THE HASHEMITE KINGDOM OF JORDAN

Ministry of Water and Irrigation

Jordan Valley Authority

ENG.HESHAM AL-HESA

His Majesty speech:

“Our water situation is a strategic challenge which can not be ignored, and we have to make balance between the domestic, industrial and agricultural needs, while keeping the domestic water issue the fundamental and most important.”

King Abdullah II Ibn Al-Hussein

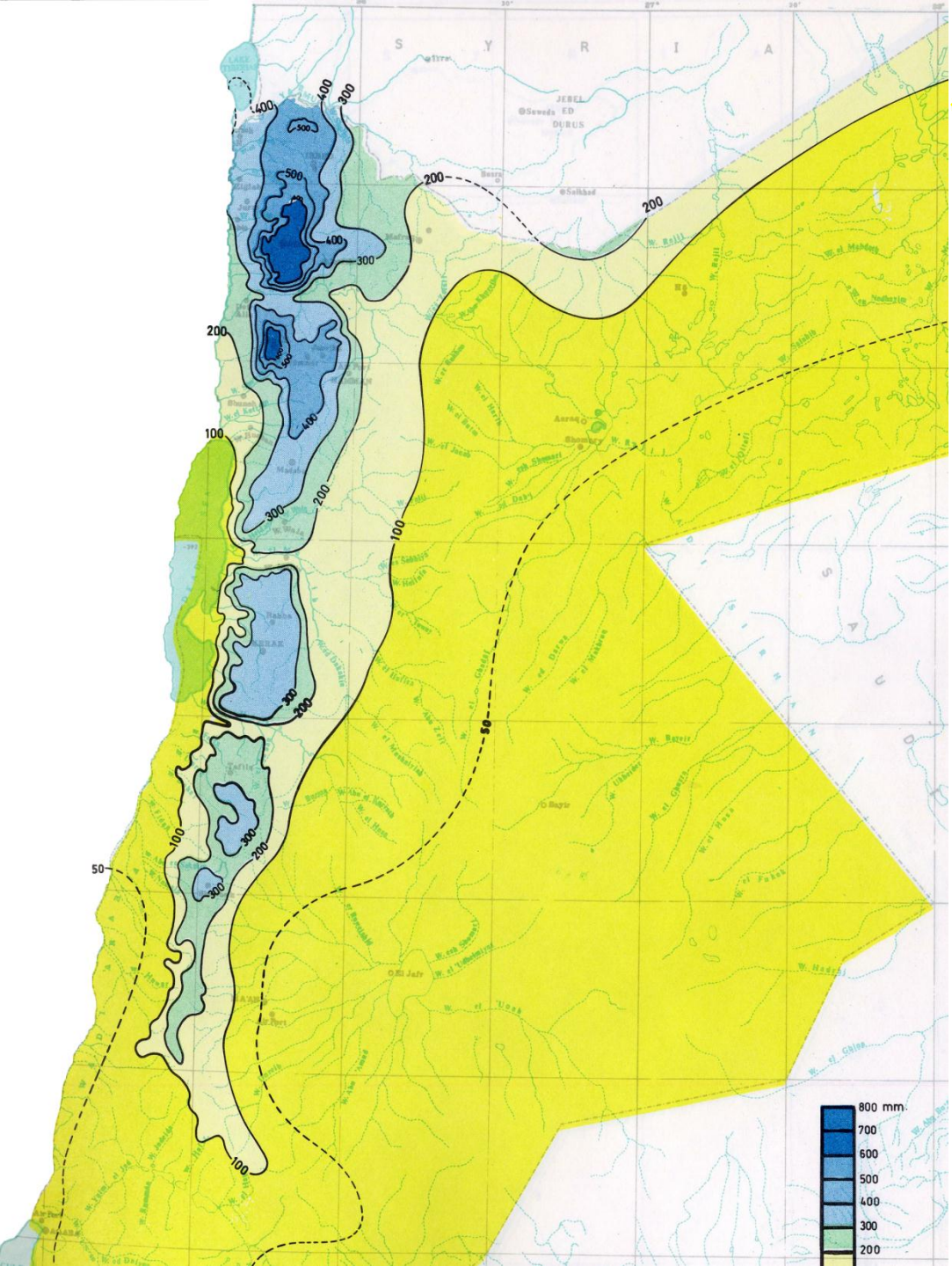
Background

Jordan is a semi arid country located in the east of the Mediterranean. Bordered by Syria to the north, Saudi Arabia to the south. Iraq and Saudi Arabia to the east' and Palestine and Israel to the west.

Area: 89400 Km2

Population:6 million

Population growth:2.84%



Average Annual Rainfal

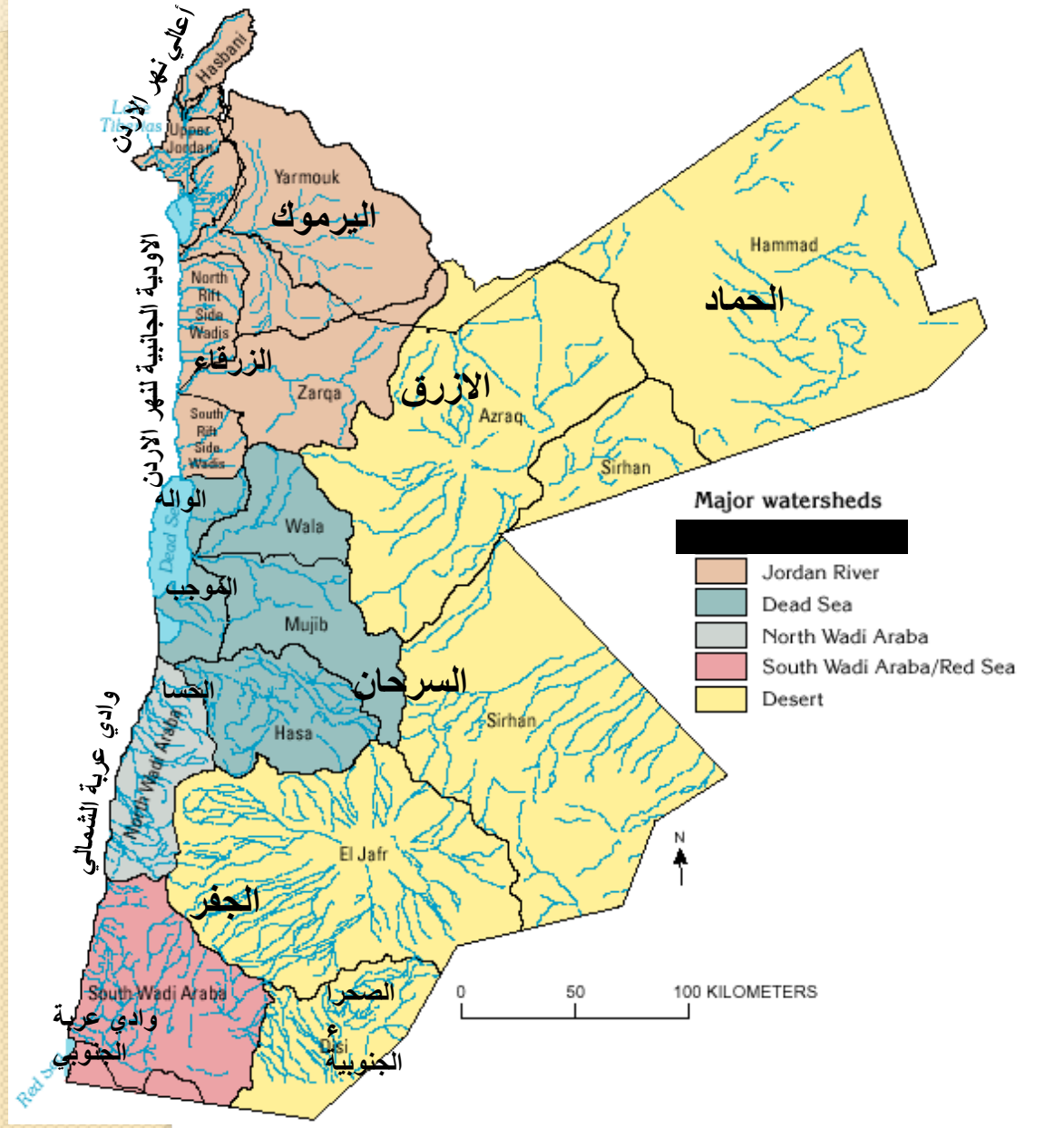
- **Jordan Valley**
  50-300 mm (5.7%)
- **High Land**
  400 – 580 mm (2.9%)
- **Desert Area (Badia)**
  50 – 200 mm (91.4%)

