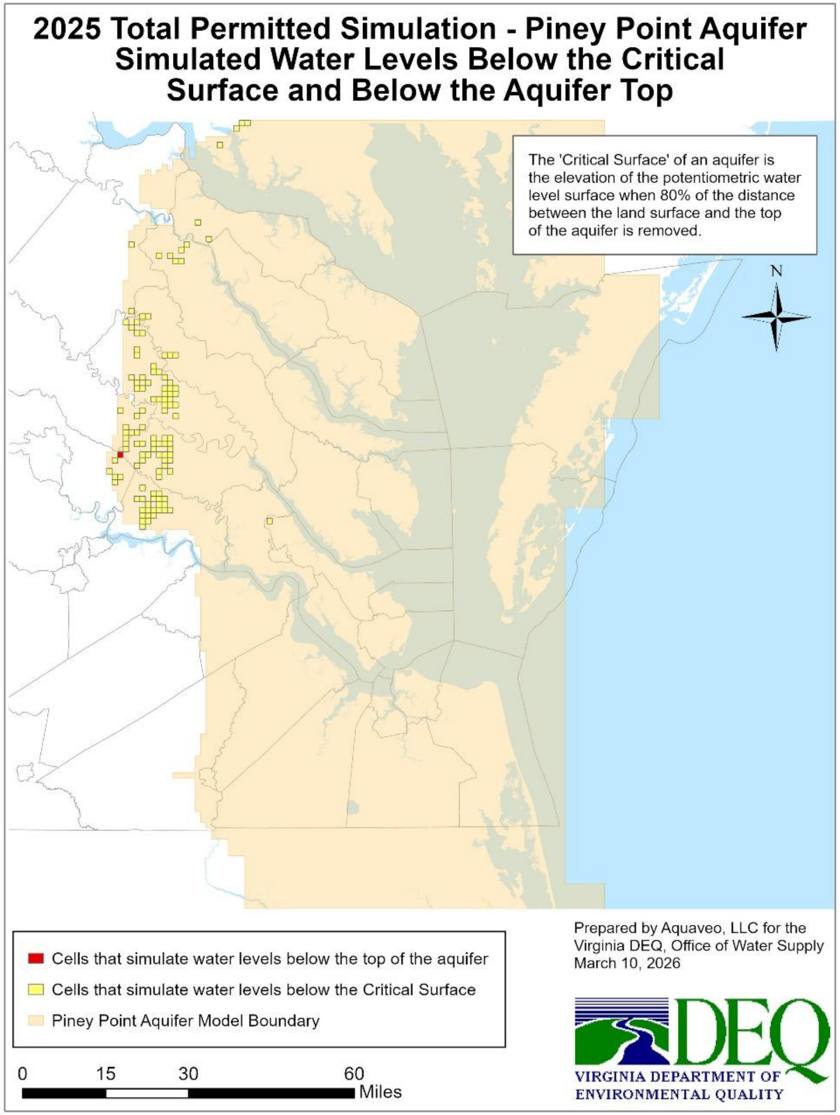
VCPM – Total Permitted





VCPM – Total Permitted



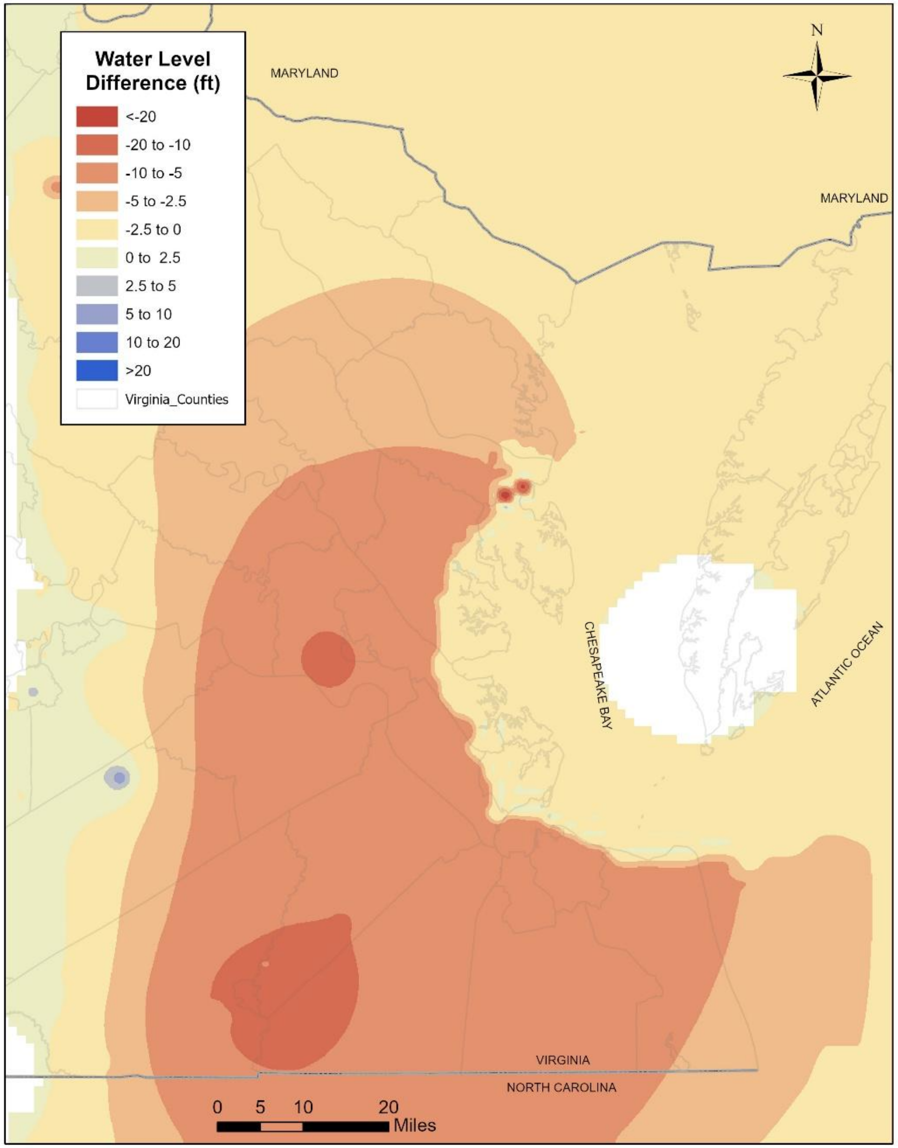


VCPM – Total Permitted

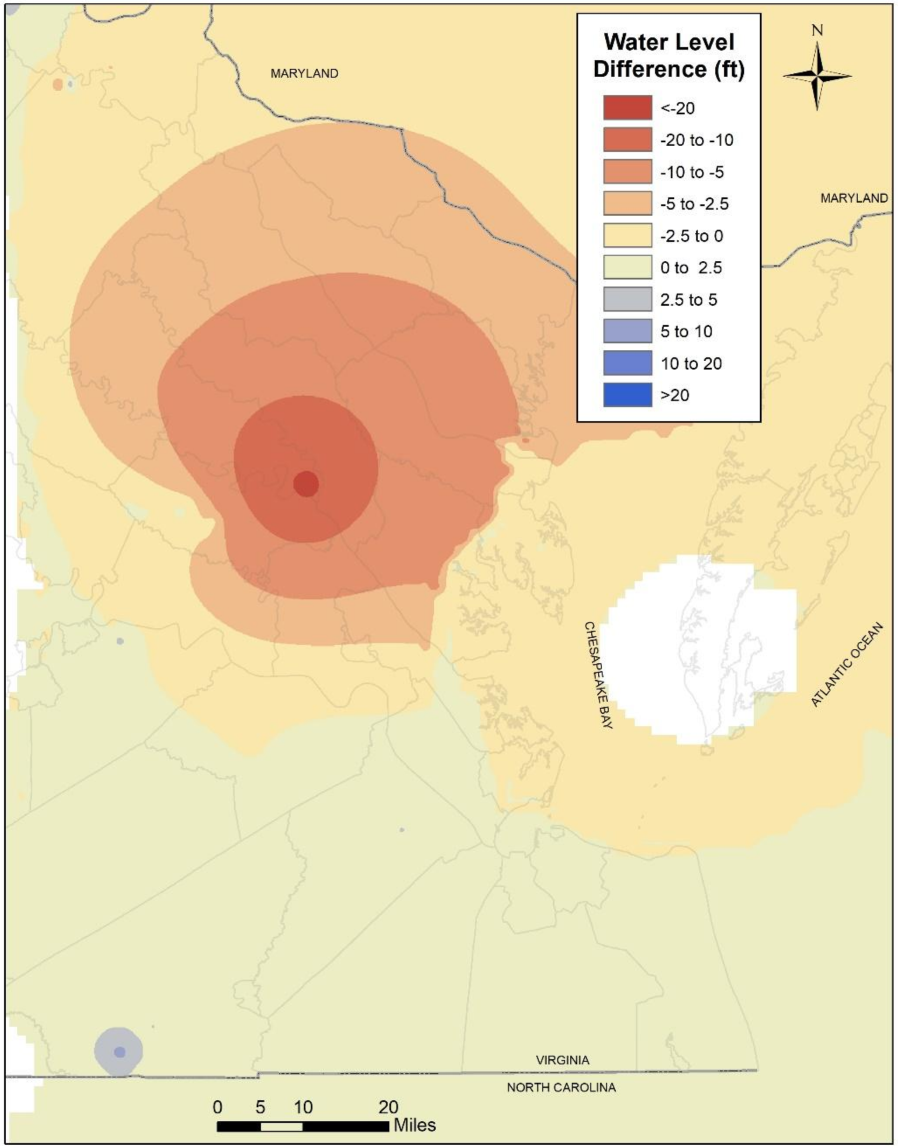
- No critical cells in Yorktown-Eastover aquifer in 2024 RU or 2025 TP models

