بسم الله الرحمن الرحيم

Exploring of Deep Groundwater in the Southwest Aquifer of Qatar

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Outline

- Background
- Objectives
- The project
- Results
- Aquifer Evaluation
- Conclusions

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Background

Qatar faces the following problems in Water:

- ☹ Limited traditional water resources
- ☹ Water resources are limited renewable
- ☹ Increasing the salinity of groundwater

- ☹ High rate of water demand (domestic, agriculture, industry)
- ☹ High drinking water demand with significant water loss
- ☹ There is significant quantity of unused treated wastewater

Background (cont.)

- **The mentioned situation has driven the Department of Water Management (MoE) to adopt the concept of :**
  - **Integrated Water Resources Management (IWRM)**

- **This includes maximizing of water resources in Qatar exploring the:**
  - **groundwater of deep aquifer**
  - **fresh water underneath the marine water**

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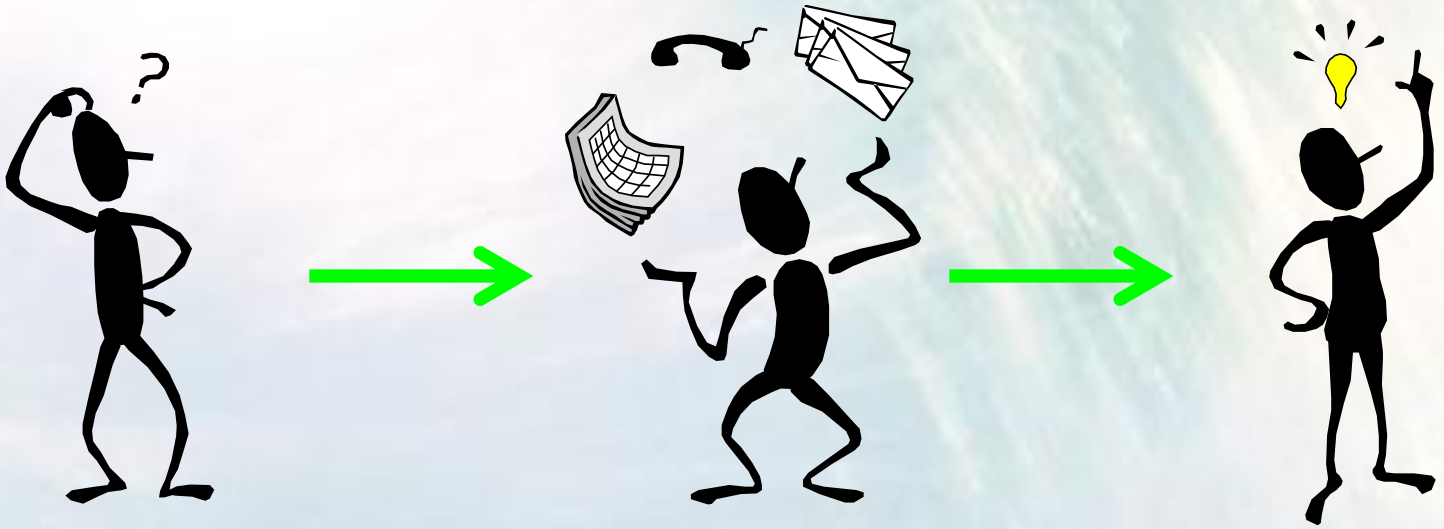
Objectives

- ✓ Characterize the deep aquifer, Aruma
- ✓ Determine the quality and quantity of the deep groundwater
- ✓ Evaluate the pumping rate and the suitability for drinking and agriculture use



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The Project

- **Drilling (4) deep wells (630 – 730 m), total 15 wells:**

  location is Aruma aquifer southwest Qatar

- **Geophysical measurements**

  groundwater level, stratigraphic (type and thickness)

- **Well tests**

  hydrogeological properties (K, T, S)

