# Updated Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters: focus on groundwater

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# Preliminary assessment of transboundary aquifers

- Geological and hydrogeological maps are a good starting point to identify transboundary aquifers.

- Stratigraphic records are also needed to determine the vertical extent of hydrogeological units. Stratigraphic logs are usually recorded in borehole databases.

- Groundwater flow direction and rate can then be determined based on groundwater levels measurements, which are usually recorded in borehole databases or in monitoring databases.

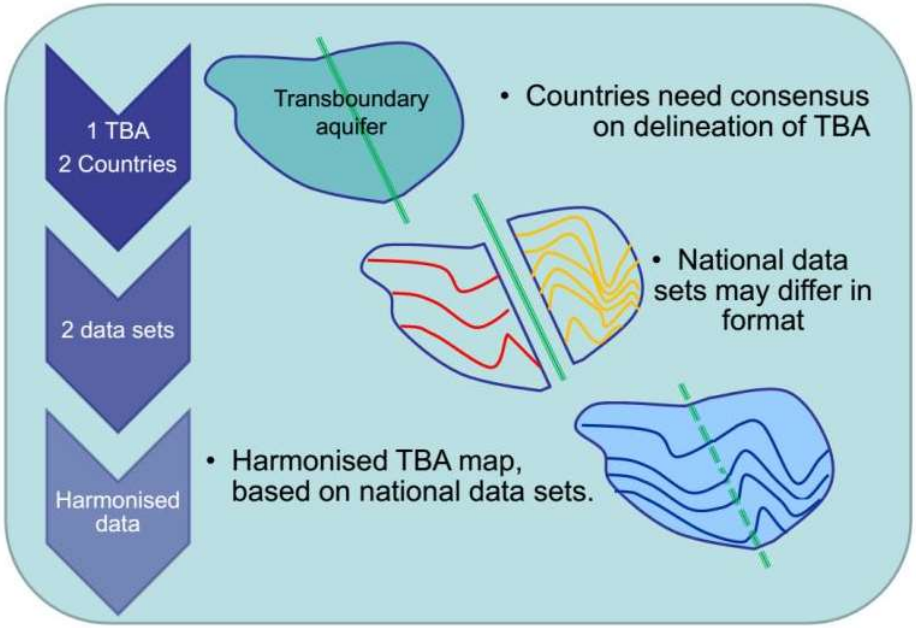
- Additional data and investigation will be needed to complement the hydrogeological assessment (e.g. geophysics, geochemical and isotopic studies, groundwater recharge estimation, numerical modeling).

- For the sake of a multidisciplinary assessment, the hydrogeological assessment needs to be complemented with data and information on the larger environmental and socio-economic context.

*https://www.un-igrac.org/sites/default/files/resources/files/Guidelines%20for%20TBA%20Assessment%2020150901.pdf*

- There will likely be discrepancies between the maps and datasets, requiring harmonization.