TP Simulations – Potomac

2025 minus 2024

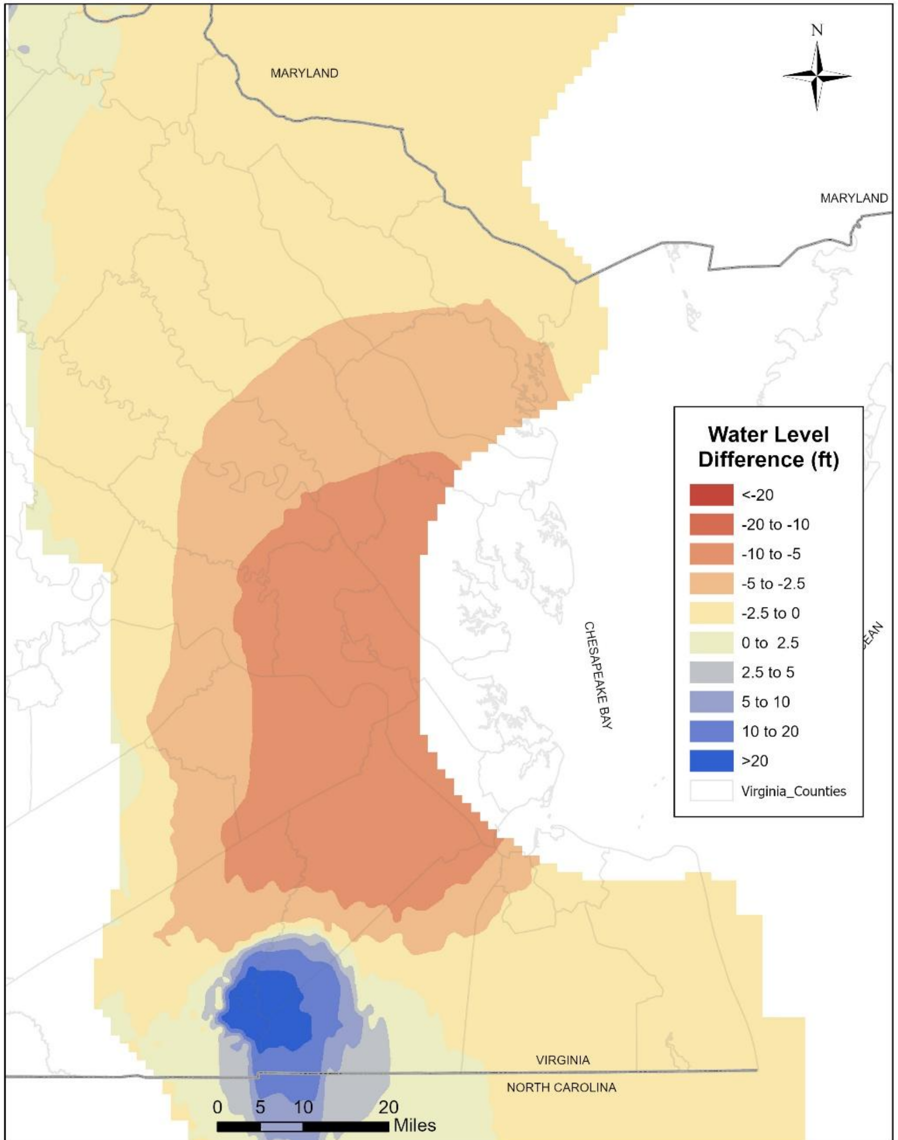


2024 minus 2023

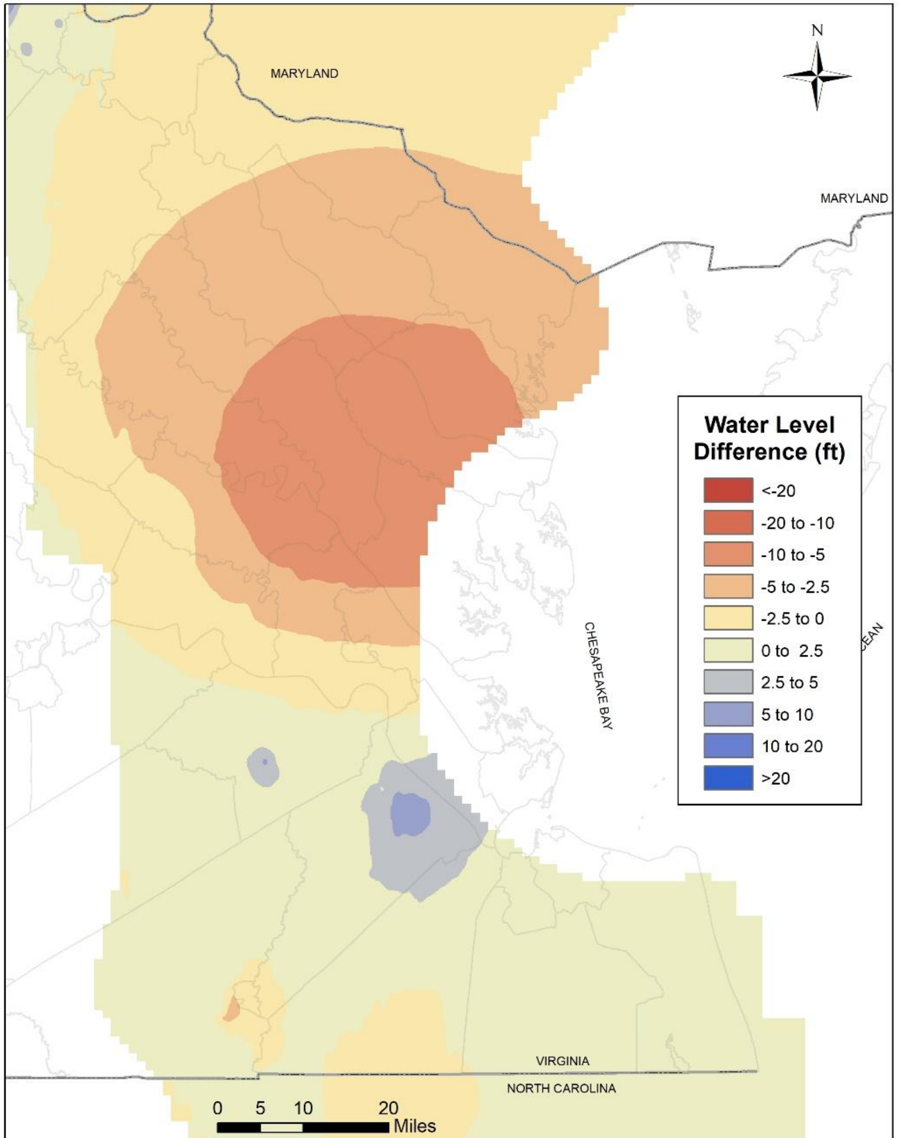


TP Simulations – Aquia

2025 minus 2024

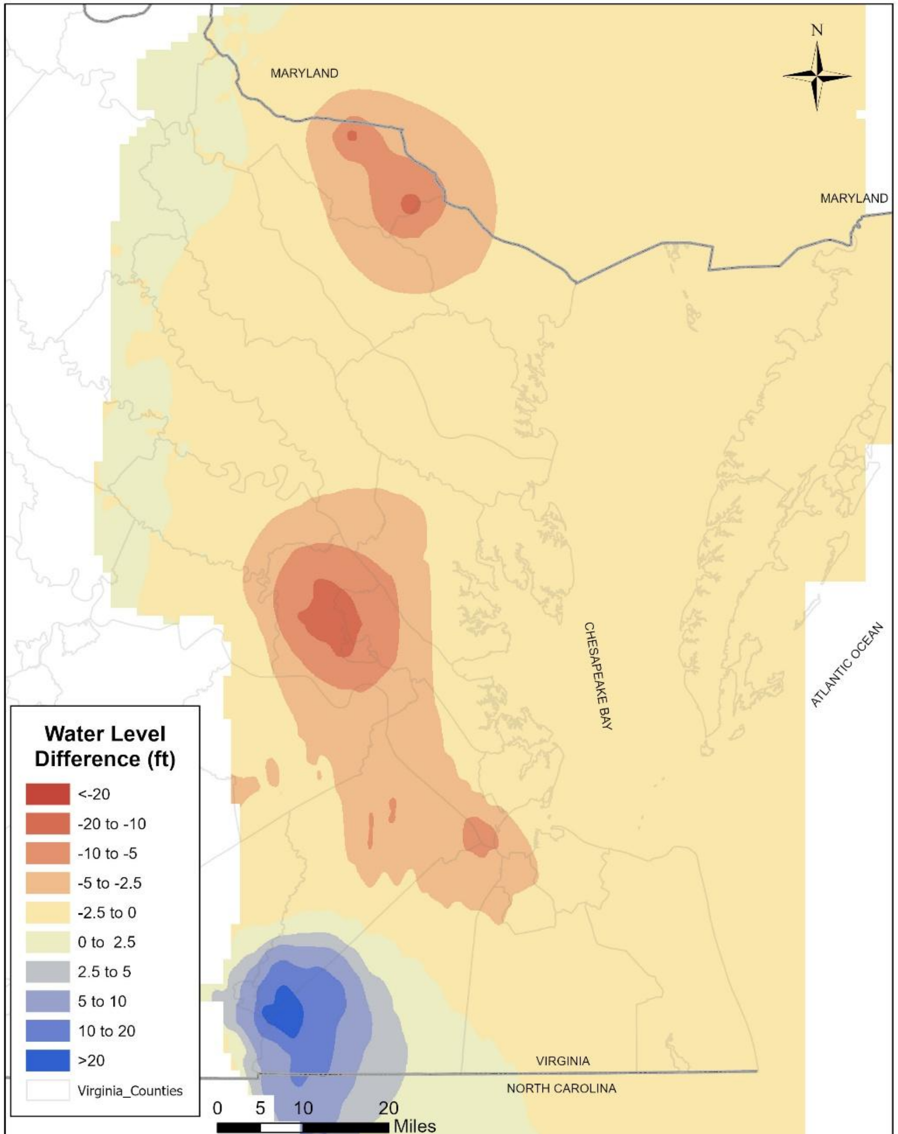


2024 minus 2023

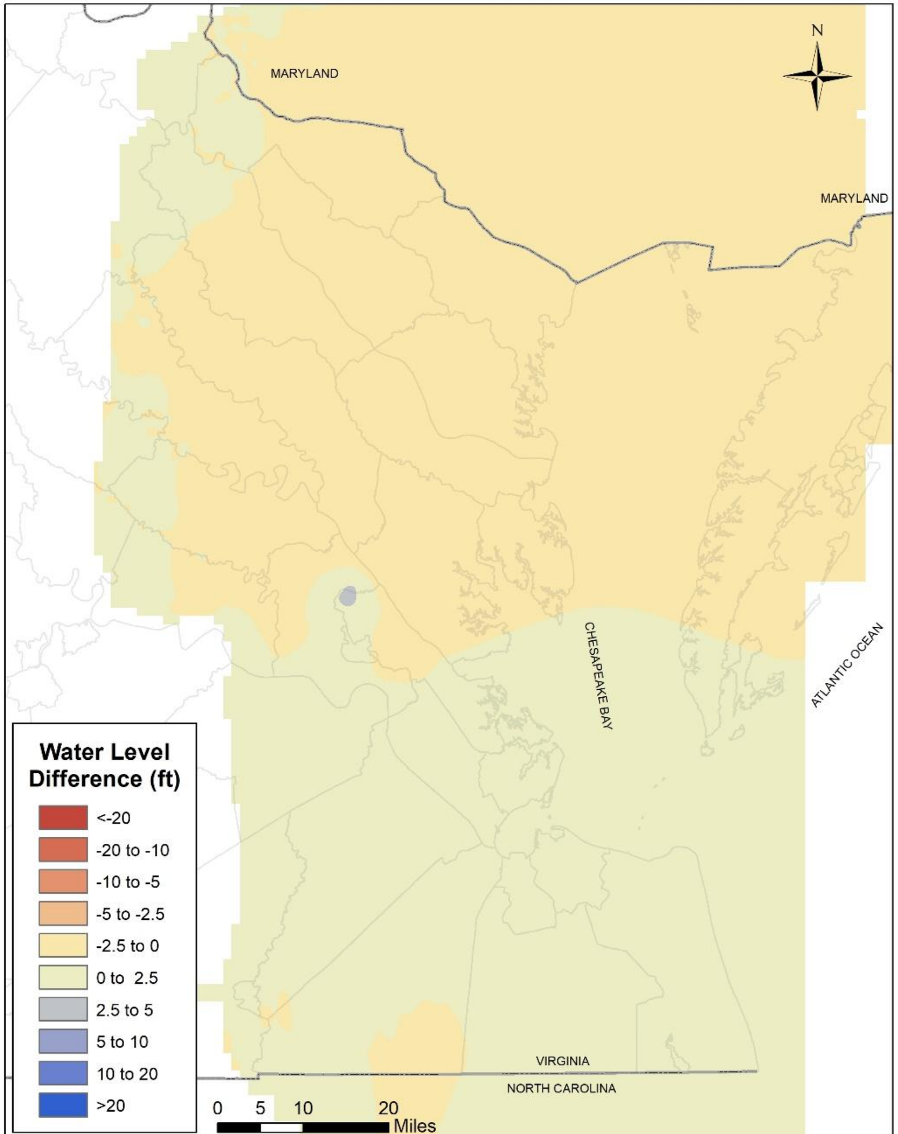


TP Simulations – Piney Point

2025 minus 2024

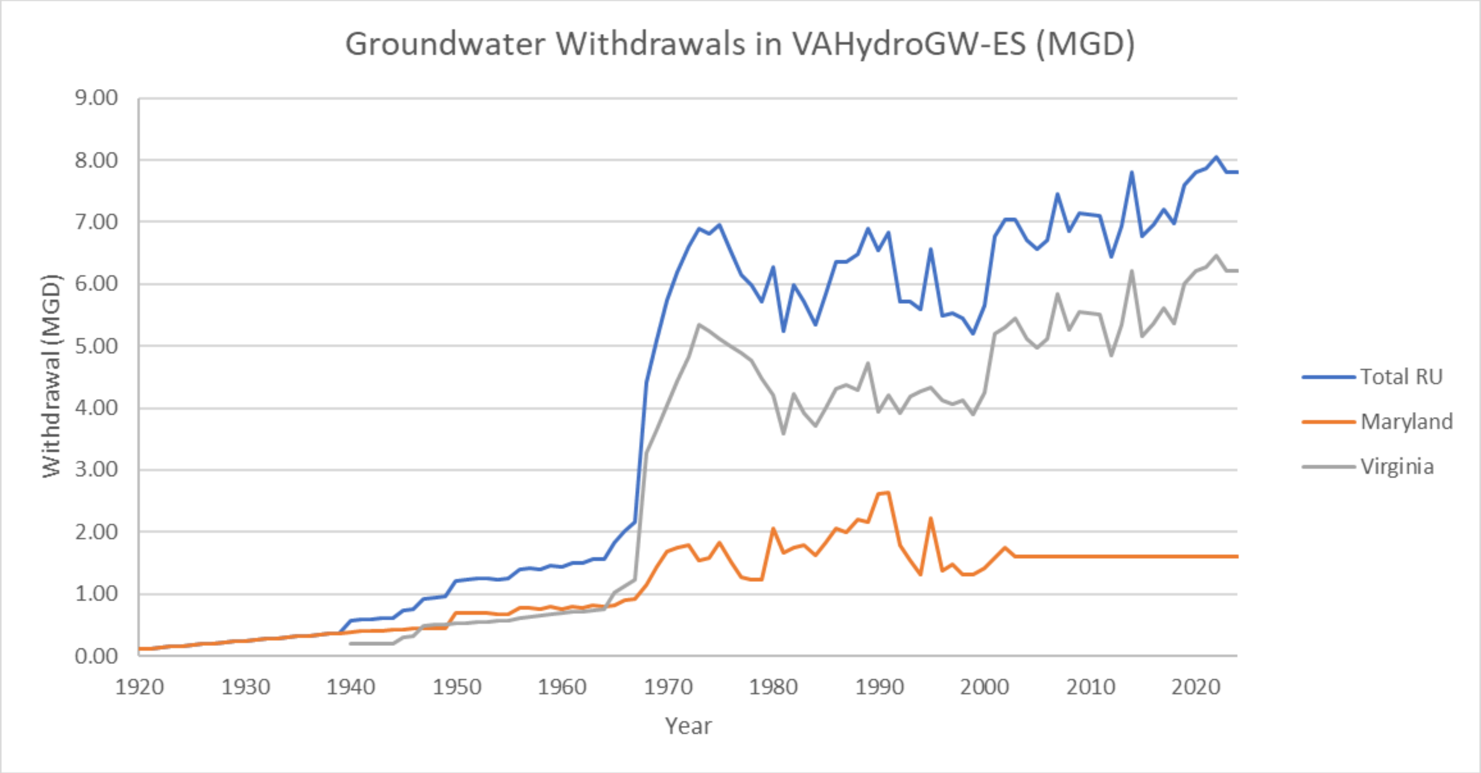


2024 minus 2023



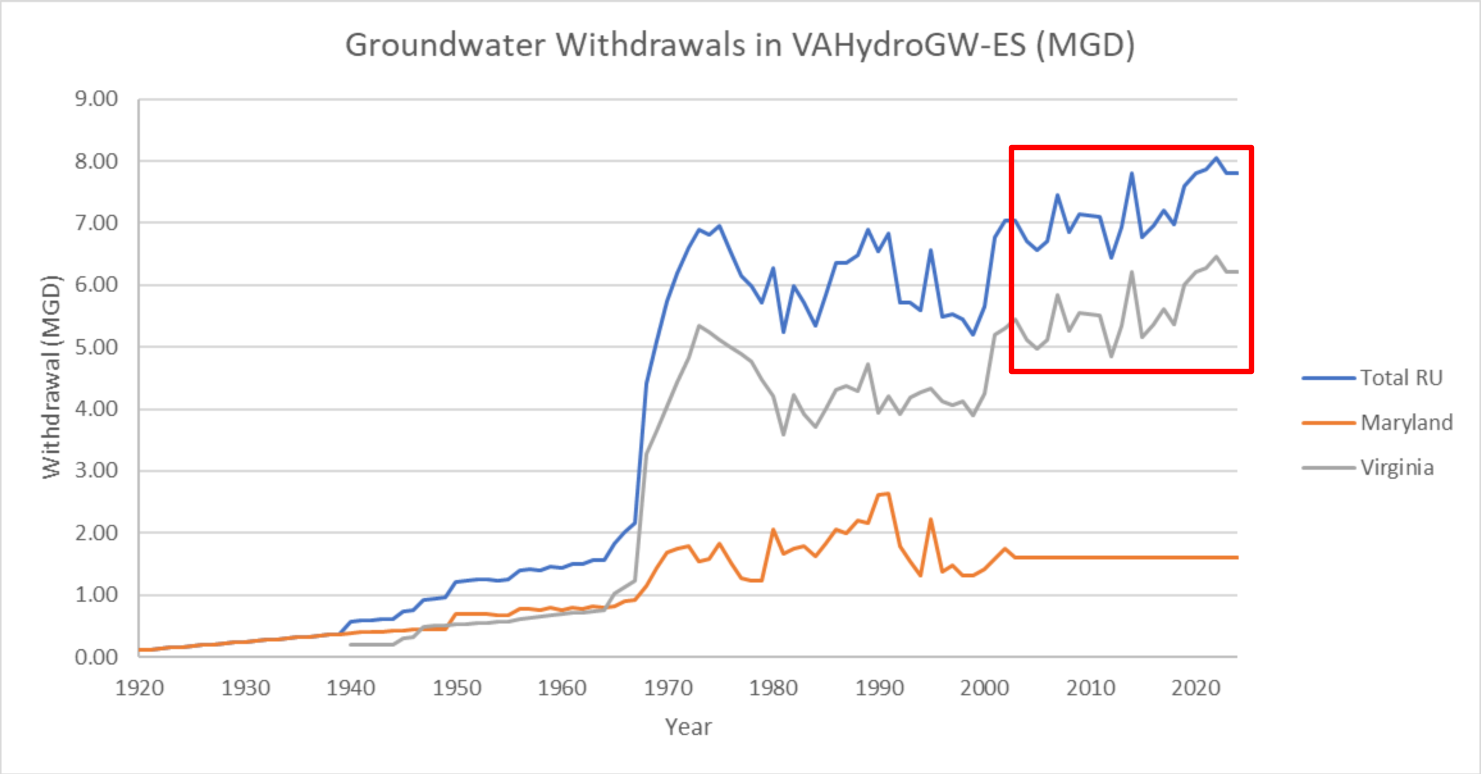
How much was withdrawn from the Eastern Shore in 2024?

VAHydroGW-ES – Reported Use



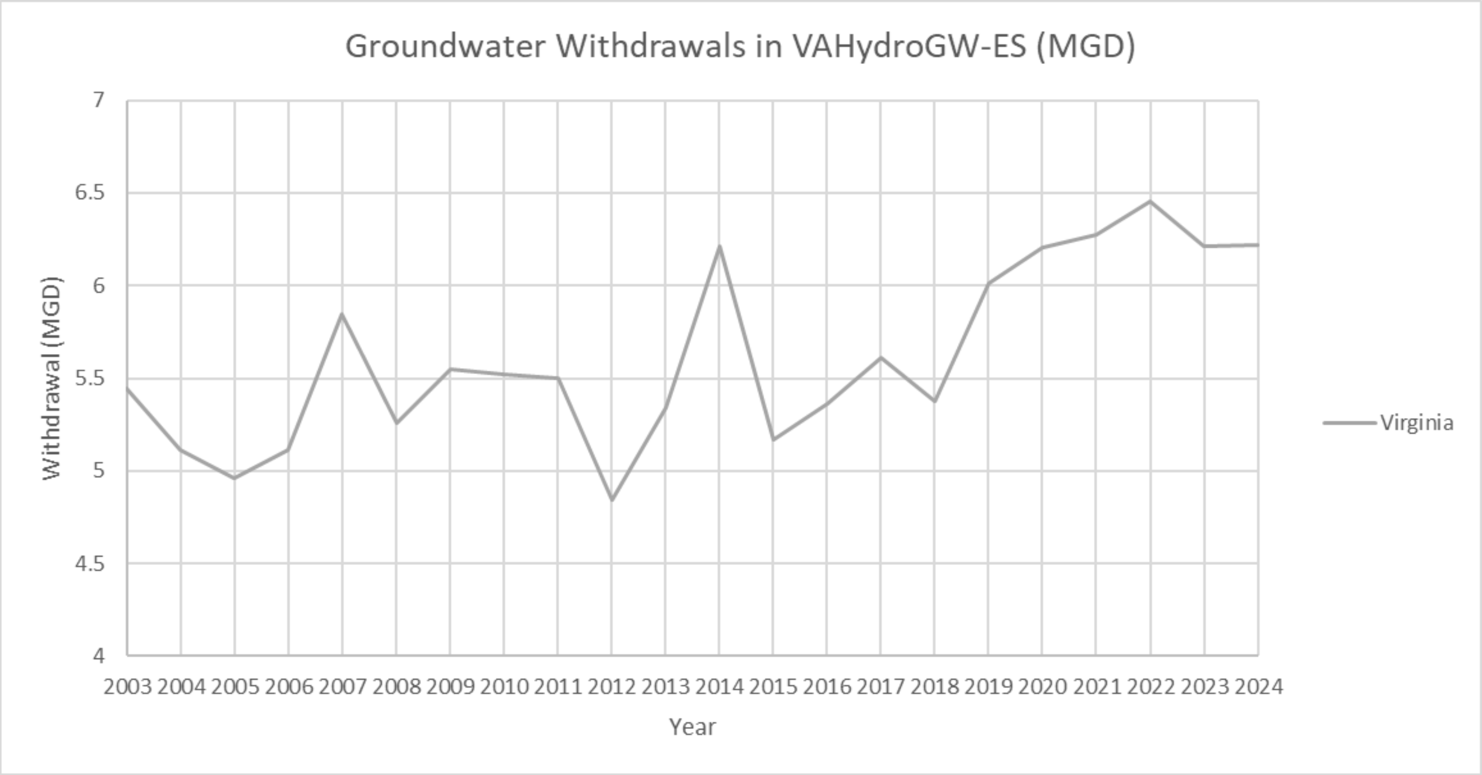
County	2022 Reported Use (MGD)	2023 Reported Use (MGD)	2024 Reported Use (MGD)
Accomack	5.20	5.15	5.14
Northampton	1.26	1.06	1.08
Maryland	1.6	1.6	1.6
TOTAL	**8.05**	**7.81**	**7.82**

VAHydroGW-ES – Reported Use



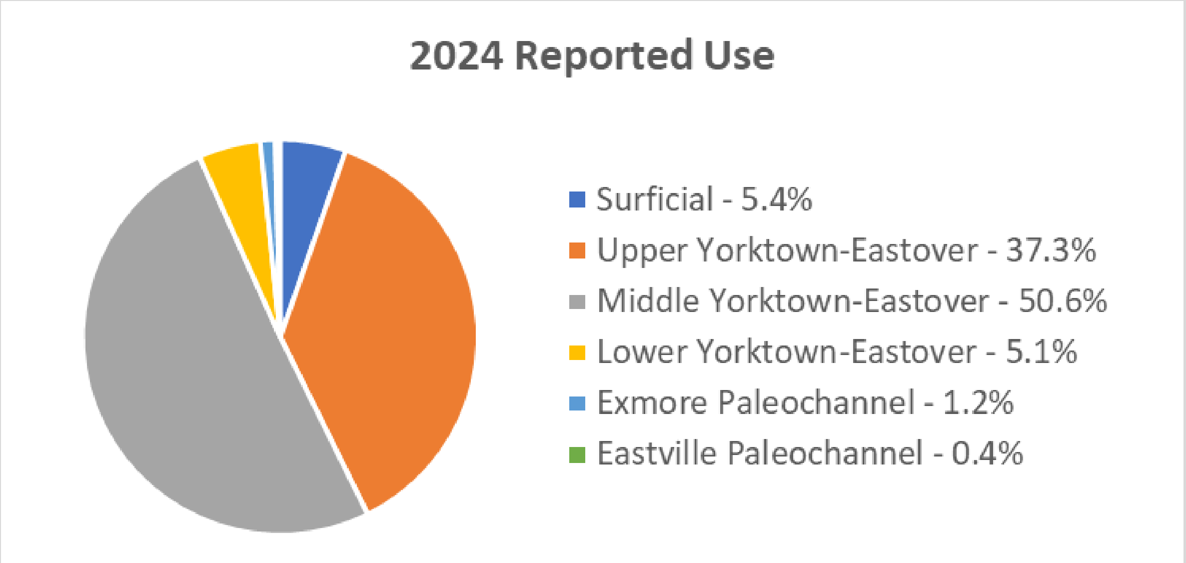
County	2022 Reported Use (MGD)	2023 Reported Use (MGD)	2024 Reported Use (MGD)
Accomack	5.20	5.15	5.14
Northampton	1.26	1.06	1.08
Maryland	1.6	1.6	1.6
TOTAL	**8.05**	**7.81**	**7.82**

VAHydroGW-ES – Reported Use



VAHydroGW-ES – Reported Use VA Aquifer Allocation

Aquifer	2022 Reported Use (MGD)	2023 Reported Use (MGD)	2024 Reported Use (MGD)
Surficial	0.34	0.33	0.33
Upper Yorktown-Eastover	2.84	2.32	2.32
Middle Yorktown-Eastover	2.80	3.14	3.15
Lower Yorktown-Eastover	0.28	0.28	0.32
Exmore Paleochannel	0.14	0.10	0.08
Eastville Paleochannel	0.05	0.03	0.02
TOTAL:	**6.46**	**6.21**	**6.22**

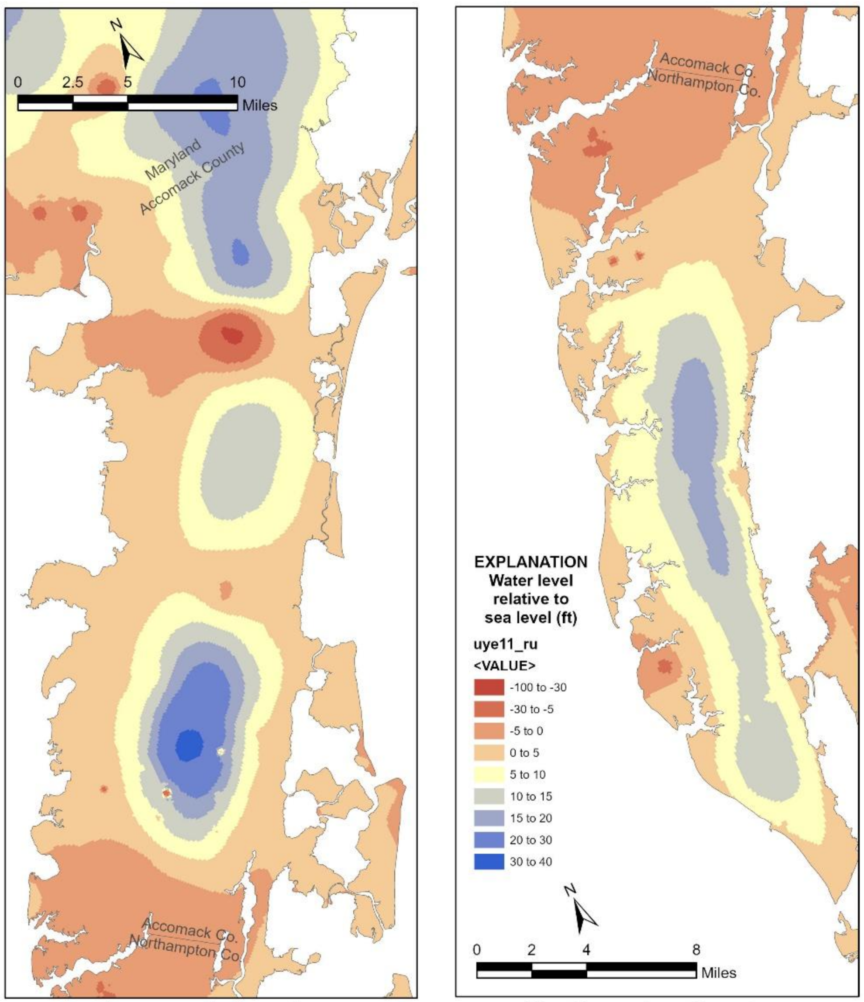


VAHydroGW-ES – Reported Use Water Levels

AQUAVEO Water Modeling Solutions

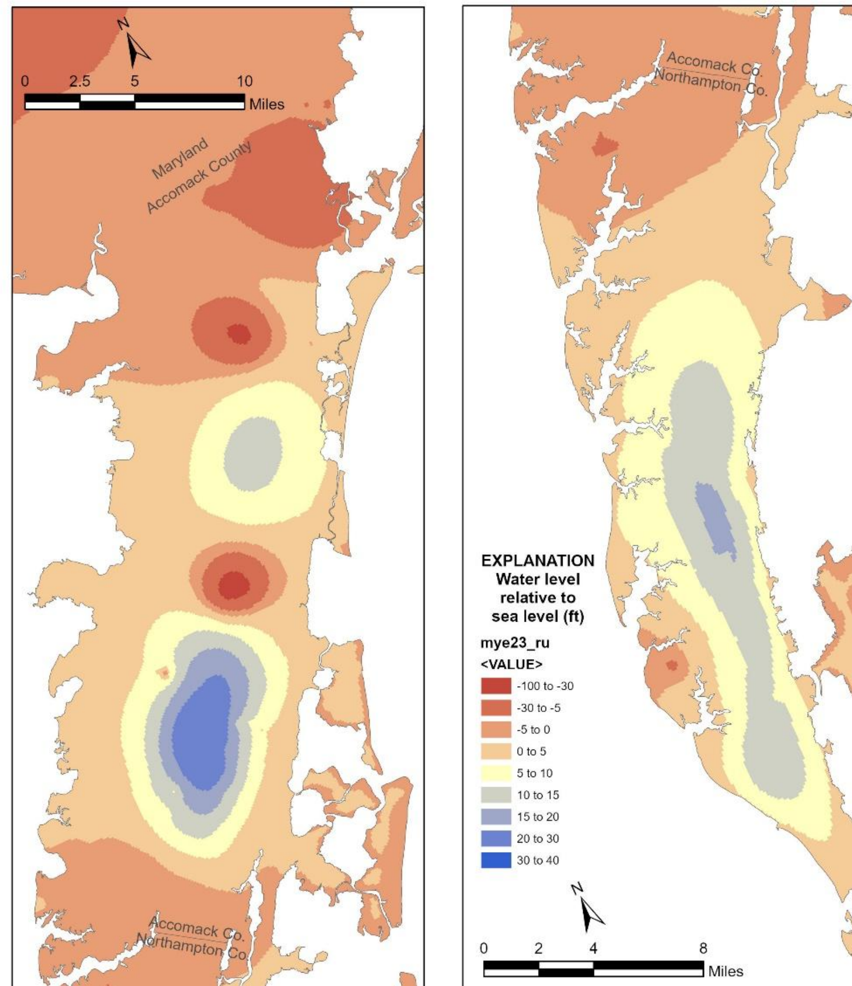
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

