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Study Conclusions

- Groundwater levels have declined.
- For several reasons, we're using it faster than it's being replenished.
- The trend is likely to continue without intervention.
- Voluntary and regulatory steps can change this trend.

2 Catocin Watershed Photo credit: Mackenzie, PEC

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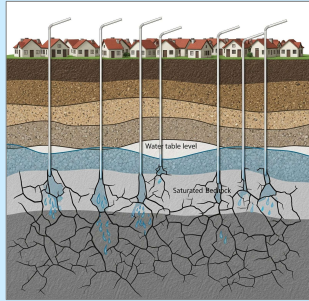
Many areas have declining groundwater levels

- Data from more than 12,000 wells were reviewed.
- Water table has fallen 10-40 feet in red areas.
- We're taking it out faster than it's going back in.
- This is a long-term trend.

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There are a Lot More "Straws" in our Groundwater

- 6,000 active wells in 1980.
- 19,000 active wells today.
- Half of all wells are within 200 feet of another well.
- 90% of all wells are within 550 feet of another well.
- At this density, well conflicts are inevitable.

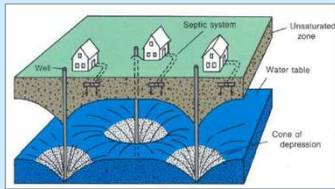


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Wells Pump from the Same Source

- Wells cause "Cone of Depression".
- Water table arches downward as water flows toward well.
- Wells interfere with each other in competition for same water source.



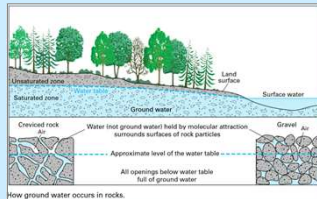
[Groundwater Photo Gallery | U.S. Geological Survey](#)

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Groundwater is the Source of Water for Our Creeks

- Without groundwater we would not have any flowing streams.
- Only 25% of rainwater infiltrates down to the water table.
- Most rainfall is lost to evapotranspiration.
- Stream flows rise within minutes and hours of rainfall from surface runoff, but is sustained over longer periods of time because of groundwater.



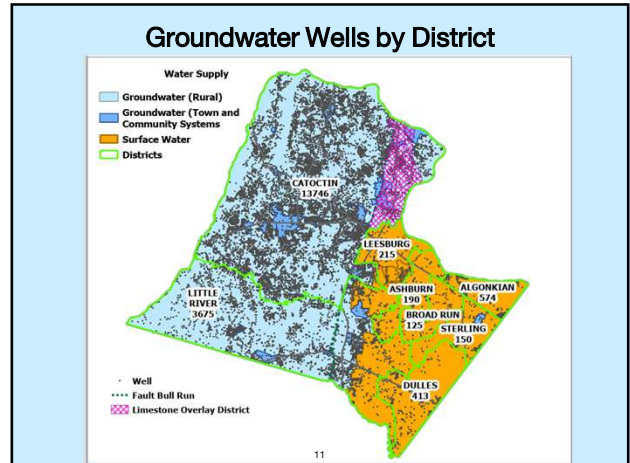
[Groundwater Photo Gallery | U.S. Geological Survey](#)

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Discussion

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WHY? Our "Bucket" is Distributed Among Cracks in the Bedrock

- Water tables are below the recharge zone.
- Water is located in fractures in the rock — no big aquifers.
- "Hydrostatic pressure" reduces well yields below 1,000 feet.

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Residential Well Operations

- Wells pump at 10 to 30 GPM.
- Pumps operate for about 1 minutes per cycle.
- Daily volume pumped 600 gallons.
- During pumping levels drop 50 to 300 feet.
- Water level recovers in minutes to hours.

<https://www.cavacoco.net/services/water/private-well-supplies/>

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Our "Bucket" does have a bottom

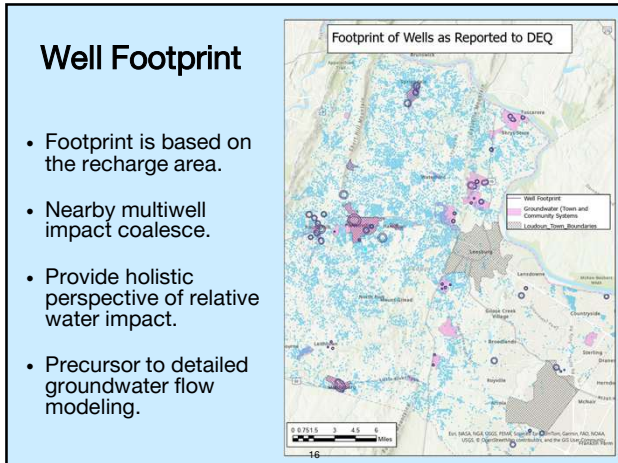
- 235 wells replaced since 2000.
- 3,200 wells abandoned.
- Drillers keep going deeper to find more water.
- Average depth was 400 feet in 2000.
- Average depth was 480 feet in 2023.
- Water can't be extracted below about 1,200 feet.

