



# **Jefferson County Water- Areas for Further Investigation and Monitoring**

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# Jefferson County...

⇒ Divided into two main sections:

Blue Ridge Province – Meta-sedimentary and  
Meta-igneous rocks;

Great Valley Province – Carbonate Rocks (i.e.  
limestone and dolomite)

**The majority of Jefferson County's aquifers fall  
within the karst terrain underlain by  
carbonate rocks.**



# What is “karst”

- ⇒ Karst is a landscape type that is *characterized* by the presence of sinkholes, springs, caves, and a pinnacled, highly irregular soil-rock interface.
- ⇒ The karst landscape is a *consequence* of the presence of soluble bedrock, most commonly carbonate rocks (e.g. limestone, dolomite, and marble).

# Karst Management...what's that?

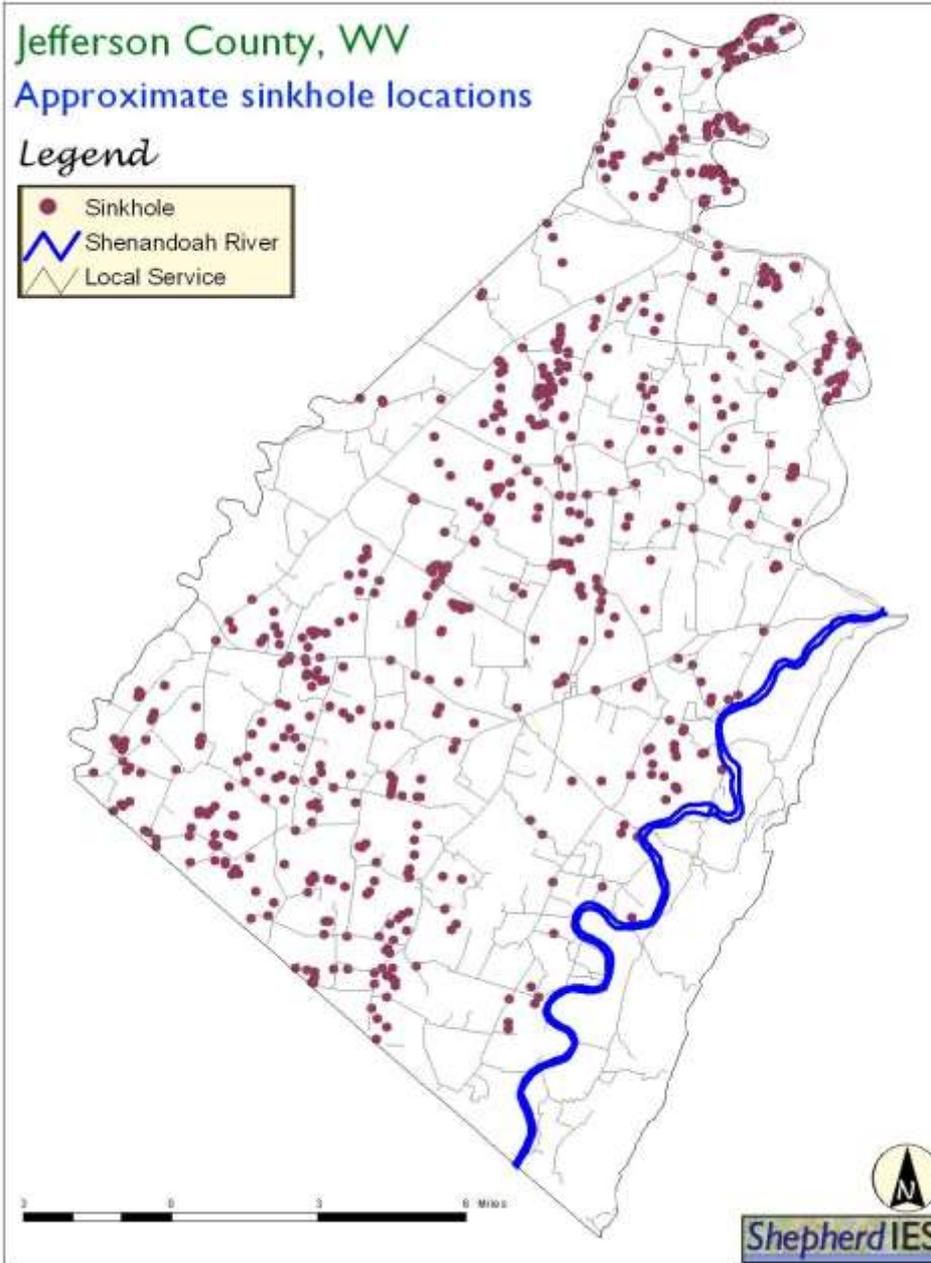
- ⇒ There is currently no coordinated or codified karst management process for Jefferson County.
- ⇒ Karst studies are often requested by the planning commission, however there is no formalized review process.
- ⇒ Karst “assessments” are often simply a sinkhole inventory, diagnostic study (ERS, EM), without any coordinated analysis and findings. Management plans are essentially non-existent.

