WATER QUALITY CONSIDERATIONS IN ARTIFICIALGROUND WATER RECHARGE AND THE OPTION OF SCALED-UP SYSTEMS

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&

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Courtesy: Thames Water, UK

Structure of the presentation

- Introduction
- Tech options for RWH and GWR
- Concerns on water quality
- Need for regulation !
- Other issues with micro-scale RWH
- Examples of scaled-up artificial GWR
- Conclusions and recommendations

Introduction

A village in Gujarat

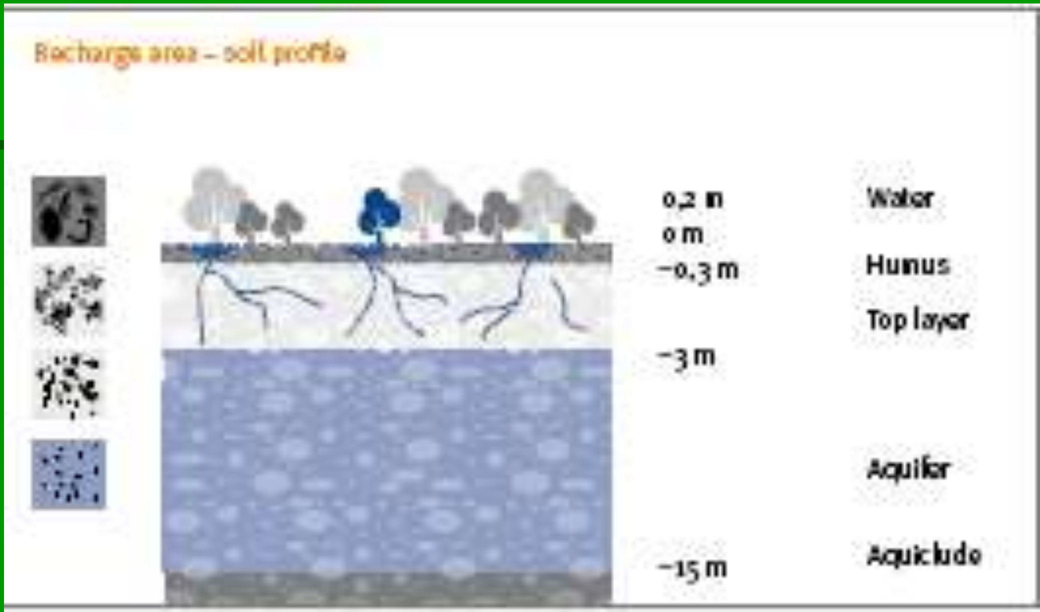
London

Scale and context

- Micro-scale decentralised
  - Rooftop RWH and GWR
- Scaled-up centralised
- Urban
- Rural
- Unconventional/ Modern
- Conventional

Technology options for GWR

- Conventional
  - Check dam, anicut
  - Weir
  - Nalla bund, percolation tank
  - Sub-surface dam
  - Pond
  - Lake



Option for RWH

Water quality is assured

Kundi in Rajasthan

Tank in rural areas

Concerns on water quality

Concerns on water quality

- Direct recharge through open wells
  - Faecal matter, pathogens
  - Fertilisers
  - Trace organic chemicals
    - Pesticides, herbicides, weedicides
  - Hydrocarbons, phenols

- Direct recharge through bore wells
  - Suspended solids
  - Bird droppings
  - Heavy metals from roof sheets

What is the safeguard?

- Just a filter bed:
  - Sand
  - Aggregates
  - Charcoal
- **Is it enough?**
- **Is it sized adequately**
- **How well is it maintained?**
- **Who will maintain it?**
- **Who will monitor it ?**

Need for regulation

- Aquifers are sacrosanct.
- Remediation is very expensive.
- Can not afford to contaminate them.

- **Who is authorised to:**
  - **Approve design, layout, location?**
  - **Construct GWR?**
  - **Certify constructed GWR?**
  - **Monitor water quality - RW & GW ?**

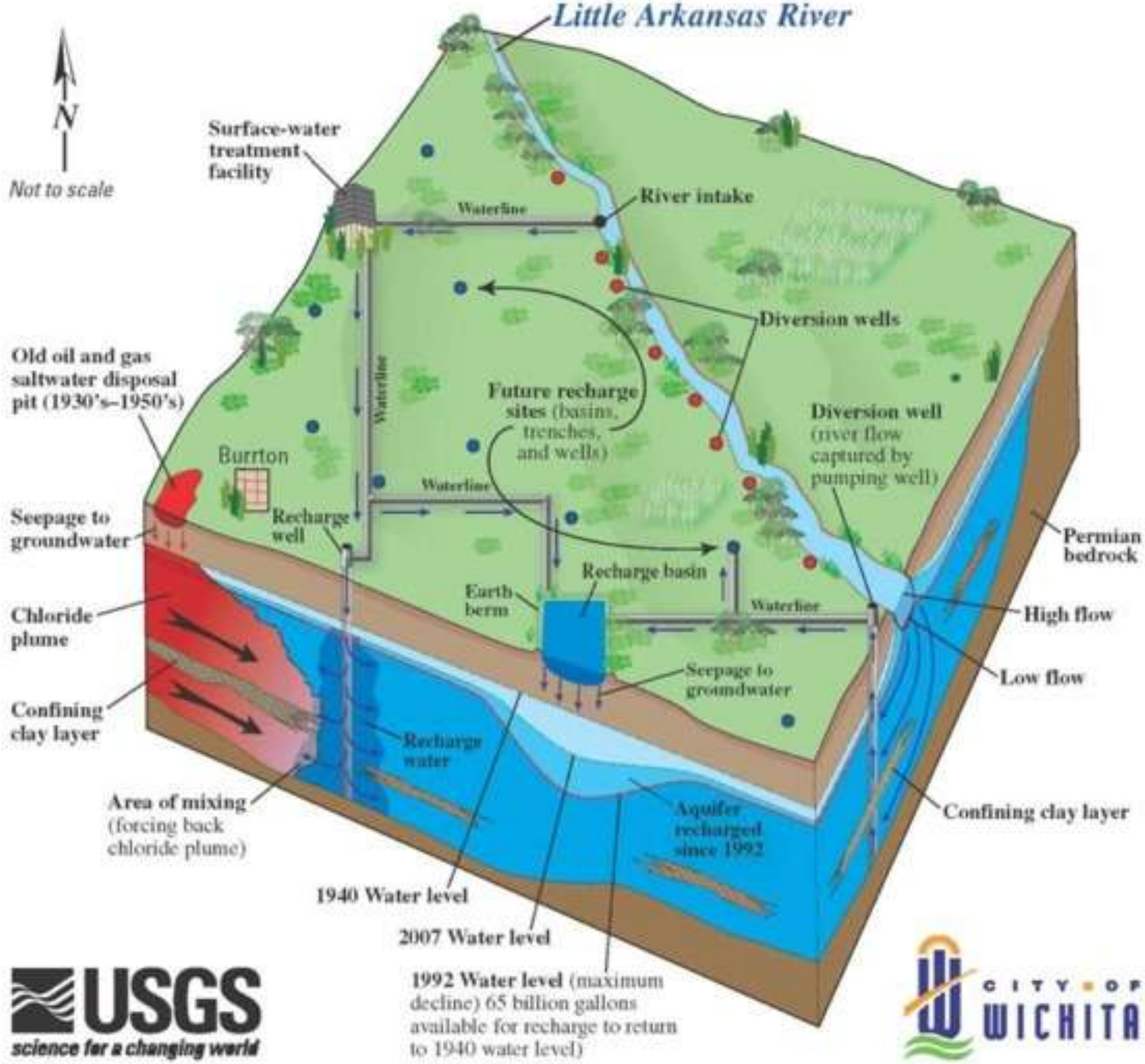
Other issues with micro-scale GWR

- Apathy in the second year !
- Choking of filters.
  - Seepage into the building.
- Effect on foundation
  - Chances of damage to building.