- **Water quality**

  physical and chemical

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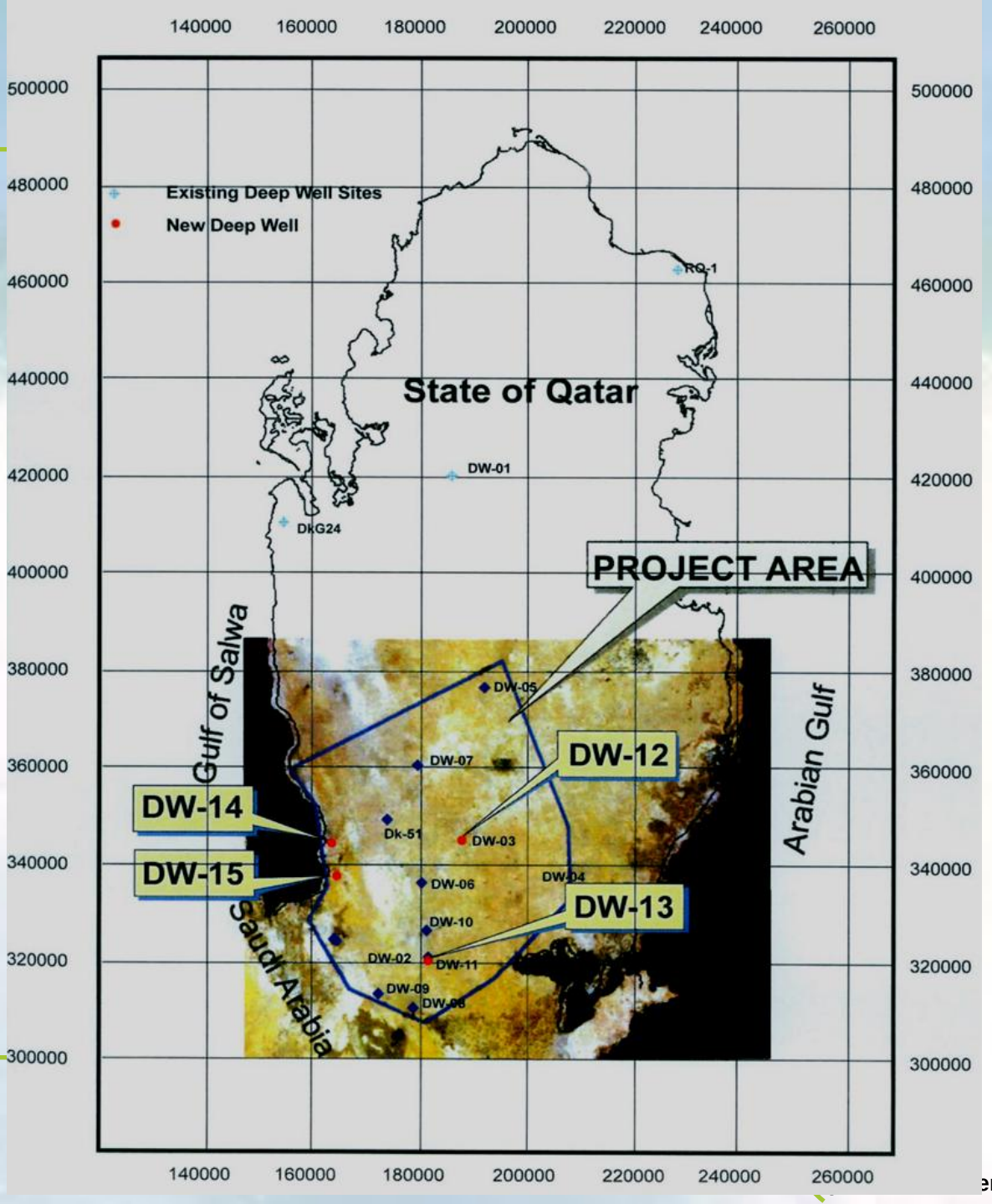
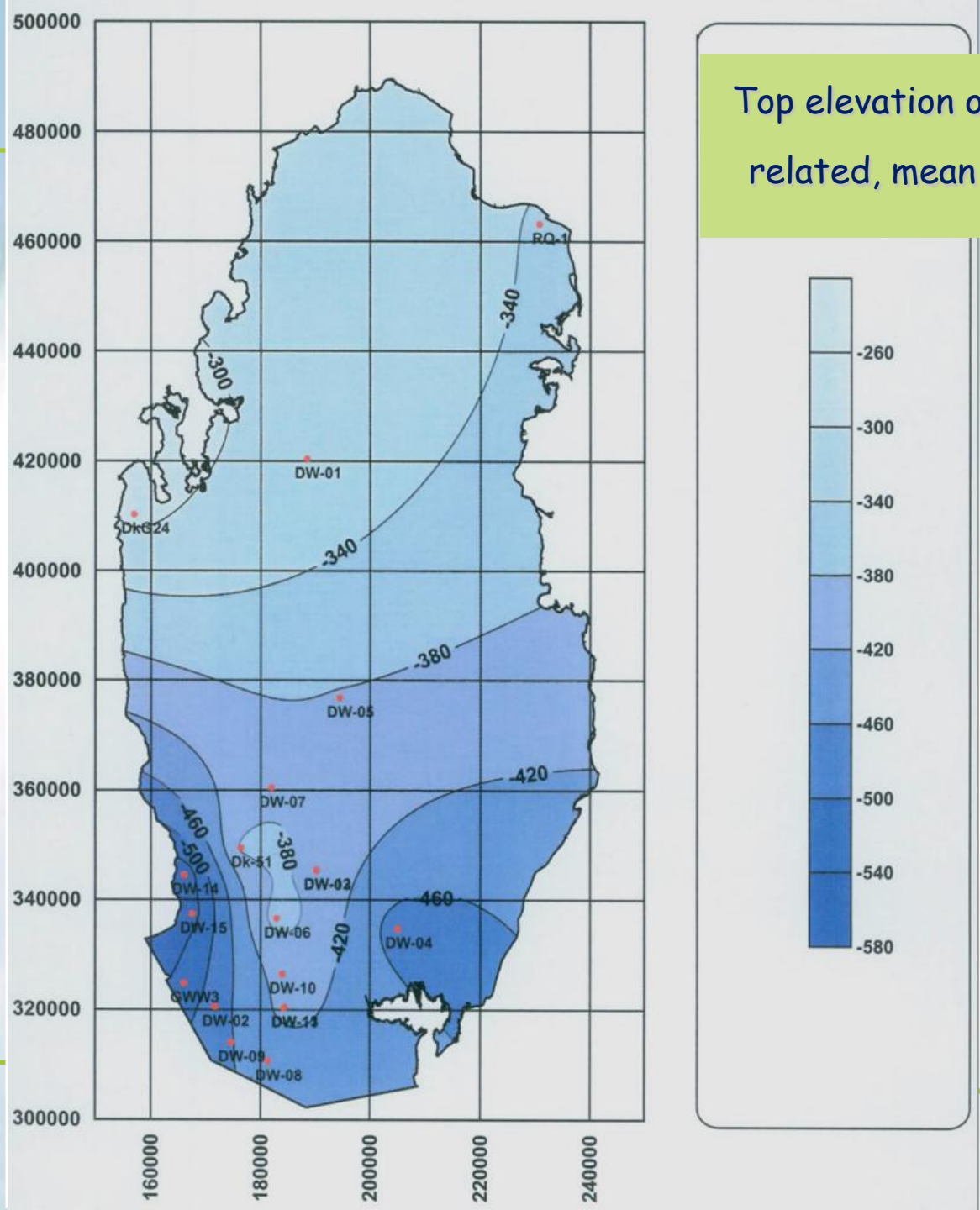
Project location



