

Monitoring of the groundwater - surface water interactions in the Victoria Nile basin of Uganda - *preliminary results*



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Overview

- Rationale
- Objectives
- Groundwater – surface water interface
- Regional groundwater storage
- Groundwater – surface water interactions
- Ongoing activities

Rationale

- low relief surface (African) supports SW & wetlands
- livelihoods – HEP, water supply, aquatic habitats, fishery, agriculture
- contribution of groundwater to SW during dry periods is unknown,
- no conceptual or numerical representation

Aim:

Improve understanding GW-SW interactions on low relief surfaces in the Victoria Nile Basin

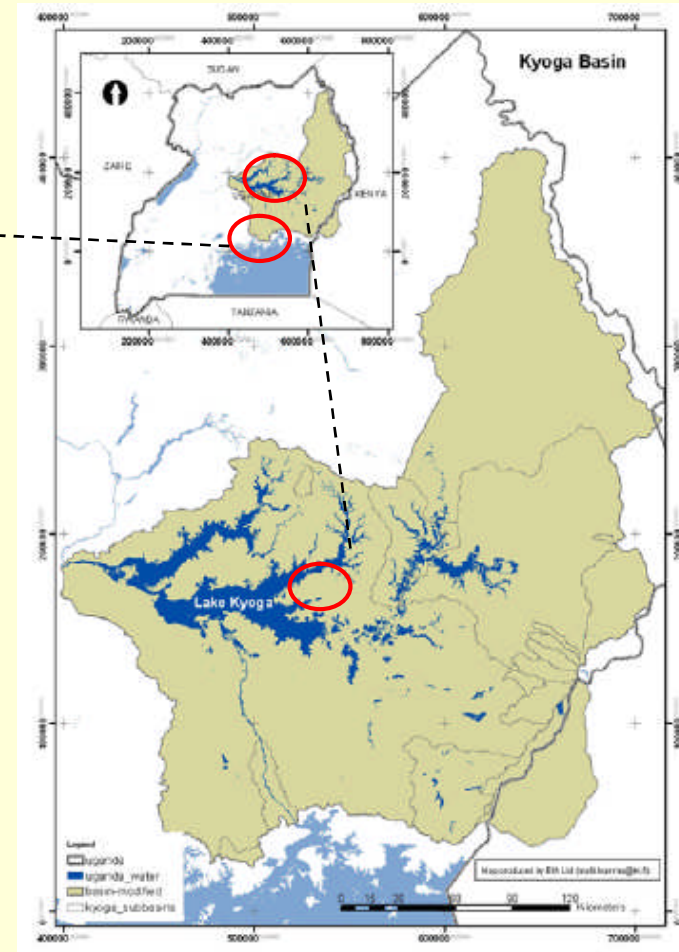
Scientific objectives:

- lithologic interface between groundwater and surface waters
- climate variability (seasonal, long-term) and abstraction on hydraulic gradient (gw-sw)
- hydrological & hydrochemical (solute) fluxes during seasonal, climate change & variability

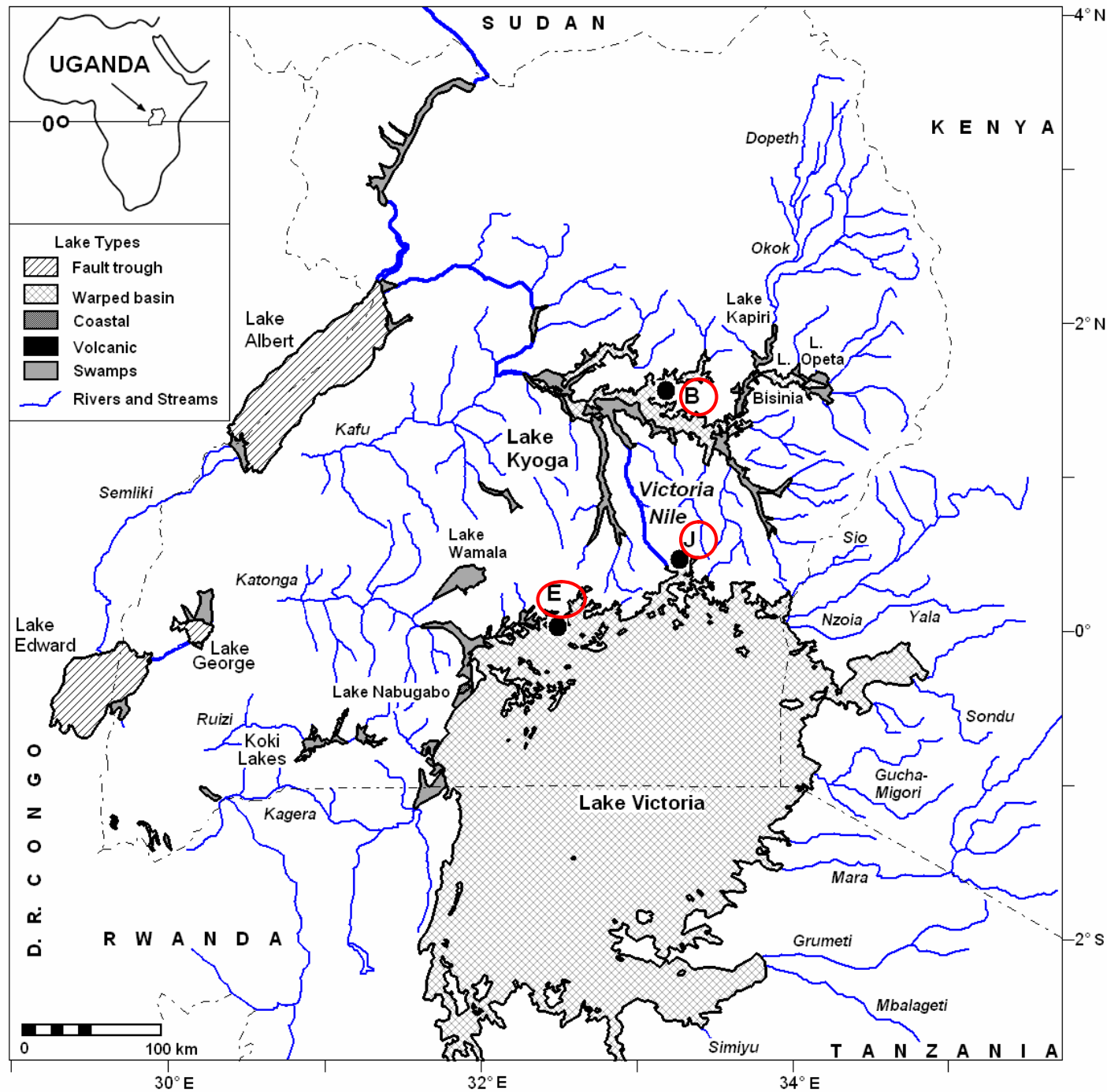
Victoria Nile Basin



- L. Victoria - 68,800 km²,
 - Catchment - 193,000 km²
- (Kayombo & Jorgensen, 2006)