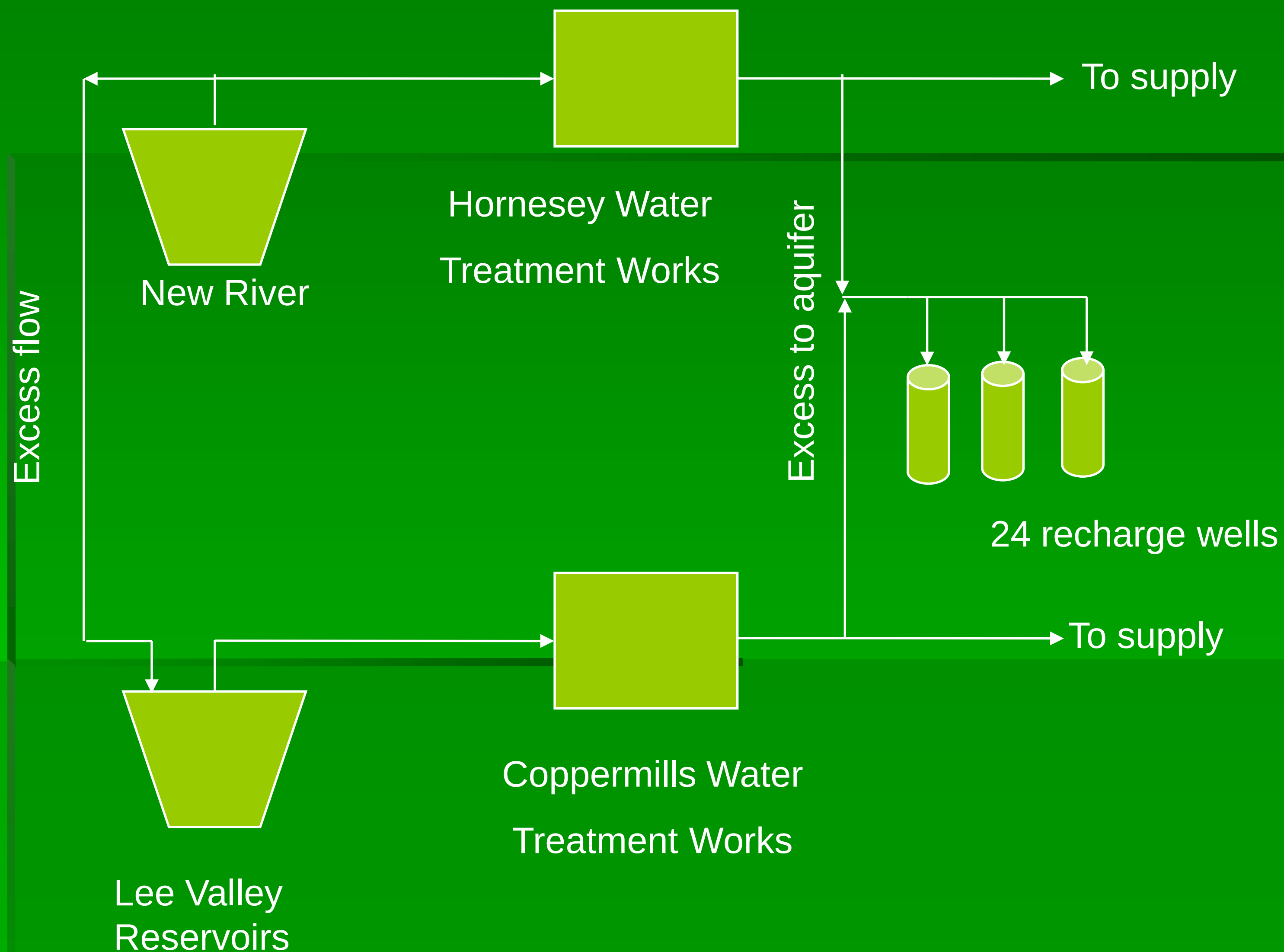
Scaled-up Artificial GWR

- North London Artificial Recharge System
- City of Wichita
- Basel water supply

Equus Beds Aquifer—*Artificial Recharge Process*

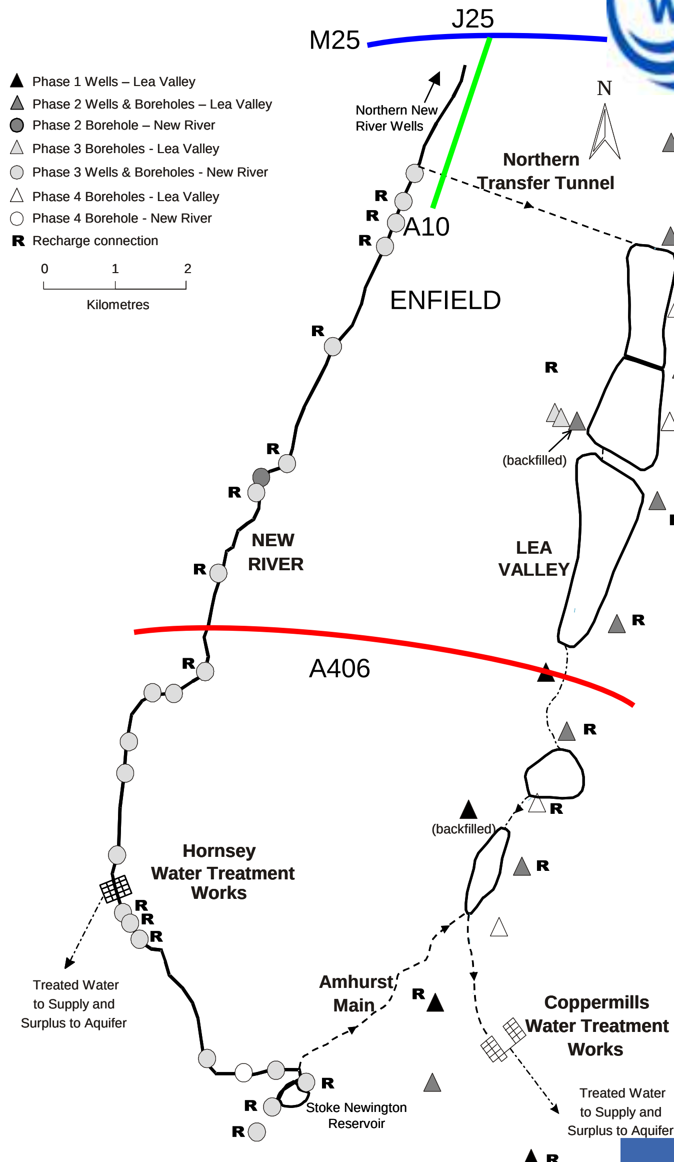


North London Artificial Recharge System

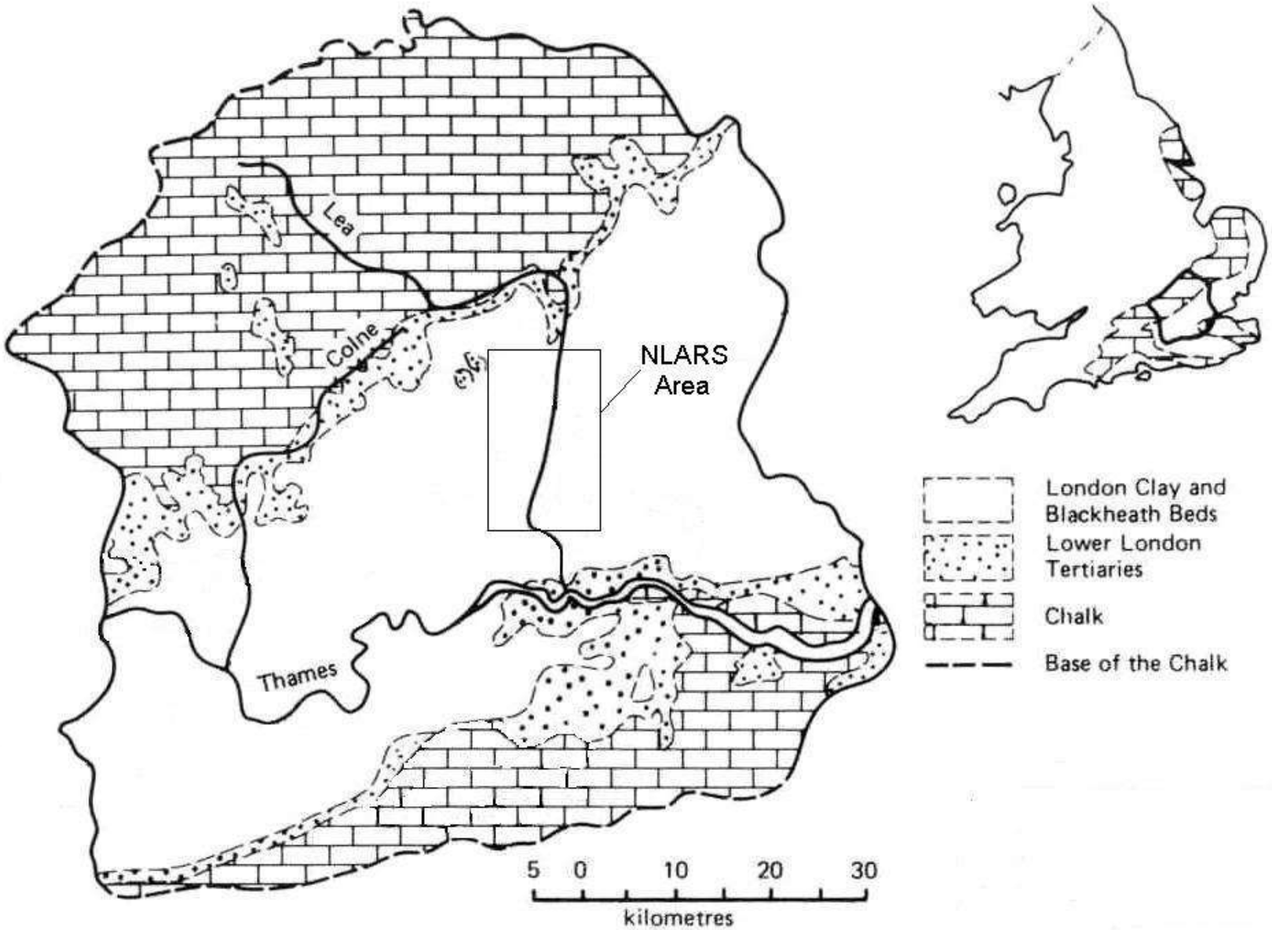


What is NLARS-1?

- NLARS - North London Artificial Recharge Scheme