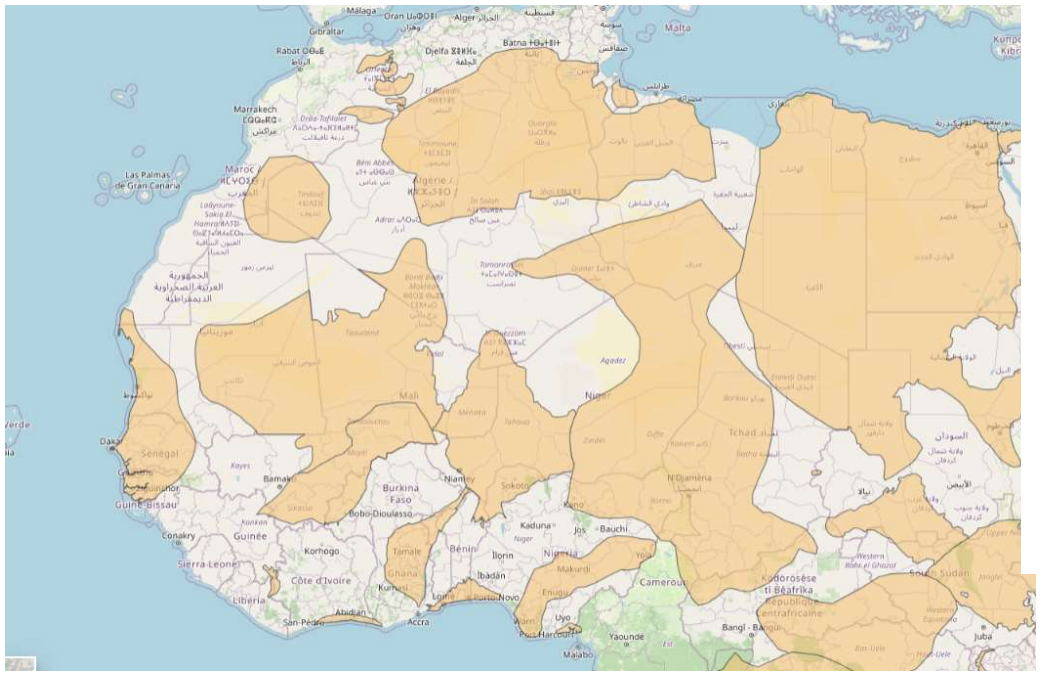
- Sharing metadata is necessary when sharing data between organizations and countries.



# Hotspots

- In large TBAs, it is recommended to identify hotspots where activities on one side of the border will most likely impact the neighboring country: groundwater over-abstraction and contamination, but also land-use changes, surface water interventions, MAR (e.g. Genevois aquifer), etc.

- Scale is key!