VAHydroGW-ES 2024 Reported Use Simulation
Upper Yorktown-Eastover Water Levels



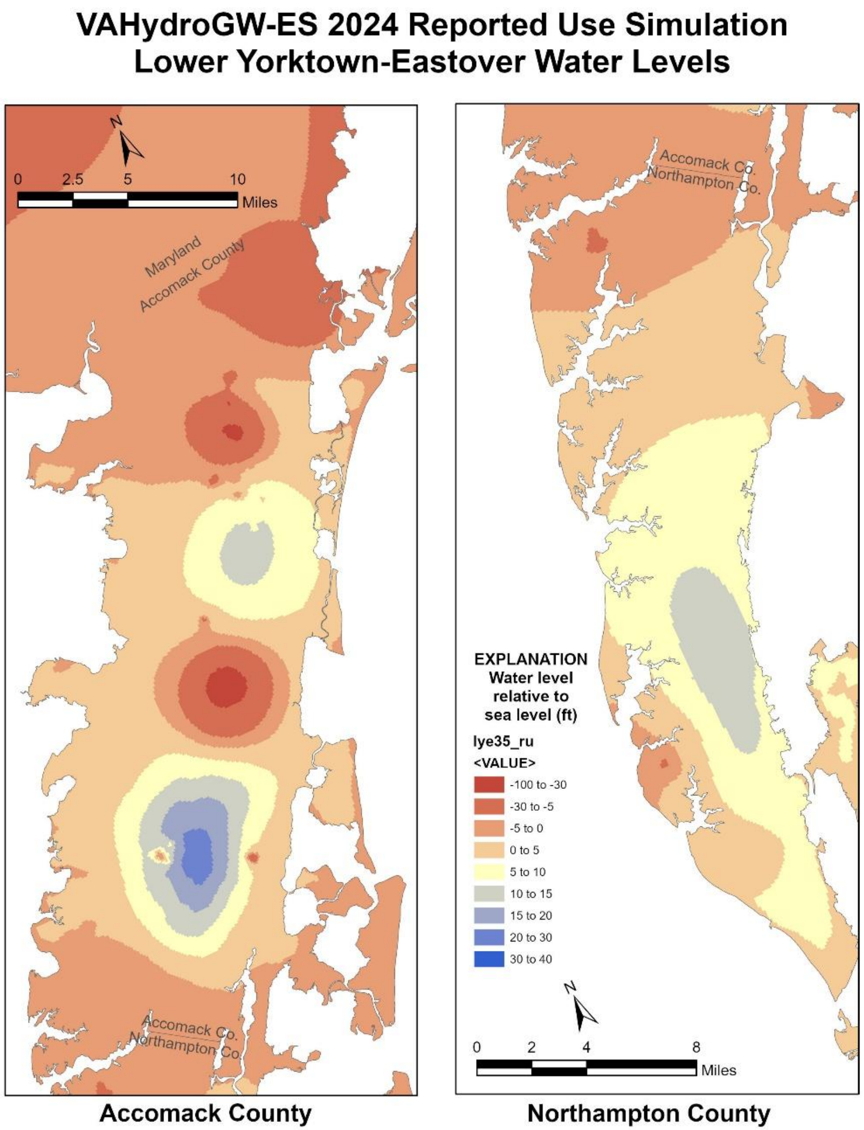
Accomack County **Northampton County**

VAHydroGW-ES 2024 Reported Use Simulation
Middle Yorktown-Eastover Water Levels



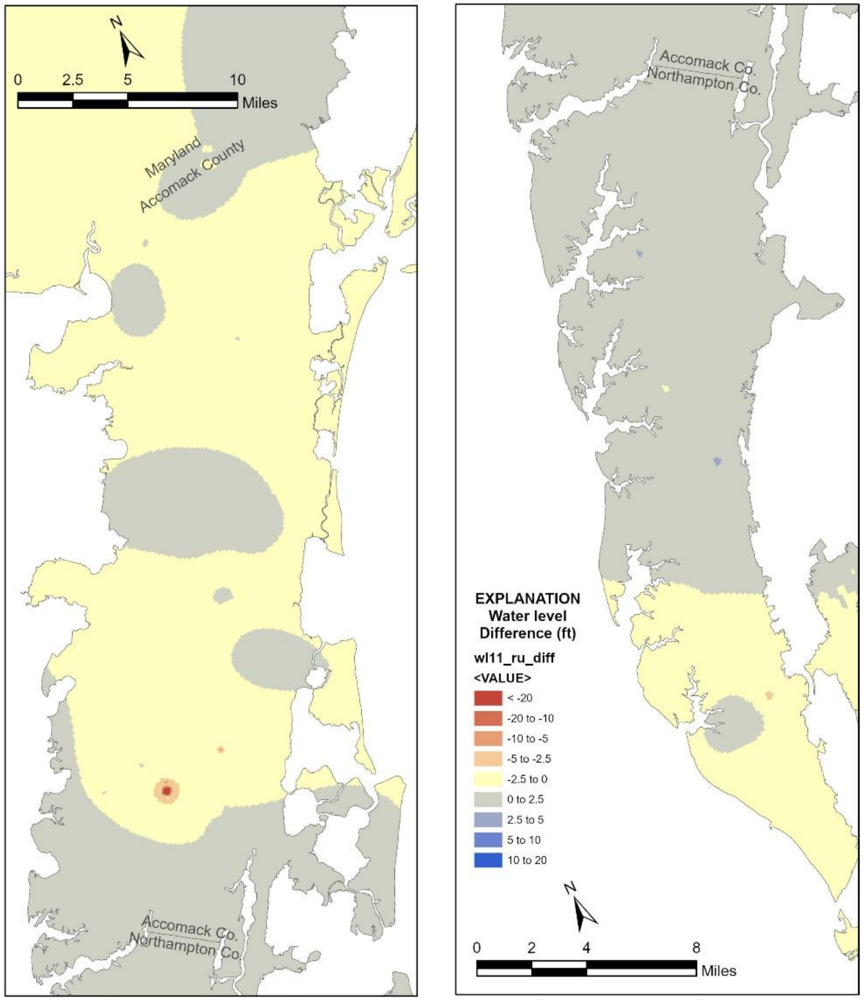
Accomack County **Northampton County**

VAHydroGW-ES – Reported Use Water Levels



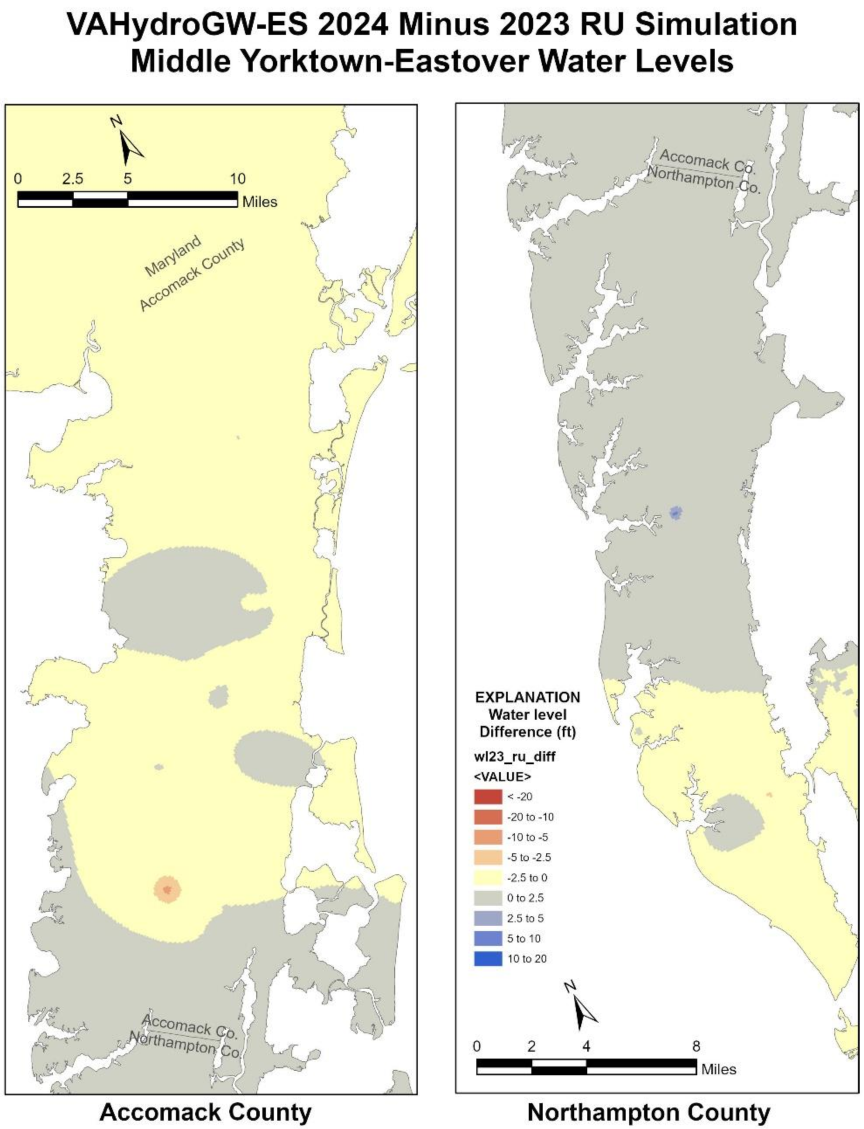
VAHydroGW-ES – Reported Use Water Levels

VAHydroGW-ES 2024 Minus 2023 RU Simulation Upper Yorktown-Eastover Water Levels



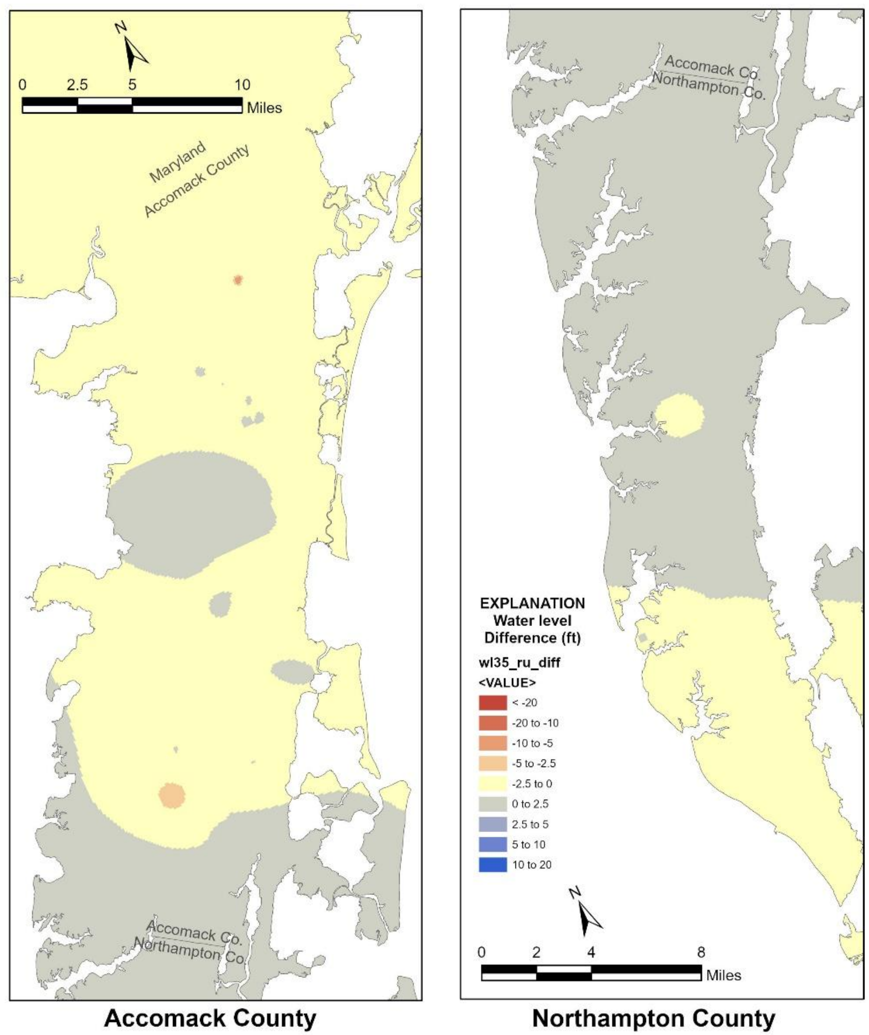
Accomack County Northampton County

VAHydroGW-ES – Reported Use Water Levels



VAHydroGW-ES – Reported Use Water Levels

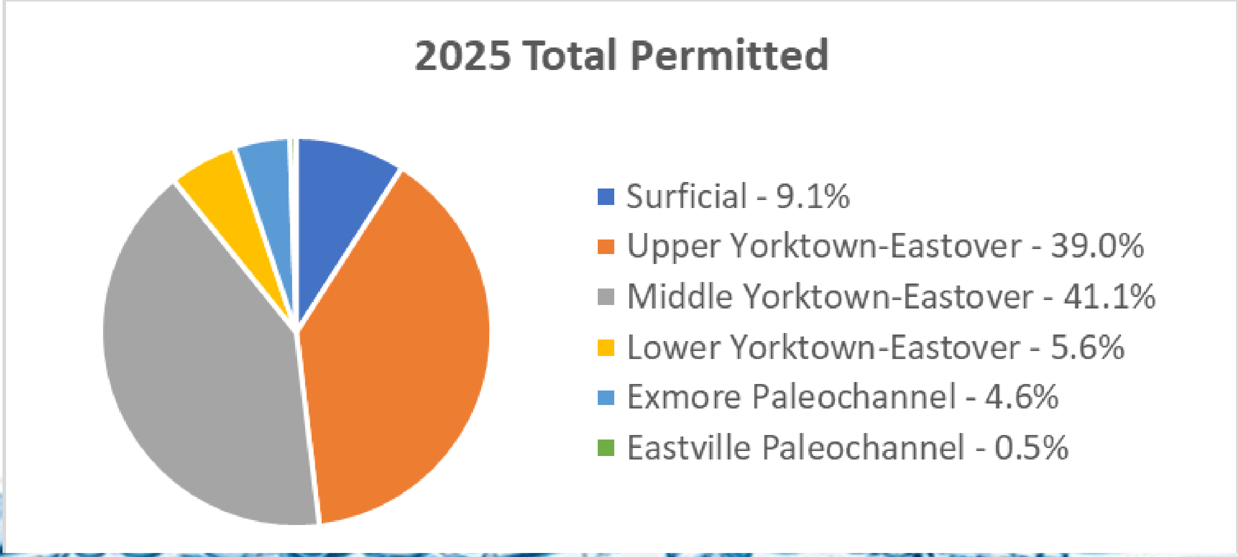
VAHydroGW-ES 2024 Minus 2023 RU Simulation
Lower Yorktown-Eastover Water Levels



How much is **permitted** to be withdrawn from the Eastern Shore in 2025?

