



HASHEMITE KINGDOM OF JORDAN  
Ministry of Water and Irrigation  
(MWI)  
Amman



Federal Institute for Geosciences  
and Natural Resources (BGR),  
Hannover, Germany

## Jordanian-German Technical Cooperation Project Groundwater Resources Management

### Coupling Sustainable Sanitation and Groundwater Protection

## Groundwater Protection and Sanitation - Practical experiences in Jordan -



Dr. Ariane Borgstedt  
Eng. Ali Subah



## Actual Situation in Jordans' Water Sector

### Groundwater Resources:

- **Renewable**
  - Average annual safe yield = 276 MCM
  - Total Renewable groundwater abstraction = **392 MCM**
- **Non-Renewable**
  - Annual potential of non-renewable groundwater = 143 MCM
  - Total non-renewable groundwater abstraction = **79 MCM**

### Surface Water Resources:

- Average annual long term flow = 713 MCM
- Average annual exploitable = 535 MCM
- Current uses from Surface water = 365 MCM
- Current storage capacity of the dams = 328 MCM

### Non-Conventional Utilized Water Resources:

- From 22 waste water treatment plants = 90 MCM



## Major Challenges in Jordans' Water Sector

- High Population Growth
- Highly Competing Sectoral Demands on scarce water resources
- Scarcity of Renewable water
- Depletion of groundwater
- Distribution inefficiencies
- Demand centers are distant from water resources
- Inadequate tariffs
- Limited wastewater treatment capabilities
- Restricted private sector involvement
- Deterioration Water quality
- Landuse???????



## Technical Cooperation - BGR with MWI

### Groundwater Resources Management Project:

- 1. Phase: 06/2002 – 05/2005
- 2. Phase: 06/2005 – 05/2009

### Objective of the current project phase:

The protection of the groundwater resources in Jordan is improved.

### Implementing agencies:

Ministry of Water and Irrigation (MWI)

Federal Institute of Geoscience and Natural Resources (BGR)



# Groundwater Resources Management Project

## 2. Phase

### Implementation of 5 new Groundwater Protection Zones

- **Delineate** five Groundwater Protection Zones (Ain Rahoub, Corridor Well Field, Hallabat Well Field, Ain Baqqouria, Karak/Lajjun Well Field)
- Monitor and Support the **Implementation** of these Protection Zones
- Conduct **Awareness Campaigns** at different stages of the Implementation Process

### Implementation of 2 new Surface Water Protection Zones

- **Delineate** of two Surface Water Protection Zones (Wadi Mujib Dam, Wadi Wala Dam)
- Monitor and Support the **Implementation** of these Protection Zones
- Conduct **Awareness Campaigns** at different stages of the Implementation Process



# Delineating and Implementing Groundwater and Surface Water Resources Protection in Jordan

- Requires the awareness of the problem within the population and the related ministries, authorities
  - Requires an integrated approach, involving many ministries and other institutions
  - Requires laws and regulations
  - Requires the involvement of all stakeholders in the implementation process
- 
- Higher Committee for Water Resources Protection established to provide guidance and to coordinate all efforts in drafting the legislation
  - The Project prepared Proposals for Groundwater and Surface Water Protection Zone Delineation



# Higher Committee for Water Resources Protection

Ministries, authorities, universities, institutions participating in the Higher Committee - under the chair of the Minister of Water & Irrigation:

- Ministry of Water and Irrigation
- Water Authority of Jordan
- Jordan Valley Authority
- Ministry of Agriculture
- Ministry of Health
- Ministry of Industry
- Ministry of Tourism
- Ministry of Municipality
- Ministry of Environment
- University of Jordan
- University of Al-Salt
- University of Al-Hashimiya
- University of M'uta
- University of Science and Technology
- Land and Survey Department
- President of the Agricultural Union
- Advisor in Legal Affairs in the Cabinet
- Federal Institute for Geosciences and Mineral Resources



**Aim:**  
**Establishment of guidelines and instructions for the delineation of protection zones**



**Issuance of the Drinking Water Resources Protection Guideline in July 2006**



# Zoning System in Jordan

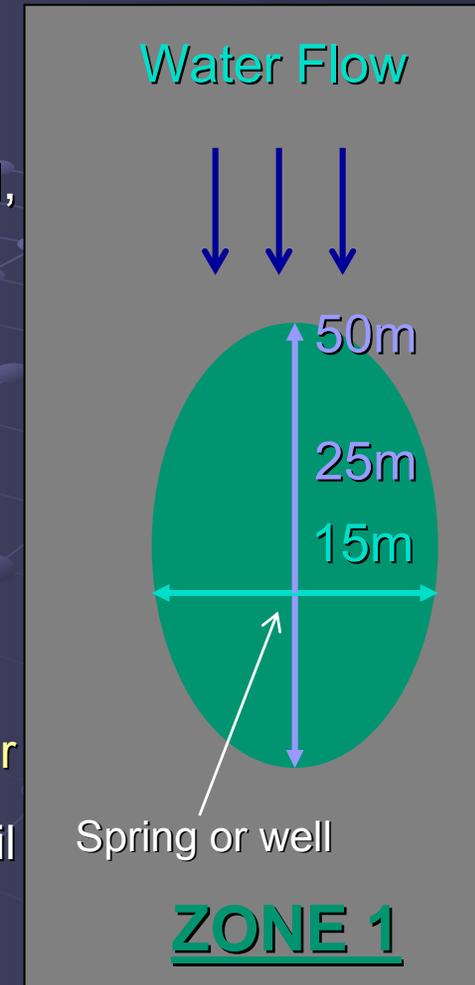
## ZONE 1 Groundwater Protection

Compasses an area of 1 dunum (1ar) around each well, about 2 dunum (2ar) around each spring.

- for public drinking water supply: Water Authority (WAJ) will acquire the land and fence it
- for private drinking water supply: a similar area should be protected

### Restrictions:

- **No activities** allowed other than those needed for water abstraction
- Any installation / construction required for groundwater resources operation has to be constructed **downstream** of the abstraction point (generator, fuel/oil storage, chemical storage facility, cesspool etc.)



## ZONE 2 Groundwater Protection

The delineation is based on **50-days travel time** but the distance from the abstraction point to the borderline of Zone 2 will not exceed

- **2 km upstream** of well or spring, and
- **50 to 150 m downstream** the extraction point

Unless its proven to be necessary by detailed studies.

Allowed activities (newly developed land)

- Residential areas with sewers or acceptable cesspit
- Organic farming

Allowed activities (already developed land)

- Residential areas (priority for sewerage)
- Organic farming
- Other activities have to implement BMP's

Activities in Zone 2 will be intensively monitored.



# Zoning System in Jordan

## ZONE 3 Groundwater Protection

### Area:

Protection of the entire groundwater catchment area of the abstraction point.

### Allowed activities:

All development activities such as agricultural, industrial and social activities under the condition that they comply with the laws and by-laws applied in Jordan and environmentally sound practices



