HRSD

Cleaning wastewater every day for a better Bay.

Sustainable Water Recycling

An integrated solution to the water issues challenging Hampton Roads and the Commonwealth of Virginia

Water Issues Challenging Virginia and Hampton Roads

- Restoration of the Chesapeake Bay
  - Harmful Algal Blooms
  - Localized bacteria impairments
  - Urban stormwater retrofits (cost and complexity)
- Adaptation to sea level rise
  - Recurrent flooding
- Depletion of groundwater resources
  - Including protection from saltwater contamination
- Wet weather sewer overflows
  - Compliance with Federal enforcement action

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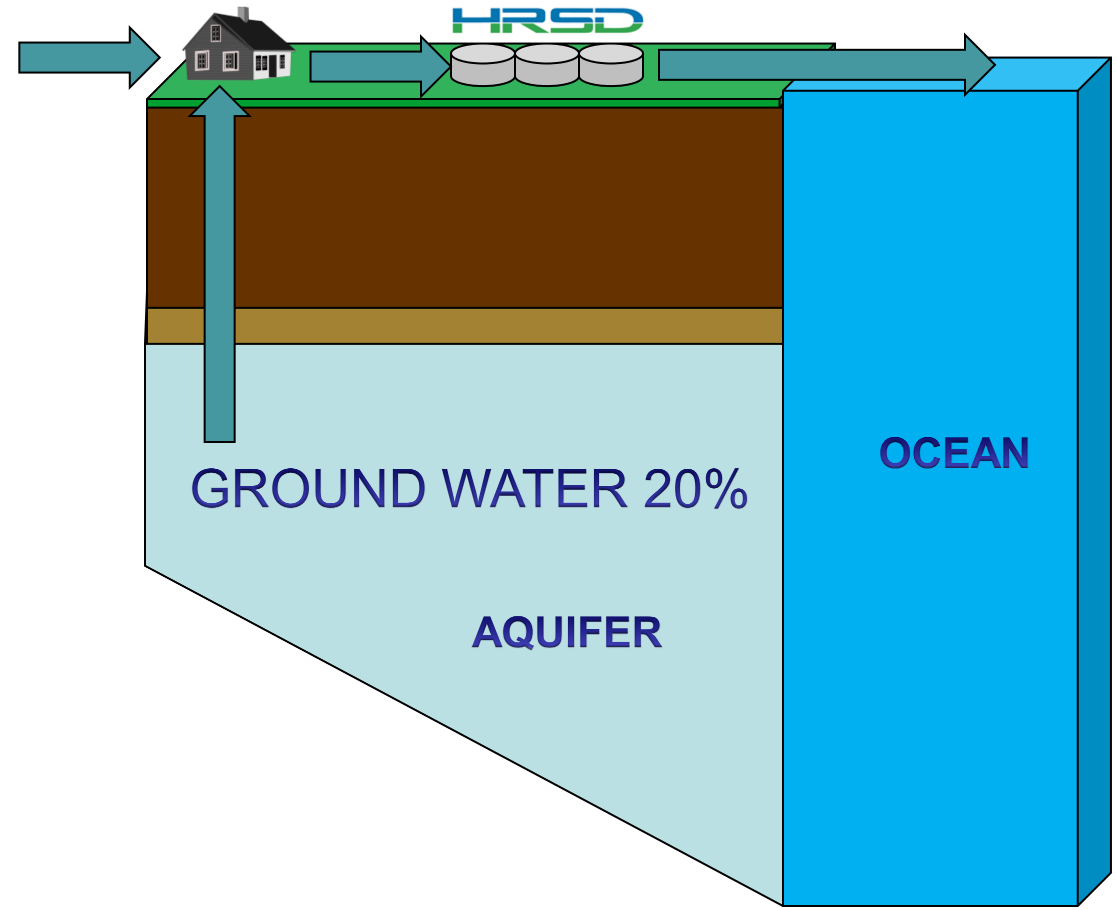
Current state of wastewater in Hampton Roads