- 41 abstraction boreholes in the Lea Valley, abstracting from the confined chalk and sand aquifers
- Boreholes discharge to the Lea Valley reservoirs or the New River which transport the water to treatment at Coppermills or Hornsey WTW
- 24 boreholes capable of aquifer artificial recharge



What is NLARS-2?



Simplified geological map showing location of NLARS

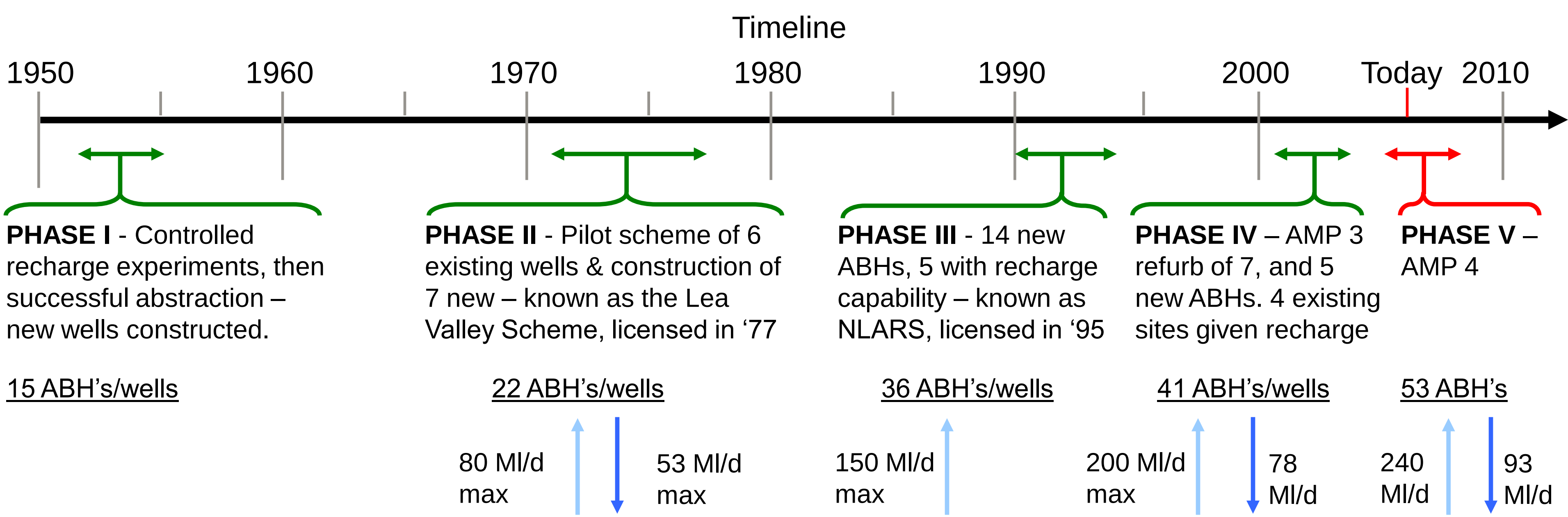
What is NLARS-3?

