



Technical Cooperation Project between Namibia (MAWF)

and Germany (BGR) "Groundwatermanagement in the North of Namibia"

# "Water in the Kalahari Sands! From Investigation to sustainable management of the Ohangwena Aquifer System, CEB"

# CAAWG November 2014





## **Outline of presentation**



- 1. Introducing the project
- 2. Investigation Approach
- 3. Preliminary findings
- 4. Outlook / Recommendations



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## **Project Partners / History of project**

- Funded by BMZ
- Co- Funded by DWAF (MAWF)
- NamWater
- EU-GIZ funded IWRM Project
- CuveWaters (BMBF funded)
- SASSCAL (BMBF funded)



BMZ 🏶 📓

Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung













# **Project Partners / Training**



- University of Namibia
- Polytechnic of Namibia





- ✓ 6 full time bursaries for junior staff (BSc, BSc (Hons), MSc)
- ✓ Over 25 student contracts
- ✓ Several BSc thesis and internships







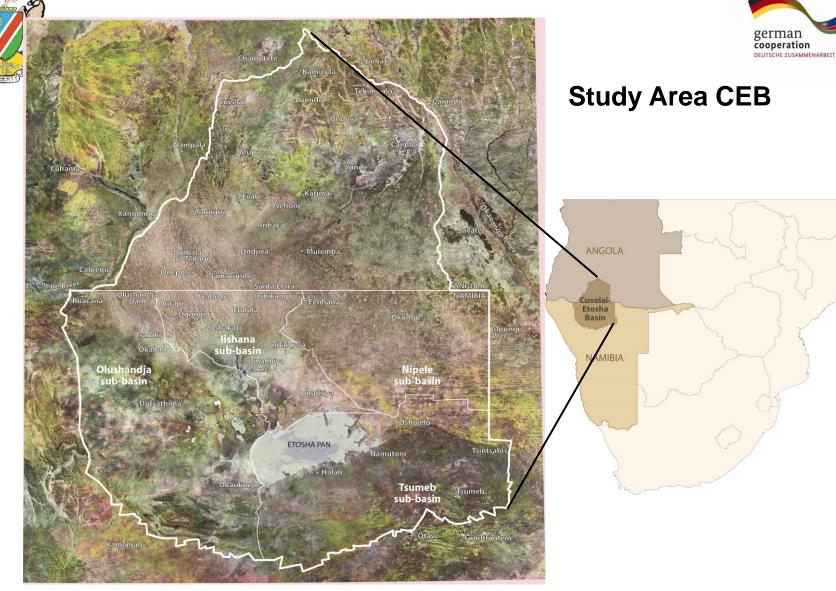
### DWAF NAMIBIA

### Resource Management Directorate

	Female	Male
Directors and Deputy Directors	100%	0%
Professionals (Geohydrology)	62.5%	37.5%
Namibian UNESCO TBA Team	80%	20%







