

AS140 - Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

Geography

Total area TBA (km²): 290 000

No. countries sharing: 4

Countries sharing: Bahrain, Qatar, Saudi Arabia, United Arab Emirates

Population: 3 600 000

Climate zone: Arid

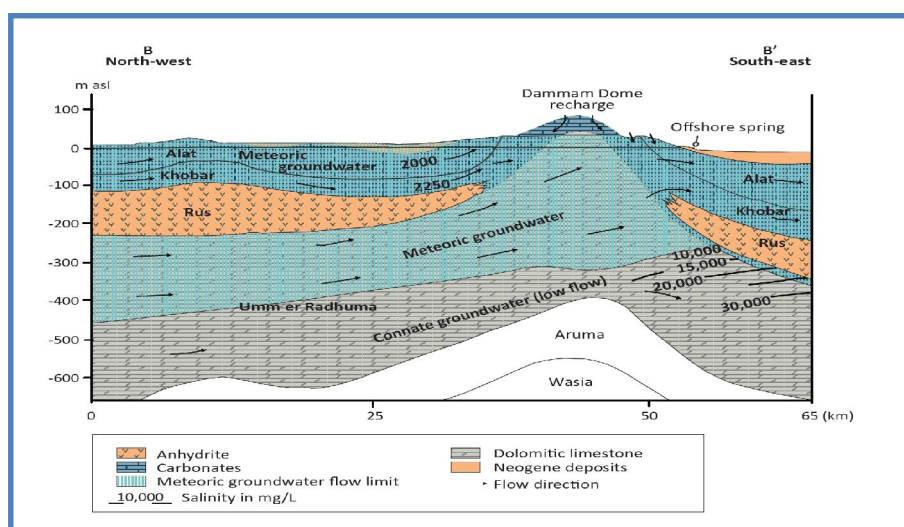
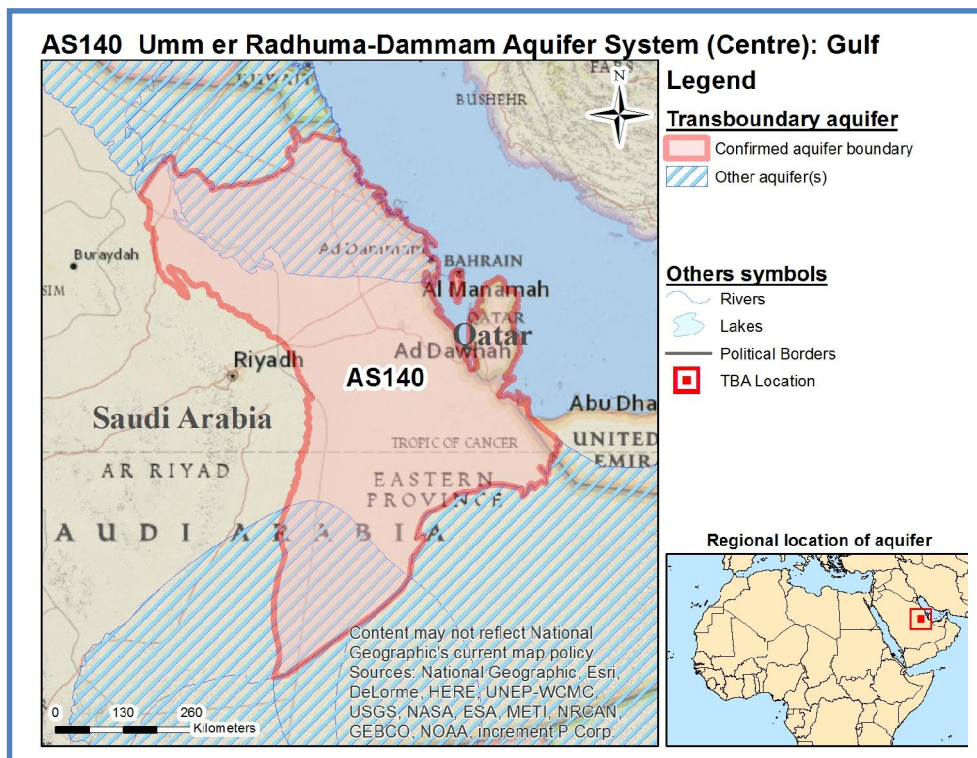
Rainfall (mm/yr): 87