# Ground- and

Wadi Al Arab w

Ain Rahoub

Pella Spring (Ta

Qunayyah Sprin

Corridor well fie

Hallabat well fie

Salt Springs

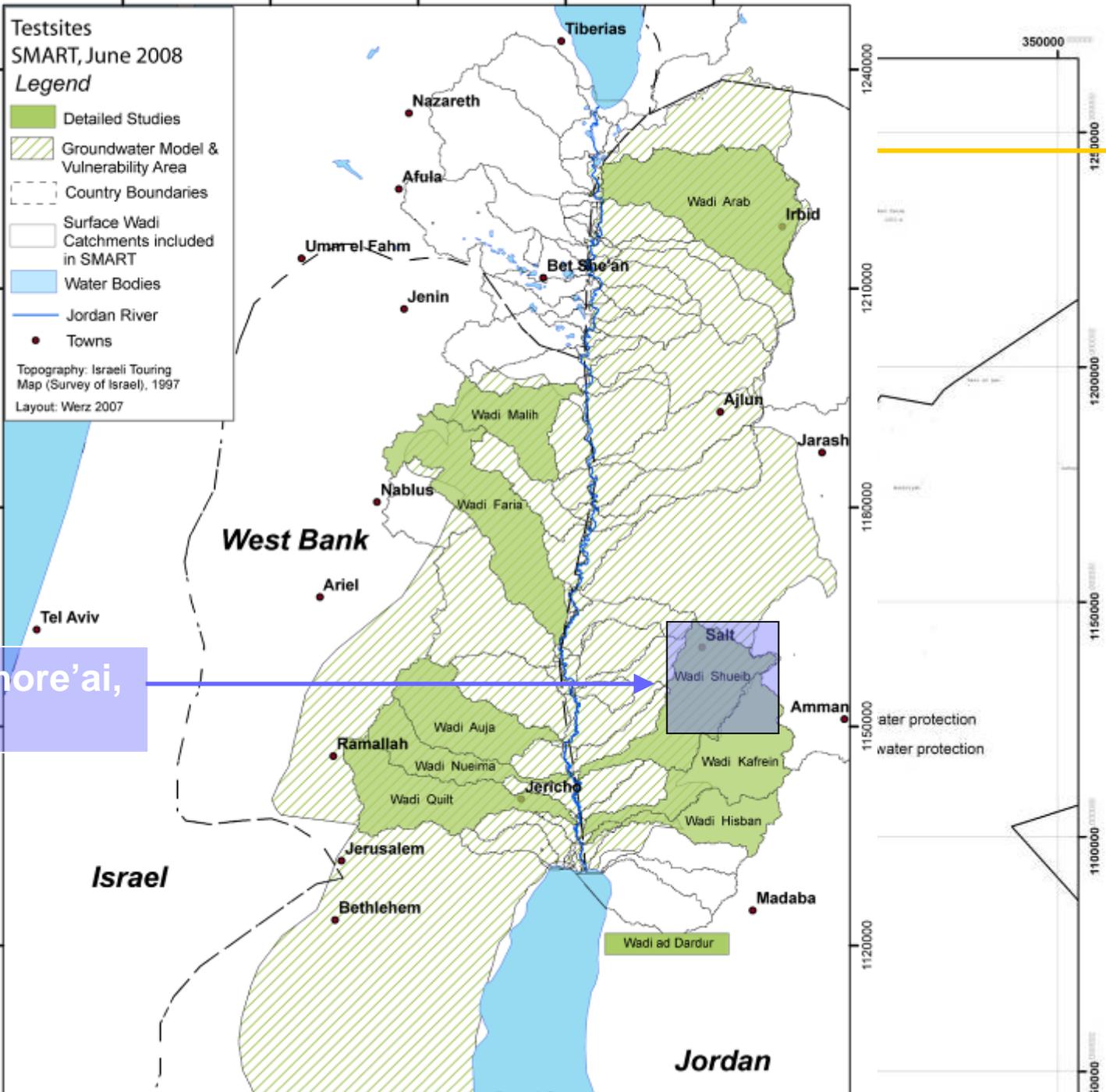
Ain Baqqouria, Shore'ai,

Hazzir, Azraq

Wadi Wala Dam

Wadi Mujib Dam

Karak/Lajjun we



# Surface Water Catchment Area Wadi Shueib Springs



**Baqqouria**



## Relevance Wadi Shueib Springs

13 springs are situated within the upper Wadi Shueib catchment area. The main springs are Hazzir, Shore'ia, Baqqouria and Azraq.

Hazzir, Shore'ai, and Baqqouria springs are used for the drinking water supply of the city of Salt whereas Azraq spring is for the Fuhais water supply.

Actually the water of Ain Hazzir is polluted with escherichia coli bacteria, ammonium and nitrate and is therefore disconnected from the water supply system.



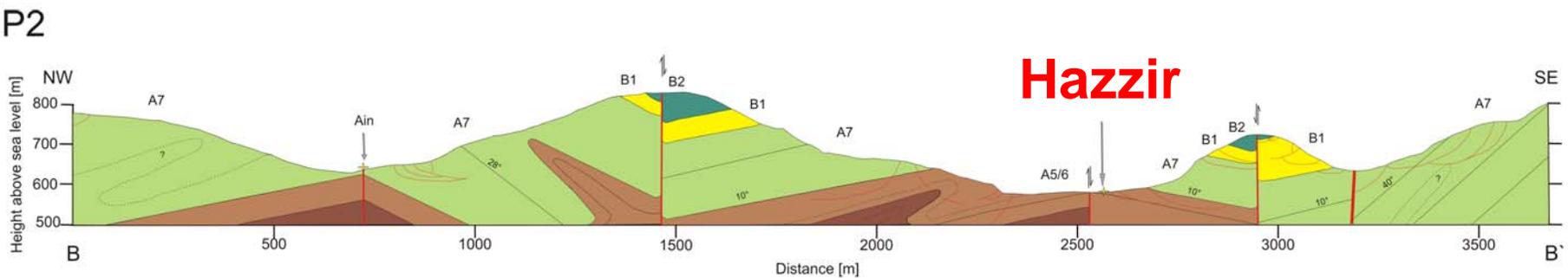
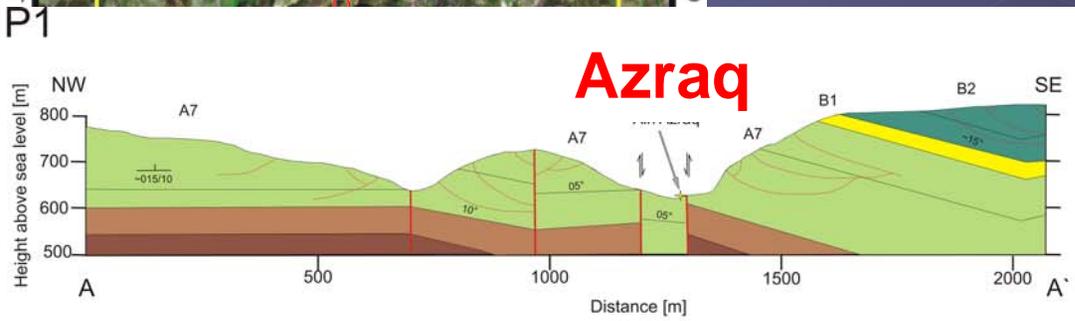
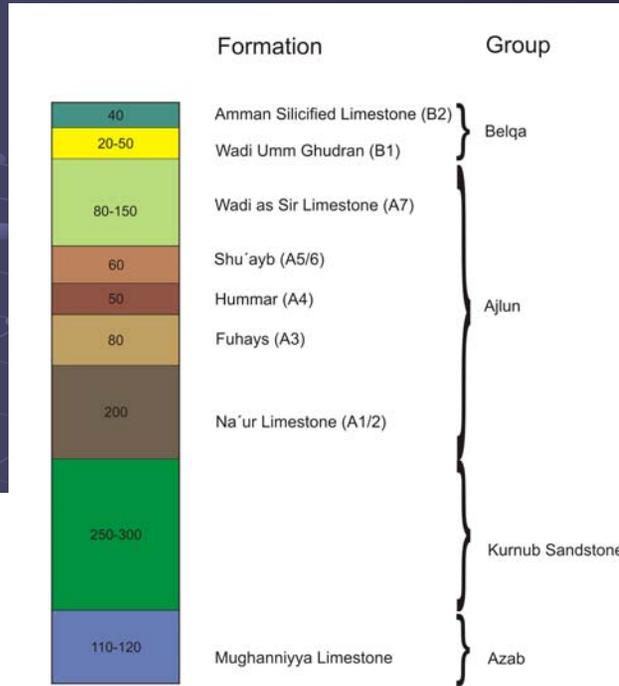
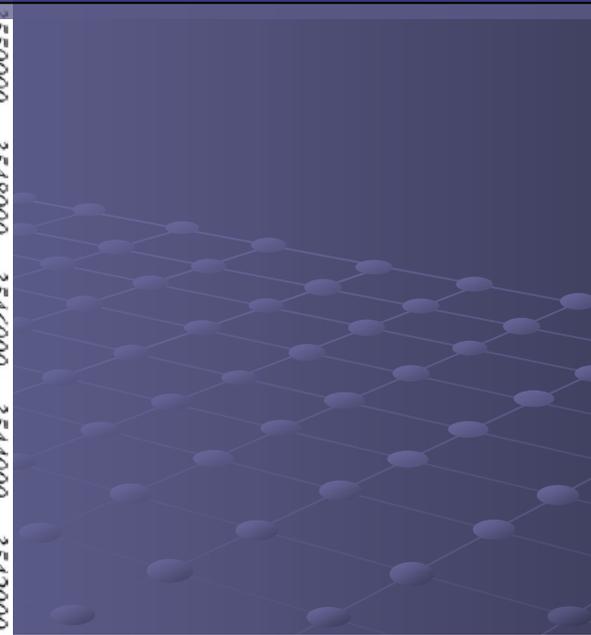
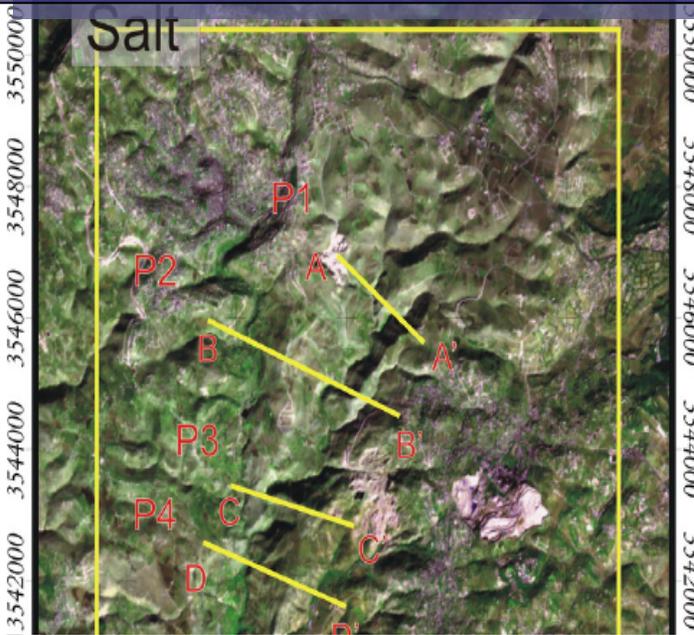
The springs (without Hazzir) have an average pumped discharge of about 7 MCM/year. Hazzir spring has a pumped discharge of 900,000 m<sup>3</sup>/year, the other 9 springs have a total discharge of 900,000 m<sup>3</sup>/year.