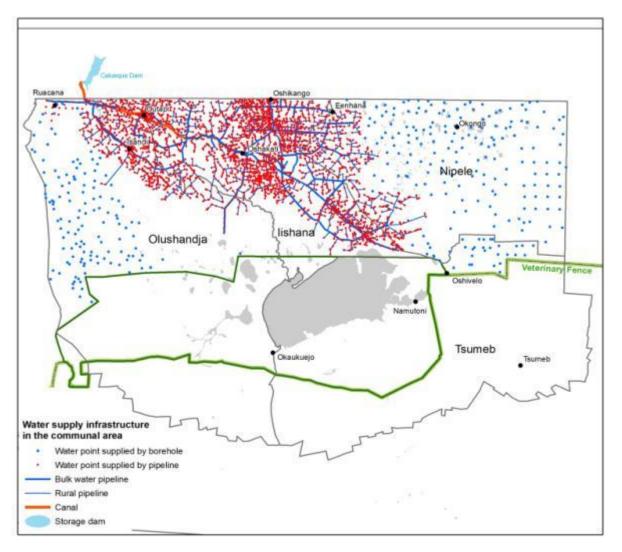






### Current water supply of northern CEB

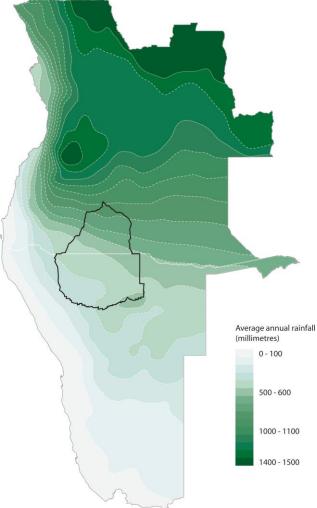




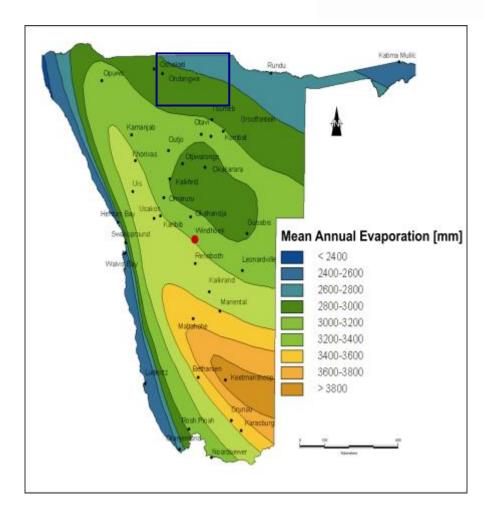




### Precipitation











# Expected results:



- Defining boundaries of different groundwater bodies in the CEB
- Elaboration of recommendations
  - + drinking water supply (freshwater)
  - + water supply for livestock and irrigation (freshwater and/or brackish water)
  - + back- up supply for other areas
- Improved Database
- Sustainable IWRM using well founded groundwater information based on a Decision Support System (DSS)



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# Investigation Approach



- 1. Desktop Study
- 2. Hydrocensus / Sampling campaign
- 3. Geophysical Investigations
- 4. Drilling of boreholes, Hydrogeological and Geophysical tests, Hydrochemical sampling campaign.
- 5. Monitoring, Protection Guidelines
- 6. Evaluate and disseminate information, elaborate abstraction volumes