*https://ggis.un-igrac.org/view/tba*

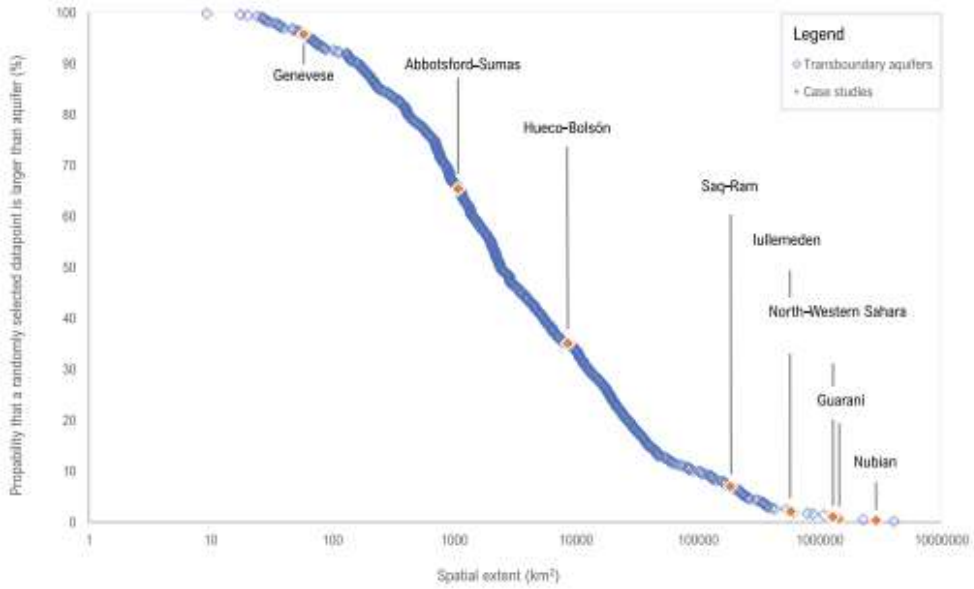
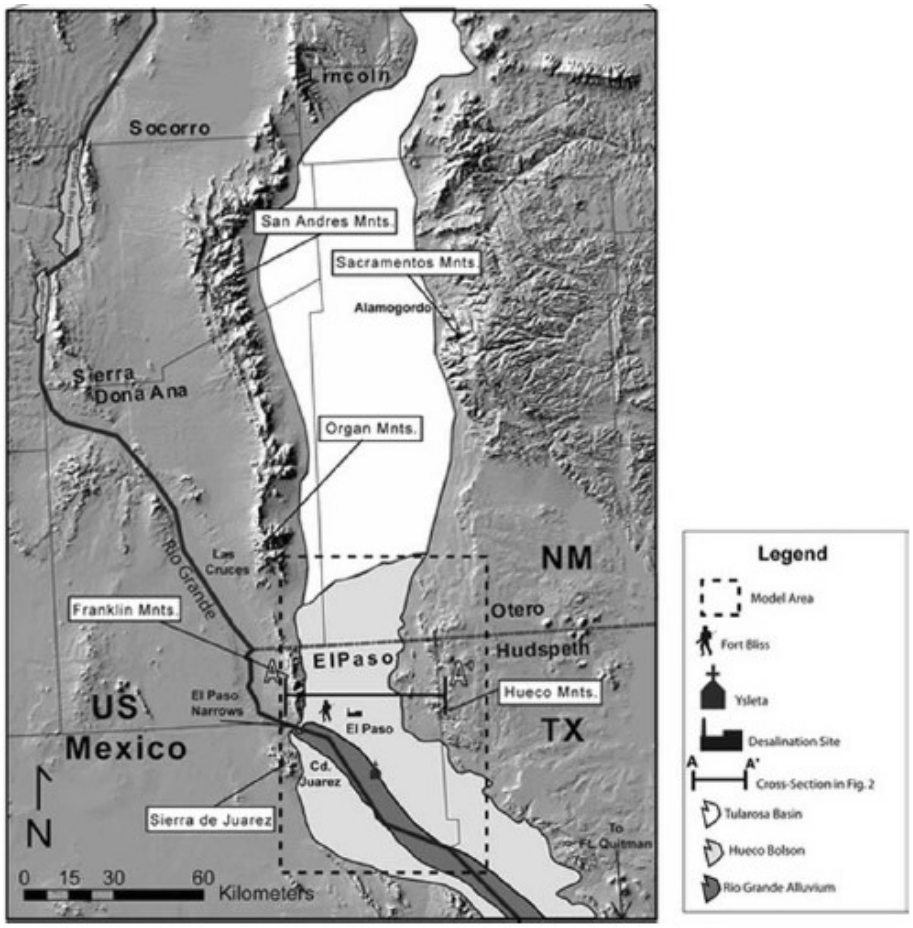
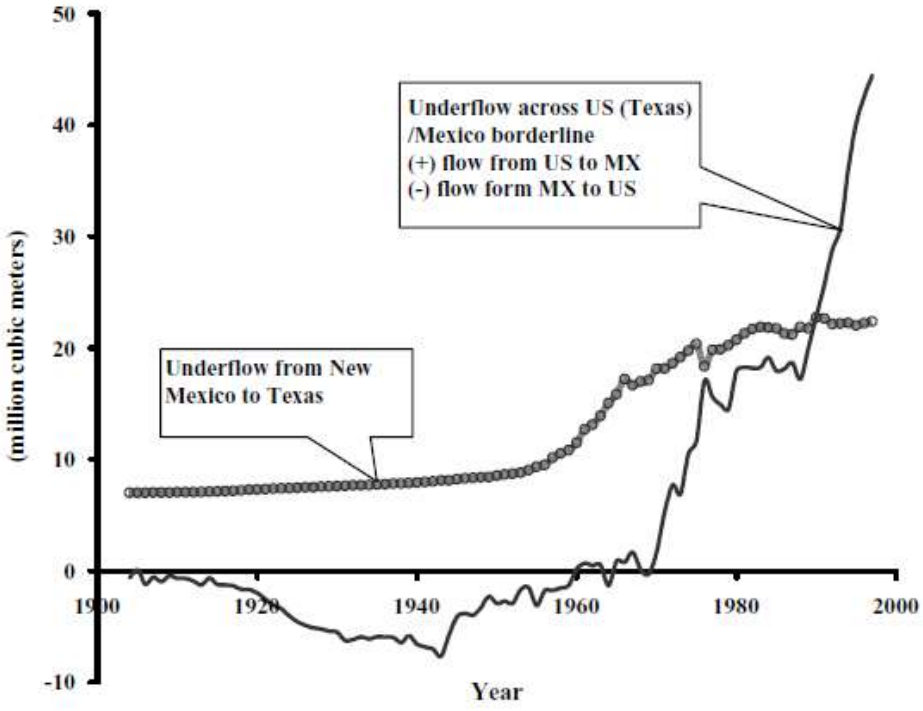