Annual quantities (MCM):

- Wet Years 11000
- Dry years 5800
- Annual average 8300

What is used from these quantities as surface and ground water is 8%

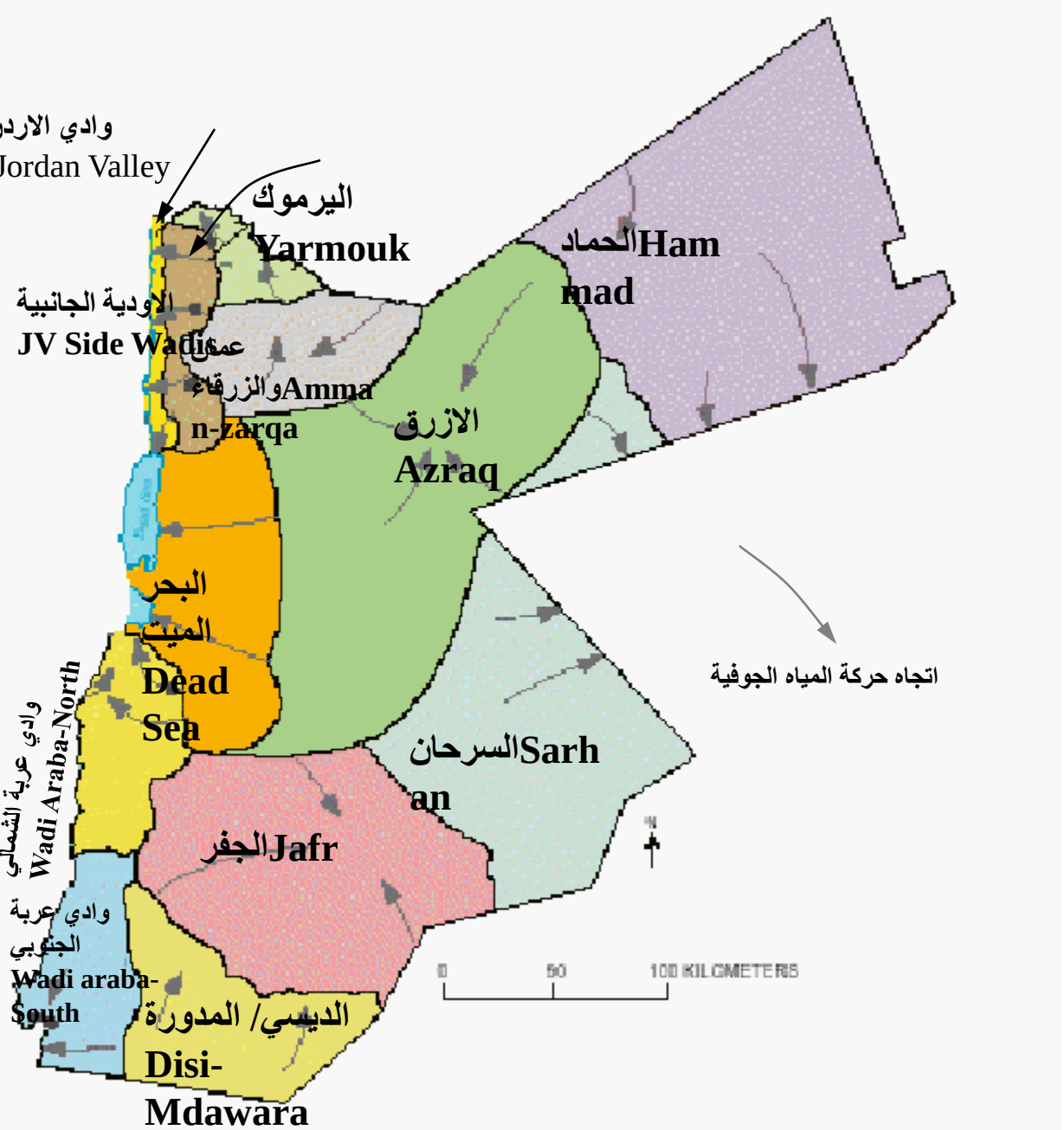
Surface Water Basins



Annual Discharge MCM	Basin
166	1) Yarmouk*
84	2) Zarqa
58	3) Northern Side wadis
58	4 Southern Side Wadis
8	5) Jordan Valley
102	6) Mujib & Wala
43	7) Dead Sea Side Wadis
43	8) Hasa
41	9) Azraq
24	10) Hammad
18	11) Sarhan
13	12) Jafr
1	13) Southern Desert
46	14) Wadi Araba - North
8	15) Wadi Araba - South
713	Total

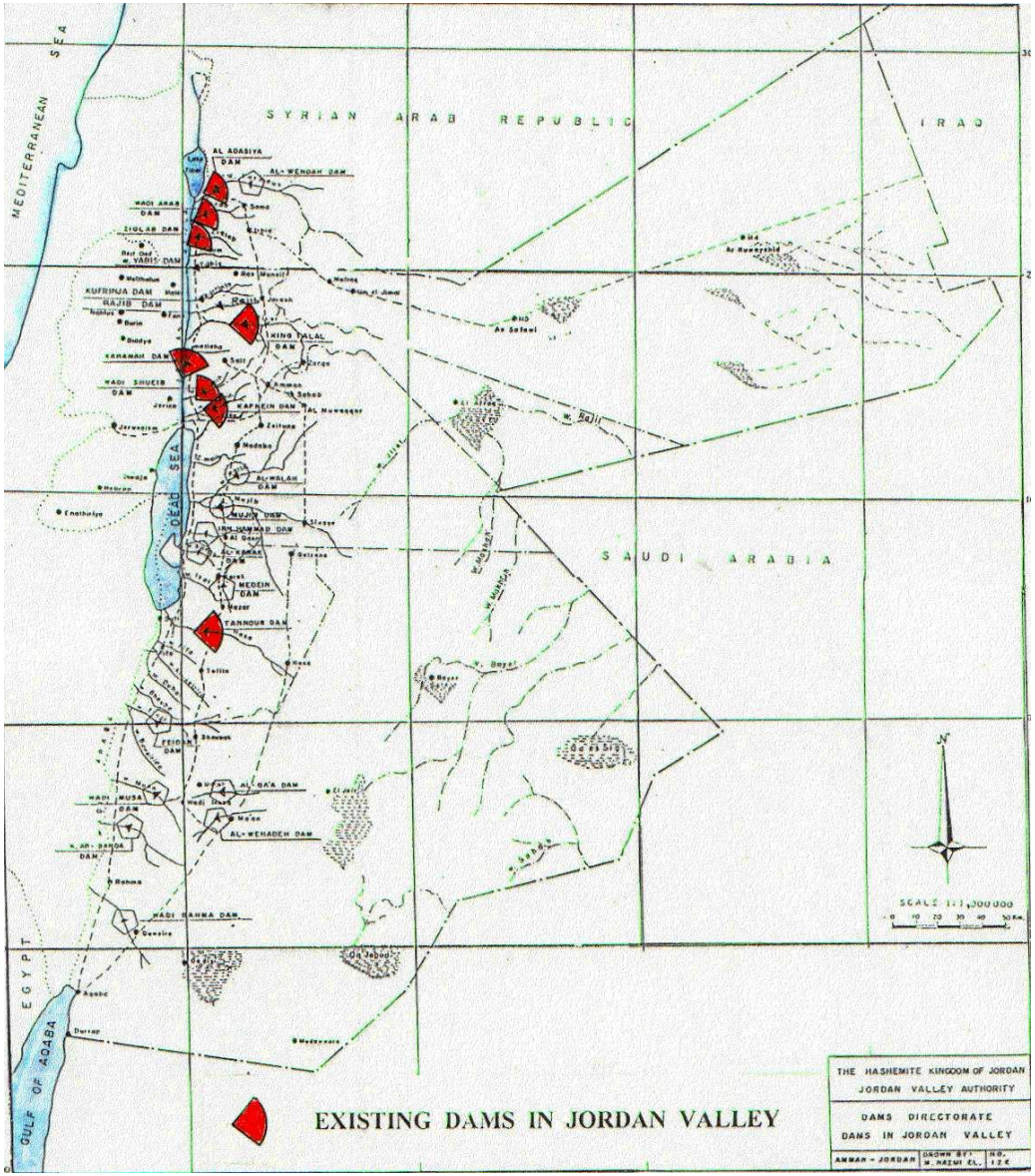
* Jordan share after the construction of Wehda dam + storage in Lake Tiberias

