

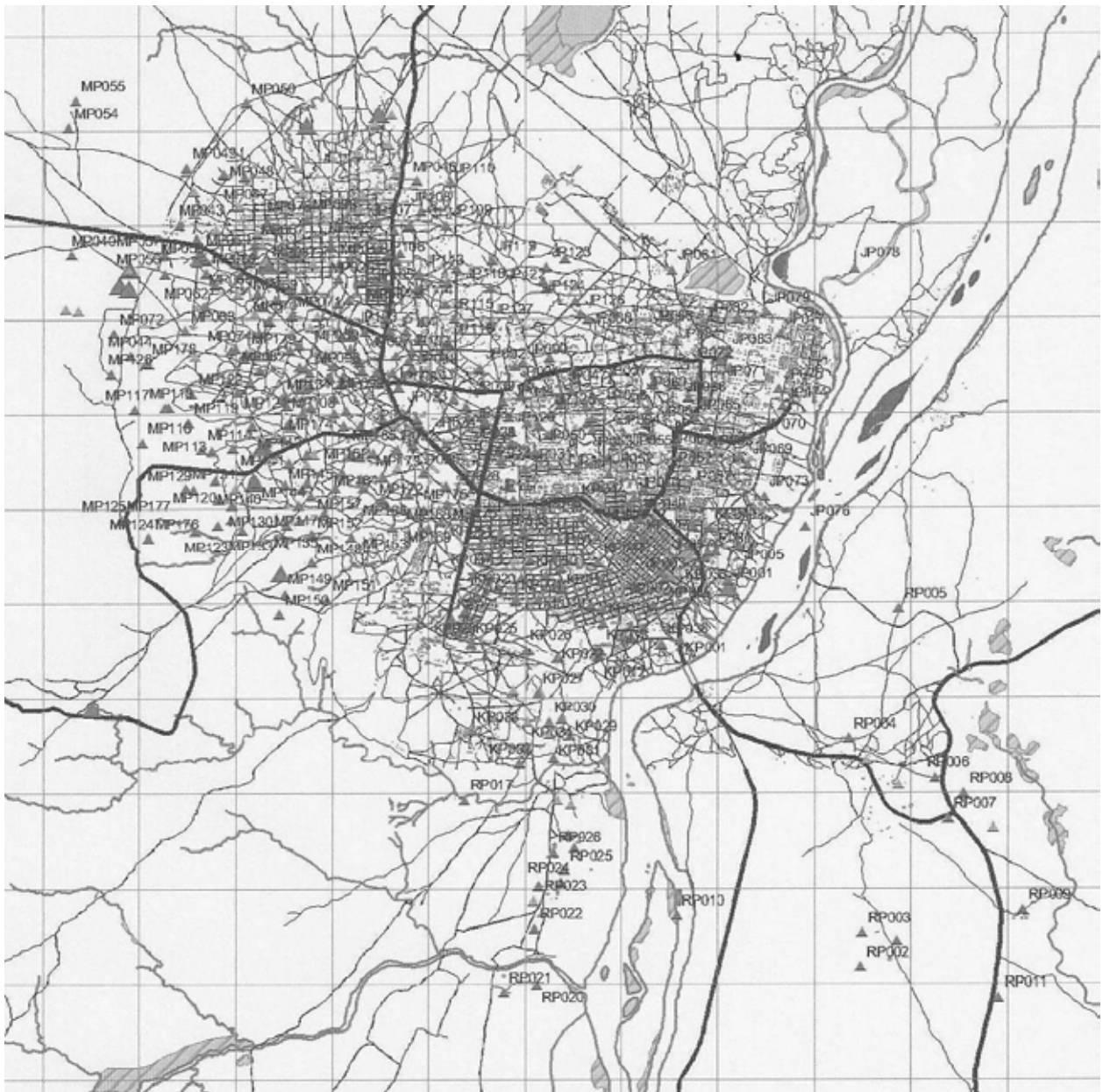
ANNEX A

GROUNDWATER SURVEY

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Annex A-1 Location Map of Existing Wells in the Study Area



