Springs: Important Hydrogeological Aspects

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Users and uses share a common resource even through different types of sources…


Access in many areas is through “common” sources…


Distribution is usually about connecting to a source and supplying to an increasing demand…


Springs, Community, Science, Participation, Technology…
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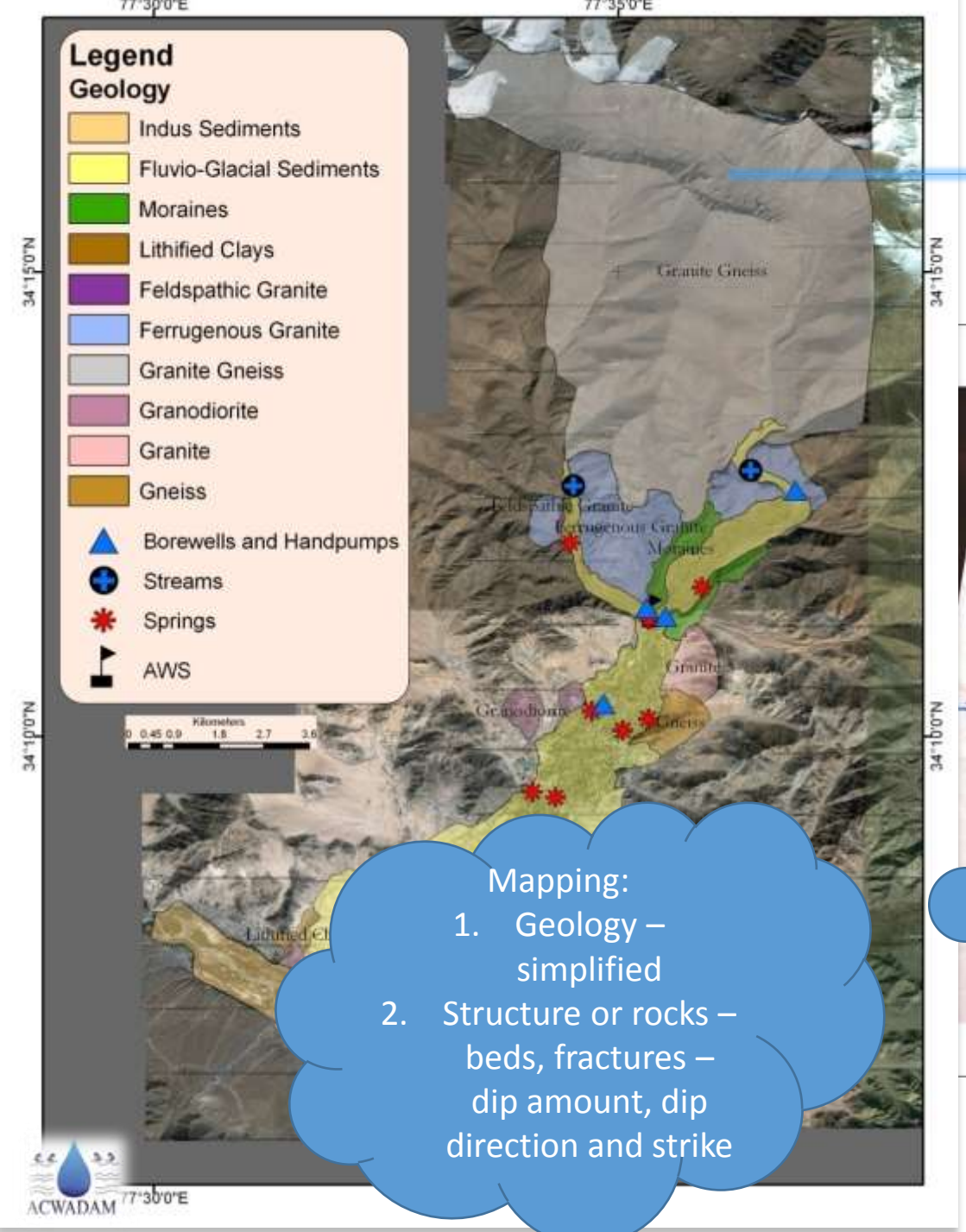
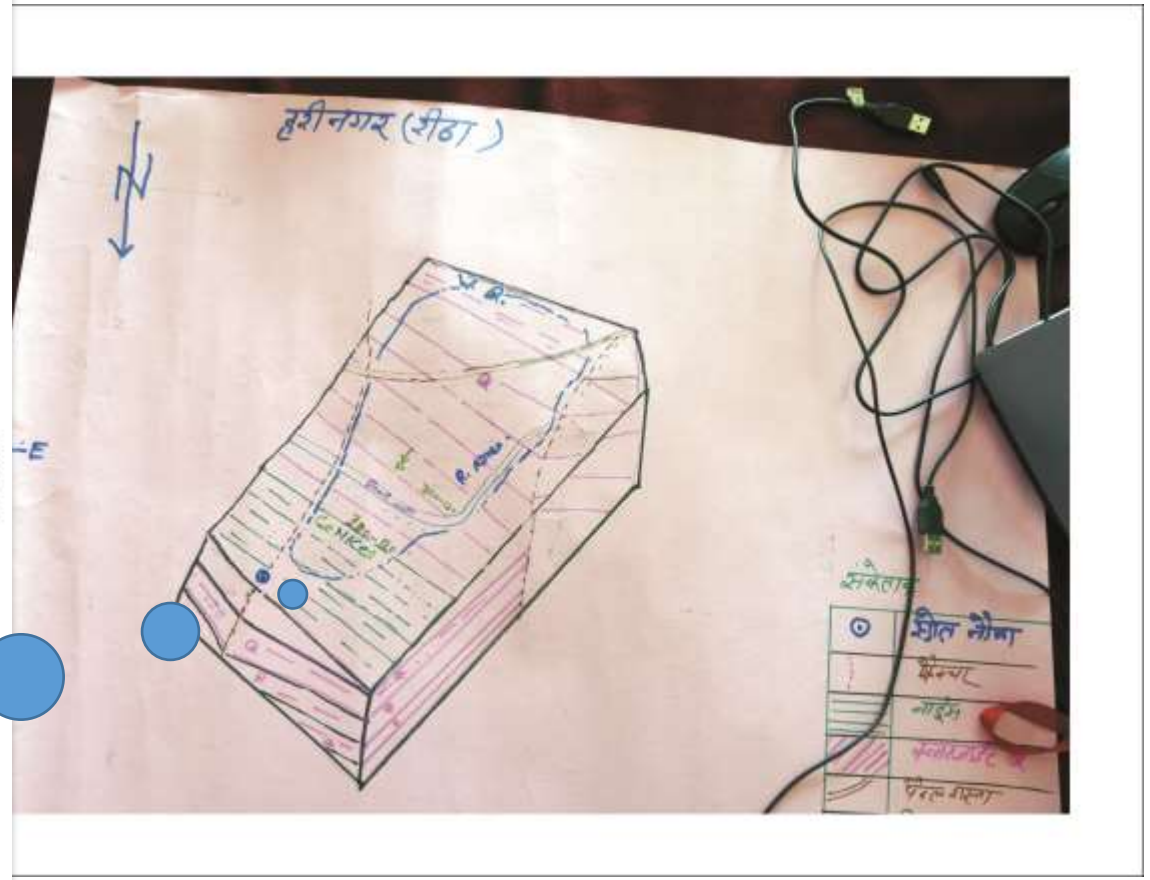
Building capacities

Inventory or springs:

1. Khar VDC - Nepal
2. Bans Maitoli watershed – Pithoragarh, India

Mapping: conventional & unconventional





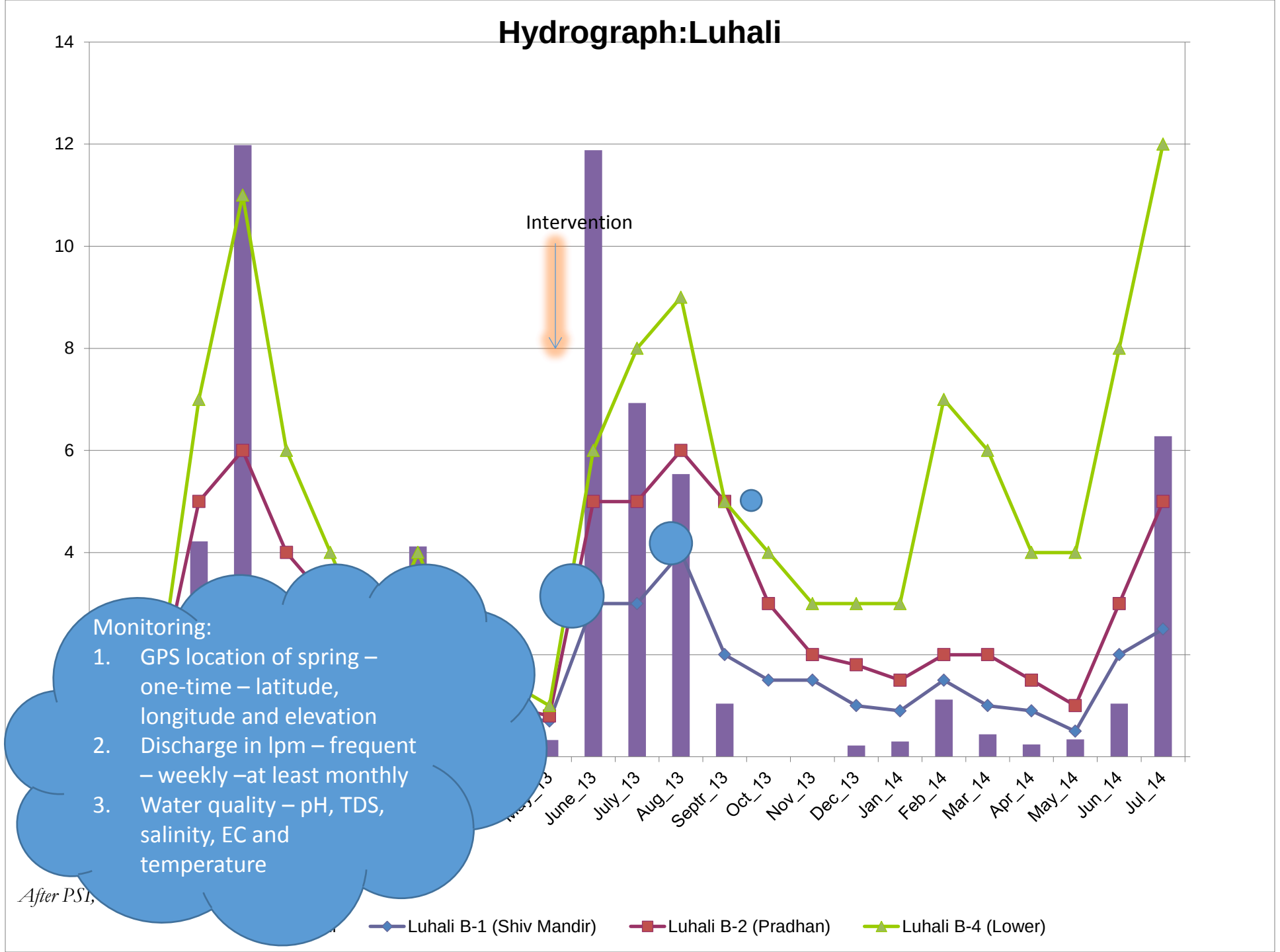
Mapping:

1. Geology – simplified
2. Structure or rocks – beds, fractures – dip amount, dip direction and strike

Action research and characterisation

Preparing maps and sections:

1. Conceptual section
2. Map – if feasible


Hydrograph:Luhali
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Intervention
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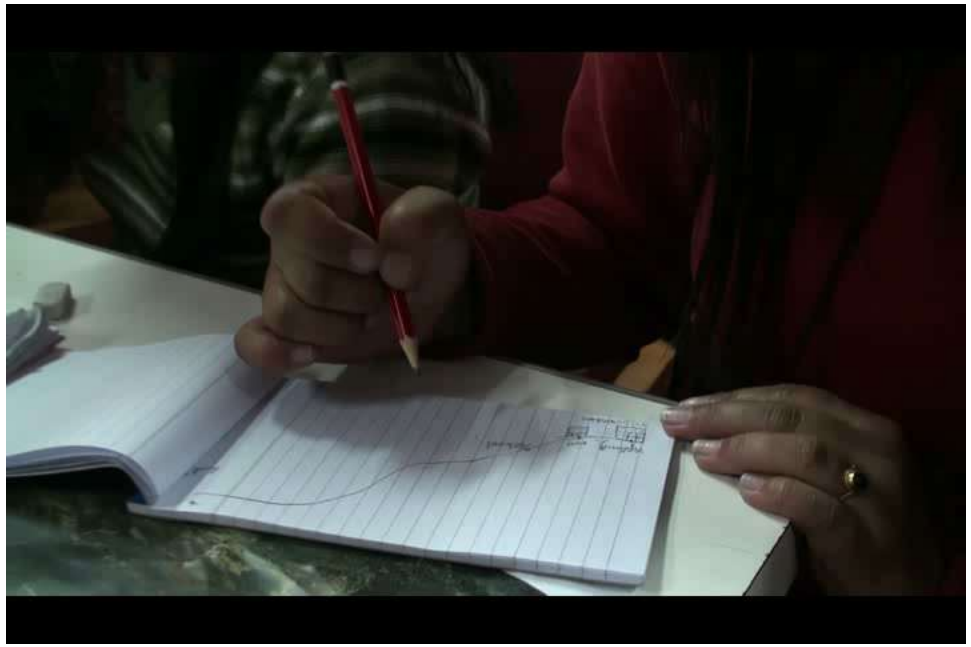
Monitoring:
1. GPS location of spring – one-time – latitude, longitude and elevation
2. Discharge in lpm – frequent – weekly –at least monthly
3. Water quality – pH, TDS, salinity, EC and temperature
Luhali B-1 (Shiv Mandir)
Luhali B-2 (Pradhan)
Luhali B-4 (Lower)

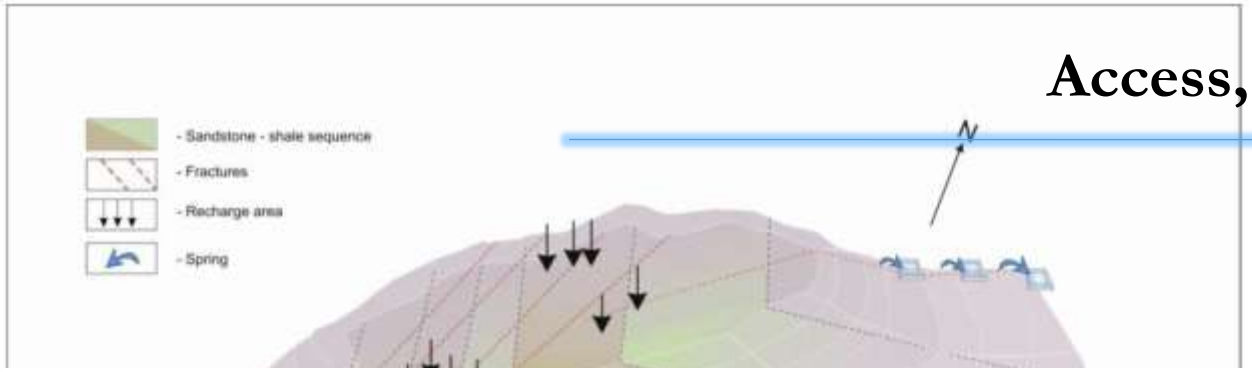
After PSI,

Hand-holding and facilitation



Planning the interventions …. Recharge and management

Access, augmentation and protection



Summary of proposed catchment treatment plan

Village	Spring	Area for recharge(ha)	Area for protection(ha)	Treatment measures suggested
Longra		1.2	6.5	Recharge pits, Staggered trenches
Yangpi		15	60	Contour trenches
		1.5	10	Staggered trenches
		0.8	17	Recharge pits
	pring	5.2	35	Contour/Staggered trenches

Fracture

Characterising springs….for appropriateness in interventions…

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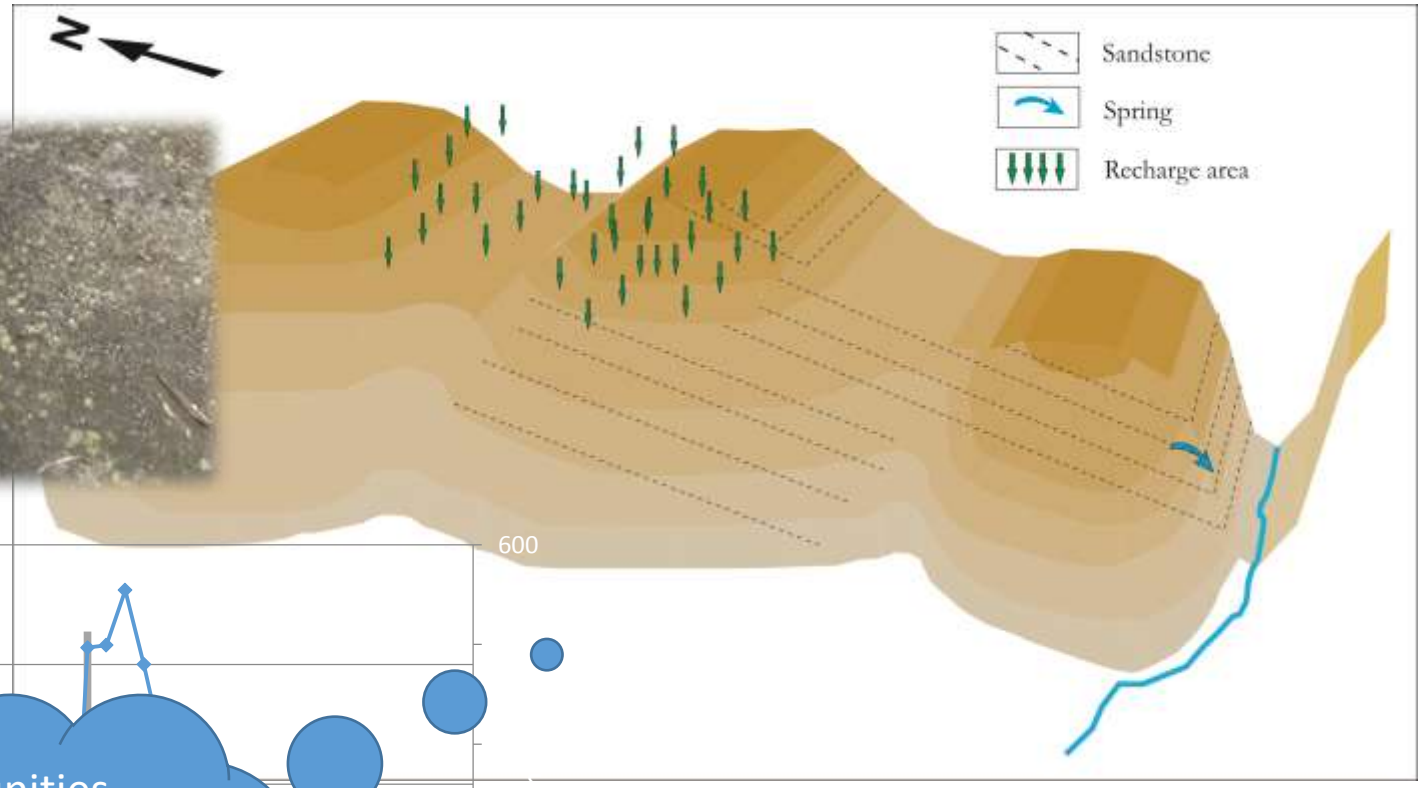
Planning



Involving communities, gathering data and influencing decisions with scientific and social mobilisation for improved spring-management!!

