



Council for Development and Reconstruction (CDR)
Ministry of Energy and Water (MoEW)
Water Establishment Beirut and Mount Lebanon (WEBML)

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

German-Lebanese Technical Cooperation Project

Public Awareness Campaign for Schools Groundwater Protection

BGR
September 2012

Dr. Armin Margane, BGR



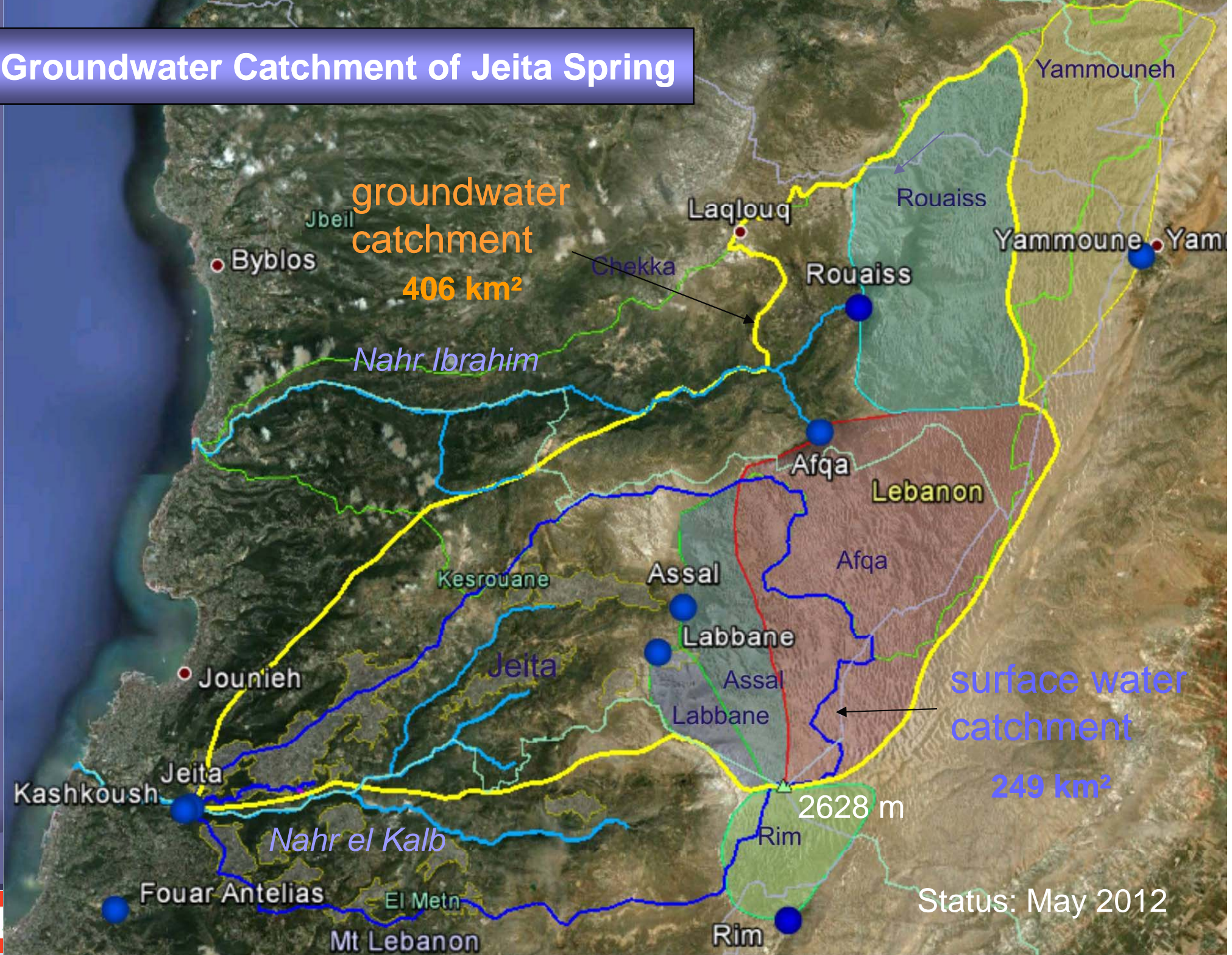
Groundwater Catchment of Jeita Spring

groundwater catchment
406 km²

surface water catchment
249 km²

2628 m

Status: May 2012



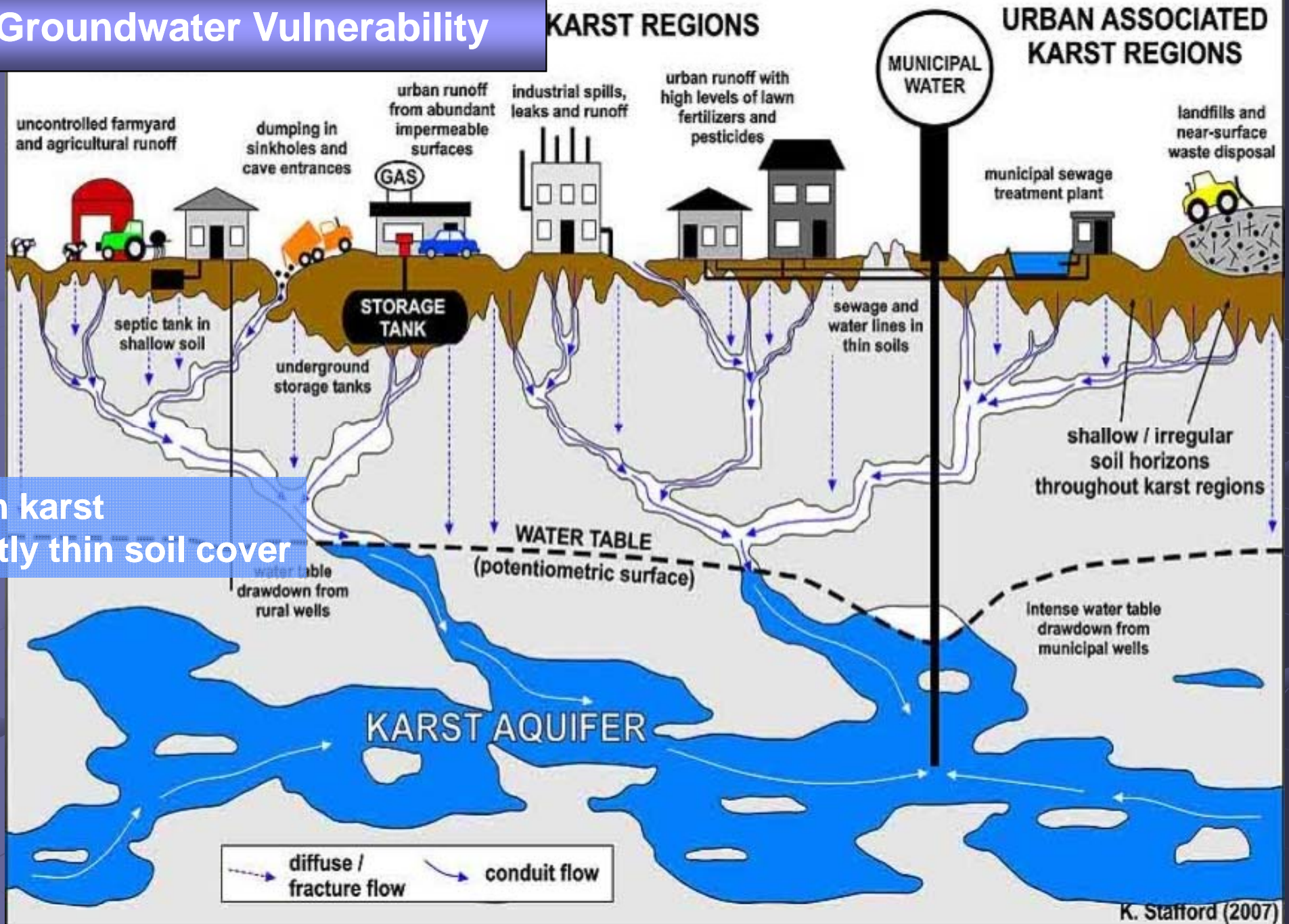
Groundwater Vulnerability