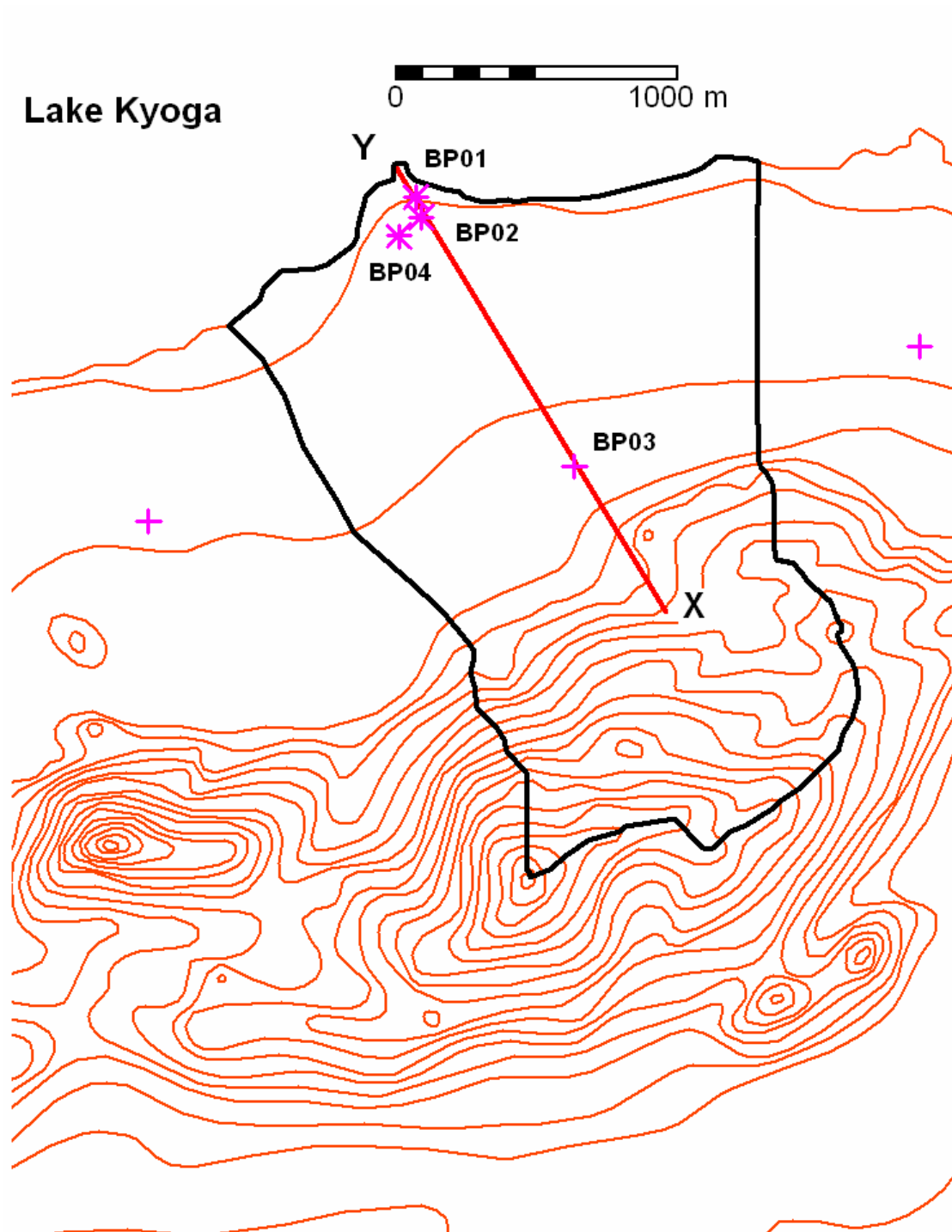


- Kyoga system - 4,222 km²
 - Catchment - 59,680 km²
- (ILM, 2004)



Victoria – Nile lakes basins (drainage modified from Temple, 1970)

- **Entebbe** (since July 1999)
- **Jinja** (since Dec 2007)
- **Bugondo** (since Dec 2007)