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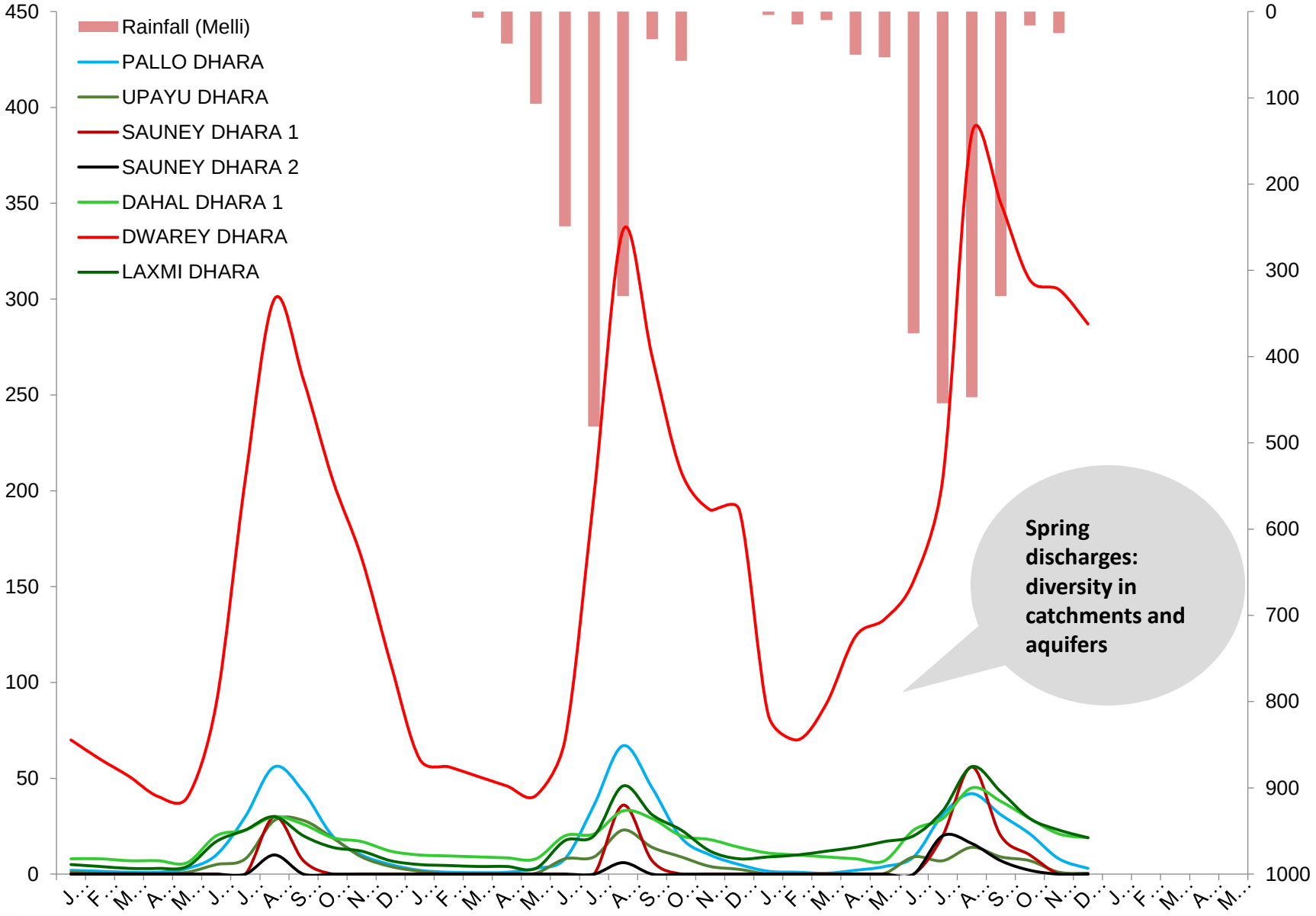
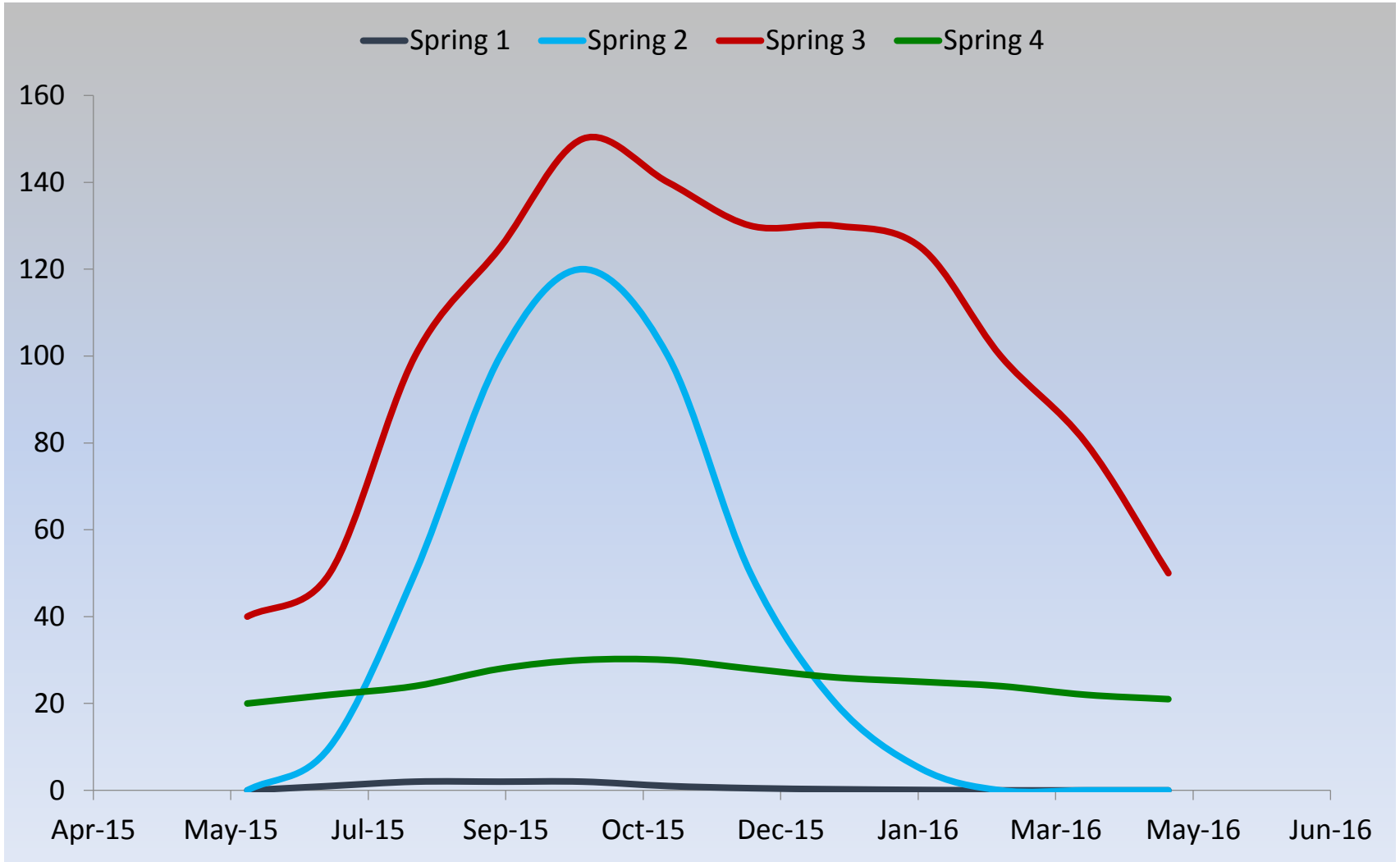
Springs tapping mountain aquifers…*differ in their characteristics*