**High karstification in
Cretaceous limestone
(Faqra)**



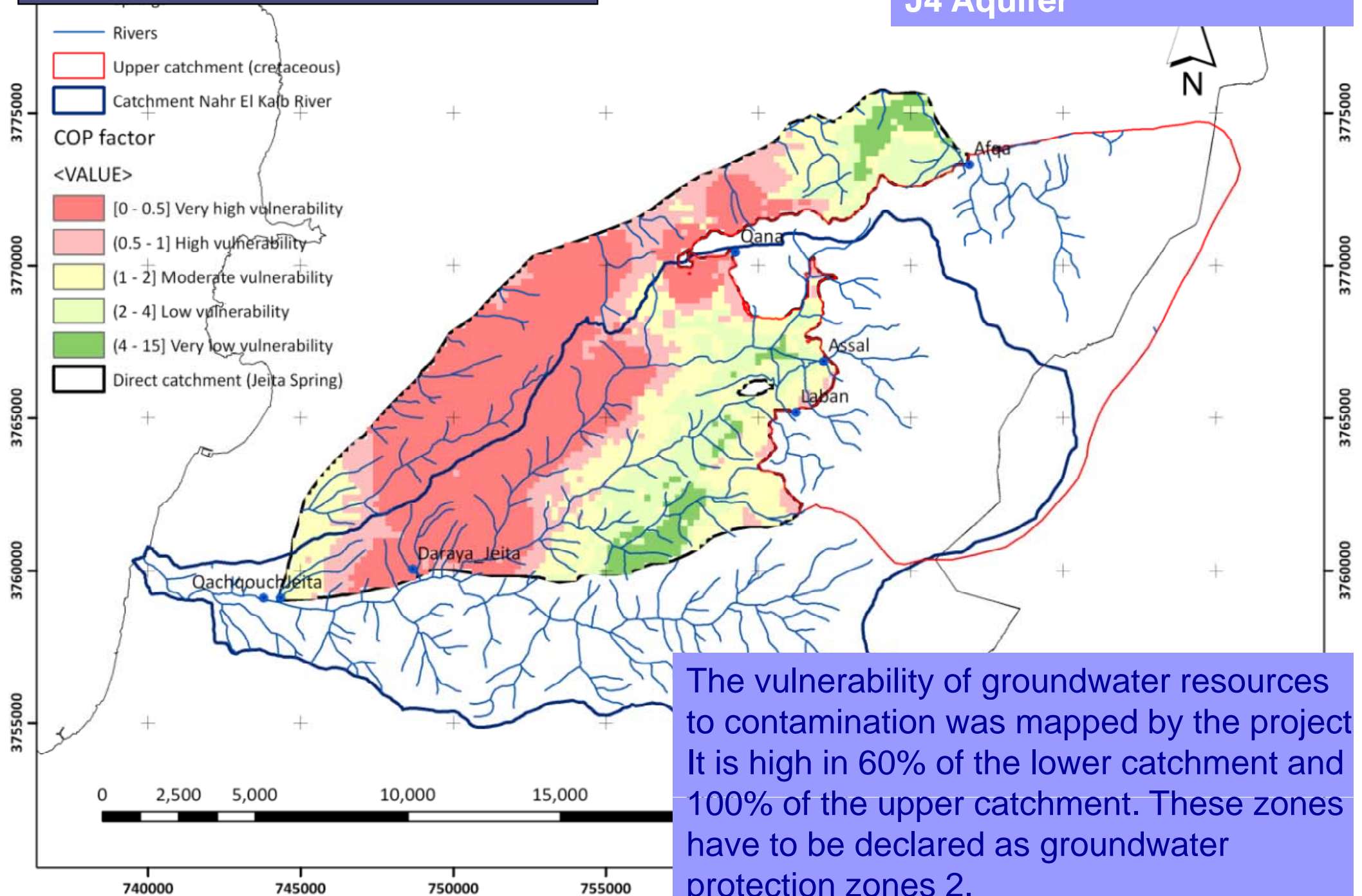
Groundwater Vulnerability

open karst
mostly thin soil cover



Groundwater Vulnerability

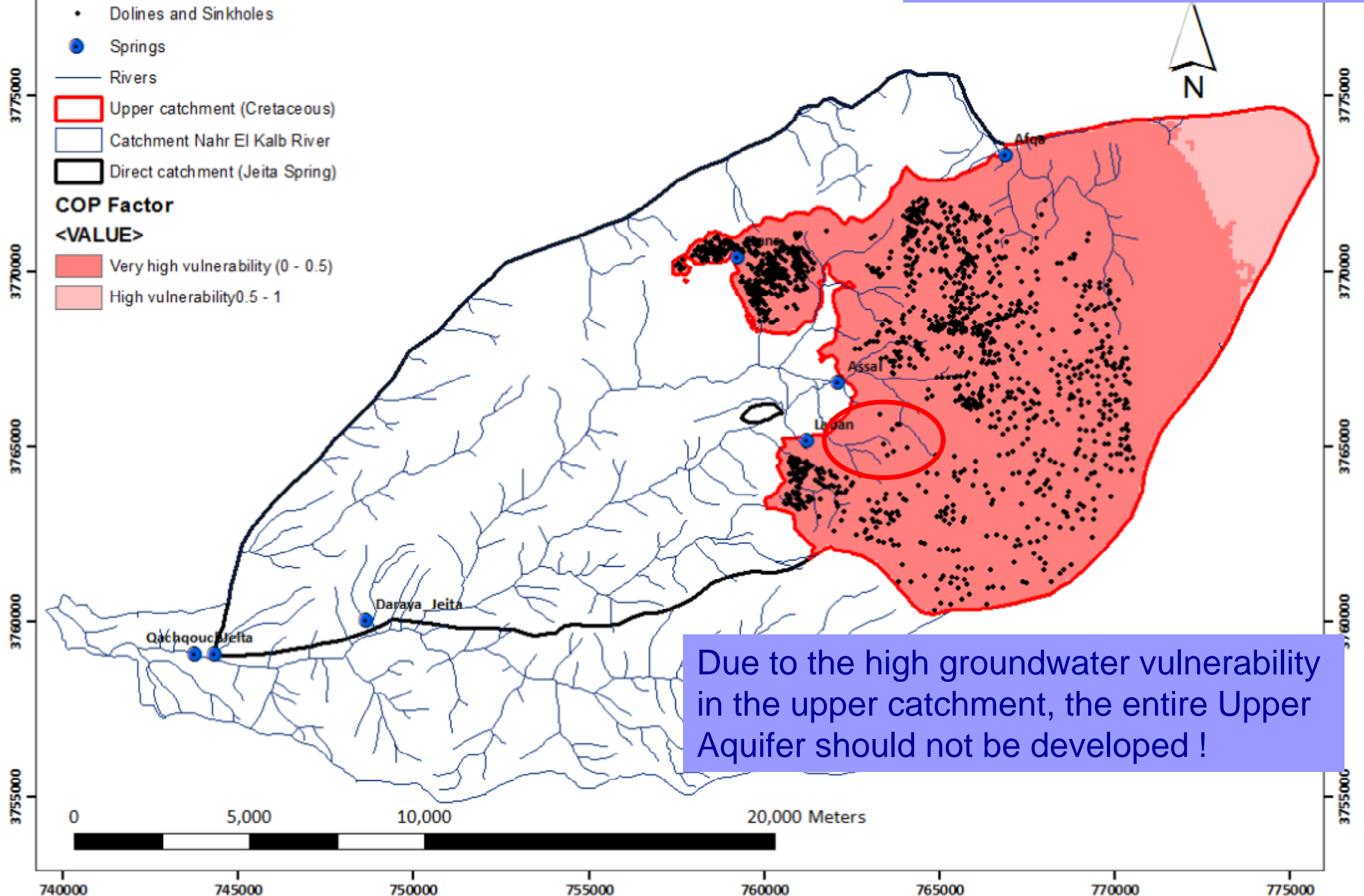
Groundwater Vulnerability Lower Catchment J4 Aquifer