SURFACE WATER 80%

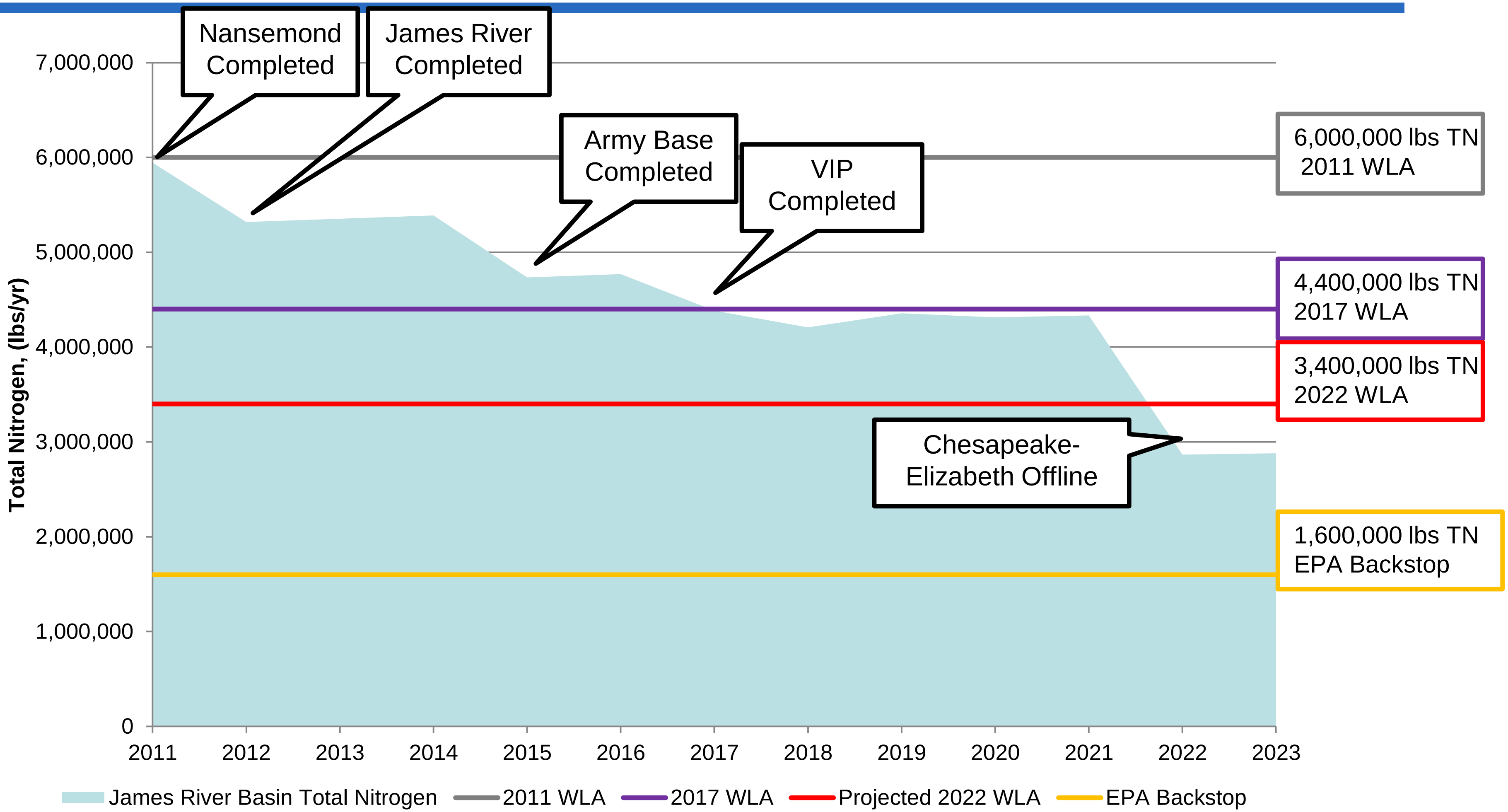


HRSD costs are rising to treat water to higher standards. Treated water currently discharged to area waterways – no beneficial use.

Regulatory uncertainty

- Wastewater permits have 5 year terms
- New regulations can require extensive investment in new treatment processes
- Always concerned about the next issue on the horizon
  - Viruses
  - Pharmaceutical products
  - Further nutrient reductions
- Technology to detect advancing much faster than technology to remove

Nutrient reductions



James River Basin – TN

WLA – Nutrient Waste Load Allocation in lbs/yr

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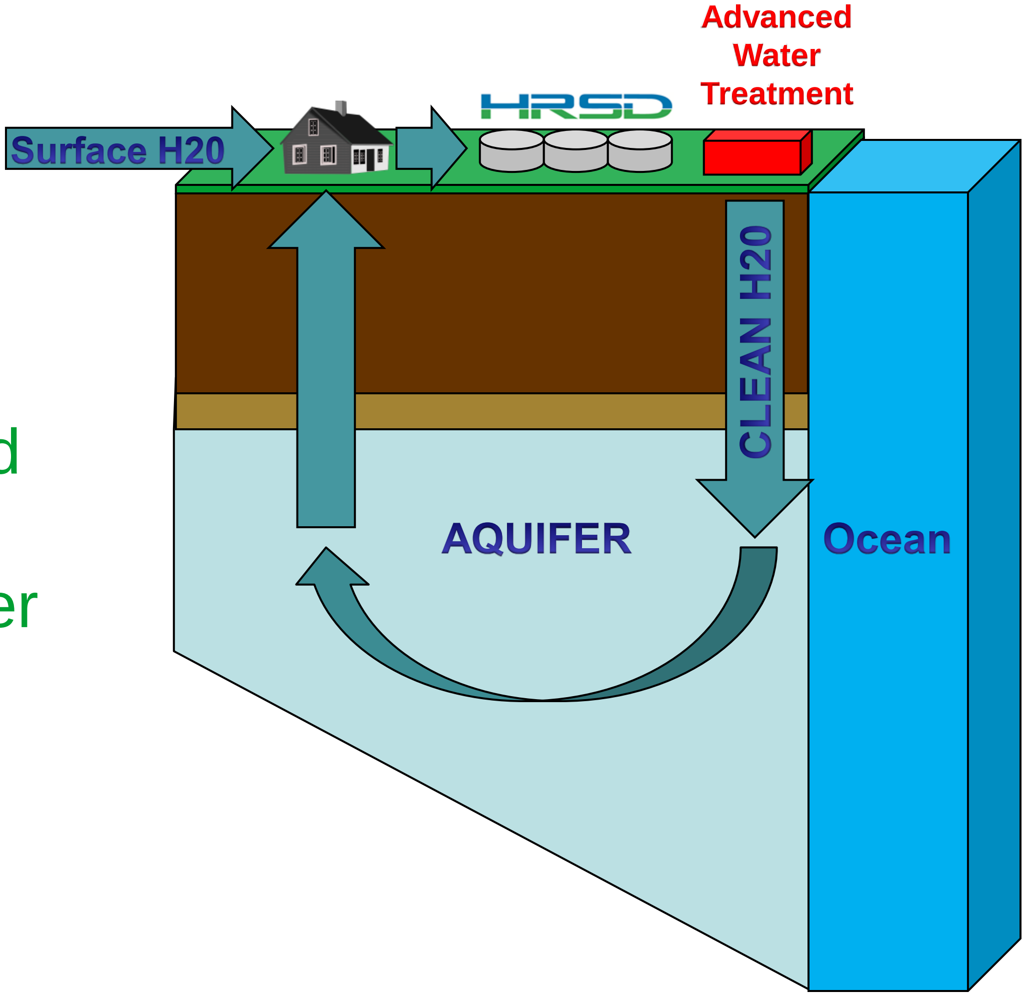
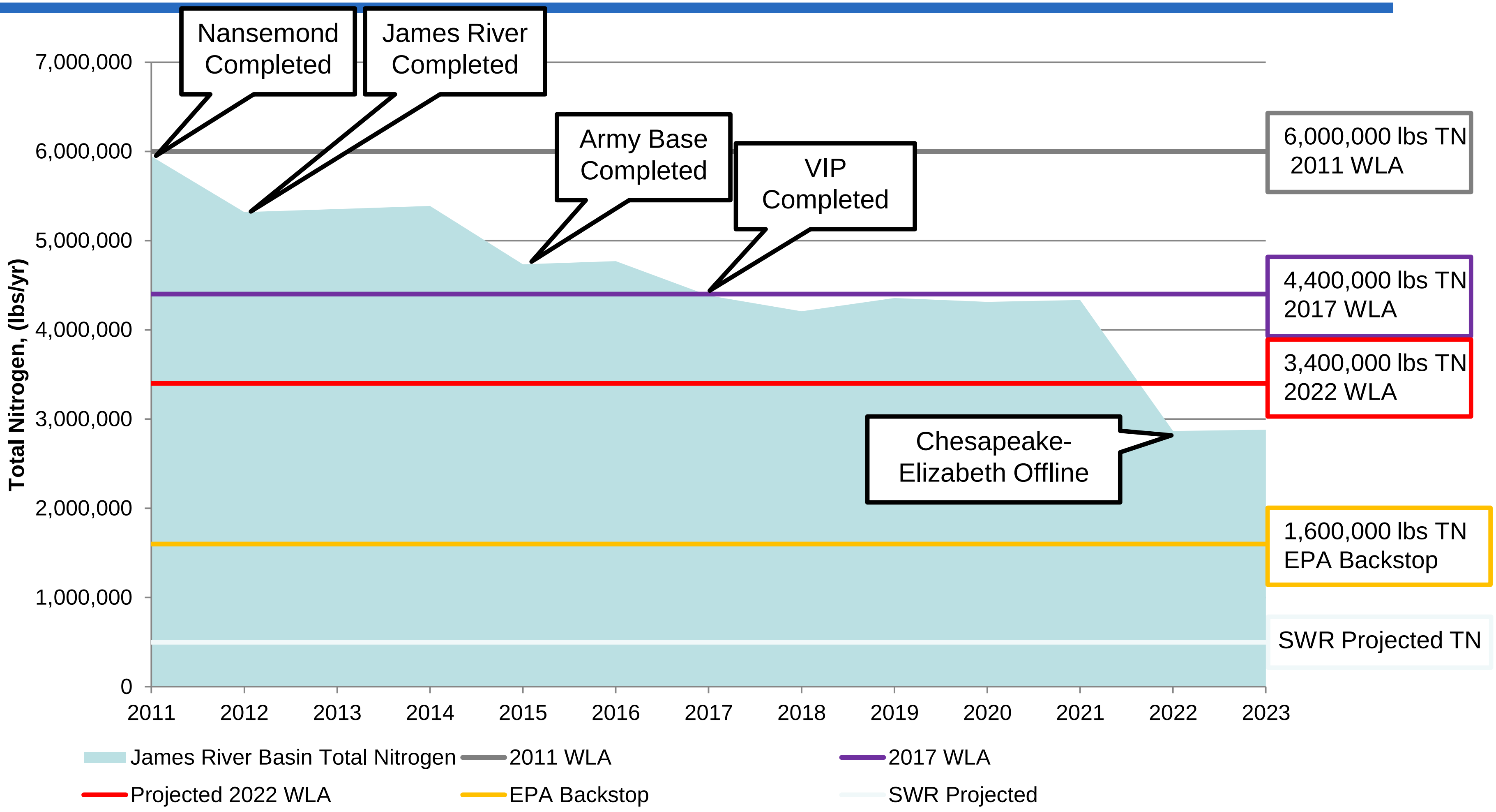
Proposed cycle of sustainable water recycling