Ground Water Basins



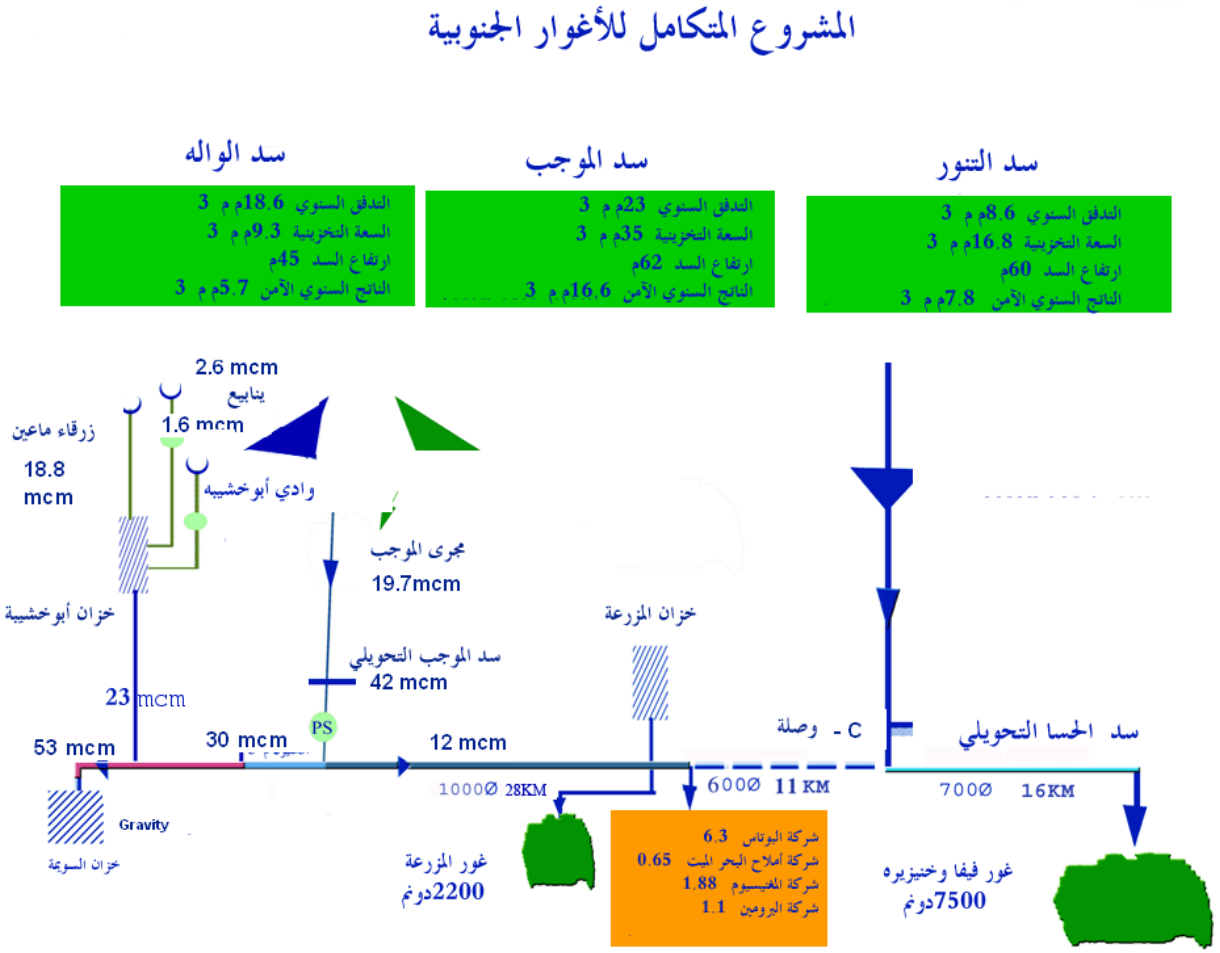
Safe Yield MCM/yr	Aquifer
60-70	1) Amman-zarqa
30-35	2) Azraq
30-35	3) Yarmouk
28-32	4) Jordan River Side Wadis
15-20	5) Jordan River
40-50	6) Dead Sea
11-12	7) Hammad
7-10	8) Sarhan
7-10	9) Jafr
2-3	10) Disi / Mdawara
5-7	11) Wadi Araba / North
4-6	12) Wadi Araba / South
240-294	Total

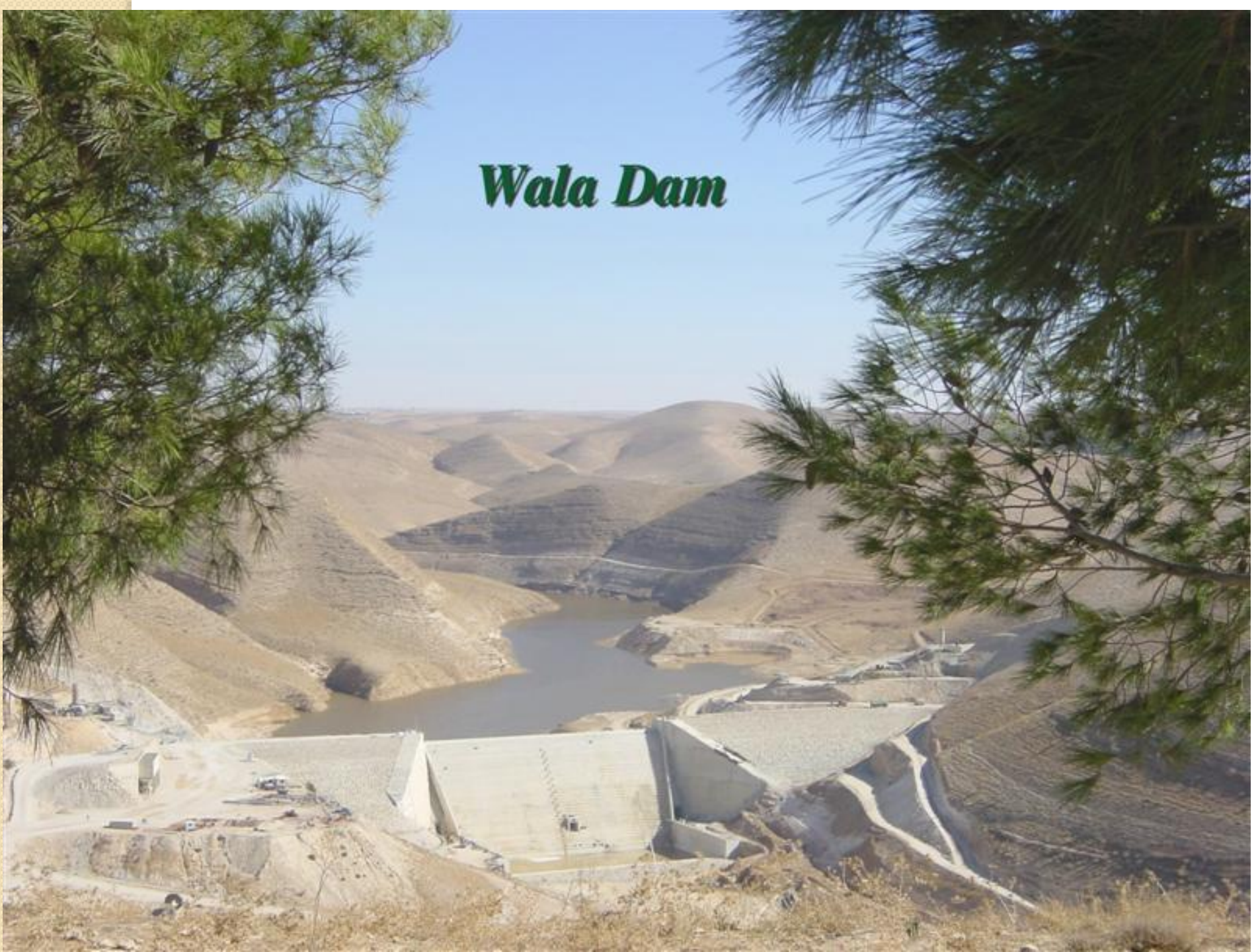
Location of Existing Dams



Integrated project of Mujib and Southern Ghors

Goals for irrigation, drinking and Industry




Wala Dam

General Information

Location : Madab Governate

River / Wadi: Wadi Wala

Contributory Area: 1,770 Km^2

Start of Operation : 2003

Construction Cost : 25 Million J.D.

