

Water and Development

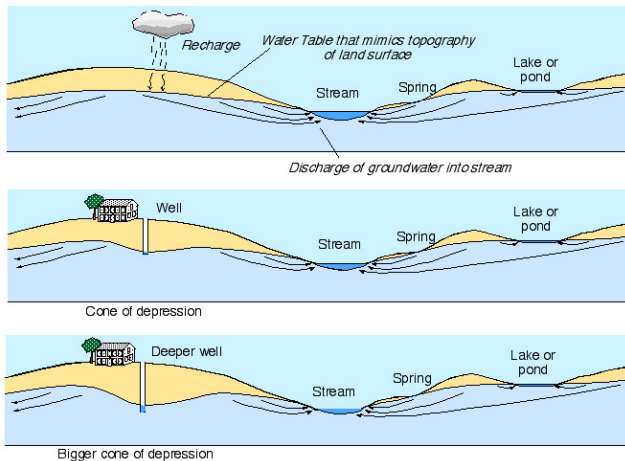
Part 3e: Regional Groundwater

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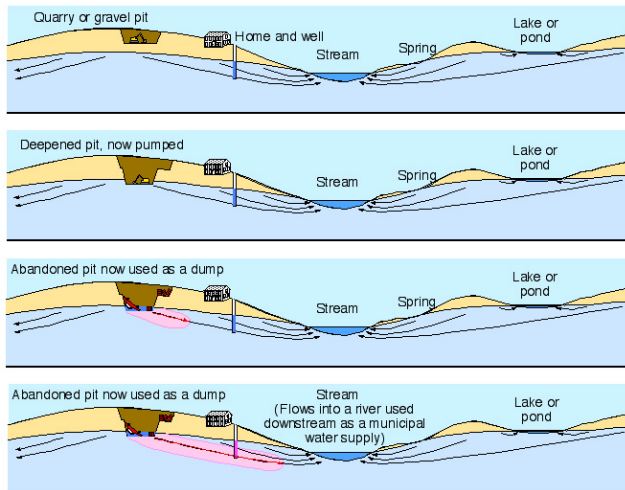
More situations



LBR 3/2002

courtesy: Bruce Railsback again!

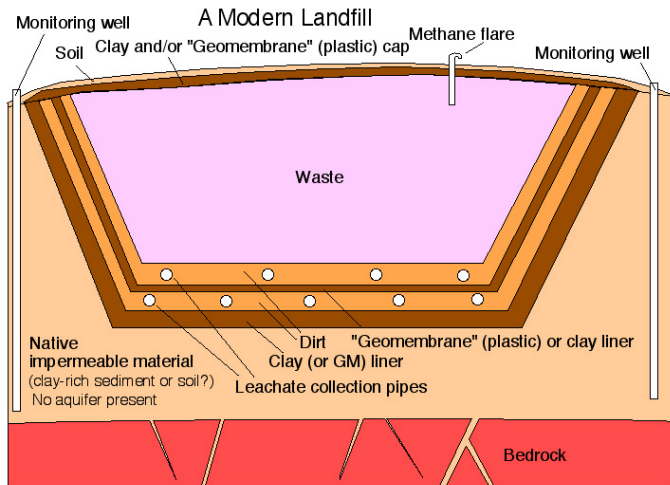
More situations



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courtesy: Bruce Railsback again!