## Hydrocensus: visited boreholes







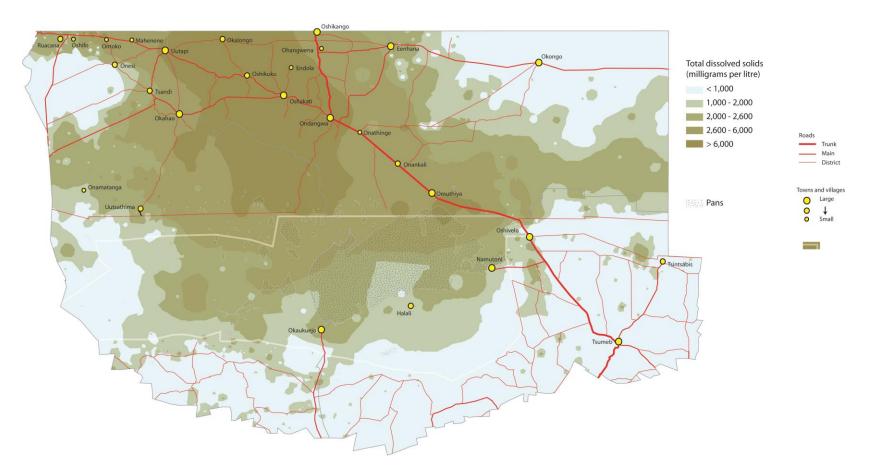






# Hydrocensus: Water quality TDS



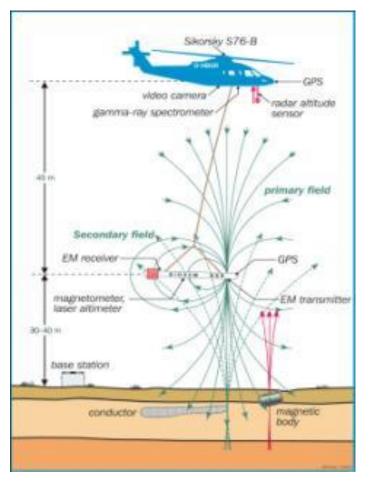






### Indirect geophysical investigation (TEM)





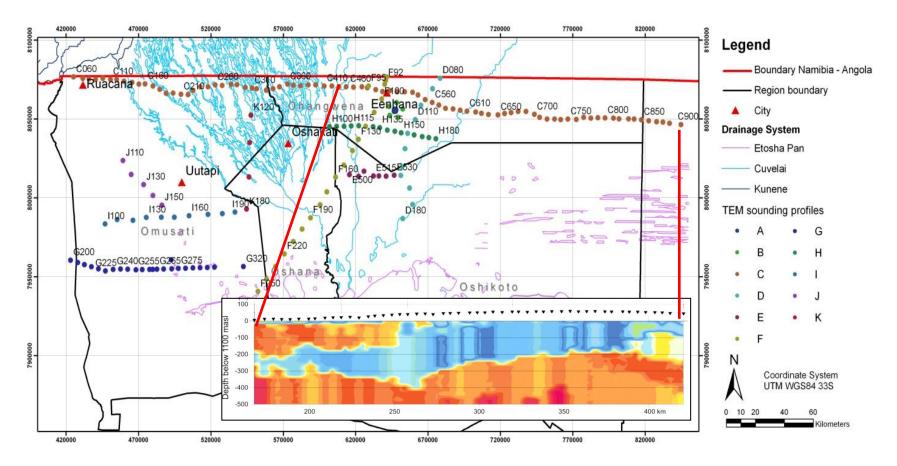






# Indirect (geophysical) investigation: Example Ohangwena









Direct investigation: Drilling of investigation and monitoring boreholes



 ✓ "Insight" to calibrate and verify indirect investigation measures.

- ✓ First assessment of yield.
- ✓ Assess quality of the water.
  ✓ Monitor the development of water resources while being used (quantity and quality)













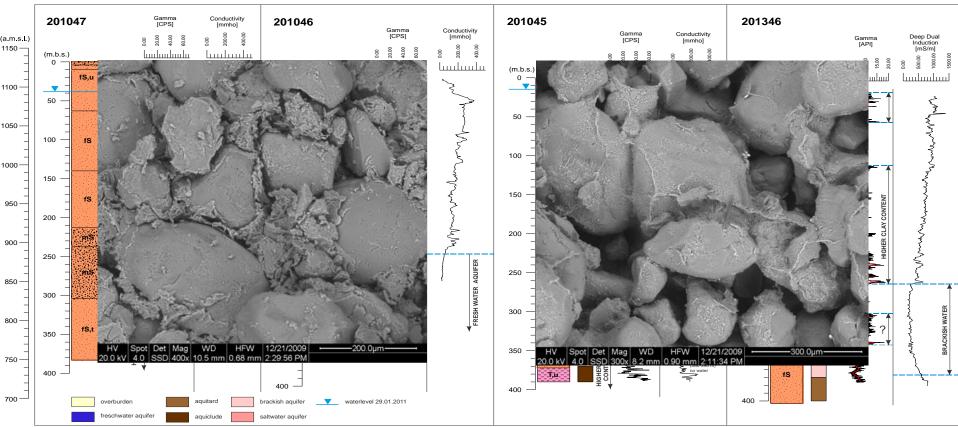


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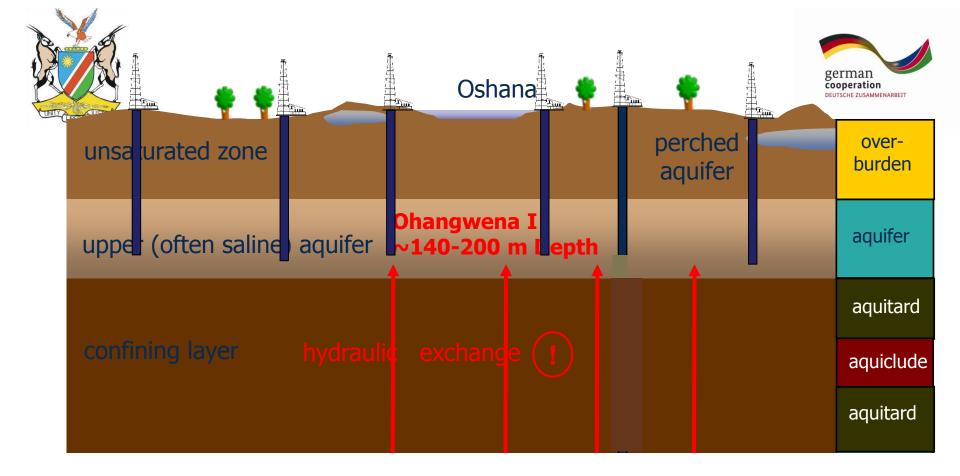