Dam Type : RCC & Earth Fill

Purpose : Irrigation, Municipal & Industrial and Recharge

DIMENSIONS :

Height	Length at Crest	Width at Crest	Body Volume
45 m	480 m	9 m	0.205 MCM RCC 7.0 MCM Fill

CAPACITY: (MCM)

Total	Dead	Life
9.3	2	7.3

Res. Area
0.86 Km^2

- **Location:**

Al Wala dam is located at about 40 km south of Amman city at Wadi AL Wala near to Kings High way, the construction started in 1999 and completed in 2002 and the impoundment started in 30/10/2002.

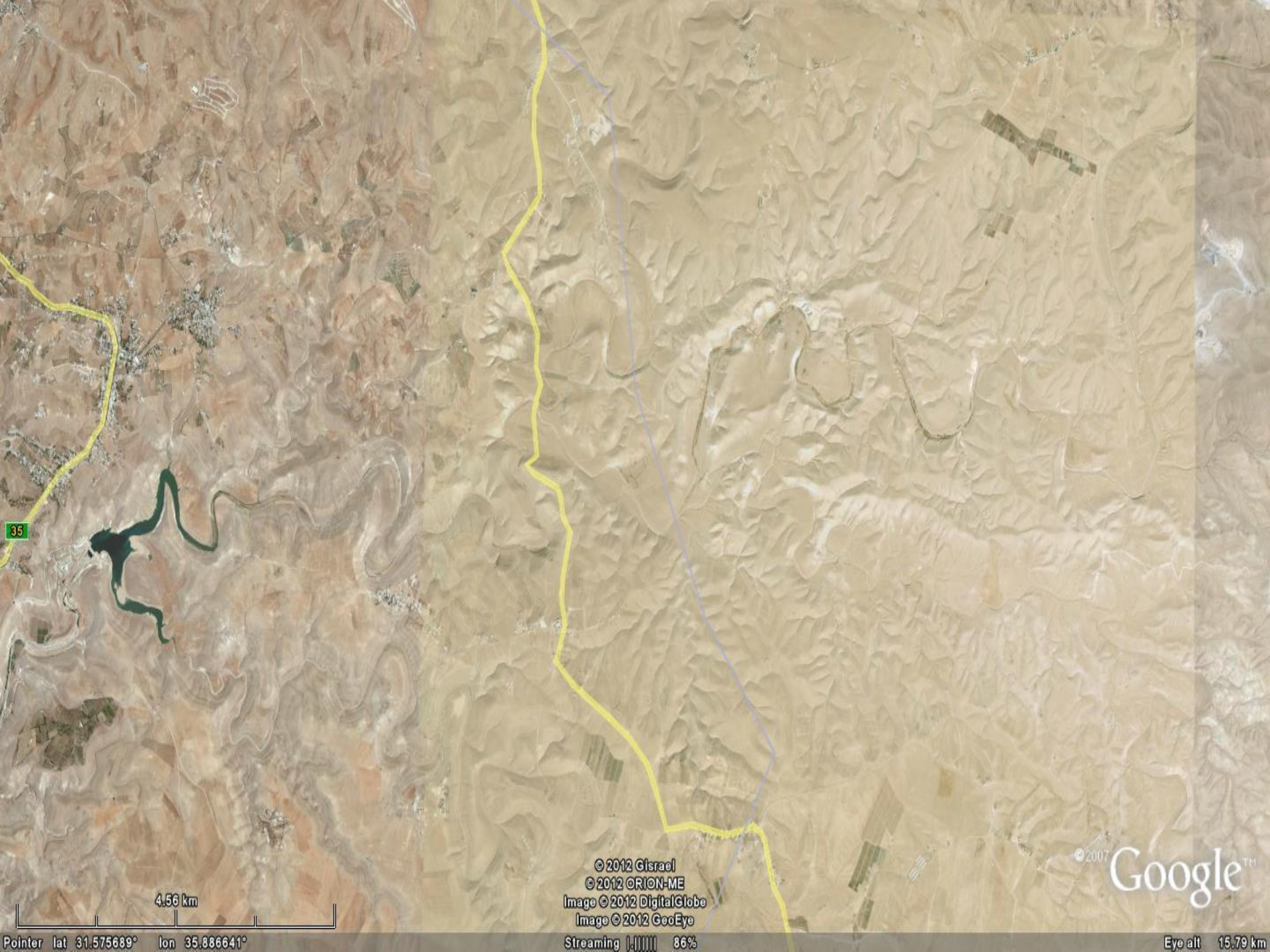
- **Dam Components:**

1-Dam body consist of Rolled Compacted Concrete (RCC) in the center & non homogenous Earth fill abutments, 45m height, 380m length, 9.3 mcm storage capacity, crest width 8 m at level 524 m.a.s.l.,

- **spillway width 105m with reservoir area at full storage level is 0.86km2**

- **catchment area :**

Reservoir and Catchment Area	
Catchment Area	1,770.0 Km2
Mean ANNUAL Inflow	17.7 MCM/Y
Reservoir surface area at FSL	860,000 M2
Reservoir Capacity at FSL	9.3 MCM
Mean Annual Sedimentation	329,000 TONNES /Y


35
4.56 km
© 2012 Gisrael
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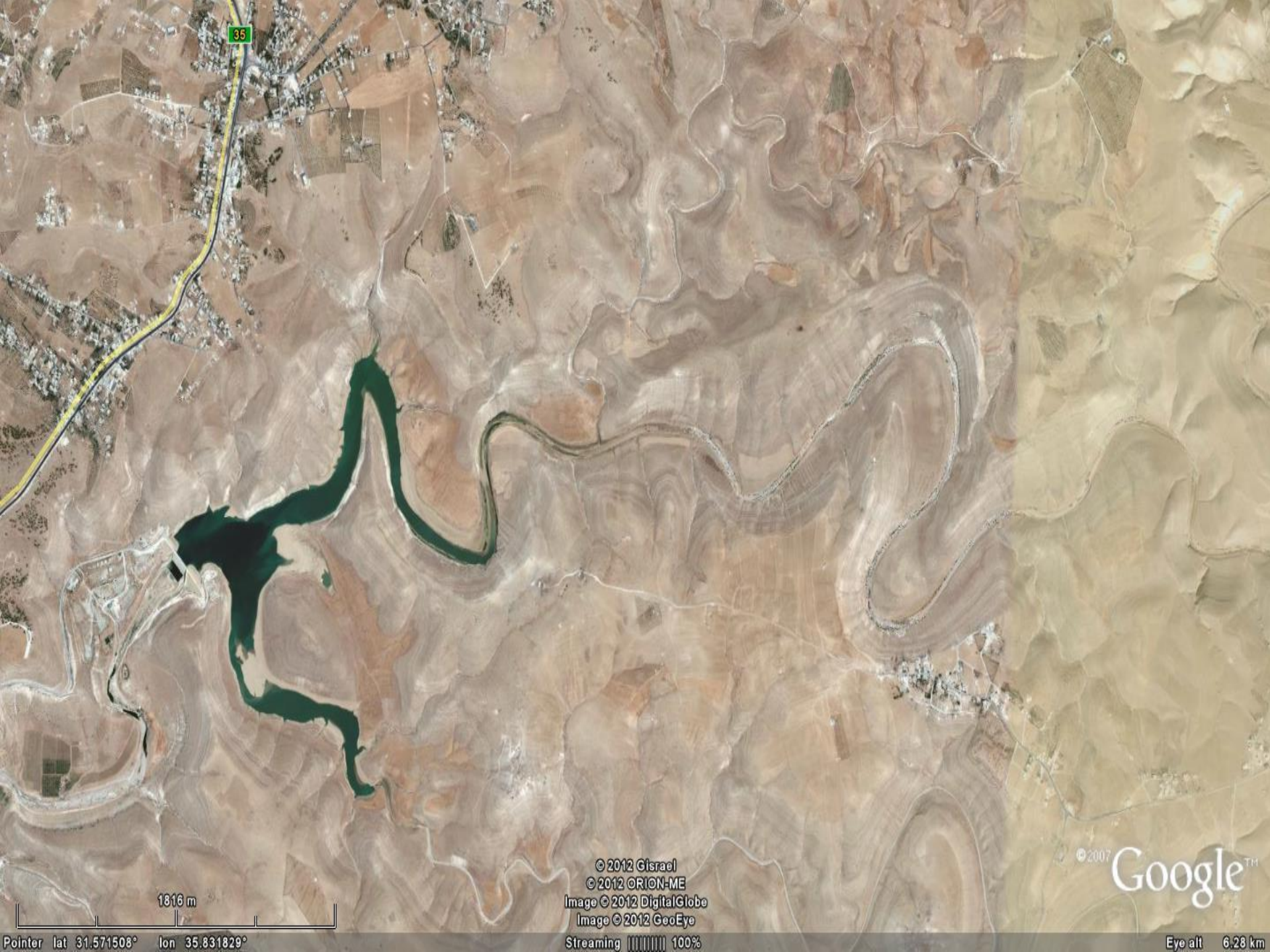
Google™
Pointer lat 31.575689° lon 35.886641°
Streaming 86%
Eye alt 15.79 km