- HRSD's concept - replenish the aquifer with clean water to:
  - Reduce nutrient discharges to the Bay
  - Reduce the rate of land subsidence
  - Protect the groundwater from saltwater contamination
  - Provide a sustainable supply of groundwater



Impact on nutrient reductions



James River Basin – TN Similar results with TP and TSS and in other river basins.

WLA – Nutrient Waste Load Allocation in lbs/yr

Potential to offset stormwater reductions

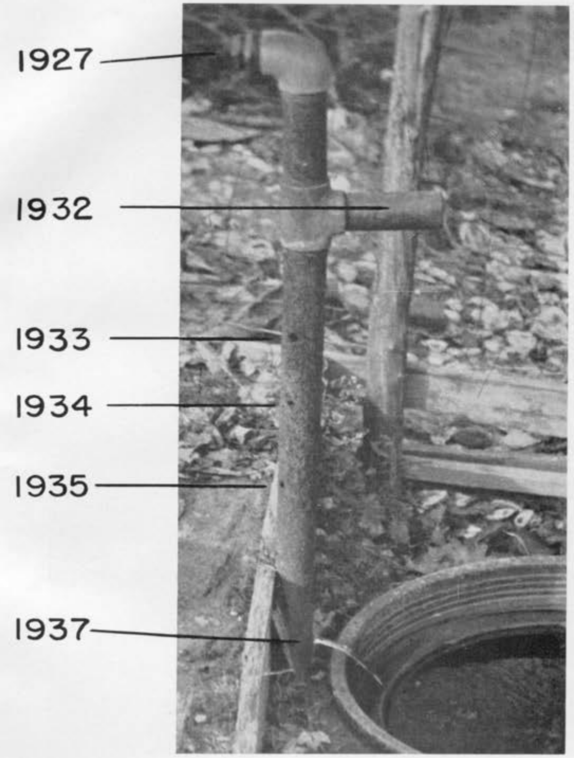
	HRSD Bay TMDL Allocations	HRSD Post SWRI Loads (2030)	Available for other needs	Stormwater Reduction Needs*
Nitrogen				
James	3,400,000	500,000	2,900,000	63,039
York	275,927	25,000	250,927	19,114
Phosphorus				
James	300,009	50,000	250,009	13,088
York	18,395	2,000	16,395	3,887
Sediment				
James	14,000,000	700,000	13,300,000	5,269,142
York	1,400,000	98,000	1,302,000	1,413,762

* DEQ Regulated Stormwater w/o federal lands

Groundwater depletion has been rapid

A, Overflow from artesian well in Isle of Wight County is wasted.

VIRGINIA GEOLOGICAL SURVEY BULLETIN 63 PLATE 13



Well with casing perforated at successively lower points in order to maintain a flow as artesian pressure declines; Isle of Wight County.

- Artesian wells in early 1900s – groundwater wells required valves not pumps!
- In about 100 years have gone from water levels at 31 feet above sea level to 200± feet below.