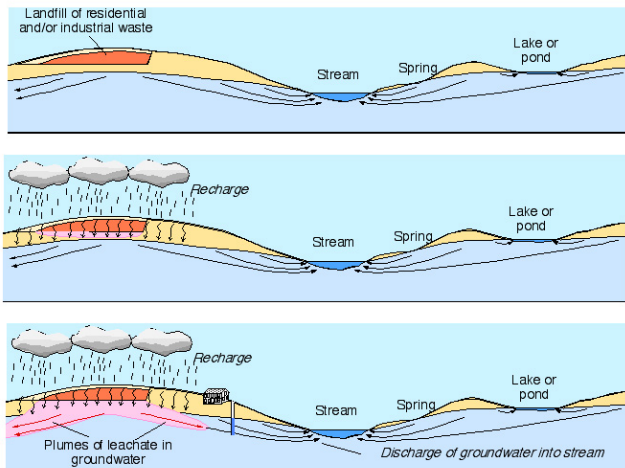
More situations



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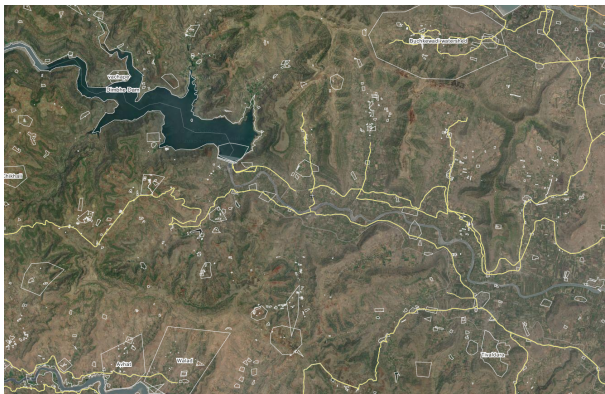
More situations



LBR 3/2002

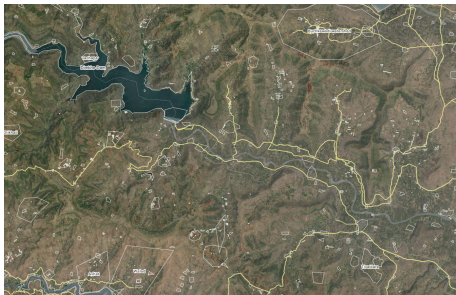
courtesy: Bruce Railsback again!

The regional situation



- Lots of unit situations. Interacting boundary conditions.
- How is this to be analysed?

Regional Objectives



- How does a region meet its water demands.
- Demands ↓. Supply ↑.

- Careful balance between run-offs and infiltration.
- Overall understanding of groundwater holding capacity and flows.
- Taking care not to contaminate surface and GW.
- Simple and fair laws and regulation.

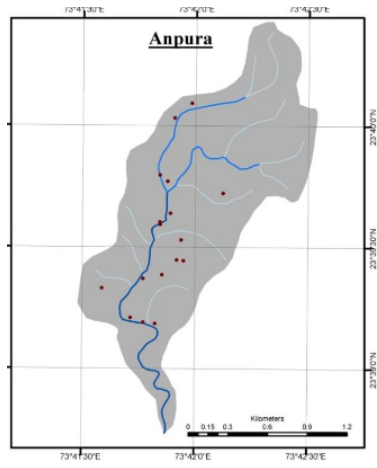
A necessary condition

Regional data. Regional processes.
Regional understanding.

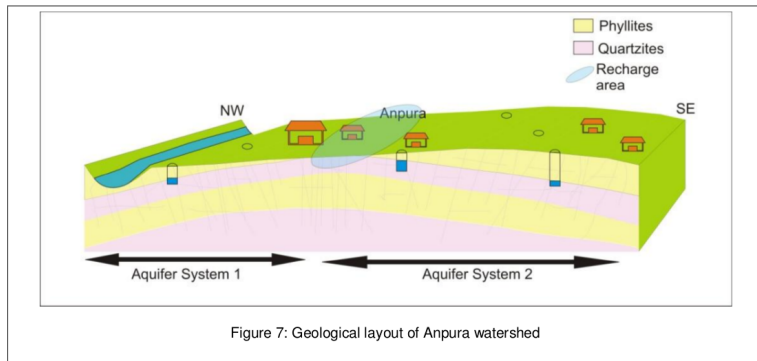
An ACWADAM study

3 watersheds and an aquifer in Dungarpur dis., Rajasthan.

http://www.acwadam.org/pdf/aquifer_based_mgmt/aquifer_pdf_01.pdf



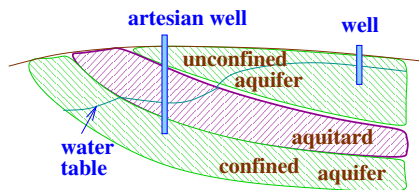
An ACWADAM study



- Field Vists, Geological Survey
- Secondary Data-Borelogs, CGWB.

