

Groundwater Vulnerability

Protection of Jeita Spring

I. Introduction

- 70% of the outcropping rock units in the Jeita catchment consist of limestones, which are highly fractured and karstified.
- The natural protection of the aquifers is low so that groundwater (GW) resources are highly vulnerable to pollution.
- Numerous pollution sources have led to a serious degradation of Jeita spring, the main source of drinking water supply to the Greater Beirut Area.
- Mapping of groundwater (GW) vulnerability was used to delineate GW protection zones for the major drinking water sources in the Jeita catchment.

II. Problem Statement

- The groundwater resources in Mount Lebanon are mainly found in karstified limestones. These limestones are mostly directly exposed (open karst) and/or are covered only with a thin soil layer.
- An extensive network of interconnected karst conduits has developed in the unsaturated- and saturated zone of the GW system.
- GW resources are therefore insufficiently naturally protected and contaminants can reach GW easily and fast.
- Almost no natural attenuation occurs in the GW system because groundwater flow is very fast (70-200 m/h) so that contaminants are hardly degraded on their way to Jeita.
- Any pollution occurring in the catchment is spread fast.
- Because treatment and monitoring of drinking water quality are insufficient and there is little consumer confidence, mainly bottled water is used for drinking purposes.

III. Mapping of GW Vulnerability - Purposes:

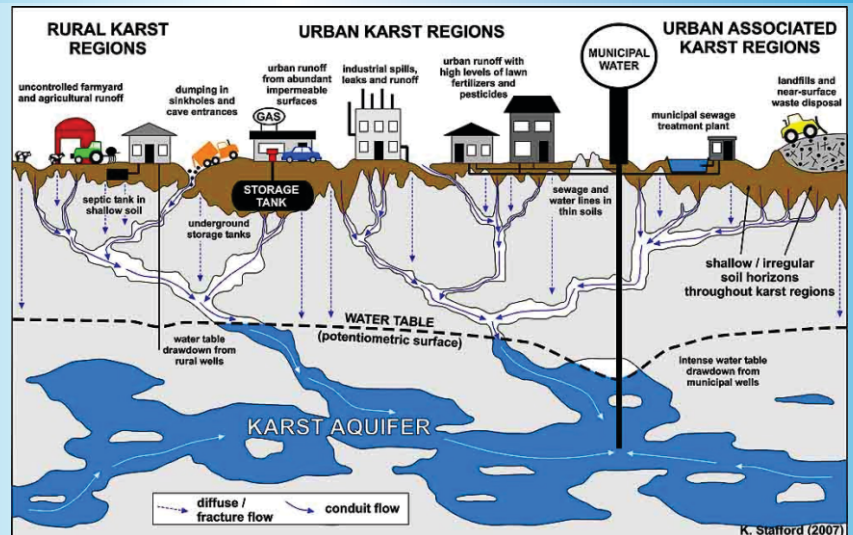
Used for different institutions:

I. By Landuse Planning Authorities:

- Selection of areas for activities hazardous to groundwater (e.g. landfills);
- Protection of very productive aquifers (conservation).

II. By Water Resources Management Authorities:

- Groundwater protection zone delineation and definition of landuse restrictions;
- Protection of resources which may be important in the future;
- Design of groundwater monitoring networks;



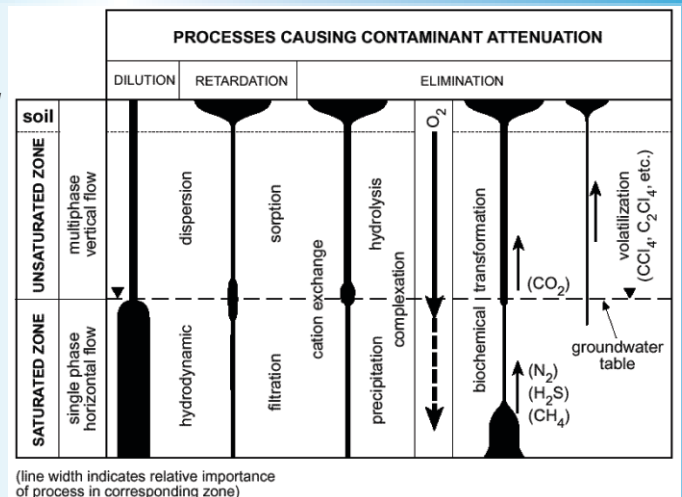
In open karst areas where a network of karst conduits has developed groundwater can be contaminated easily.

- Environmental Impact Assessments (EIA);
- Detection of pollution sources and pathways.