VAHydroGW-ES – Total Permitted AQ Allocation

Aquifer	2024 Total Permitted (MGD)	2025 Total Permitted (MGD)
Surficial	0.66	0.88
Upper Yorktown-Eastover	3.99	3.80
Middle Yorktown-Eastover	3.64	4.00
Lower Yorktown-Eastover	0.55	0.55
Exmore Paleochannel	0.47	0.45
Eastville Paleochannel	0.05	0.05
TOTAL:	**9.37**	**9.73**



VAHydroGW-ES – Total Permitted County Allocation

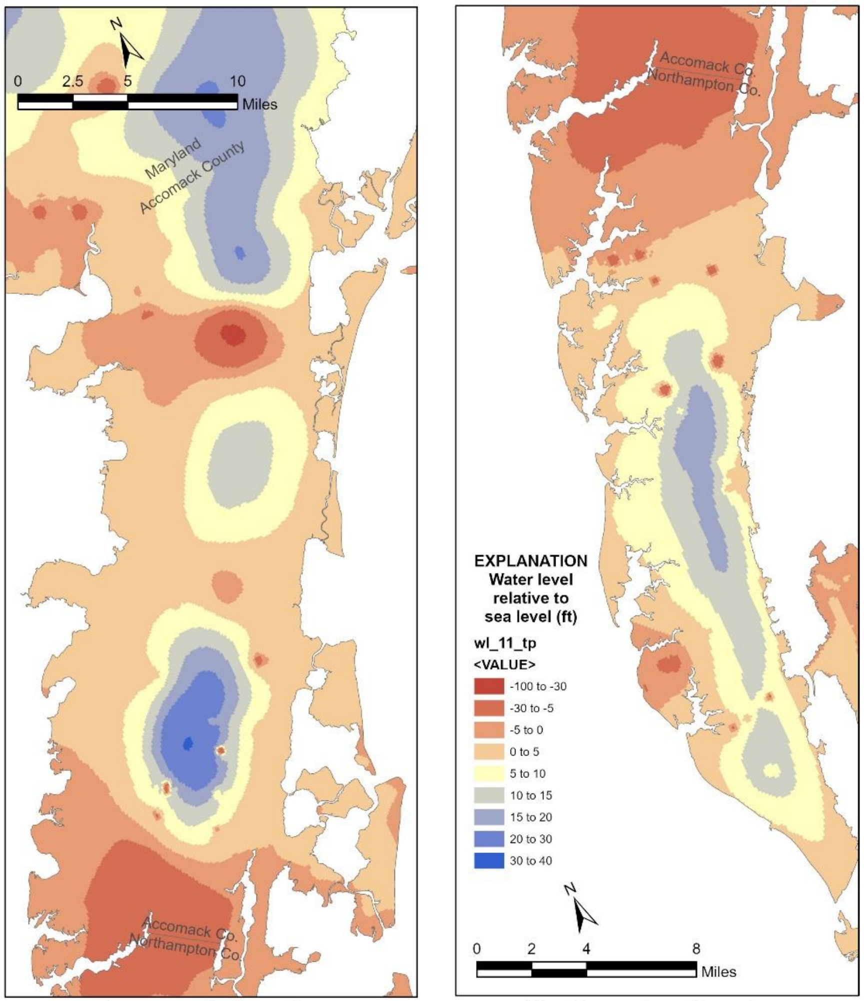
County	2024 Reported Use (MGD)	2025 Total Permitted (MGD)	RU/TP
Accomack	5.14	7.76	66.2%
Northampton	1.08	1.98	54.7%
TOTAL	**6.22**	**9.73**	**63.9%**

VAHydroGW-ES – Total Permitted Water Levels

AQUAVEO Water Modeling Solutions

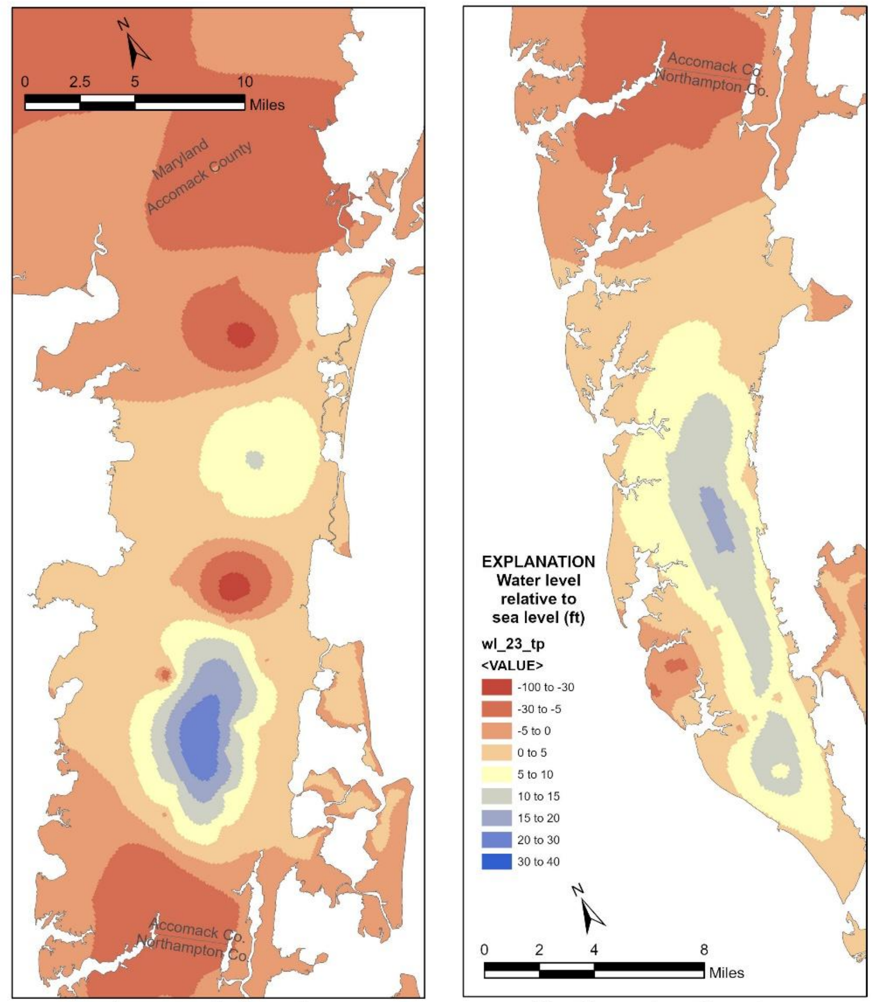
DEQ Virginia Department of Environmental Quality

VAHydroGW-ES 2025 Total Permitted Simulation Upper Yorktown-Eastover Water Levels



Accomack County | Northampton County

VAHydroGW-ES 2025 Total Permitted Simulation Middle Yorktown-Eastover Water Levels



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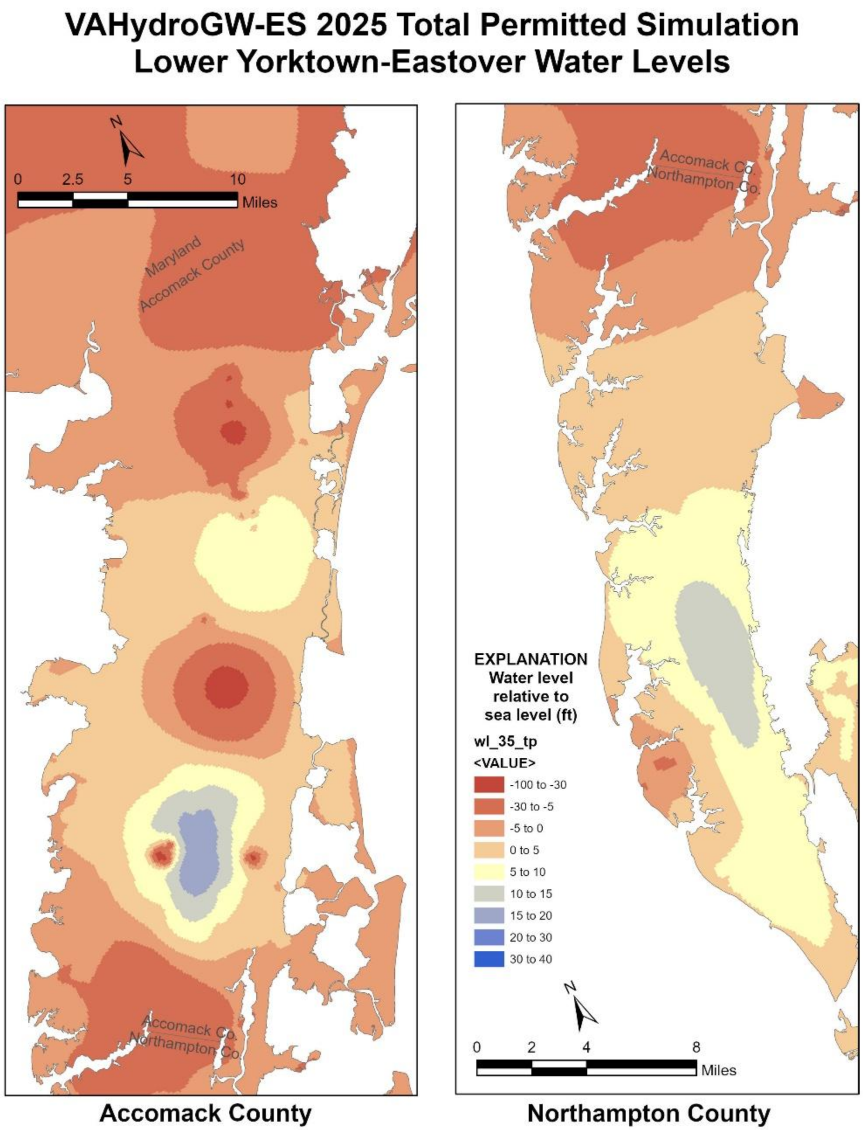
VAHydroGW-ES – Total Permitted Water Levels



VAHydroGW-ES – Total Permitted Critical Cells

- No critical cells in 2024 RU or 2025 TP models

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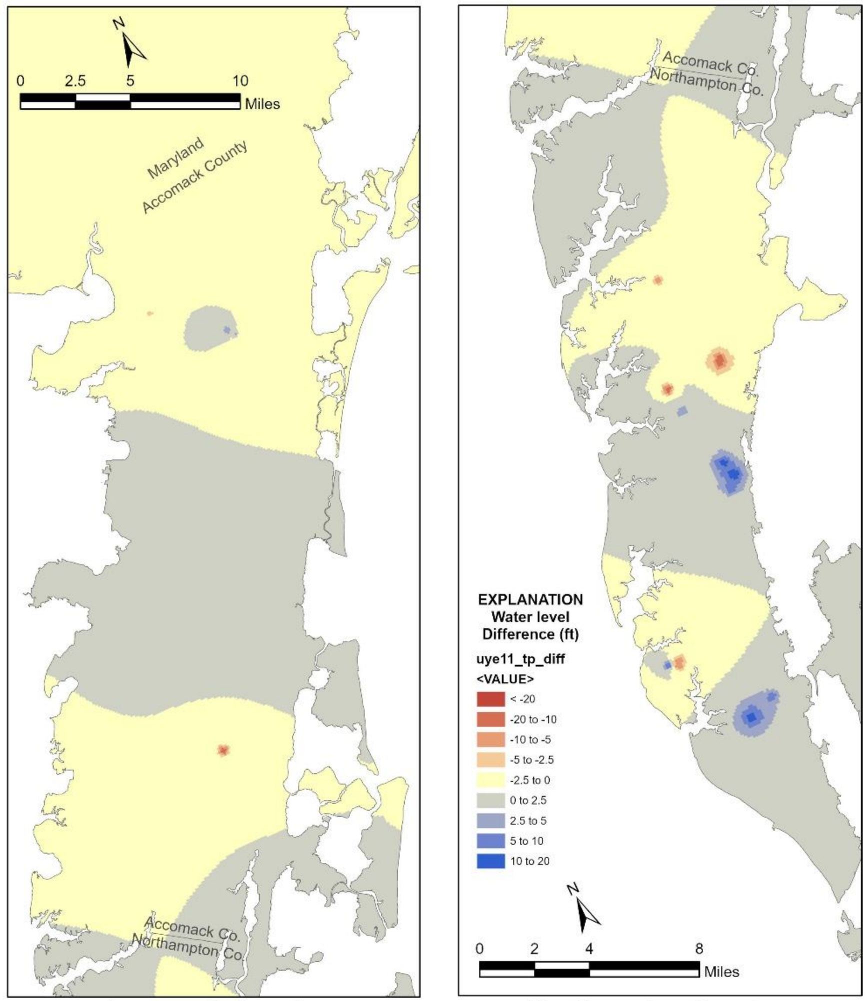
DEQ Virginia Department of Environmental Quality

VAHydroGW-ES – Total Permitted Water Levels

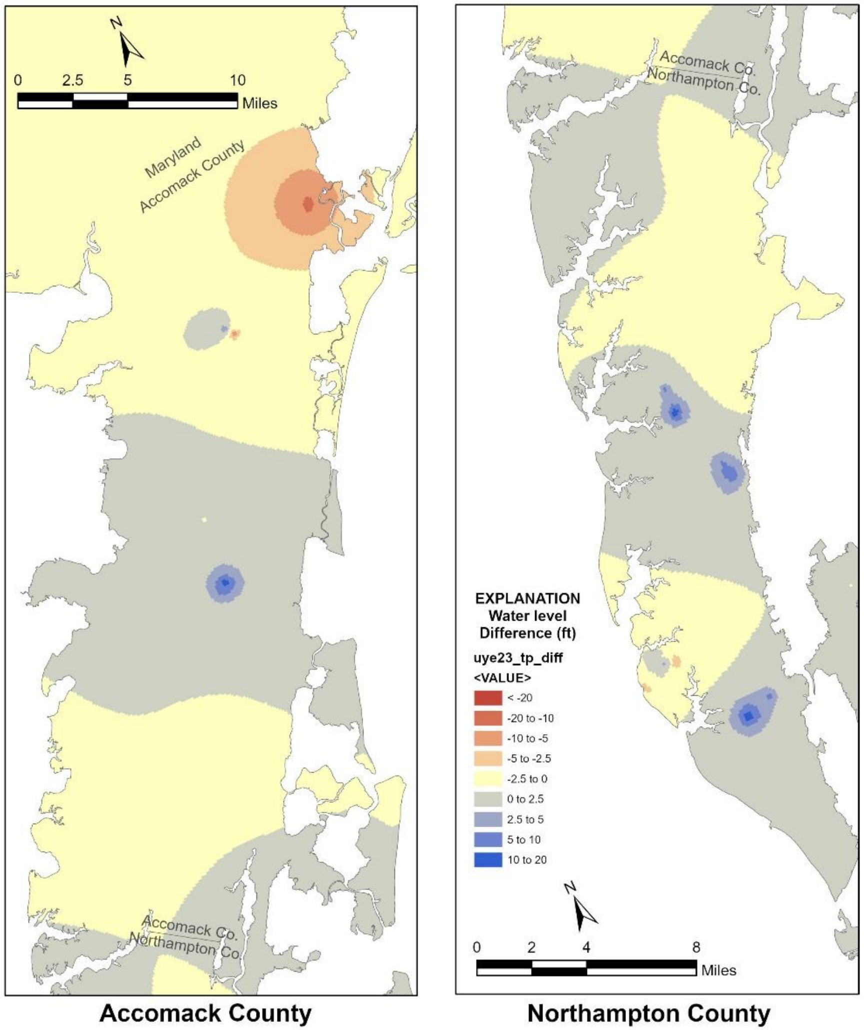
VAHydroGW-ES 2025 Minus 2024 TP Simulation
Upper Yorktown-Eastover Water Levels



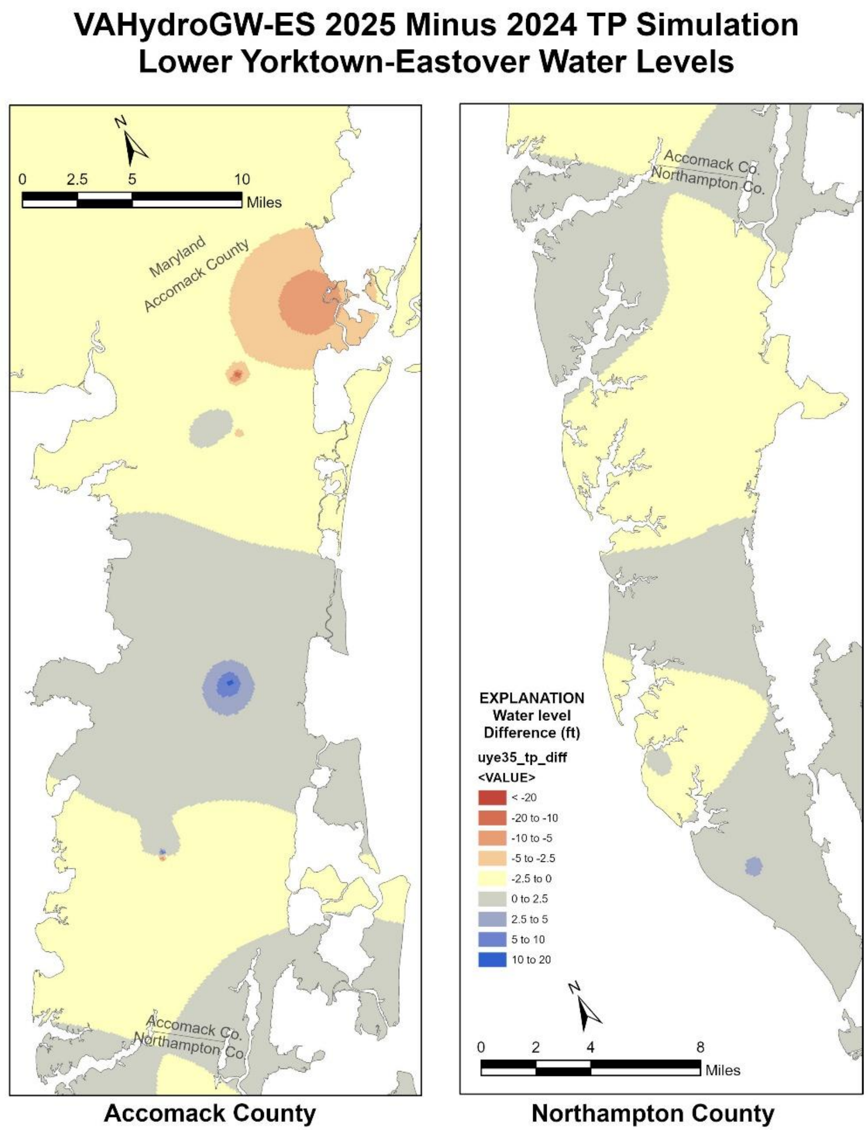
Accomack County　　Northampton County

VAHydroGW-ES – Total Permitted Water Levels

VAHydroGW-ES 2025 Minus 2024 TP Simulation
Middle Yorktown-Eastover Water Levels

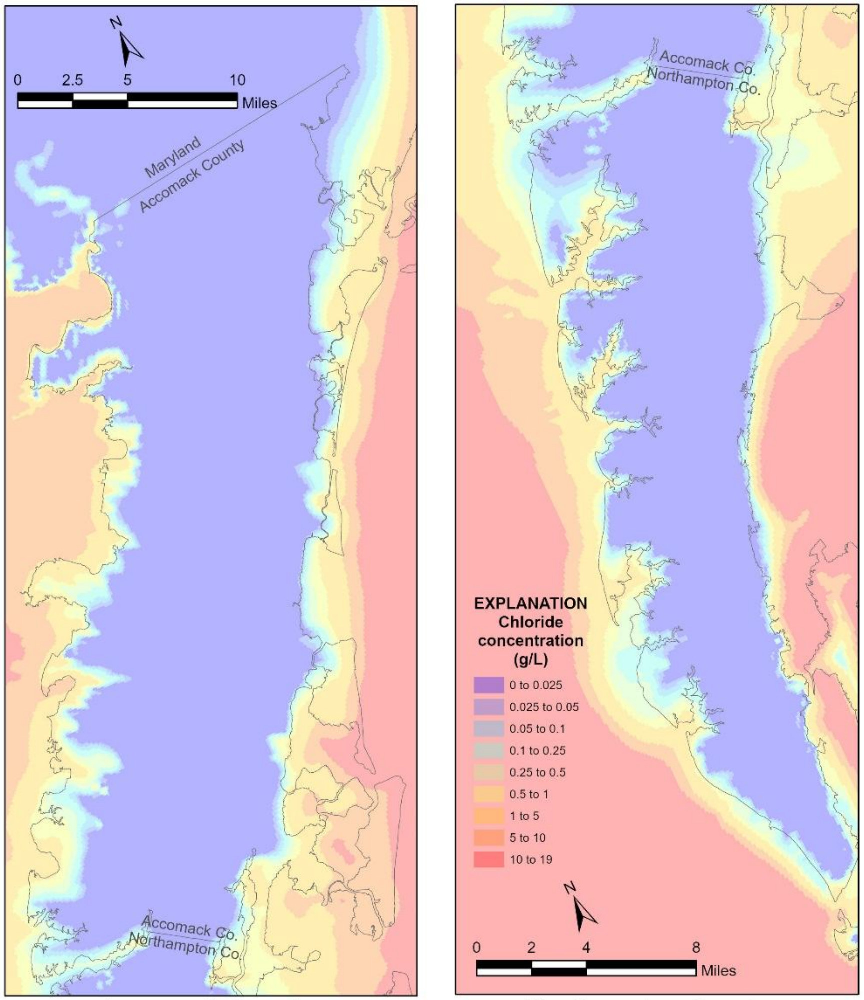


VAHydroGW-ES – Total Permitted Water Levels



VAHydroGW-ES – TP Chloride Concentrations

VAHydroGW-ES 2025 Total Permitted Simulation Upper Yorktown-Eastover Chloride Concentrations