Aquifers

- Materials which are poor in conductivity or storage are called **aquifers**.
- Example: Base Rock, Clays.
- **Unconfined aquifer**: accessible from the surface.
 - ▶ also **replenishable**: maximum sustainable pumping rate is recharge rate.
- **Confined or partially confined**: access blocked or limited by aquitard.
 - ▶ also **fossil**: depletion is almost permanent.



- The **water table** itself may cross many layers.
- Extraction of water from confined and unconfined layers cause different changes.

Regional Analysis

Typical groundwater flows are more complicated than earlier unit situations

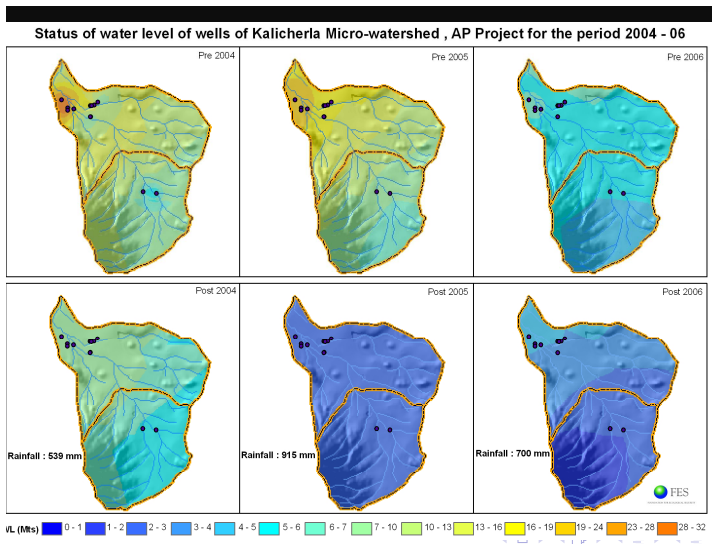
- Surface water/Groundwater interactions.
 - ▶ lakes and streams
 - ▶ springs (seepage)
- Ambient water-table movements
 - ▶ Seasonal changes
 - ▶ Inteferece with other water end-users.
- Inherent Complexity
 - ▶ aquifer characteristics
 - ▶ extraction and use, rain, surface cover etc.

Typical First Step:

- Observation Wells: Depth of water table at various (x, y) locations.
- Piezo meters: Heads at various (x, y, z) points.
- Estimation of the WT at all points.
- Plot iso-contour lines for WT.
- GW Flowlines: perpendicular to iso-WT lines.