Results

Top elevation of Aruma Aquifer related, mean sea level (msl)



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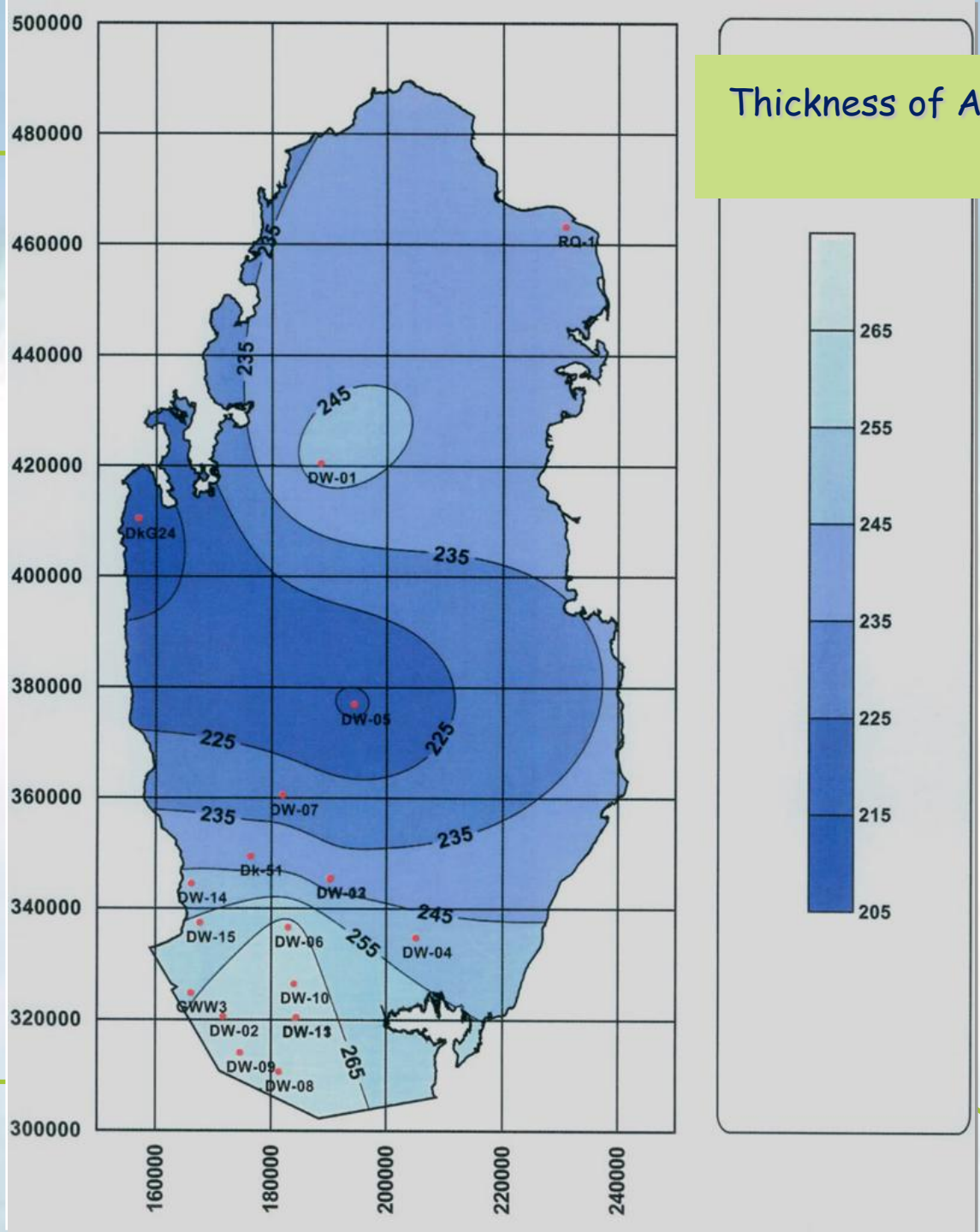
Results