IV. Methodology

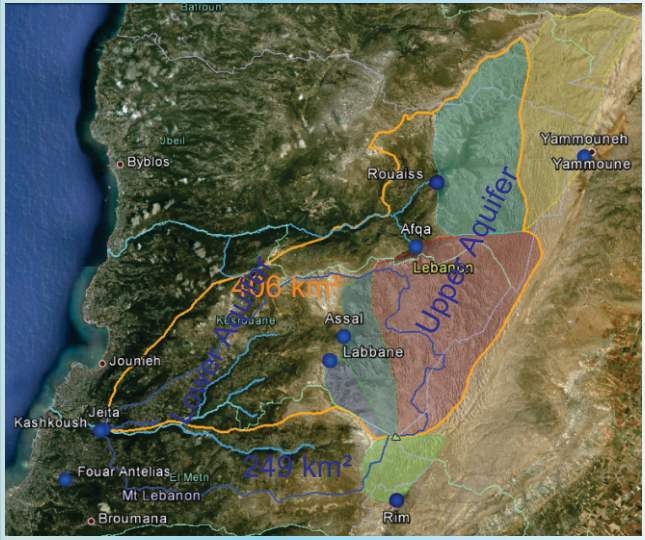
- Two different methods were used, COP and EPIK, which are developed for karst regions.
- Both require detailed mapping:
 - Karst features
 - Geology
 - Depth to saturated zone
 - Soil thickness and texture
 - Topography
 - Vegetation
 - Precipitation

The unsaturated zone can reach up to 800 m in the Lower Aquifer. It contains CO₂ and oxygen; water flow velocity is less than in the saturated zone.

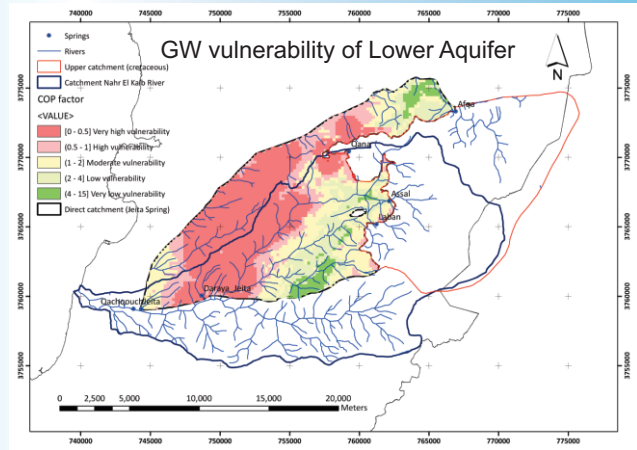


Groundwater Vulnerability

Protection of Jeita Spring



The GW catchment of Jeita (orange) is very different from the surface water (SW) catchment (blue).

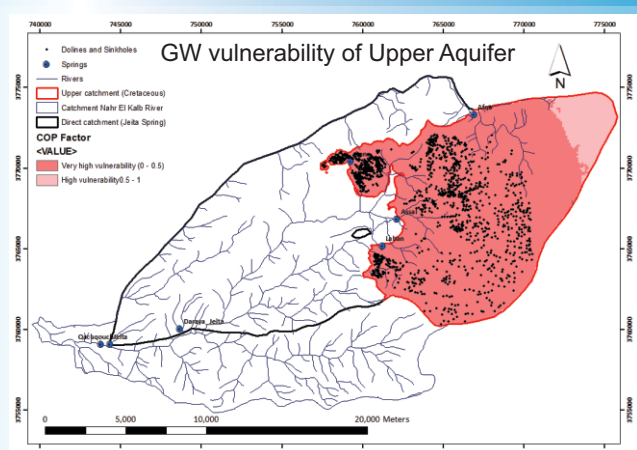


The zone colored in red indicates the area with a high groundwater vulnerability. It will be designated as GW protection zone 2. The remainder of the catchment will be declared as GW protection zone 3 (groundwater contribution zone). The Lower Aquifer supplies Beirut with drinking water.



injection of organic dye during May 2011 in sinkhole

The high plateau (Upper Cretaceous limestone) is highly karstified. There are more than 2000 dolinas, where groundwater directly infiltrates. Groundwater flow is very rapid here.



The entire upper part of the GW catchment (Upper Aquifer) has a high GW vulnerability and needs to be very well protected. No further development should be allowed here. This is where currently drinking water in the Keserwan district mainly comes from.

Contact

German-Lebanese Technical Cooperation Project
 Protection of Jeita Spring
 German Federal Institute for Geosciences and Natural Resources (BGR)
 Dr. Armin Margane
 Project Team Leader, Senior Hydrogeologist
 Raifoun, Lebanon
 09/957348 - 70/398027
 armin.margane@bgr.de
 www.bgr.bund.de/jeita



Satellite-Housing on the highly vulnerable J4 aquifer

In areas of high karstification wastewater infiltrates rapidly and unhindered into groundwater.