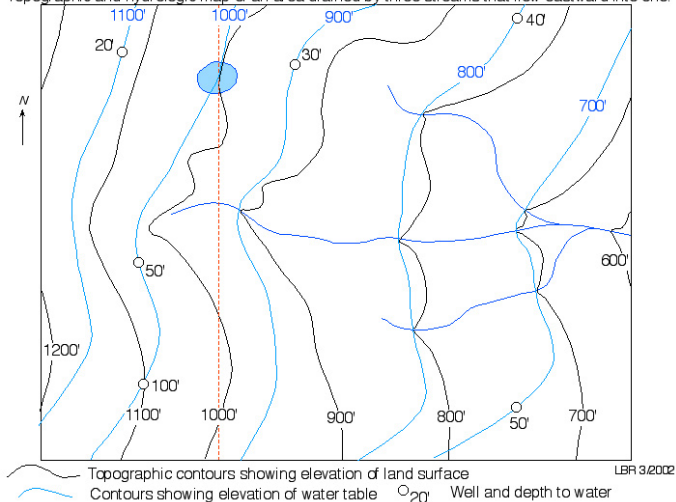
A watershed*

*Thanks to FES.org



WT and Elevation contours

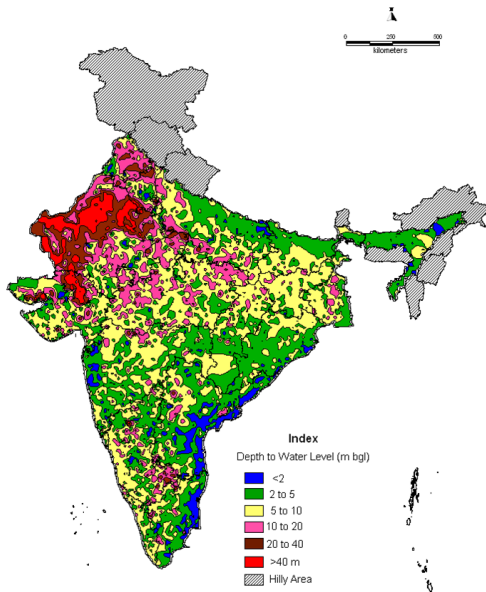
Topographic and hydrologic map of an area drained by three streams that flow eastward into one.



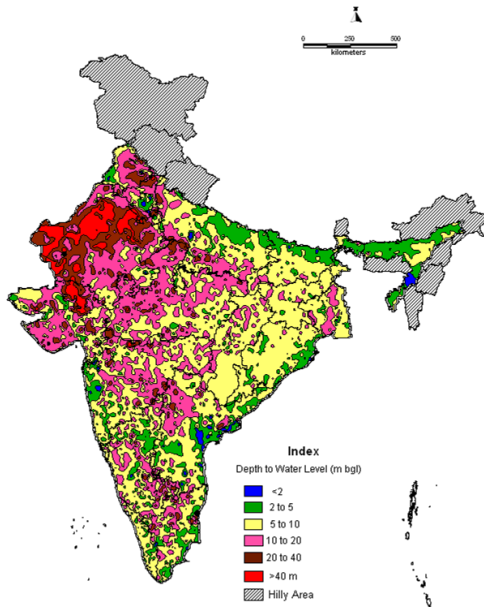
from: Prof. Bruce Railsback

<http://www.glv.uga.edu/railsback/GeologicalDiagrams2.html>

Depth to Water Level Map (January - 2011)



Depth to Water Level Map (Pre Monsoon - 2010)



Maharashtra-GSDA

- Water is a state-subject, and so is Groundwater.
- In Maharashtra: **Groundwater Surveys and Development Agency**

<http://mahagsda.org>

under the **Water Supply and Sanitation Department**

- **Groundwater extraction and utilization falls under the MWRRA.**

- **Functions:**

- ▶ Generate and supply data related to ground-water.
- ▶ Undertake studies and advise the govt. and people.
- ▶ Implement and execute acts and laws related to ground-water.

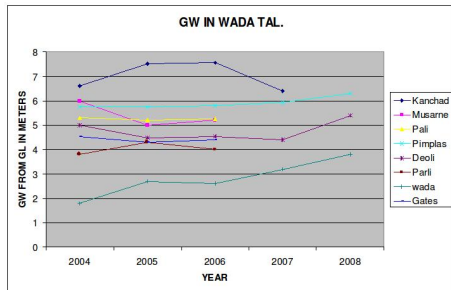
- **Infrastructure:**

- ▶ Thousands of observation wells (WT) and piezo-meters (heads).
- ▶ field-offices, weather, topographical and geological data.

- **Example** : Thane district of area 9500 sq. km. has 92 observation wells (**i.e., one observation per 100 sq. km.!**), which are monitored quarterly.