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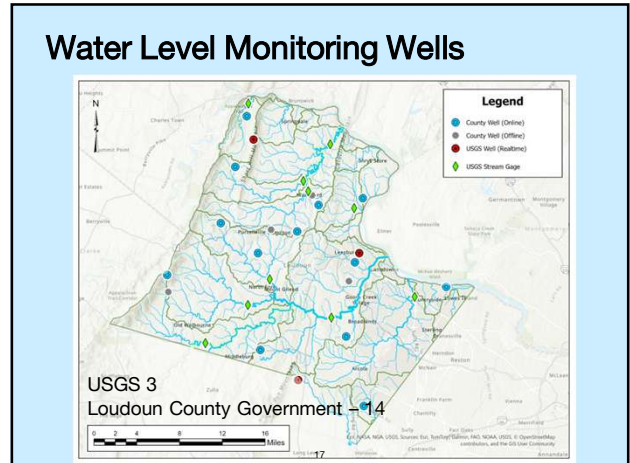
Western Loudoun – Groundwater is the source for drinking water, actually all water use

- Western Loudoun Water Supply – Groundwater
- Eastern Loudoun Water Supply - Potomac River
- Number of residents using groundwater as water supply is approximately 75,000 persons.
- In eastern Loudoun, surface water is used by nearly 5 times the number of persons as those served by groundwater in western Loudoun County.

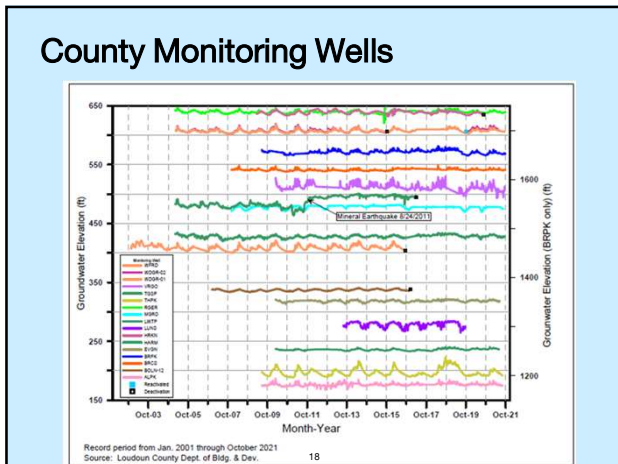
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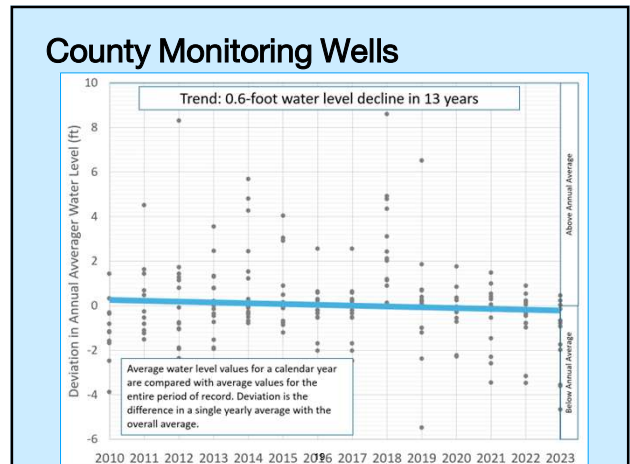
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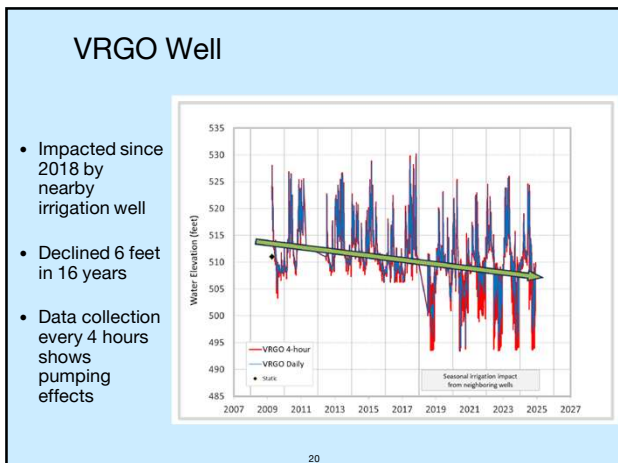
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County Water Level Wells