Source: Rural Water Supply Department (MC&RD/MWRI)

Annex A-2 Memorandum of Meeting on Land Use for Construction of Test Wells

(1) First Stakeholder Meeting

MINUTES OF INITIAL STAKEHOLDERS MEETING
ON
JUBA URBAN WATER SUPPLY AND CAPACITY DEVELOPMENT STUDY
IN THE SOUTHERN SUDAN
GOVERNMENT OF SOUTHERN SUDAN AND JICA

Date: 21st Nov. 2008

Time: 10:30 – 12:30

Venue: Shalom Hotel, Juba, Southern Sudan

Attendants: Attachment

1. Presentation by Study Team

The presentation on the following contents was made by JICA Study Team.

- Overall study methodology
- Environmental and social considerations
- Preliminary results of groundwater survey in Paleochannel
- Permission for proposed locations of test wells by land owners
- Land for proposed water treatment plant for water supply to Juba City

2. Discussions

In the meeting, the main discussion was made on the land for proposed locations of test wells by land owners in Tokiman area in the Paleo-channel.

Mr. Joseph Ebere (Director of UWC)

He explained that a new water treatment plant with capacity of 7,000 m³/day will be commenced at the end of this year or in the early next year. However, he expressed a concern that the produced water cannot be reached to the people due to old and leaky distribution network. In this regards, he raised a question what will be the role of JICA in distribution network.

Mr. Kuol ALoung (MWRI, D/Director of MCRD GOSS)

He also showed the same concern that we have existing old network and what will happen if you open new water treatment plant without changing it.

Mr. Sato (Study Team Leader)

He replied that we are preparing water supply master plan, in which the rehabilitation plan of existing distribution network is prepared. The plan includes design, cost estimation, implementation plan and feasibility study. Using this plan, GOSS can request the project implementation to Government of Japan or other donors. We are a study team but we are neither a financial nor implementation organization.

Regarding distribution of treated water from the new water treatment plant, I am recommending UWC that the part of the treated water should be supplied through water tanker truck, which now pumped up raw river water and distributed unhygienic water to the people, through existing elevated towers located in 4 locations over the city. This will be an efficient way to distribute precious treated water.

JICA Study Team Leader

He asked stakeholders to give a permission to construct test wells.

Gumbo Chief (Mr. Daniel Iado)

He asked a question who had allowed JICA Study Team to work in our area without our permission.

Deputy Director of Rejaf Payam (Mr. David Serverino)

We have no problem and what we want is to give JICA Study Team an approval to work in the area which has been selected at the site (Tokiman). So JICA Study Team is allowed to carry out their study in the area. What we need only is to make Tokiman community aware of the current activities by JICA Study Team in their area.

Executive Director of Juba County /CES (Mr. Peter Tongtun)

He explained that JICA study team is not working alone and their work has been endorsed by GOSS and the County Authority. So what we will do is to introduce them to the people of Tokiman, in the present of the Paramount Chief and Sub-chiefs pulse the Tokiman community at large, who is present here and listen to the presentation they made to us now. So after this meeting we have to schedule the next meeting at the site with the community. The JICA Study Team and the County office will decide when the meeting will take place. At the site if the community has any question it will be answered by the County Authority and we will tell them more how people will be benefited from the project.

3. Conclusions

The Paramount Chief, Sub-chief, Payam Director, Goss representatives and JICA Study Team have agreed to have the next meeting with the community at the site, which will be decided by JICA Study Team and the County Executive Director. The rest of activities in the sites will be follow by JICA Study Team as usual.

4. Closing remarks

Executive Director (CES)

He said that the work by JICA Study Team will not be the community's benefit, but we, Southern Sudanese, will benefit from clean water. So we need to work in cooperation with JICA Study Team to help to finish the Study in good time without hindering.

Paramount Chief

He gave a vote of thanks to all the participants and appreciation that JICA Study Team has done good work. Please carry on the survey. There will be no problem with us.

The meeting ended.