Thickness of Aruma Aquifer, m



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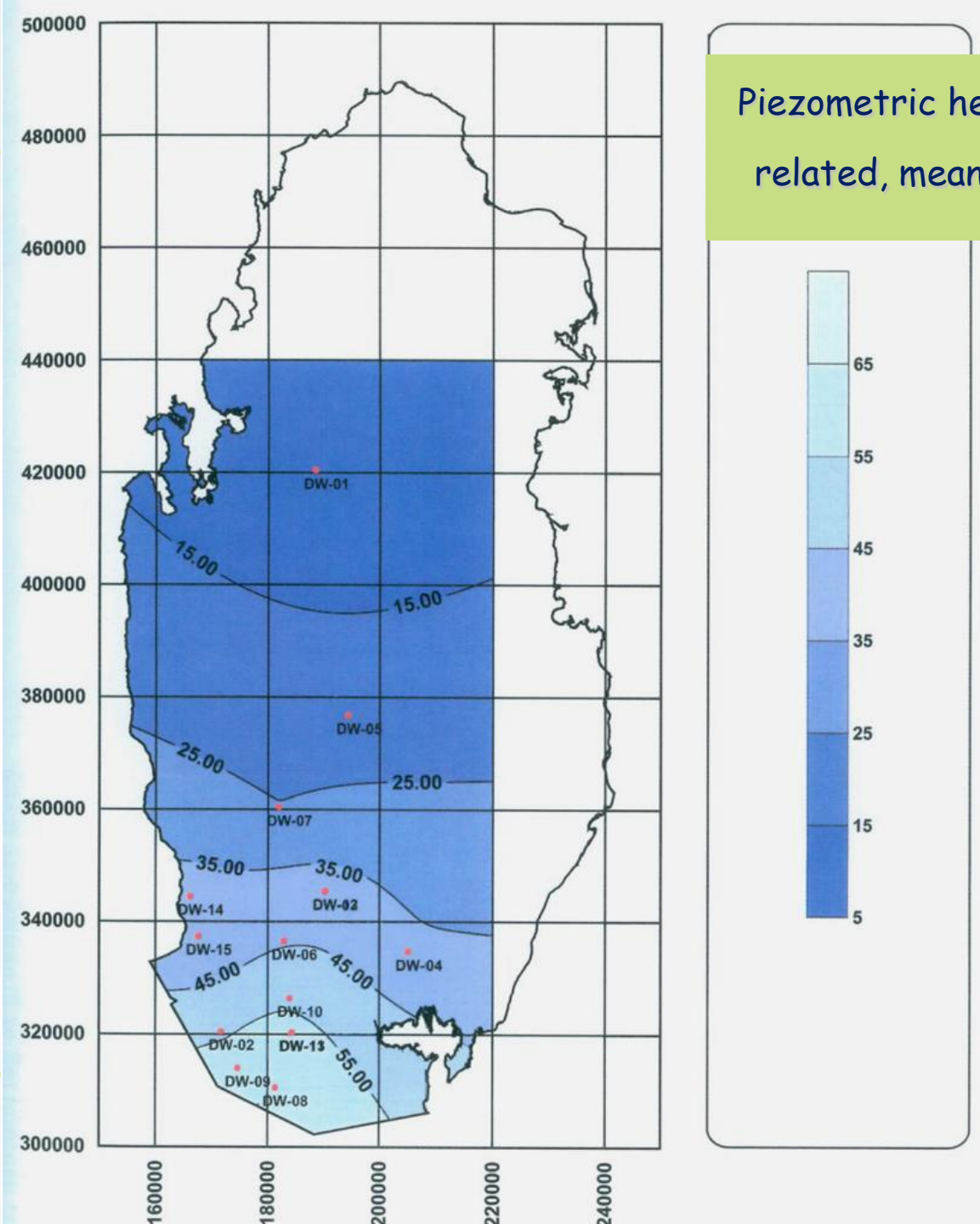
Results