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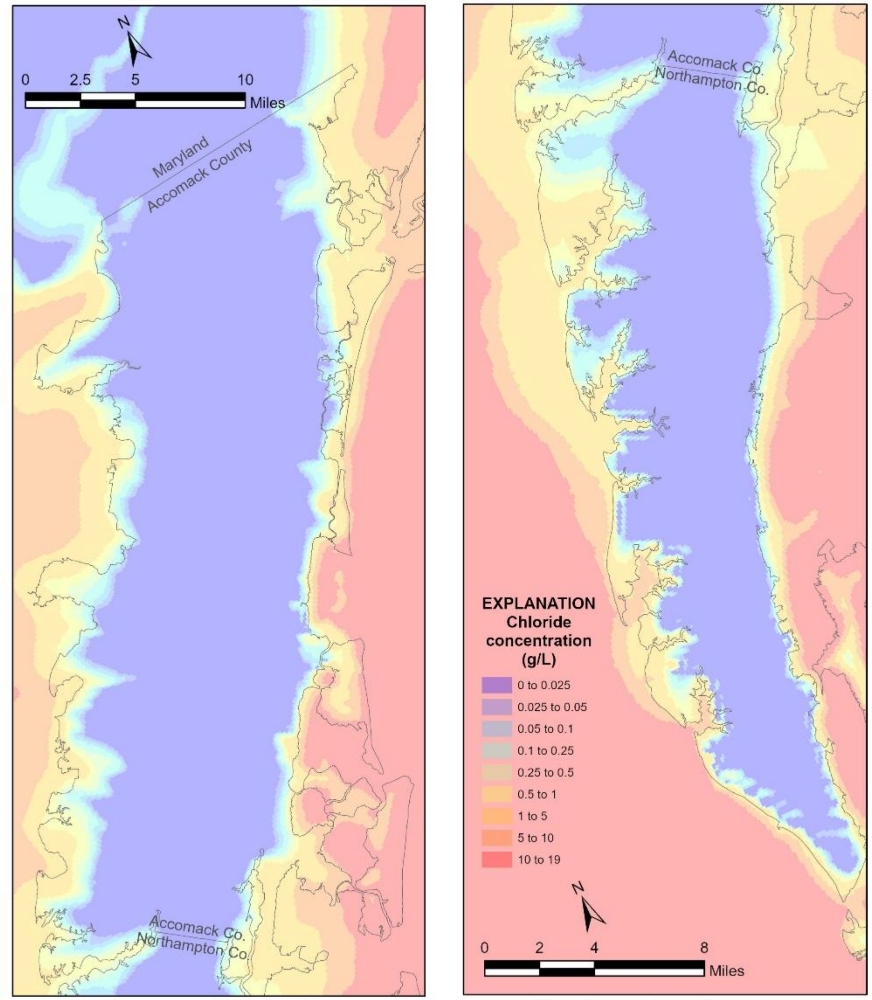
VAHydroGW-ES 2025 Total Permitted Simulation Middle Yorktown-Eastover Chloride Concentrations



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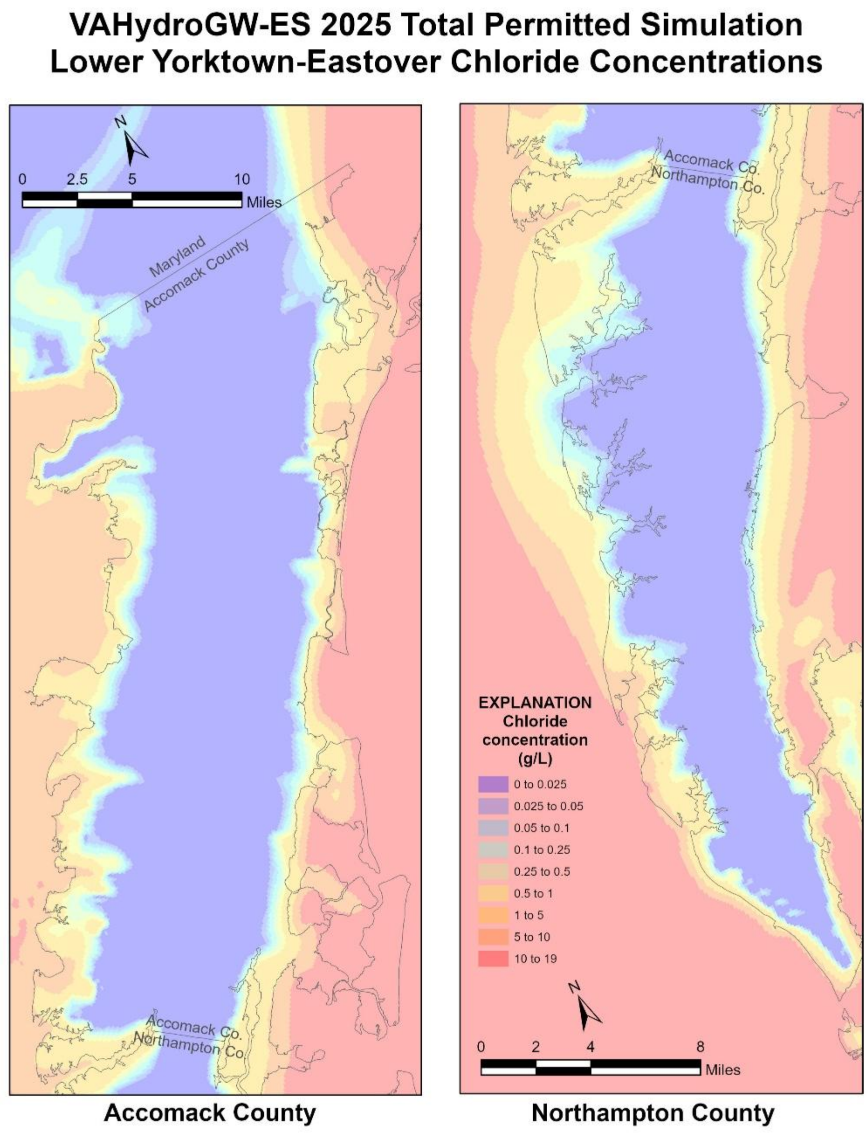
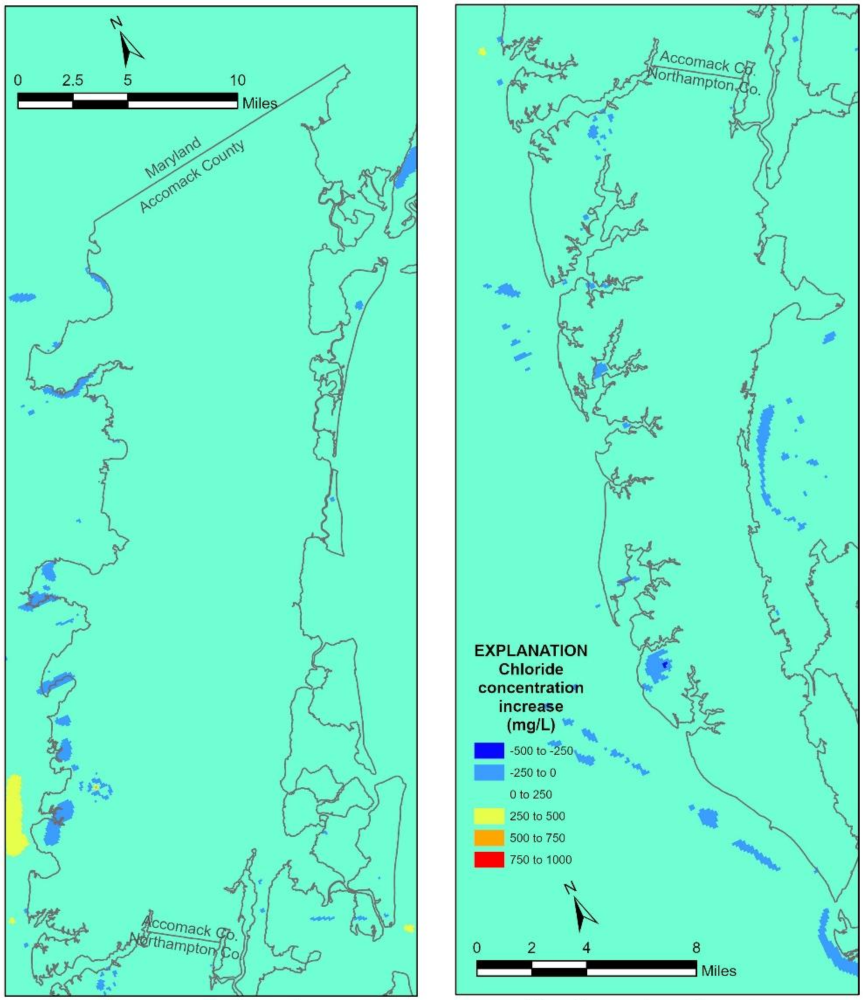
VAHydroGW-ES – TP Chloride Concentrations



VAHydroGW-ES – Chloride Concentrations Comparison

VAHydroGW-ES 2025 Upper Yorktown-Eastover Aquifer Chloride Concentrations Increase - Total Permitted versus Reported Use



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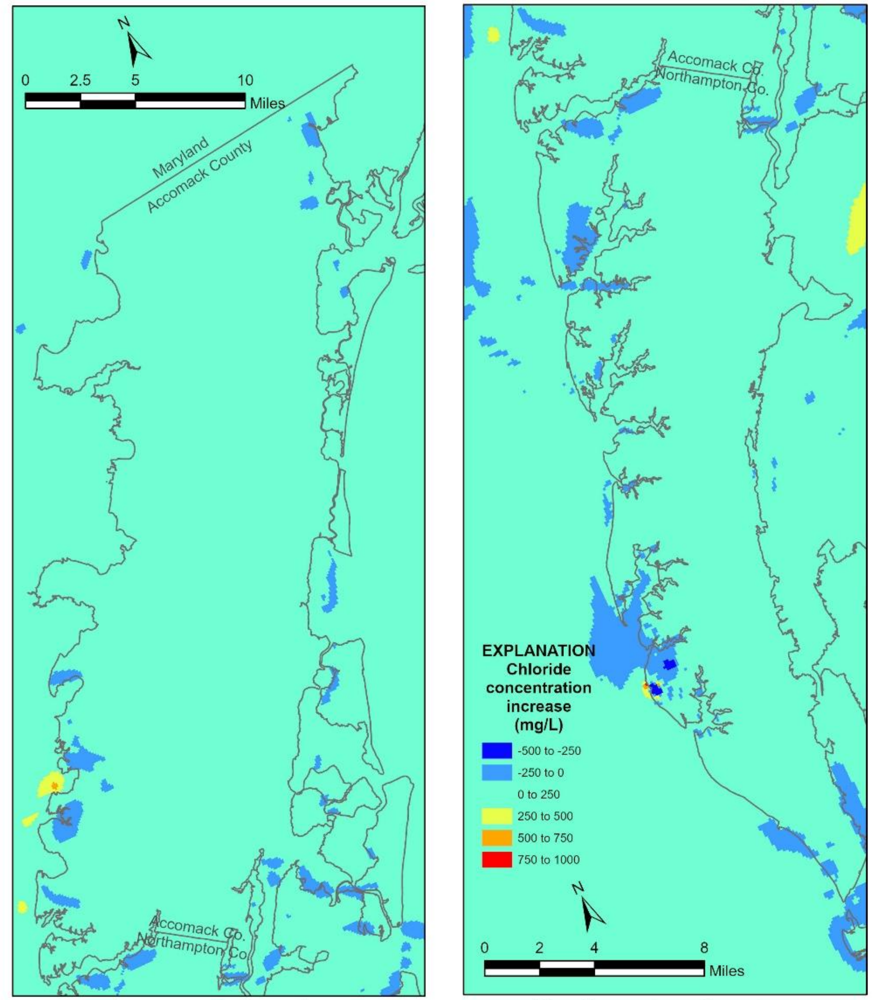
VAHydroGW-ES 2025 Middle Yorktown-Eastover Aquifer Chloride Concentrations Increase - Total Permitted versus Reported Use



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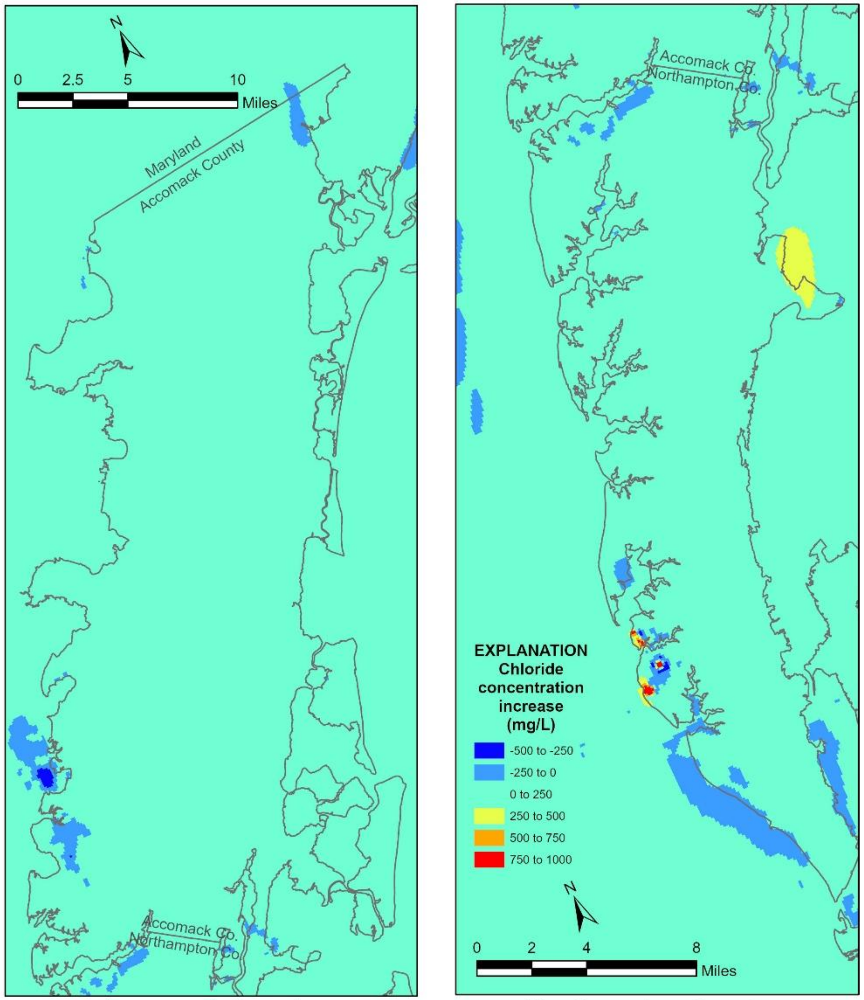
VAHydroGW-ES – Chloride Concentrations Comparison

VAHydroGW-ES 2025 Lower Yorktown-Eastover Aquifer
Chloride Concentrations Increase -
Total Permitted versus Reported Use



Accomack County

Northampton County

Senate Joint Resolution No. 25: Groundwater Supply East of Interstate 95

Summary of Technical Findings for Eastern Virginia Groundwater Management Advisory Committee

Brian J. Campbell, P.G.
Groundwater Characterization and Monitoring Manager
Virginia Department of Environmental Quality
April 8, 2026

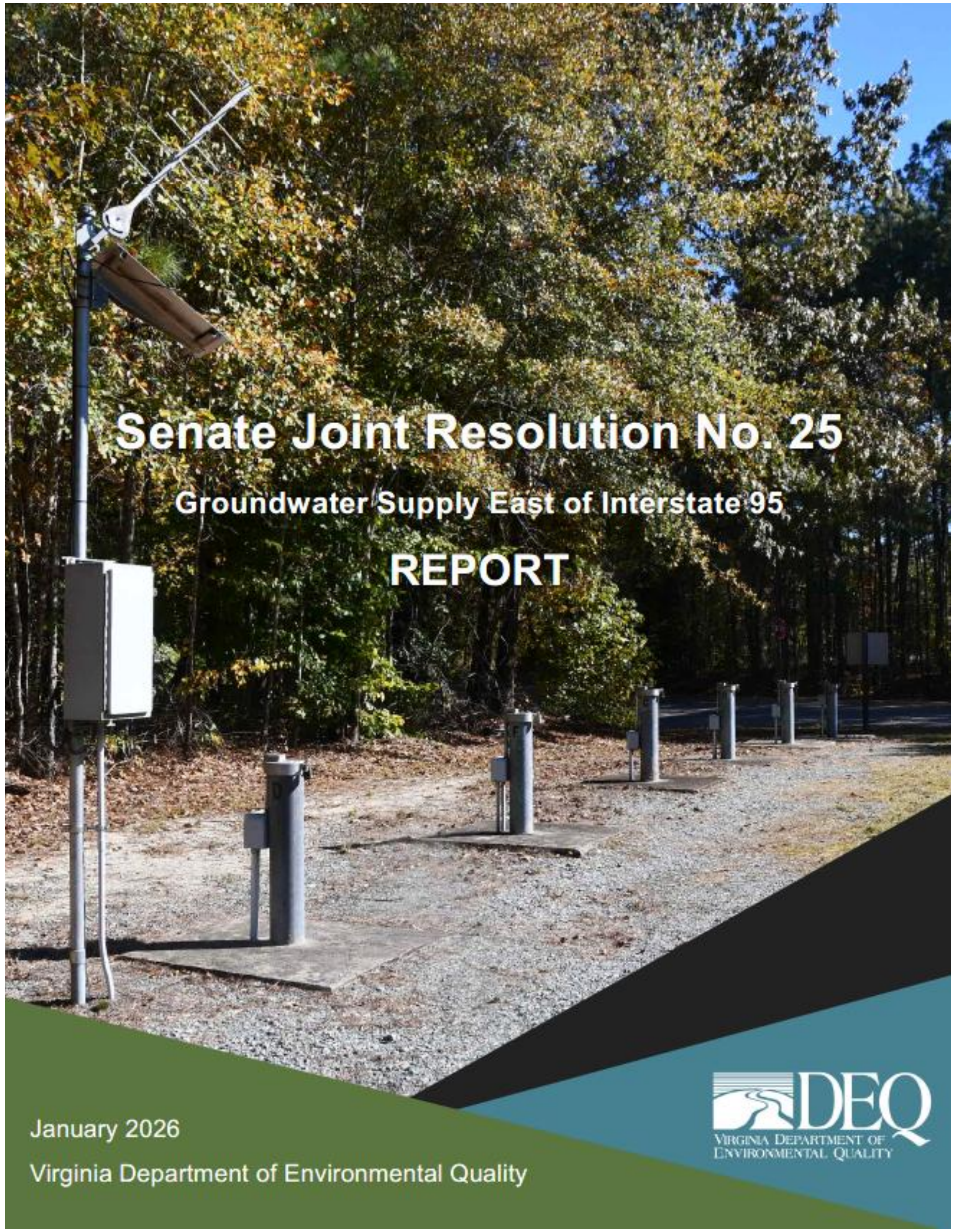
Acknowledgments

- DEQ Water Resources Division
  - Groundwater Characterization and Monitoring Program
  - Water Supply Planning and Analysis Program
  - Office of Water Withdrawal Permitting
- DEQ Policy Division
- U.S. Geological Survey (USGS)
  - Virginia and West Virginia Water Science Center
- Aquaveo, LLC

DEQ

Outline

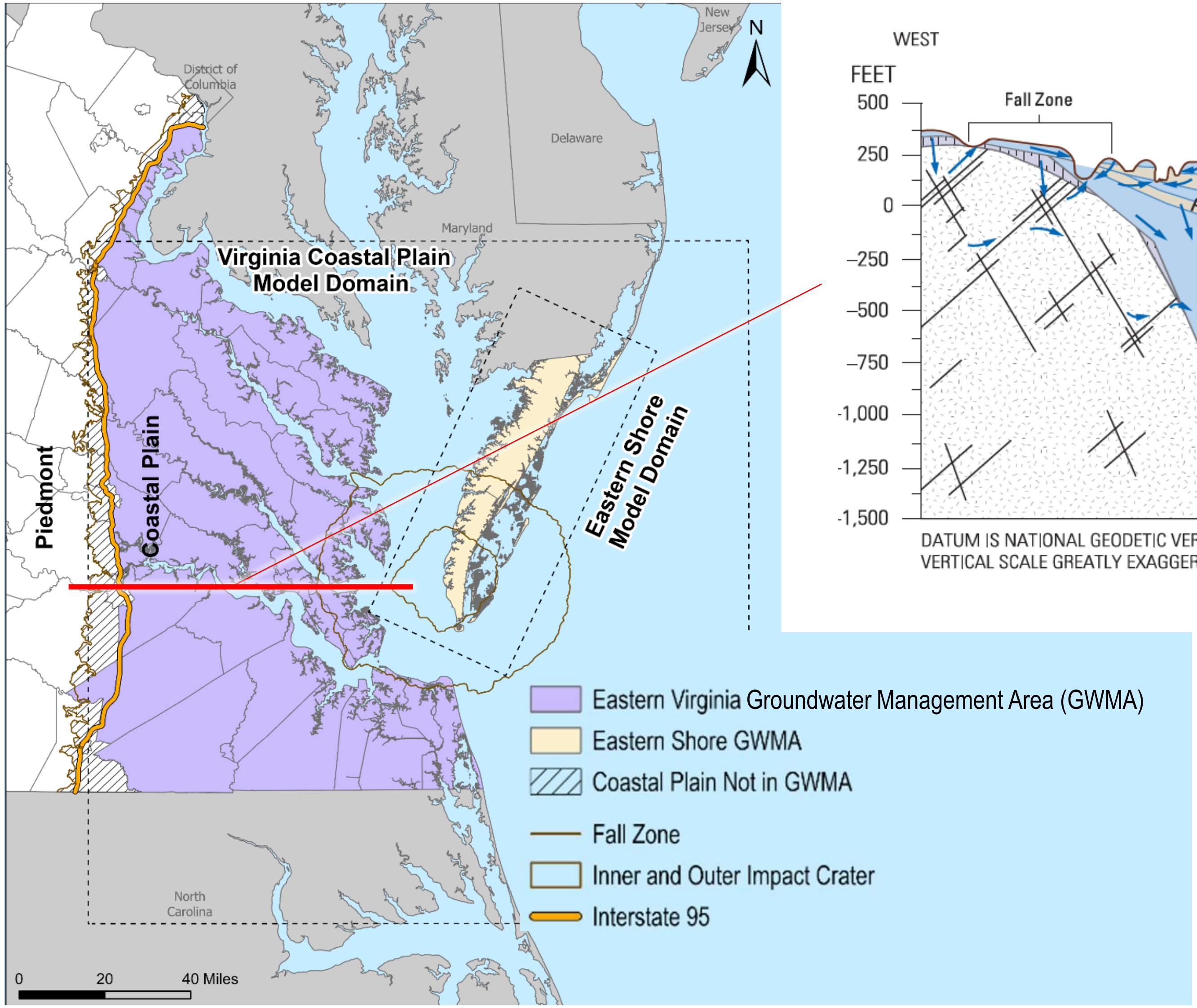
- Focusing on Eastern Virginia Groundwater Mgmt Area
- Overview of aquifer system and groundwater (GW) supply
- Historical context
- Observed GW-level data
- Model-based analyses
- GW quality
- Brief assessment of Ground Water Management Act of 1992