Impacted by nearby wells, land use change and earthquake

SITE NAME	S NAME	0-50 ft	50-75 ft	75-100	100-150	150-200	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000	Comments	
HARMONY	HARM-01														Earthquake shift	
WATERFORD	WFRD-01				3	6	4	3	13	8	10	10	10			
RUGGIERI	RGER-01															
BRCS	BRCS-01															
BOLN 12	BOLN-12															
MGRDON 1	MGRD-01								1							
WOODGROVE DEEP	WDGR-01															
WOODGROVE SHALLOW	WDGR-02															
TELEGRAPH SPRINGS	TSPG-01					1	1	3	2	1	2		4	2		
HORKAN	HRKN-01														3	
BRPARK	BRPK-01									1					2	
ALGONKIAN	ALPK-01														Influenced by Potomac River 1,000 ft away	
TEMPLE HALL	THPK-01														Limestone	
LEESBURG WWTP	LWTP-01															
EVERGREEN	EVGN-01									1						
VRGO	VRGO-01			1			1								Influenced by nearby pumping	
LUNSFORD MS	LUNS-01			2							1	2	1		Influenced by nearby pumping	
SCOTT JENKINS	JENK-01						1					1	1			
USGS Short Hill	USGS-01															
USGS Leesburg	USGS-02														Land Use shift	
USGS Prince William	USGS-03														1	2

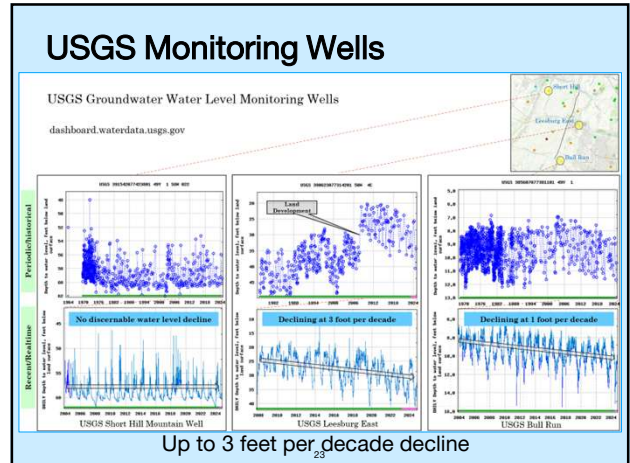
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County Water Level Wells

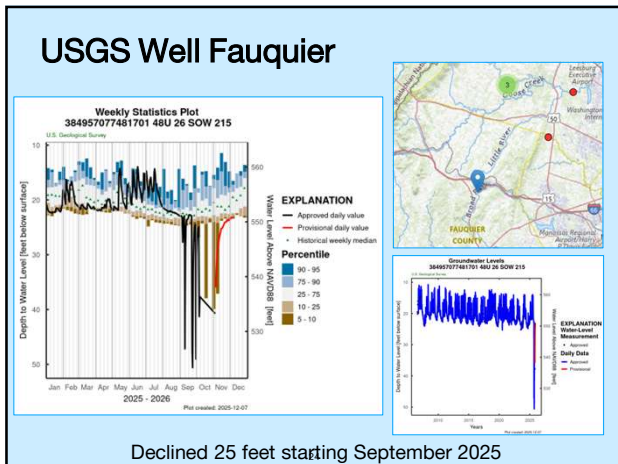
Most wells do not show significant trend, but two are impacted by nearby pumping

Well	Recent Trend
ALKP	Slightly Increasing
BOLN	Slightly Increasing
BRCS	Slightly Increasing
BRPK	Increasing
EVGN	Slightly Increasing
HARM	Slightly Decreasing
HRKN	None
JENK	None (ret)
LUNS	Slightly Increasing (but may actually be no trend)
LWTP	Slightly increasing possibly due to modified stormwater management
MGRD	Slightly decreasing
MGED	None
THPK	Significantly decreasing
UGSP	Slightly increasing
VRGO	Significantly decreasing
WDGR	Slightly increasing
01	Indeterminant
02	Indeterminant
WFRD	None