Piezometric head, Aruma Aquifer related, mean sea level (masl)



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Results, aquifer properties

Constant rate tests for Aruma aquifer

Well No.	Duration of Constant Rate Test	Discharge	Hydraulic Calculations			Aquifer Thickness	Estimated Permeability
DW-12	912 minutes	10.9 l/s	Pumping well: Obs. Well:	T = 51 m²/day T = 68 m²/day, S = 0.00005 T = 65m²/day, S = 0.00006 T = 66 m2/day	 (Jacob-Cooper Analysis) (Thies Analysis) (Recovery Analysis)	135 m	0.37 m/day
	585 minutes	10.7 l/s	Pumping well: Obs. Well:	T = 61 m²/day T = 69 m²/day, S = 0.00005 T = 50m²/day, S = 0.00007 T = 65 m²/day	 (Jacob-Cooper Analysis) (Thies Analysis) (Recovery)		
	8632 minutes	10.9 l/s	Pumping well Obs. Well:	T = 50 m²/day T = 65 m²/day, S = 0.00005 T = 52m²/day, S = 0.00008 T = 67 m²/day	 (Jacob-Cooper Analysis) (Thies Analysis) (Recovery)		
DW-13	6665 minutes	16.2 l/s	Pumping well: Obs. Well:	T = 36 m²/day T = 38 m²/day, S = 0.00015 T = 45m2/day, S = 0.00016 T = 36 m2/day	 (Jacob-Cooper Analysis) (Thies Analysis) (Recovery)	132 m	0.30 m/day
DW-14	840 minutes	11.5 l/s	Pumping well:	T = 29 m²/day	(Jacob Cooper Analysis)	155 m	0.20 m/day
	2880 minutes	11.6 l/s	Pumping well:	T = 30 m²/day	(Jacob Cooper Analysis)		
DW-15	2928 minutes	16.2 l/s	Pumping well:	T = 47 m²/day	(Jacob Cooper Analysis)	147 m	0.31 m/day

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Results, constant rate pumping