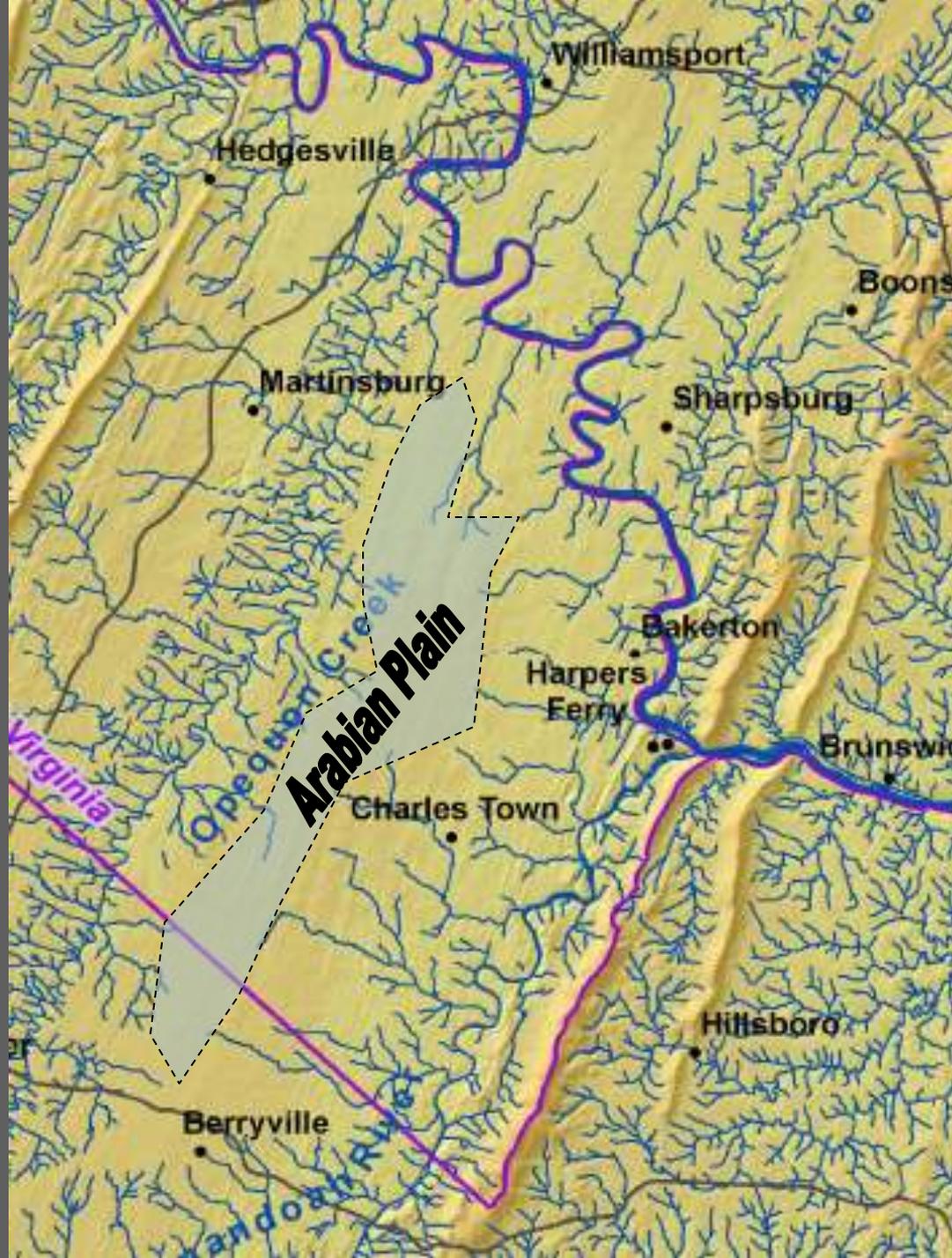
# Jefferson County, WV

## Approximate sinkhole locations

### Legend

- Sinkhole
- ~ Shenandoah River
- △ Local Service





# The “arabian plain” ...

- ⇒ An upland area with relatively few surface streams.
- ⇒ Seasonal variability in the water table that results in numerous estavelles.
- ⇒ Water emerges along the margins, flowing both east and west.
- ⇒ May be the remnant of a former carbonate plateau.



# So what's an "Estavelle"?

- ⇒ Estavelles (sinkholes that function as springs or exurgences in wet weather and insurgences in dry)
- ⇒ Turloughs – Gaelic for “dry lake”, ephemeral lakes that appear during wet weather in karst areas, often due to overflowing of a shallow karst conduit.