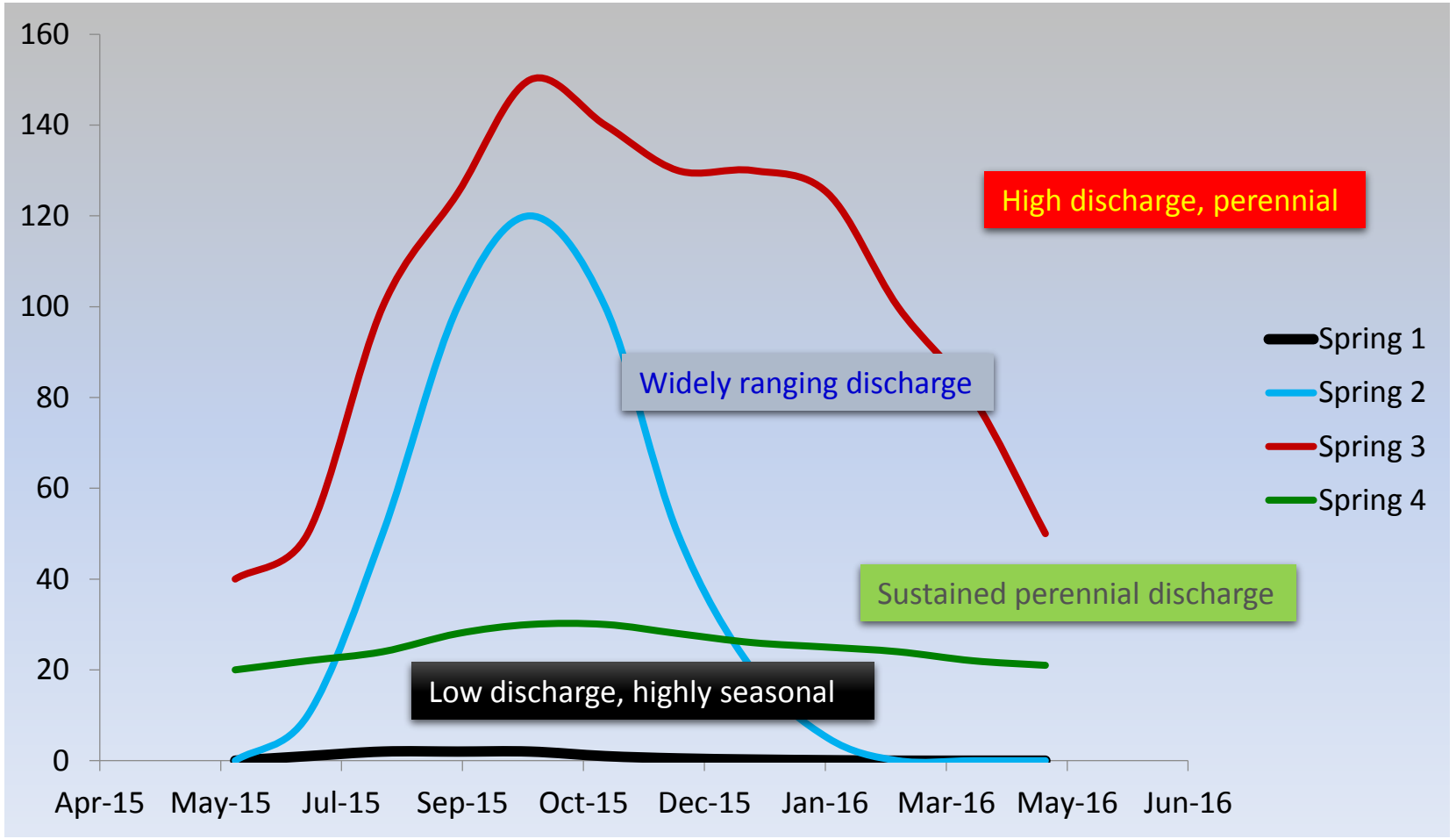


Credit: Mr. Suren Mohra, RM&DD-Sikkim

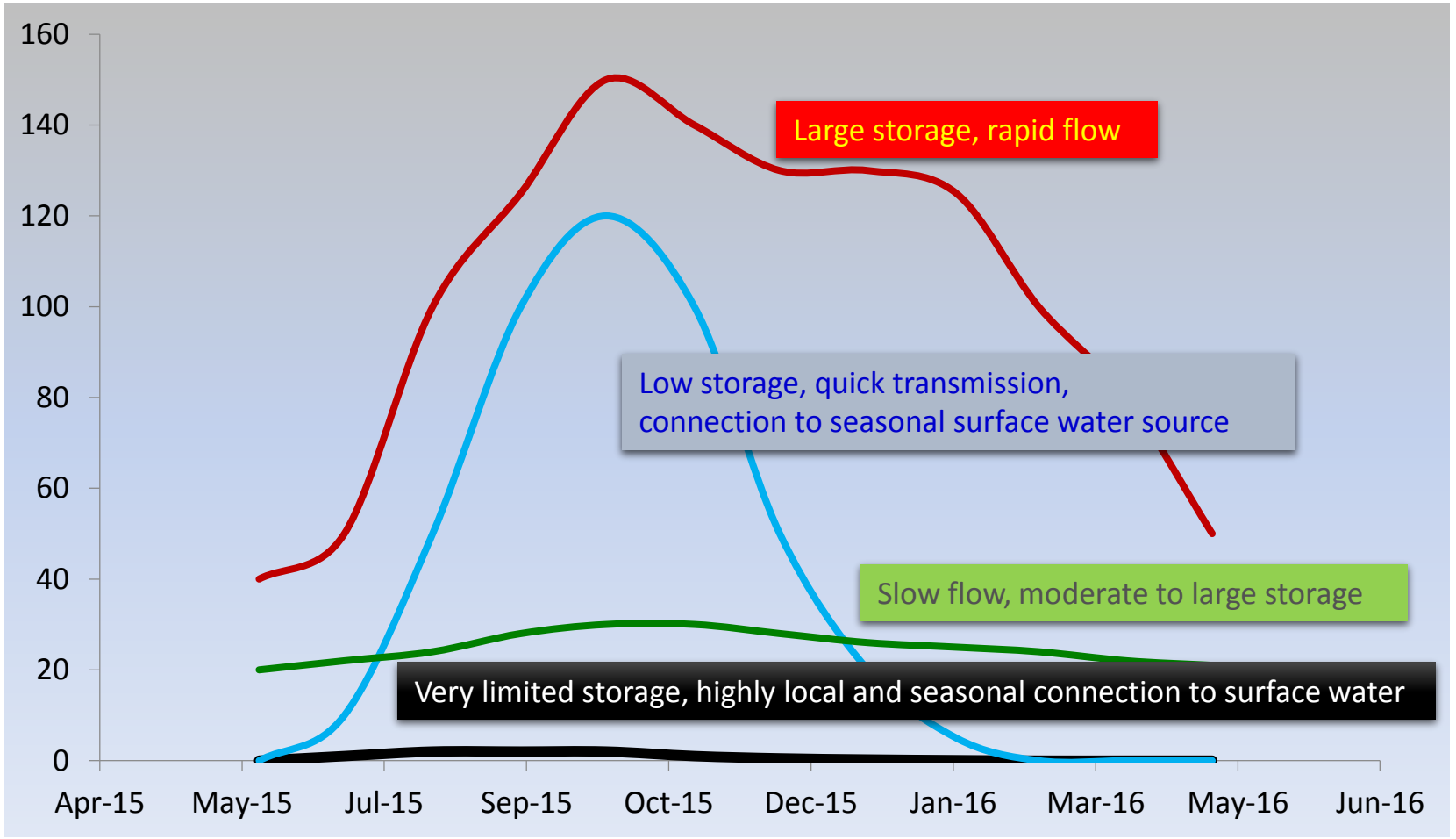
Springs and aquifers: discharge trends – annual cycle



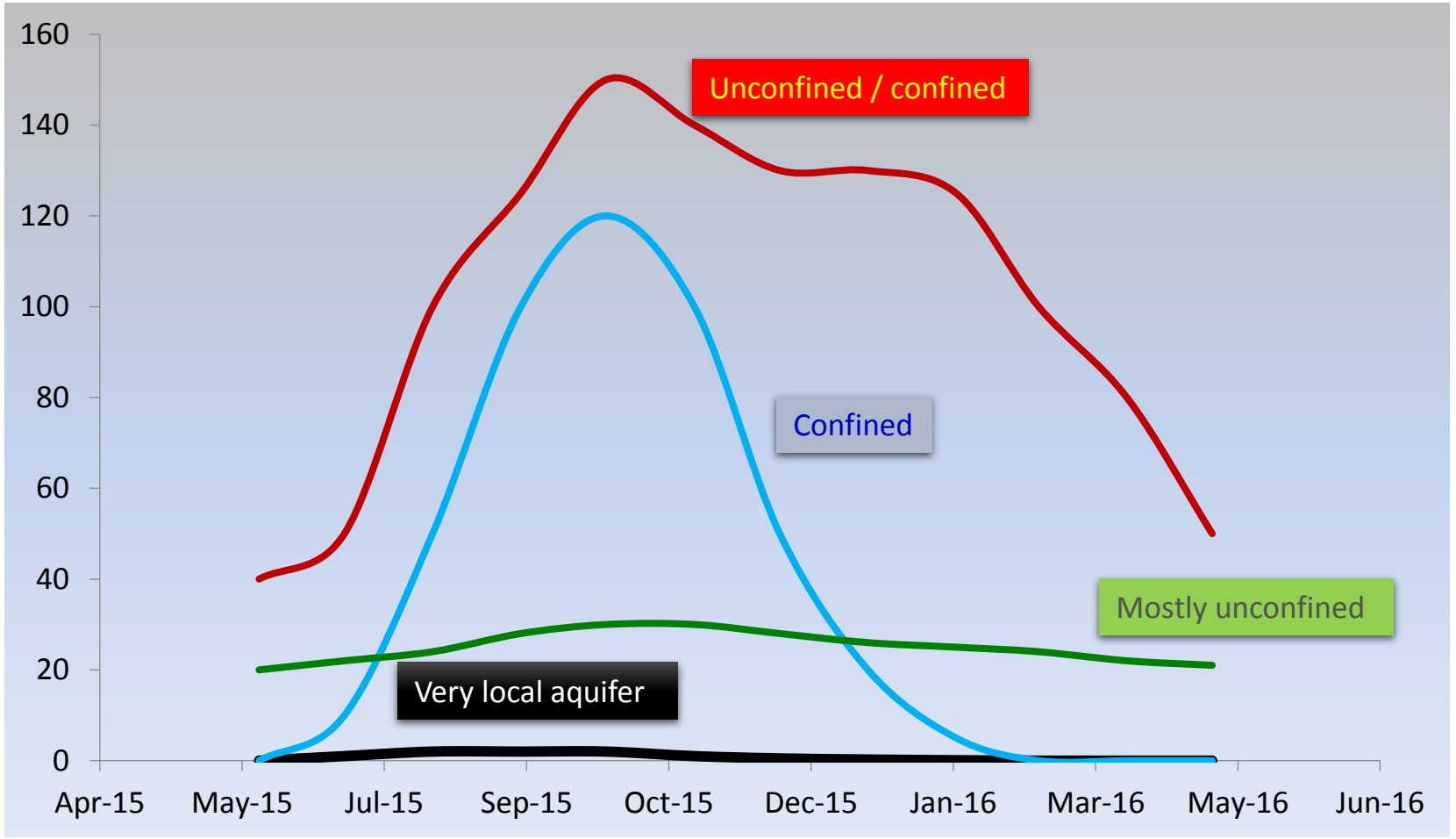
Describing a spring based on its discharge



Spring discharge: accumulation and flow in underlying aquifers



Spring discharge: mostly likely aquifer types



Indicator matrix

	Recharge zone - proximity to spring	Recharge zone - size
Spring 3	Could be either closeby or far away (large aquifer storage)	Large
Spring 2	At distance	Small
Spring 4	At distance (moderate to low transmissivity)	Large
Spring 1	Very close	Small, probably negligible

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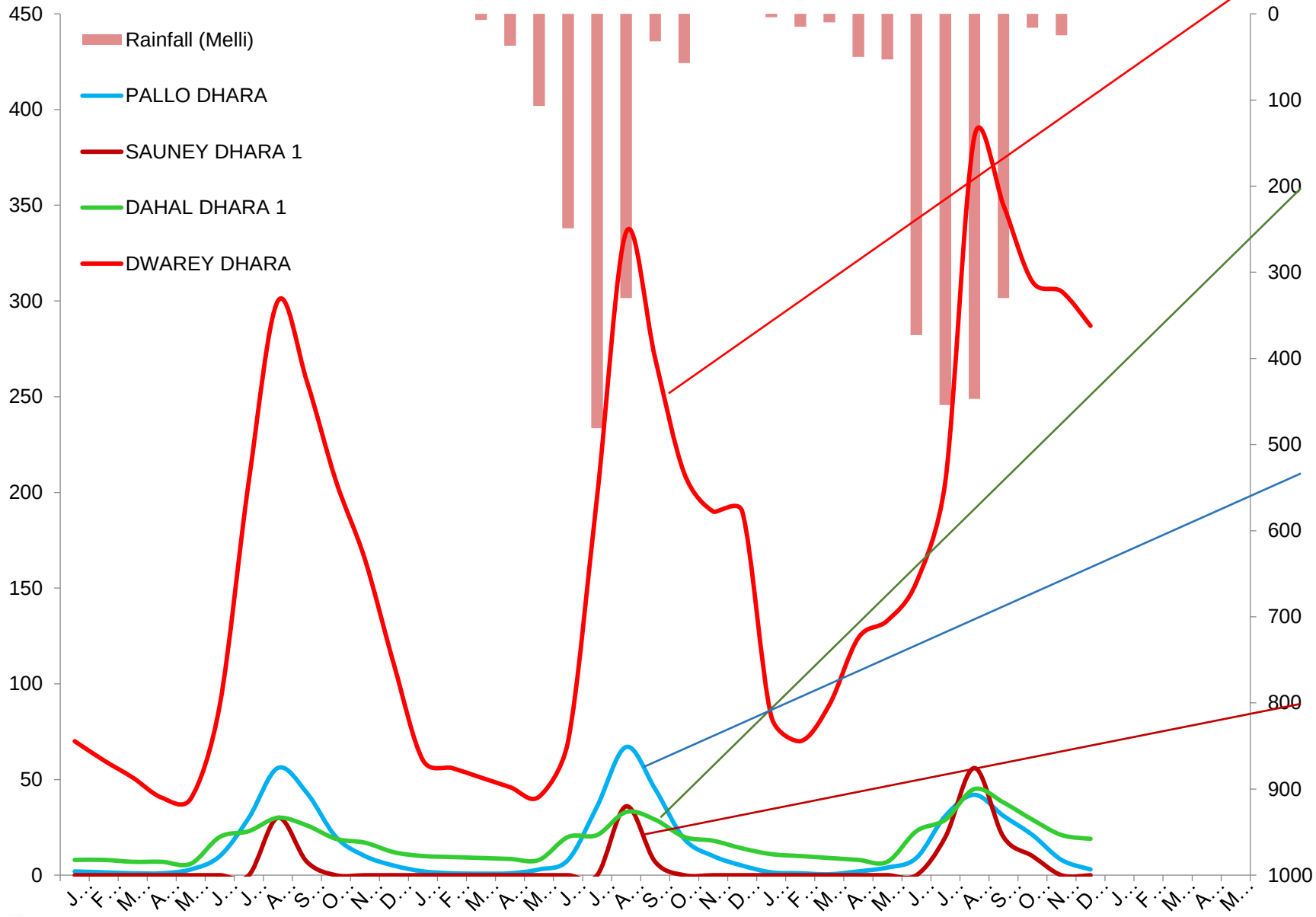
...so are springs tapping mountain aquifers