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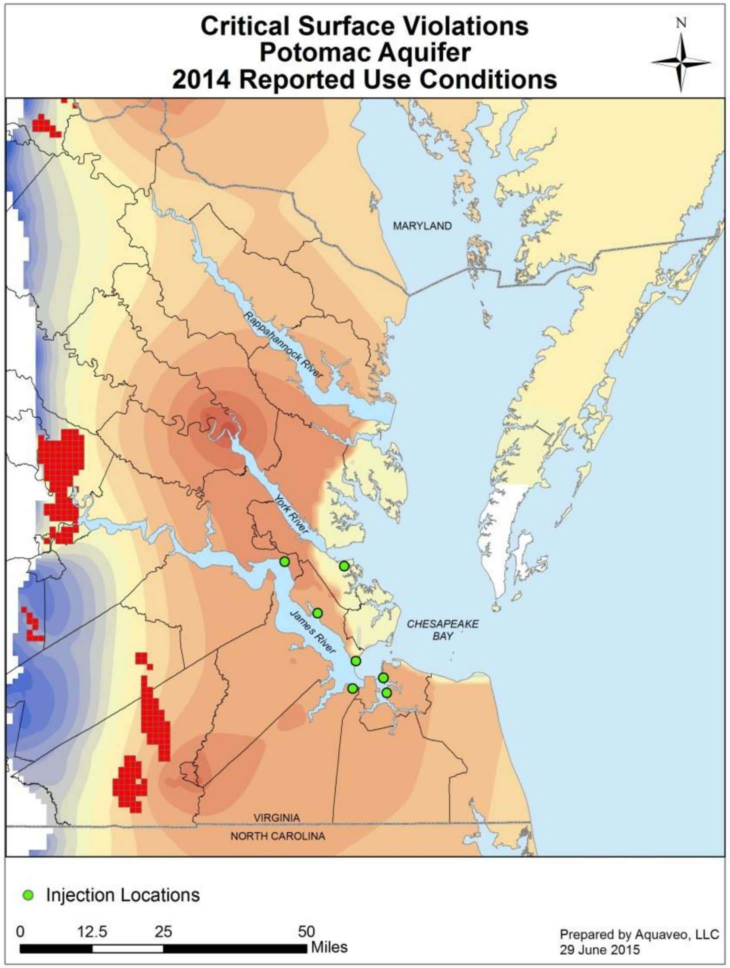
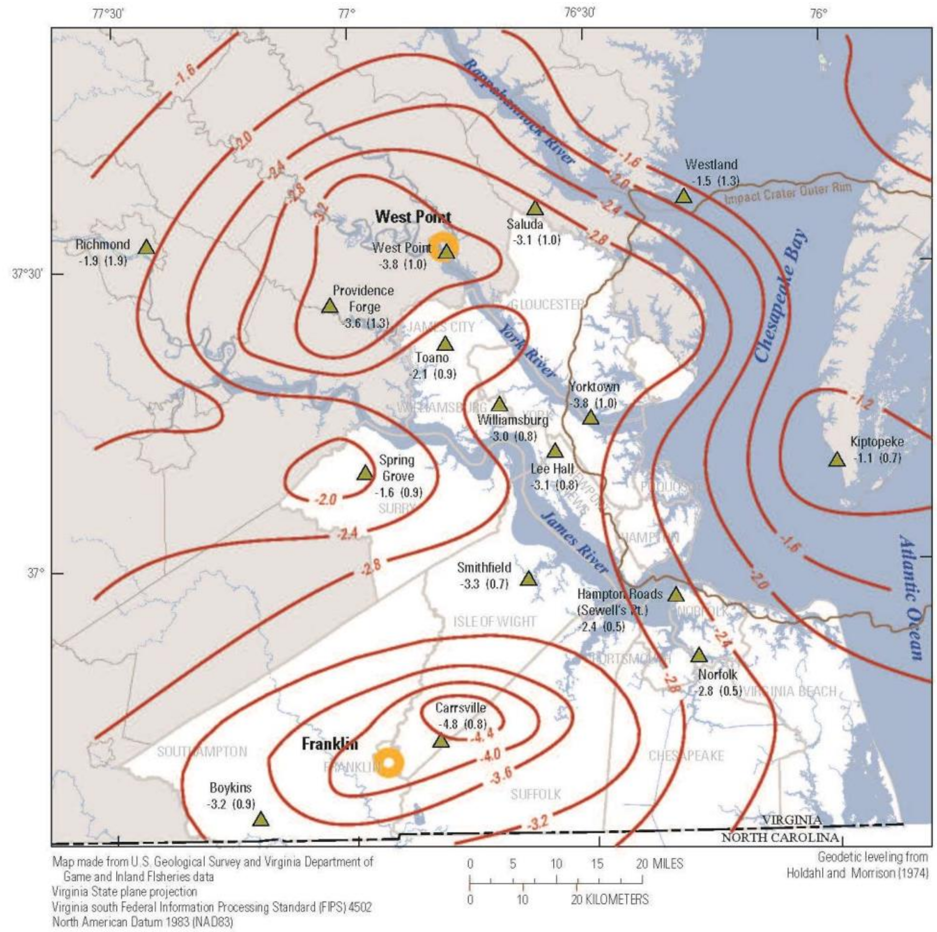
Unsustainable Aquifer Withdrawals

- Over-allocated permitted withdrawal
  - Water levels falling several feet/yr
  - Some water levels below the aquifer tops in western Coastal Plain
- Total permitted withdrawals are **unsustainable**
  - Areas below regulatory criteria
  - Areas experience aquifer dewatering



Land subsidence – *we are sinking*

- According to USGS
  - Up to 50% of sea-level rise may be due to land subsidence
  - **Up to 50% of land subsidence may be due to aquifer compaction**
- Potential solutions
  - Reduced withdrawal
  - Aquifer recharge



HAMPTON ROADS IS THE #2 LARGEST POPULATION CENTER AT RISK

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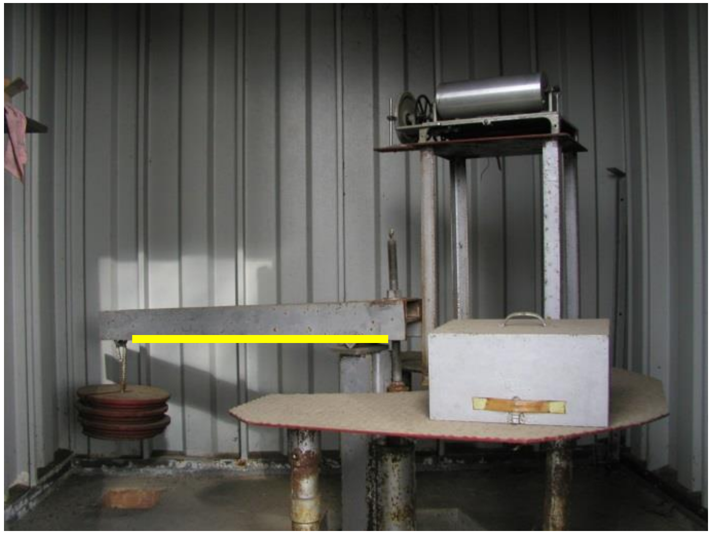
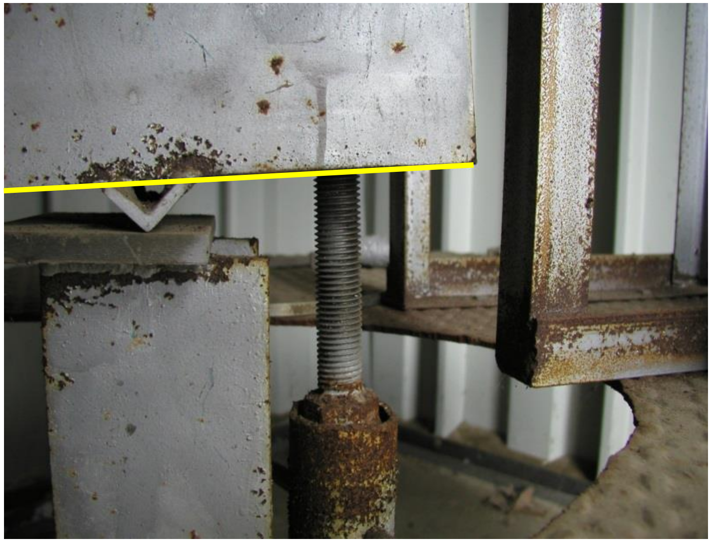
Evidence of groundwater impacts on subsidence