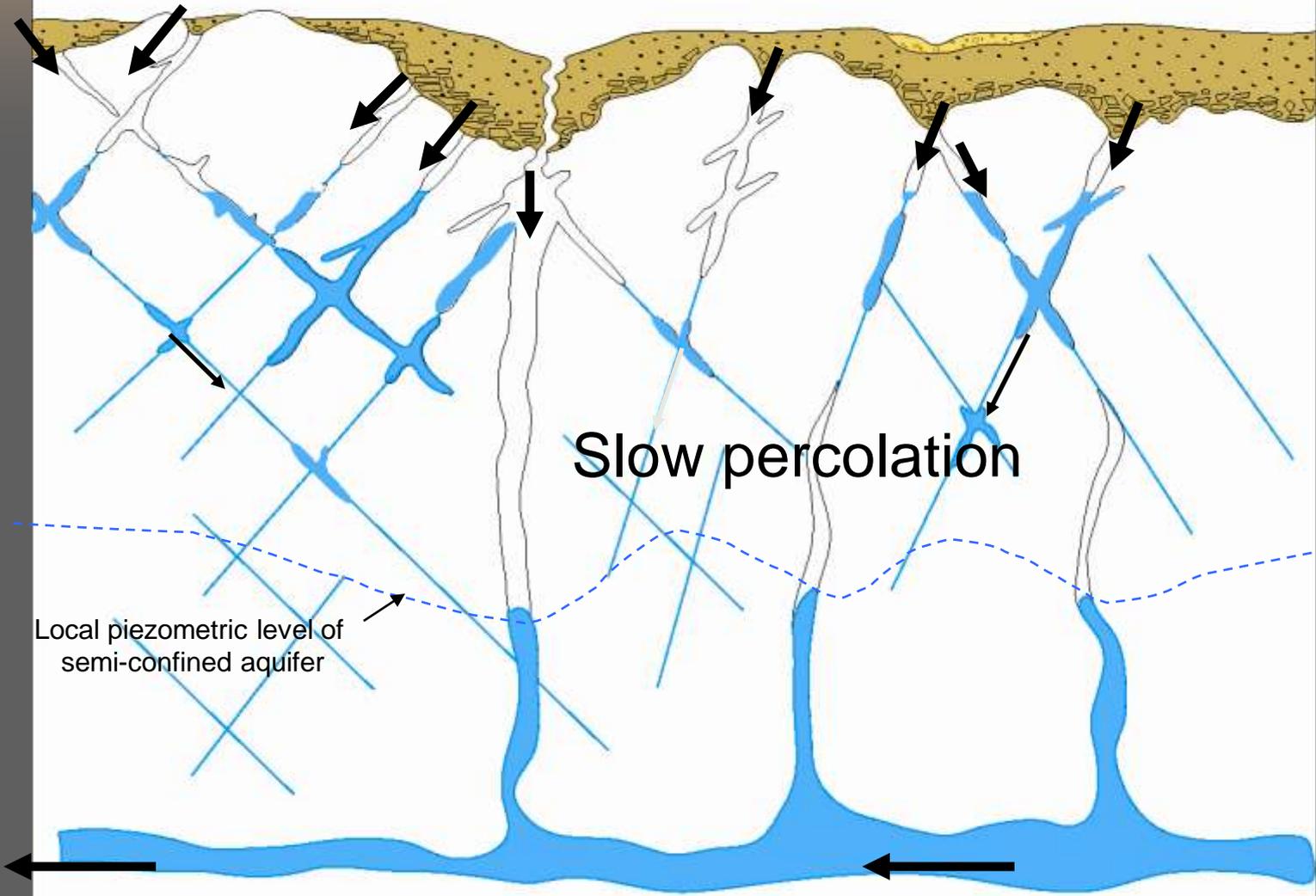






# DRY CONDITIONS

Rapid surface drainage



Slow percolation

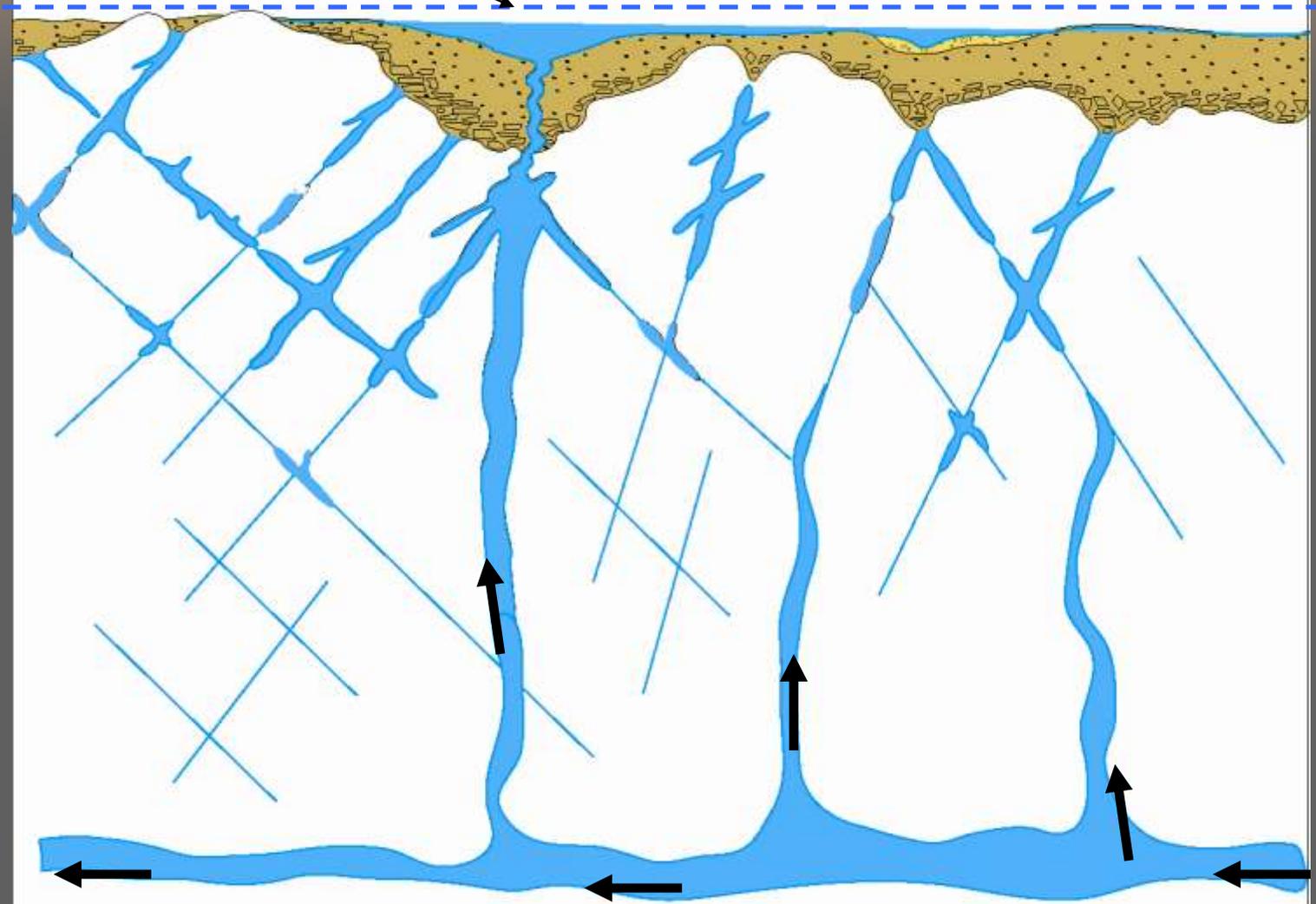
Local piezometric level of semi-confined aquifer