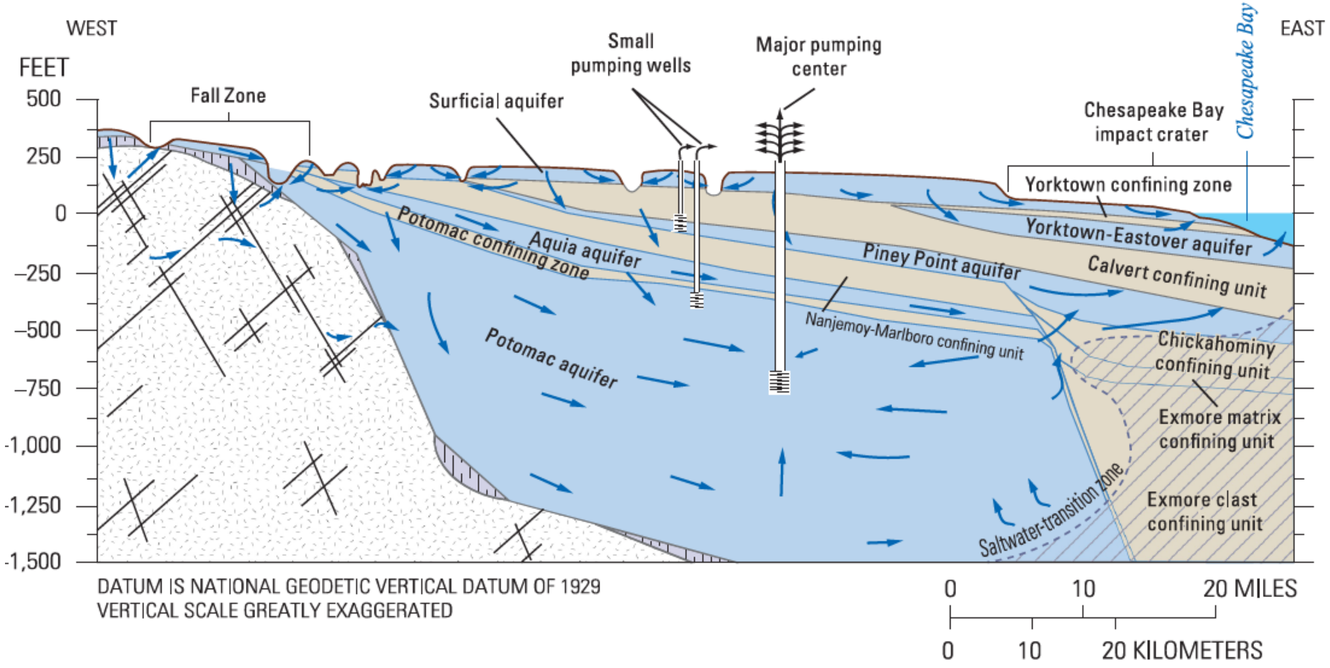


DEQ

Overview of Aquifer System and GW Supply

Virginia Coastal Plain (VCP) Aquifer System

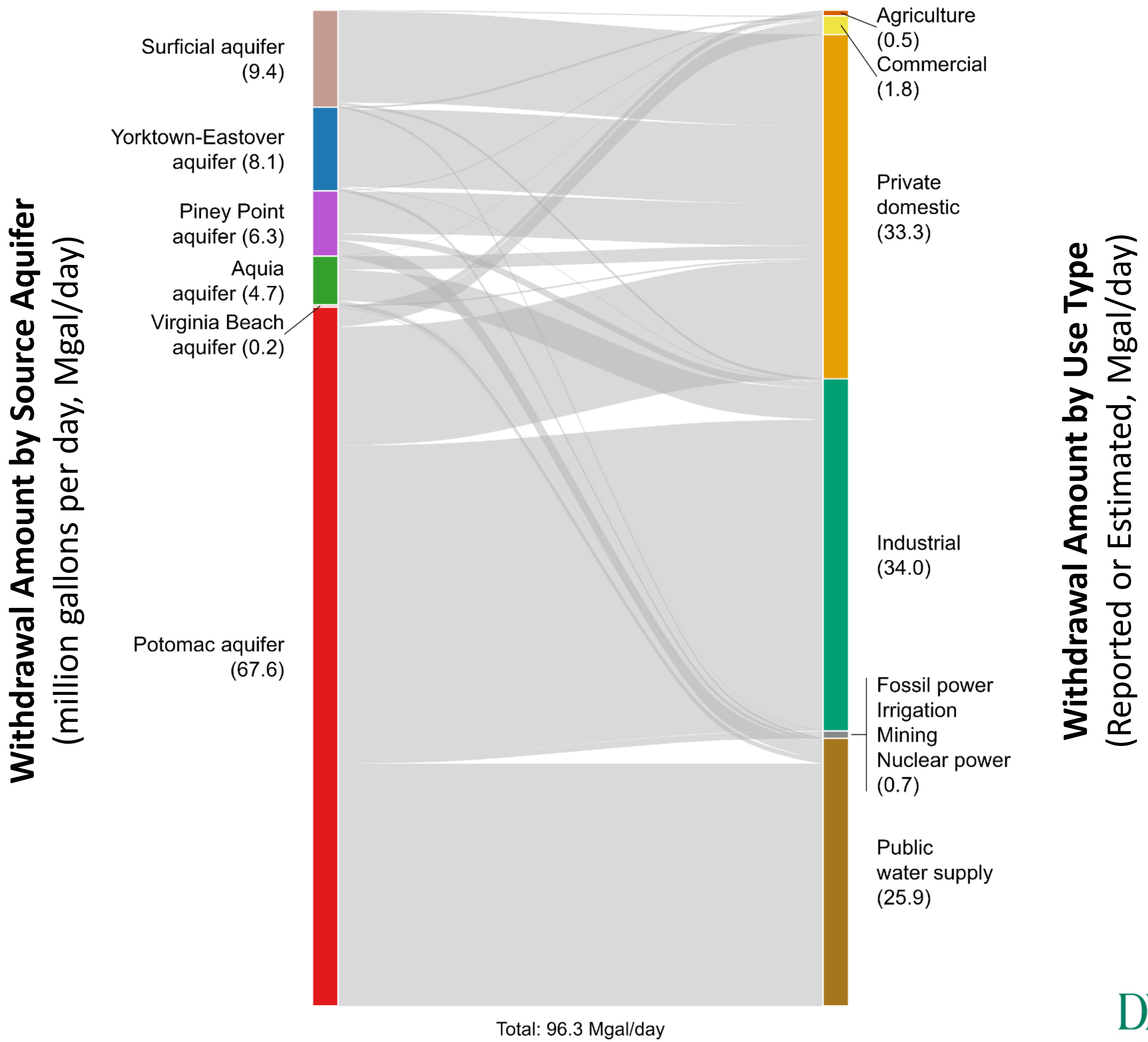




DEQ

VCP Aquifers and GW Use Types

- Eastern Virginia GW Mgmt Area shown
- Potomac aquifer
  - Largest and deepest
  - 70% of total withdrawal
- Main uses
  - Industrial (35%)
  - Private domestic (35%) – **growing**
  - Public water supply (27%)

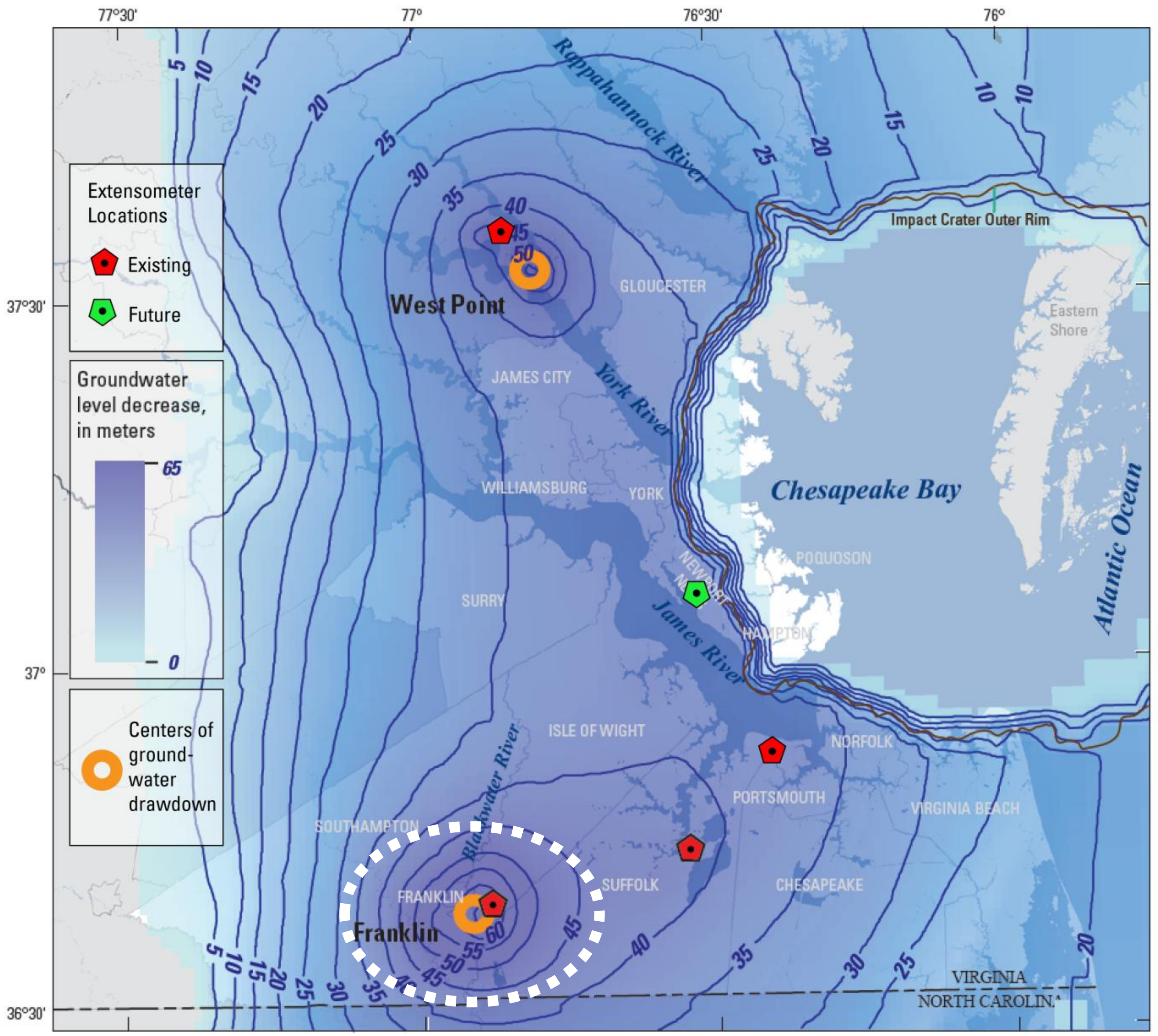


DEQ

Historical Context

GW Levels and Flows

- Potomac aquifer shown
- Major industrial withdrawals since early 1900s
- GW levels declined below sea level
- Altered flow patterns (now inward and downward)
- Land subsidence (sinking)
- Potential for regional saltwater intrusion



Map made from U.S. Geological Survey and Virginia Department of Game and Inland Fisheries data
Virginia State plane projection
Virginia south Federeal Information Processing Standard (FIPS) 4502
North American Datum 1983 (NAD83)

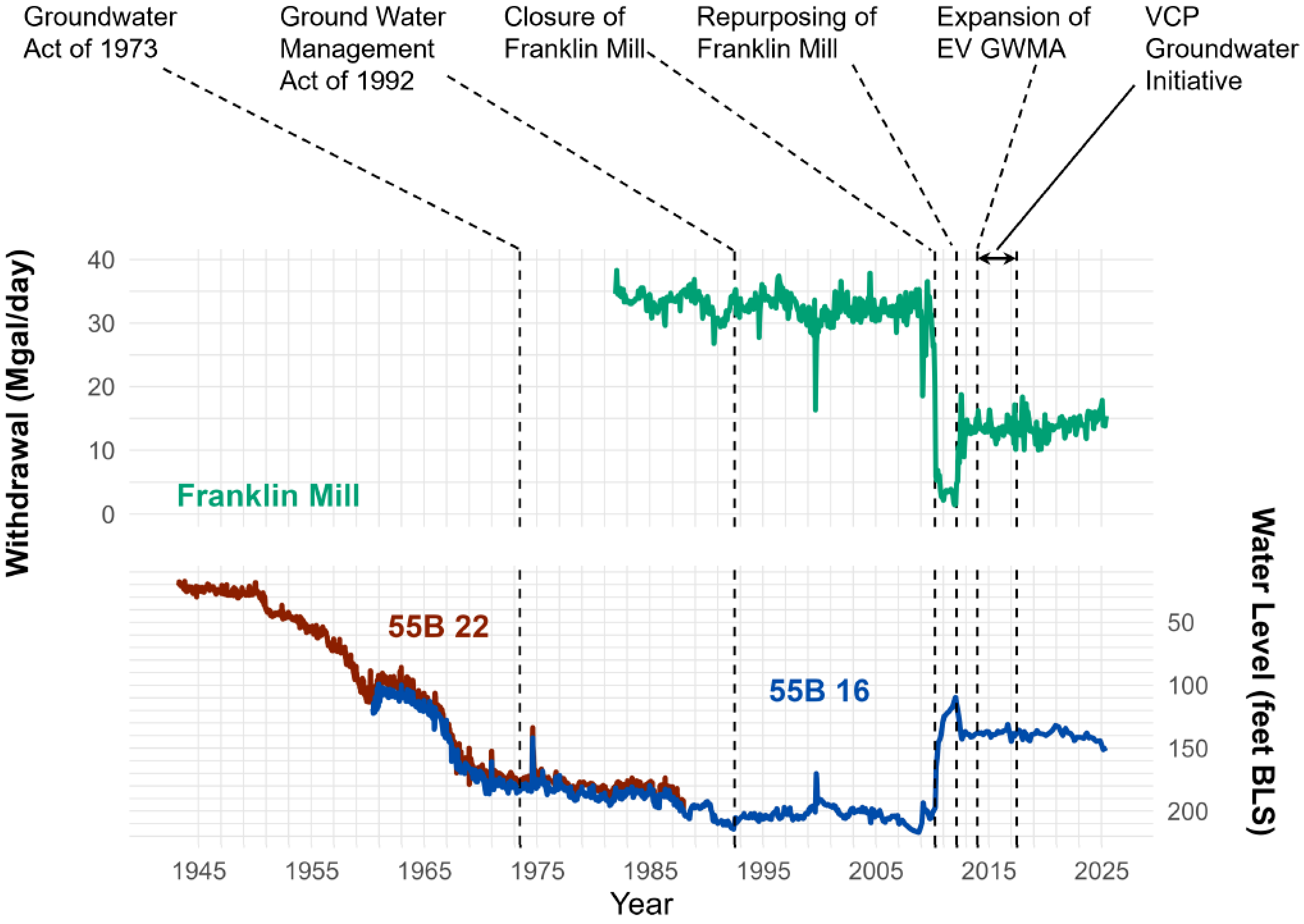
0 20 MILES
0 10 20 KILOMETERS

https://www.usgs.gov/media/images/virginia-extensometer-network

DEQ

Historical Withdrawals and GW Levels

Near Franklin, 1941. Potomac-aquifer water level 7 feet above land surface (Cederstrom, 1945).