### **Correlation of BH- logs**









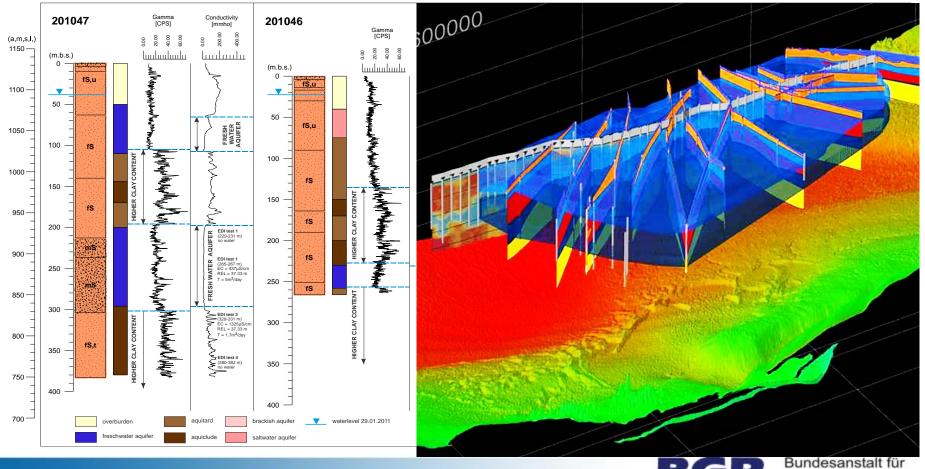




### Modelling



- A first conceptual and numerical Model is developed.
- A Weap Model as part of the Information-Management was created for the whole CEB





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### Groundwater quality evaluation





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# Investigations on Groundwater Resources in the CEB

7 Groundwater Sampling campaigns in the Ohangwena Region were conducted :

- Water Quality Sampling, general composition, rare earth elements, stabile isotopes, radio isotopes (C-14), Fluoride Studies
- 20 boreholes are installed with water level monitoring devices. Continuous measuring
- > Cooperation with Unam, IAEA, Sasscal established