Table 5.1: Projected drawdown at test sites due to continuous pumping

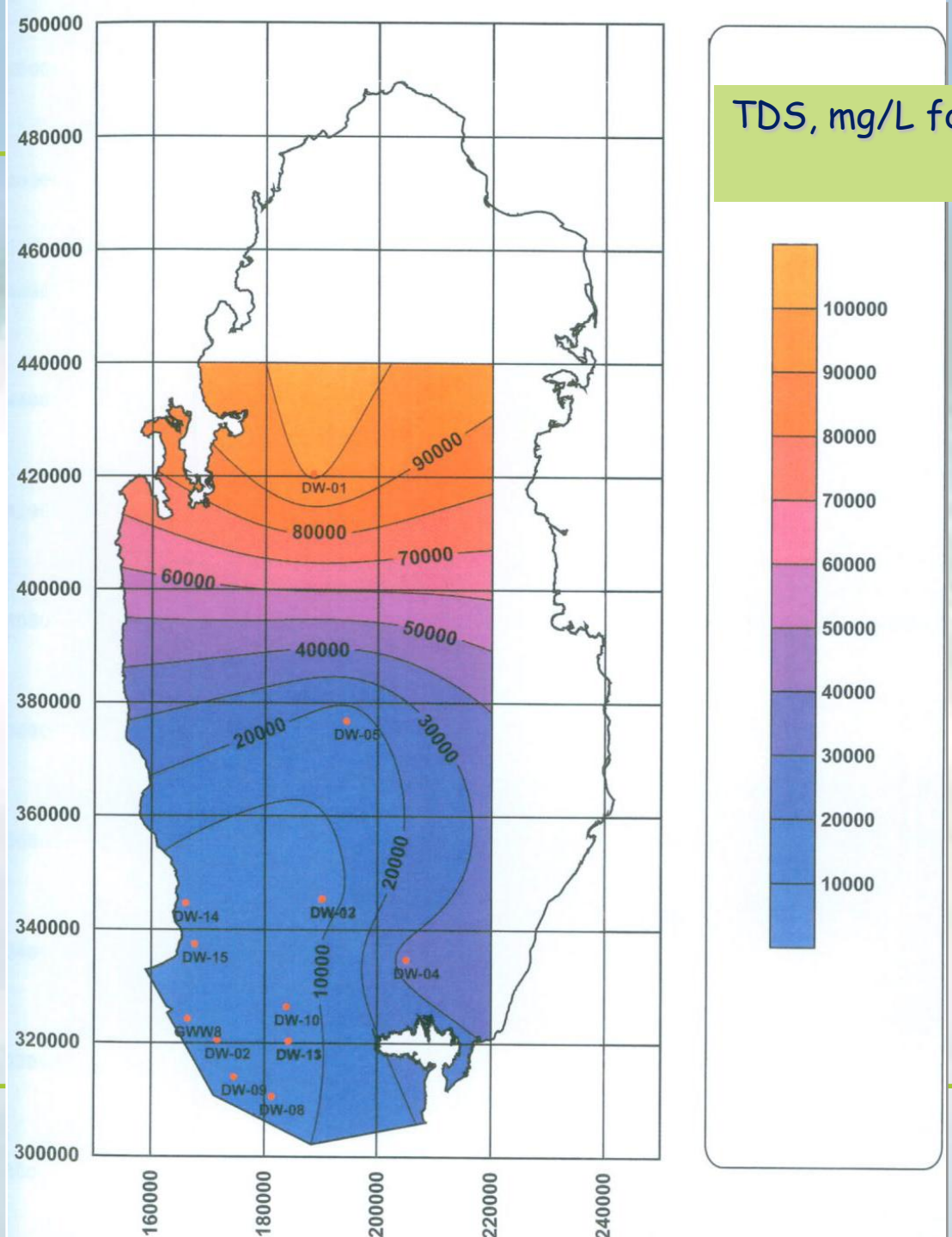
Well No.	Test Discharge (litres/second)	Projected drawdown due to continued pumping (metres)					Derived Transmissivity. (m^2/day)
		24 hour	10 days	30 days	300 days	1000 days	
DW-12	10.9	40.5	44.5	46	49	51	65
DW-13	16.2	111	119	122	129	133	38
DW-14	11.6	99	106	109	114	118	29
DW-15	16.2	71	78	80	85	88	47

Results, water quality

Well No. / Date	DW - 12 May 2003	DW – 13 March 2003	DW – 14 June 2003	DW – 15 June 2003
Field Measurements				
EC (micromhos/cm)	8510	7220	7160	5360
PH (units)	7.45	7.44	7.44	7.33
Temp deg C	44.9	46.4	47.2	47.9
H2S (mg/1)	>2<5	>2<5		
Laboratory Analysis				
Calcium (mg/1)	105	110	100	80
Magnesium (mg/1)	55	61	49	42
Sodium (mg/1)	1688	1398	1360	980
Potassium (mg/1)	102	82	82	62
Manganese (mg/1)	0.009	0.03	<0.001	<0.001
Carbonate (mg/1)	Absent	Absent	Absent	Absent
Bicarbonate (mg/1)	351	329	305	311
Sulphate (mg/1)	346	345	325	329
Chloride (mg/1)	2552	2127	2092	1453
Nitrate (mg/1) as NO3	<0.1	<0.1	<0.1	<0.1
Alkalinity (as CaCo3) P (mg/1)	Absent	Absent	Absent	Absent
Alkalinity (as CaCo3) Mo (mg/1)	288	270	250	255
Total Hardness (as CaCo3) (mg/1)	488	525	450	375
Carbonate Hardness (mg/1)	263	270	250	200
Non-Carbonate Hardness (mg/1)	225	255	203	173
Total Iron (mg/1)	0.50	0.93	<0.01	<0.01
Nitrite (mg/1)	<0.001	<0.001	<0.001	<0.001
Nitrogen-Ammonia (mg/1)	3.4	2.7	3.5	3.4
Orthophosphate (mg/1)	0.04	0.02	0.01	0.01
Bromine (mg/1)	0.06	0.04	0.049	0.053
Flouride (mg/1)	4.70	5.3	4.628	4.008
Silica (mg/1)	19.15	19.5	17.880	17.930
Boron (mg/1)	1.16	1.1	1.192	1.189
Strontium (mg/1)	44.3	44	40.550	32.430
Iodide (mg/1)	0.49	0.6	0.43	0.44
Copper (mg/1)	0.003	<0.005	<0.001	<0.001
Chromium (mg/1)	<0.001	<0.01	<0.001	<0.001
Total Dissolved Solids (mg/1)	6175	5182	5253	3871
Ec. @ 25 deg C (micromhos/cm)	8820	7510	7390	5520
PH (units)	7.56	7.68		
Free CO2 (calculated) (mg/1)	20.4	19.6	18.1	23.8
Turbidity NT Units	3.60	5.03	12.16	4.04
Ion Balance (%)	1.9	2.17	0.25	1.42