The vulnerability of groundwater resources to contamination was mapped by the project. It is high in 60% of the lower catchment and 100% of the upper catchment. These zones have to be declared as groundwater protection zones 2.

Groundwater Vulnerability

Groundwater Vulnerability Upper Catchment C4 Aquifer



Due to the high groundwater vulnerability in the upper catchment, the entire Upper Aquifer should not be developed !

Groundwater Protection Measures

What needs to be done to protect the groundwater resources ?

- An **inventory of groundwater hazards** helps to identify the pollution sources
- A **risk assessment** for critical pollution sources must be done
- The raw water quality must be controlled to find out whether there is an impact from the pollution source
- A **clean-up operation (land reclamation)** may be necessary, if technically and financially feasible
- Contaminants from pollution sources must be collected and treated (**wastewater, waste, hazardous substances**)
- **Groundwater protection zones** must be established and the related landuse restrictions be implemented and enforced. In protection zones certain landuses and practices are not allowed (new landuse licensing requests)



Groundwater Hazards Inventory

Solid Waste Disposal Name	
Database ID	
GIS ID	
Location (Lat / Long / Alt)	
Description of location:	
Owner:	
Operated since:	
Date closed:	
Estimated lifetime of operation (years):	
Capacity:	
Legal status:	Yes / no
Topographic condition:	Non-sloping terrain: Slope 0-5° Slope > 5°
Distance from village/residential area:	
Distance to airport < 5 km:	Yes / no
Distance to water sources:	Springs Wells Dams Canals / use
Distance to other critical point (school, public place, army):	
Depth to groundwater:	
Natural protection of aquifer:	
Type of disposal:	No preparation of land surface Excavated ponds
Number of basins:	
Geological barrier	Yes / no
Technical barrier	Yes / no
Waste compaction:	Yes / no
Drainage collection	Yes / no
On-site drainage treatment	Yes / no / where:
Gas collection wells:	Yes / no
Waste management	
Waste recycling:	Yes / no
Access restricted and controlled:	Yes / no
Controlled dumping	Yes / no
Dumping of different	Yes / no

Groundwater Hazards Inventory

All point and non-point pollution sources must be visited in order to assess the pollution risk. The critical sites must be described as good as possible using a standard formsheet.