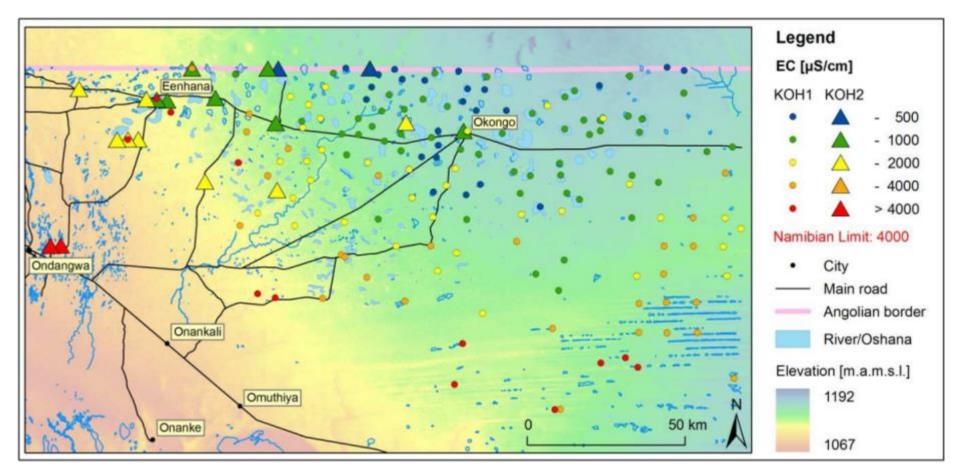


DEUTSCHE ZUSAMMENARBEIT



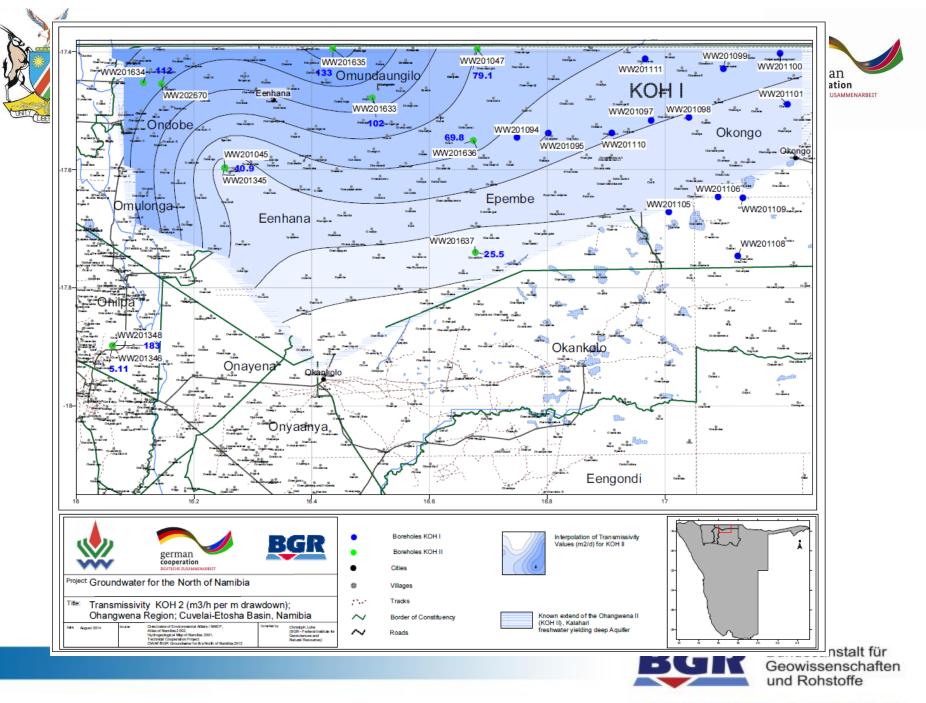
### Electric conductivity in the Ohangwena region







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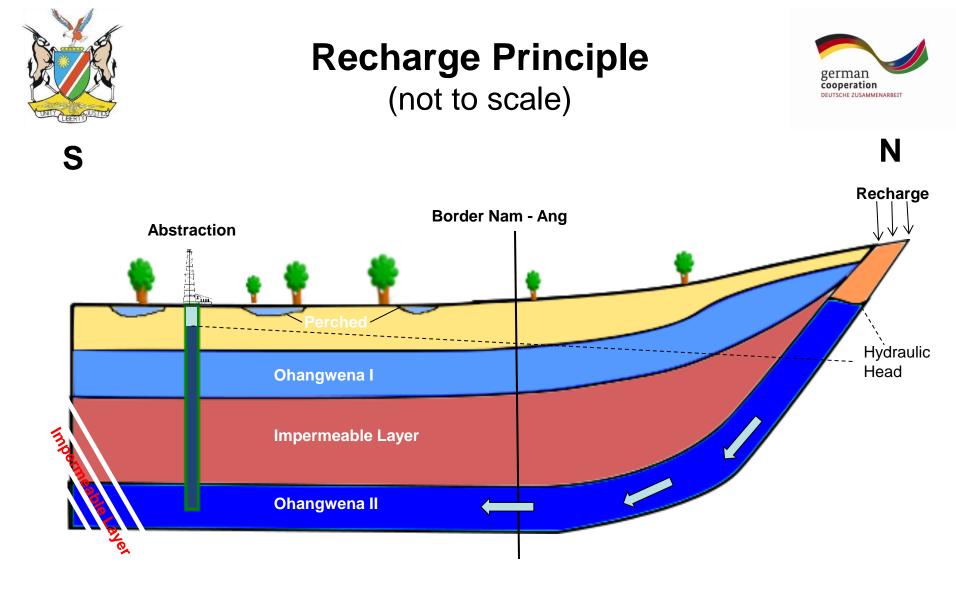