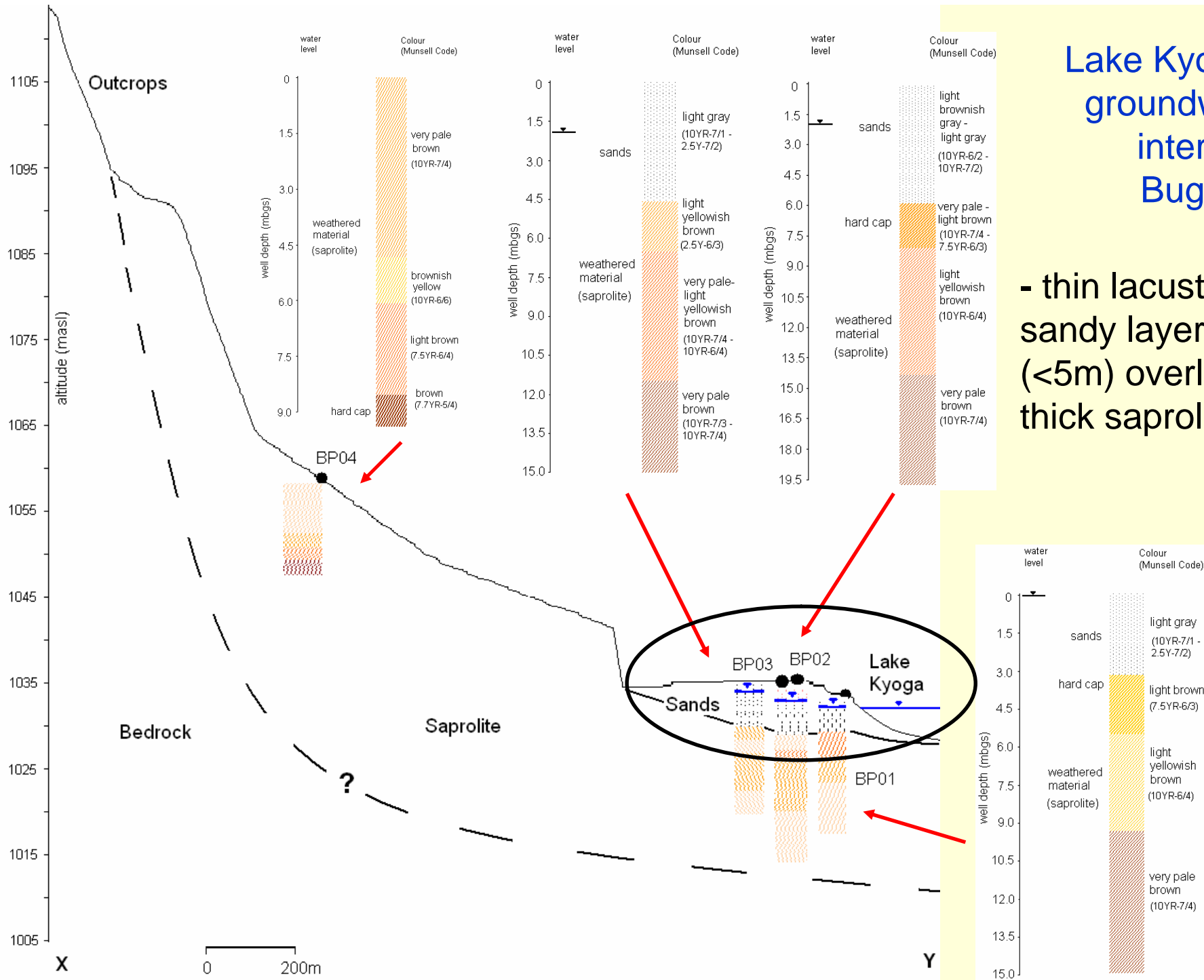


Lake Kyoga –
groundwater interface,
Bugondo

Precambrian mudstones,
conglomerates and
silicified rocks

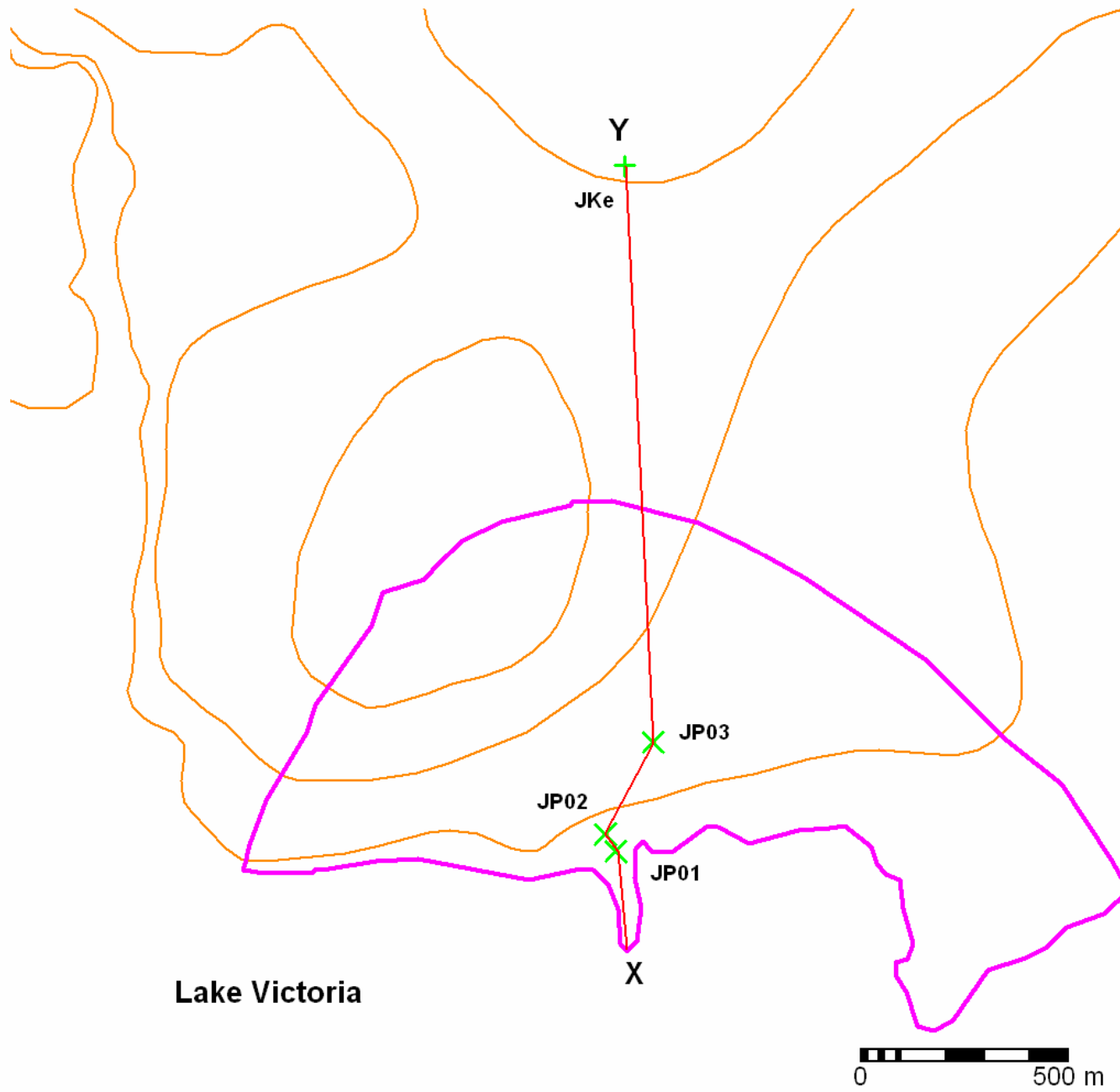
Lake Kyoga – groundwater interface, Bugondo

- thin lacustrine sandy layer (<5m) overlies thick saprolite

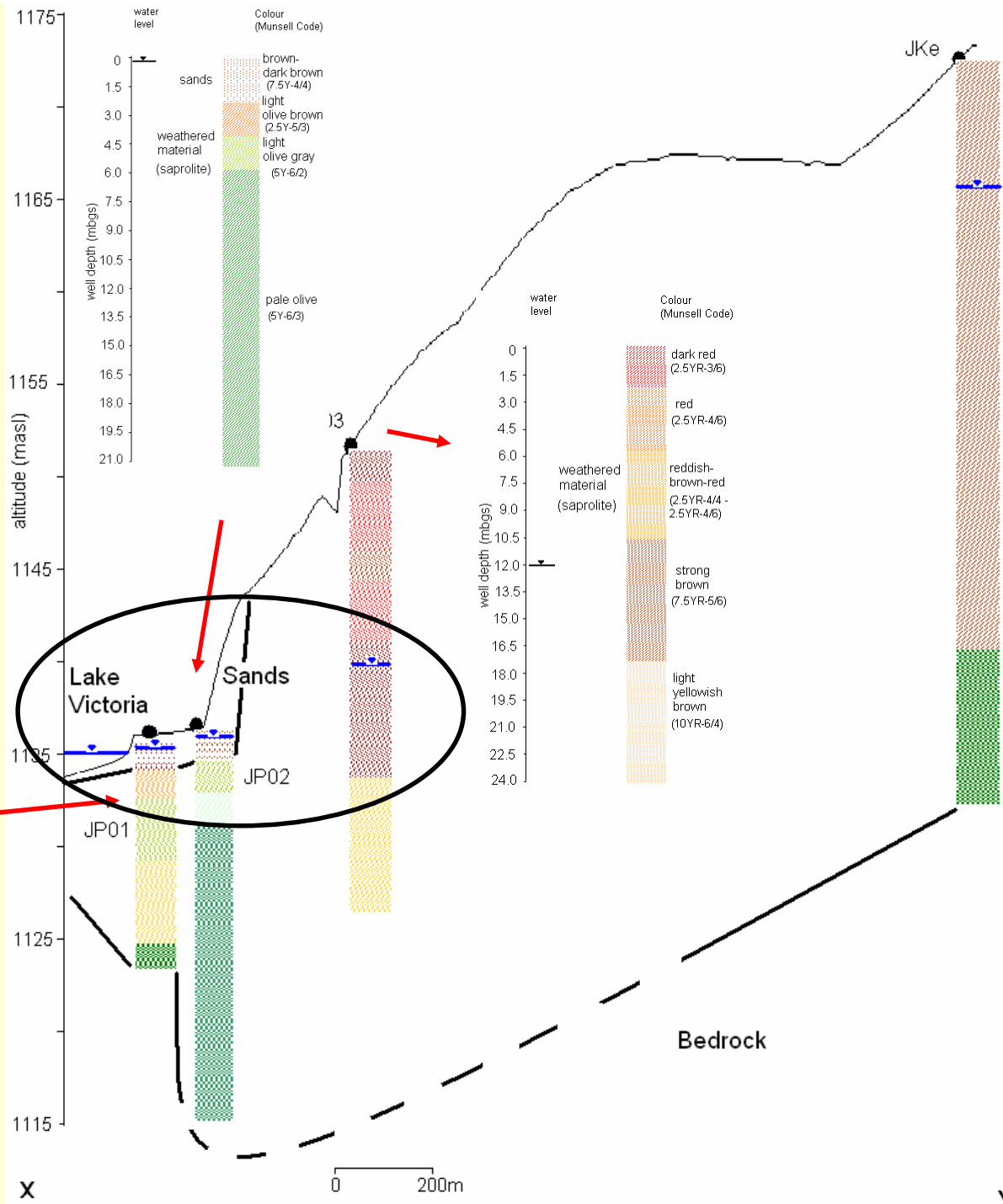
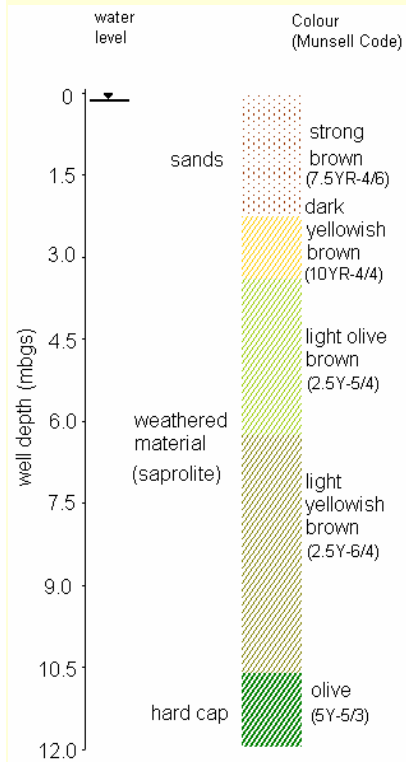