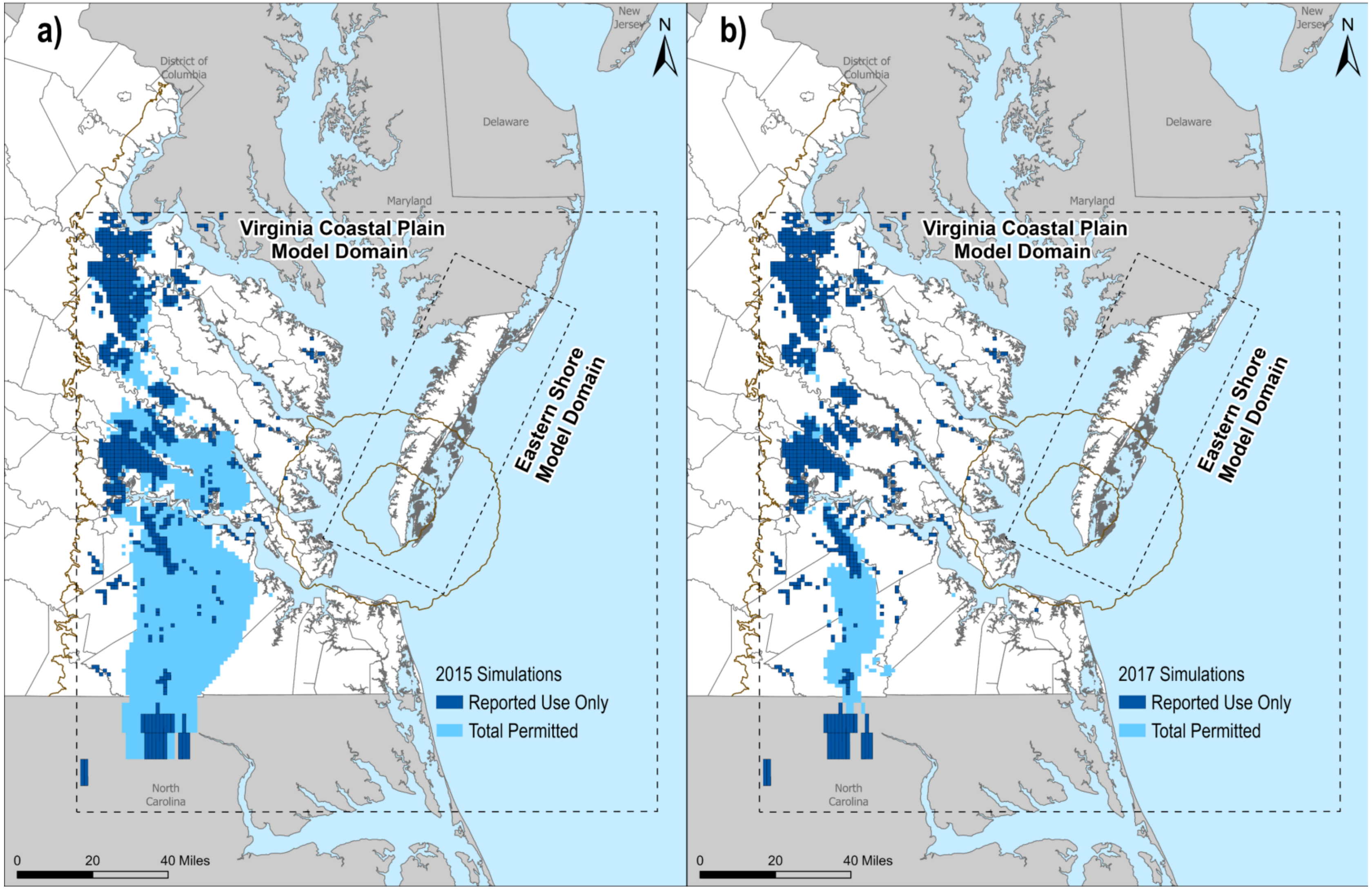


DEQ

VCP GW Initiative

50-year simulations in 2015

Before negotiated reductions of largest permitted withdrawal limits



50-year simulations in 2017

After negotiated reductions

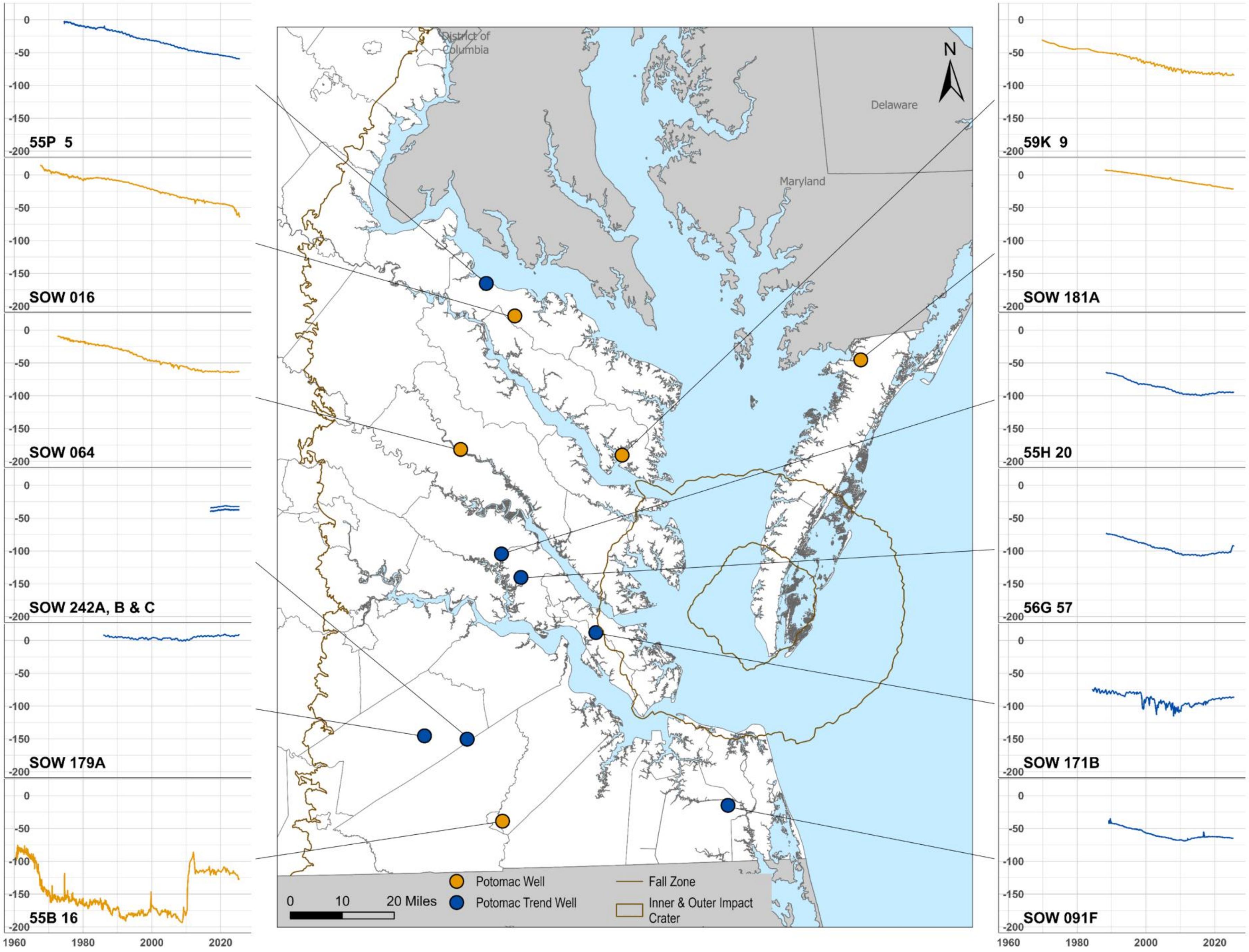
Note smaller extent of “total permitted” critical cells (where model predicted unacceptably low future water levels)

DEQ

Analyses of Observed GW-Level Data

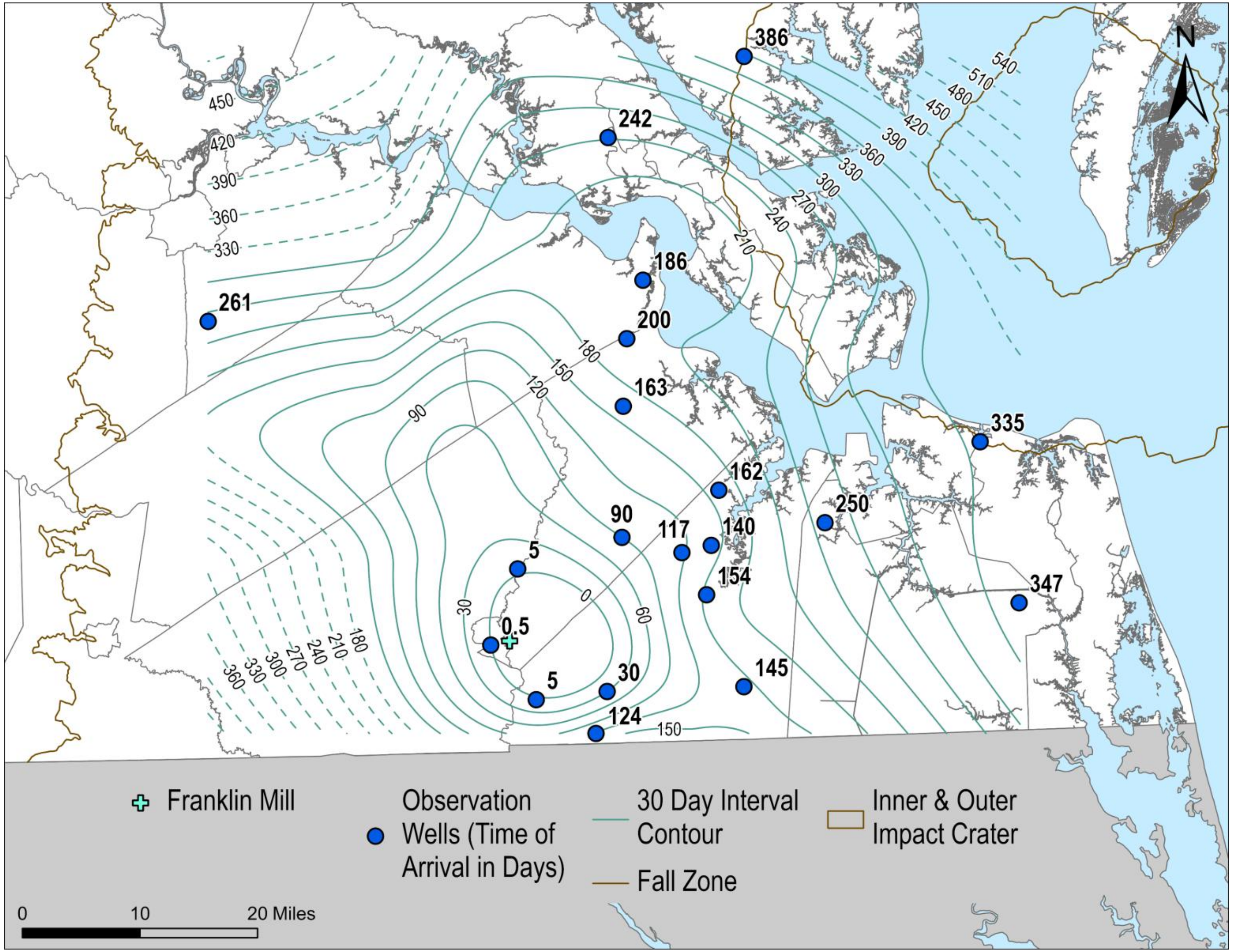
Selected Hydrographs

- Potomac aquifer GW levels
- Plotted on consistent axes
- Blue wells selected for GW-level trend analysis (later slide)
- Note post-2010 inflection points



Analysis of 2010 Franklin Mill Closure Pressure Effects

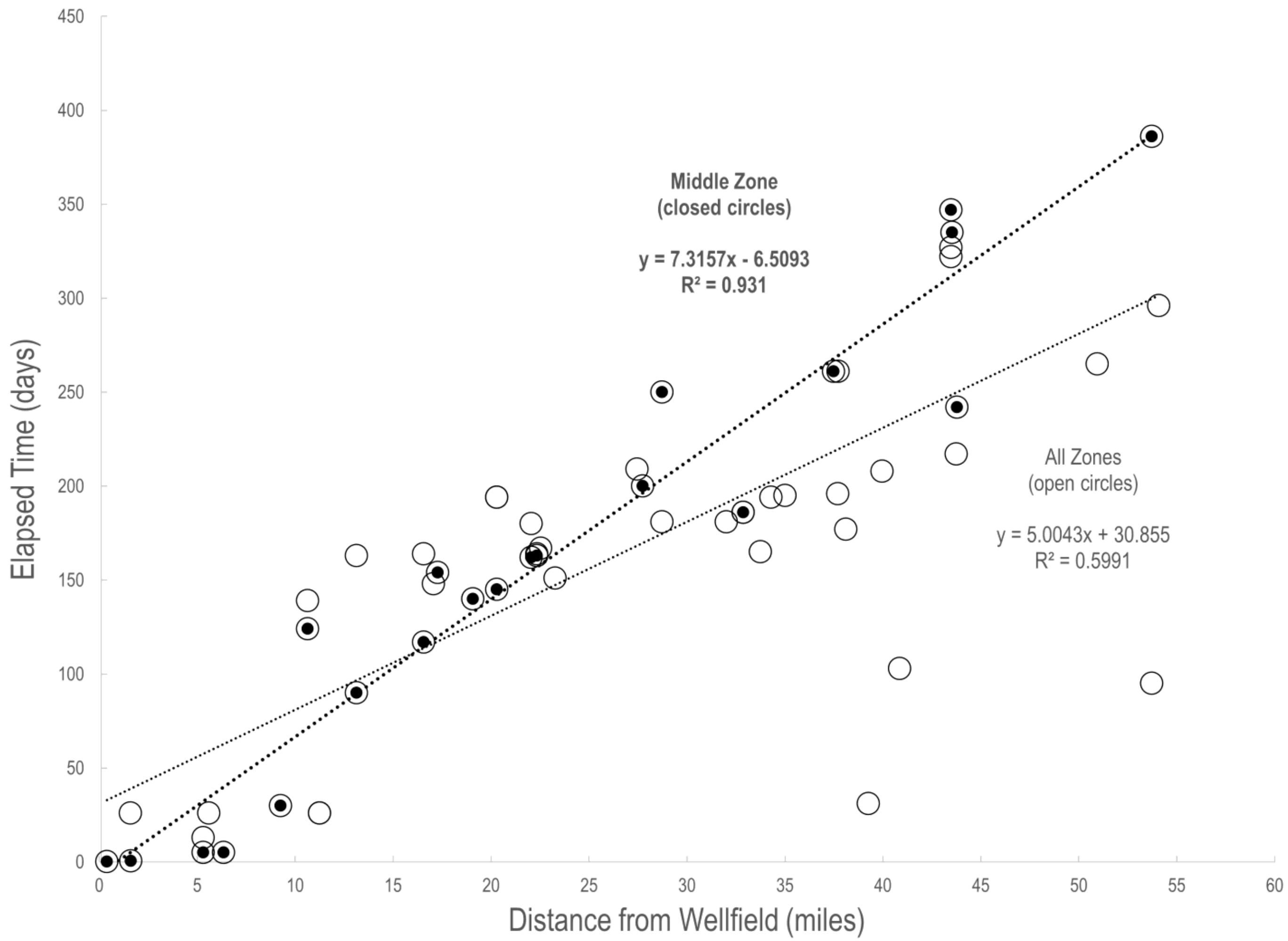
- Reviewed hydrographs to identify inflection point indicating arrival of pressure effects
- Mapped the locations to determine travel time vs. distance



DEQ

Lateral Propagation of Franklin Mill Closure Signal

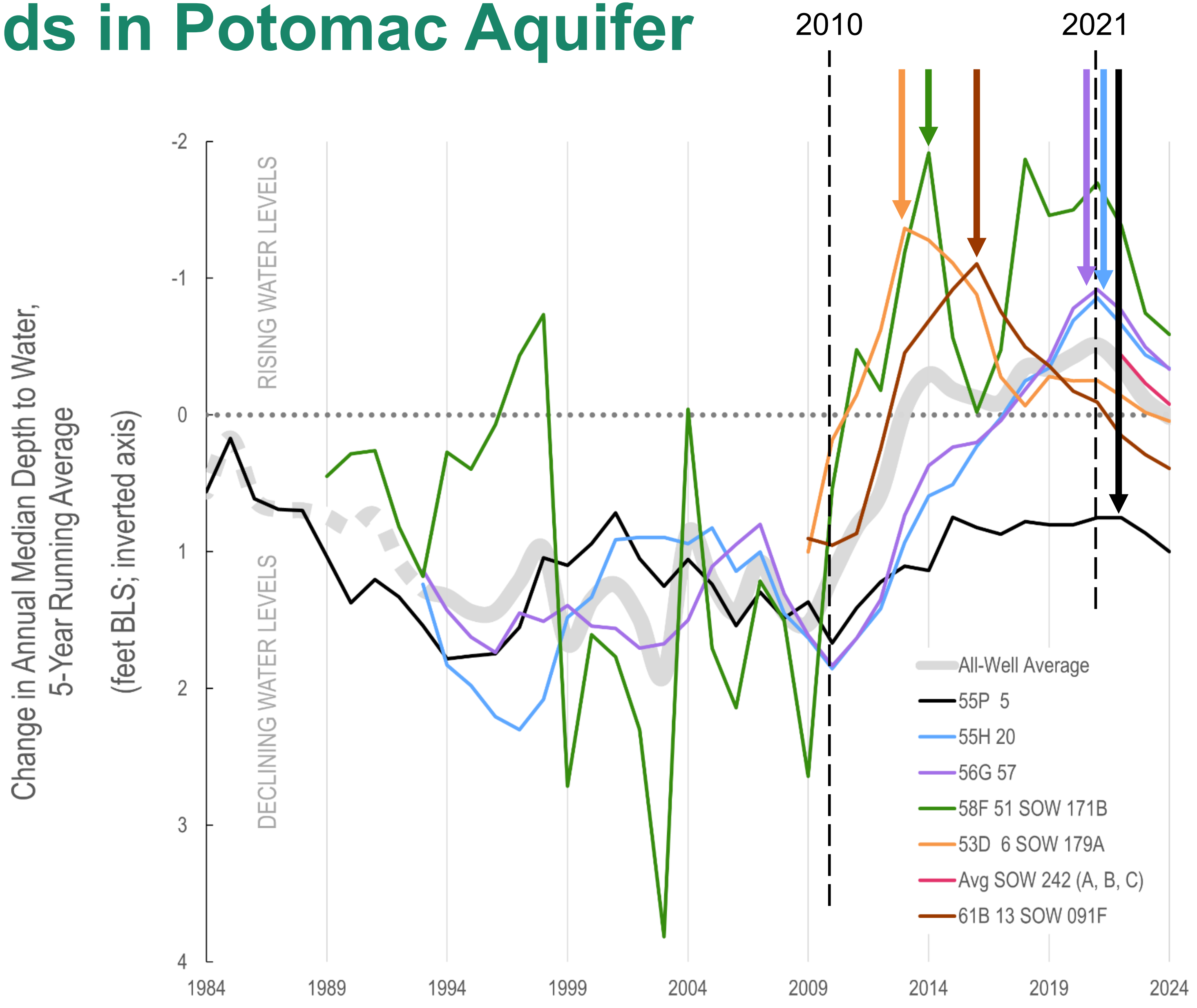
- Pressure front propagated through middle zone of Potomac aquifer at ~0.14 miles/day or **270,000 feet/year**
- Compare with USGS estimated bulk GW flow rates of up to **10 feet/year**



DEQ

Observed GW-Level Trends in Potomac Aquifer

- Trend wells (colored lines) with overall average (thick gray line)
- After 2010, GW levels across the Potomac aquifer broadly rose and stabilized for about a decade
- By around 2021, rising trends stalled and began to reverse
- Levels throughout Potomac aquifer projected to resume declining in the next 5 to 10 years

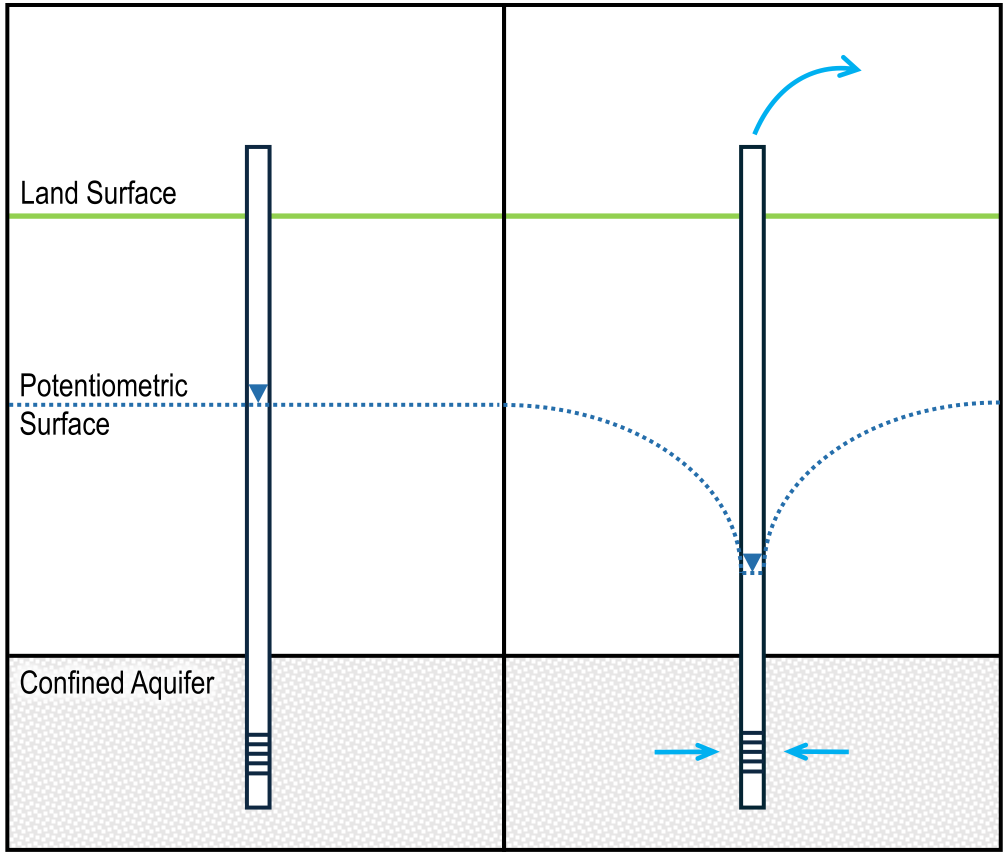


DEQ

Implications for Managed Aquifer Recharge (MAR)

- Within the Potomac aquifer, pressure effects may travel tens of thousands of times faster than the typical flow of GW molecules
- **Injections into the aquifer may yield a regional increase in GW levels with only local migration of the injected water itself**
- **However, regional GW-level gains may be sensitive to disruption and could prove transient if injections were suspended for any reason**
- This finding complicates the forecasting of GW levels that could result from MAR projects, such as the Sustainable Water Initiative for Tomorrow (SWIFT)
- The next two slides illustrate the conceptual difference between injected water molecules and the resulting pressure effects

