

IAH network on “Coastal aquifer dynamics and coastal zone management” QUESTIONNAIRE

IAH national committees, IAH members and non members from all around the world involved in SWI and SGD research and management are kindly asked to fill in the questionnaire in this page with as many details as possible.

A world database will be set up and made available, with basic coastal aquifer main characteristics.

We expect to gather standard and comparable information on the knowledge level and hopefully the state of the art of the research on SWI and SGD, and coastal aquifer management methods adopted around the world

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| 1) | Location of aquifer (country, more specific location): | Beirut, Lebanon |
| 2) | Reported by: | Mutasem El-Fadel, Grace Rachid, Ibrahim Alameddine and Majdi Abu Najm |
| 3) | Type of medium (karst, porous, fracture) | Karst,Fractured |
| 4) | Type of aquifer (phreatic or confined) | Phreatic,Unconfined |
| 5) | Main lithology - (e.g. gravel, sand and clay) | Carbonate (Cenomanian limestone and Senonian marl of the Cretaceous period) consisting of dolomitic and marly limestone and marl; in addition to Eolian sands and alluvium of the Quaternary . period and marly limestone, sand and conglomerates belonging to the Tertiary period (Miocene) |
| 6) | Hydrochemistry: fresh or saline | Fresh and saline |
| 7) | Saltwater intrusion: lateral from sea or lakes - upconing | Seawater intrusion(lateral) |
| 8) | Aquifer geometry: hydraulic characteristics | Single saturated zone with an estimated thickness of 700m |
| 9) | Aquifer parameters: storage - annual water pumping - (in MCMA - millions cubic meters, annually) | Estimated, unconfirmed annual water pumping: 14MCMA
Average annual rainfall: ~ 800 mm |
| 10) | Depth of aquifer (water level and bottom) - water level 5-30 m - aquifer depth - 50-200 m | Aquifer depth: ~ 700 m
Water level: not measured |
| 11) | Major chemistry (anions - ?; Cations - ?): | Cl ⁻ , Na ⁺ ,SO ₄ ²⁻ , Ca ²⁺ , Mg ²⁺ and HCO ₃ ⁻ |
| 12) | Major salinity sources: | Saltwater intrusion is the primary source of salinity due to proliferation of building wells and over extraction. |
| 13) | Population: | Beirut is a highly urbanized and populated metropolitan with a population of ~ 400,000. It suffers from water shortages and hence is highly dependent on groundwater resources. |
| 14) | Aquifer status: special features - e.g. thermal springs, major faults,... | It is heavily jointed and faulted where two faults, the Beirut River and Beirut harbor, are known to run parallel in a NE to SW direction from the Eastern coast of Beirut towards its center while multiple small faults are thought to exist along the Western coast |
| 15) | Investigation methods - e.g. water level measurements, EC (electrical conductivity profiles), TDEM (geophysical), | Hydrogeochemical (indicator parameters, ionic ratios, GQI, HCSA, water types and facies, Cl/Br end member, ionic deltas) and geostatistical analysis (spatial vulnerability mapping; interpolations) were undertaken. One geophysical study was done in 1969 by FAO |
| 16) | Numerical hydrological modeling, chemical and isotopic methods, age determination, IR survey, seepage meters (for Submarine Groundwater Discharge, SGD) | First numerical modeling attempt of the Beirut aquifer is ongoing; Ionic relationships, hydro-chemical diagrams (Piper),Simpson classification |
| 17) | Monitoring methods applied and duration - water level measurements, EC (electrical conductivity profiles - seasonal) | Monitoring program extended from June 2013 to April 2014 where sampling rounds covered 3 seasons (early dry/ late dry/ late wet) and 170 building scale wells were sampled. |
| 18) | Management methods: | No enforcement of governing laws. As a result, there is an estimate of ~1600 unlicensed well. Government's management plans focus on providing alternative sources for water to Beirut to alleviate the reliance on groundwater resources |
| 19) | Aquifer management actions: | No aquifer management actions are enforced by the government. Recommended actions include: enforcement of permitting and licensing of wells,injection wells or artificial recharge |
| 20) | Identification of existing or potential problems: | Spatial and temporal heterogeneity in aquifer salinization. Advanced saltwater intrusion in the dry and late dry season rendering water unfit for most uses in most of Beirut. Residents shift to other nonconventional water sources at a cost |
| 21) | Annexes: | |
| 22) | Observations: | |