Lake Victoria – groundwater interface, Jinja

Proterozoic
argillites (phyllites
and schists) with
basal quartzites
and local
amphibolites,
recent sediments



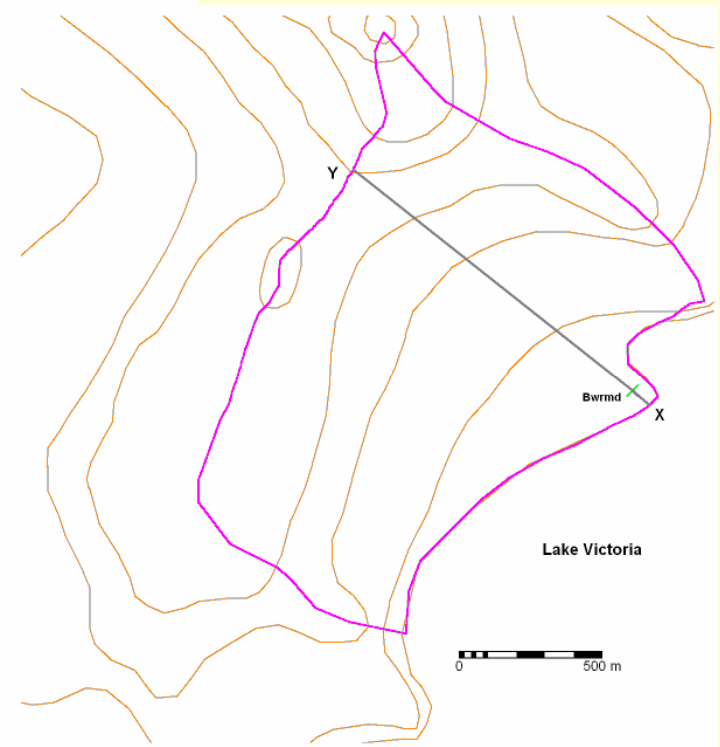
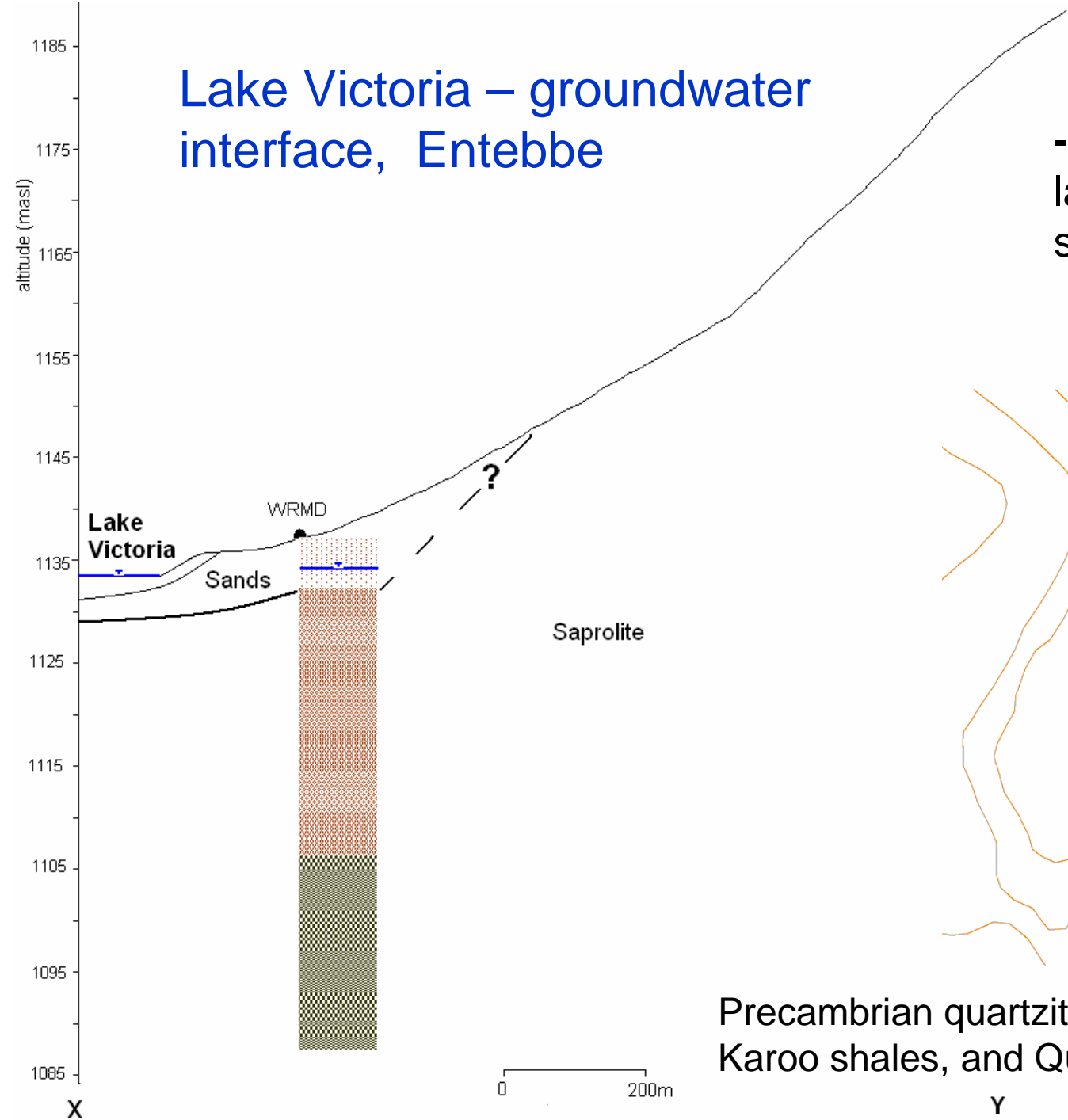
Lake Victoria — groundwater interface, Jinja



- Thin lacustrine sandy layer (<3m) overlies thick saprolite

Lake Victoria – groundwater interface, Entebbe

- Thin lacustrine sandy layer (<5m) overlies thick saprolite



Precambrian quartzites and gneisses, Paleozoic Karoo shales, and Quaternary sediments