Pressure Effects of Withdrawal



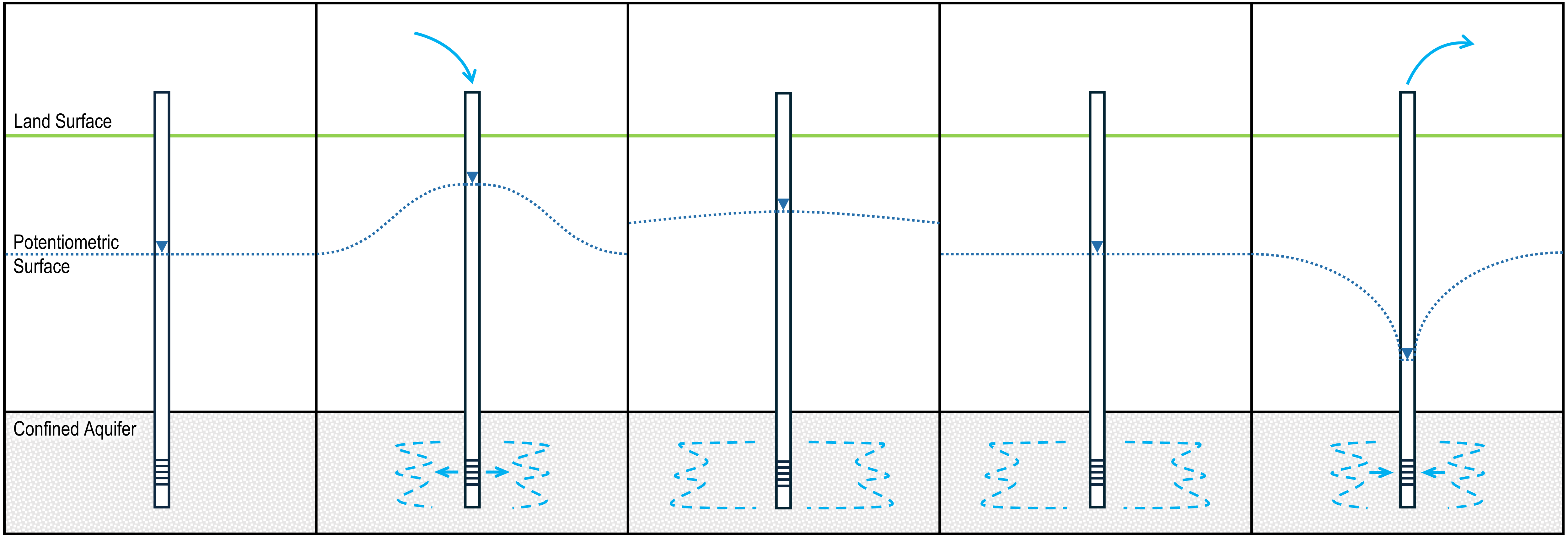
Time t_0
Hydraulic equilibrium

Time t_1
GW withdrawal
Hydraulic drawdown

Conceptual diagrams not to scale

DEQ

Pressure Effects of Injection and Later Withdrawal



Time t_0	Time t_1	Time t_2	Time t_3	Time t_4
Hydraulic equilibrium	Injection of water	Post-injection plume	Post-injection plume	Withdrawal of injected water
	Local hydraulic buildup	Local hydraulic decline	Return to hydraulic equilibrium	Hydraulic drawdown
	Lateral propagation of pressure front	Continued diffusion of broader hydraulic gains		

DEQ

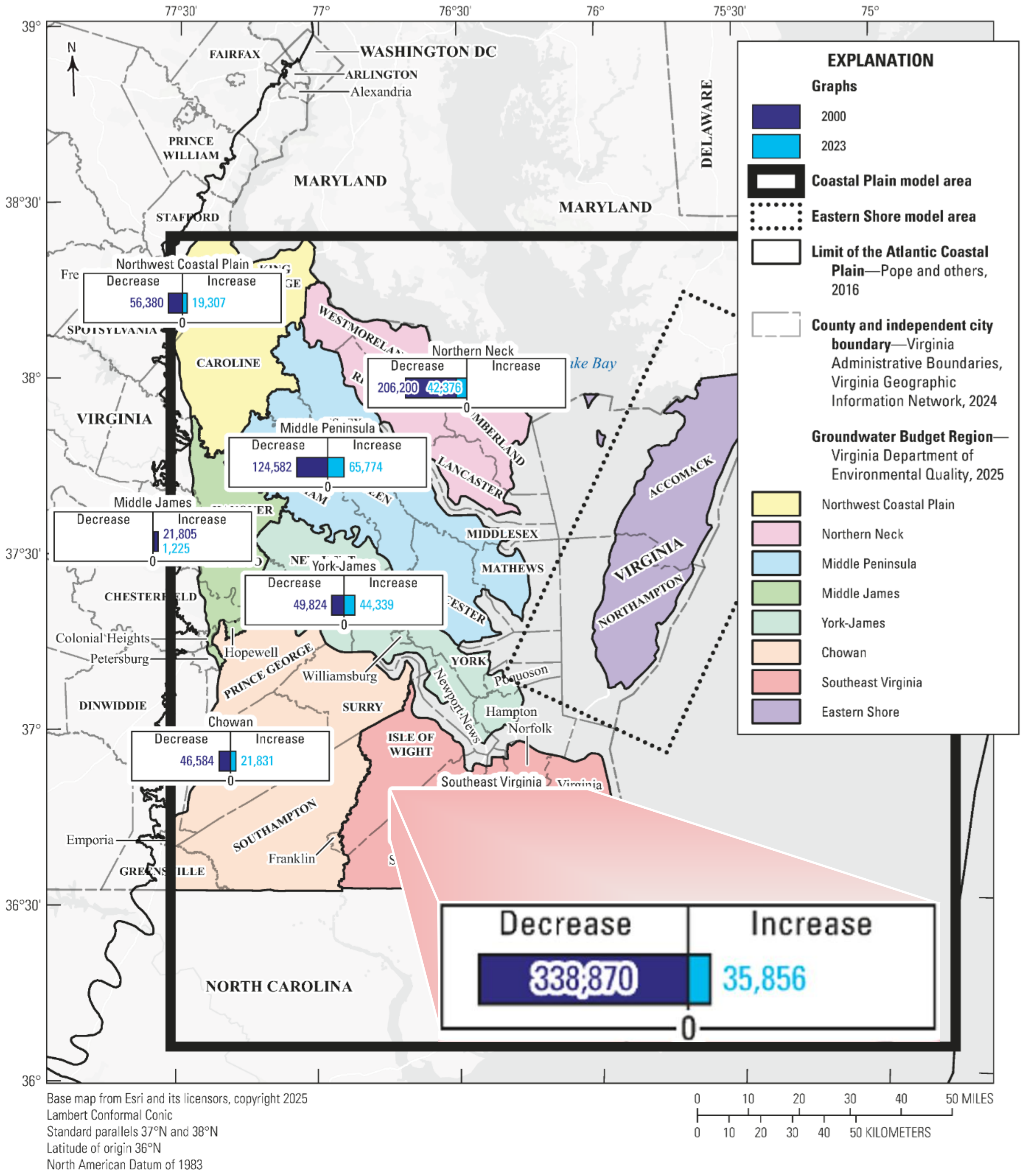
Model-Based Analyses

Regional GW Budget Analysis

- DEQ subdivided the VCP aquifer system into 8 GW budget regions, modified from pre-existing drought evaluation regions
- USGS used ZONEBUDGET software and DEQ/Aquaveo “reported use” simulations to compute a comprehensive GW budget (inflows and outflows) for each region over the modeled historical period 1890–2023 and future period 2024–2073
- Focused on representative moments: 2000 and 2023
- Results: in confined VCP aquifer system, GW generally flows
  - **inward** from perimeter regions and
  - **downward** from overlying hydrogeologic units to Potomac aquifer

Modeled Storage Rates in Potomac Aquifer

- 8 GW budget regions shown in different colors
- Comparison of annual GW storage rates by region
- **2000** vs. **2023**
- Bar charts show values increasing to the right
- Values in cubic feet per day

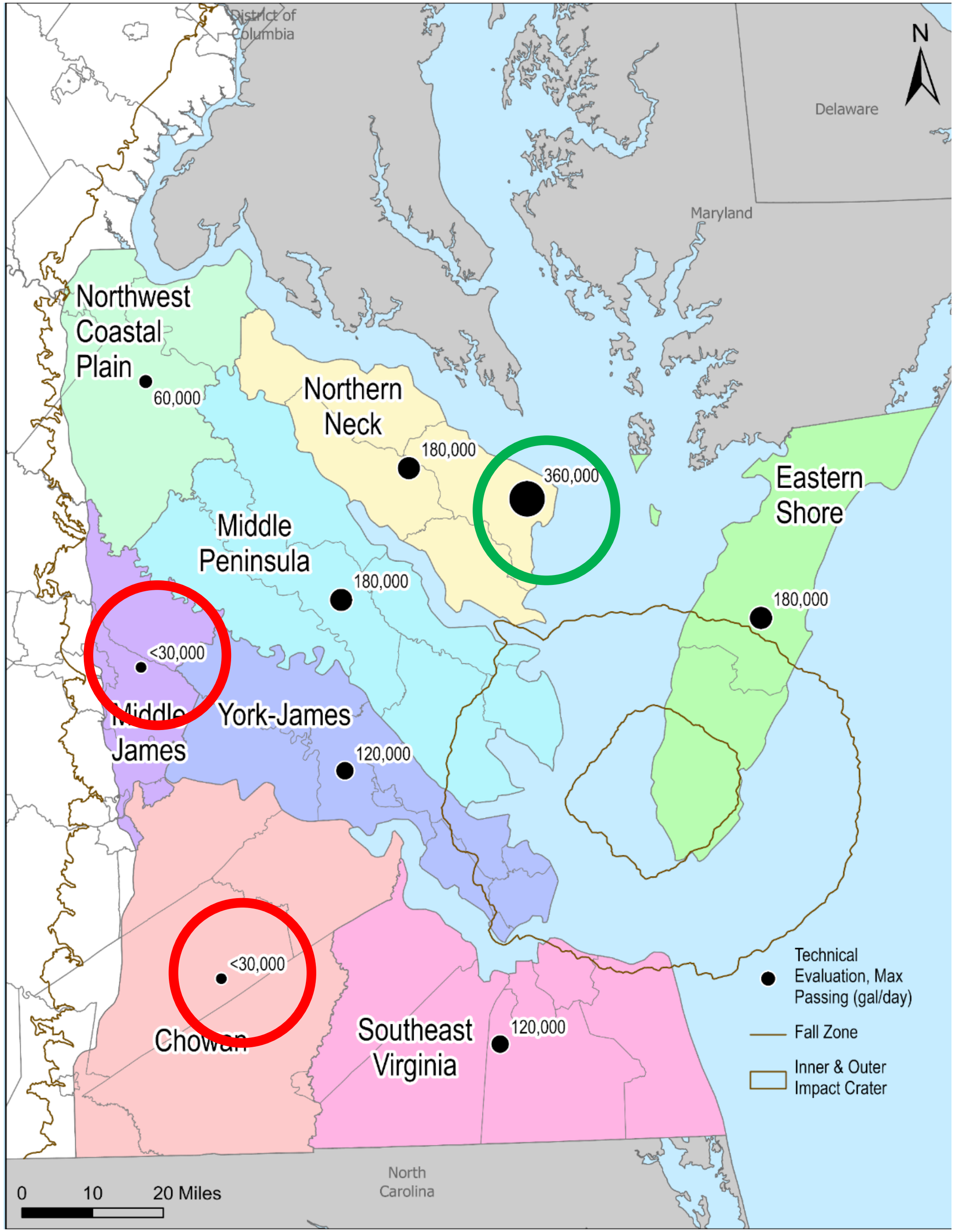


Pope et al., 2026, Computation of regional groundwater budgets for the Virginia Coastal Plain aquifer system, EarthArXiv, https://doi.org/10.31223/X5HB5D.

DEQ

Limited Capacity for New GW Withdrawals

- Simulated a single additional withdrawal of 3 Mgal/day at each of 9 locations
- None passed criteria for permitting
- Maximum-passing amount varied regionally
  - 360,000 gal/day in Northumberland County
  - <30,000 gal/day in western regions
- Only the best-case estimate would support a large withdrawal



DEQ

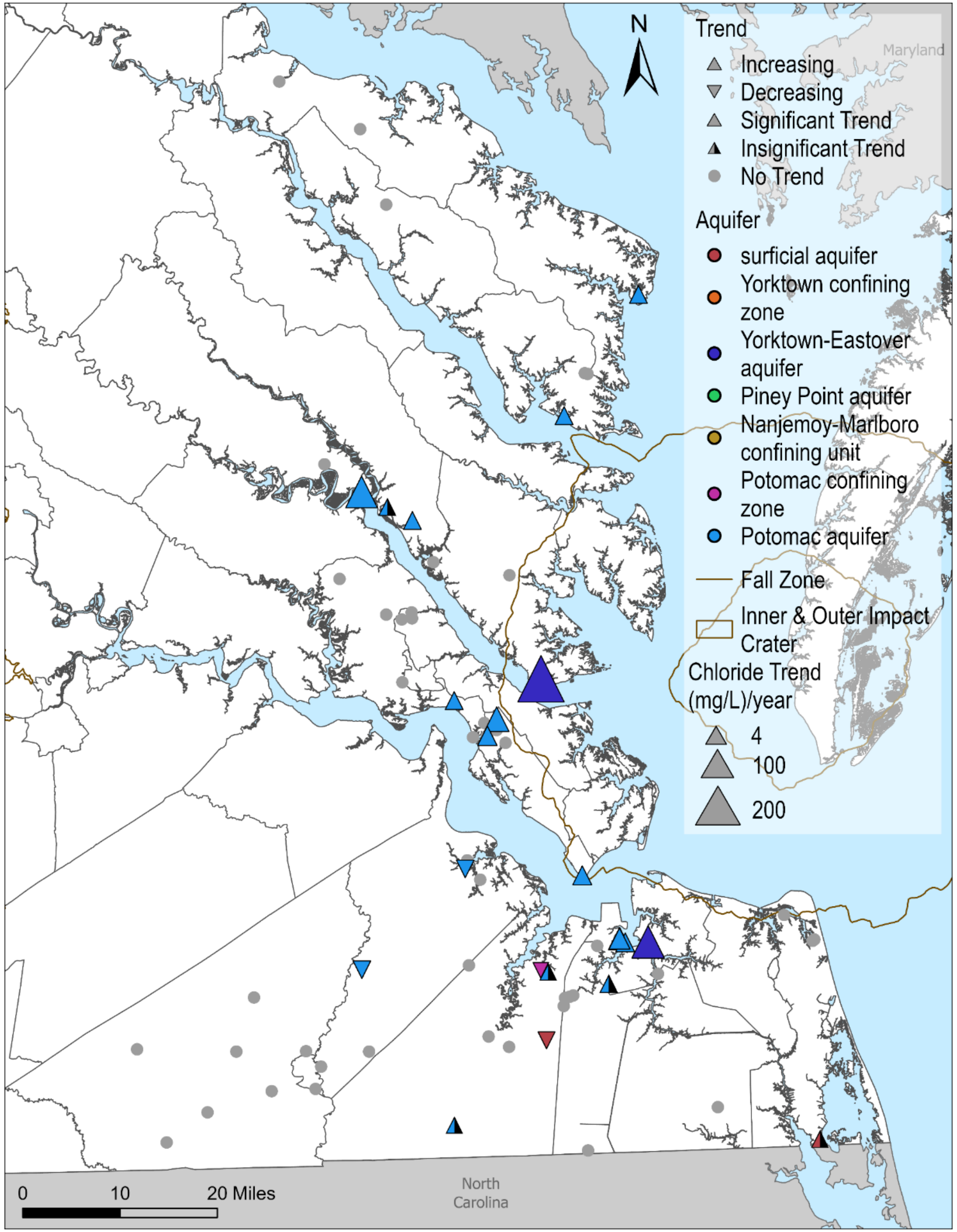
GW Quality

Regional GW Quality

- DEQ updated and expanded the analyses of 2010 USGS report on VCP GW quality (https://pubs.usgs.gov/pp/1772/)
- Compared that report's data set (1906–2007) with more recent data (2007–2024)
- Demonstrated that overall regional GW quality has been stable since 2007
- Supported previous finding that GW quality has been largely stable since early 20th century
- Identified locally increasing chloride concentration (salinity) trends, consistent with previous USGS findings

Locally Increasing Chloride

- On both mainland (shown here) and Eastern Shore
- At different times across full historical period of available data
- Mainly in Potomac aquifer and Yorktown-Eastover aquifer, near known GW withdrawal sites
- Trend results generally consistent with GW-level analyses
- DEQ chloride monitoring network to be expanded



DEQ

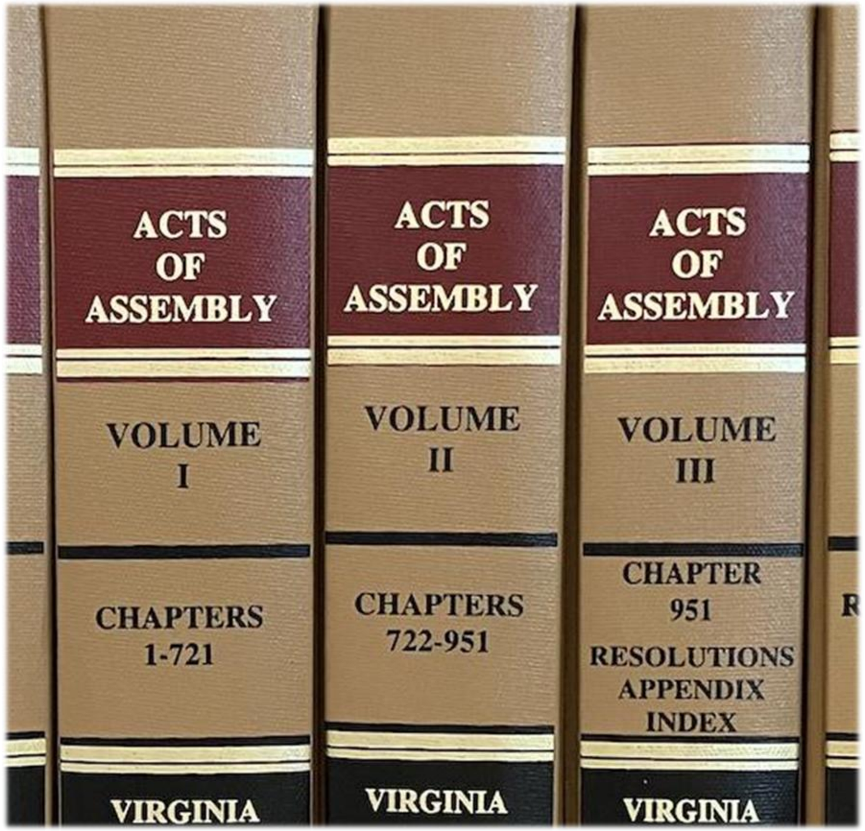
Conclusions

Key Technical Findings

- Major industrial withdrawals have caused inland GW levels to decline below sea level, inducing inward and downward flows
- Sharp decrease in a major industrial withdrawal (2010), plus special management efforts (2014–2017), reduced GW deficit to near zero in the overall Potomac aquifer (with regional variation)
- GW levels in the Potomac aquifer rose and broadly stabilized until about 2021, when rising trends stalled and began to reverse
- MAR has potential to increase regional GW levels, but these gains may dissipate rapidly when injections cease
- VCP aquifer system currently has limited capacity for significant new withdrawals (varying by region from near zero to ~360,000 gal/day)
- Chloride concentrations in the aquifer system have increased locally in parts of Eastern Virginia and parts of the Eastern Shore

Assessment of the Act

- The Ground Water Management Act of 1992 and its implementation show that regulation has positive effects on GW supply
- These effects are currently insufficient for long-term sustainability
- The SJ 25 report will offer recommendations on how to make the Act more effective
  - Statutory and regulatory authority
  - Resources (staff and funding)



DEQ

Questions?

Flowing artesian well near Norfolk, Virginia, early 1940s (Cederstrom, 1945)