Slow groundwater flow to perennial spring

# WET CONDITIONS

FLOODED SINKHOLE

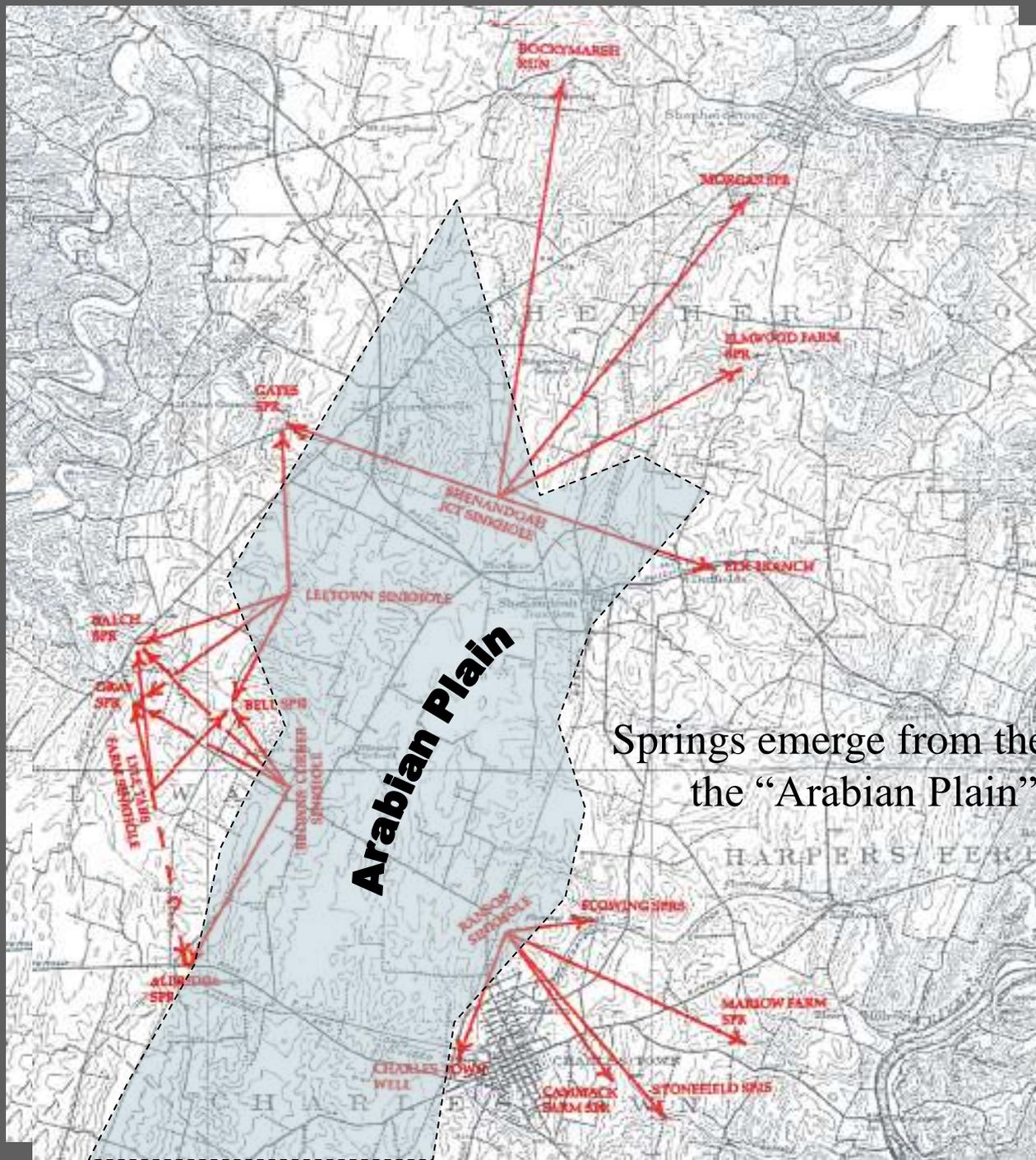
Local piezometric level of semi-confined aquifer