GOVERNMENT OF SOUTHERN SUDAN AND JICA
JUBA URBAN WATER SUPPLY AND CAPACITY DEVELOPMENT STUDY
IN THE SOUTHERN SUDAN
INITIAL STAKEHOLDER MEETING

Date 21st NOV 2008

Venue: shalom hotel Juba

ATTENDANCE LIST

No	Names	Organization	Title/ Position	Tel
1	Peter Tongum	Juba County	Ex: Director	0126-271843
2	Denis Daramollo	Paramount Chief Tokiwi	Paramount Chief Tokiw	0126-711352
3	Azkangelo Stozzs	Rajaf Payam	Director	256-771080079
4	David Lado	Rajaf Payam	Chief Gudeo	0126-780661
5	Marino Piya	Rajaf Payam	Chief Tokiw	0477-151798
6	David Scverino	Rajaf Payam	D, Director Rajaf	0122-424305
7	Engueex Dimdtri	Tokiman	Chairman	0122-25545
8	Marcello Andea	Tokiman	Member Bc	0121-221575
9	Joseph Loku	Tokiman	Member Bc	0128-11758
10	Augustnio Mori	S Tokiman	Sub Chief	
11	Qwino Jada	Tokiman	Sub Chief	
12	David L Gubek	Munirab	D/ General	0911-705612
13	Joseph Ebere	Ssuwc/Ces	Area Manager	0477-124337
14	Jelly Eliona A	Town Plcs/Ces	Townncs	0126-565895
15	Kuol Aluons	Rwssd/Goss	Director	0121-677953
16	Hiroataka Sato	JICA Study Team	Team Leader	256-477236839
17	Komei Ozaki	JICA Study Team	Hydrogeology	249-926794082
18	Yasurori Ishida	JICA Study Team	Geo Electrical Survey	249-926794117
19	Norio Tanaka	JICA Study Team	Facility Designing	256-477236839
20	Shiro Jimbo	JICA Study Team	Water Treatment Plant	256-477239422
21	Manyok Wai	JICA Study Team	Office Manager	0477-195571

(2) Second Stakeholder Meeting

**MINUTES OF STAKEHOLDERS MEETING IN TOKIMAN COMMUNITY
FOR
JUBA URBAN WATER SUPPLY AND CAPACITY DEVELOPMENT STUDY
IN THE SOUTHERN SUDAN
GOVERNMENT OF SOUTHERN SUDAN AND JICA**

Date: 6th Dec. 2008

Time: 10:30 – 15:30

Venue: Meeting Place of Tokiman Community in Rejaf Payam

Attendants: Attachment

1. Agendas

- a) Permission for construction for five test wells
- b) Cooperation from Tokiman community

2. Explanation of JICA Study Team

JICA study team leader explained about the purpose of construction of test wells, followed by translation and additional explanation by Director General of Ministry of Housing, Physical Planning and Environment in local language. Then the team's hydro-geologist explained about the technical details of test wells.

3. Outlines of Discussions

Arkangelo Stoss (Director for Rejaf Payam)

The Japanese you see here are not working for themselves but with the Government for your benefit. After all they are not taking water to Japan, but for Juba City and the surroundings including Tokiman community. With their study they have found that your area has high potential of groundwater resource for the consumption of Juba city and Tokiman community. It's up to you to decide to allow them doing the work under your security.

Peter Lado (Tokiman Community)

I want to know which farm these test wells fall in and then we will decide what to do.

Kuria Pitia Gore (one of sub-chief)

If your test wells fall in my farm it may affect my garden and mongo trees in my farm. If you chase me away from the farm, where do you take me and how is the compensation?

Dennis (Paramount Chief)

What we can do is to let us go to the field to see which farm is affected by these test wells. Then we will make a decision.

Justus (Sub-chief)

If your project is to be done here in this area what we need is a memorandum of understanding on compensation according to the Compressive Peace Agreement (Interim constitution).

Michael Daniel Lako (Director of Tokiman community)

If God gives us this people to supply us with clean water there is no need to prevent them to do their work, let us allow them to work in this chosen area of Tokiman as a Paleo-channel.