In wintertime the spring discharge is more or less sufficient to cover the needs of the Salt/Fuhais water supply.

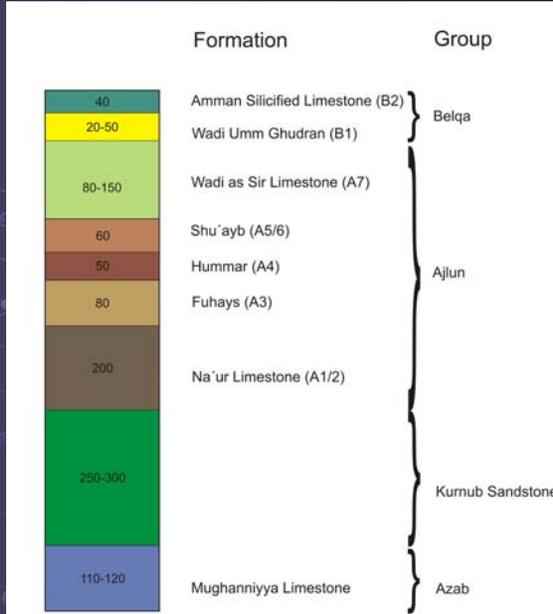
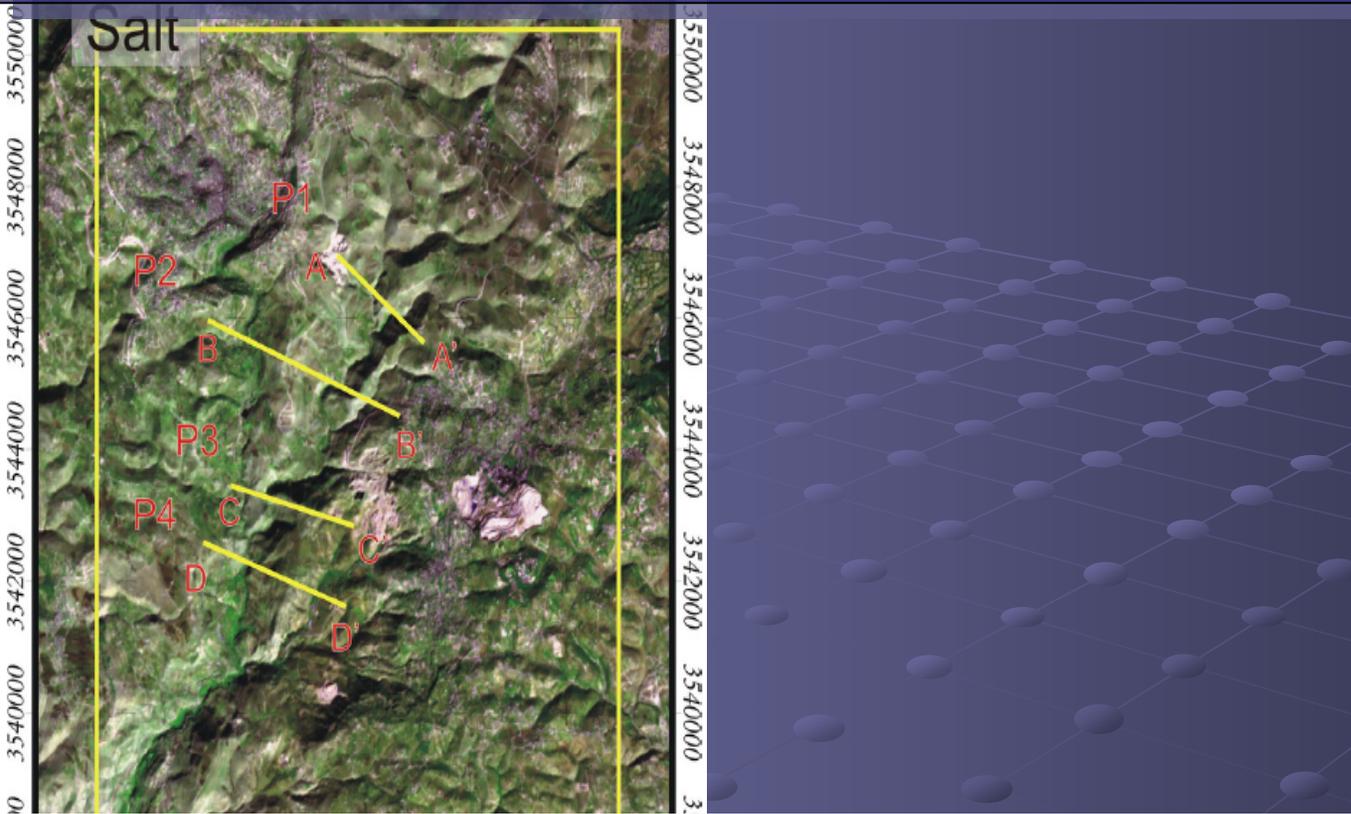
In summertime, the spring discharge is not sufficient and therefore wells are put in operation. This situation is aggravated since the water of Ain Hazzir is not usable.



