

# Africa Groundwater Atlas

Making African groundwater information more visible and accessible

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<http://www.bgs.ac.uk/africagroundwateratlas/index.cfm>



**British Geological Survey**  
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# What is the Africa Groundwater Atlas?

- Atlas: “book of maps”
- Brings together **existing groundwater information** from many sources in a **consistent** way
- A consistent overview of groundwater resources, status & management for **51 African countries**
- A starting point for **understanding groundwater at a country-scale**
- A **gateway** to more detailed information
- In collaboration with IAH & hydrogeologists across Africa



Unlocking the  
Potential of  
Groundwater  
for the Poor



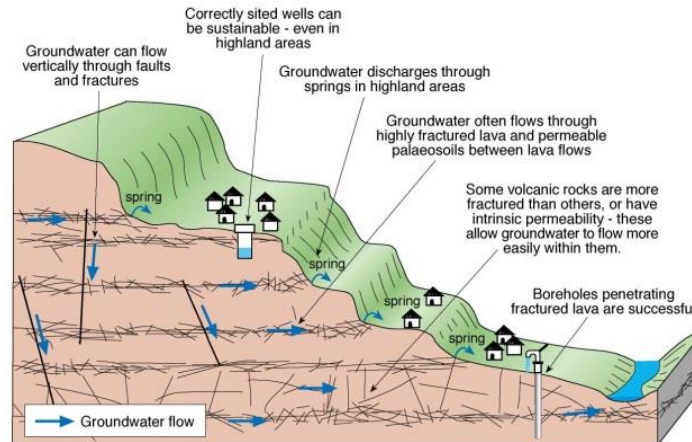
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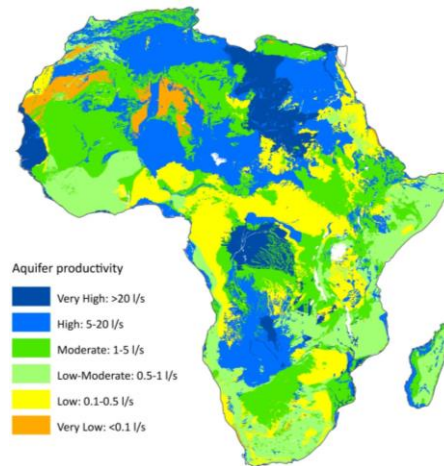
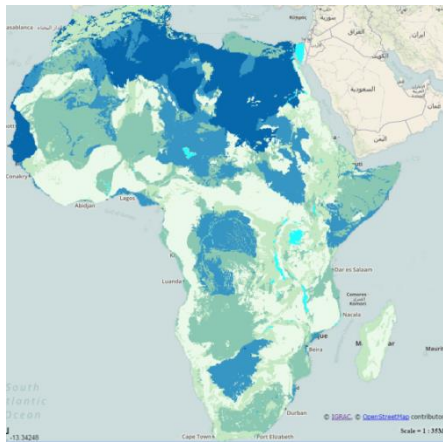
# Why is the Atlas important?

- For safe, sustainable groundwater development we need to **understand groundwater**
- To understand groundwater we need **good information** – which is hard to find!
- **BUT** there is lots of good information out there – it's just not always easily **visible** and **accessible**



# Background to the Atlas

- Publication of continental-scale maps of **aquifer productivity**, **groundwater storage** and **depth to groundwater**