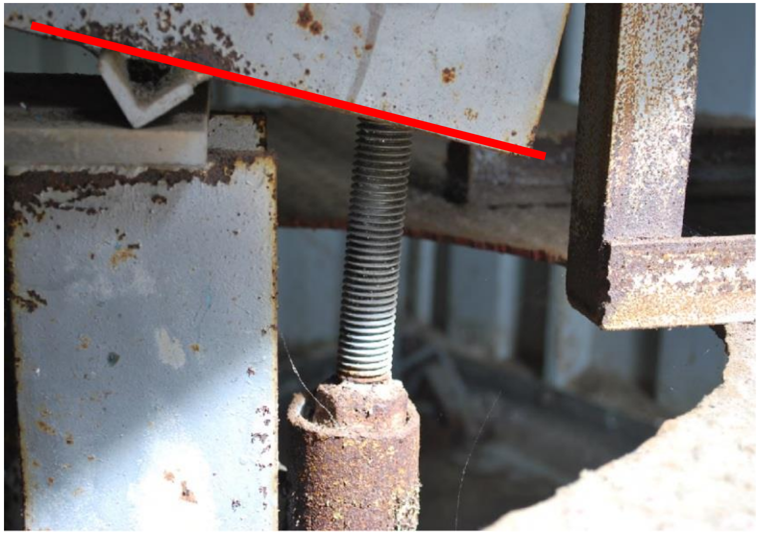
2002





USGS found ground level rose 32 mm between 2002 and 2015 coinciding with reduced groundwater withdrawal by Franklin paper mill.

2015



USGS science for a changing world

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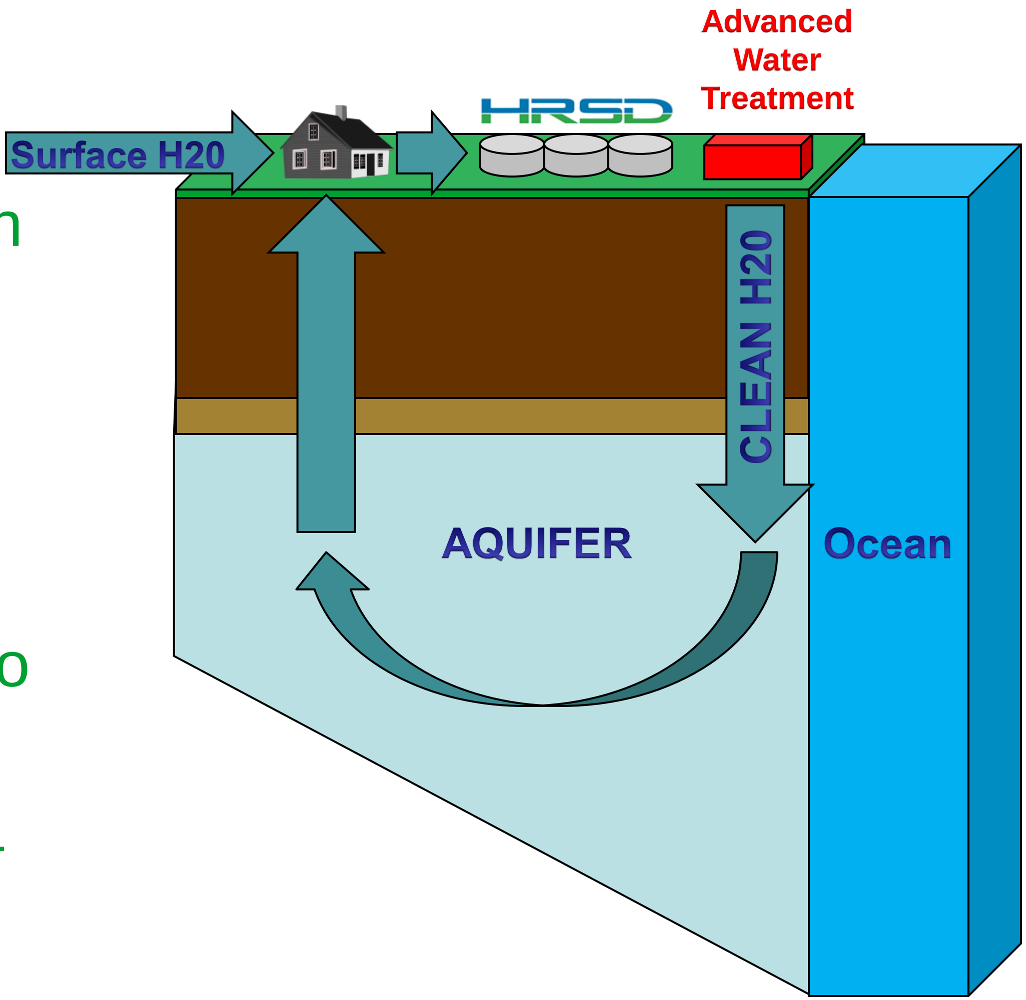
Advanced water treatment to produce **DRINKING WATER**

- Advanced treatment used throughout world, many locations in USA and even in Virginia to produce water that exceeds drinking water standards
  - Upper Occoquan Service Authority/Fairfax Water
  - Loudoun Water
- Aquifer replenishment also done in many places including Virginia
  - City of Chesapeake Aquifer Storage and Recovery system – over 2.8 billion gallons pumped to date