Baseline= 90 lpm
Impact= 97 lpm
8.33% increase over the whole year

Baseline= 9.5 lpm
Impact= 10.5 lpm
10.6% increase over the whole year

Baseline= 16.5 lpm
Impact= 18 lpm
8% increase but over 300 days

Baseline= 11 lpm
Impact= 13 lpm
17% increase but over 80 days

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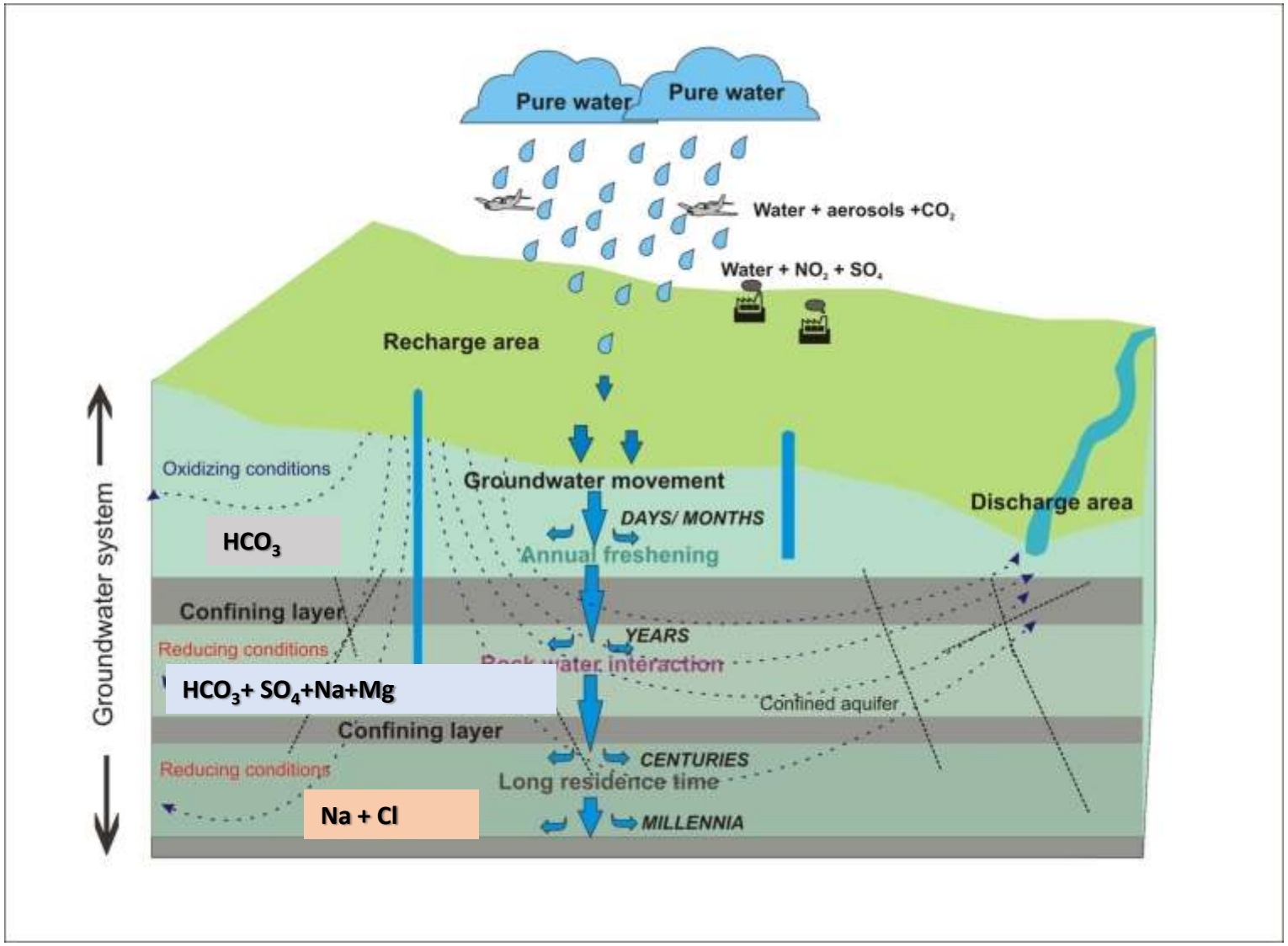
Credit: Mr. Suren Mohra, RM&DD-Sikkim

Movement of water from the atmosphere to great depths…



Anion change $HCO_3 \rightarrow SO_4 \rightarrow Cl$

Cation change $Ca \rightarrow Mg \rightarrow Na$

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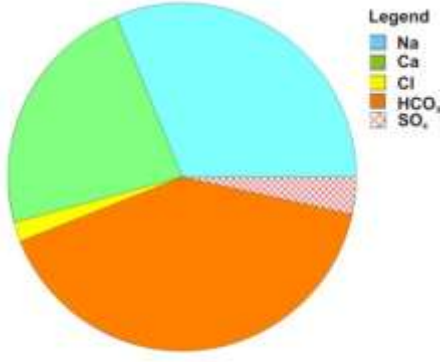
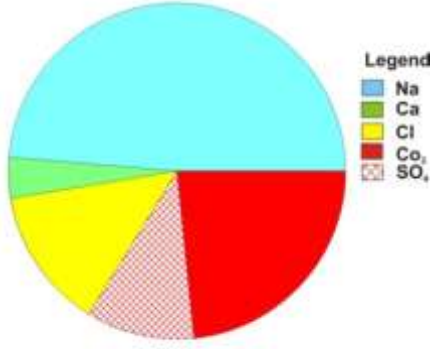
Shallow and deep groundwater

Properties	Unconfined aquifer	Confined aquifer
Recharge	Usually immediate recharge	Receives late recharge due to more travel time for water
Mineralization	Less mineralized	More mineralized
Water type	HCO_3 type	CO3-SO4-Cl-Na-Mg type
Dissolved solids	Low TDS	High TDS
Contaminants	More biological contamination	More chemical contamination

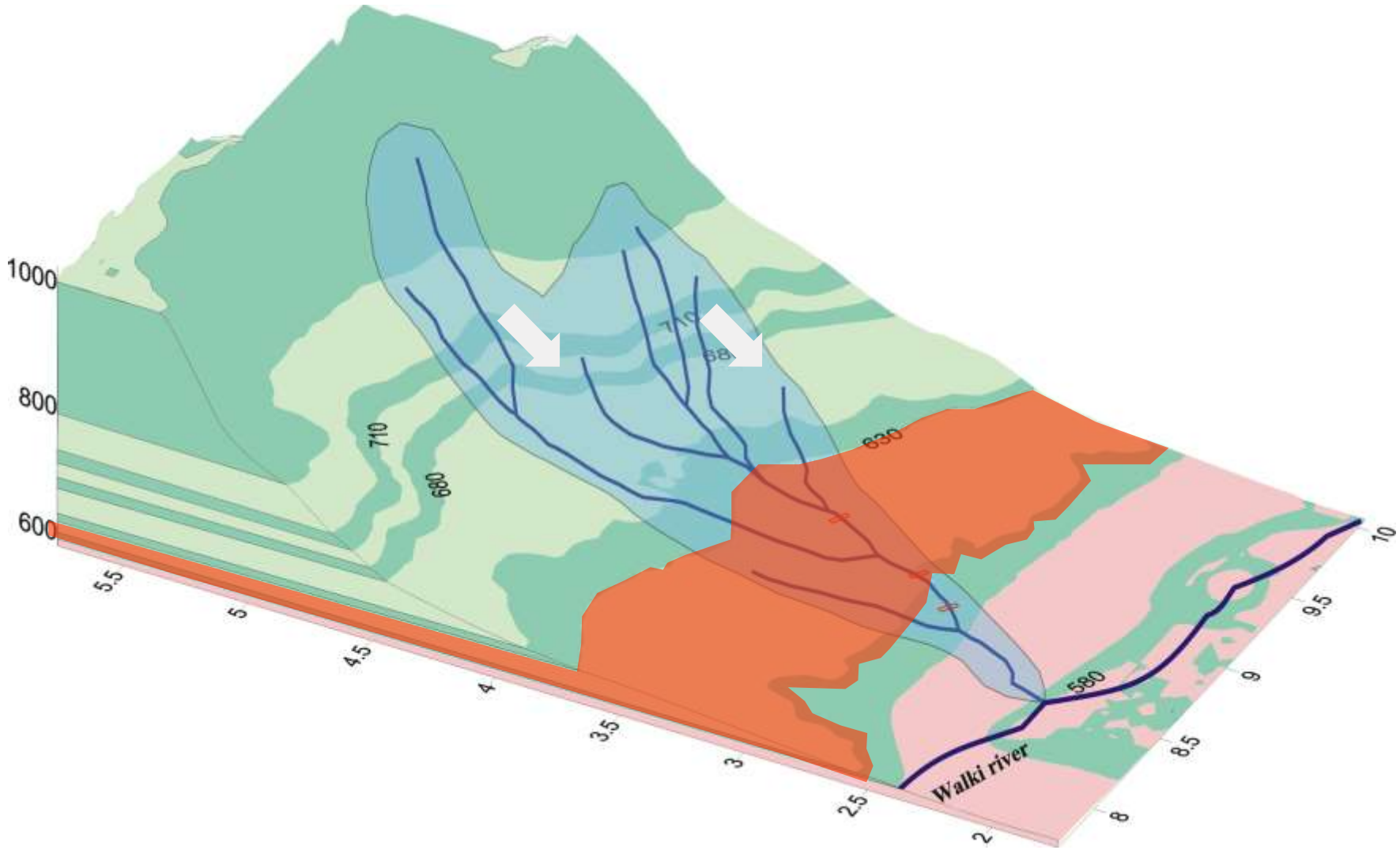
Chemical composition



Pie diagram for BH2 (Shallow bore well)