**Figure 2.** Distribution of transboundary aquifers by spatial extent, reflecting case study heterogeneity. Note: The Genevese belongs to the smallest 5% transboundary aquifers in the world; the Nubian Sandstone, Guaraní and the North-Western Sahara aquifer systems are among the largest 1.0%.

*Maya Velis, Kirstin I. Conti & Frank Biermann (2022)*
*DOI: 10.1080/02508060.2022.2038925*

- The natural direction and rate of groundwater flow can be modified by abstraction. Therefore, the distinction between upstream and downstream countries is not always relevant. Example of the Hueco Bolson aquifer shared between Mexico and USA.

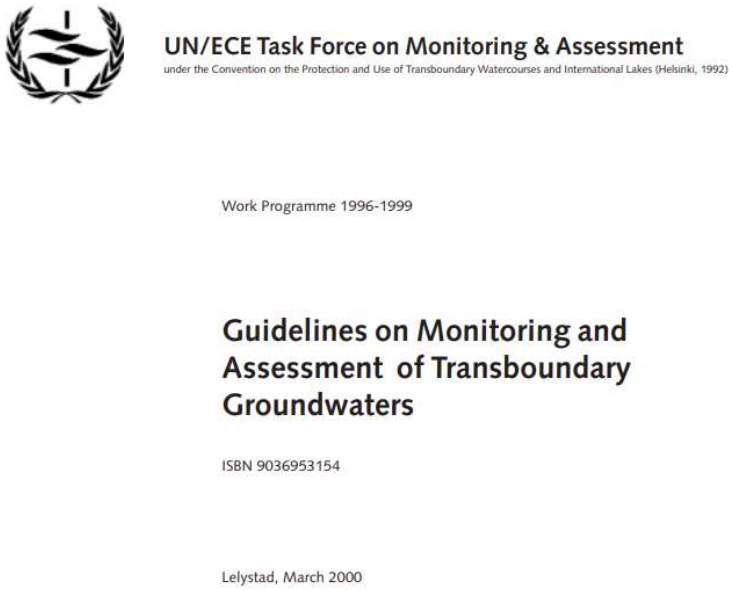



*Source: Sheng, Z., Devere, J. (2005) https://doi.org/10.1007/s10040-005-0451-8*

# Transboundary groundwater monitoring

- The specific aspects of transboundary groundwater monitoring have been captured in an annex, based on the earlier *Guidelines on Monitoring and Assessment of Transboundary Groundwater*.



UN/ECE Task Force on Monitoring & Assessment

under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992)

Work Programme 1996-1999

**Guidelines on Monitoring and Assessment of Transboundary Groundwaters**

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Lelystad, March 2000

- The design of a joint monitoring network will depend on the objectives of transboundary cooperation.