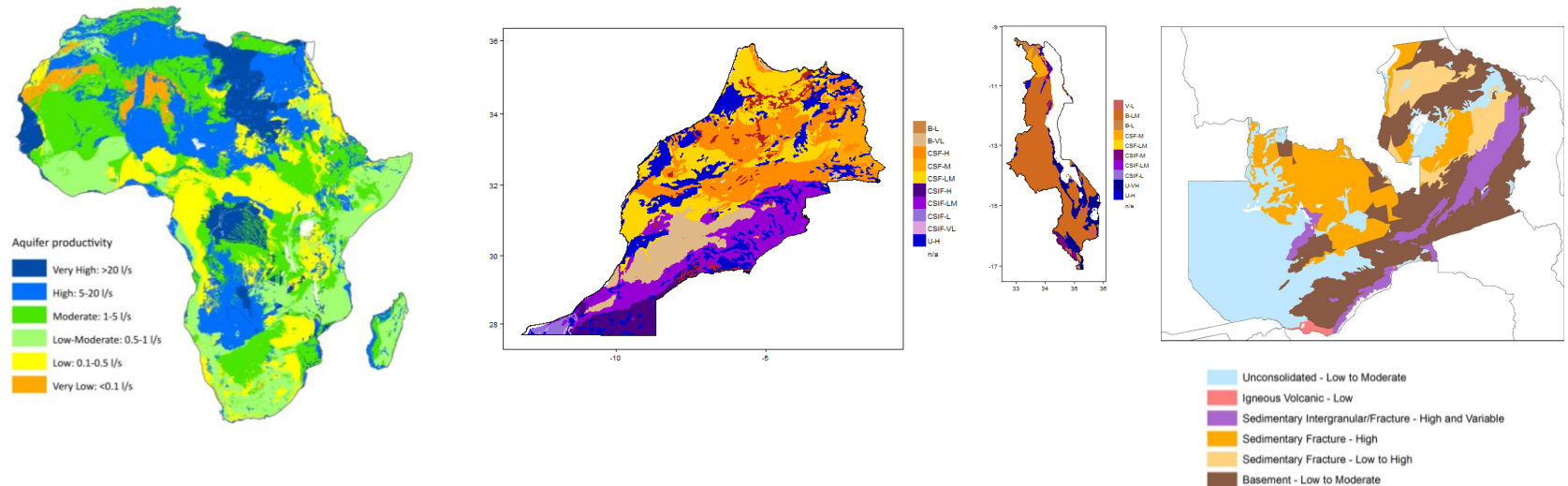
*Download maps from BGS website as GIS files<sup>1</sup>  
or  
View IGRAC's Groundwater Resources in Africa webpage<sup>2</sup>*

- Demand for **country-scale** information
- Increased spending from UK government on overseas development research e.g. UPGro

<sup>1</sup><http://www.bgs.ac.uk/research/groundwater/international/africanGroundwater/maps.html>

<sup>2</sup><https://ggis.un-igrac.org/ggis-viewer/viewer/groundwaterafrica/public/default>