NLARS Purpose?

- Developed as a drought management tool
- 2 major abstraction events since 1995 - then a significant recharge period
- Aquifer recharged with potable water - the aquifer is used as an underground reservoir
- Abstraction capability of 240 Ml/d (licensed up to 275 Ml/d)
- **Recharge capability of 93 Ml/d**
- NLARS is the only large-scale operational artificial recharge scheme in the UK

A Brief History

- The current NLARS has been licensed for 10 years, however, its history dates back over 100 years
- At the end of 19th Century the chalk aquifer was over abstracted forming dewatered zones
- Pioneering work undertaken in the late 1800's to investigate the viability of artificial recharge to recover aquifer storage
- Five phases of evolution:



Phase II (1970's) ABH

King George Reservoir ABH

Phase III (1990's) ABH

Kings Arms Bridge ABH

Phase IV (2001-2003) ABH

Waterhall ABH

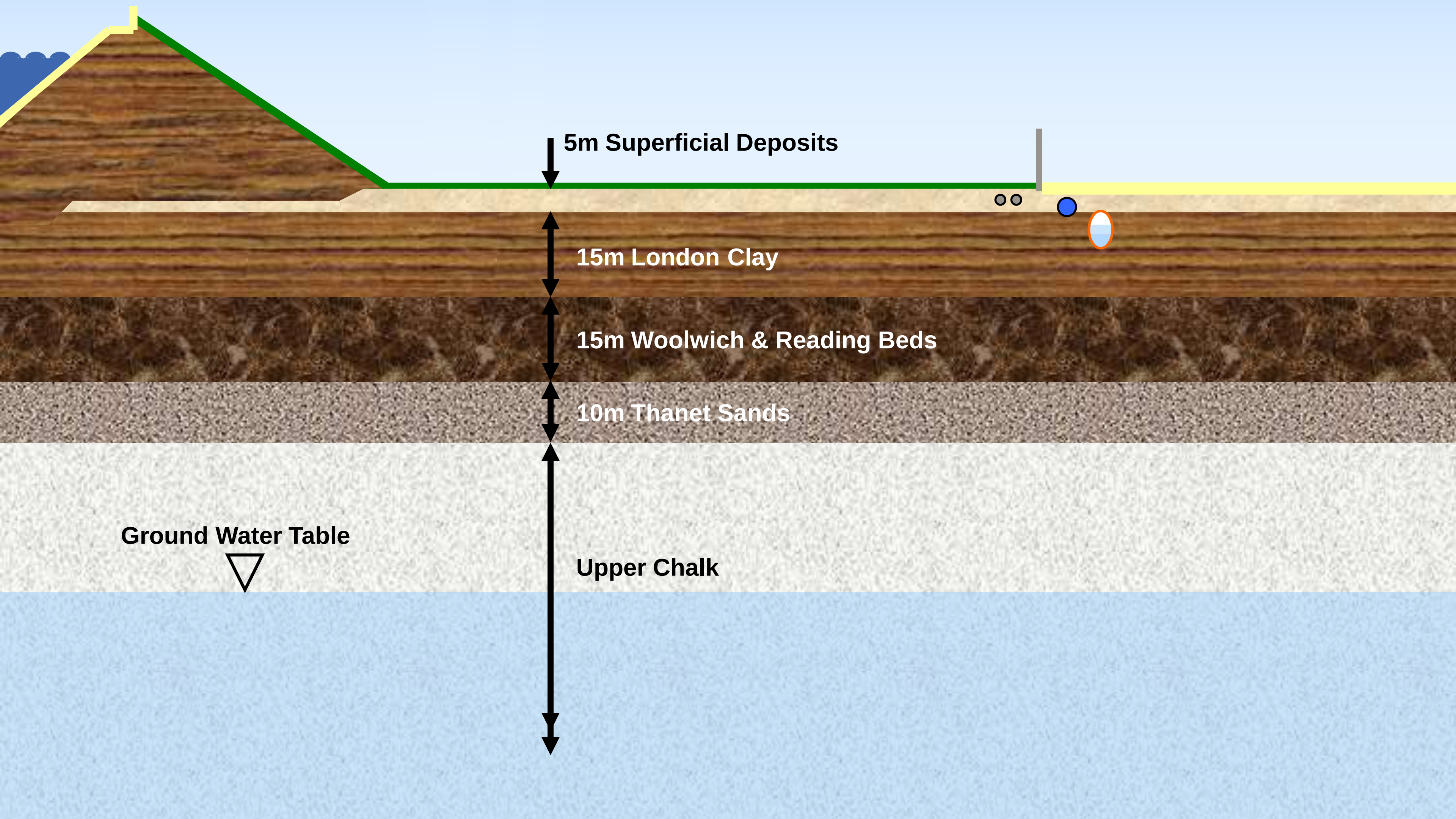
NLARS Extension Development AMP 4 (Phase V)

- The scheme estimated a yield of 40 Ml/d
- Original Scope of work:
  - 10 new abstraction boreholes and pumping stations (6 with recharge capability)
    - 7 on TW land, 3 on third party land
  - Upgrade and equipping of 4 existing abstraction borehole pumping stations
  - Drilling of 6 new observation boreholes
  - Refurbishment of 23 existing observation boreholes
- Programme March 2005 (BDA) – March 2008 (TOD)