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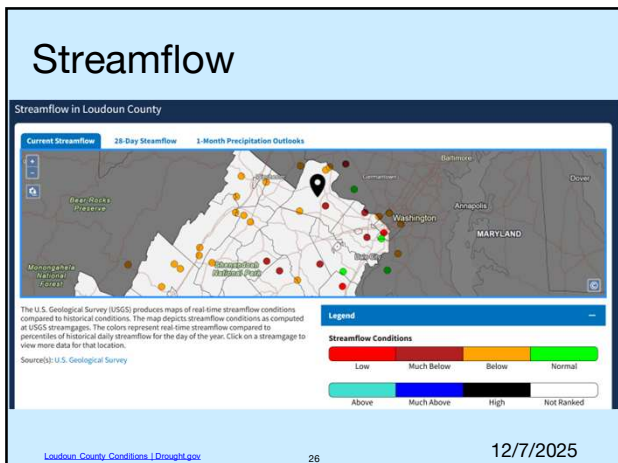
Large Water Producers

Town	Population
Purcellville	8,965
Hillsboro	110
Round Hill	687
Hamilton	599
Middleburg	679
Lovettsville	2,706
All Towns	13,746

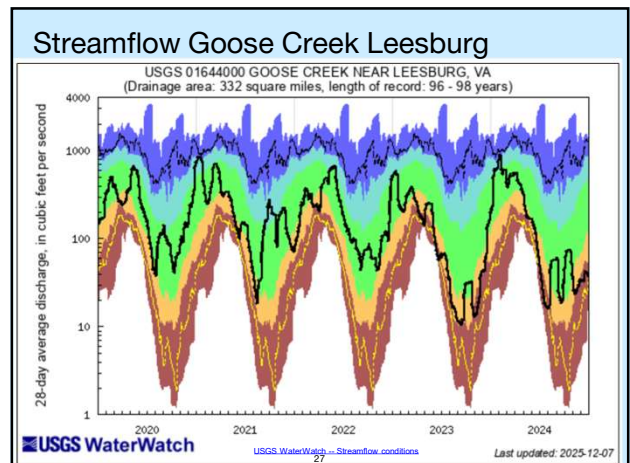
Active water wells	18,000
Per household	3.0
Resident on wells	54,000

Loudoun Water Community Systems	3,500
Total Western Loudoun on Groundwater	~75,000

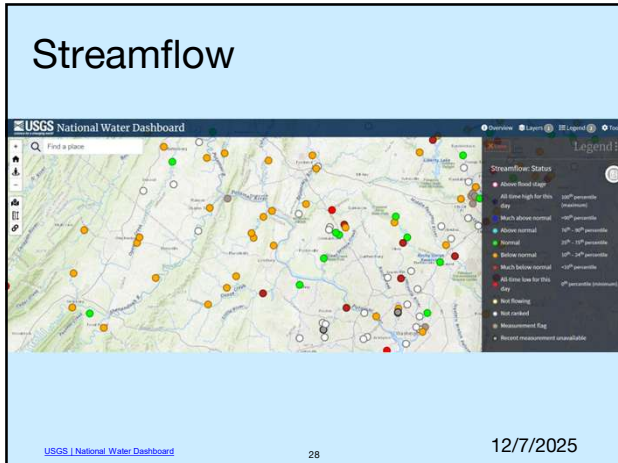
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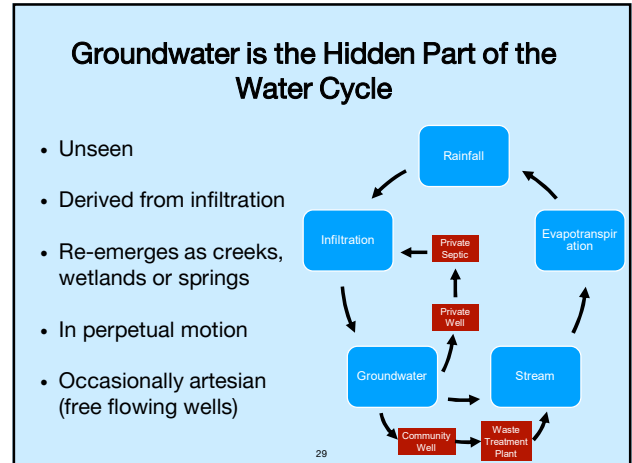
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Our Water is in the Rocks

