11N - Nogales

Geography
Total area TBA (km²): 1700
No. countries sharing: 2
Countries sharing: Mexico, United States of America
Population: 74 000
Climate zone: Arid
Rainfall (mm/yr): 460

Hydrogeology
Aquifer type: 2-layered system
Degree of confinement: Unconfined
Main Lithology: Sediment - sand

Map and cross-section are only provided for illustrative purposes. Dimensions are only approximate.
## TWAP Groundwater Indicators from Global Inventory

<table>
<thead>
<tr>
<th></th>
<th>Mexico</th>
<th>United States of America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recharge (mm/y)</td>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>Renewable ground water per capita (m³/y/capita)</td>
<td>200</td>
<td>TBA level</td>
</tr>
<tr>
<td>Natural background groundwater quality (%)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Human dependency on groundwater (%)</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Groundwater depletion (mm/y)</td>
<td>B</td>
<td>15</td>
</tr>
<tr>
<td>Groundwater pollution (%)</td>
<td>0</td>
<td>A</td>
</tr>
<tr>
<td>Population density (Persons/km²)</td>
<td>100</td>
<td>15</td>
</tr>
<tr>
<td>Groundwater development stress (%)</td>
<td>33</td>
<td>A</td>
</tr>
<tr>
<td>Transboundary legal framework (Score)</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Transboundary institutional framework (Score)</td>
<td>C</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).
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>Parameter</th>
<th>Mexico</th>
<th>United States of America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from ground surface to groundwater table (m)</td>
<td>34</td>
<td>TBA level</td>
</tr>
<tr>
<td>Depth to top of aquifer formation (m)</td>
<td>&lt;5</td>
<td>TBA level</td>
</tr>
<tr>
<td>Full vertical thickness of the aquifer (system)* (m)</td>
<td>90</td>
<td>TBA level</td>
</tr>
<tr>
<td>Degree of confinement</td>
<td>Whole aquifer unconfined</td>
<td>TBA level</td>
</tr>
<tr>
<td>Predominant aquifer lithology</td>
<td>Sediment - Sand</td>
<td>TBA level</td>
</tr>
<tr>
<td>Predominant type of porosity or voids</td>
<td>High primary porosity fine/medium sedimentary deposits</td>
<td>TBA level</td>
</tr>
<tr>
<td>Secondary porosity: Fractures</td>
<td>Secondary porosity: Fractures</td>
<td>TBA level</td>
</tr>
<tr>
<td>Transmissivity (m²/d)</td>
<td>240</td>
<td>TBA level</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

Only Mexico has provided data

Aquifer geometry
It is a 2-layered aquifer system. Distance to groundwater level 34m (max. 140m). The average vertical thickness of the aquifer system is 90m. The whole aquifer is unconfined.

Hydrogeological aspects
The predominant lithology is sediment – sand with a high primary porosity fine/medium sedimentary deposits as well as secondary porosity: Fractures. Transmissivity is estimated at 240m²/day and total groundwater volume as 0.54km³. The average annual groundwater recharge 5.2Mm³/annum from a recharge area of 120km².

Linkages with other water systems
Recharge to the aquifer is from precipitation on the aquifer area and discharge through groundwater flow into another aquifer.

Environmental aspects
Just 1% of the aquifer the natural groundwater quality is not suitable for human consumption. Some pollution has been identified. The extent is not known. Besides unknown sources, there are indications of industrial pollution, resulting in elevated nitrogen species, pathogens and industrial organic compounds. Over 3% of the aquifer area groundwater levels are shallow (< 5m) and groundwater dependent ecosystems occur.

Socio-economic aspects
The annual groundwater abstraction in Mexico is 0.8Mm³/annum, which is also the figure for total fresh water abstraction. No groundwater depletion is occurring at present.

Legal and Institutional aspects
Mexico reports a signed bi-lateral agreement with full scope as well as a national institution with full mandate and capacity. Groundwater is comprehensively managed according to the laws and regulations of the country.

Emerging issues
Groundwater use is low, but indications of industrial pollution should be a concern.

Contributors to Global Inventory

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
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<tr>
<td>Sención Aceves</td>
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</table>
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.

The TBA system could not be described fully, because only one of the TBA countries provided adequate numerical information.

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.

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:

- 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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