Hydrogeology

Aquifer type: Multiple 3-layered, hydraulically connected

Degree of confinement: Mostly confined, some parts unconfined

Main Lithology: Sedimentary rocks - limestone and dolomites with some evaporites



Geological Cross-section across part of the system

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.

AS140 - Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

TWAP Groundwater Indicators from Global Inventory

	Recharge (mm/y) (1)	Renewable groundwater per capita (m ³ /y/capita)	Natural background groundwater quality (%) (2)	Human dependency on groundwater (%)	Groundwater depletion (mm/y)	Groundwater pollution (%) (3)	Population density (persons/km ²)	Groundwater development stress (%) (4)	Transboundary legal framework (Scores) (5)	Transboundary institutional framework (Scores) (6)
Bahrain							1130			
Qatar							56			
Saudi Arabia							9			
United Arab Emirates							18			
TBA level	4	350	60		2		13	65	D	D

(1) Recharge: This is the long term average recharge (in m³/yr) divided by the surface area (m²) of the complete country segment of the aquifer (i.e. not only the recharge area).

(2) Natural background groundwater quality: Estimate of percentage of surface area of aquifer where the natural groundwater quality satisfies local drinking water standards.

(3) Groundwater pollution: A. No pollution has been identified; B. Some pollution has been identified; Positive number: Significant pollution has been identified (% of surface area of aquifer).

(4) Groundwater development stress: Annual groundwater abstraction divided by recharge.

(5) Legal framework: A. Agreement with full scope for TBA management signed by all parties; B. Agreement with limited scope for TBA management signed by all parties; C. Agreement under preparation or available as an unsigned draft; D. No agreement exists, nor under preparation; E. Legal Framework differs between Aquifer States (see data at National level).

(6) Institutional Framework: A. Dedicated transboundary institution fully operational; B. Dedicated transboundary institution in place, but not fully operational; C. National/Domestic institution fully operational; D. National/Domestic institution in place, but not fully operational; E. No institution exists for TBA management; F. Institutional Framework differs between Aquifer States (see data at National level).

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

Key parameters table from Global Inventory

	Distance from ground surface to groundwater table (m)	Depth to top of aquifer formation (m)	Full vertical thickness of the aquifer (system)* (m)	Degree of confinement	Predominant aquifer lithology	Predominant type of porosity (or voids)	Secondary Porosity	Transmissivity (m ² /d)
Bahrain								
Qatar								
Saudi Arabia								
United Arab Emirates								
TBA level				Aquifer mostly confined, but some parts unconfined	Sedimentary rock: Limestone		Secondary porosity: Dissolution	

* Including aquitards/aquicludes

X A value was provided in the questionnaire, but it was considered un-realistic and therefore removed from the table.

AS140 - Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

Aquifer description

Aquifer geometry

The central section of the Umm er Radhuma-Dammam Aquifer System extends over a 400 km-wide structural platform that stretches across three Gulf States: Bahrain, Qatar and Saudi Arabia. Geo-structural and physiographic features were used to approximate the boundaries of this system, which comprises 3 hydraulically connected layers. It is mostly confined although some parts are unconfined. The thickness of the aquifer system, including aquitards, varies from 300m to 720m.

Hydrogeological aspects

The predominant aquifer lithology consists of sedimentary rocks - limestones and dolomites with some evaporites. System replenishment is very low to low (0-20 mm/annum), amounting to an average recharge of about 1300 Mm³/annum of freshwater, but a much higher value of 5400 Mm³/annum due to extreme events has been recorded. This natural recharge water percolates through an area of approximately 220 000 km². A secondary type of porosity is predominant that allows for a low vertical connectivity between layers. An extremely variable range of values have been recorded for transmissivity across the Aquifer States, ranging between 1m²/d and 55 000m²/d.