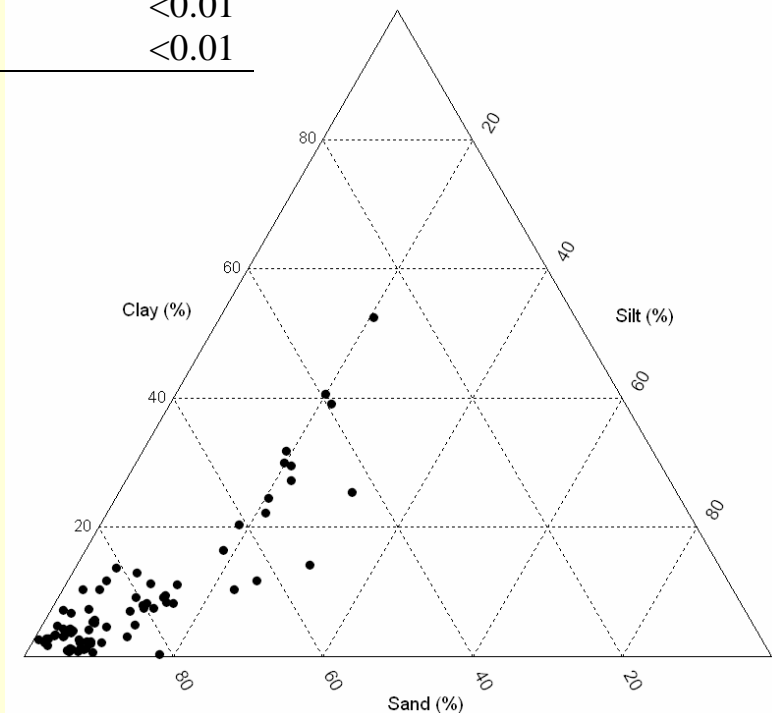
depth (m)	Bugondo				Jinja		
	BP01	BP02	BP03	BP04	JP01	JP02	JP03
1.5	0.15	0.25	<0.01	0.08	<0.01	<0.01	<0.01
3	0.21	0.25	<0.01	0.09	<0.01	<0.01	<0.01
4.5	0.21	0.26	<0.01	<0.01	<0.01	<0.01	<0.01
6	0.24	0.24	<0.01	<0.01	<0.01	0.02	<0.01
7.5	0.02	0.24	<0.01	0.05	0.08	0.14	<0.01
9	0.03	0.18	<0.01	0.06	0.10	0.13	<0.01
10.5	0.05	0.14		0.10	0.10	0.09	<0.01
12	0.03	0.18		0.15	0.07	0.10	<0.01
13.5	0.13	0.15		0.13		0.10	<0.01
15	0.07	0.07		0.02		0.18	<0.01
16.5		0.02				0.15	<0.01
18		0.03				0.16	0.02
19.5		0.06				0.16	<0.01
21						0.18	<0.01
22.5							<0.01
24							<0.01

Indicative S_y values

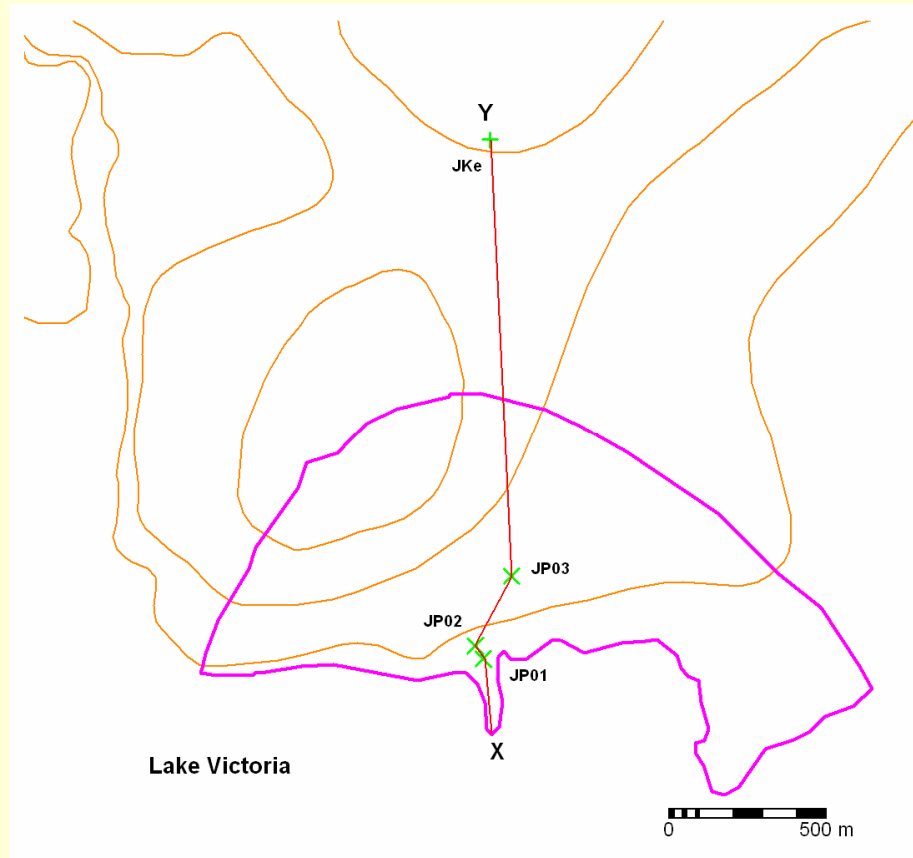
- based on particle-size analyses

(Kasenow, 2008; Drainage manual, 1984)

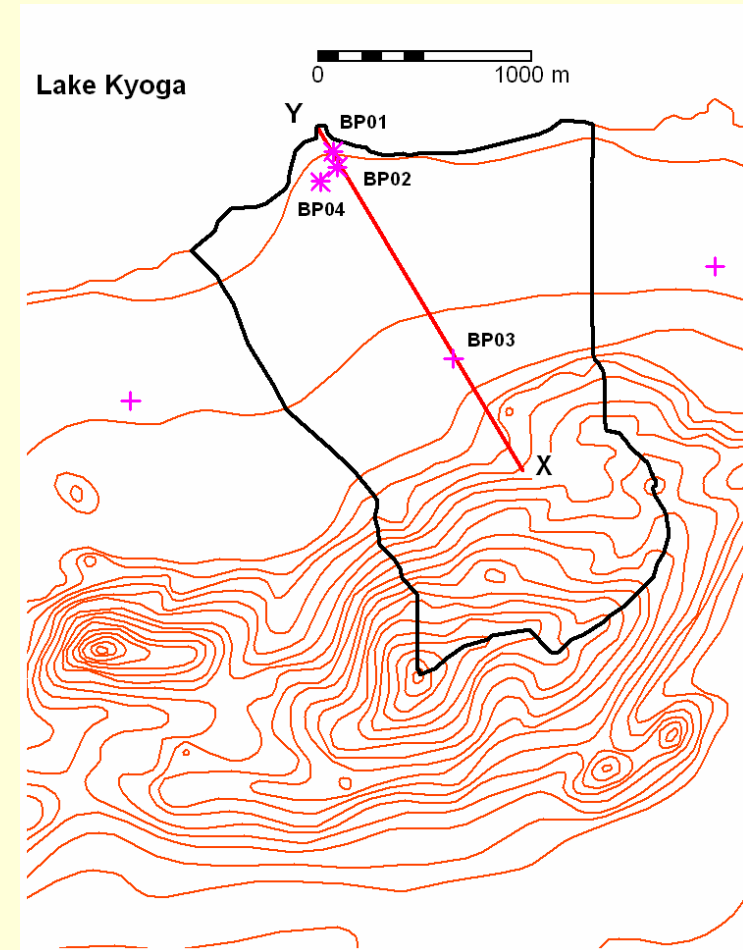
- sands, loamy sand, sandy loam, silty loam,
- clay loam, loam, clays (USDA soil texture classification system)