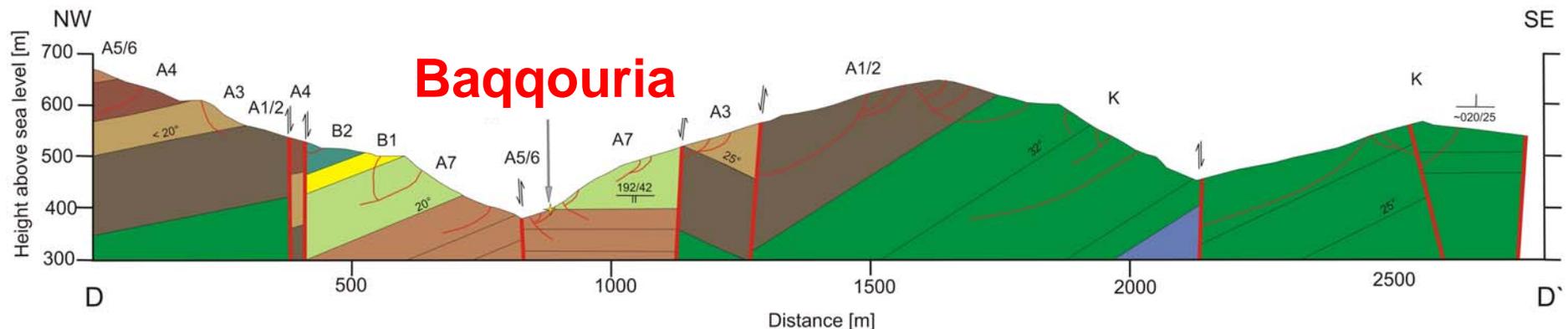
# Geological Cross Section Upper Wadi Shueib Catchment Area



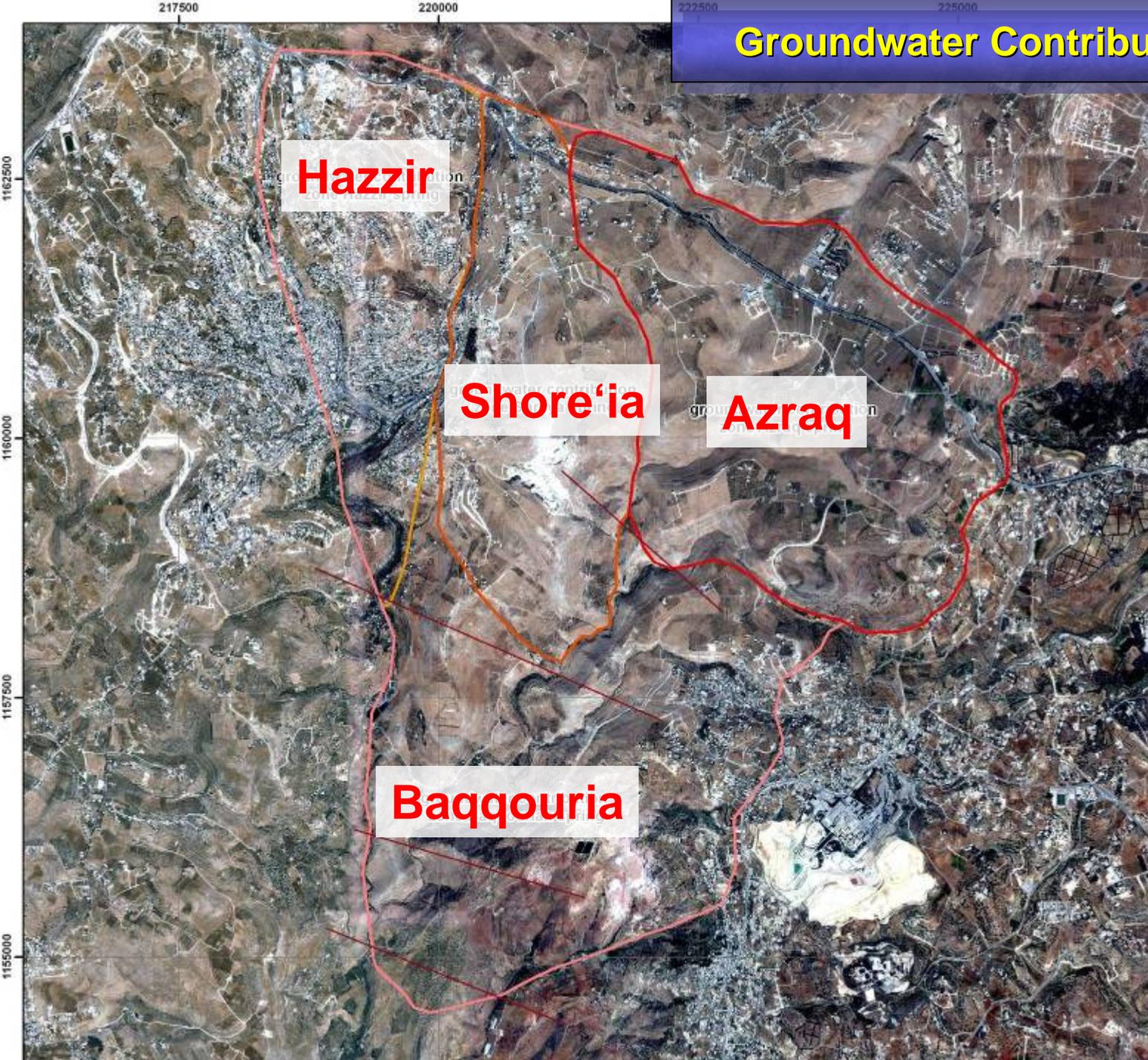
# Geological Cross Section Upper Wadi Shueib Catchment Area



P4



# Groundwater Contribution Zones



## Potential Pollution Sources

**11 gas stations**  
**2 slaughterhouses**  
**2 hospitals**  
**illegal waste dump sites**  
**2 waste water treatment plants**  
**Sewer system**

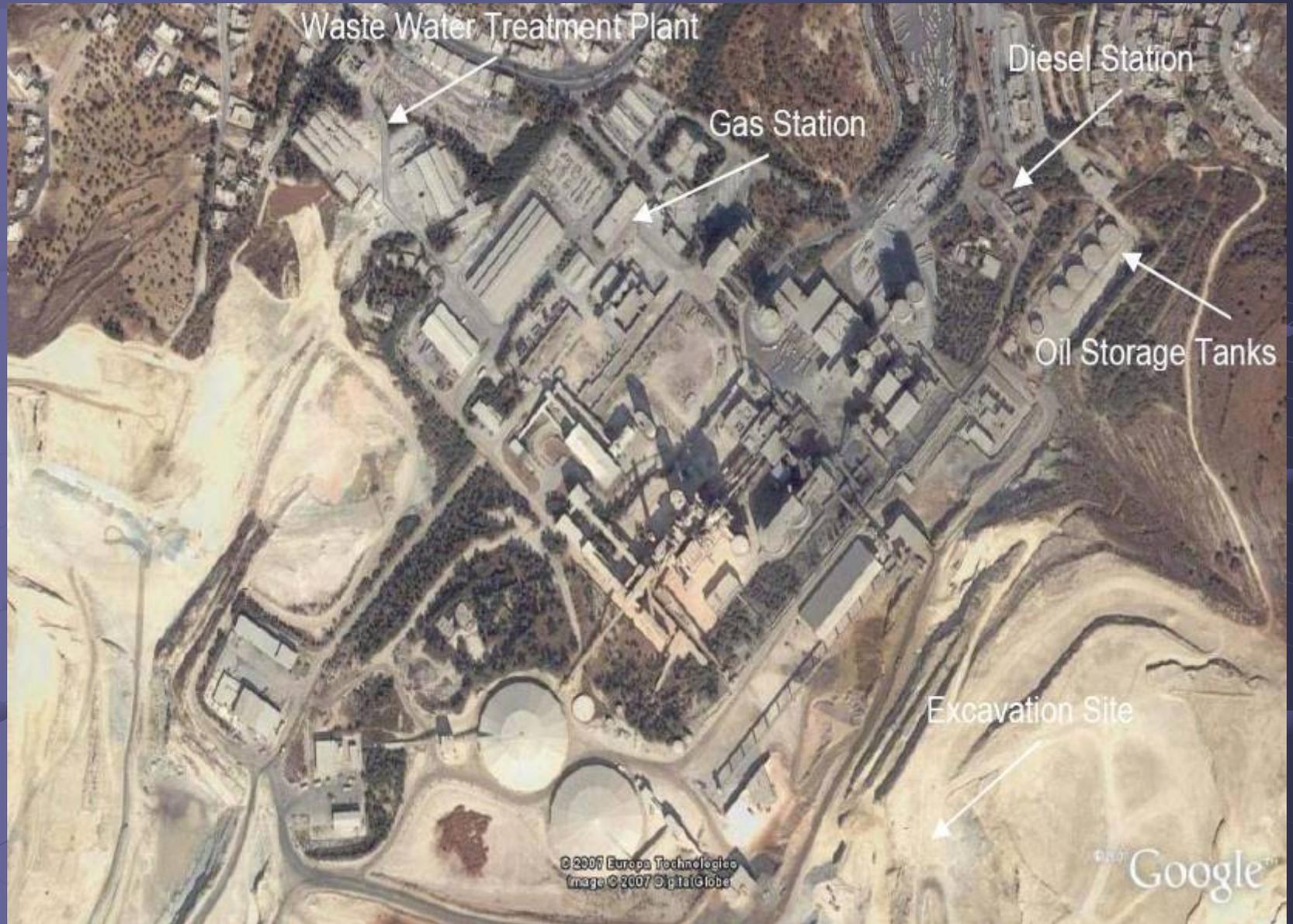
**66 car service stations**  
**15 carpenters**  
**13 locksmitheries**  
**10 aluminium manufacturing**