Uncontrolled illegal dumping near Mar Roukoz school



Groundwater Hazards Inventory

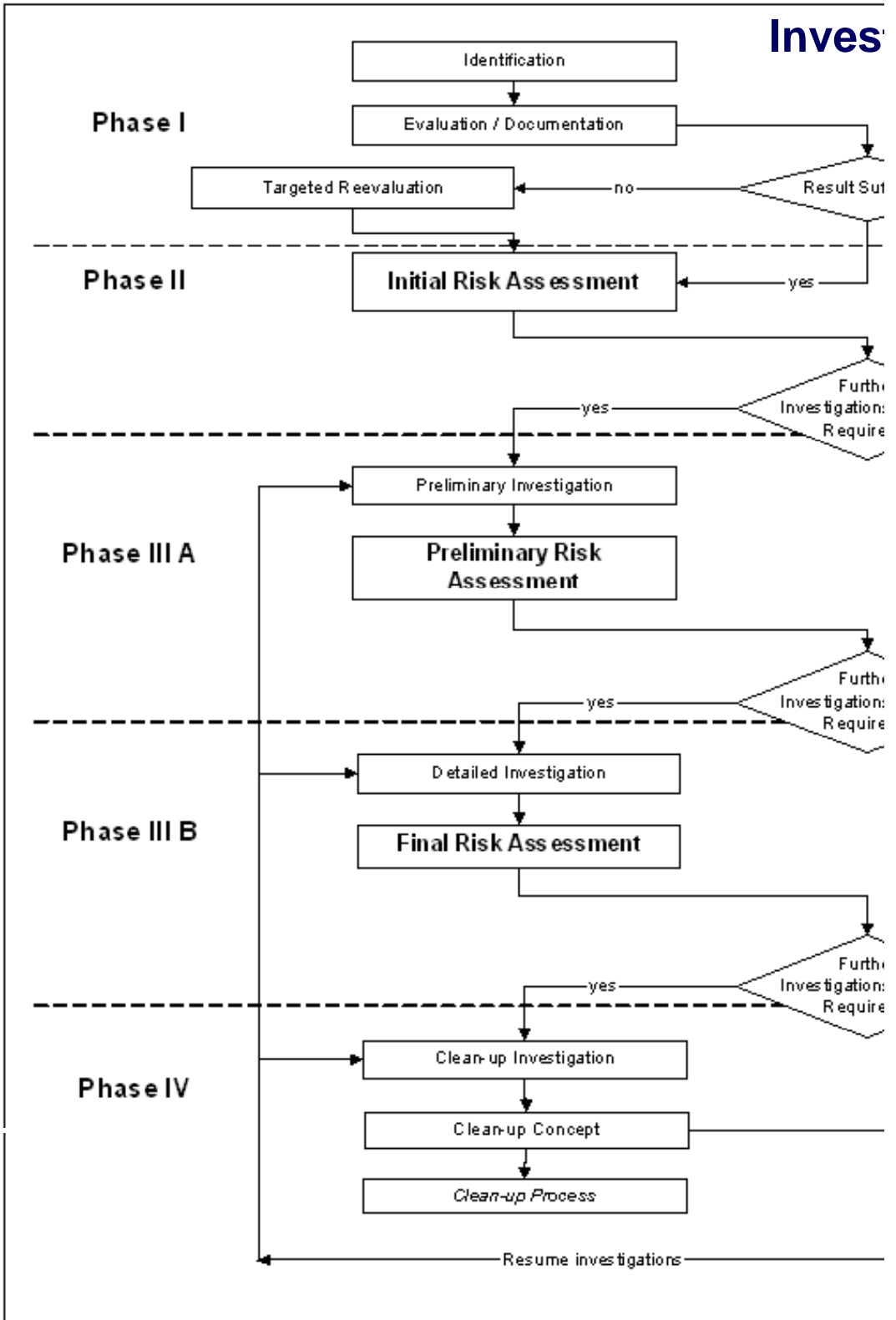
Important Groundwater Hazards

Wastewater (cesspits, untreated/treated)	point source– non-point source
Storage & Handling of Hazardous Substances (gas stations, generators)	point source
Mineral Extraction & Processing (quarries)	point source – non-point source
Waste Disposal	point source
Industry (spills, wastewater)	point source
Agriculture (fertilizers, pesticides) ➤ irrigation return flow	non-point source
Commercial Buildings (spills, wastewater)	point source



Risk Assessment

1. Identification of hazards and possible associated substances.
2. Determination of the likelihood of a release of these substances.
3. Determination of the possible points of release of the substances
4. Evaluation of the toxicity of the used substances to human health
5. Determination of the possible pathways of pollution.
6. If a contamination has occurred already, what are the remediation goals.
7. Determination of the “value” of the protection target and the remediation feasibility.
8. Evaluation of the costs for remediation.
9. Decision to protect/ remediate a resource/source or not (definition of goal)



Clean-up of Contaminated Sites

The experiences in Germany and the US with clean-up of contaminated sites have shown that costs for investigations and clean-up are extremely high.

Once polluted contaminated sites are difficult and expensive to clean up. In a karst system with an unsaturated zone of several 100 m (up to ~ 700 m) clean-up is mission impossible.

Therefore it is important to prevent contamination by implementing landuse restrictions.