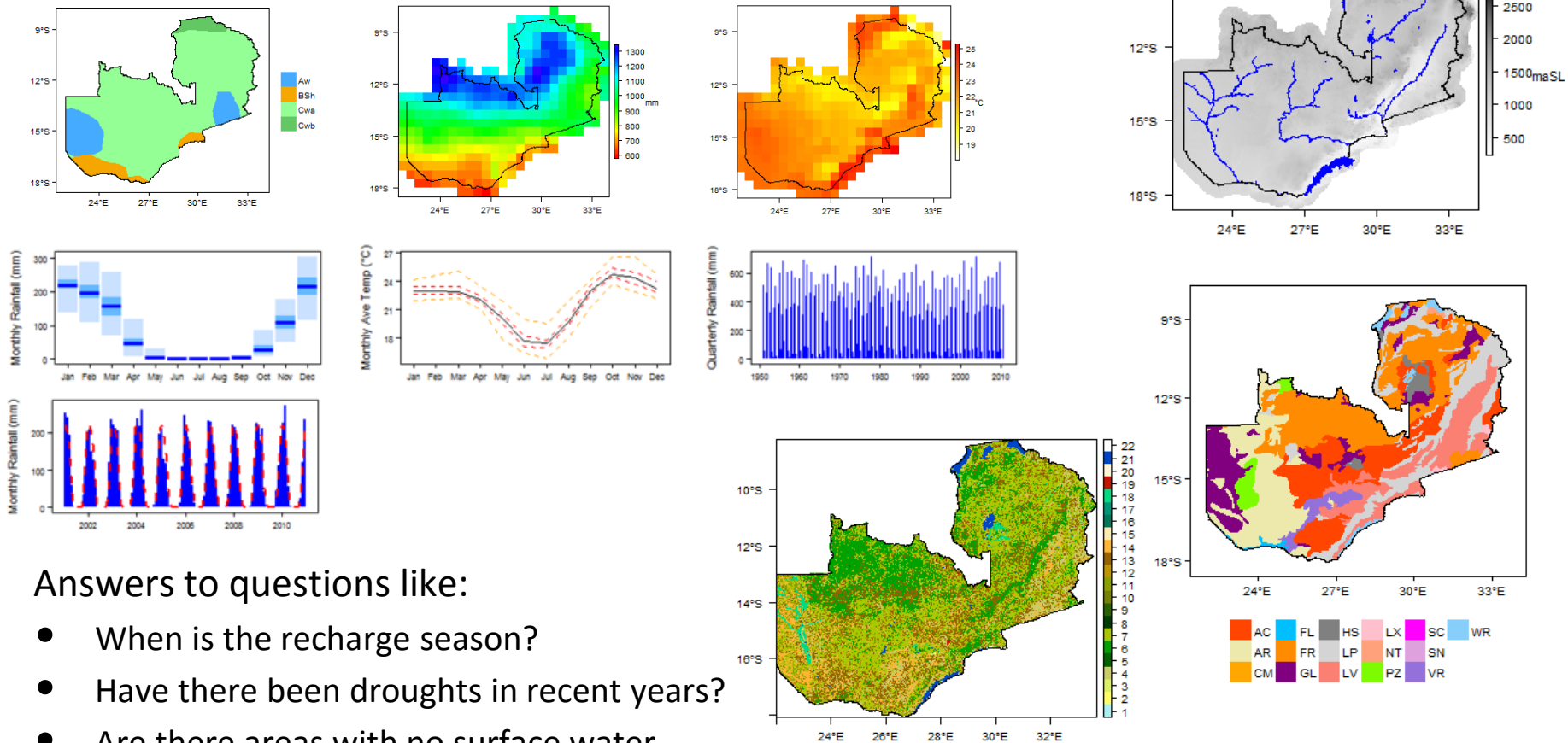
# Developing the Africa Groundwater Atlas



- 1:5M USGS Geology Map of Africa > BGS Geology & Hydrogeology Map of Africa > country hydrogeology maps
- Country profiles for **51 countries**
- Co-written with hydrogeologists from across Africa
- Online and free
- Offline version available

# What's inside the Atlas: Climate, Soil, Land Cover

- Derived from 3<sup>rd</sup> party data
- Easy to compare from one country to another