Results

TDS, mg/L for Aruma Aquifer



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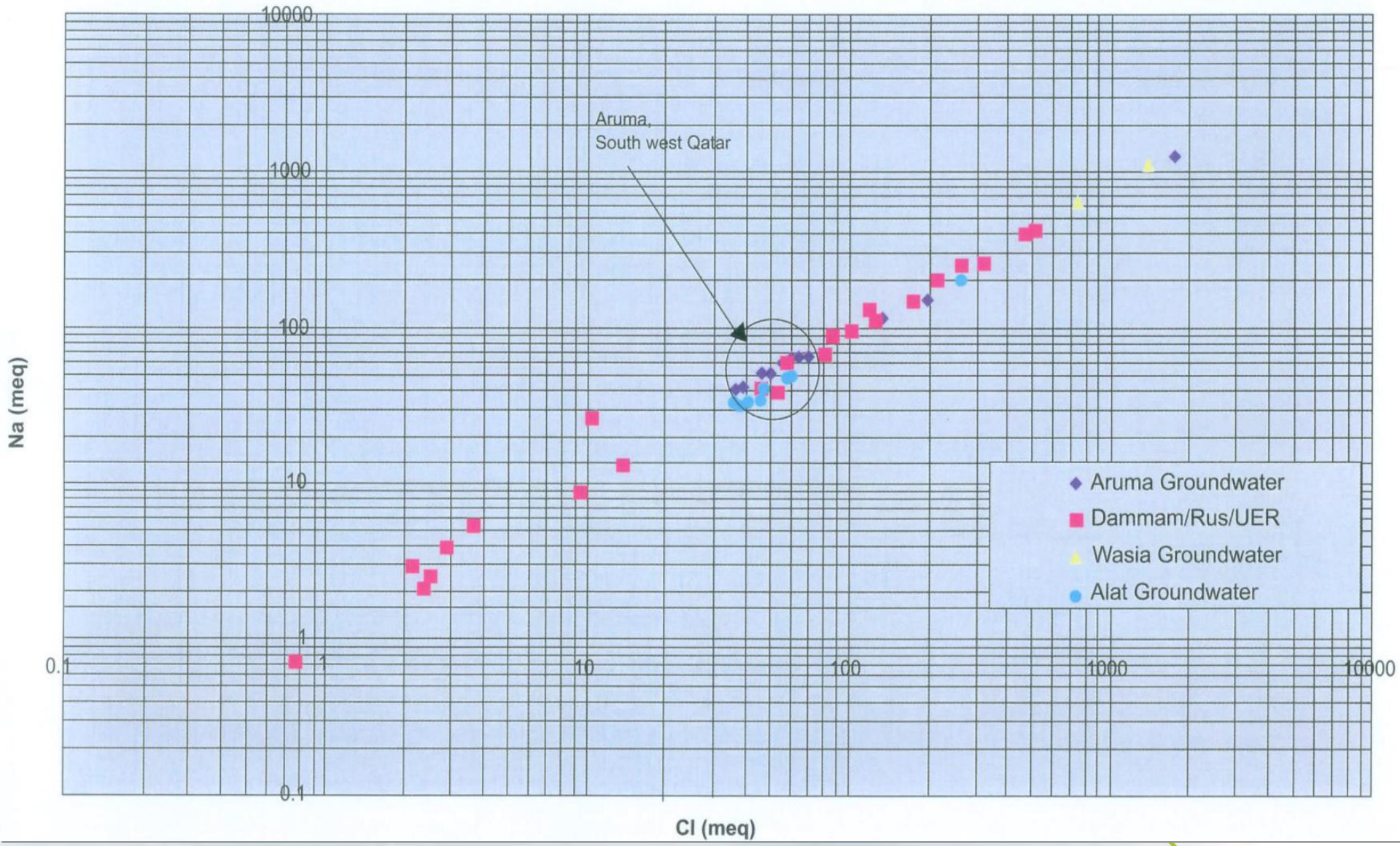
Results, water type