35
1816 m
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© 2007 Google™
Pointer lat 31.571508° lon 35.831829°
Streaming 100%
Eye alt 6.28 km

- **Bottom outlet for sediment flushing and reservoir release in case of emergency with capacity (50 m3/s),**

Bottom Outlet and Draw off Works

Bottom outlet type and Diameter	2m X 2m , steel lined , guard & operation gates
Invert of Bottom Outlet	485.4 m ASL
Discharge at FSL	50 m3/s
Draw off Intakes Levels	lower at El 495, upper at El 505


5-Bottom outlet

- **Water Balance-Wala dams**

Year	Incom Water Q. During The Year	Spilling	recharge		EVA
			Recharge 1	Recharge 2	
2002	4045375	-	3677610	-	367760
2003	22603689	9453148	11955038	-	1195503
2004	11073209	-	10066554	-	1006655
2005	8336442	2485522	5319055	-	531905
2006	11755713	2576463	8304831	-	874419
2007	8762461	43618	7926221	-	792622
2008	1349793	-	1220721	-	122072
2009	16381583	6754228	8777947	-	849408
2010	34570535	25173738	9617735	-	1026701
2011	3223646	-	1815202	330476	865538
TOTAL	122095441	46486717	68680914	330476	7632583

Wala Dam
Monthly Water Balance 2012

Month	Inflow (m^3)	Outflow (m^3)		
		Evaporation	N.Recharge	A. Recharge
Jan	500393	12313	151837	0
Feb	2169490	24619	128002	0
Mar	1944681	53628	675830	0
Apr	0	106503	522787	0
May	0	136969	370921	11150
Jun	48312	182475	299400	116447
Jul	0	189333	156662	73944
Aug	0	158060	280479	115187
Sep	0	104389	152917	71970
Oct	0	68010	175603	66984
Nov	88335	31728	154908	15680
Dec				
Total	4751211	1068027	3069346	471362

- **Areas Utilized from the Dam:**

Agriculture areas at Wadi Al Wala & Al Hiddan D/S from the Dam.
Madaba & Amman Governorates (with drinkable water through increasing the recharge of Al Wala and Al Hiddan wells of about (3mcm/y).

Managed Aquifer recharge of groundwater is used in the implementation of Integrated Water Resource

The Wala dam was constructed to collect floodwater and recharge it into the underlying limestone aquifer, where it is reclaimed for drinking water supply at Heidan well field (Figure 1).

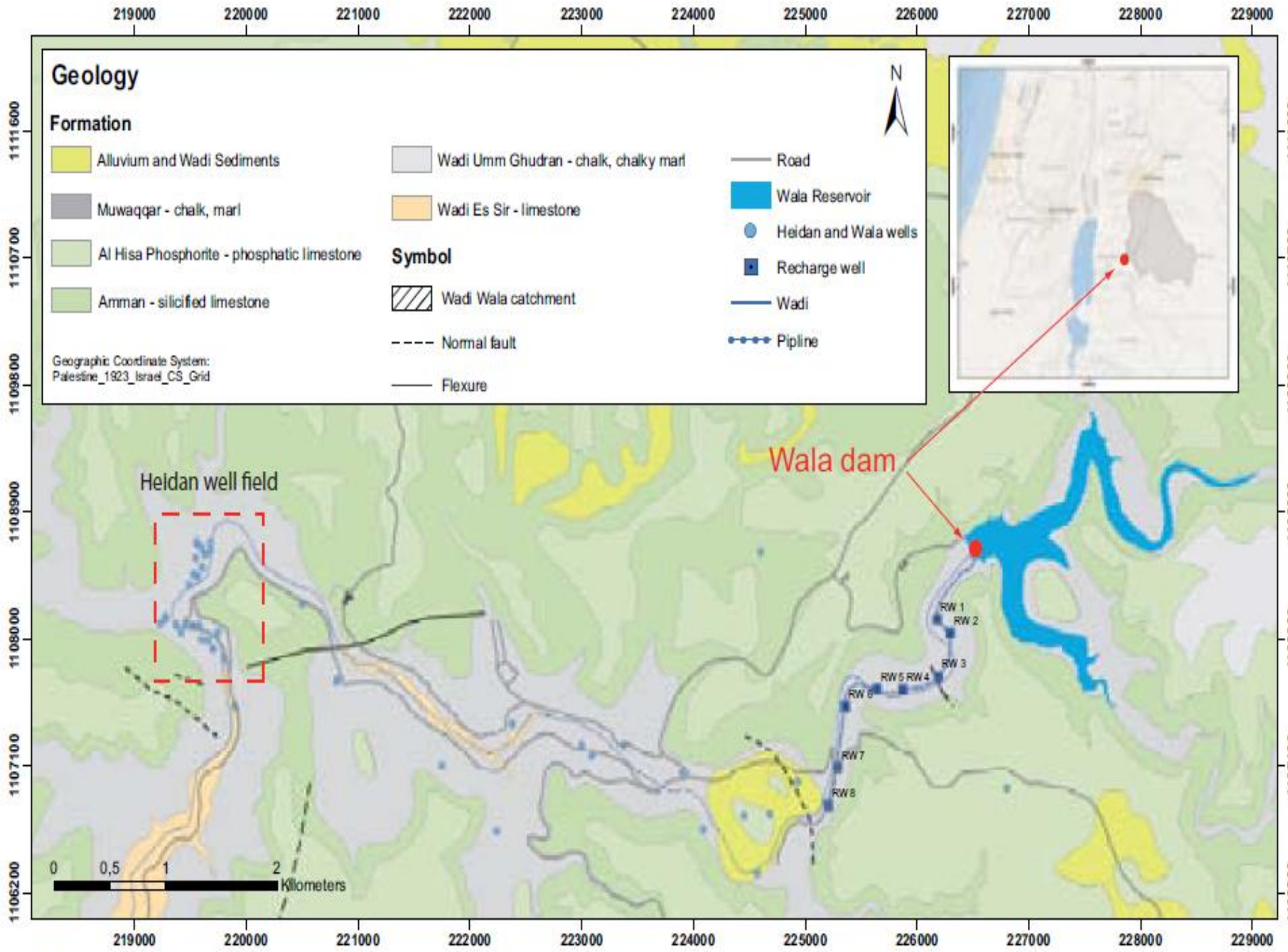


Figure 1: Geological and geographical overwiev about the Wadi Wala area.