Pie diagram for BH1 (Deep bore well)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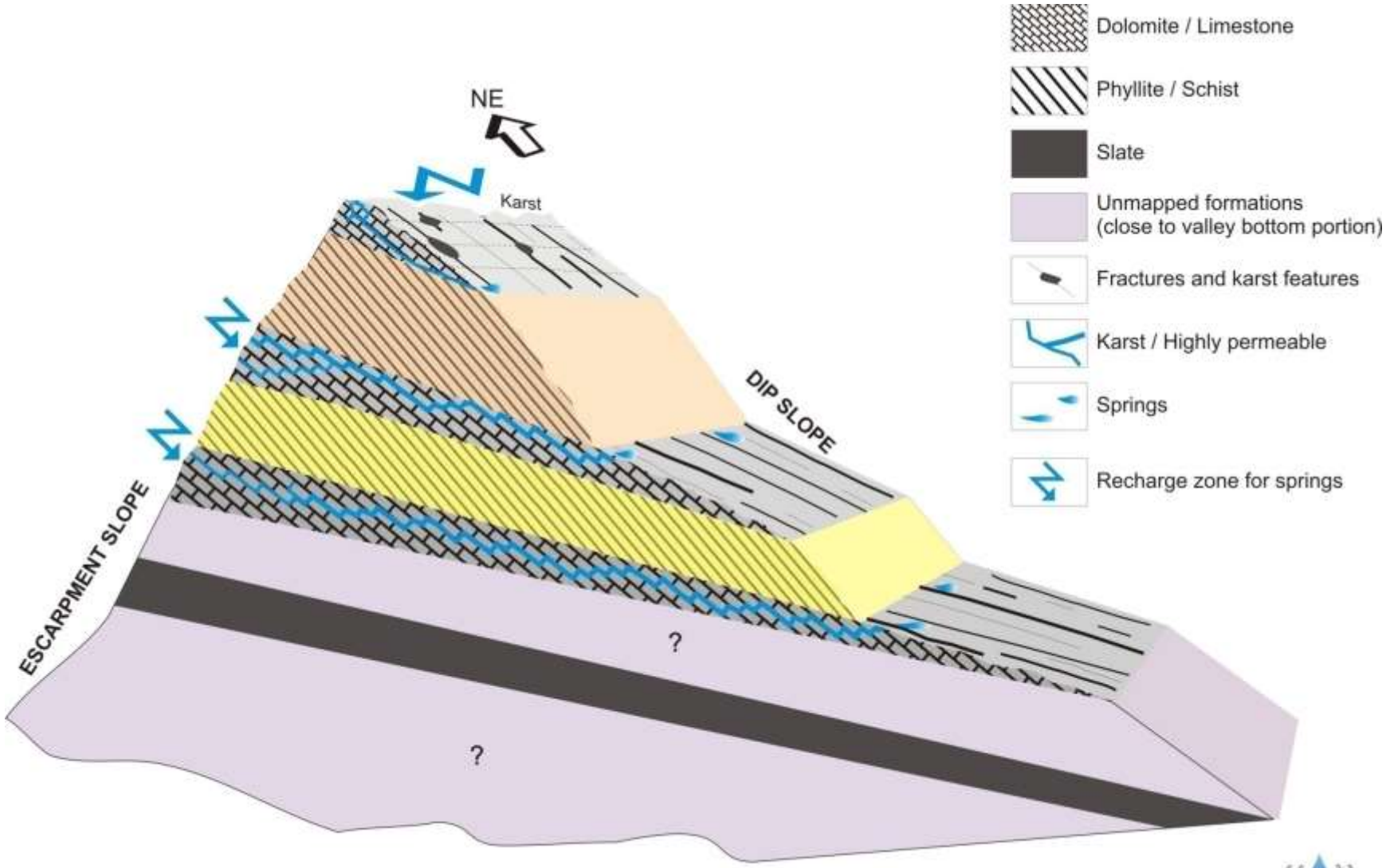

PIRNA WATERSHED: Subsurface geology and conceptualisation of Karst Springs

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Hydrogeology helps strategise recharge

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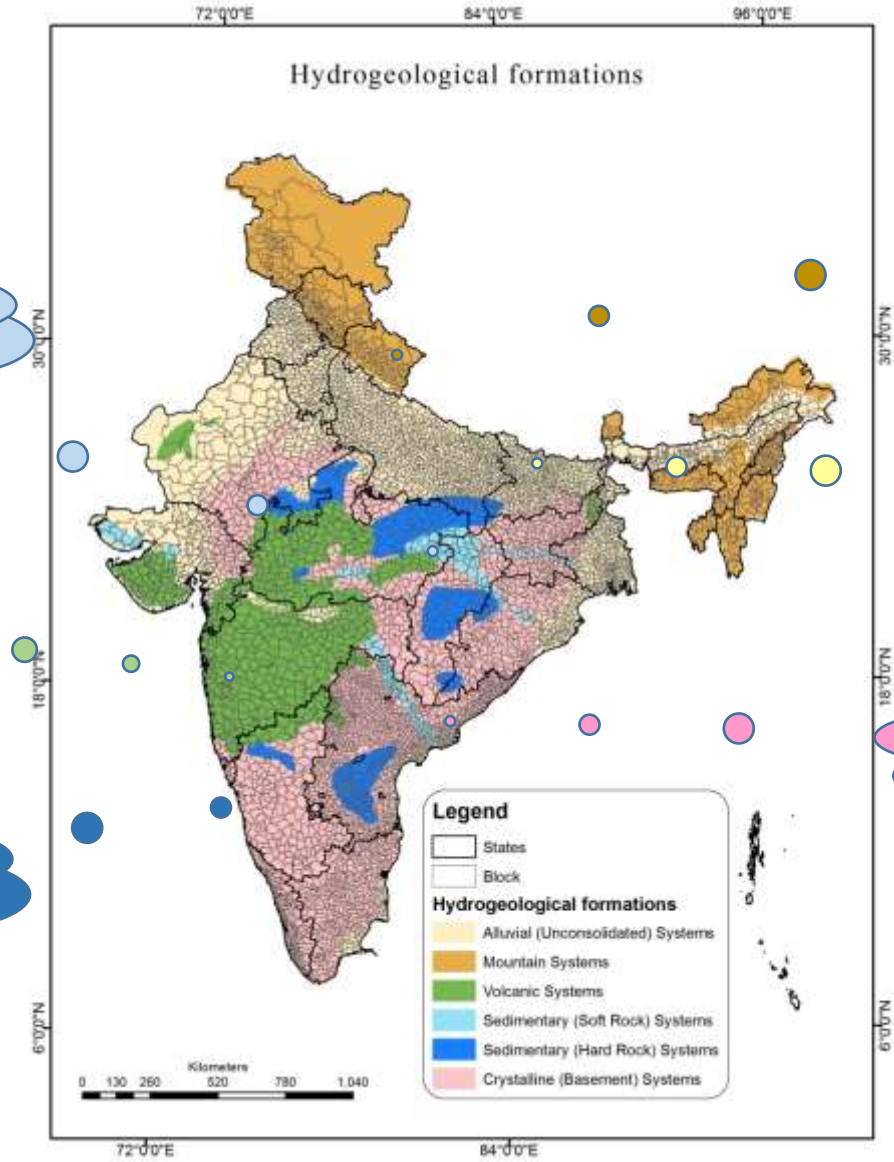
Karst springs, contact springs

Contact springs

Fracture springs



After: COMMAN 2005; GSI (various years), ACWADAM (various publ.), CGWB (2012)

All types – fracture springs dominate?

Depression springs

Contact, depression & fracture springs

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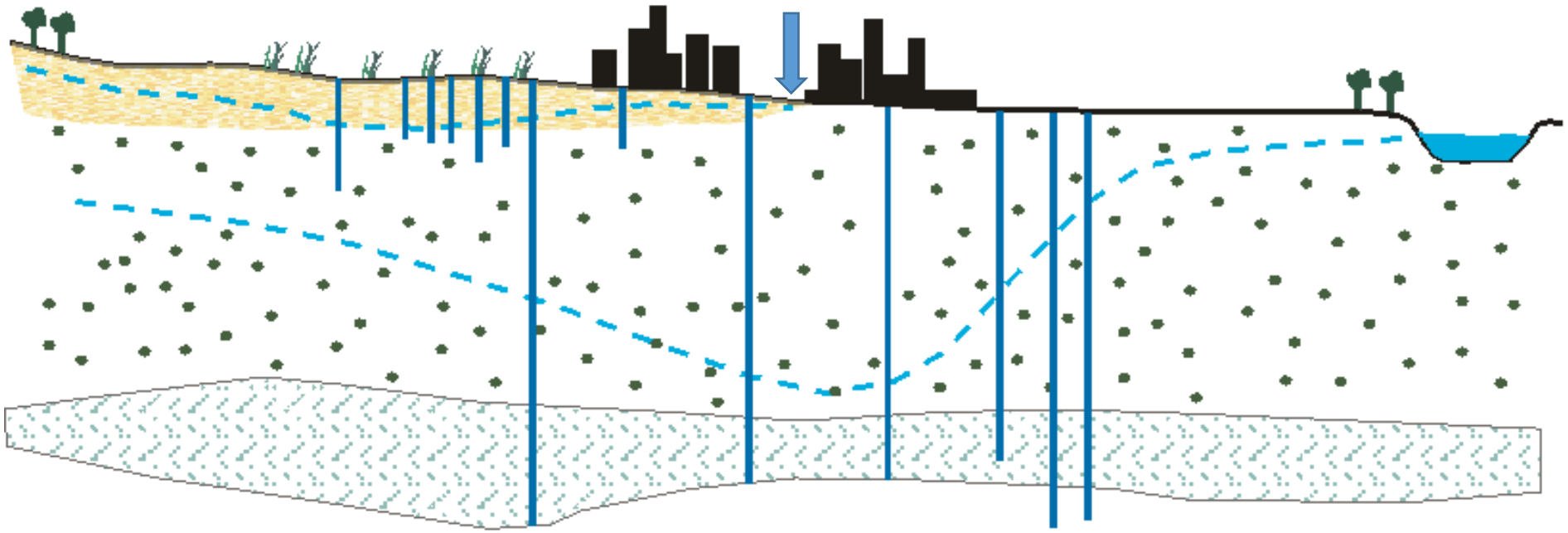
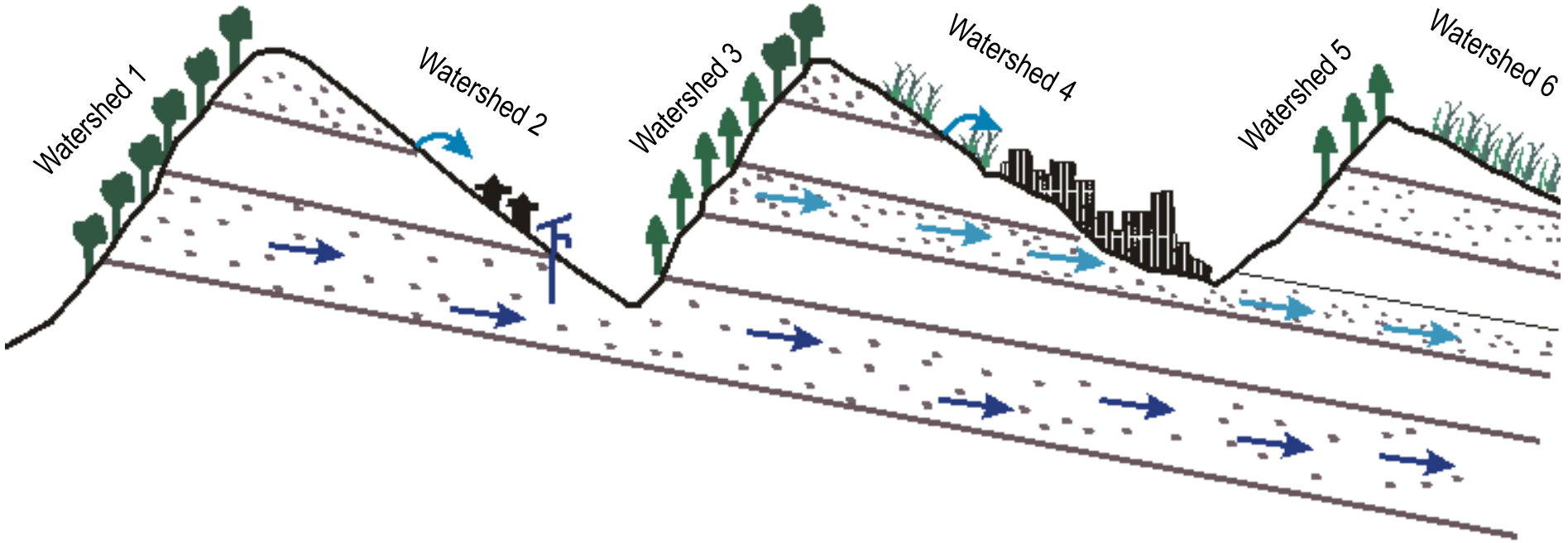
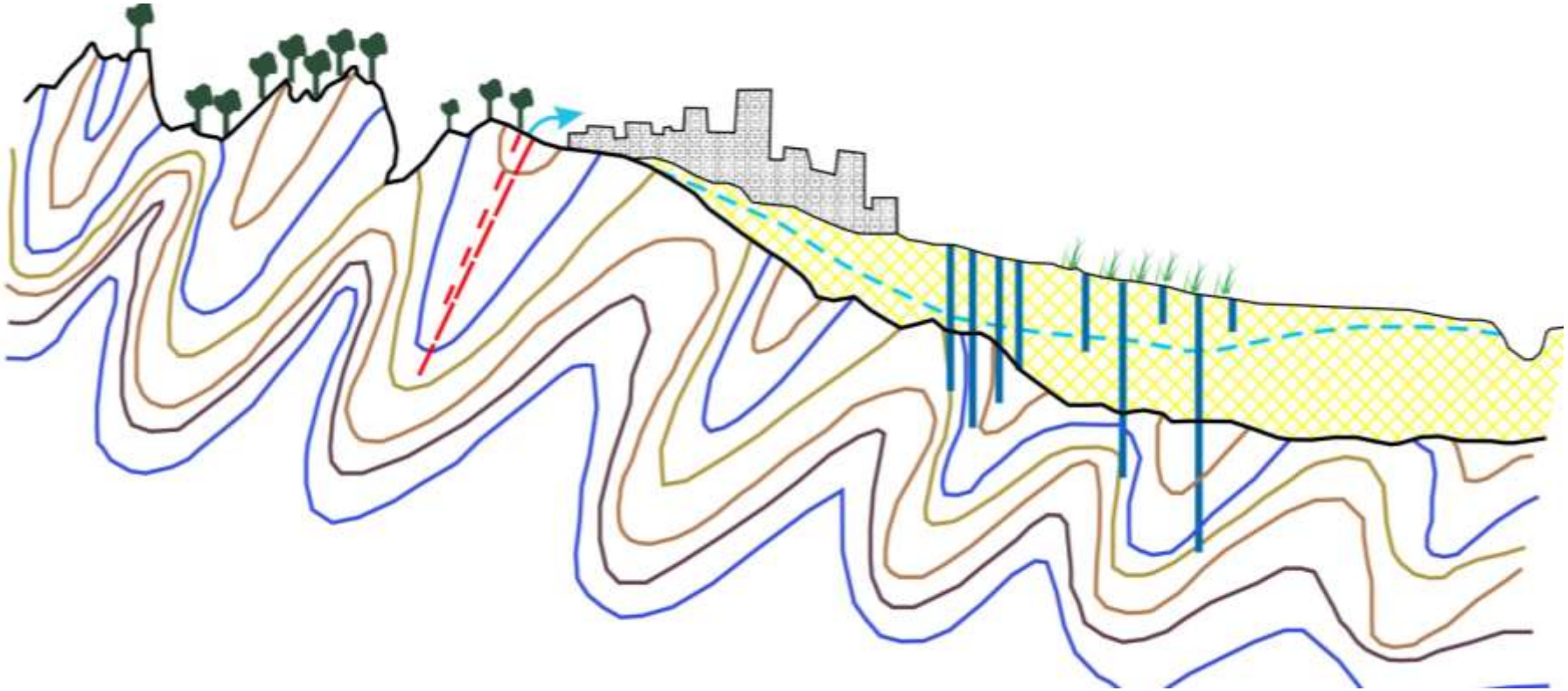
Alluvial: *extensive and deep aquifer systems*