# Recharge?

# Quality during usage?





### Namibia

### Angola

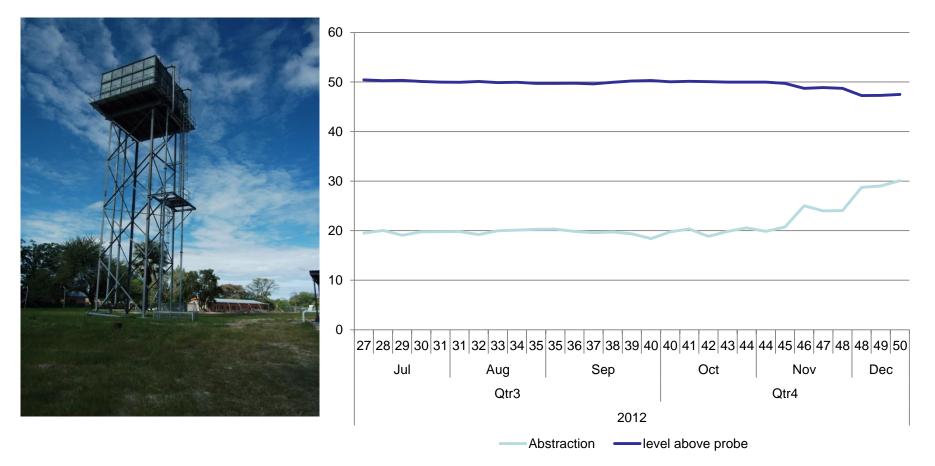


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## Long-term test pumping Eenhana









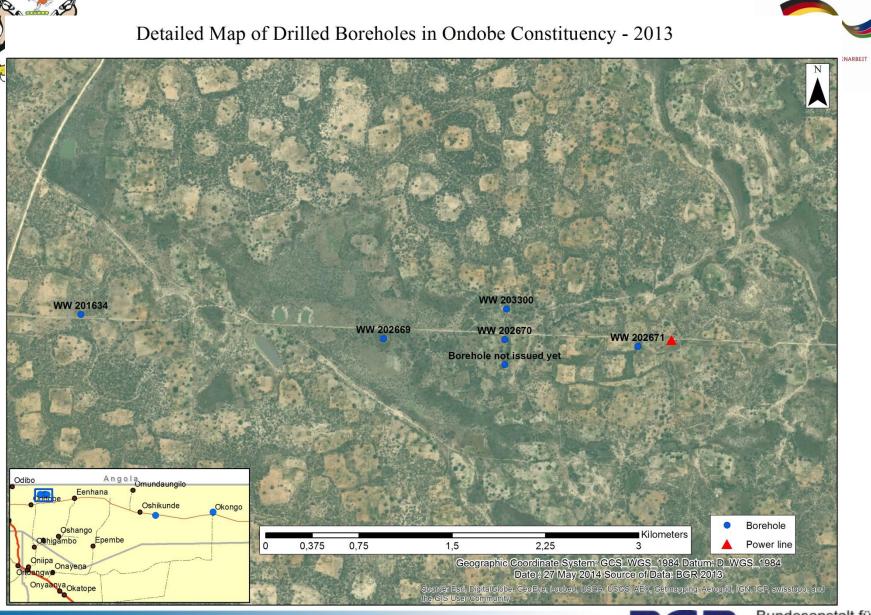
# Key Figures KOH II



Parameter	Values presented in 2013	Current Status Values
Area covered Namibia	2500 km <sup>2</sup>	5170 km²
Stored volume	5 billion m <sup>3</sup>	20 billion m <sup>3</sup>
Actual recharge 2011/2012	???	635,000m <sup>3</sup>
Potential recharge	???	???
Average depth to top of aquifer	250 m	235 m (189 – 331)
Average thickness	60	65 m (33 – 97)
Average rest water level below ground	20 m	17 m (9 – 29)
Average Transmisivity	???	74 m²/day (5 – 240)
Average specific yield per m draw down	???	1,4 m <sup>3</sup> /h (0.28 – 5.29)