Linkages with other water systems

Recharge occurs through karstic and dissolution features in the limestones, mainly in the Umm er Radhuma outcrop areas. Discharge takes place through a large number of karst springs in eastern Saudi Arabia.

Environmental aspects

Groundwater is fresh (mostly <1000 mg/l TDS) to hypersaline in some coastal areas, with quality not satisfying local standards in about 40% of aquifer area (see Appendix 1). Superficial layers of the aquifer system are also vulnerable to anthropogenic pollution from agricultural practice and oil/gas production. Salinization, nitrogen species and hydrocarbons are the most common pollutants affecting the groundwater quality.

Socio-economic aspects

A total of 800 Mm³/annum of groundwater is abstracted by the three aquifer states, mainly for agricultural, also domestic, industrial and urban irrigational use, with the bulk of abstraction taking place in Saudi Arabia.

Legal and Institutional aspects

National institutions for the management of groundwater exist in all of the aquifer states but no formal Transboundary Agreement has been made.

Hot spot

Abstraction already amounts to more than 60% of the mean annual replenishment. The main issue for this TBA is the rapid changes in hydraulic head which allows for up-coning of formation water at depth as well as for seawater intrusion. Groundwater quality deterioration has mainly affected Bahrain and Qatar. Close monitoring of both groundwater quality and hydraulic gradients is required and special measures may be needed to protect the system from hydrocarbon pollution. A Multi-lateral Agreement on the management of the Transboundary Aquifer is becoming essential.

Contributors to Global Inventory

Name	Organisation	Country	E-mail	Role
Abdelkader Dodo	Observatoire du Sahara et du Sahel	Tunisia	abdelkader.dodo@oss.org.tn	Regional coordinator
Lamine Babasy	Observatoire du Sahara et du Sahel	Tunisia	lamine.babasy@oss.org.tn	Regional coordinator

AS140 - Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

Name	Organisation	Country	E-mail	Role
Yusuf Al-Mooji		Lebanon	mooji46@yahoo.com	Regional coordinator

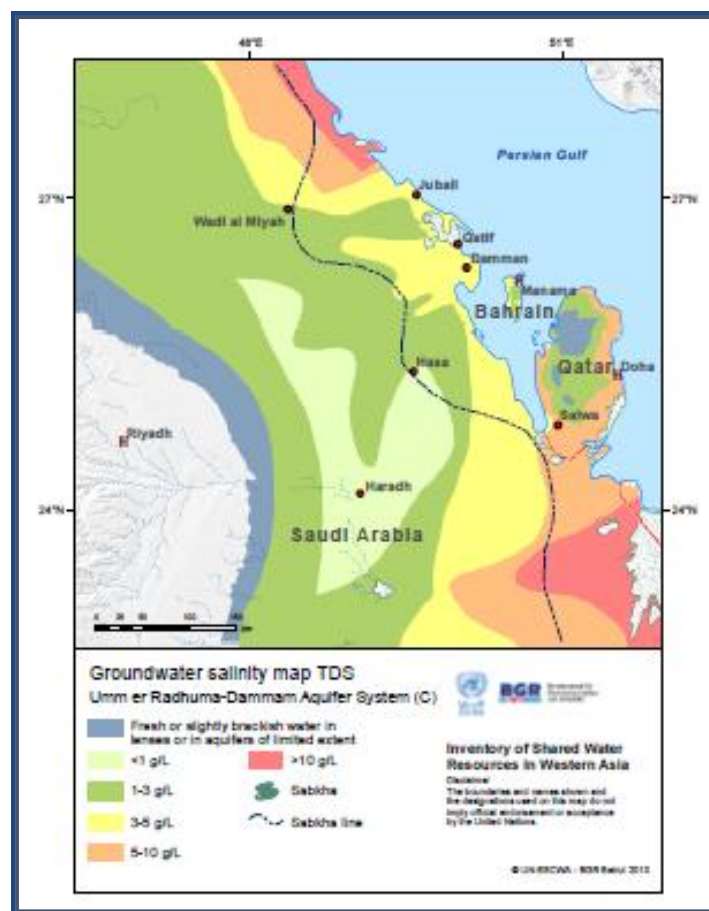
Considerations and recommendations

Most data in the tables and text above have been provided by national and regional experts (listed above) or have been derived from the global WaterGAP model. See colophon for more information, including references to data from other sources.