**9 chicken farms**  
**4 animal barns**  
**4 greenhouses**  
**4 intensive agricultural areas**  
**> 50 orchards**

**1 cement factory**  
**3 excavation sites**  
**2 chemical industries**  
**1 alcohol distillery**



# Potential Pollution Sources



# Salt Slaughterhouse



Groundwater Resources

# Salt Waste Disposal



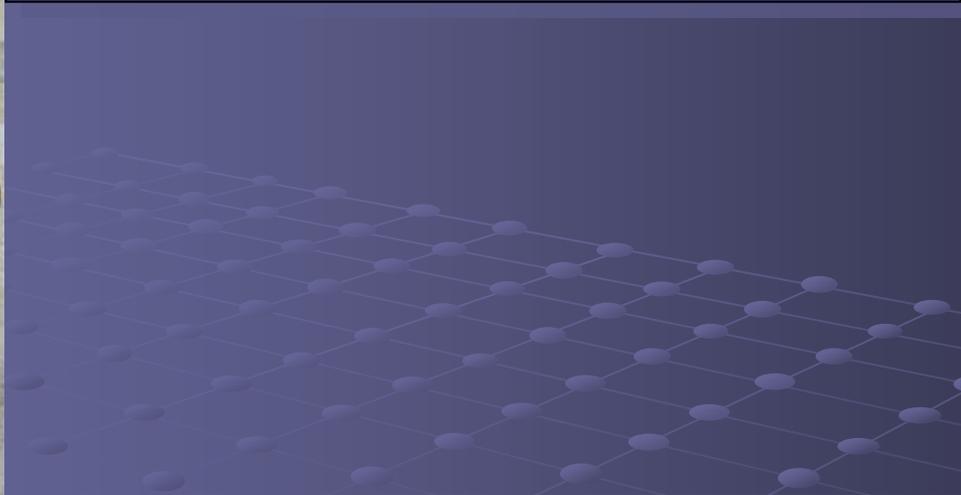
## Salt Car Service Stations / Repair Shops