Cross sections for groundwater hydraulic profiles adjacent to Lakes Victoria and Kyoga



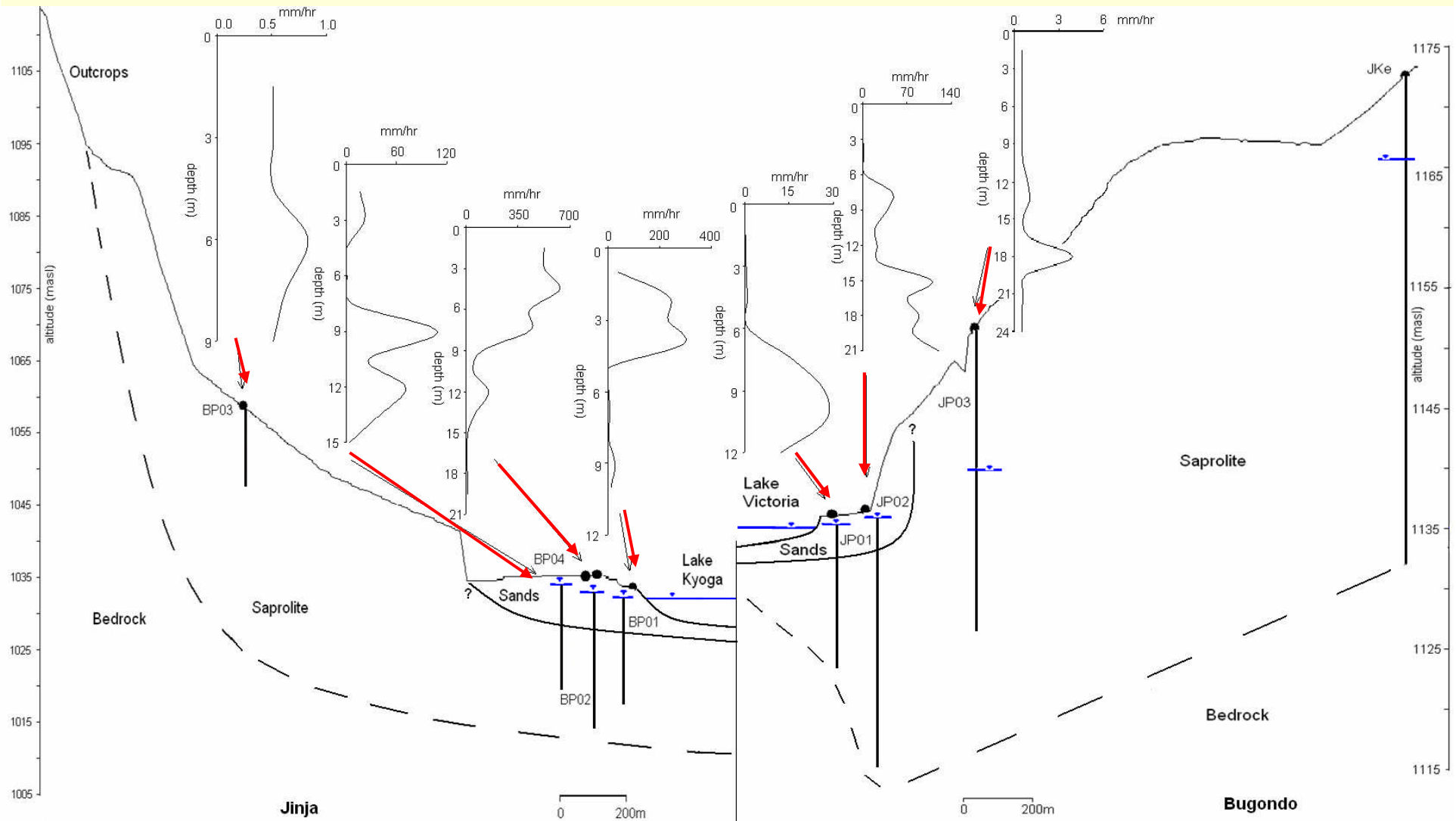
Jinja



Bugondo

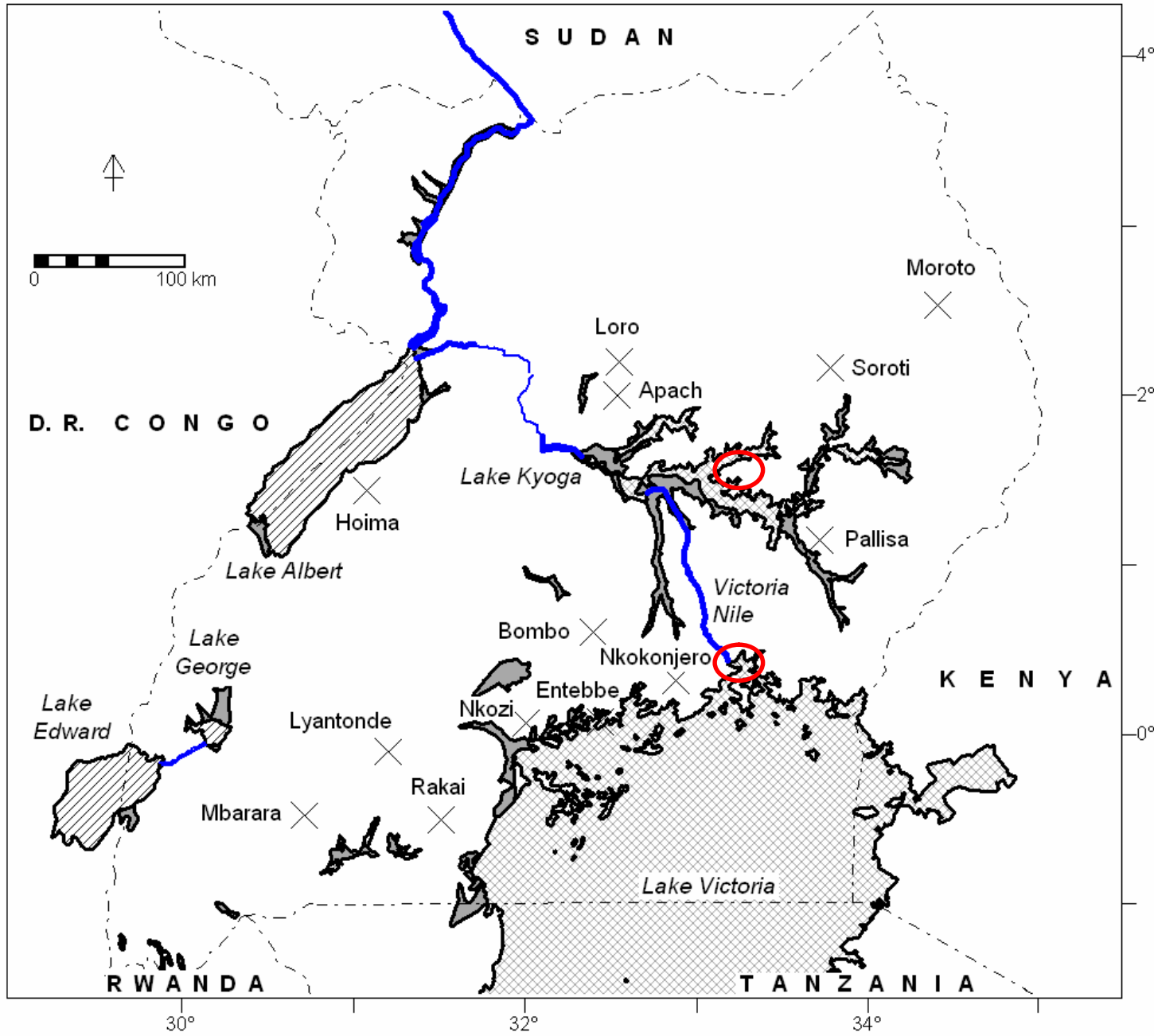
indicative K profiles (mm/hr)

