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Natural treatment systems for waste water

Some methods for Artificial Recharge

July 11, 2012

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Artificial recharge

- Infiltration of injection of water in the subsoil to augment the amount of groundwater
- The source predominantly is surplus river or lake water, wastewater, urban storm water
- Under controlled conditions
- With the intention of storage or treatment

Artificial recharge methods

- Surface systems (ponds and basins) that can be used to recharge unconfined (phreatic) aquifers only

- Wells that penetrate the target aquifer in case it is confined, covered with thick impermeable layers or if land is scarce or not available

Open recharge (‘ponding’)

Advantages	Disadvantages
Construction and operation is easy and cheap	Footprint, required area is large, costs of land might be prohibitive
Pre-treatment might be limited to avoid clogging	Periodic scraping of basins is adviced (‘required’)
	Some evaporation losses from open water surface
	Direct sunlight induces algae growth and clogging
	Limited availability of suitable sites
	Odor problems in case of waste water
	Proliferation of mosquitoes

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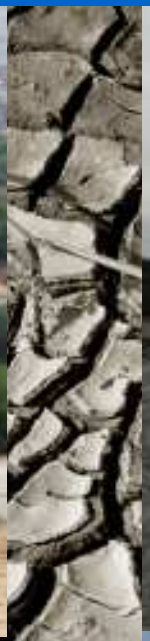
Clogging/scraping of recharge basins



Well recharge (‘injection’)

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Advantages	Disadvantages
Area required is limited	Wells are expensive
Backpumping option (reverse flow for maintenance and redevelopment of wells)	To avoid clogging (suspended solids and bacterial growth) very high level of pre-treatment is needed
Dual purpose option (injection and pumping)	Improvement of water quality during soil passage is rather limited

Comparison of basins and wells

	Spreading basins	**Injection wells**
Aquifer type	Unconfined, shallow	Confined, deeper target aquifers
Pre-treatment requirements	Low level of pre-treatment	High pre-treatment, high quality needed
Capital costs	Acquisition of land, construction of distribution system	Wells, up to € 300.000 per well (if less than 100 m deep)
Capacity (on the longterm)	100 – 3000 m3/ha/day	500 – 2000 m3/day per well
Maintenance	Drying and scraping	Backpumping for redevelopment
Estimated lifecycle	More than 100 years	20 – 30 years

Limitations of artificial recharge

- Area needed for spreading basins
- Costs for treatment and monitoring may be prohibitive
- Aquifer contamination due to inadequate pre-treatment
- Poor recovery due to mixing with native water
- Complex hydrogeology (clay and loam layers, faults, brackish water)
- Liabilities, legal problems, lack of regulatory standards
- Operational problems due to clogging
- Environmental damage to project area during construction (basins, wells, transport system)

Precautions

- Pilot tests and detailed (environmental impact) studies carried out by qualified specialist
- Permits issued by governments and regulators to prevent pollution or side impacts
- Permits that take into account water quality
- Provisions that apply to:
  - Monitoring (water quality, water levels), reporting
  - Construction, operation and maintenance
- Periodic check of compliance with permits

Further reading

- Artificial Groundwater Recharge (L. Huisman and Th. N. Olsthoorn), Faculty of Civil Engineering, University Delft, 1989
- Artificial Recharge of Groundwater, Proceedings of International Symposium Helsinki, Finland (1996)
- Artificial Recharge of Groundwater, Proceedings of Third International Symposium on Artificial Recharge of Groundwater, Amsterdam (1998)
- Australian guidelines for water recycling: managing health and environmental risks, managed aquifer recharge (National Water Quality Strategy), 2009
- Sharma, Saroj K & Gary Amy, Chapter 15. Natural Treatment Systems. In: Drinking Water Treatment: Handbook of Water Supply. AWWA, Sixth edition, Mc Graw Hill Publications, USA