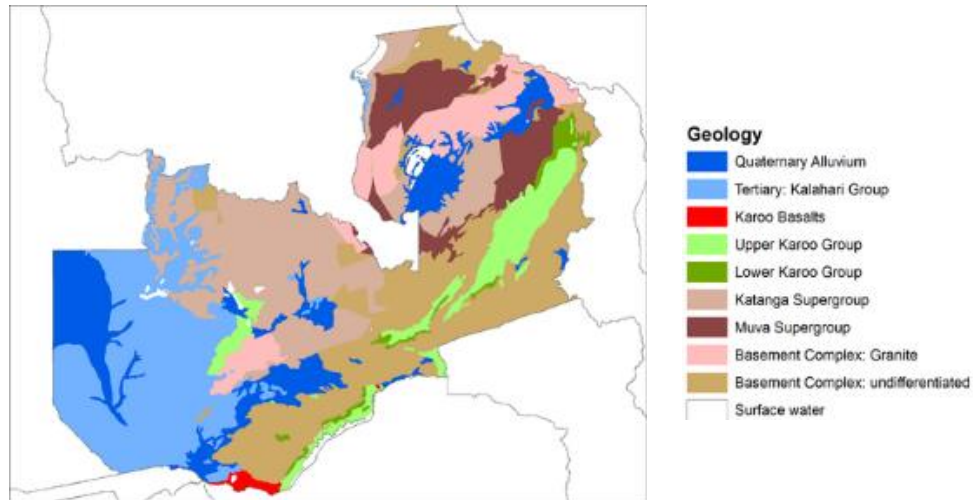


Answers to questions like:

- When is the recharge season?
- Have there been droughts in recent years?
- Are there areas with no surface water resources?

# What's inside the Atlas: Geology

## Summary of main geological formations

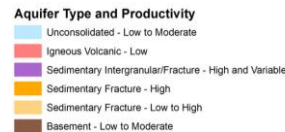
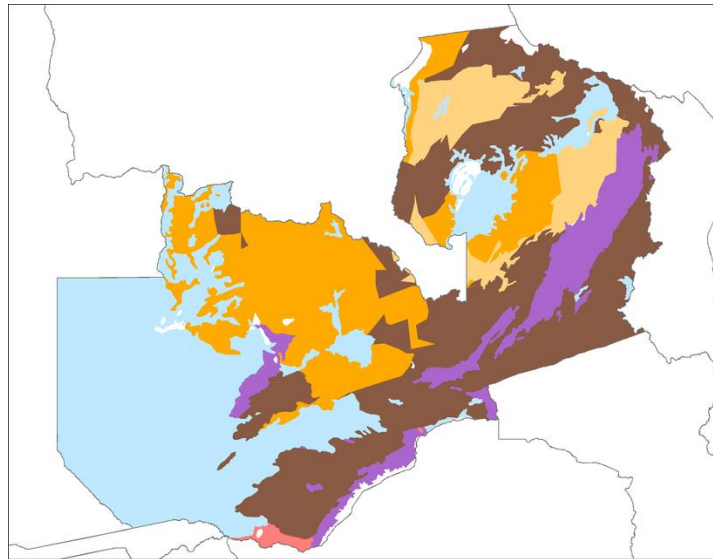


**Geological Environments**

Key Formations	Period	Lithology	Structure
<b>Alluvium</b>			
Alluvium and lacustrine deposits	Recent (Quaternary)	Unconsolidated alluvial soil, sands and gravels; and some clays near lakes	
<b>Kalahari Group</b>			
Zambezi Formation	Tertiary - Recent	Ferricrete, evaporites, conglomerate and gravel	
Barotse Formation	Tertiary	Sandstone, Chert, Quartzite	Sedimentary bedding
<b>Upper Karoo Group and Karoo Basalts</b>			
Luano, Siavonga, Kato, Luangwa and Batoka formations	Jurassic - Early Cretaceous	Most of the sequence comprises consolidated sedimentary rocks: mudstone, sandstone, siltstone, coal, gritstone, tillite, mixite and conglomerate. The uppermost Batoka Formation consists of basalt with interbedded sandstone, distinguished on the geology map above as Karoo Basalts.	Sedimentary bedding, laminations and ripple marks
<b>Lower Karoo Group</b>			
Siakandobo, Gwembe and Madumabisa formations	Carboniferous - Jurassic	Consolidated sedimentary rocks: sandstone, gritstone, siltstone, mudstone	Sedimentary bedding, laminations and ripple marks
<b>Katanga Supergroup</b>			
Including Upper Roan Dolomite, Lusaka, Kaleya, Chifumbu and Chalugoma formations and Kundelungu Limestone	Precambrian (870-620 Ma)	Variably metamorphosed marble, schist, argillite, quartzite, dolomite and limestone.	Sedimentary bedding, metamorphic foliation and banding, folding
<b>Muva Supergroup</b>			
Kankaluwe, Rufunsa and Chakwenga River formations	Precambrian (1355±28 Ma)	Metamorphic rocks: carbonatite, gabbro, amphibolite, granodiorite and schist	Metamorphic foliation; jointing and folding
Chitobe, Kabweluma, Nsama and Mbala formations	Precambrian (1355±28 Ma)	Variably metamorphosed conglomerate, quartzite, limestone and carbonates	Metamorphic foliation; jointing and folding
<b>Basement Complex: Granite</b>			
	Mainly older Precambrian	Granite	Quartz veins.
<b>Basement Complex: undifferentiated</b>			
	Mainly older Precambrian	Metamorphosed rocks; gabbro, basalt, granite, dolerite, apilite, andesite.	Quartz veins; faulted, folded and jointed