- **Interrelation with other projects:**

- **The capacity of pumped water quantities to Madaba and Amman Governorates will be increased in result of increasing the recharge of Wala and Al Hiddan aquifer.**

- **Raising the Dam will help to achieve the targets of the Badia Restoration Project by increasing the green cover of the area upstream of the dam which will extend to north east Badia.**

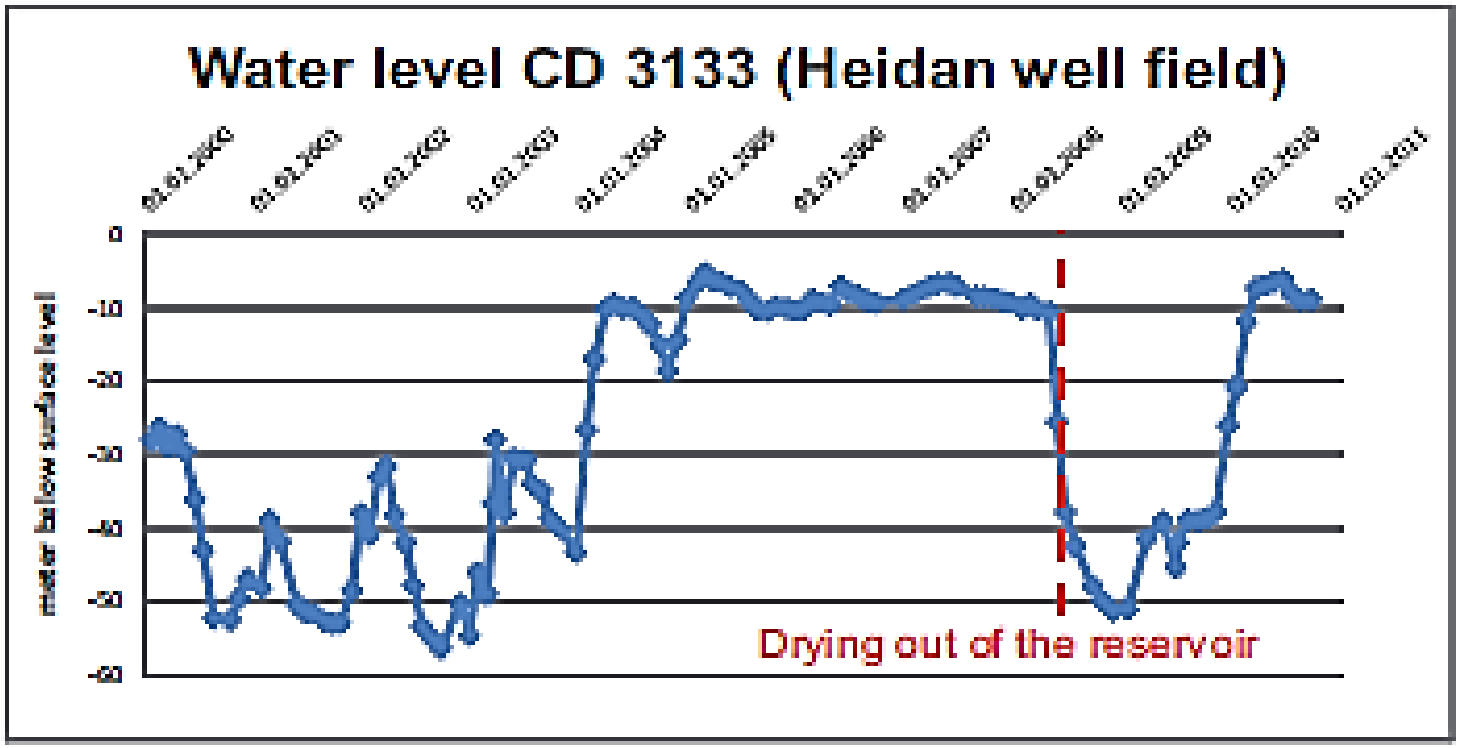


Figure 2: The replenishment of the aquifer is documented in the groundwater level record of the Heidan well field. Mean annual abstraction (2002-2011) is around 11,86 MCM, mostly used for drinking water supply.

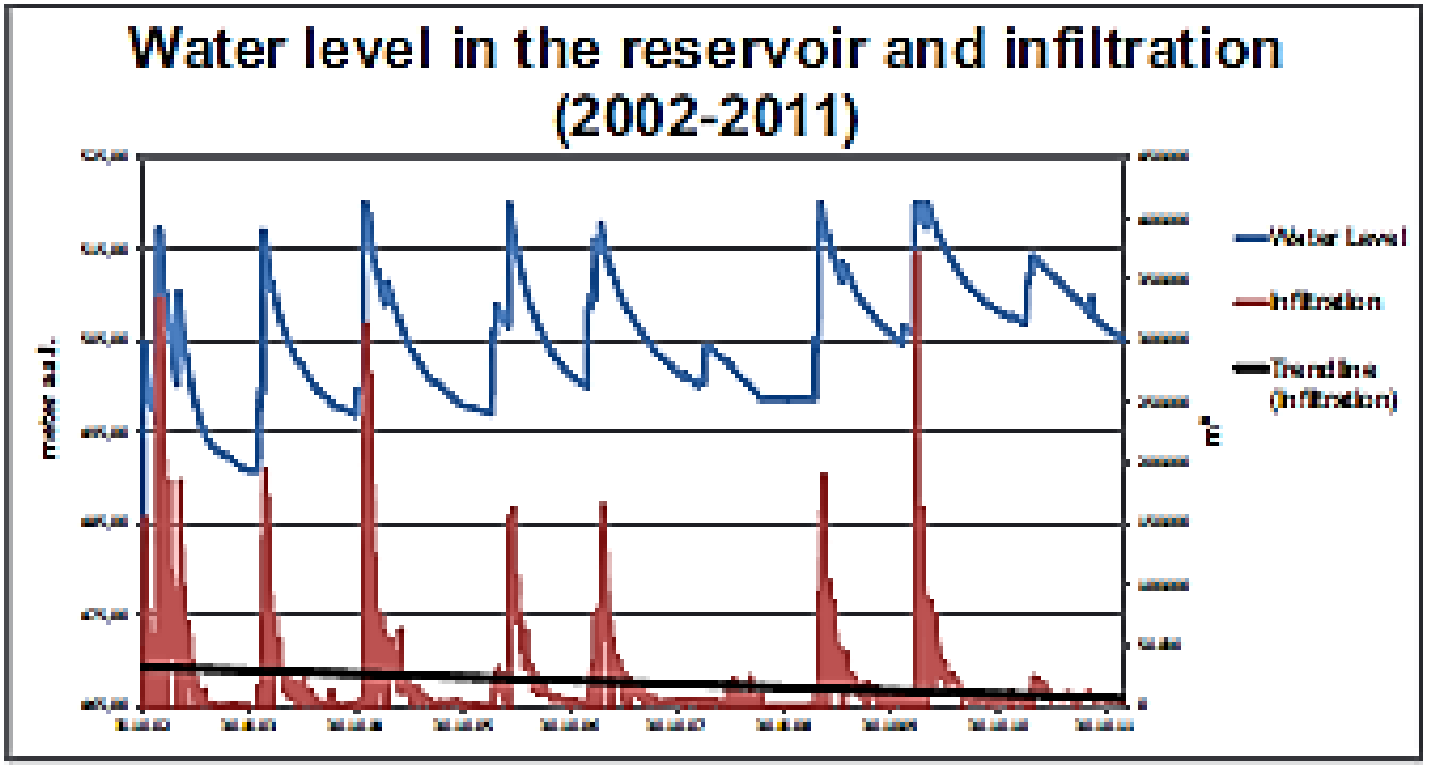


Figure 3: Reduced infiltration rate caused by sedimentation. Most of the infiltration from the reservoir takes place laterally along the vertical and horizontal faults and fractures.