New Site Locations

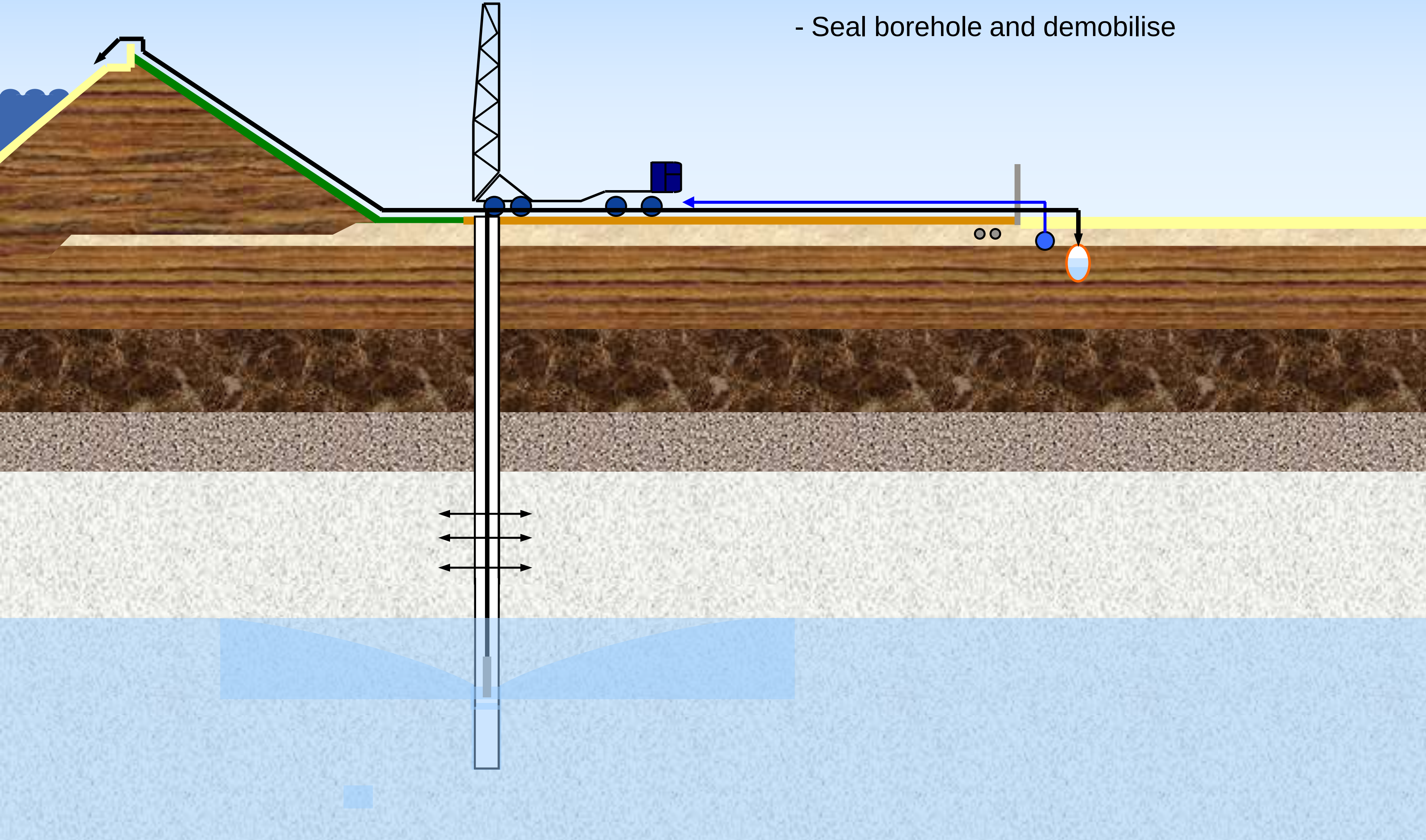
Borehole Construction Sequence (Phase 1 & 2)

Lea Valley Geology



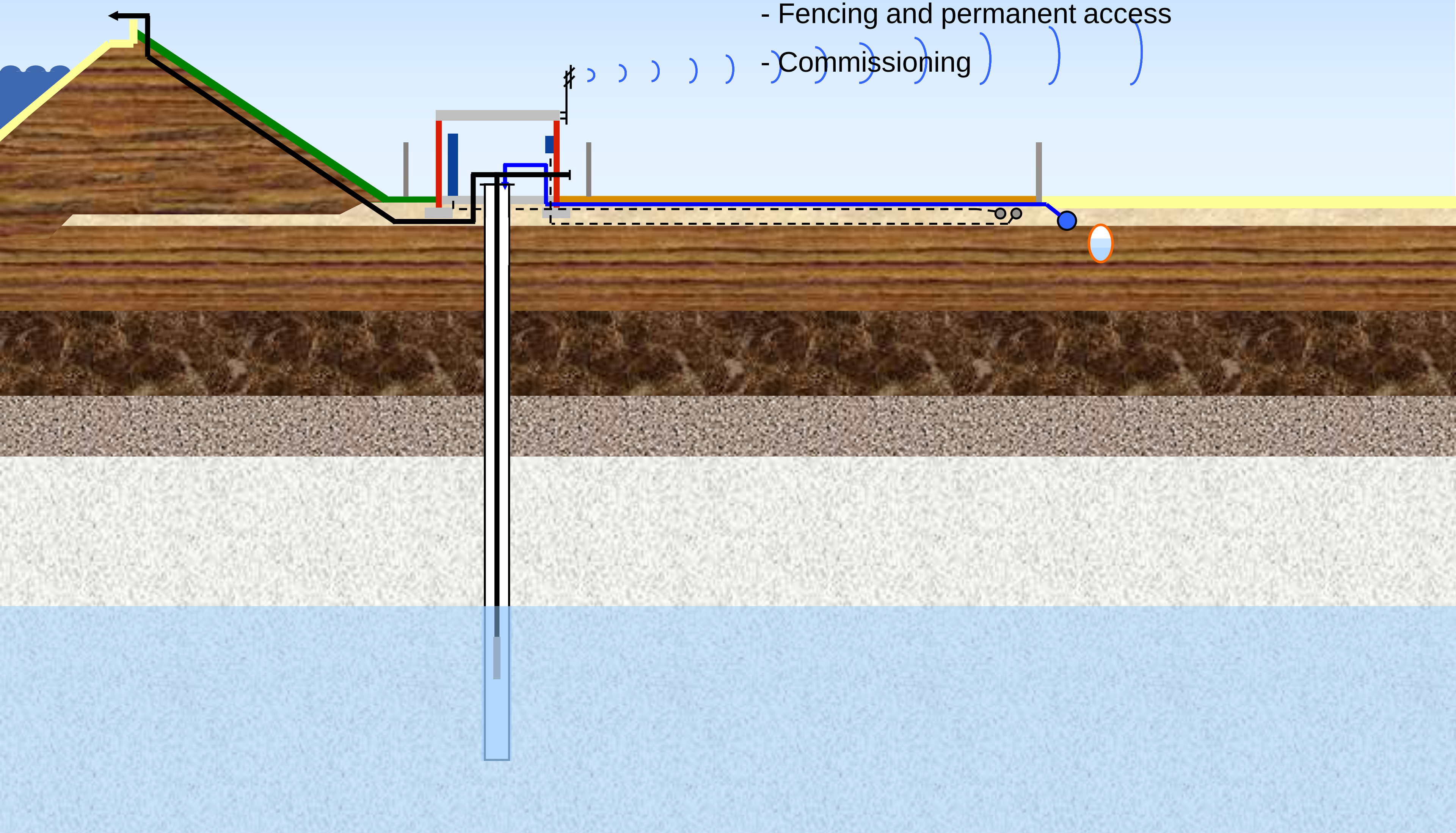
Phase 1 – Drill Borehole

- Site enabling work and set-up
- Borehole drill to approx 130m BGL
- Acidise borehole to improve yield and then airlift
- Clearance pump and test pump
- Seal borehole and demobilise