Rising deep groundwater flow

# How does the groundwater move?

- ⇒ It has been assumed that the majority of the groundwater in the “arabian plain” moves by slow, diffuse transmission.
- ⇒ This assumption has been based on various dye trace studies.



**Arabian Plain**

Springs emerge from the margins of the “Arabian Plain” upland

# Managing the Resource...

- ⇒ The “arabian plain” shares characteristics with the Edwards Aquifer of Texas.
- ⇒ The area contains major quantities of water in the epikarst, however they can be easily contaminated.
- ⇒ The margin springs are directly affected by the water quality at the insurgences.



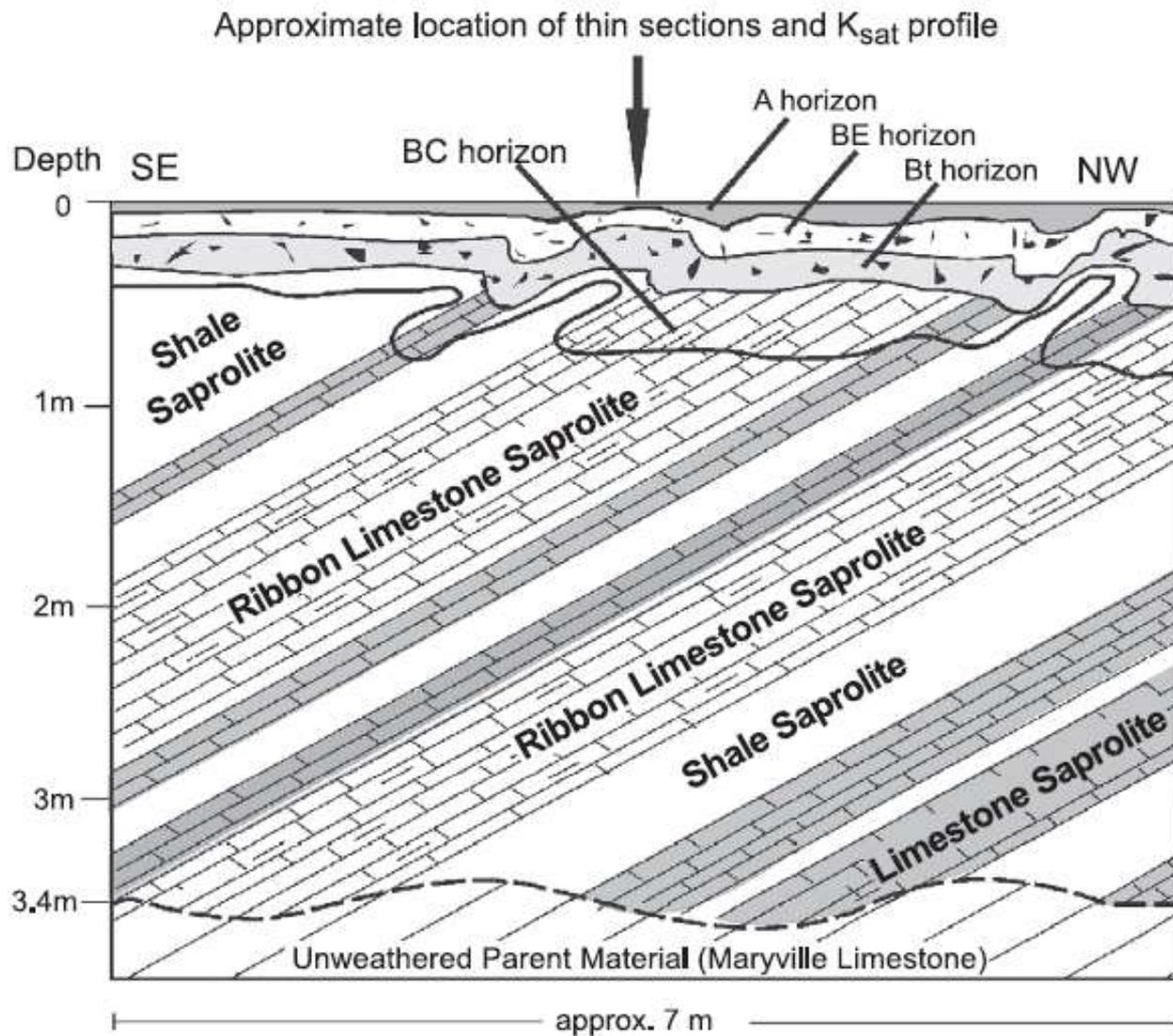
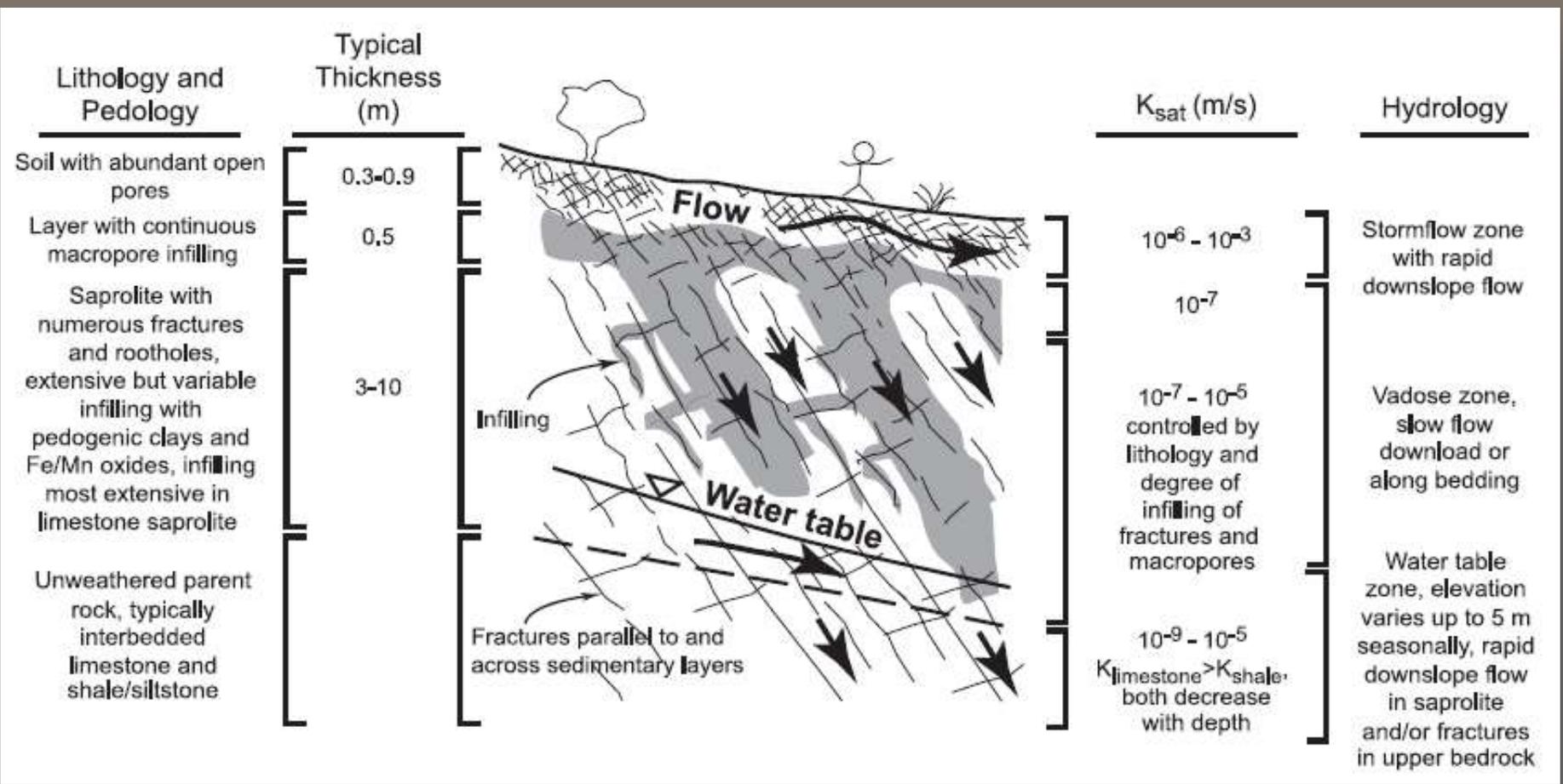