*Table 2.3: Example of data needs from different data sources for specified objectives*

| | Monitoring objectives | Groundwater observation wells | | | Groundwater pumping wells | | | Springs | | | Surface water observation points | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | levels | discharge | quality | level | discharge | quality | level | discharge | quality | level | base flow | quality |
| | *Groundwater development* | | | | | | | | | | | | |
| 1 | GW system characterisation | xx | n.a. | | x | | | x | | | x | | |
| 2 | GW potential for development (quantity and quality) | xx | n.a. | xx | | xx | xx | | xx | xx | | xx | x |
| 3 | Best locations for well fields | xx | | xx | | | xx | | | x | | | (x) |
| | *Control and protection* | | | | | | | | | | | | |
| 4 | Trends of over-exploitation | xx | n.a. | | x | xx | | | xx | | | xx | |
| 5 | Nature conservation | xx | n.a. | | | xx | | x | xx | | | xx | |
| 6 | Saline water intrusion | x | n.a. | xx* | x | xx | xx* | | | | x | x | (x) |
| 7 | Land subsidence | x | n.a. | | | xx | | | | | | | |
| 8 | Contamination of aquifers | | n.a. | xx | | | xx | | | xx | | | xx |

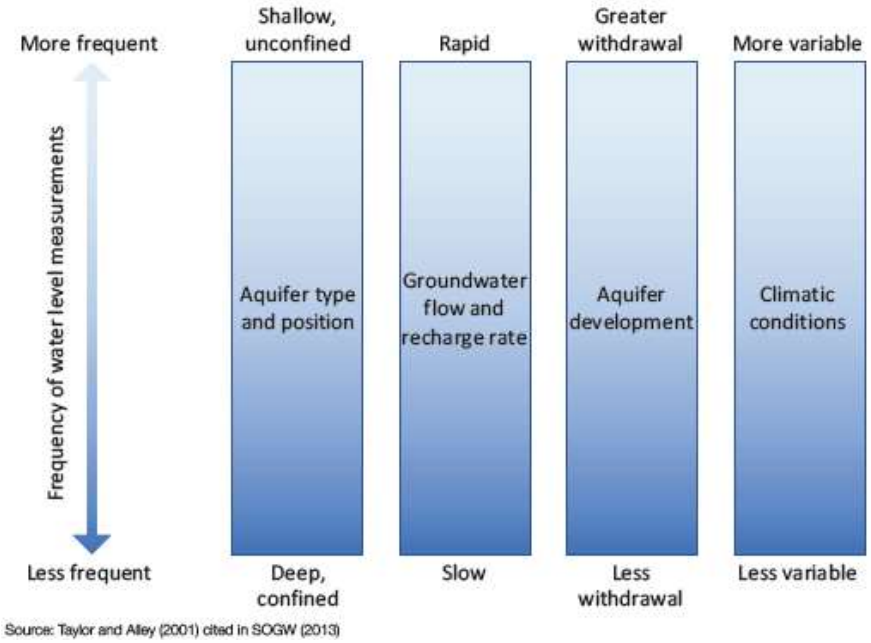
x = desirable data; xx = necessary data; xx* = mainly Chloride; n.a. = not applicable.

*IGRAC (2008) https://www.un-igrac.org/sites/default/files/resources/files/WG1-7-Guideline-v12-03-08.pdf*

- It will usually include groundwater level, groundwater quality and groundwater abstraction monitoring.

- The design of a joint monitoring network will also reflect the scale and the complexity of the hydrogeological system.