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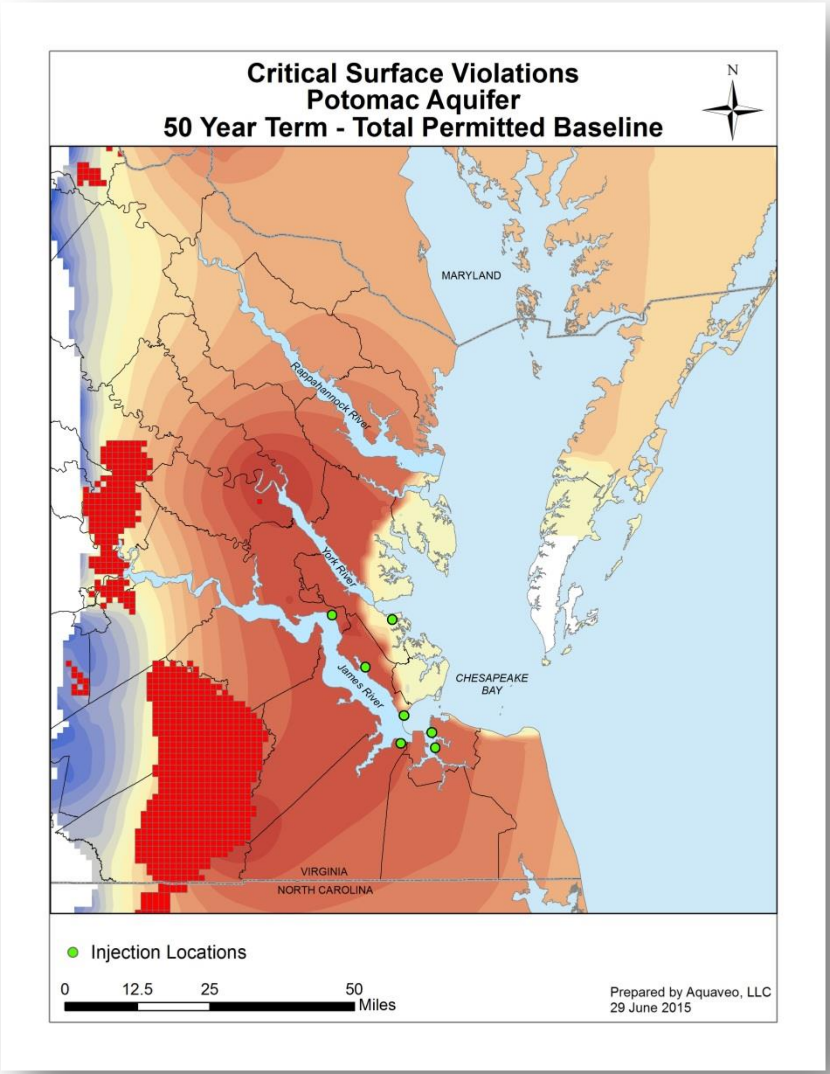
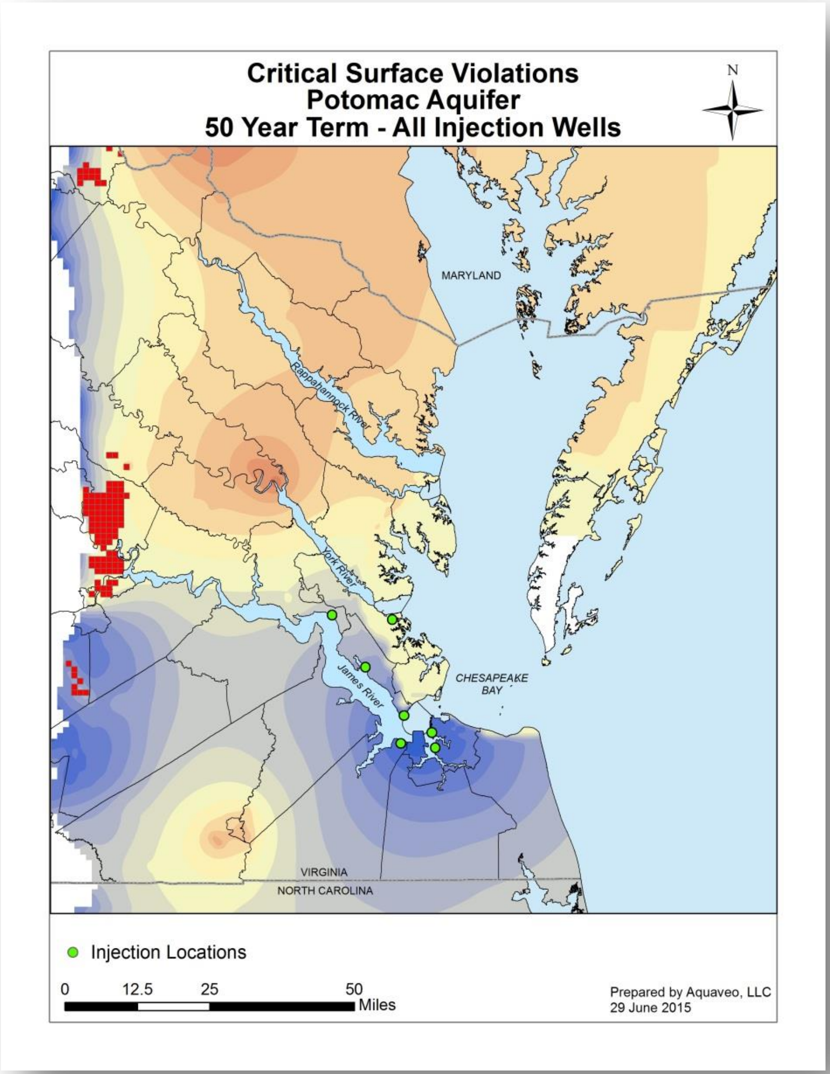
Potomac Aquifer water levels before and after injection





Cost Summary

- Total project in the $1 billion range (120 mgd)
  - For 7 plants (not Ches-Liz or Atlantic)
- Annual operating costs $21 - $43 M
- Can only be achieved if EPA allows enough flexibility to integrate into wet weather work
  - Cannot afford to add SWRI into existing plan without significant rate increases and potential downgrade
  - Approximately 50% of HRSD $4.4B CIP will be dedicated to wet weather
    - Not most important water quality issue
    - Plan would be to accomplish critical wet weather issues and SWRI in early years and delay remaining wet weather work

Conclusion – Summary of Benefits

- Regulatory stability for treatment processes
- Significantly reduced discharge into the Chesapeake Bay (only during wet weather)
  - Creates source of nutrient allocation to support other needs **(STORMWATER)**
  - May increase available oyster grounds
- Potential reduction in the rate of land subsidence
- Sustainable source for groundwater replenishment
- Protection of groundwater from saltwater contamination

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Timeline

- Complete next phase of study with consultant by end of 2016
- Room scale pilot projects – operating in May 2016
- 2017
  - Public outreach
  - **Endorsement from Hampton Roads localities**
  - Endorsement from DEQ/VDH to move forward
  - Groundwater Committee recommends recharge project
  - EPA agrees to integrated plan to meet Consent Decree requirements
  - Phase 3 WIP includes this project to achieve TMDL goals
- 2018
  - Demonstration pilot (2 year study)
- 2020
  - EPA/DEQ/VDH formally approves Certificate to Construct for SWR
- 2020 to 2030
  - Construction through phased implementation
- 2030 Fully operational
  - 120 MGD of clean water put into the aquifer

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Questions?

*Future generations will inherit clean waterways and **be able to keep them clean**.*