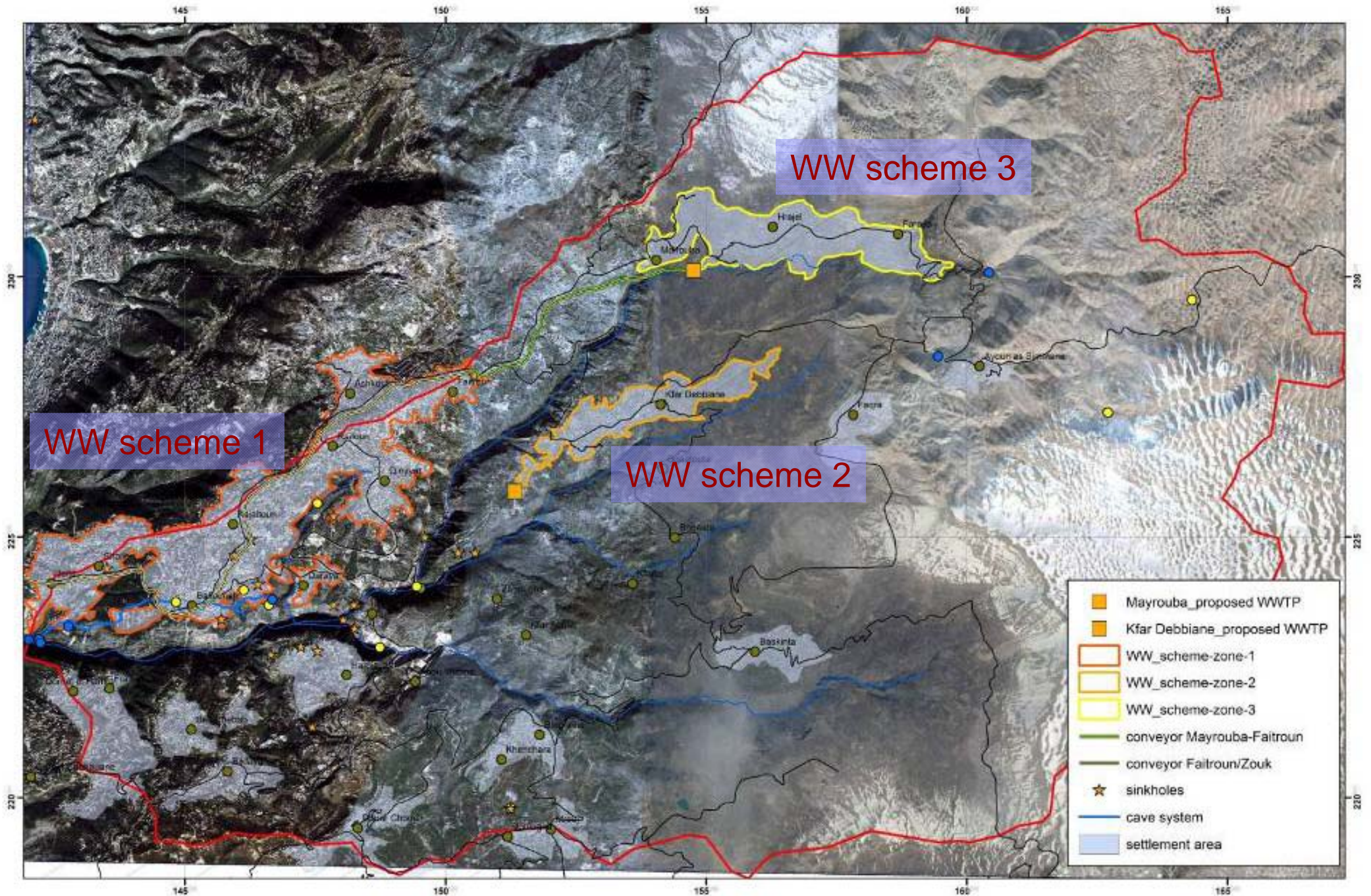
Wastewater Management

In order to establish a wastewater scheme (collection & treatment),

- a **Wastewater Master Plan** (WMP) has to be developed. This WMP defines the target for a specific planning horizon (e.g. 25 years), i.e. what must principally be done to cover a certain area with adequate collection and treatment facilities. The WMP proposes several individual wastewater schemes. It includes a rough estimation of costs.
- An **initial site investigation** for the proposed wastewater treatment plants (WWTP) has to be conducted to determine their suitability (draft environmental impact assessment (EIA), especially on water resources). Based on this draft EIA an update of the WMP is done.
- The agencies responsible for planning in the wastewater sector (here: CDR, MoEW), according to the available funds, define which wastewater schemes will be implemented, what are the exact boundaries of these schemes and what is the time line for implementation.
- The **municipalities** involved in the proposed wastewater schemes **have to agree** to the planned wastewater facilities.
- Tender documents are prepared and a consultant is contracted to build the wastewater scheme.
- The EIA for the scheme is prepared by the consultant and discussed with all stakeholders (public participation)
- The wastewater facilities are built and transferred to the agency operating it (WEBML)



Proposed Wastewater Schemes



Waste Management

- **Waste Disposal:** waste should not be dumped "at" (=in) the sea.
- **Waste separation** helps to reduce and recycle waste (paper, metal, glass, plastic).
- **Collection points** for separated waste and hazardous waste (paint, batteries, expired drugs, tyres, ...) should be established at central places in the catchment. (e.g. Jeita, Ballouneh, Faitroun, Kfar Debbiane, Mayrouba).
- Sites for dumping of **construction waste** should be established at different points in the catchment (e.g. abandoned quarries). It must be ensured that only construction waste is dumped there.
- **Industrial/hospital waste** collection must be improved



waste glass collection



paper, plastic, metal collection



Hazardous Substances

Hazardous substances are generated in the Jeita GW catchment from:

- industries (e.g. galvanizing fluids)
- gas stations (leaking e.g. fuel tanks, fuel/oil spills, car wash)
- commercial businesses (e.g. dry cleans, gas stations, car repair workshops)
- hospitals (radioactive substances/x-ray, infectious waste, drugs)
- quarries (fuel/oil leaks/spills)

Often the collection system for generated hazardous waste is inadequate.