# What's inside the Atlas: Hydrogeology

## Summary of key aquifers



Answers to questions like:

- Where are the high yielding aquifers?
- Is groundwater storage and flow in pores or weathered zones or fractures?
- What are typical borehole yields from an aquifer?
- What is the groundwater quality?

### Unconsolidated: Intergranular Flow

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
Alluvium (Quaternary)				Direct recharge from rainfall, and recharge from rivers.
Kalahari Group (Tertiary)	This aquifer comprises 20 to 40 m of unconsolidated sands, which are usually unconfined. Flow and storage are intergranular. The water table is usually at a depth of about 10 to 20 m below ground surface, but sometimes is as much as 30 m deep. Yields of 0.2 to 5 l/s are obtainable.		Sometimes brackish.	Largely direct recharge from rainfall.

### Igneous

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
Karoo Basalts	The aquifer comprises basalts with interbedded sandstone. It is characterised by a weathered zone up to 20 m deep. Below this are fractures that allow groundwater flow, which are more common above about 45 to 50 m depth. The aquifer is unconfined, and the water table varies from about 10 to 25m deep. Boreholes are usually between 45 and 50 m deep, to the base of the most fractured zone. One transmissivity value quoted for the aquifer is 5.7 m <sup>2</sup> /day. Borehole yields are usually low, less than 2 l/s. Higher yields may be encountered in zones where low permeability crystallised quartz horizons have created 'dams' and increased local groundwater storage, although such higher yields may not be sustainable in the long term as groundwater storage is used up.		Usually good	Recharge can occur through fractures

### Upper and Lower Karoo Groups: Consolidated Sedimentary Aquifer with Intergranular & Fracture Flow

Named Aquifers	General Description	Water quantity issues	Water quality issues	Recharge
Upper and Lower Karoo Groups	Sandstones in the Karoo sequence form high porosity, high permeability aquifers with significant intergranular flow. The aquifers are typically unconfined, but occasionally confined. The water table is often between 15 to 20 m below ground surface. Yields of up to 15 l/s are possible. Shales, mudstones and other fine grained lithologies in the Karoo sequence typically form low productivity aquifers, with yields of 0.2 to 2 l/s.		Sometimes fresh, but in most cases brackish.	Direct recharge.



# What's inside the Atlas: Additional GW Info

- Quality
- Status
- Use
- Management

## Groundwater use and management

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### Groundwater use

There are currently inadequate data to make an accurate assessment of Zambia's groundwater availability and use. Personal experiences and estimates would put groundwater usage at about 60% – 70% of total national water supplies, although this is highly variable spatially.

The groundwater resource has greatly suffered from unregulated exploitation and exposure to pollution – aspects that may threaten it as an important source of water in the future.

The National Water Master Plan (JICA-MEWD, 1995) estimated that the breakdown of groundwater use was:

- 30% irrigation
- 27% rural water supply
- 22% livestock
- 13% urban supply.

Groundwater is accessed from a variety of sources: boreholes equipped with electric pump, hand-pumps, windmills, solar pump, diesel pumps and rope and bucket. There are no recent statistics on the different pump technologies employed, but a nationwide inventory carried out by government in 1998 produced an estimated total of 11,000 boreholes (electric and hand pump) and 22,000 protected wells in the country (National Water Policy 2010).