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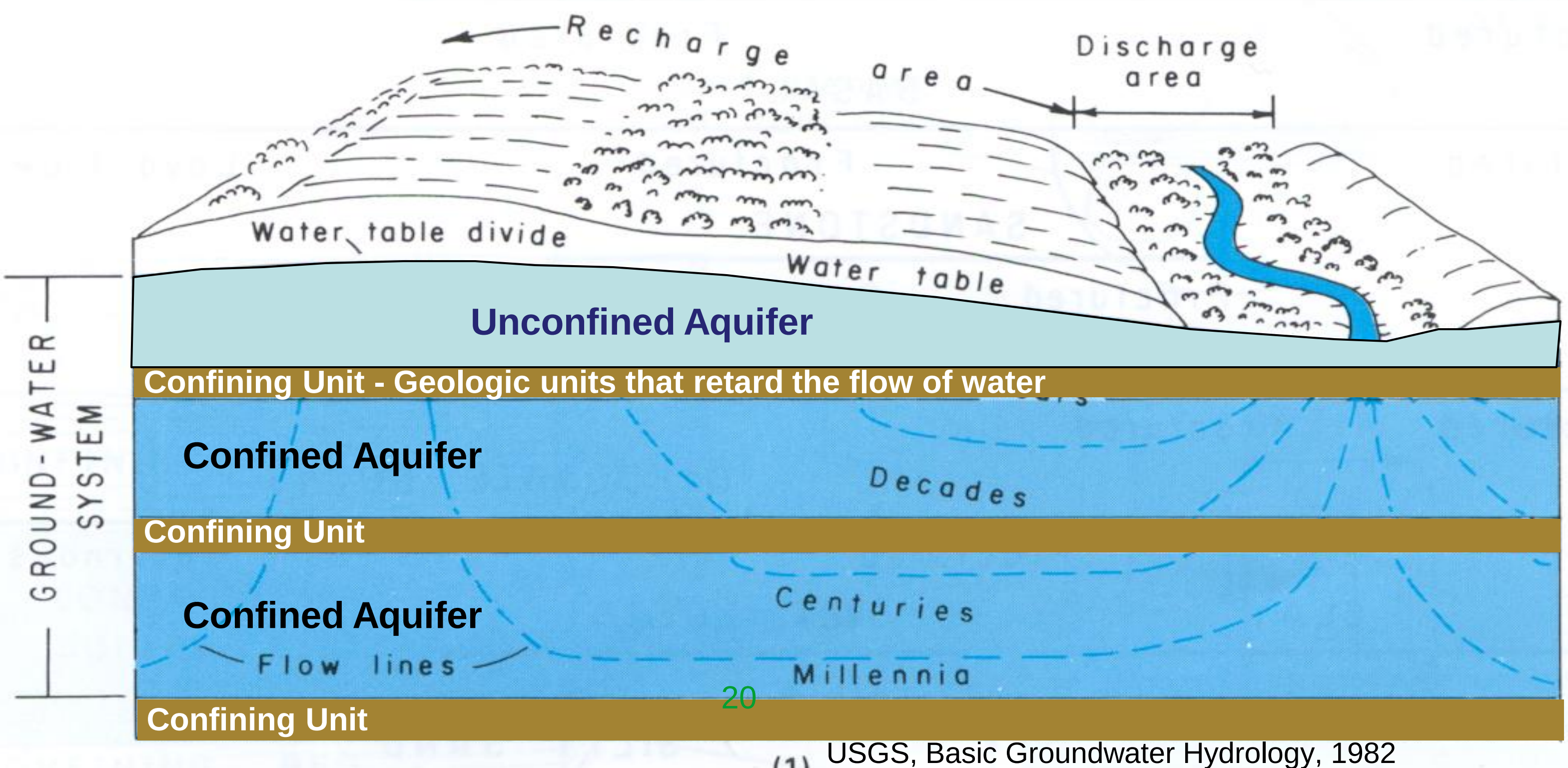
http://www.hrsd.com/SWR.shtml

Extra Slides

Hydrogeologic framework

- Subsurface Geology - sediments (sands, silts, clays, shells, bedrock way down there)
- Aquifers - geologic units that easily store and transmit water
  - Unconfined
  - Confined - pressurized

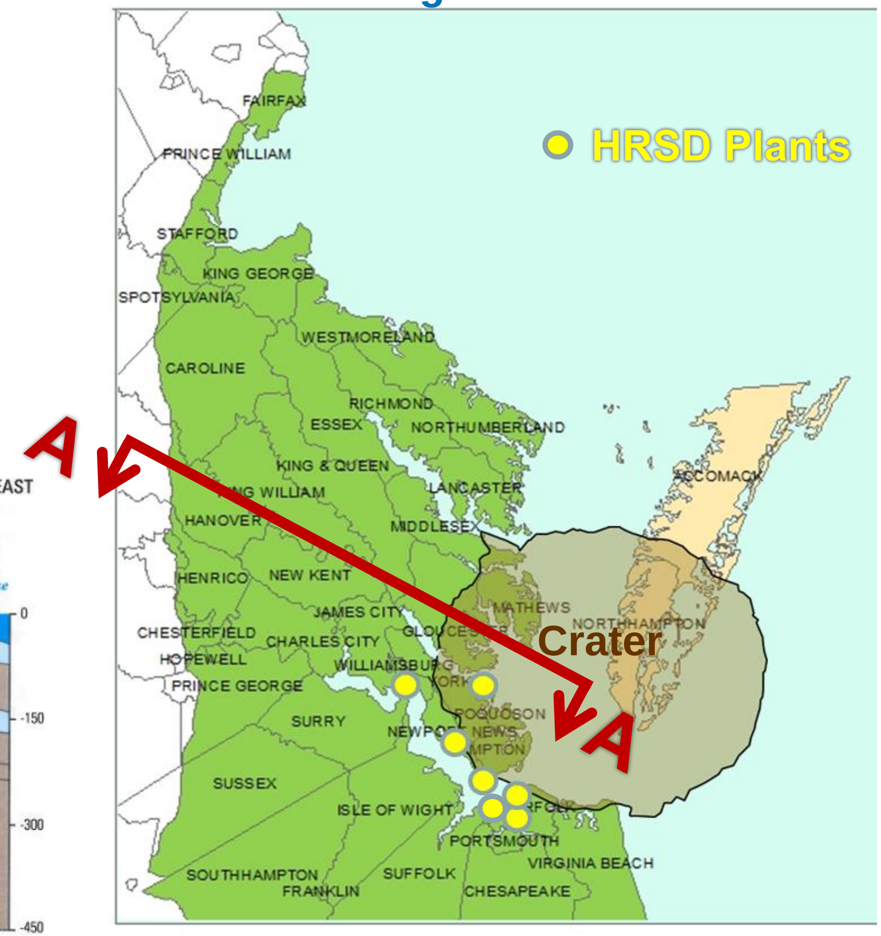


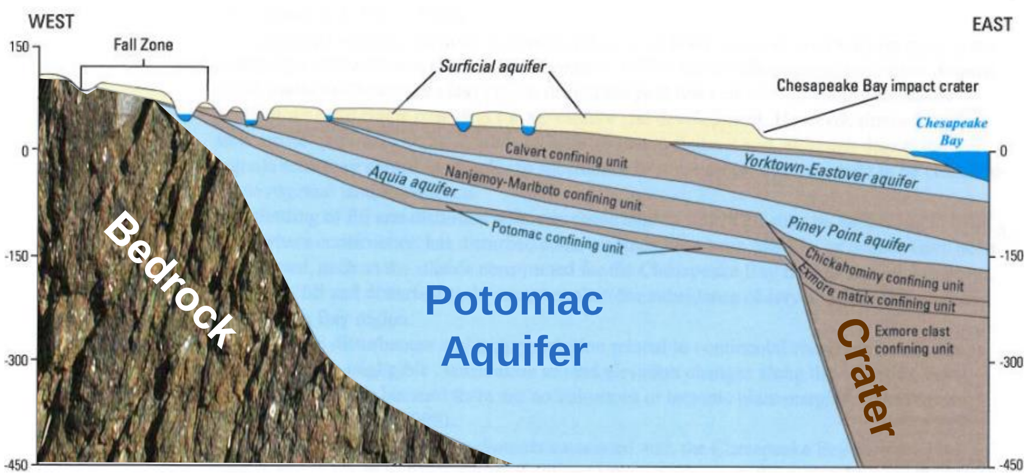
USGS, Basic Groundwater Hydrology, 1982

Hydrogeologic setting in the Coastal Plain of Virginia

- Fall Line (around I-95 corridor) to the Ocean
- Truncated by Chesapeake Bay Impact Crater (Bolide/Meteor)
- Essentially no natural recharge
  - Aquifer water is 40,000 years old