It must be improved and the implementation of pollution avoidance measures must be controlled.



Groundwater protection zones define areas where certain landuses are not allowed in order to avoid groundwater contamination

The dimensioning of the protection zones has to be done very carefully in order to balance the competing interests:

- as large as necessary for safeguarding the water supply,
- as small as possible for avoiding inadequate restrictions.

Jordanian Guideline 2006 (similar in Syria)

Zone I - Immediate Protection Zone

Protects the wells and their immediate environment from any contamination and interference. No access for the public allowed.

Zone II - Inner Protection Zone (50 days line)

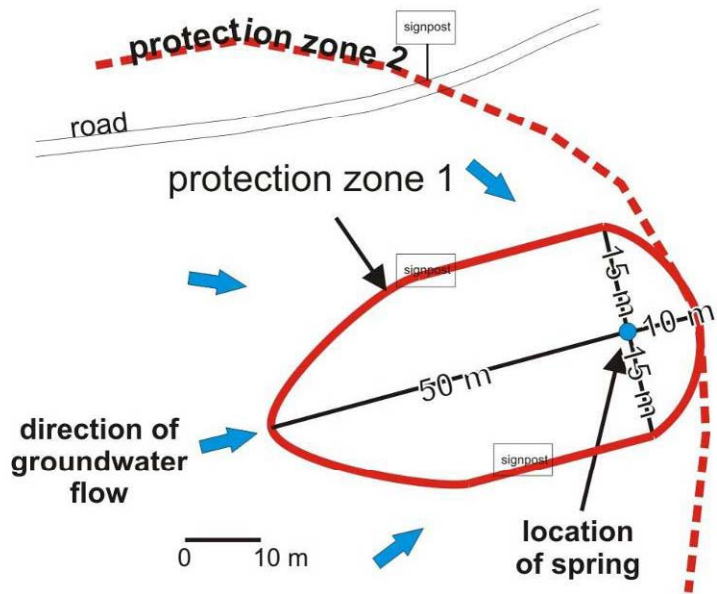
Protection against pathogenic micro-biological constituents such as bacteria, viruses, parasites and worm eggs.

Zone III - Outer (Wider) Protection Zone

Protection from contamination affecting water over long distances such as contamination by chemicals which are non- or hardly degradable.