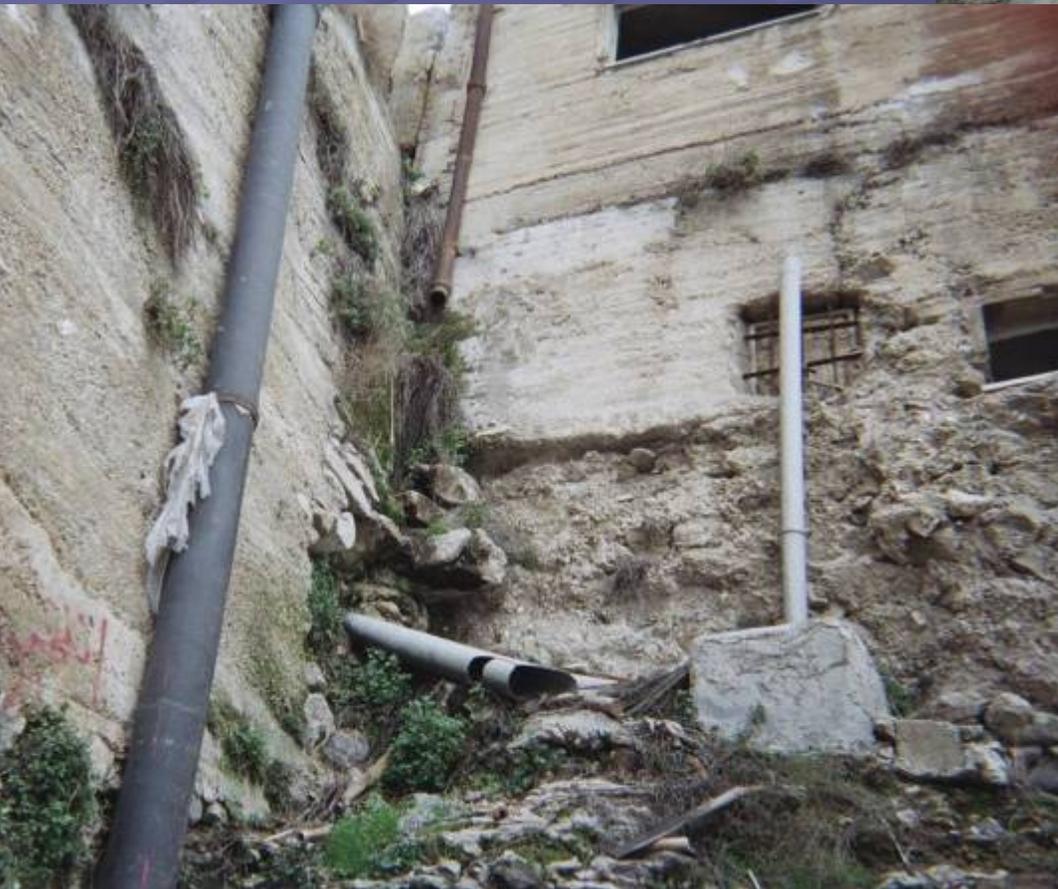
# Salt Water Supply System



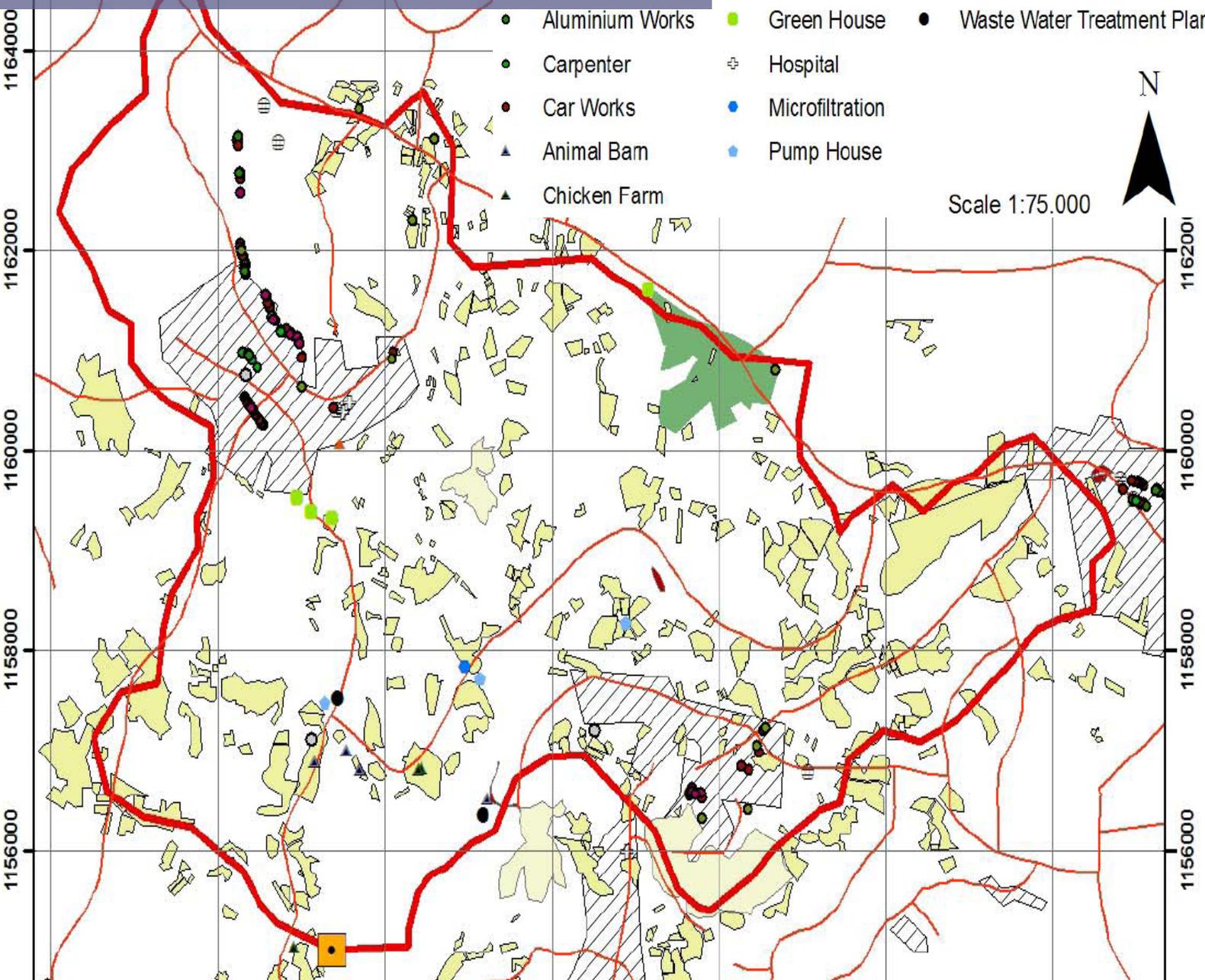
# Salt Sewer Pipes / Sewage Collector



# Salt Sewer Pipes / Cessspits



# Map of potential pollution sources



- Aluminium Works
- Green House
- Carpenter
- Hospital
- Car Works
- Microfiltration
- ▲ Animal Barn
- Pump House
- ▲ Chicken Farm