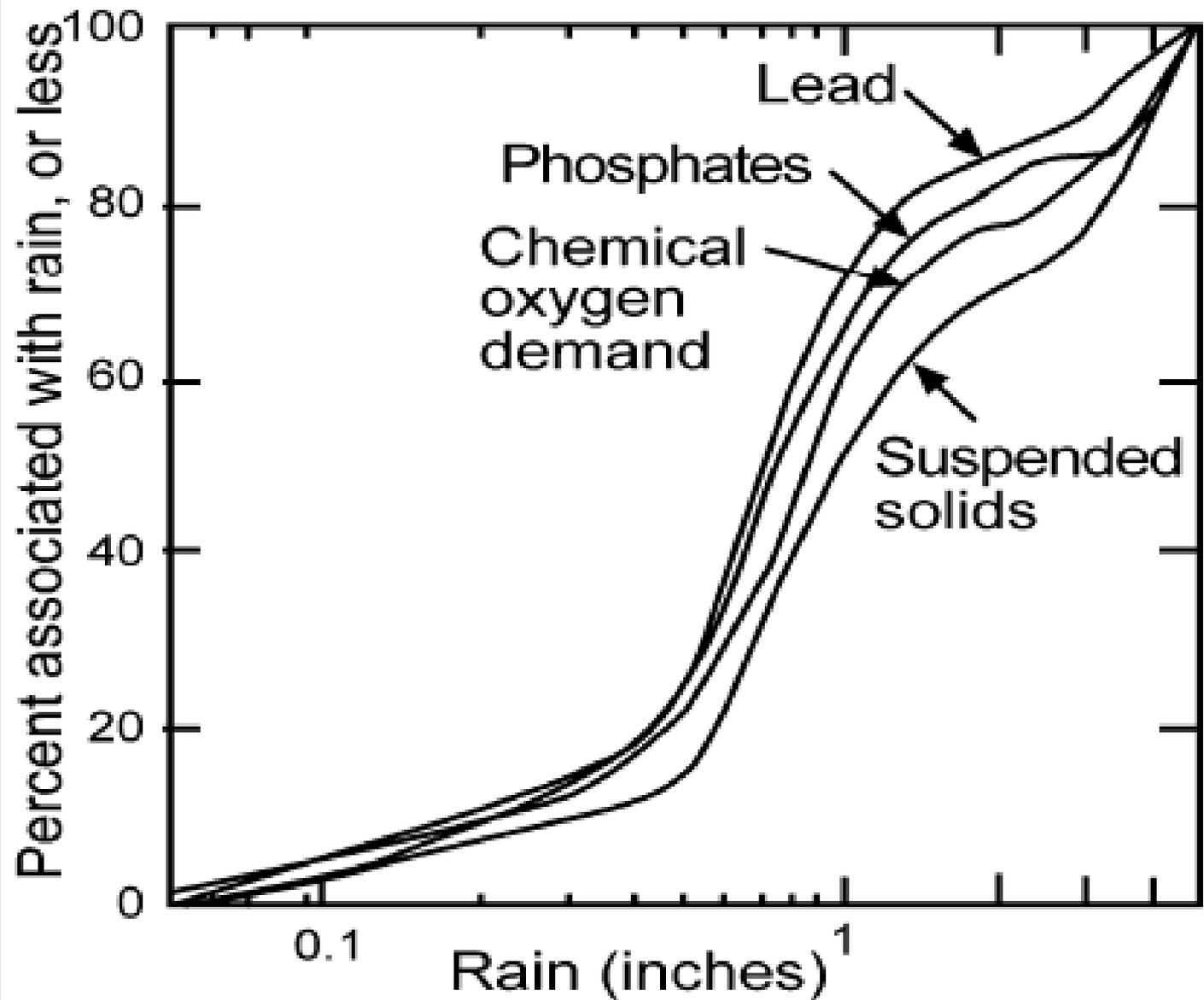
Fig. 1. Schematic diagram of vertical pit face of site KS-1 weathering profile developed on Maryville Limestone in eastern Tennessee, showing soil horizons, saprolite lithologies, and bedding inherited from parent material.



L.D. McKay et al. / Geoderma 126 (2005) 27-45

# Contaminant Attenuation...

- ⇒ Is dependant on the nature of the substance;
- ⇒ Non-polar compounds such as petroleum hydrocarbons tend to adsorb to organic soil particles;
- ⇒ Polar compounds (salts, metals, etc.) adsorb to mineral surfaces, particularly clays;
- ⇒ Regardless of adsorption, eventually the sediment will begin to yield excess to the aqueous environment as a dissolved phase.







# Sinking Ephemeral Streams

- ⇒ Intermittent or ephemeral streams that sink into the ground also must be managed carefully;
- ⇒ Hydrologic studies should be conducted to determine the peak flow, the frequency of insurgence, and where the water goes and how fast it gets there.
- ⇒ Remediation of these types of sinkholes can be undertaken, but with great care and attention to management.
- ⇒ Under no circumstances should the flow to a sinkhole be increased by redirection of surface stormwater as this may exacerbate the formation of downgradient sinkholes.