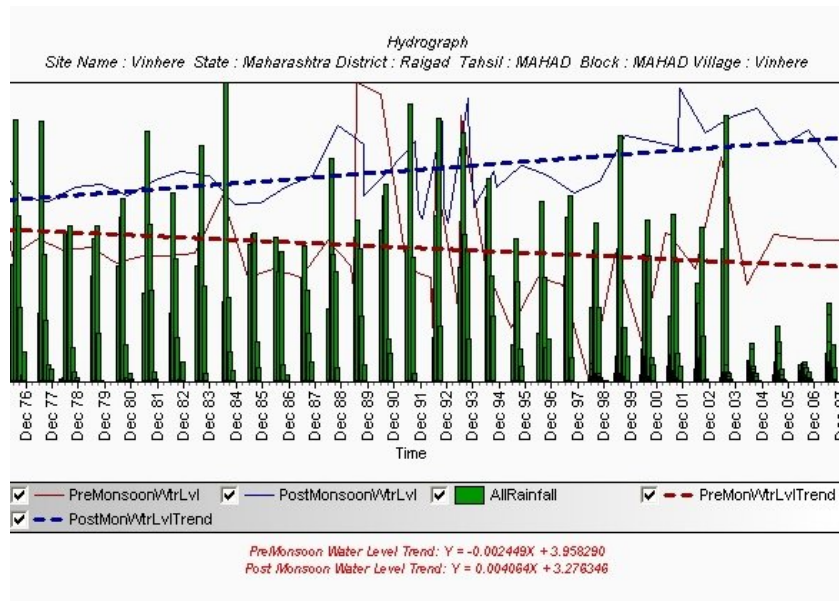
GSDA-Organization and Reports

- **HQ at Pune** , 6 branches (Amravati, Nagpur, Nashik, Kokan, Aurangabad, Pune).
- Each branch with a **Senior Geologist, Deputy Engineer** with a jurisdiction of roughly 5 districts.
- Organization of Maharashtra into basins and sub-basins.
- **Construction of Summary data on Water-balance.**
 - ▶ rainfall, wells, borewells, extraction, recharge.
 - ▶ borewell success rates, subsidies.

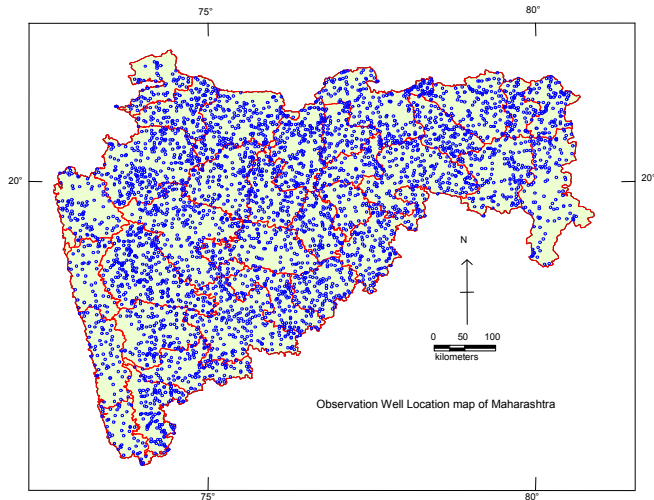


Observation well data for Summer of Wada taluka, Thane district.

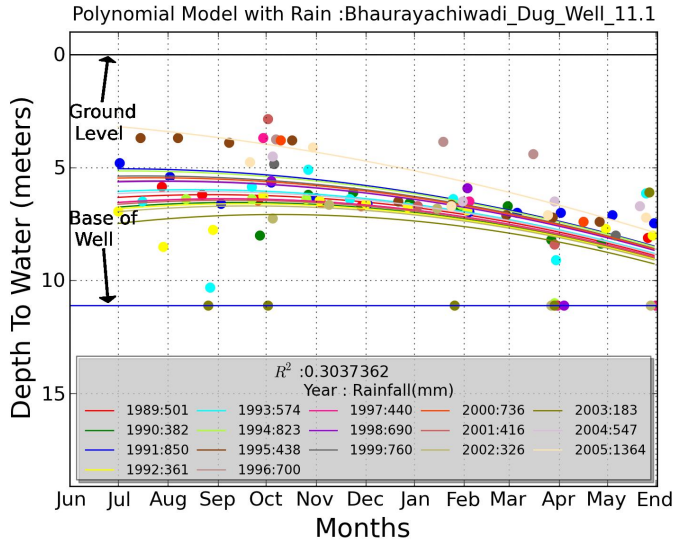
Raigad district Hydrograph (source GSDA)



Observation Wells



Models



Thanks