Scale 1:75.000

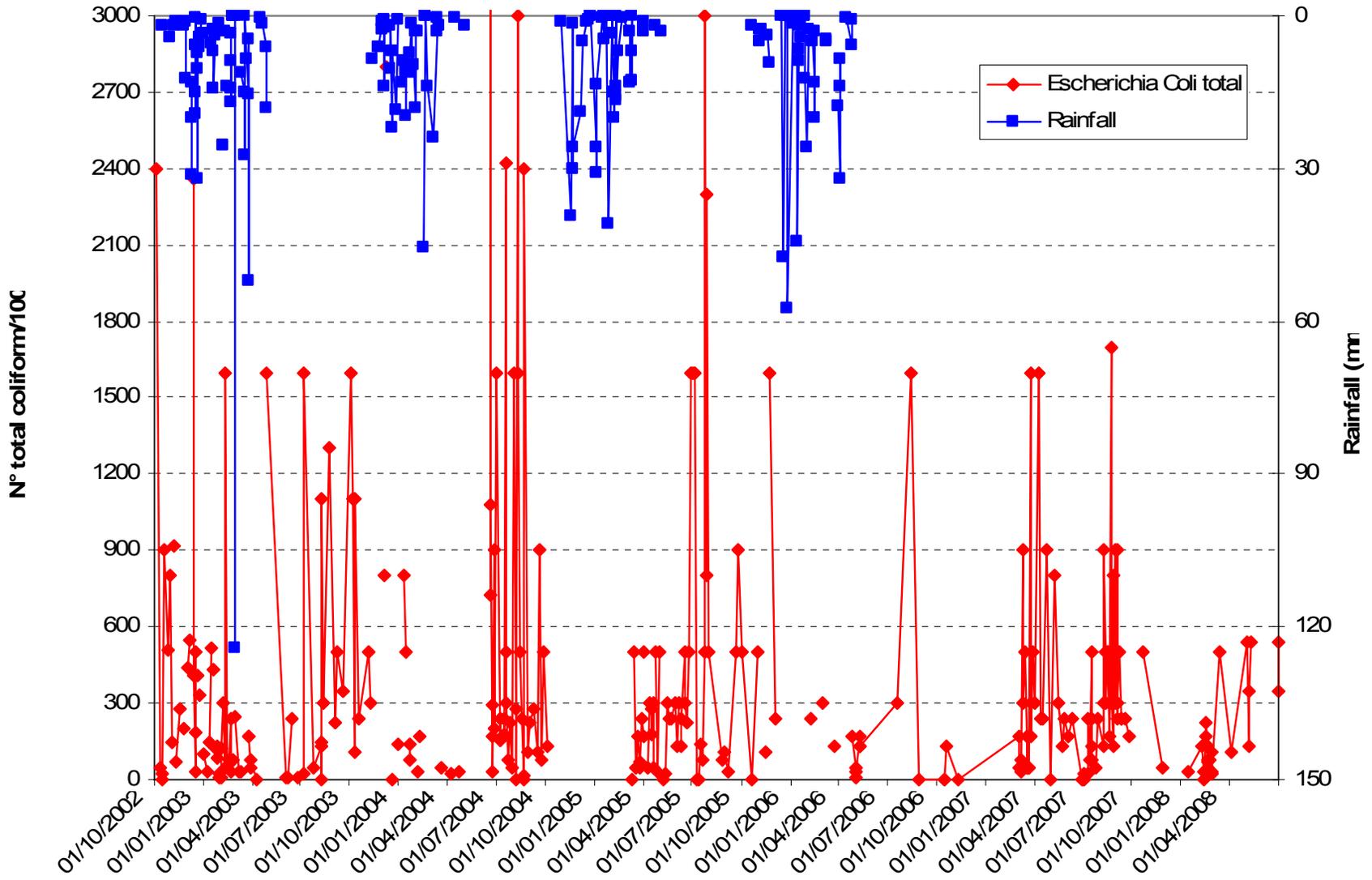


- Orchards
- Agriculture
- Excavation
- Waste Disposal
- ▨ Town
- Baqqouria



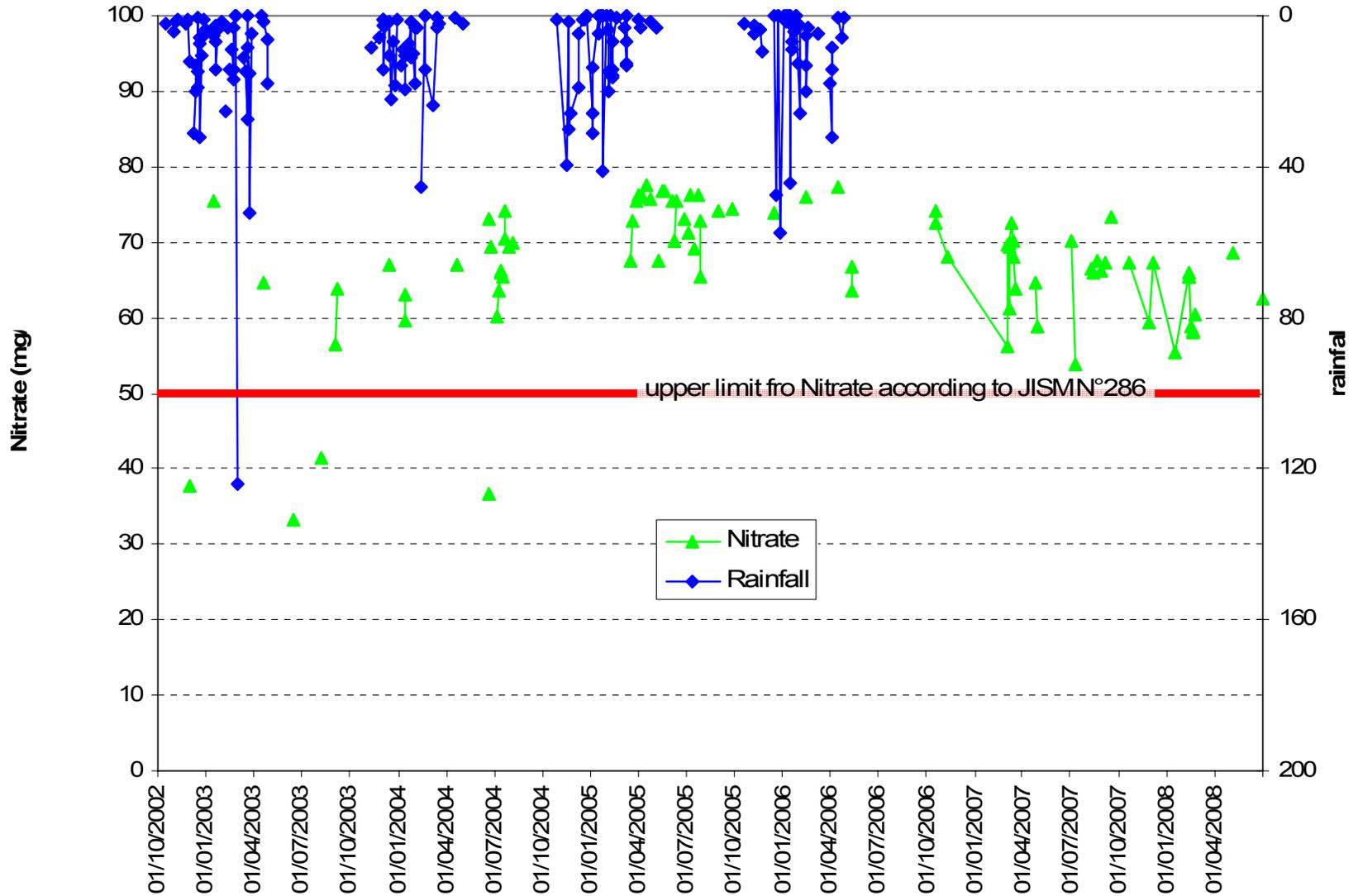
# Water Quality of the Wadi Shueib Springs

AM0512 - Ain Hazzir



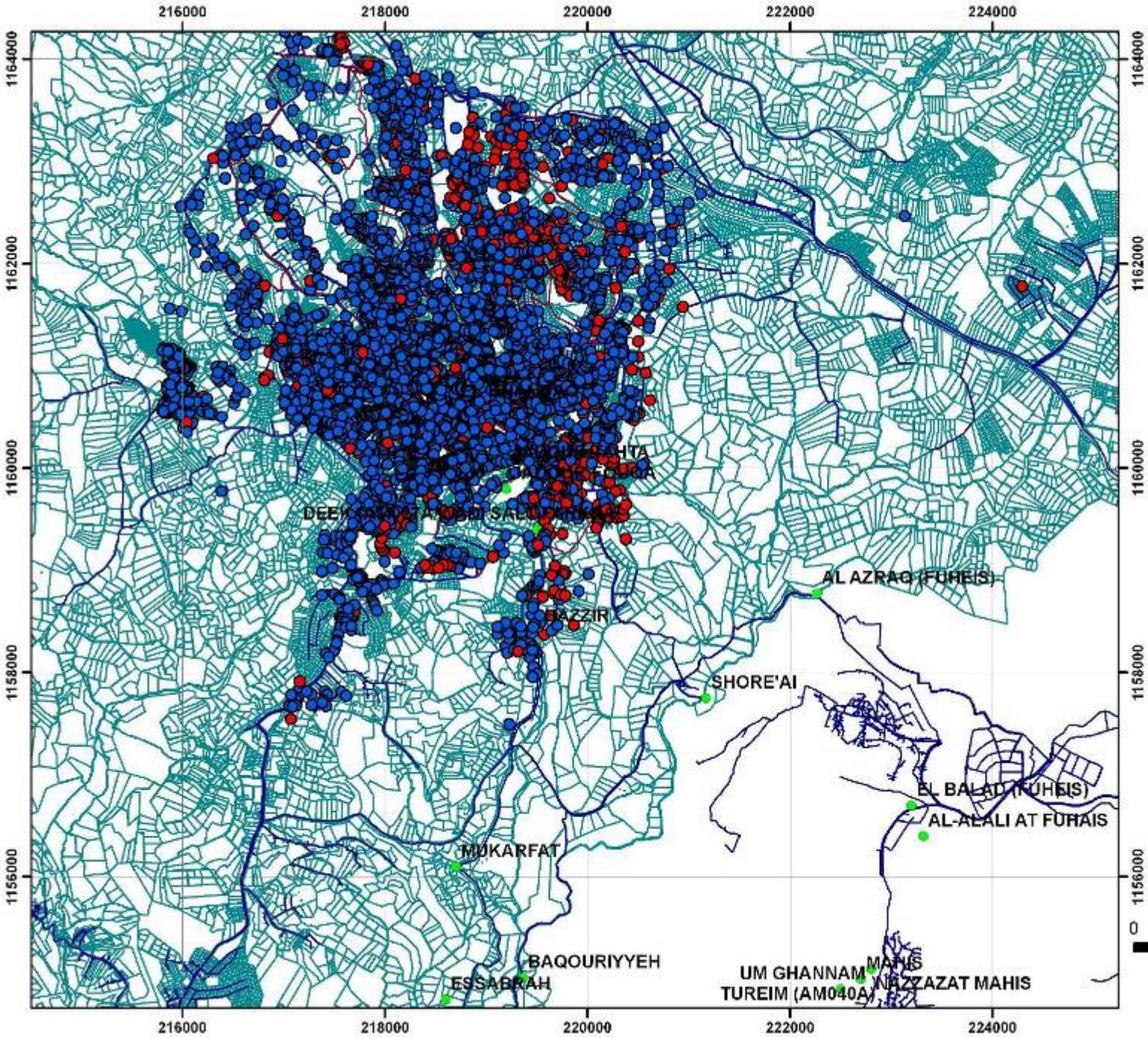
# Water Quality of the Wadi Shueib Springs

AM0512 - Ain Hazzir



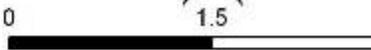
Tab. 16: Sewer connection within the study area [Data available from Dorsch Consultant, 2007].

