LECTURE NOTES
Engineering and Hydrogeological Consideration of Artificial Recharge

Learning objectives

1. **Describe** types of groundwater recharge
2. **Compare** requirements and disadvantages of different artificial recharge methods
3. **Assemble** the data requirements, design, and management considerations for undertaking in Cache Valley.

1. Types of Groundwater Recharge

- Natural
- Enhanced (manage vegetation=>ET)
- Induced (wells near surface water)
- Incidental (septic-tank leach fields, irrigation infiltration, urban runoff)
- Artificial
    - Surface infiltration in basins, furrows, or ditches (in- or off-stream)
    - Vadose zone infiltration trenches, shafts, or wells
    - Injection wells

2. Requirements and Disadvantages of Artificial Recharge Methods

Method	Requirements	Disadvantages
Surface infiltration	• Permeable soil with high infiltration rates • Land area • Vadose zone free of contaminants, clay, and other impermeable layers	• Require high-quality water • Prone to clog • Require down time to dry, clean, and unclog
Vadose zone	• Trenches 1 m by 5 m deep • “Dry” wells 1 m diameter up to 60 m deep • Backfilled with coarse sand or fine gravel • Avoid free falling water • Cheap to construct	• Require high-quality water • Eventually clog • Cannot clean or backwash
Injection wells	• Treat injected water to meet drinking water standards • Frequently pump well to avoid clogging	• Expensive
Aquifer storage and recover wells	• Recharge when there is surplus surface water • Pump when not • Changing seasonal demands	• Minimum chlorine treatment of pumped water

3. Data Requirements, Design, and Management

Data Requirements:

- Soil infiltration rate => high transmissivity => large hydraulic conductivity
  - Soil maps, hydrogeological studies
  - Be wary of infiltrometer tests which only cover a small area (~ 30 cm diameter) – not representative of spreading basin scale
- Clogging potential
  - Physical – suspended solids in recharge water; downward movement of particles in the soil
  - Biological – algae, bacteria, microorganism growth, biofilms, etc.
  - Chemical – precipitation, water viscosity (colder temps =>lower infiltration rates; use winter-time temperature for design)
  - Determine through pilot tests

Example 1. What is the effective soil infiltration rate for a spreading basin whose soil infiltration rate is initially measured at 1 m/day, the rate decreases to 0.5 m/day over two weeks, and the basin must be dried for two weeks to restore the original infiltration rate of 1 m/day?

- Infiltration rate is also affected by the depth to groundwater and the water level in the basin. This effect is negligible when depth to groundwater is large.

- Costs
  - Construction
  - Recharge capacities, number of wells needed, their useful lives,
  - Maintenance and/or replacement costs
  - Cost of necessary pretreatment of the water

Example 2. What data is still needed to study potential ASR sites in Cache Valley? Hint: Look at the Cache Valley ASR Report.

The Golden Rule of ASR Management: start small, learn as you go, and expand as needed

4. Wrap-up