For the transboundary aquifers of Western Asia, data are only available at the level of the complete aquifer and not of the country segments. All this data as well as information elements in the aquifer description are coming from a comprehensive, United Nations-led inventory to catalogue and characterize transboundary surface and groundwater resources in the Middle East (Source: UN-ESCWA and BGR (United Nations Economic and Social Commission for Western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe). 2013. Inventory of Shared Water Resources in Western Asia. Beirut).

Data gaps and also differences between data from national experts (Global Inventory) and data derived from WaterGAP highlight the need for further research on transboundary aquifers.

Appendix 1: AS140



Groundwater salinity map - TDS of the Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

AS140 - Umm er Radhuma-Dammam Aquifer System (Centre): Gulf

Colophon

This Transboundary Aquifers information sheet has been produced as part of the Groundwater Component of the GEF Transboundary Water Assessment Programme (GEF TWAP). **GEF TWAP** is the first truly global comparative assessment of transboundary groundwater, lakes, rivers, large marine ecosystems and the open ocean. More information on TWAP can be found on: www.geftwap.org. **The Groundwater component** of TWAP carried out a global comparison of 199 transboundary aquifers and the groundwater systems of 41 Small Island Developing States. The data used to compile this transboundary aquifer information sheet has been made available by national and regional experts from countries involved in the TWAP Groundwater project. For aquifers larger than 20 000 km² and which are not overlapping, additional data are available from modelling done by the Goethe University Frankfurt (Germany) as part of TWAP Groundwater. All data were compiled by UNESCO-IHP and the International Groundwater Resources Assessment Centre (IGRAC – UNESCO Category II Institute). Values given in the fact-sheet represent an approximate guide only and should not replace data obtained from recent local assessments. The editors of this information sheet are not responsible for the quality of the data.

For more information on TWAP Groundwater and for more data, please have a look at the TWAP Groundwater Information Management System which is accessible via www.twap.isarm.org or www.un-igrac.org.

Request:

If you have additional data or information about this transboundary aquifer that can improve the quality of this information sheet and the underlying database, please contact us via email at info@un-igrac.org. If appropriate, the information will be uploaded to the database of transboundary aquifers and will also be used in new versions of this information sheet.

References:

- Population: Population has been calculated based on the aquifer map and grid information on population. Source population data: Center for International Earth Science Information Network - CIESIN - Columbia University, United Nations Food and Agriculture Programme - FAO, and Centro Internacional de Agricultura Tropical - CIAT. 2005. Gridded Population of the World, Version 3 (GPWv3): Population Count Grid, Future Estimates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). <http://dx.doi.org/10.7927/H42B8VZZ>. Accessed Jan 2015.
- Rainfall: Average rainfall per TBA has been calculated based on the aquifer map and grid data for precipitation. Source precipitation data: Hijmans, R.J., S.E. Cameron, J.L. Parra, P.G. Jones and A. Jarvis, 2005. Very high resolution interpolated climate surfaces for global land areas. International Journal of Climatology 25: 1965-1978. Grid data download from www.worldclim.org (2015): Data for current conditions (~1950-2000), ESRI grids, 30 arc seconds, Precipitation.
- Climate: Climate indicates the major climate zone which occurs in the aquifer area. If more than 1 climate zone is present the zone with the largest surface area was selected. Source climate data: ArcGIS Online (2015), Simplified World Climate zones. Owner: Mapping Our World GIS Education. Original map: National Geographic World Atlas for Young Explorers (1998).
- All other data: TWAP Groundwater (2015).

Version: October 2015