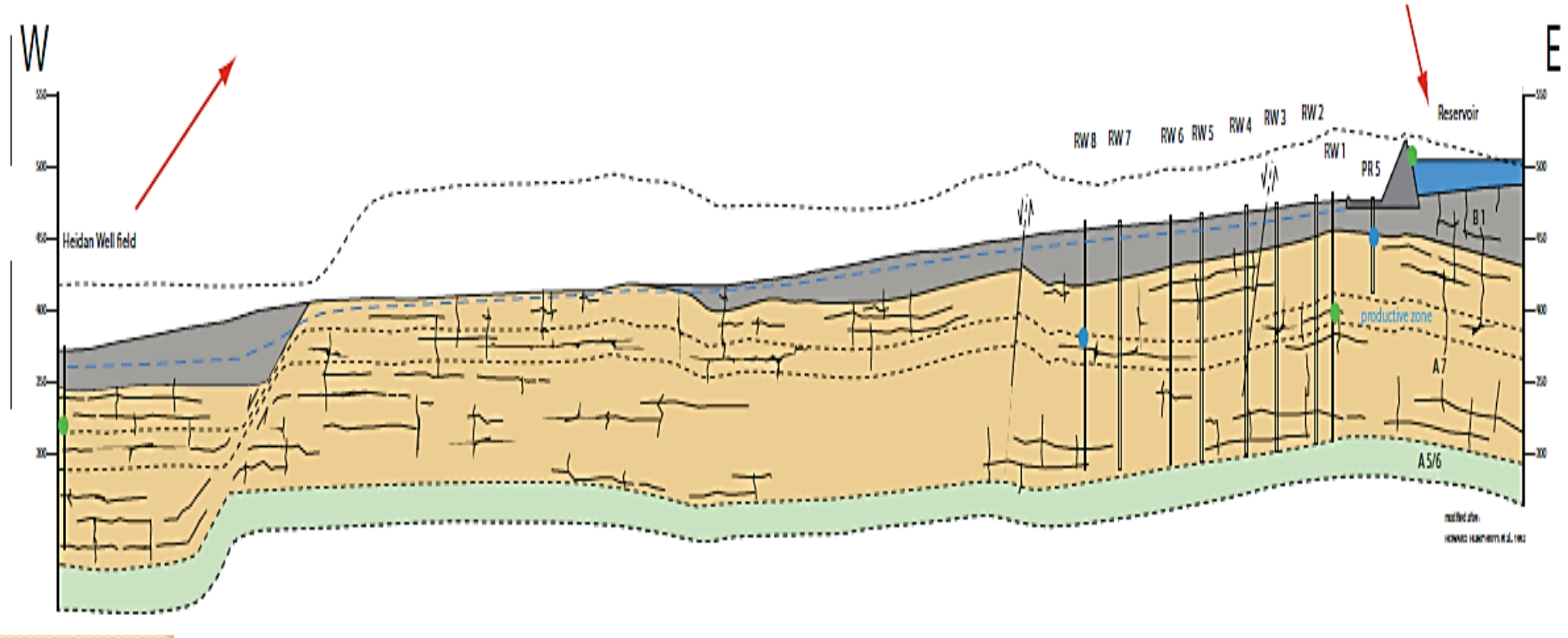


Figure 4: Schematic profile along the Wadi - Groundwater flows from east to west. In the area between the dam and the Heidan well field, several faults crossing the Wadi in N-S direction.
The flexure 1 km east of the well field has a vertical displacement of approximately 50 m.

- **Methods and Results:**

For recording the water level fluctuation in the reservoir
and the aquifer, 5 Divers were installed in selected
wells in November 2011 (Figure 5).
CTD Diver - Water level, Temperature, EC
Cera Diver - Water level, Temperature

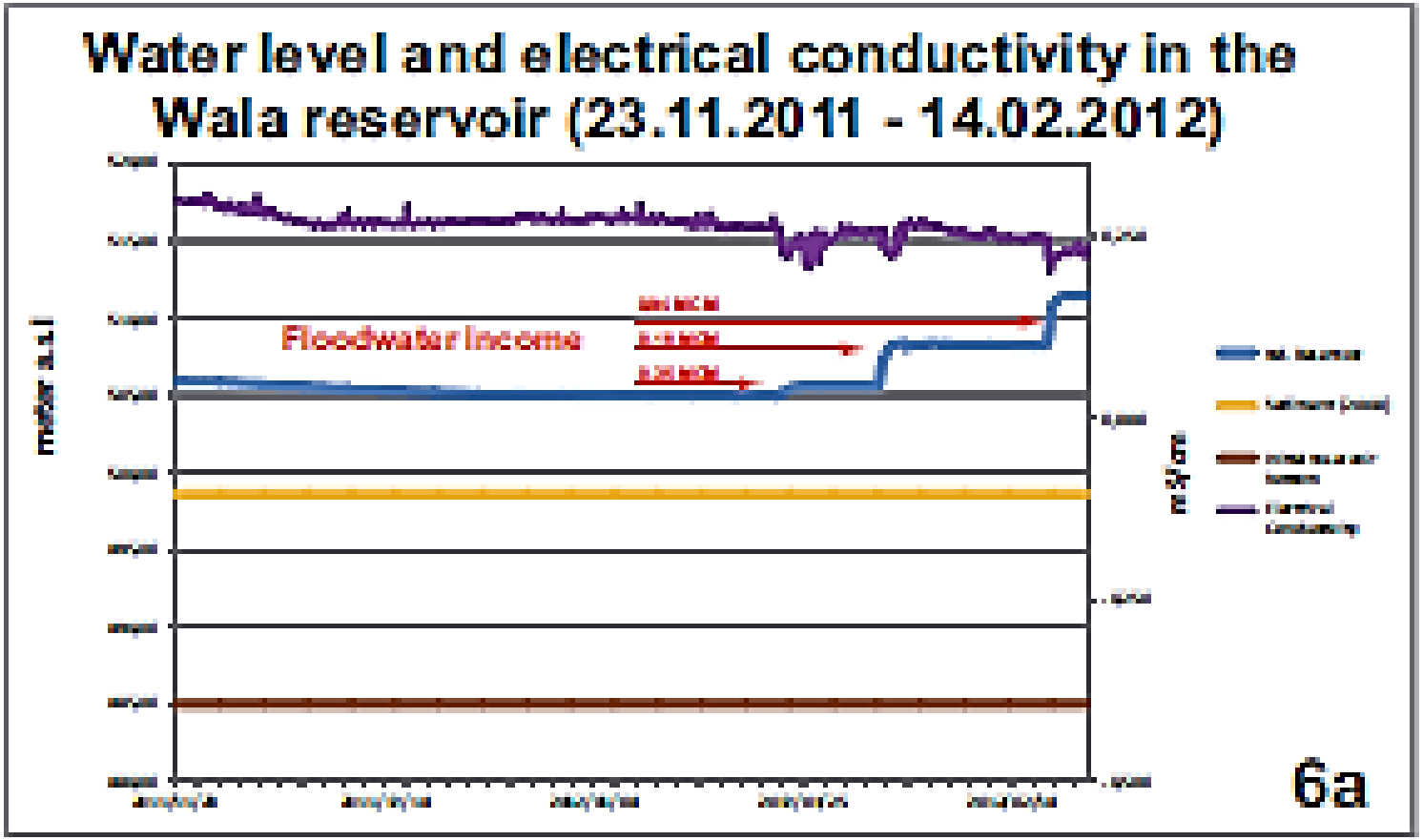


Figure 6a : shows the rising water level in the reservoir during flood events and the associated changing of the electrical conductivity.