Qatar groundwater: Na and Cl



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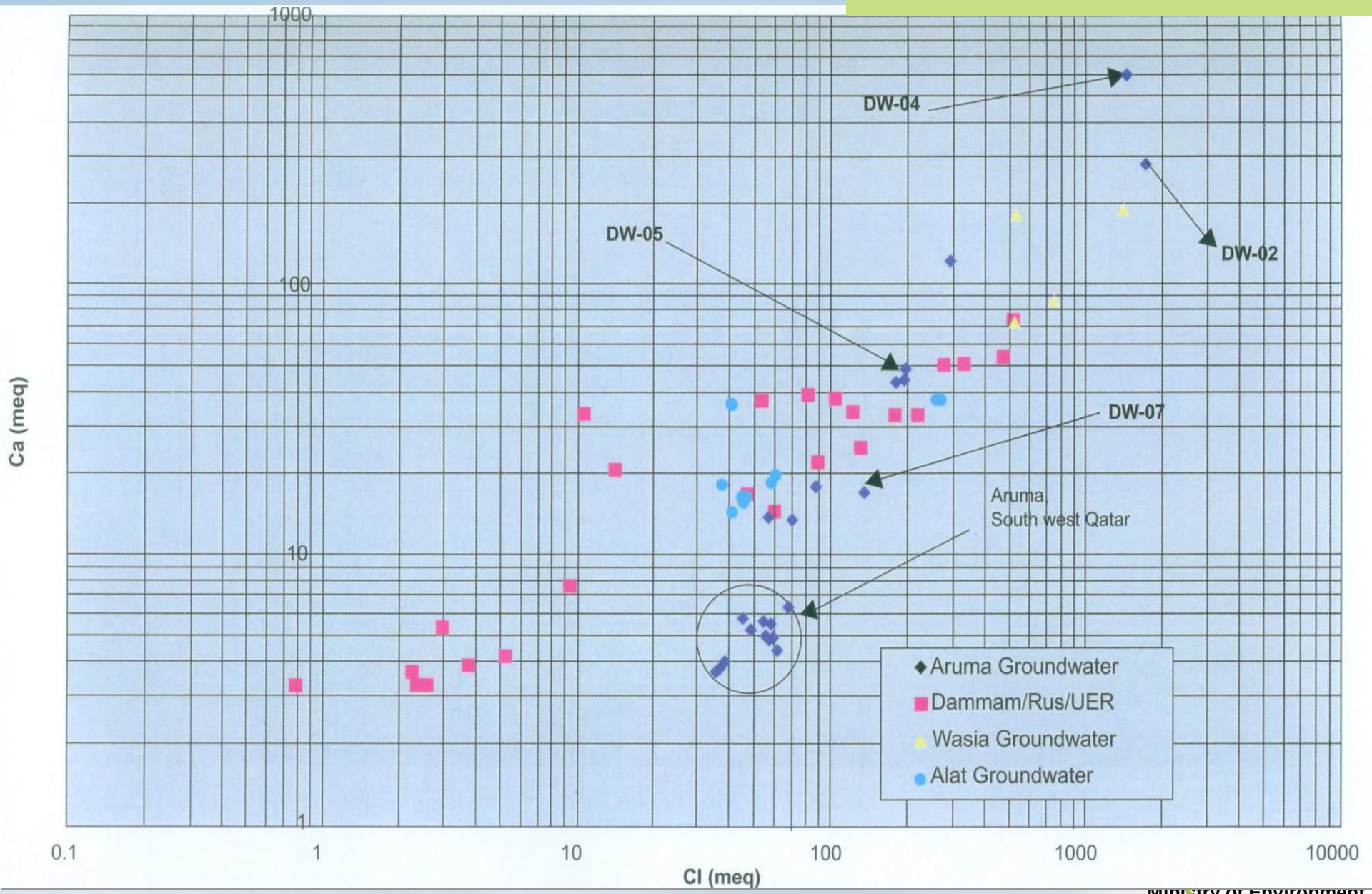
Results, water type

Qatar groundwater: Ca and Cl



Conclusions

- The characterization and feasibility of deep Aruma groundwater located southwest of Qatar was evaluated depending on data from (15) wells.
- The sustainable abstraction of Aruma groundwater is not significant and controlled by low transmissivity.
- Also, Aruma groundwater has high TDS and H_2S which make it not suitable for Drinking without treating and careful agriculture use
- H_2S values of Aruma groundwater indicate it is corrosive for abstraction equipments and materials.
- However, the lack of regional monitoring data prevents any firm conclusions regarding the full potential for sustainable development.
- Numerical modeling with more regional data of Aruma aquifer will be very helpful for firm development scenarios..

Thank you

Dr. Mohamed Shamrukh

“Water is life, sanitation is dignity.”