# What about coliform?

- ⇒ The specific source(s) of coliform bacteria in Jefferson County groundwater is still uncertain.
- ⇒ Studies suggest that a significant portion of the coliform may be originating with bacterial decomposition of organic materials.
- ⇒ Livestock may contribute as much to the presence of *E. coli* as human activities (i.e. septic tanks, leaky sewer lines, etc.).



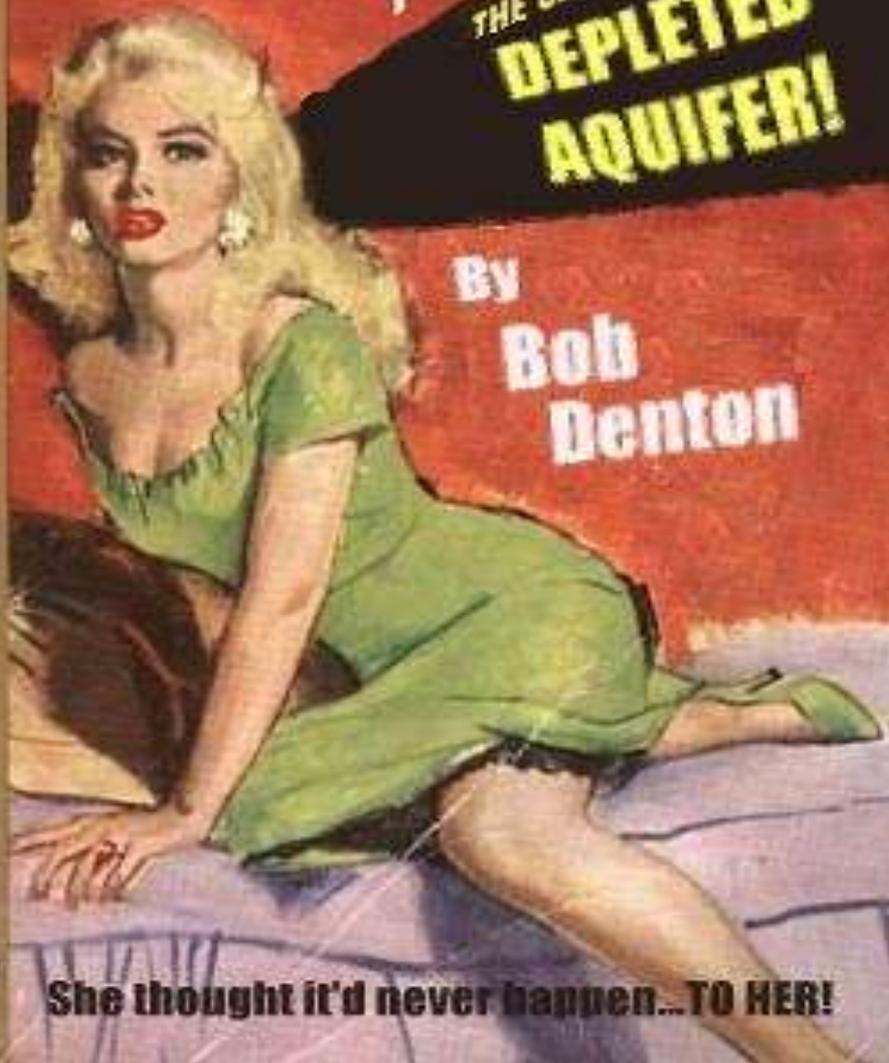
POCKET  
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# Perry Mason

THE CASE OF THE  
**DEPLETED  
AQUIFER!**

By  
**Bob  
Denton**



THE  
COMPLETE  
BOOK

**She thought it'd never happen...TO HER!**

# Water Budget- Recharge vs. Extraction

- ⇒ Recharge zones require delineation and protection.
- ⇒ Groundwater extraction has to be carefully monitored and balanced with the overall water budget.
- ⇒ Base-flow studies are critical in developing a water budget model.

# Groundwater Sustainability

- ⇒ The State of WV currently has minimal requirements for well proving, far less stringent than any similar jurisdiction.
- ⇒ WVDHHR permit for residential wells has NO sustainability requirements, regardless of the number of wells in a subdivision.
- ⇒ The permitting of community wells only requires a stable drawdown for 8-hours, or a 24-hour test if the stable drawdown cannot be produced (extrapolated out to 6 months without precipitation).

# Other Jurisdictions

- ⇒ NY - 72 hours pump test for ALL community wells.
- ⇒ Texas (Edwards Aquifer, Balcones Aquifer) – 48 hour pump test with a formal water budget and management plan **REQUIRED!**
- ⇒ California – Minimum 48 hour pump test on all community wells.

# What about Berkeley County?

Now requires hydrological assessments of groundwater removal-

1. Large subdivisions with individual wells
2. Community wells

Reviews are performed by 3<sup>rd</sup> party geologist (not county staff) or hydrologist (due to specific knowledge requirements).