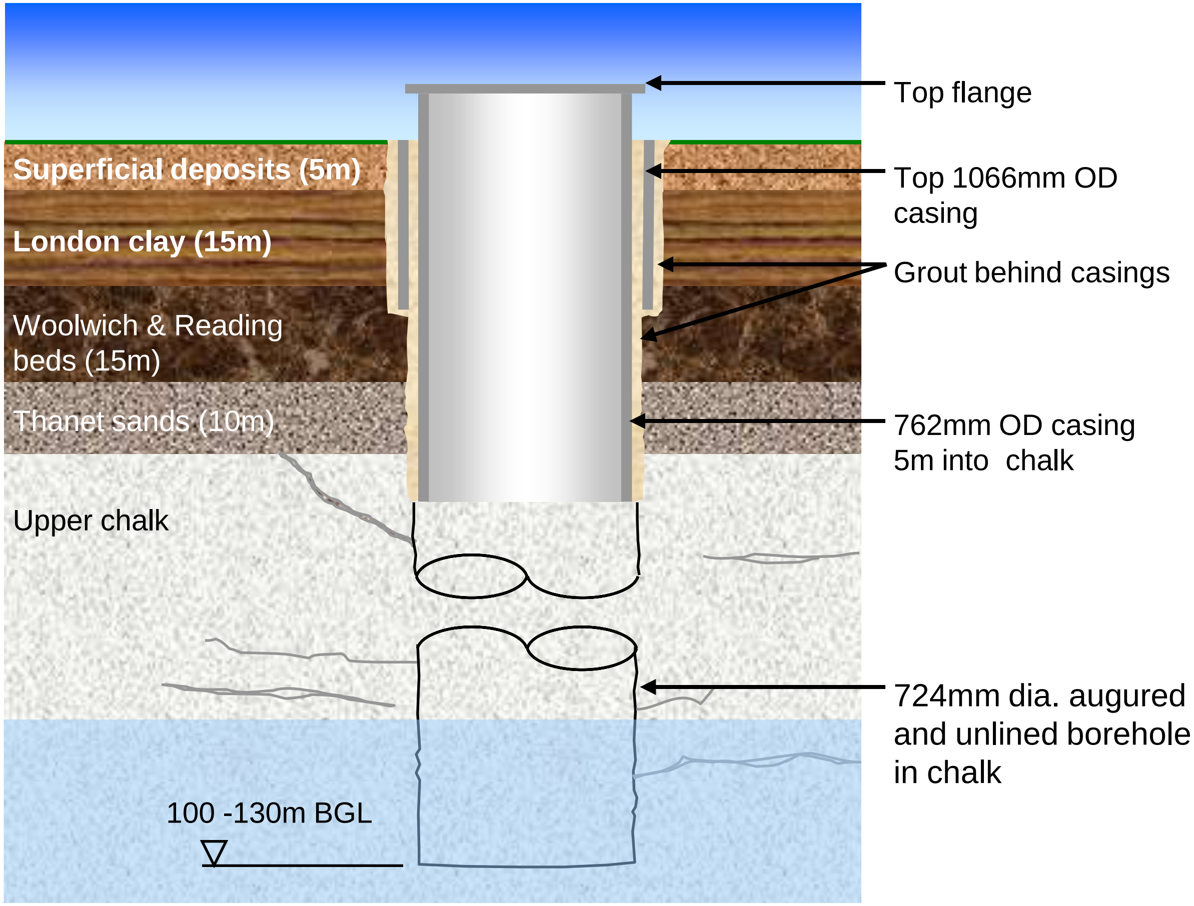


Phase 2 – Equip Borehole

- Pump installation and pipeline connections
  - Abstraction pipeline with run to waste facility
  - Recharge Pipeline
- Construct PS building
- Power supply, ICA installation and communications
- Fencing and permanent access
- Commissioning