Eastern Va Groundwater Management Area





Section A-A

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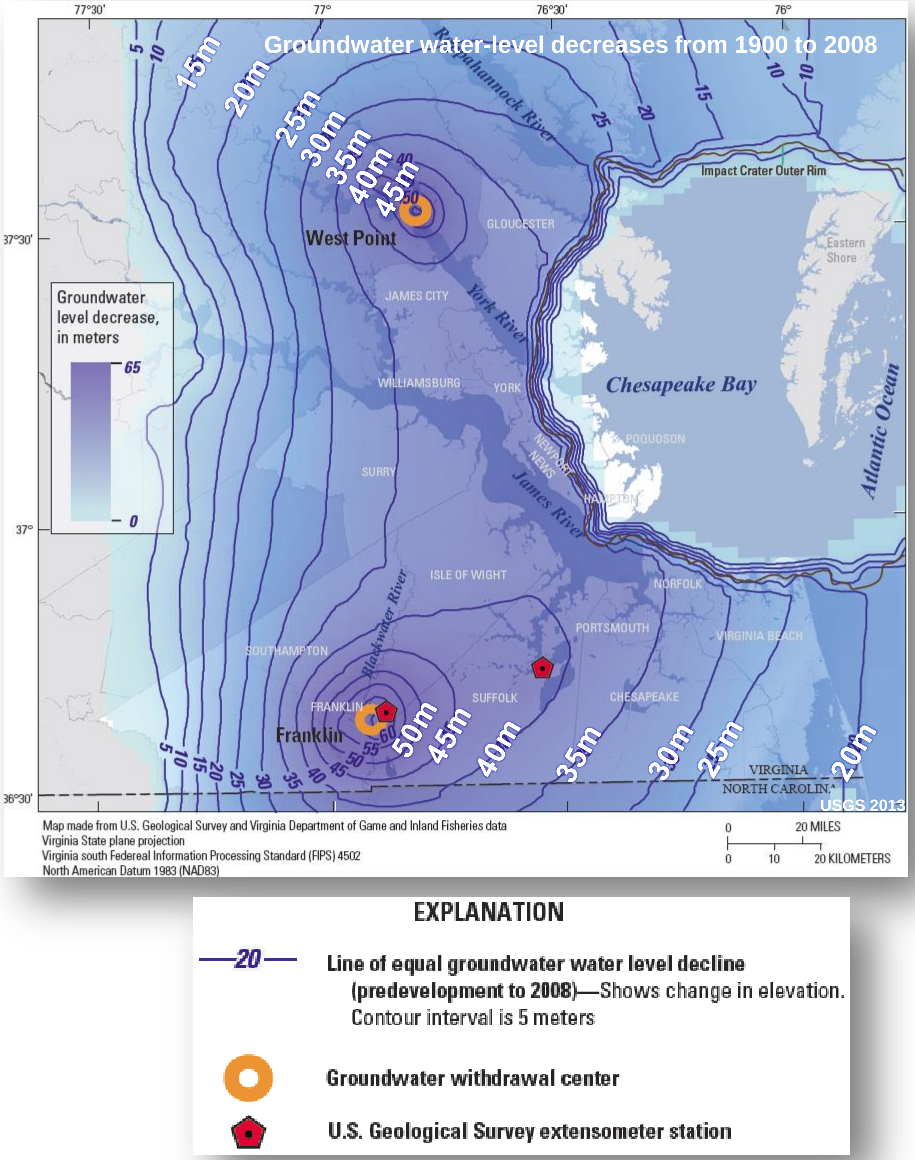
Groundwater depletion

- Top DEQ priority
- 177 permits = 147.3 MGD
  - Currently withdrawing approximately 115 mgd
- 200,000 unpermitted "domestic" wells
  - Estimated to be withdrawing approx. 40 mgd
  - Growing at 1 MGD/year



Operational water recycling projects

Project	Location	Type of Potable Reuse	Year	Capacity	Current Advanced Treatment Process
Montebello Forebay, CA	Coastal	GW recharge via spreading basins	1962	44 mgd	GMF + Cl_2 + SAT (spreading basins)
Windhoek, Namibia	Inland	Direct potable reuse	1968	5.5 mgd	O_3 + Coag + DAF + GMF + O_3/H_2O_2 + BAC + GAC + UF + Cl_2 (process as of 2002)
UOSA, VA	**Inland**	**Surface water augmentation**	**1978**	**54 mgd**	**Lime + GMF + GAC + Cl_2**
Hueco Bolson, El Paso, TX	Inland	GW recharge via direct injection and spreading basins	1985	10 mgd	Lime + GMF + Ozone + GAC + Cl_2
Clayton County, GA	Inland	Surface water augmentation	1985	18 mgd	Cl_2 + UV disinfection + SAT (wetlands)
West Basin, El Segundo, CA	Coastal	GW recharge via direct injection	1993	12.5 mgd	MF + RO + UVAOP
Scottsdale, AZ	Inland	GW recharge via direct injection	1999	20 mgd	MF + RO + Cl_2
Gwinnett County, GA	Inland	Surface water augmentation	2000	60 mgd	Coag/floc/sed + UF + Ozone + GAC + Ozone
NEWater, Singapore	Coastal	Surface water augmentation	2000	146 mgd (5 plants)	MF + RO + UV disinfection
Los Alamitos, CA	Coastal	GW recharge via direct injection	2006	3.0 mgd	MF + RO + UV disinfection
Chino GW Recharge, CA	Inland	GW recharge via spreading basins	2007	18 mgd	GMF + Cl_2 + SAT (spreading basins)
GWRS, Orange County, CA	Coastal	GW recharge via direct injection and spreading basins	2008	70 mgd	MF + RO + UVAOP + SAT (spreading basins for a portion of the flow)
Queensland, Australia	Coastal	Surface water augmentation	2009	66 mgd via three plants	MF + RO + UVAOP
Arapahoe County, CO	Inland	GW recharge via spreading	2009	9 mgd	SAT (via RBF) + RO + UVAOP
Loudoun County, VA	**Inland**	**Surface water augmentation**	**2009**	**11 mgd**	**MBR + GAC + UV**
Big Spring (Wichita Falls), TX	Inland	Direct potable reuse through raw water blending	2013	1.8 mgd	MF + RO + UVAOP