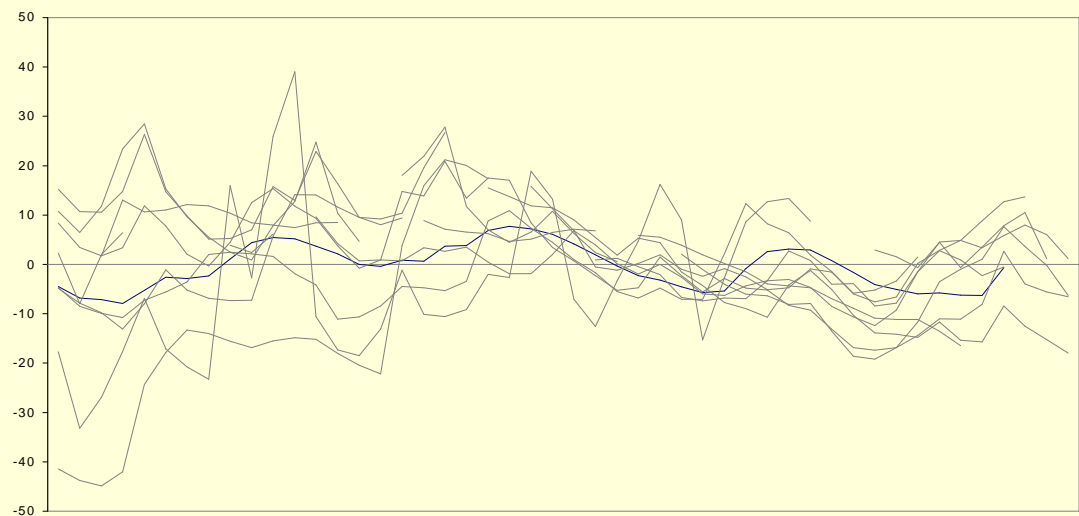
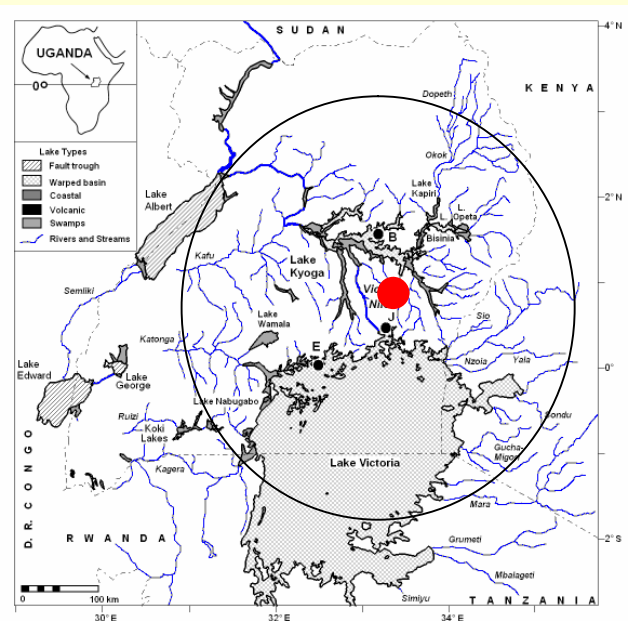
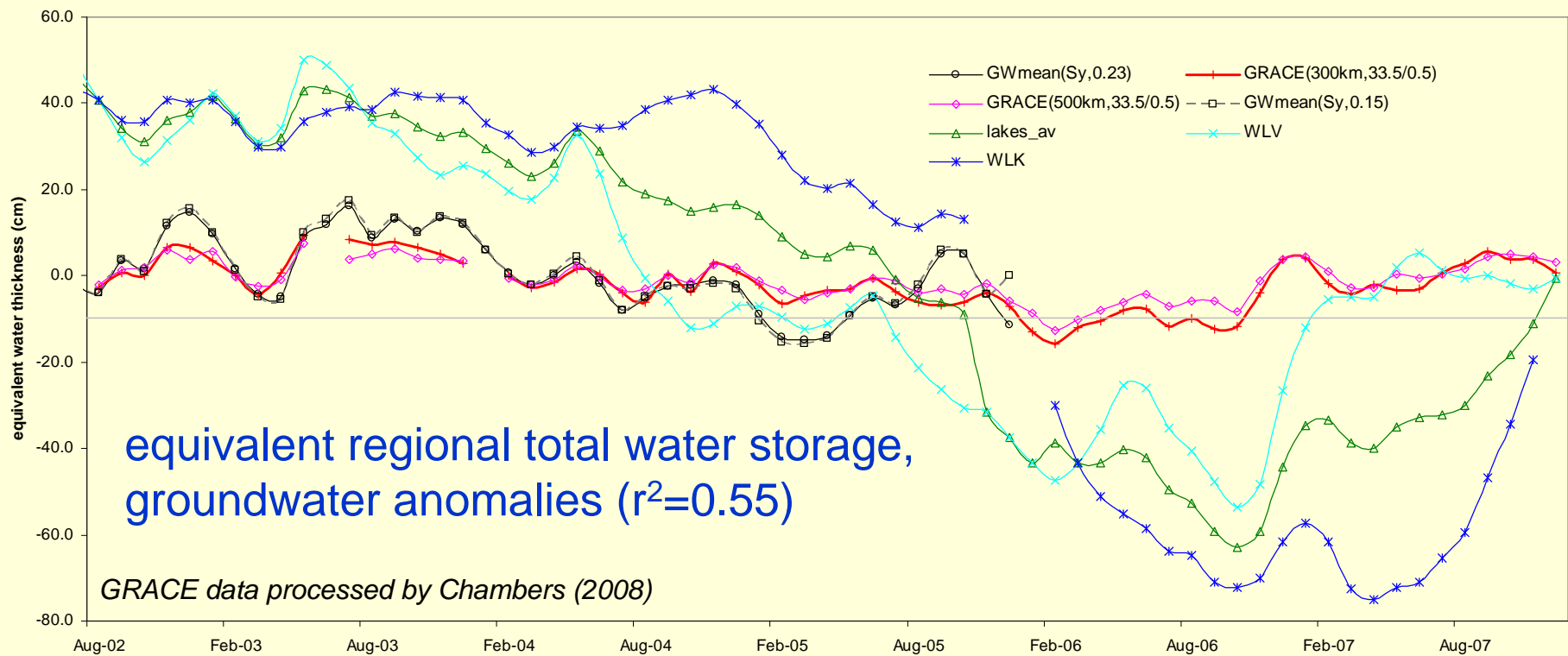
- based on particle-size analyses (after Hazen, 1892 modified by Shepherd, 1989)



Groundwater monitoring network – earliest about 1998 (DWRM)