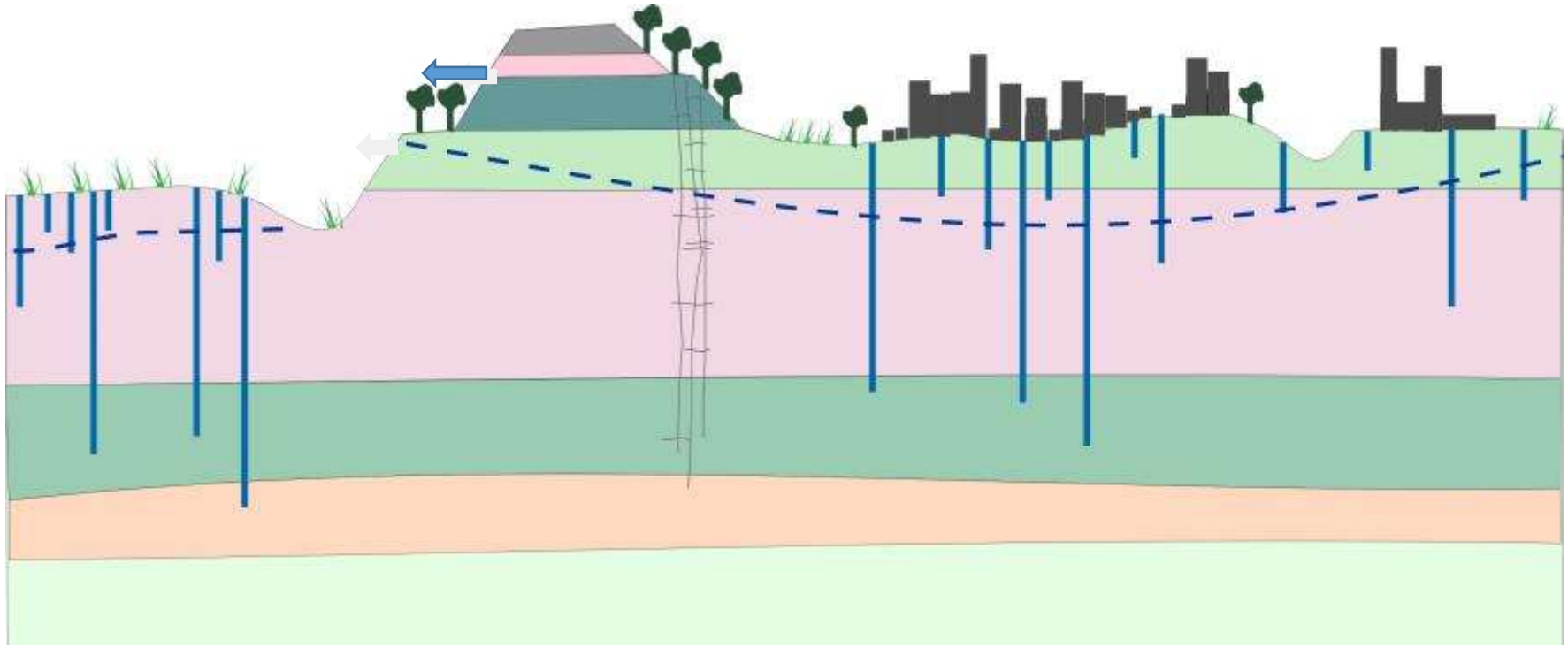
Himalayan: *continuity across watersheds*



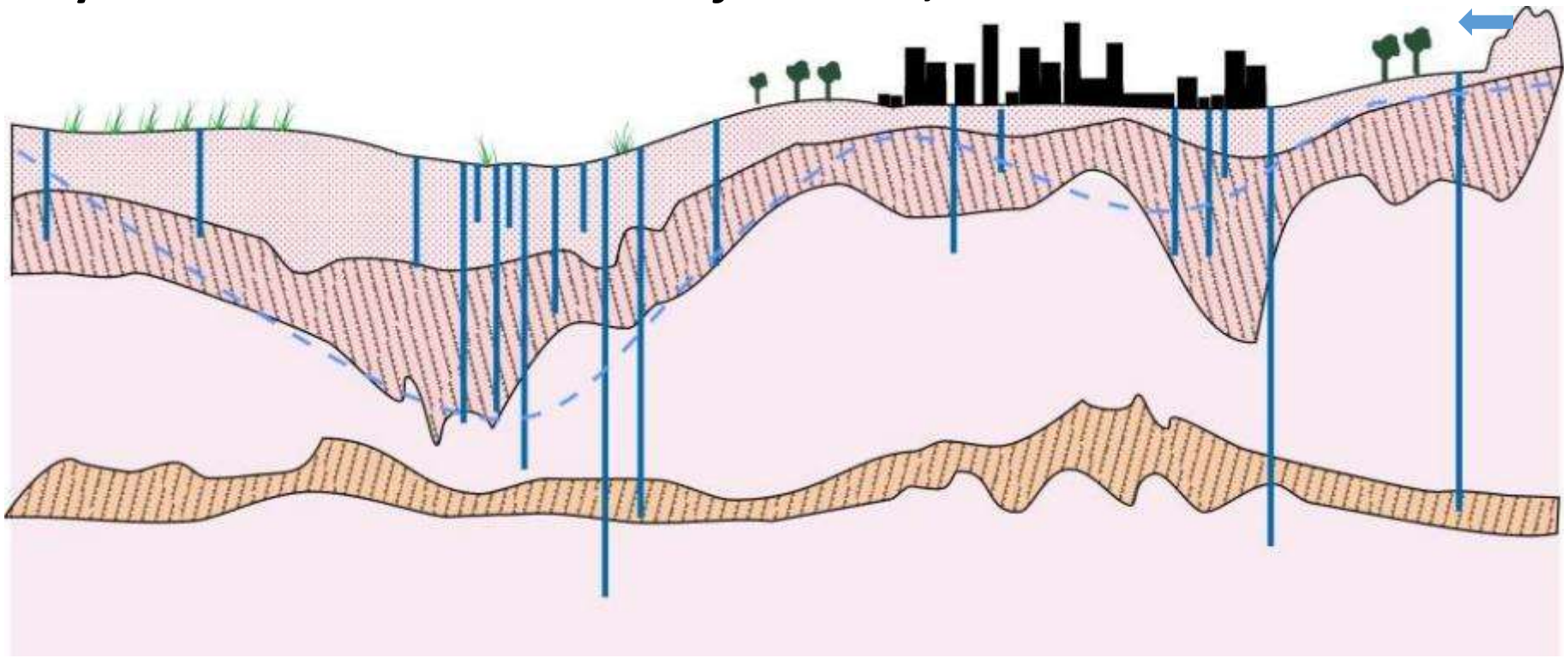
Transition: *continuity across geological settings*