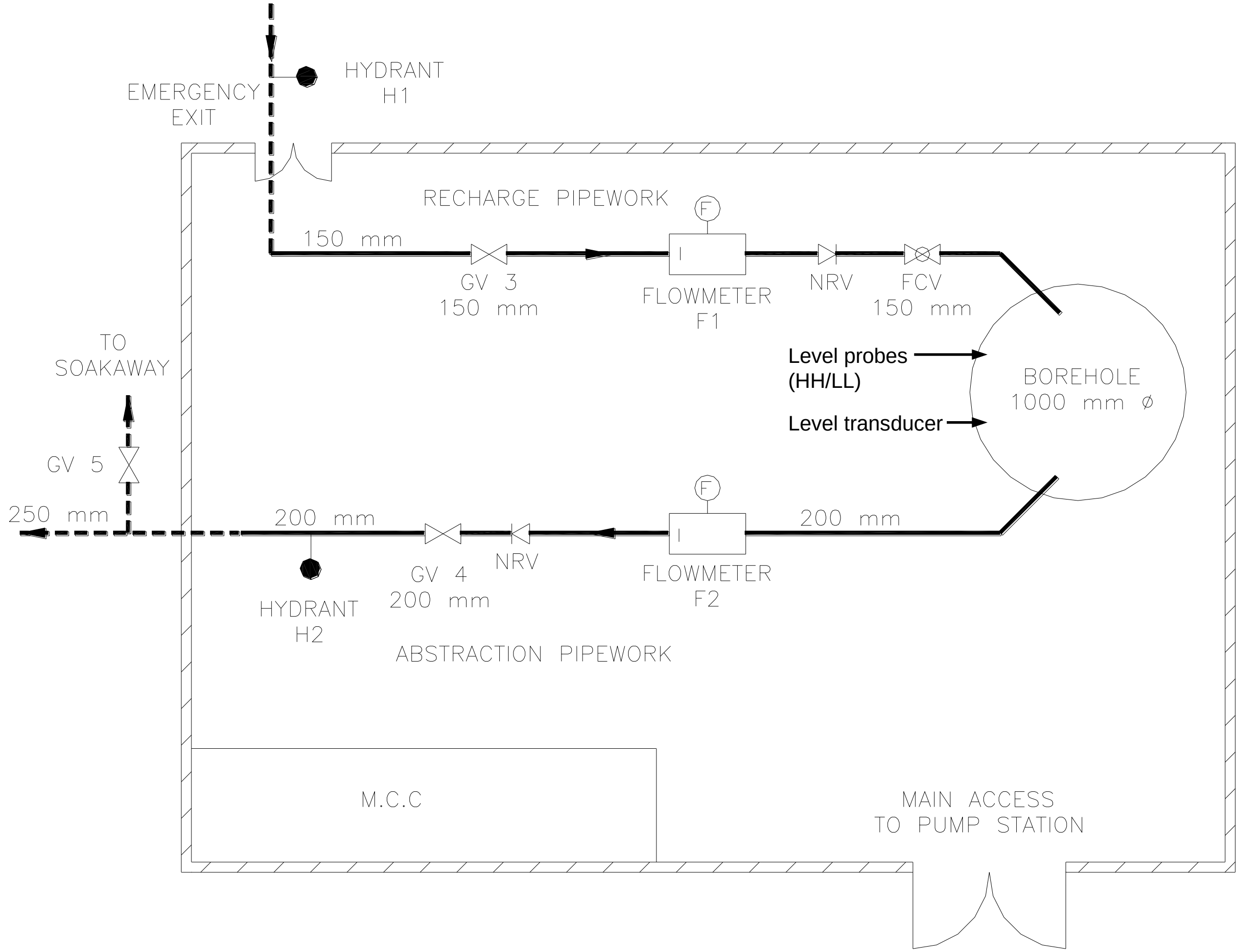
Typical NLARS Borehole Detail



Section Thru' Typical NLARS Borehole

King George South Borehole

Typical NLARS Borehole PS Detail



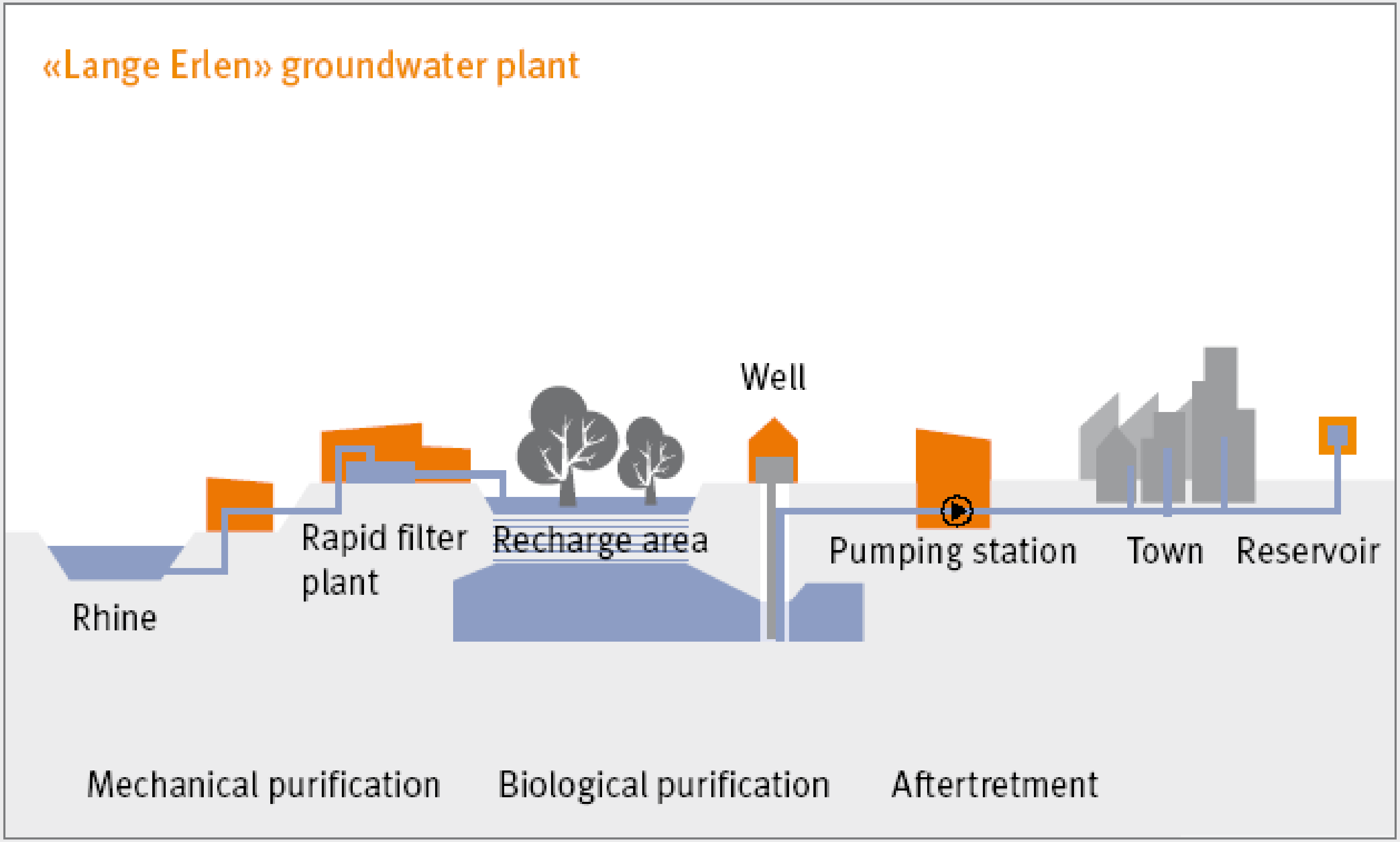
Schematic Layout Plan of a Typical NLARS Borehole

The Future Use of NLARS

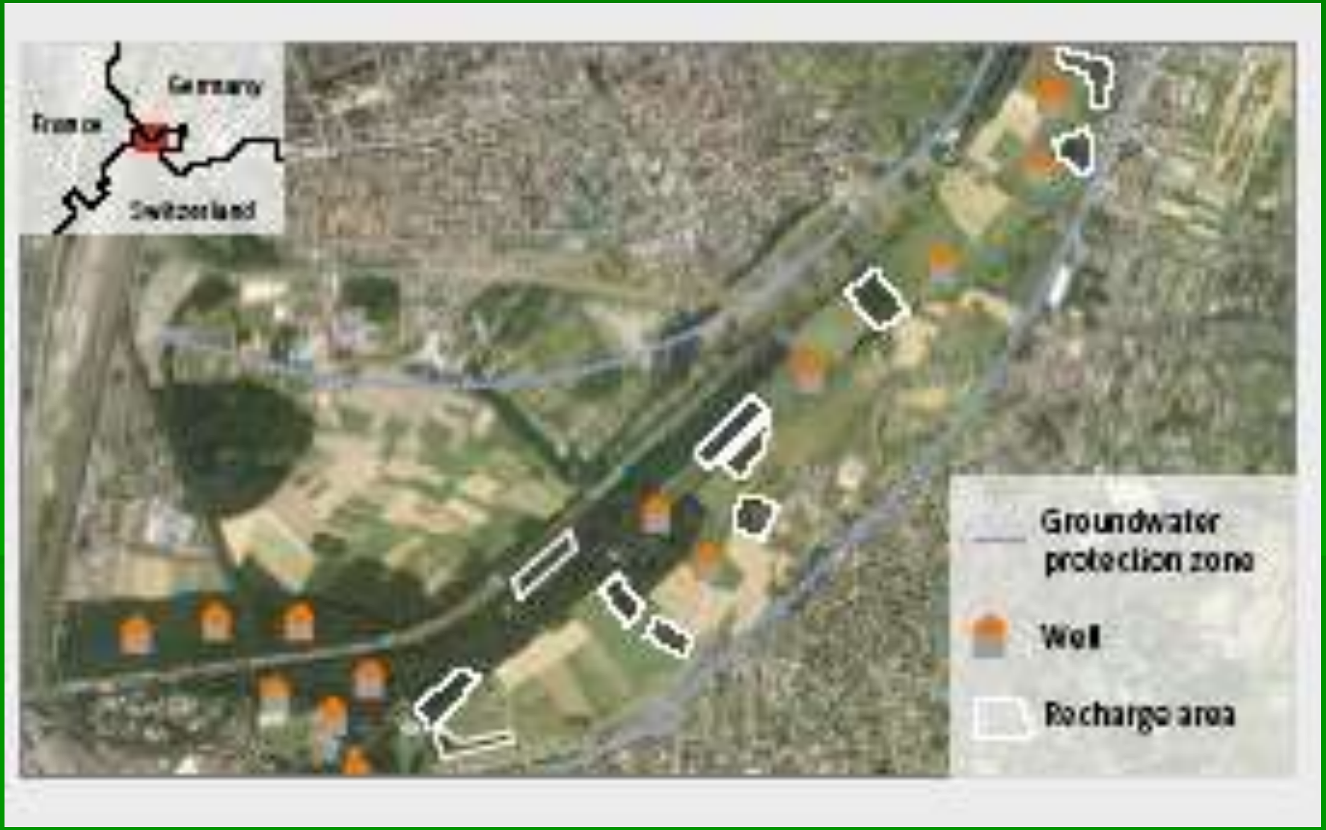
Potential for greater flexibility in its use?