- Water table below the bedrock
- Water is located in fractures in the granite bedrock — no big aquifers
- “Hydrostatic pressure” reduces well yields below 1,200 feet

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Our Water Table is Falling

- Data from more than 12,000 wells where driller has reported the depth to water
- Over past several decades the water table has fallen 10-40 feet in local areas
- We’re taking it out faster by pumping than it’s naturally going back in from rainfall and septic return flow

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Wells Intercept Groundwater which Flows to the Creeks

- Wells intercept groundwater which normally flows to our creeks and wetlands.
- Wells intercept the flow causing “stream depletion”.
- Too much pumping can reverse this flow pattern causing creeks to lose water.

Loudoun County Geology Primer

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Overlapping Drawdown Cones

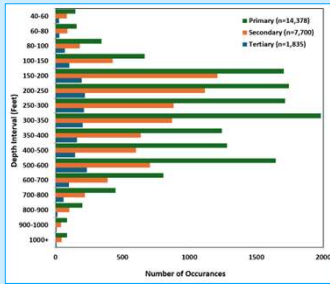
- Overpumping forms a deeper cone of depression and can cause “stream depletion”.
- Overlapping drawdown cones can further lower the water table to the point where neighboring homeowner wells and streams go dry.

Best Practices for Owners of Domestic Wells in Alluvial Aquifers, The Groundwater Project, 2006, gw-project.org

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Groundwater is in Shallow Fracture Zones

- Most fractures zones are often 200 to 600 feet below ground.
- Water is often produced from several fracture zones.
- Most ground water is stored in soils and shallow bedrock.
- Fractured bedrock offers little water storage capacity.
- Groundwater age is typically less than 10 years.
- Water table has been dropping over time, limiting the overall water storage.

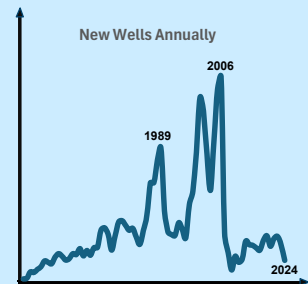


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More and more wells each year

- Water tables below the bedrock.
- Water is located in fractures in the rock — no big aquifers.
- “Hydrostatic pressure” reduces well yields below 1,200 feet.
- Number of new wells typically reflects housing starts.

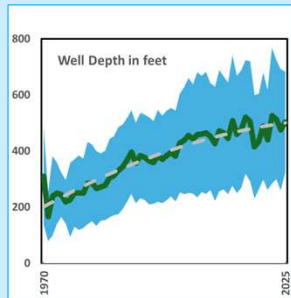


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Approaching the Bottom of the Barrel

- Over time we are going deeper and deeper to find more water
- Recent average well depth was 500 feet
- Water can't be extracted below about 1,200 feet as fractures are squeezed shut
- 3,200 wells abandoned

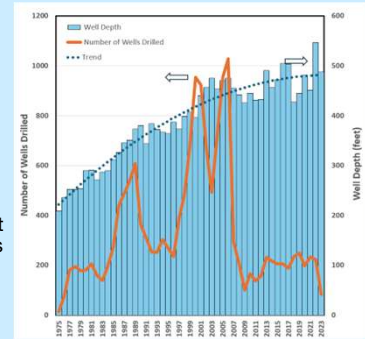


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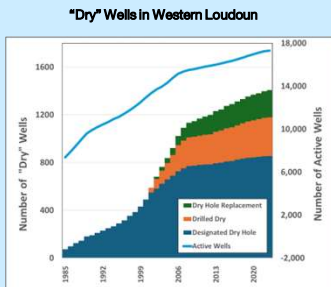


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More “Straws in the Bucket”

- 1,000 active wells in 1990.
- 18,000 active wells today.
- Half of all wells are within 200 feet of another well.
- 90% of all wells are within 550 feet of another well.
- At this density, well conflicts are inevitable.
- Every year about 10% of wells drilled are “dry” and not useable.