### Groundwater management

The key groundwater institutions are:

- Department of Water Affairs – for water policy formulation.
- Ministry of Local Government and Housing – for rural water supply
- Water Resources Management Authority (WARMA) – for water resources development, utilisation and management

The legal framework for groundwater monitoring in Zambia comprises the following:

- The Revised National Water Policy of 2010
- The Water Resources Management Act of 2011, which stipulates that there shall be no private ownership of water and that any permission to use water will be time-limited. The Act provides for permits to drill and abstract groundwater, but these have not yet been implemented. The greatest challenge to effective (ground)water resources management in the country is posed by poor institutional and legal frameworks; inadequate water resources data and information systems; poor coordination of various ministries, departments and institutions dealing with water; centralised management of water resources; and lack of monitoring and evaluation of programmes and projects relating to water (National Water Policy 2010).

There is much good information on water points, including boreholes and wells, but it is fragmented across several institutions. For example, there is a well-organised borehole database for the Southern region, including geological logs, related to a project carried out by GTZ.

### Transboundary aquifers

Zambia has two transboundary aquifers identified by the SADC Hydrogeological Mapping Project (SADC, 2010). The "Medium Zambezi Aquifer" crosses the border with Zimbabwe, and the "Sands and gravel aquifer" crosses the border with Malawi.

For further information about transboundary aquifers, please see the [Transboundary aquifers resources page](#)

### Groundwater monitoring

Groundwater level measurements are taken automatically at some stations in Lusaka on a daily basis, while in other places, these are read fortnightly.

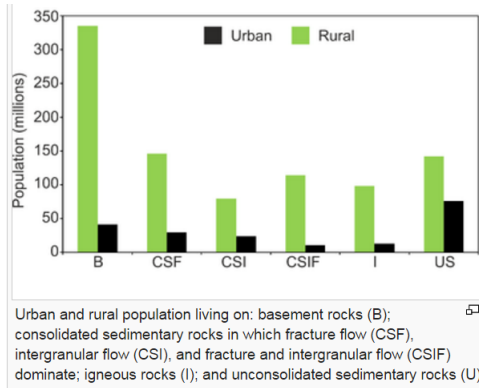
There is no national or regional groundwater quality monitoring.

## Answers to questions like:

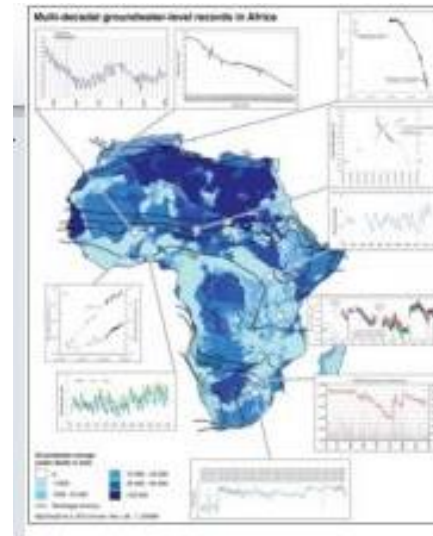
- What are the main uses of groundwater?
- Are there any big groundwater problems? (water quality? over-abstraction?)
- Which institutions are involved with groundwater management?
- Is there groundwater monitoring?
- Are there national groundwater databases?