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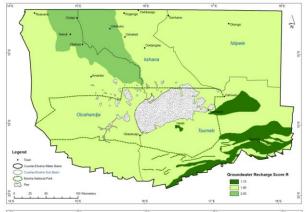
### **Stakeholder Participation (Communication)**

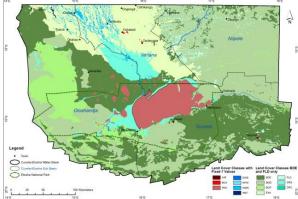


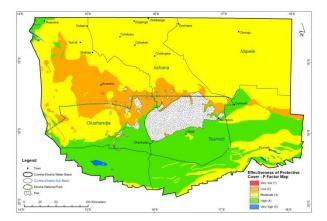
- From the start all stakeholder groups were informed and involved
- > Cooperation with traditional leaders and local political decision makers is essential
- The newly established Basin Management Committees (BMC) proved to be an ideal platform to apply IWRM principles.
- On the job-training with more than more than 40 water experts and students from Ministries and Universities, preferably from the region
- > Awareness campaigns in schools sensitizes the next generation on the importance of clean water
- Without stakeholder involvement, it is impossible to secure compliance with regulations in Namibia!

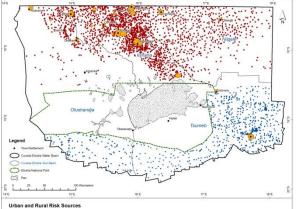












### Population Size in Urban Area

Urban Areas

294 - 1000

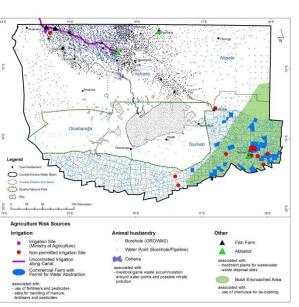
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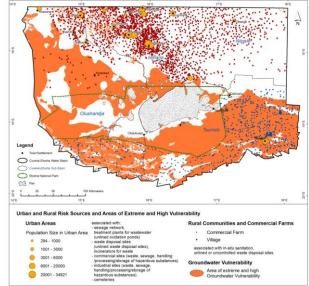
3001 - 6000

6001 - 20000



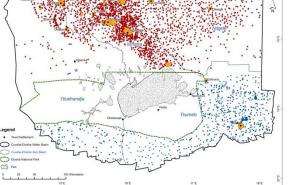
#### Rural Communities and Commercial Farms Commercial Farm Village associated with in-situ sanitation, unlined or uncontrolled waste disposal sites

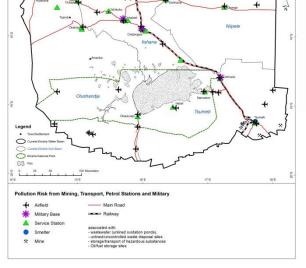






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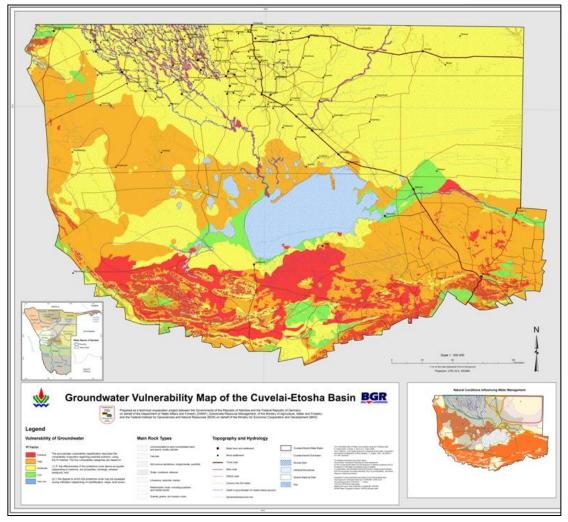