- To blend with reservoir water in times of algal blooms.
- Use water more directly (e.g. in the CHARS scheme four boreholes discharge directly to the Chingford WTW contact tank)
- Blend water into the NR at time of high bromate concentration from the contaminated Northern Wells
- To provide short term water supply to assist operational activities (e.g. King George V reservoir drain down)
- London Resilience – potential for NLARS sources to provide an emergency supply using temporary treatment at short notice

BASEL WATER TREATMENT SCHEME



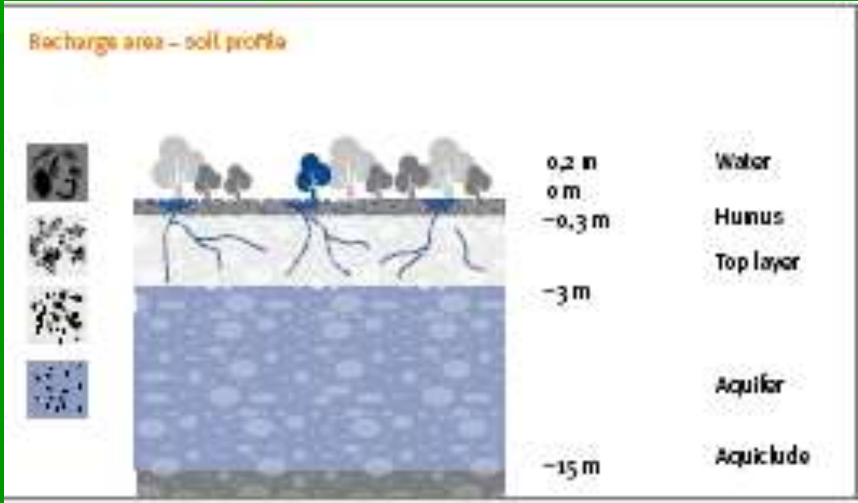
GWR in Basel for city supply



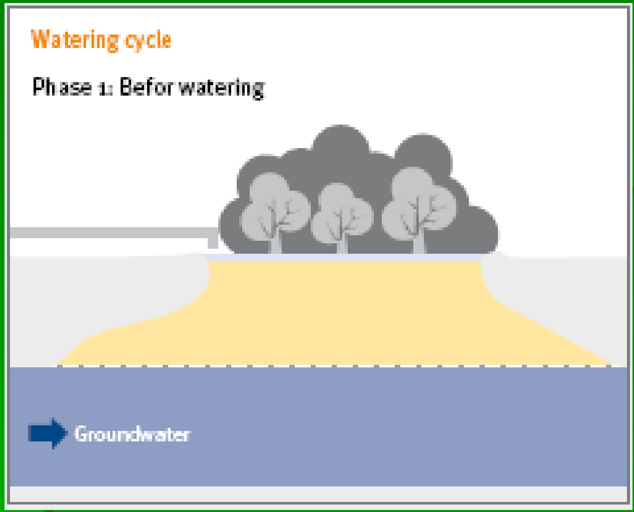
Recharge area

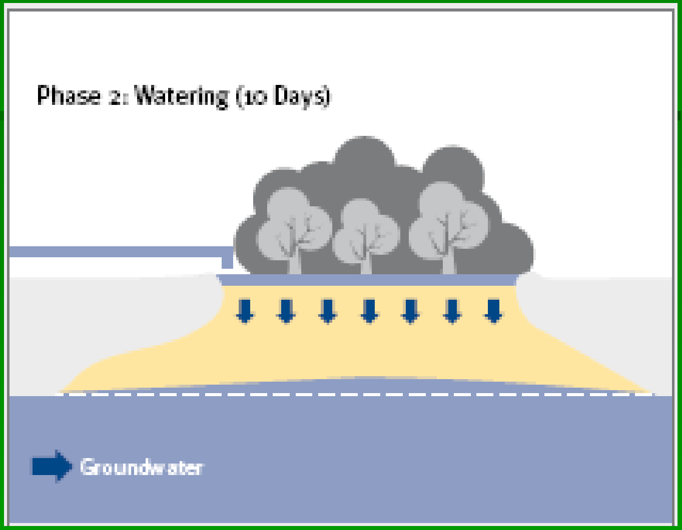
Watering in recharge area with pre-filtered Rhine water

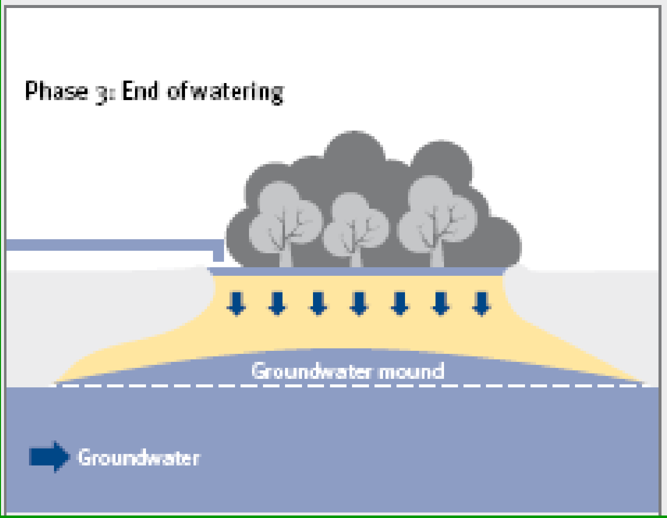
Filtered water seepage through natural flood plain

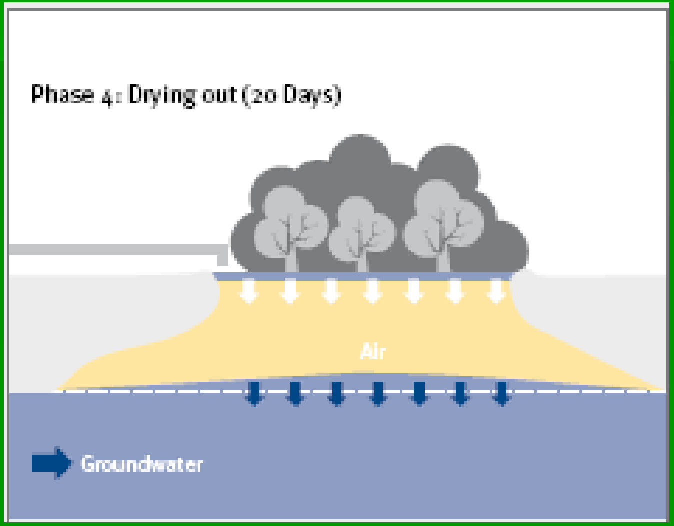


Recharging cycle









Conclusions and recommendations

- Micro-scale GWR without safeguards:
  - Contamination of aquifer.
  - Adverse effect on public health.

- **Strong need for regulation:**
  - **Site selection**
  - **Safeguards**
    - **Design**
    - **Construction specifications**
  - **Monitoring**

Conclusions and recommendations

- Isolated Micro-scale GWR :
  - Limited potential.
  - Uncertain functional sustainability.

- **Need to respond to the scale of the problem:**
  - **Implement scaled-up well engineered Artificial GWR systems.**
  - **Conduct hydrogeological studies at sub-basin level to determine aquifer characteristics.**
  - **Implement a set of pilots – e.g., in Delhi.**

Stop the Ganga Maiya overflow from every rooftop !

Thank you very much