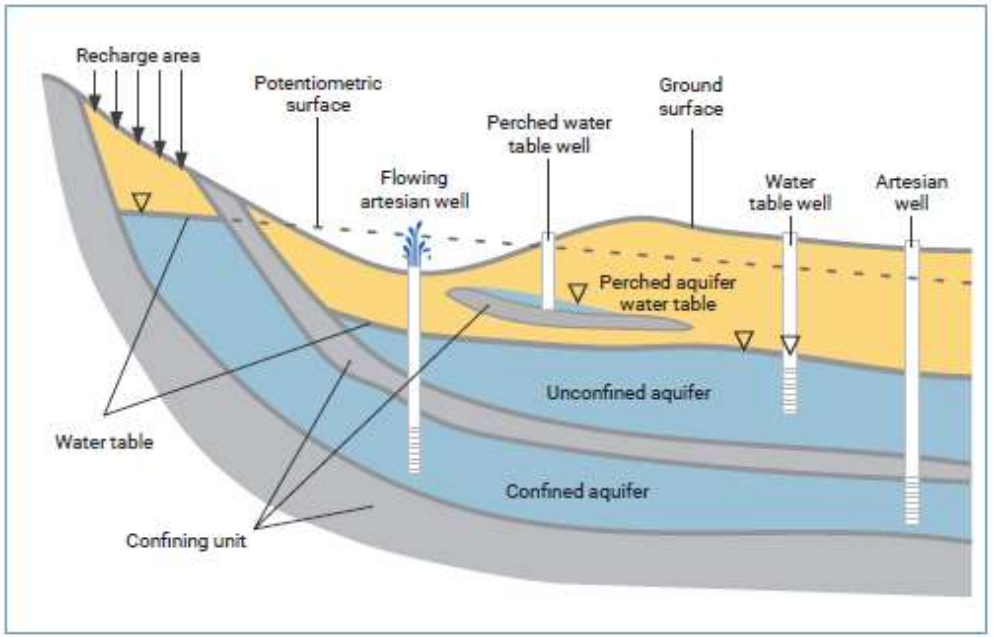
- Groundwater monitoring has usually a lower frequency than in rivers, because groundwater flow is slower.



Source: Taylor and Alley (2001) cited in SOGW (2013)

*Taylor and Alley (2001) cited in SOGW (2013)*

- Compared to surface water, more observation points might be necessary to capture the 3-dimensional complexity of hydrogeological systems.




*WWAP 2022*

- Existing observation wells would be used in the first place. However, TBA monitoring might require additional wells. This would require additional cooperation efforts from the countries.

- Monitoring of groundwater abstraction is usually restricted to wells owned by water companies or large private users. The number of boreholes and their average yield is usually used as a proxy, but it requires new boreholes to be registered. This is not always a legal obligation, and when it is, it is often not properly enforced.

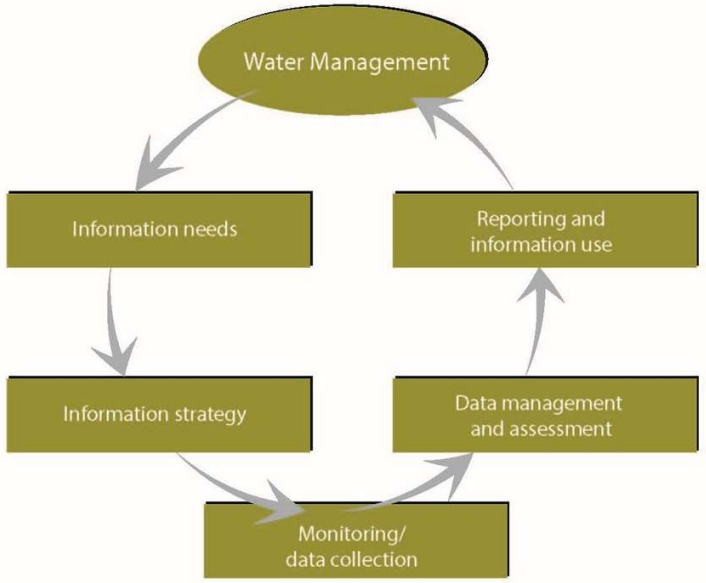
Example of the Doñana National Park, a World Heritage site threatened by illegal wells.

*https://www.wwf.eu/?3877416/EU-court-rules-Spain-at-fault-over-degradation-of-Donana*

- In addition to hydrogeological data (monitoring data and borehole data), other data and information might be exchanged if relevant to potential cross-border impacts.

- The monitoring program should be evaluated and updated frequently.

- New monitoring data might allow refining the assessment of TBA. It is an ongoing effort!




- The interpretation of new data requires capacity (hydrogeologists). A joint team responsible for the monitoring and the assessment of transboundary aquifers seems instrumental.

- It can be an intergovernmental institution (e.g. RBO or TBA authority), or a multi-country taskforce.

# *Thank you for your attention!*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