

Groundwater Protection

Protection of Jeita Spring

I. Introduction

- Currently, the natural protection of groundwater (GW) is insufficient.
- Numerous pollution sources exist in the GW catchment, leading to a significant contaminant load at Jeita spring, the main source for water supply in the Greater Beirut Area.
- Urban development is spreading fast over the catchment area but landuse planning procedures are unable to minimize pollution risks.
- Urgent protection measures (zones with restricted landuse) have to be introduced to protect Jeita and other springs.

II. Problem Statement

- The water resources in Mount Lebanon are mainly found in highly karstified limestones. These limestones are mostly directly exposed (open karst) and are covered only with a thin soil.
- GW resources are therefore insufficiently naturally protected and contaminants can reach GW easily.
- Groundwater flow velocity is very rapid (70-200 m/h) so that contaminations are spread fast.
- Jeita spring shows a continuously high level of microbiological contamination since many years.
- Current landuse practices and licensing regulations do mostly not consider water resources protection needs.
- There is a considerable lack of awareness or even ignorance in the population and among decision makers concerning environmental and water resources protection needs.
- Because the government was not acting, local municipalities have begun to implement wastewater networks.

III. Protection Measures

Wastewater Schemes

- Wastewater needs to be collected and treated in the entire groundwater catchments of Jeita spring. Highest priority must be given to areas with high groundwater vulnerability (protection zones 2).
- Because of high GW flow velocities, centralized wastewater schemes with treatment downstream of water sources is preferable to a decentralized approach.
- Geological investigations concerning the suitability of WWTP site selections and potential impacts of geohazards on the schemes are indispensable.

Groundwater Protection Zones & Landuse Planning

- GW protection zones minimize the pollution risk by defining restrictions for landuse practices at different distances from the water source being used for drinking water supply.
- In karst areas the boundaries of protection zones depend on GW vulnerability and travel times. Tracer tests (colorations) are used to determine travel times.
- Protection zone 1 is the area where water is directly accessible, e.g. Jeita grotto and the canal from Jeita to Dbayeh.
- Protection zone 2 is the area of high groundwater vulnerability and travel times less than 10 days.
- Protection zone 3 is the entire GW catchment.
- Landuse practices have to be adapted to the high pollution risk.
- Regulations and procedures for landuse licensing must be changed to ensure adequate protection of water resources, e.g. for gas stations, quarries, etc.
- Industries using potentially polluting substances should not be allowed in the entire catchment.

IV. Results

- A wastewater scheme for the lower part of the Jeita GW catchment is under implementation.
- Geoscientific investigations helped to determine the optimal site for treatment and effluent discharge as well as geohazards for the WW facilities.
- GW protection zones were delineated and landuse restrictions will now jointly be defined together with the involved stakeholders.
- Implementation and enforcement of landuse restrictions must be ensured to minimize the contamination risk for Jeita spring.
- The lack of water governance and awareness is dramatic.

V. Recommendations

- Monitoring of water quality within the catchment must be improved.
- An authority responsible for control and enforcement of water resources protection policies should be established (environmental police).
- Capacity building of the agencies responsible for water resources protection is necessary.



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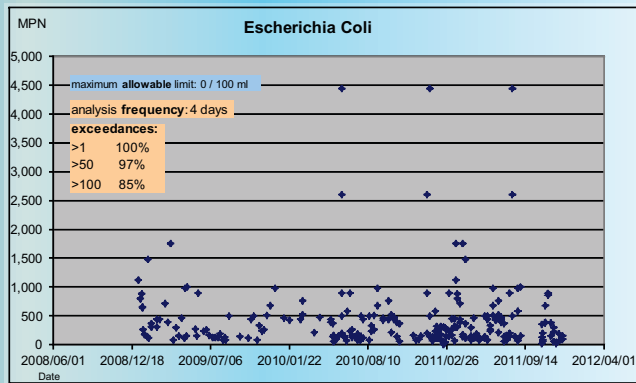
Actions to Minimize Pollution Risks:

- An inventory of groundwater hazards helps to identify potential pollution sources.
- A risk assessment for critical pollution sources must be done; it allows to define actions (where critical landuse activities must be abandoned).
- The raw water quality must be controlled to find out whether there is an impact from identified pollution sources.
- A clean-up operation (land reclamation) may be necessary, if feasible.
- Contaminants from pollution sources must be collected and treated (wastewater, solid and liquid wastes, hazardous substances).
- Groundwater protection zones must be established, including implementation and enforcement of related landuse restrictions.
- Regulations on landuse licensing must be revised based on water resources protection needs.



Ghadeer WWTP/Beirut

Wastewater is the main pollution source in the Jeita GW catchment. Only if all wastewater is collected and treated, microbiological contamination loads will decrease.



Due to the vast number of point-sources of contamination by wastewater, bacteriological contamination in raw water is continuously very extensive. The microbes, present in spring water are the cause for serious illnesses.

Not all bacteria, viruses and protozoa can be eliminated by chlorination. This is why even treated water may not be safe.



Abu Mizaine quarry

Quarries constitute a major pollution risk. One reason is the large amounts of fuel and oil often stored here. Also, infiltration of fine sediments causes turbidity peaks in downstream water resources causing problems in water treatment.

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Dbayeh treatment plant

Dbayeh drinking water treatment plant was built in 1896. It's capacity is too small and it cannot treat inorganic constituents, heavy metals and other hazardous substances. The laboratory capacity is also insufficient to monitor pollution.