### Planningtool Vulnerability Map



### **Products:**

- Vulnerability Map of Groundwater Resources in the CEB
- Risk Assessment / Hazardous sites
- Main technical Report
- Simple manual on how to use the map
- Update of GROWAS database
- GIS Hydrochemistry CEB
- Guideline GW Protection zones





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# **GROWAS II Modules**





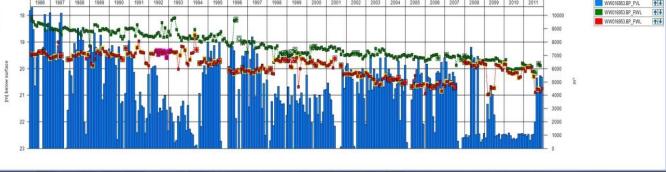




# **GROWAS II** monitoring data



	WW016953.8P_PVL WW016953.8P_PWL W0016953.8P_PWL													End date and time span										
1xn nx1 nxn		No.	и	datetir	те	Pumped w level read		Pumped level rem		Pumped level me	water asured by	Pumped water level measurement method		ped water I equipment	ed water status of		ed water last modified	level	ped water Llast flication dat	. Ber	imped water vel unit	ŕ	2011 • Dec	• 26
8 / WW16818 8 / WW16858		0000073	WW016953	01.06	1992	19.35										admin	ť,	18.07	7 2013 17 1	2 (m)	below surfac	e	Display all	svalable data
6 / WW16886		0000074																					Display te	nporary data
8 / WW16919 8 / WW16923		0000075																				•		nfirmed data
/ WW16925 / WW16947		0000076																						1
/ WW16950		0000677		01.10	10000	19.36																e 8	Set scaling	Manual
/ WW16952		0000078		01	Select #	ll.																•		
/ WW16994 / WW17010		0000075		01	Deselec	t All																	WW016953.BP PVL	(295
/WW17011		0000680		01	Export	o Excel																•	WWW010355.DP_PVL	
/ WW17012 / WW17013		0000681		01	Export a	II to Excel																•	Total # of values	298
/ WW17368 / WW17491		0000082	WW016953	01	Export	o ASCII										admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Used for calculation:	298
/ WW17493		0000083	WW016953	01	Unconfirm selected data	data									admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Unconfirmed:	0	
/ WW17503 / WW17539		0000084	WW016953	01										admin		18.07	7.2013 17:1	2 [m]	below surfac	e				
/ WW17626 / WW17722		0000085	WW016953	01				-								admin		18.07	7.2013 17:1	2 [m]	below surfac	8	First date:	01.01.198
/WW17791 /WW17792 *		0000086	WW016953	01		irm all data										admin		18.07	7.2013 17:1	2 [m]	below surfac		Last date:	01.03.201
7 WW17732		0000087	WW016953	WW016953 01	Delete all data									admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Mean:			
production - Hour meter reading		0000088	WW016953	01	Paste											admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Variance:	61
production - Pump inlet depth production - Pumped hours		0000089 WW016953 01	Change	nange value									admin		18.07	18.07.2013 17:12		[m] below surface						
production - Pumped volume		0000090	WW016953	01.11	1993	19.31										admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Standard deviation:	
hole production - Pumped water level hole production - Recommended produ- hole production - Rest water level		0000091	WW016953	01.12	1993	19.79										admin		18.07	7.2013 17:1	2 [m]	below surfac	e	Coeffient of var.:	
		0000092	WW016953	01.01	1994	19.86										admin		18.07	7.2013 17:1	2 [m]	below surfac	0	Minimum:	
production - Water meter reading		0000093	WW016953	01.02	1994	19.67										admin		18.07	7.2013 17:1	2 [m]	below surfac	e .	Maximum	











- The Ohangwena II Aquifer can be considered as a secure back- up supply option for the region if developed accordingly.
- To assess the option for sustainable long- term exploitation further investigations are fundamental! (minimum time frame 3 years)
- For testing purposes the aquifer should be used (long term test pumping), but reducing the supply must be an option if the results indicate insufficient recharge or negative development. *(with NamWater, DWSSC)*
- A sound legal framework must be in place to control any development of the system! (with D- Law + Admin)



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### Awareness water cycle: for the future generation