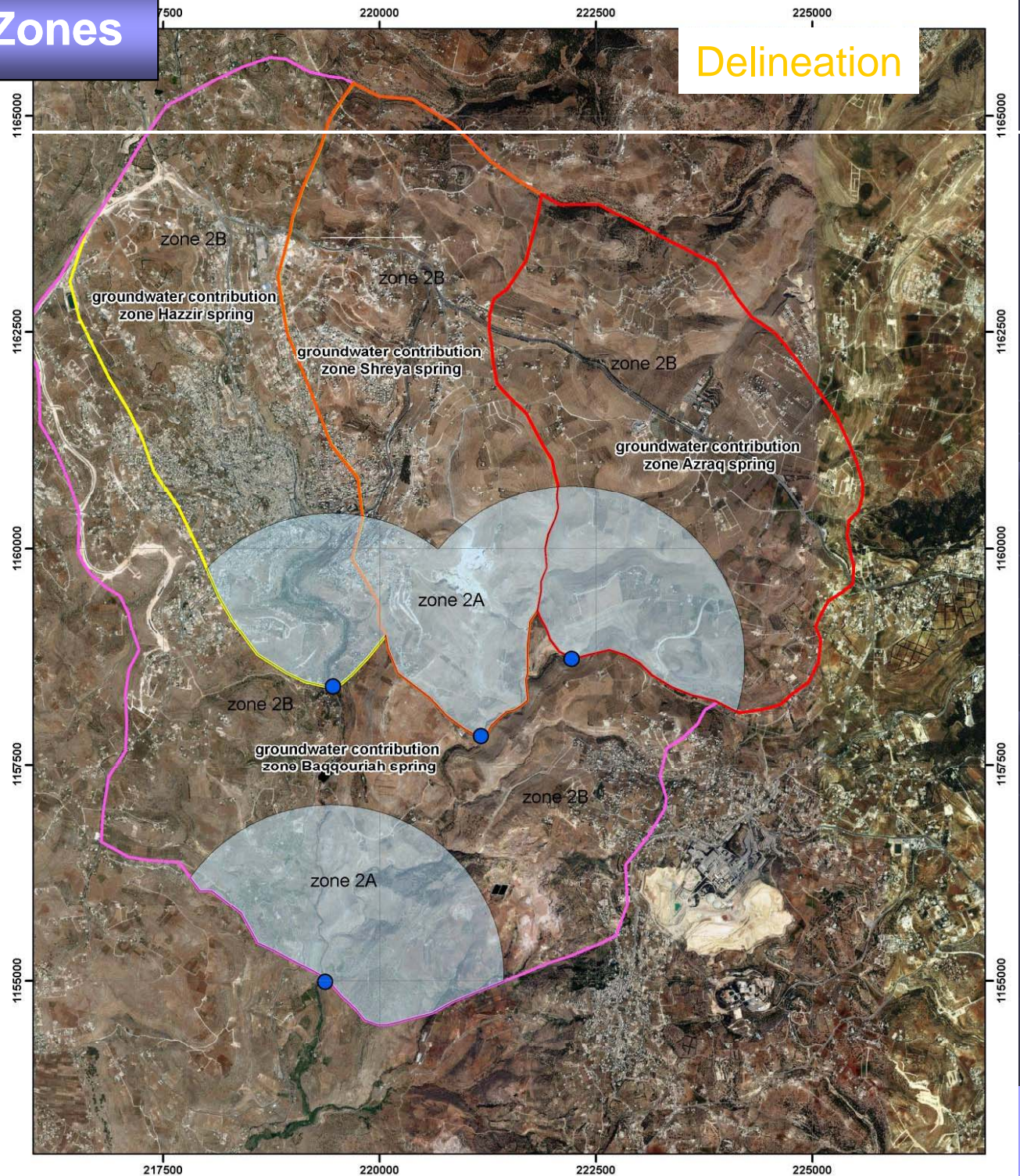
Groundwater Protection Zones



Example of groundwater protection zones from Jordan (Wadi Shuayb; MARGANE et al., 2010)



P



Groundwater Protection Zones

Implementation

Awareness campaigns

Boundaries of GW protection zones
have to be clearly marked **Zone I**

Control mechanism
(environmental rangers)

Zone II

منطقة الحماية الأولى لمصادر المياه
(أنت الآن في منطقة الحماية الأولى)

لحماية مصادر المياه من التلوث يجب:

-  **عدم إلقاء النفايات**
-  **عدم الرعي وسقاية الحيوانات**
-  **عدم تجاوز هذا السياج**

الرجاء التبليغ عن أي من التجاوزات أعلاه أو أي أعمال قد تؤدي الى تلويث المياه والبيئة على رقم الخط الساخن للشرطة البيئية:

USAID BGR

منطقة الحماية الثانية لمصادر المياه
(أنت الآن في منطقة الحماية الثانية)

لحماية مصادر المياه من التلوث يجب:

-  **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**

الرجاء التبليغ عن أي من التجاوزات أعلاه أو أي أعمال قد تؤدي الى تلويث المياه والبيئة على رقم الخط الساخن للشرطة البيئية:

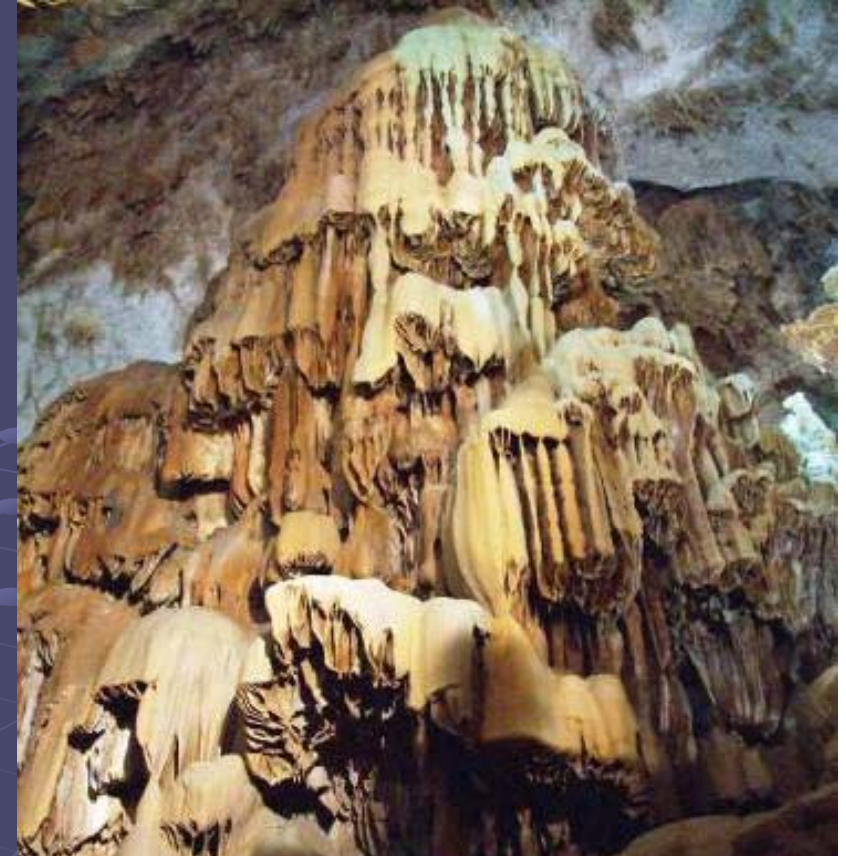
USAID BGR



*Thank you for your
kind attention*

www.bgr.bund.de/jeita

Dr. Armin Margane – Project Team Leader
Raifoun, Saint Roche Street
armin.margane@bgr.de +961 70 398027



Protection of Jeita Spring