# What's inside the Atlas: Additional Resources

## Groundwater use



## Groundwater monitoring



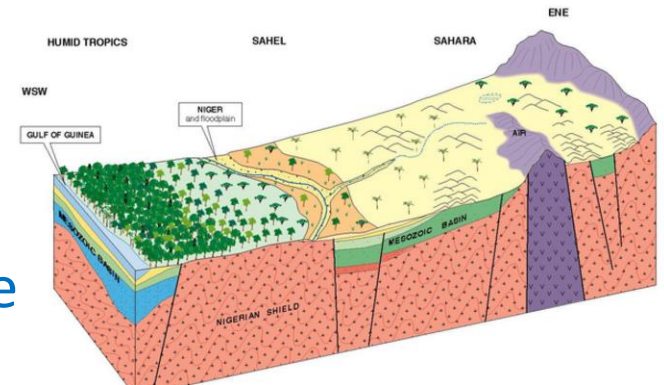
## Groundwater quality



Groundwater Assessment Platform



## MAIN LANDSCAPE ELEMENTS, GROUNDWATER RECHARGE AND WATER QUALITY EVOLUTION IN THE SAHARA/SAHEL

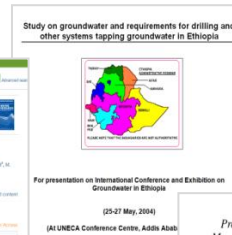
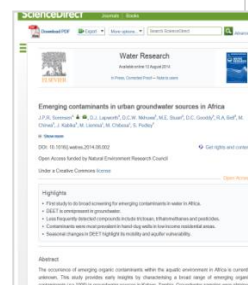
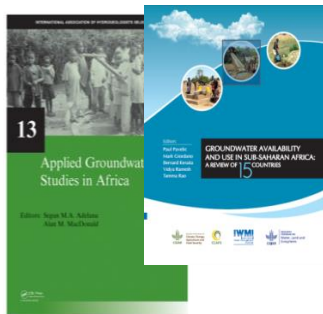


## Recharge

# Where to find more information: Africa Groundwater Literature Archive

- The most comprehensive yet index of African groundwater literature: **~7000 entries** (so far!)
- **Full text download** if available; or for copyrighted documents, **link to online abstract** if available
- Full bibliographic references
- Complements other literature archives: e.g. WRC; IRD; SADC Grey Literature Archive

The screenshot shows the homepage of the Africa Groundwater Literature Archive. The header features the title 'Africa Groundwater Literature Archive' in a blue banner. Below the header, there is a navigation menu with links for 'Home', 'Introduction', 'About the Archive', 'External links', 'Search Archive', and 'Select Country'. The 'Introduction' section provides a welcome message and explains the archive's purpose. It mentions that the archive is a searchable database of published and unpublished groundwater literature about Africa, including reports, journal articles, conference papers, and maps. It also notes that the archive is not an exhaustive list and that users are encouraged to provide feedback. The page includes logos for 'UP Gro' (Unlocking the Potential of Groundwater for the Poor), 'British Geological Survey' (Natural Environment Research Council), 'UKaid' (UK Aid for Africa), and 'NERC'. There are also sections for 'Prepared by:', 'Jointly funded by:', 'Searching the Archive', 'Search Form', and 'Map Search'.



# What's next?

- Updates & corrections
- Digital (GIS) hydrogeology and geology maps to download
- Translation into French
- More information for some countries
- Increasing relevant social science information
- Adding new references & documents to the Literature Archive – as many as possible with full text digital copies

# What's next?

- Feedback from users – what is useful for you?
- Making the hydrogeological information easier to use for non-hydrogeologists?
- Case studies of how maps/information can be used at different scales?
- Additional detail of groundwater monitoring (data)?
- Resources to help understand groundwater?
- Further interpretation of groundwater information in the Atlas

# Thankyou!

If you have any comments on the Atlas or Archive, please get in touch.

Email us on [AfricaGWAtlas@bgs.ac.uk](mailto:AfricaGWAtlas@bgs.ac.uk)

And/or fill out the online survey:

- English version – <https://www.surveymonkey.co.uk/r/Z9DYD9D>
- French version – <https://www.surveymonkey.co.uk/r/ZTQ8MYF>

The Africa Groundwater Atlas is at:  
<http://www.bgs.ac.uk/africagroundwateratlas/index.cfm>