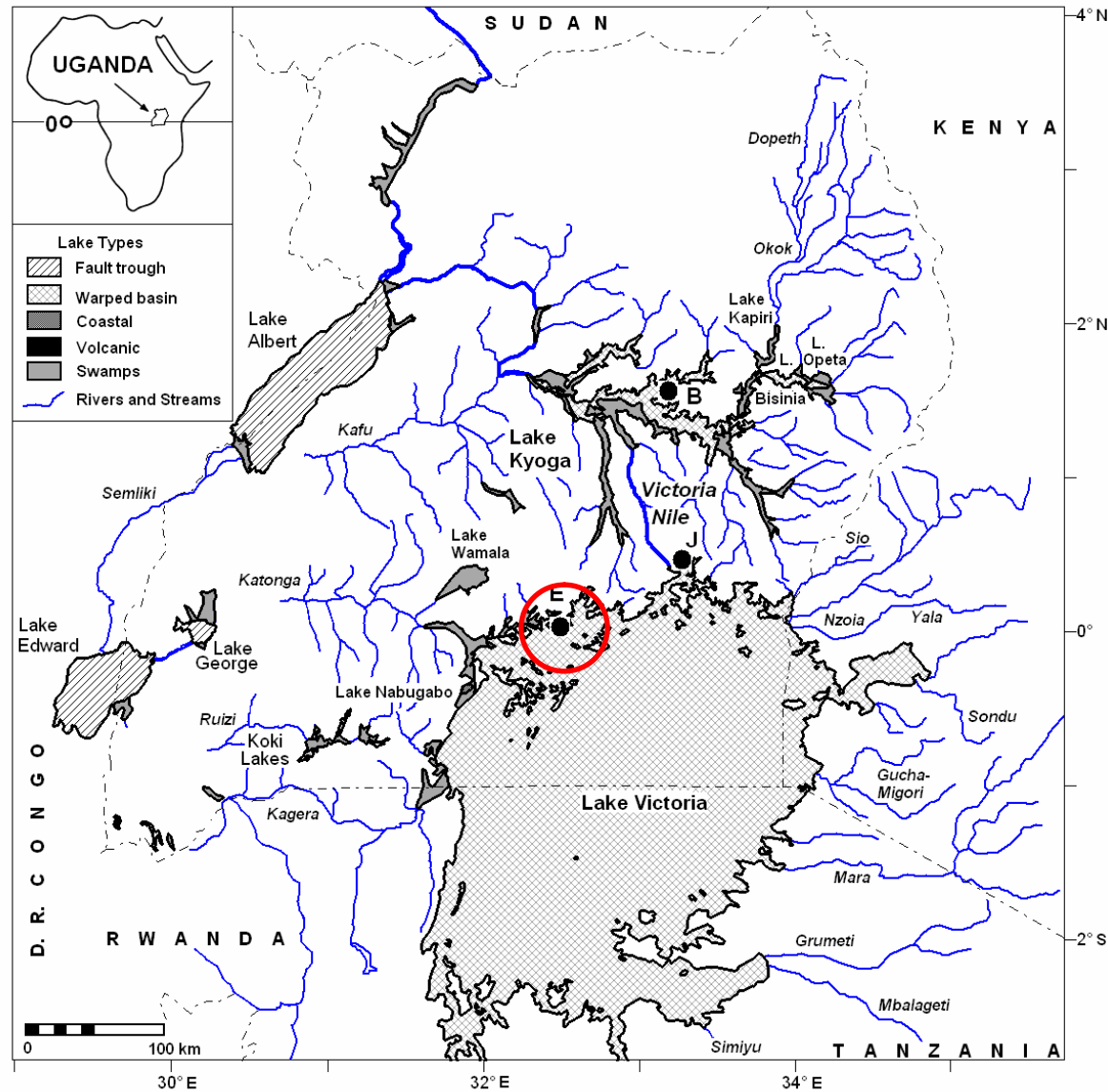
discrete aquifers within weathered crystalline rock

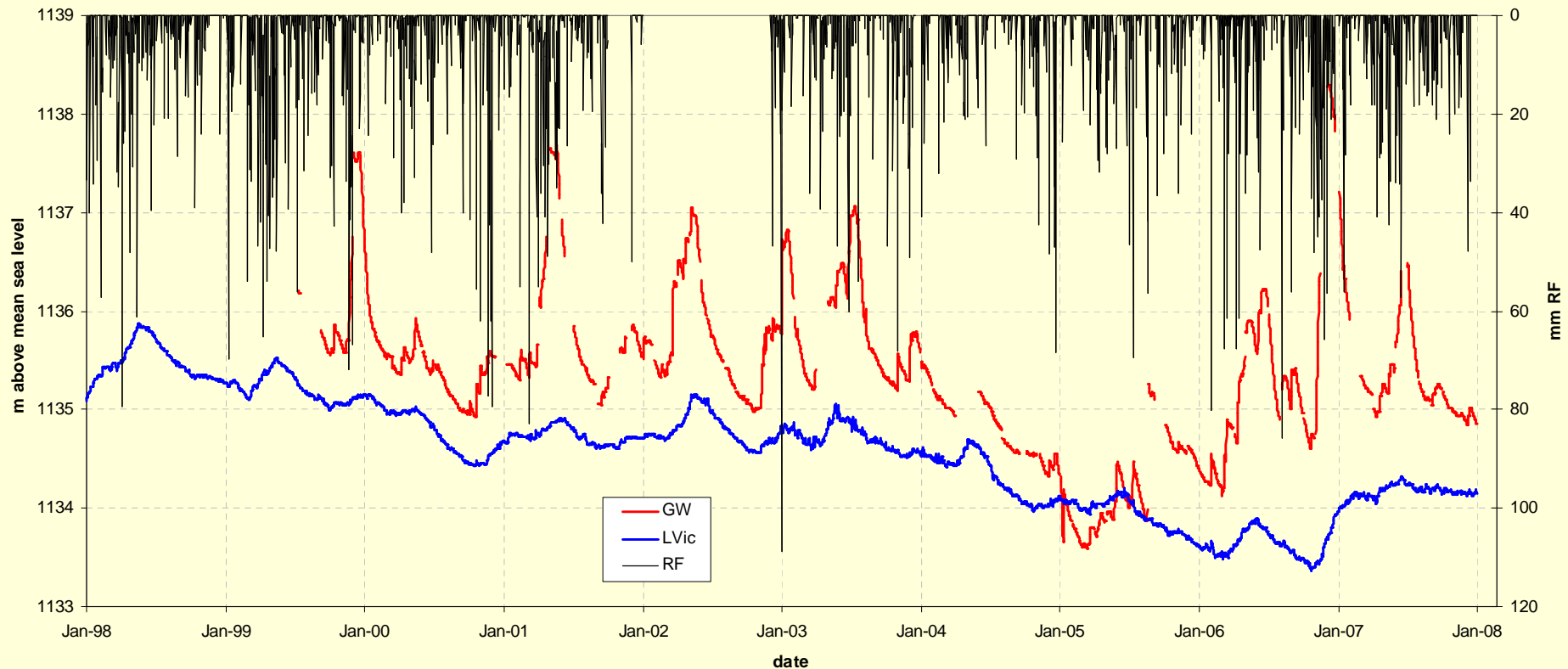




water thickness based on S_y of 0.23 (Taylor et al., in press)

Groundwater – surface water interactions: Case of Lake Victoria at Entebbe (DWRM)





- more recharge occurs during second (SON) rainy season; water-table fluctuations suggest lower S_y of 0.15
- groundwater (primarily) discharges into the lake; magnitude strongly influenced by rainfall
- lake levels fell 1.45 m from Jul 1999 to Jan 2006, groundwater declined by 0.9 m

Ongoing activities

1. hydrochemical evaluation of gw-sw interactions (inorganic and stable isotope chemistry (^2H , ^{18}O))
2. surface geophysical surveys of gw-sw interface
3. hydraulic testing and hydrometeorological evaluations
4. physically based modelling of gw-sw interactions (MIKE-SHE)
5. upscaling – GRACE, groundwater, Lakes Victoria and Kyoga levels, soil moisture datasets



Thank you

19.13.28