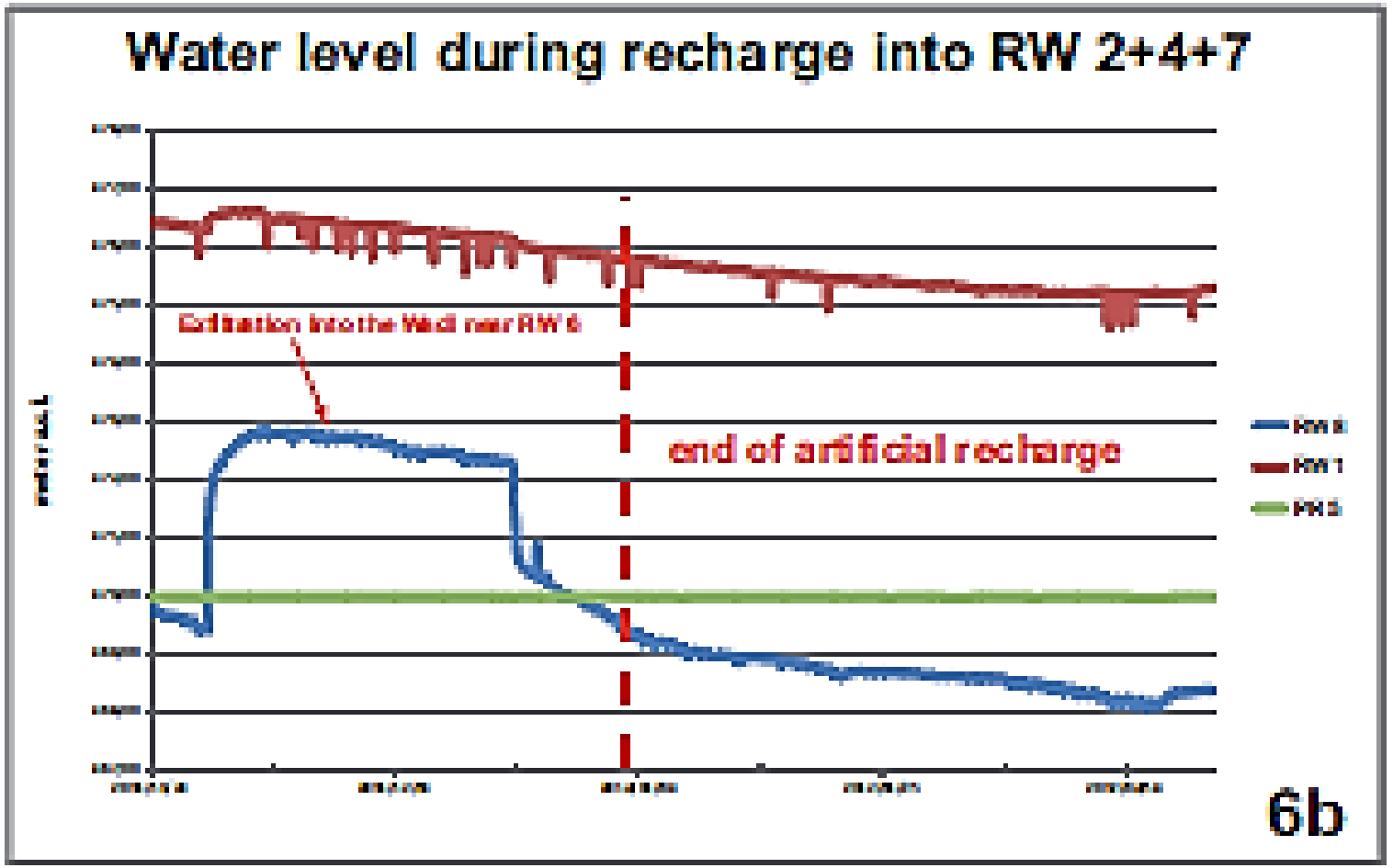


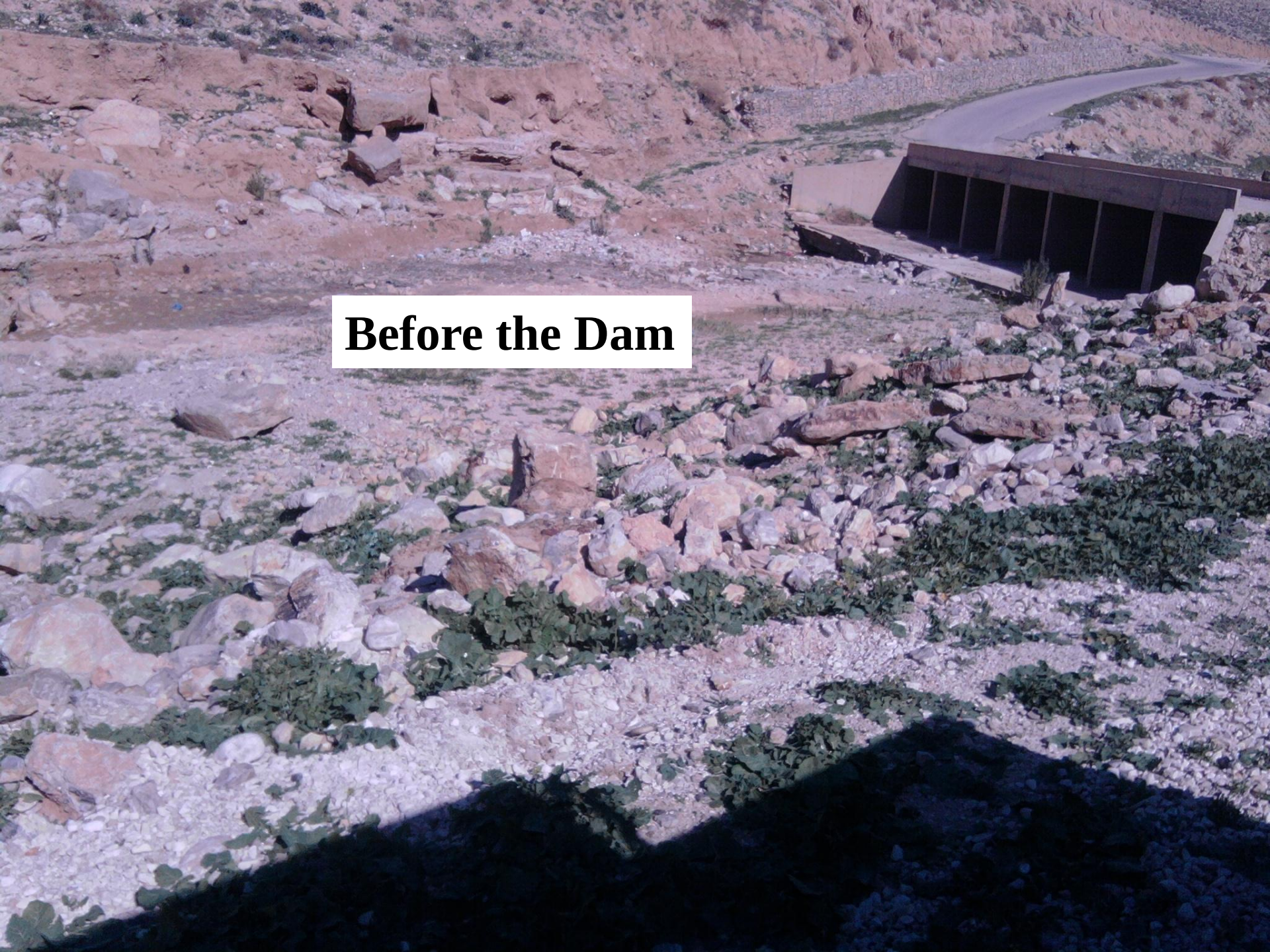
Figure 6b :shows the decreasing water level in two recharge wells after the ending of artificial recharge.
Hereby, 1000m³ per day were infiltrated by gravitation into the aquifer (Jun. 2011 - Jan. 2012).

- **Environmental Impacts:**

- **Improving water quality at Wadi Al Hiddan.**
- **Improving water quality at Reservoir of the Dam.**
- **Restoration the wildlife specially downstream.**
- **Restoration of Vegetation.**
- **Improving Biotic Society.**

- Sedimentation in the reservoir led to a reduction of the infiltration rate
(Figure 3), especially during low water level.
- Most of the infiltration from the reservoir takes place laterally.
- The blocked outlet of the dam makes it difficult to control the water level,
which led to overflow events in the past.
- With the installation of water level recorders it is possible to determine the behavior
of the aquifer during artificial recharge. This helps to improve the
management of the recharge wells e.g. to avoid overflow of the dam and also the
exfiltration from the aquifer into the Wadi near the recharge wells.

- Implementation of a tracer test to determine flow path,- and transit times from the reservoir to the well field.
- Numerical simulation (FEFLOW) of the test site.
- Measurements (sediment traps, yard sticks) and investigation (core drillings) of the sediments in the reservoir.
- Observation of turbidity and fecal bacteria in the groundwater.


Before the Dam


After the Dam


After the Dam


Thank
You