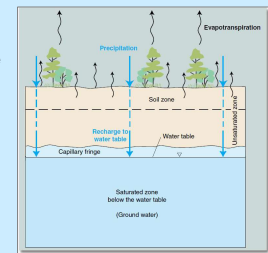


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Not Enough Water Going Back Down into the Ground

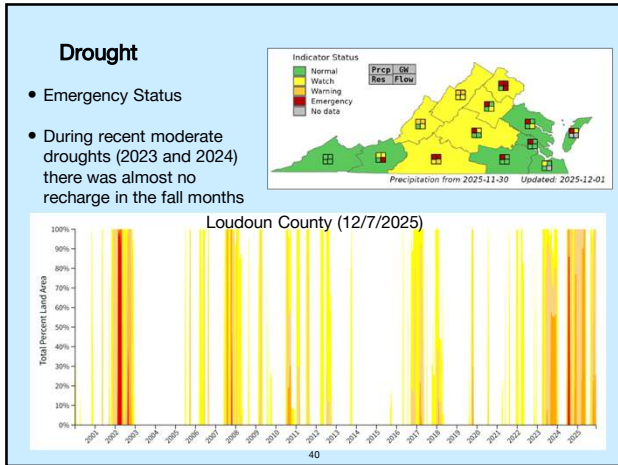
- Based on streamflow data, recharge has decreased 5 to 10% over past several decades.
- Seasonal variation: In the spring is the largest recharge rate and fall is the smallest.
- During recent moderate droughts (2023 and 2024) there was almost no recharge in the fall months.
- Recharge reductions caused by:
 - Increasing runoff due to development
 - More impervious surfaces: roofs, roads, and turf
 - More community water systems replacing recharge from private septic systems



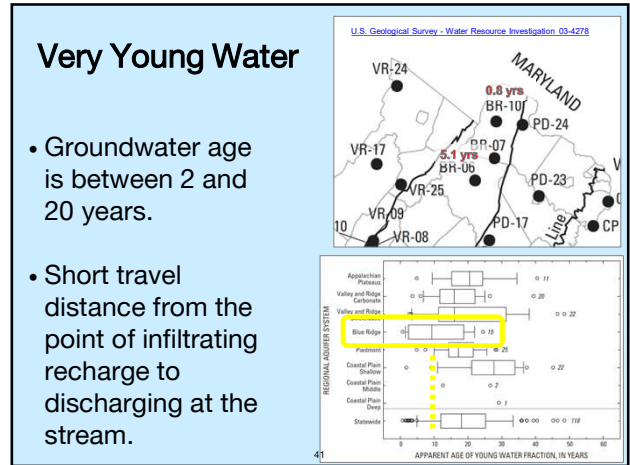
Groundwater Photo Gallery U.S. Geological Survey

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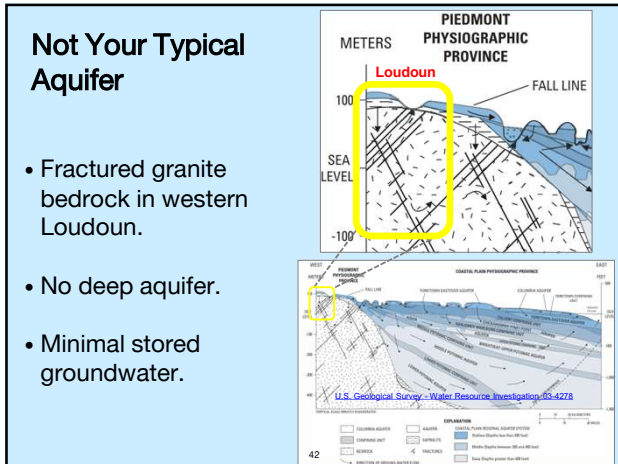
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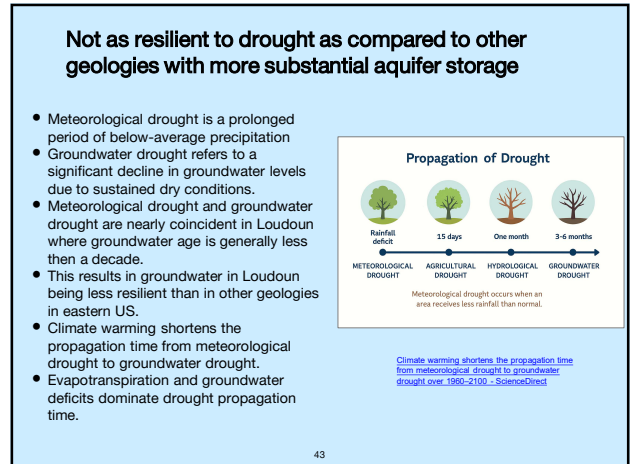
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