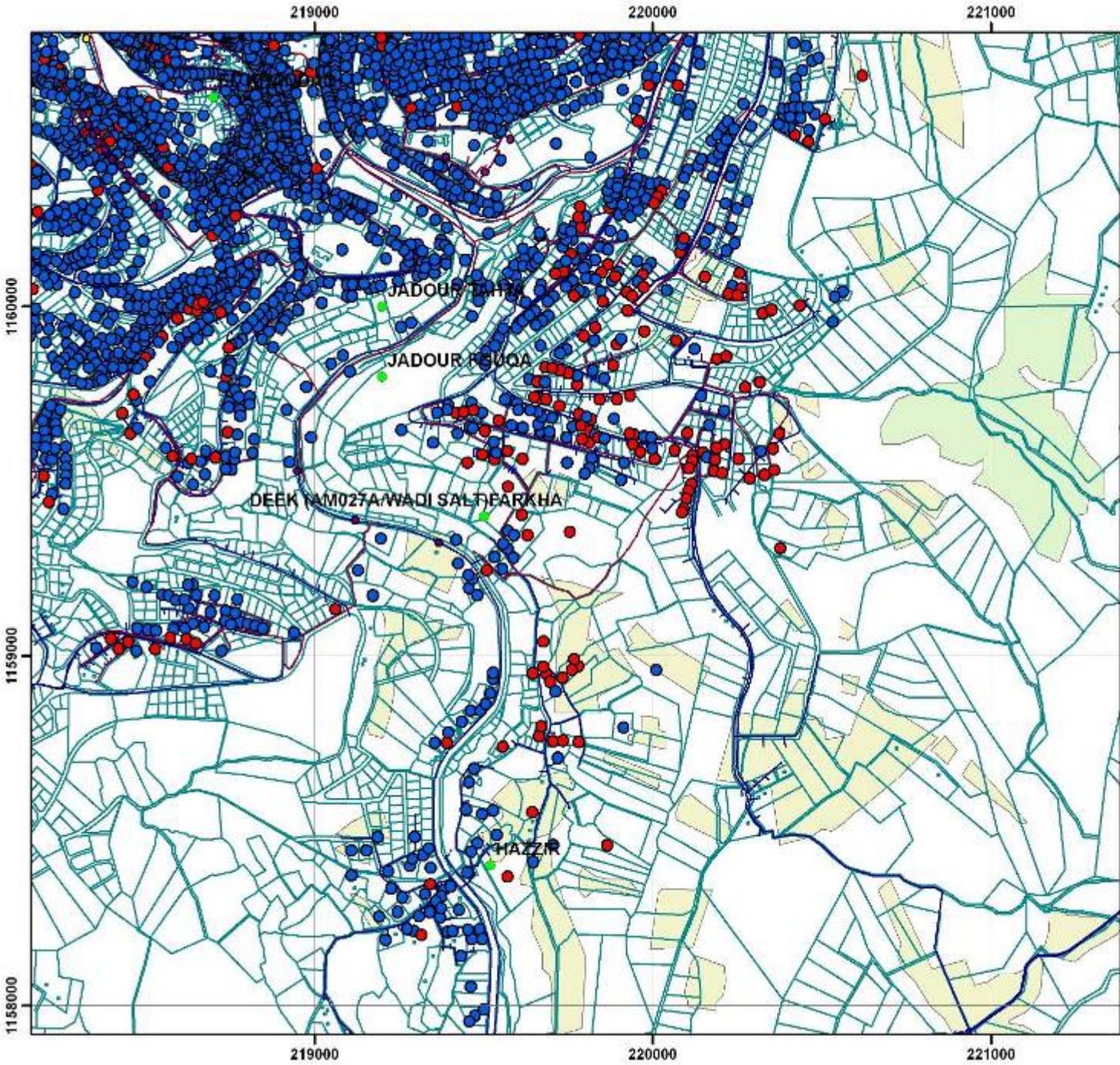
Area	Total Persons	Total Persons with Sewer	Total Persons with No Sewer	Percent of Persons with No Sewer
Al Fuhays	4657	3640	1017	22 %
Mahis	6198	4132	2066	33 %
As Salt	30559	24907	5652	19 %
Watershed	67632	54267	13456	20 %



**Legend**  
**Sewage System / Existing Manholes**

- N
- Y
- Springs
- Salt\_Sewer\_HC
- Salt\_Sewer\_Lines
- pressurizedmain
- lot\_line

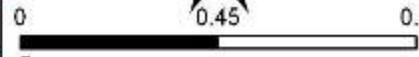




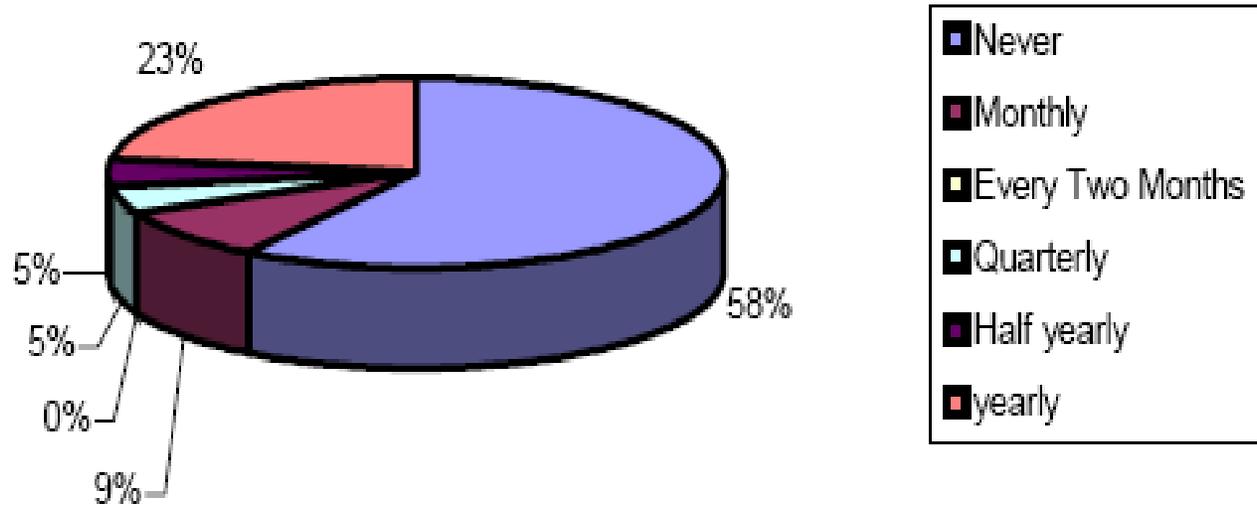
### Legend

#### Sewage System / Existing Manholes

- N
- Y
- Springs
- Salt\_Sewer\_HC
- Salt\_Sewer\_Lines
- pressurizedmain
- Animal Barn
- Transformer Station
- Slaughter House
- Locksmithery
- Hospital
- Green House
- Graveyard
- Gas Station
- Chicken Farm
- Cement Factory
- Carpenter
- Car Works



How often do you need to empty your waste-water tank?(Salt)



- **Sewage System**
- **Agricultural activity**

### **Planned activities:**

- **Tracer tests in cooperation with SMART-project**
- **Detailed chemical analyses**



**Delineation of the protection zones**  
**Recommendation for the implementation**

**Implementation of the different protection zones**

- **Erecting signposts for zone 1 and 2**
- **Developing monitoring schedule for water quality**
- **Developing monitoring schedule for the supervision of possible hazards activities in zone 2 and 3 (environmental rangers)**

**Information and awareness campaigns within the population and the concerned authorities**



# منطقة الحماية الأولى لمصادر المياه

( أنت الآن في منطقة الحماية الأولى )



## Signposts

لحماية مصادر المياه من التلوث يجب:



عدم  
إلقاء النفايات



حيوانات



# منطقة الحماية الثانية لمصادر المياه

( أنت الآن في منطقة الحماية الثانية )



لحماية مصادر المياه من التلوث يجب:



تلويث



عدم إلقاء النفايات الصلبة،  
والتخلص منها في

( )



تفريغ

الحضر الامتصاصية بانتظام  
والتخلص من الحمولة في

( )



عدم طرح

المشتقات البترولية والزيوت



عدم استخدام

المبيدات والأسمدة الكيماوية



لرجاء التبليغ عن أي من التجاوزات أعلاه أو أي أعمال قد تؤدي إلى تلويث

المياه والبيئة على رقم الخط الساخن للشرطة البيئية،

**Cooperation with the SMART-Research Project**  
**Development of a DSS including Groundwater Protection**  
→ Costs / benefits of rehabilitating the existing sewer system and/or connecting unconnected houses and/or installation of a decentralized waste water treatment system  
→ Costs / benefits for treatment of „polluted“ drinking water

**Rehabilitation of the existing sewer system and/or connecting unconnected houses with KfW fund for water resources protection**

**Continuing awareness campaigns within the population and the concerned authorities**



# *Thank you for your kind attention*

Technical Cooperation Project  
*Groundwater Resources Management*  
Ministry of Water and Irrigation  
P.O. Box 2412  
Amman 11183

Eng. Ali Subah  
[Ali\\_subah@mwi.gov.jo](mailto:Ali_subah@mwi.gov.jo)

Phone + 962 6 5685257  
Mobile + 962 777 /+962 79 6870085

Dr. Ariane Borgstedt  
[Ariane.Borgstedt@bgr.de](mailto:Ariane.Borgstedt@bgr.de)