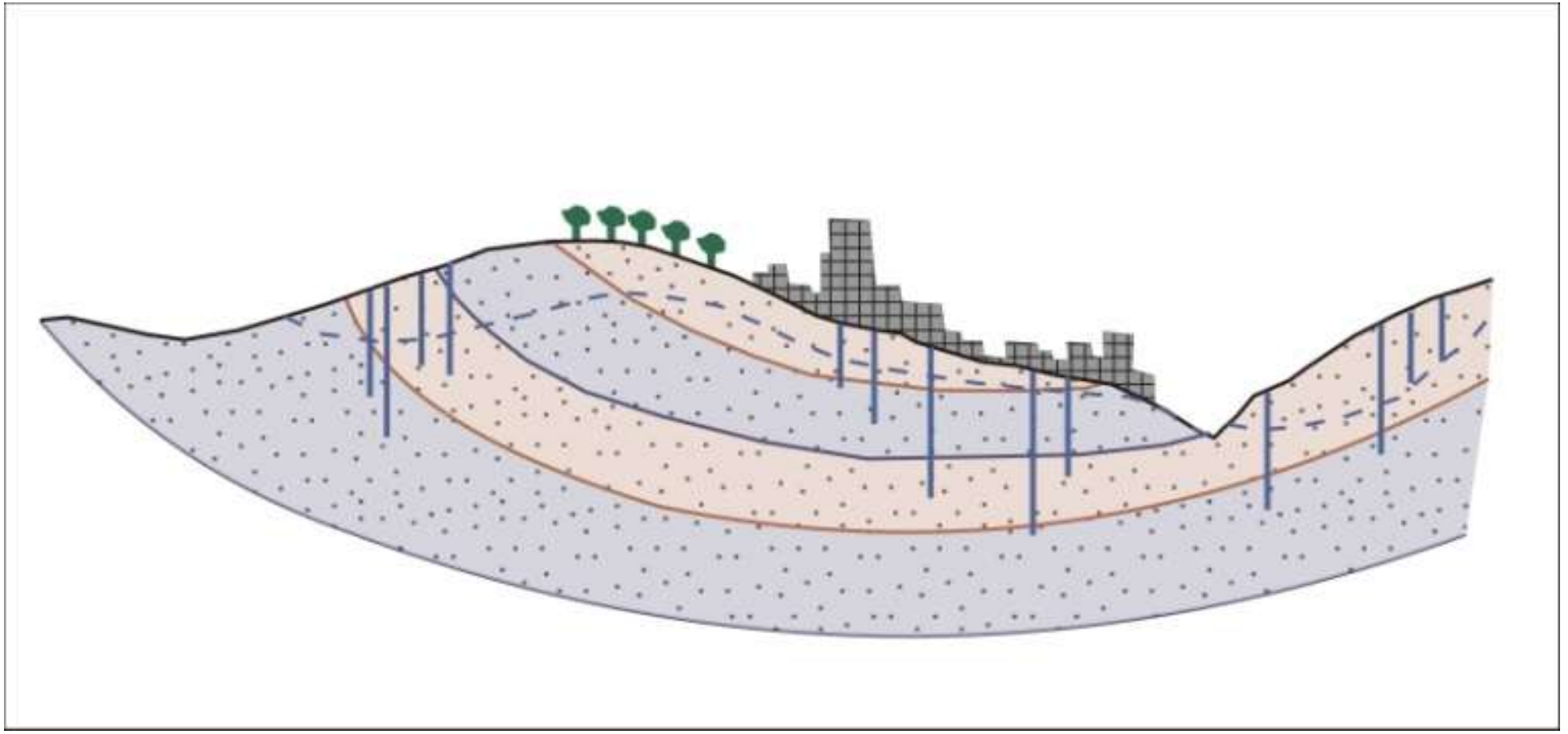
Volcanic – Deccan Basalt: *Layered heterogeneous aquifers – vertically connected*



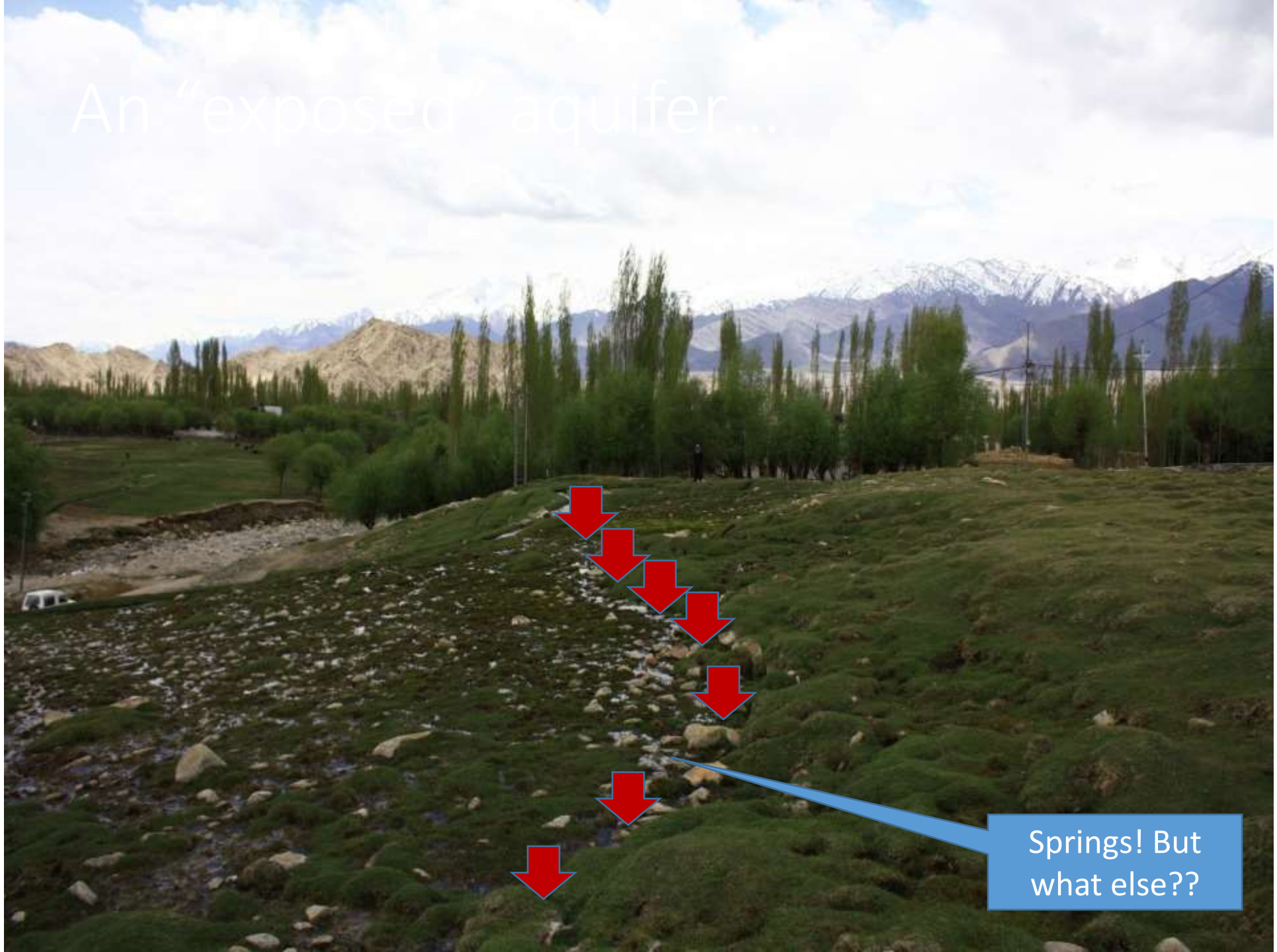
Crystalline rock – basement : *often local, sometimes extensive*



Sedimentary: *sometimes local, often extensive and continuous*



An "exposed" aquifer...



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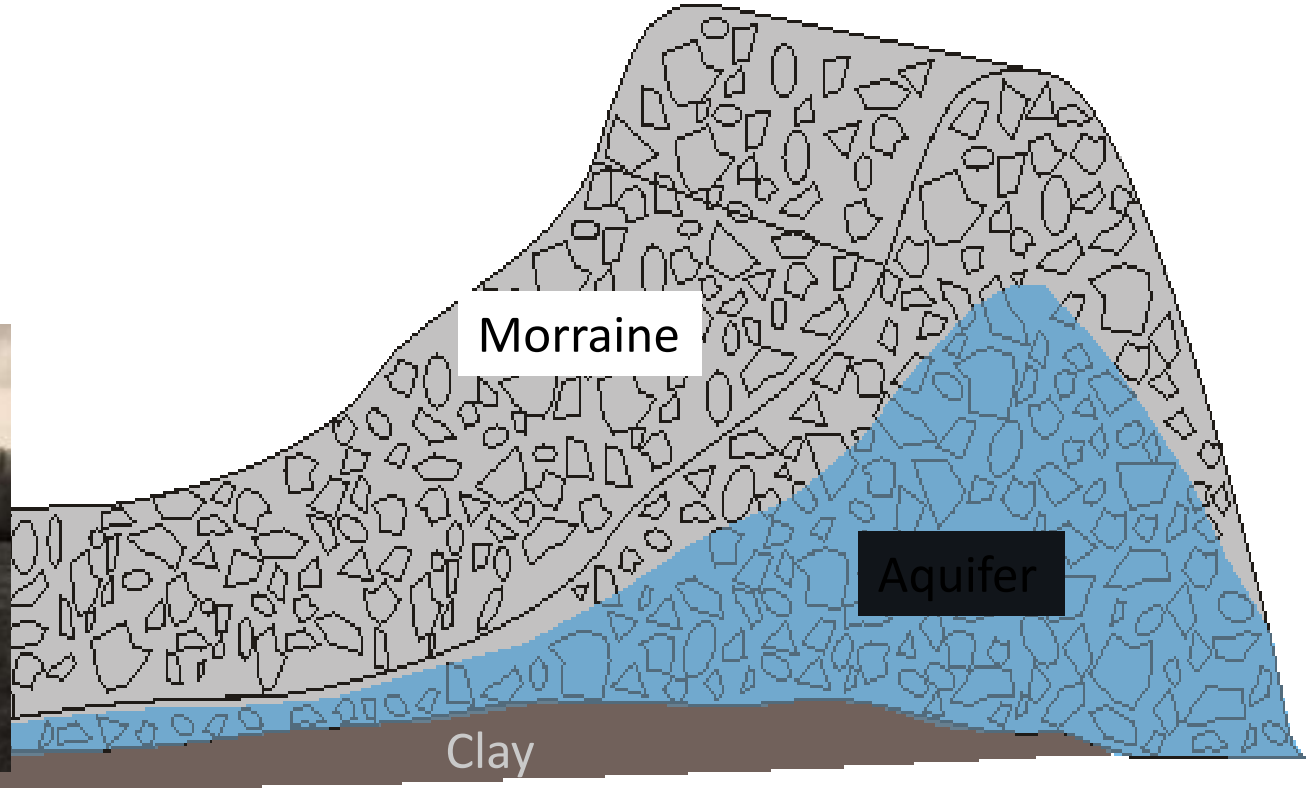
The aquifer feeding the springs



ACWADAM

Advanced Center for Water Resources Development and Management (ACWADAM)
Plot 4, Lenyadri society, Sus road, Pashan, Pune-411021.
☎020-25871539;
Email: acwadam@vsnl.net;
Website: www.acwadam.org