Transboundary Aquifer Information Sheet

AS139 - Wasia-Biyadh-Aruma Aquifer System (South): Tawila-Mahra/Cretaceous Sands

**Geography**
- Total area TBA (km$^2$): 160 000
- No. countries sharing: 2
- Countries sharing: Saudi Arabia, Yemen
- Population: 870 000
- Climate zone: Arid
- Rainfall (mm/yr): 61

**Hydrogeology**
- Aquifer type: 2-layered, hydraulically connected
- Degree of confinement: Mostly confined, some parts unconfined
- Main Lithology: Sedimentary rocks - sandstones with some marls and siltstones

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**Legend**
- Transboundary aquifer
  - Confirmed aquifer boundary
  - Other aquifer(s)

**Others symbols**
- Rivers
- Lakes
- Political Borders
- TBA Location

**Regional location of aquifer**

**Geological Cross-section across part of the system (N – SE)**
Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.
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TWAP Groundwater Indicators from Global Inventory

<table>
<thead>
<tr>
<th>Recharge (mm/y)</th>
<th>Renewable groundwater per capita (m³/y/capita)</th>
<th>Natural background groundwater quality (%)</th>
<th>Human dependency on groundwater (%)</th>
<th>Groundwater depletion (mm/y)</th>
<th>Groundwater pollution (%)</th>
<th>Population density (Persons/km²)</th>
<th>Groundwater development stress (%)</th>
<th>Transboundary legal framework (Score)</th>
<th>Transboundary institutional framework (Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
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<td></td>
<td></td>
<td>7</td>
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<tr>
<td>Yemen</td>
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<td></td>
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<td></td>
<td></td>
<td>4</td>
<td>D</td>
</tr>
<tr>
<td>TBA level</td>
<td>3</td>
<td>580</td>
<td>90</td>
<td></td>
<td></td>
<td>6</td>
<td>3</td>
<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

(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

<table>
<thead>
<tr>
<th>Distance from ground surface to groundwater table (m)</th>
<th>Depth to top of aquifer formation (m)</th>
<th>Full vertical thickness of the aquifer system* (m)</th>
<th>Degree of confinement</th>
<th>Predominant aquifer lithology</th>
<th>Predominant type of porosity (%)</th>
<th>Secondary Porosity</th>
<th>Transmissivity (m²/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td></td>
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</tr>
<tr>
<td>TBA level</td>
<td>3</td>
<td>580</td>
<td>90</td>
<td></td>
<td>Aquifer mostly confined, but some parts unconfined</td>
<td>Sedimentary rock: Sandstone</td>
<td>High primary porosity fine/medium sedimentary deposits</td>
</tr>
</tbody>
</table>

* Including aquitards/aquicludes

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

Aquifer geometry
The Wasia-Biyadh Sandstones merge with the Aruma in the southern areas of Saudi Arabia to constitute the so-called Cretaceous Sands. These sandstones extend across the Rub’ al Khali Depression into Yemen where stratigraphically correlatable sandstones exist (the so-called Tawila-Mahra Group), thus forming a transboundary aquifer system denoted here as the Wasia-Biyadh-Aruma Aquifer System (South). Geo-structural and physiographic features were used to approximate the boundaries of this system, which comprises 2 hydraulically connected layers. It is mostly confined although some parts are unconfined. The thickness of the aquifer system, including aquitards, varies from 100m to 1000m.

Hydrogeological aspects
The predominant aquifer lithology consists of Sedimentary rocks - sandstones with some marls and siltstones. System replenishment from natural sources is very low (0-2 mm/annum), amounting to an average recharge of about 500Mm³/annum across an area of approximately 56 000 km². The primary type of porosity is predominant that allows high vertical connectivity between layers. Transmissivity across the aquifer states ranges between 200 m²/d and 730 m²/d.

Linkages with other water systems
Limited recharge occurs in localized areas, either directly from rainfall or indirectly via coarse aeolian sand dunes and fractured outcrop zones. There are no visible signs of discharge on the surface (see Appendix 1).

Environmental aspects
Groundwater is fresh (400-800 mg/l TDS) and quality does not satisfy local drinking water standards in only about 10% of aquifer area, particularly in superficial layers of the aquifer system.

Socio-economic aspects
Abstraction of groundwater from the system is known to be very limited because of its remoteness (for desert nomads and border posts), but the potential is there in both Aquifer States.

Legal and Institutional aspects
National Institutions for the management of groundwater exist in both Aquifer States but no formal Transboundary Agreement has been made.

Emerging issues
No priority issue exists at the present, as abstraction from the system is limited. This large reservoir of fresh groundwater is an important resource for the economic development of the Sharurah/Al Abr area in the future. It may also prove to be a source of water for more distant but rapidly developing urban areas in both Saudi Arabia and Yemen. The existence of radon in the sandstones needs to be assessed since it may become a limiting factor in the long-term.

Contributors to Global Inventory

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Country</th>
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<th>Role</th>
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<tbody>
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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: AS139

Wasia-Biyadh-Aruma Aquifer System (South): Tawila-Mahra/Cretaceous Sands: indicating Groundwater flow directions
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](http://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](http://www.twap.isarm.org) or [www.un-igrac.org](http://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:

- 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).

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