Gore (One of sub-chiefs)

We have agreed about the project. But what will you do for those people who will affect by the development of the Paleo-channel?

JICA STUDY TEAM

JICA study team gave an answer that test wells will be constructed so as to monitor the change of water table when groundwater is withdrawn, and the quantity of water withdrew will be designed not so as to affect the garden and mongo trees. In addition, we could not see garden and mango tress near the proposed location of test wells.

Arkangelo Stoss (Director of Rejaf Payam)

I come here to witness the meeting and I know this will be good thing to you and for the whole community as well. Also the JICA study team is still searching where they can have good water yield with good quality for human consumption. After they search it, memorandum of understanding will be required.

Dennis (Paramount Chief)

He told the Tokiman people that you don't worry. All the workers for the site during the construction of wells will be your people. So this is also a good thing for you as Tokiman community. So let us allow JICA study team to do their work which they have studied. Now let go to the field to see where the test wells pegs are marked.

4. Visit to Proposed Site for Test Wells

All the stakeholders, government officials and study team go to see and inspect the proposed construction sites of 5 wells, where the test wells are pointed by the pegs.

5. Conclusion by Paramount Chief

After the field visit and investigation, all community members, Paramount chief and Sub-chiefs agreed that JICA study team is allowed to do their works. After they find good water yield, then memorandum of understanding will be required and signed between the Government and the Tokiman community.

Paramount Chief introduced one coordinator (school master) of the Stakeholders to the study team. The study team will communicate with him on the well construction from now on.

Finally, Paramount Chief showed the appreciation to the Japanese government fund, by which several schools and hospitals have been constructed in Southern Sudan. The meeting was closed after the remark of the study team leader on appreciation to successful meeting.

Annex A-3 Drilling Log
Test Well 1 (Well Structure)

Borehole Log (No.1)													
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan				Date :		27-Feb-09 — 9-Mar-09					
Borehole No. :		Test Well No.1		Drilling Depth :		50.00 m		Static water Level :					
District :		Juba		Well Depth :		50.00 m		Dynamic water Level :					
Village :		Tokiman		Drilling Diameter :		500 / 300 mm		Pumping Rate (by air lift) :					
Coordination :		N: 4° 47' 12.8"		Drilling Methods		Mud / DTH		Limited Pumping Rate :					
		E: 31° 35' 54.1"		Drilling Machine		TOP 750		Development					
Altitude		H: 456 m		Well Diameter :		200 mm		Gravel Size					
Client :		JICA Study Team		Length of Screen		15.00 m		Volume					
Supervisor		Mr.Koji Takahashi		Type of Screen		Wire Wounded		Temperature of Water					
Contractor :		Urban Tone Corporation		Slot Size of Screen		1.0 mm		pH					
Hydro-geologist :		Mr. Katsuhiko ADACHI		Material of Casing		Steel		EC					
Depth (m)	Lithology Data			Water level	Electrical Logging				Drilling		Well Structure		Depth (m)
	Log	Description of Lithology	Color		(ohm.m)				Diameter (inch)	Gravel Packing	Casing Program		
	1	Top Soil	Black	200				Wing Bit	Grout	11			
	3	fine ~ medium Sand	Brownish	4				20" Surface casing	Sealing	11	4.10	5m	
5m	6	Medium ~ coarse Sand	Brownish	8				14" (7.5m)		10	7.35	10m	
	7.5	Gravel with Sand	Brownish Gray-White	12						9	10.60	10m	
10m	13	weathered Gneiss	Brownish Gray	16						8	16.63	15m	
15m	19	slightly weathered Granite fine Gneiss	greenish grey ~ brownish gray	20				1st DTH 8"12		7	22.66	20m	
20m				24				2nd DTH 9"18		6	25.85	25m	
25m				28				3rd DTH 12"14		5	31.85	30m	
30m				32						4	35.10	35m	
35m		Granitic fine Gneiss	Greenish Gray-White	36						3	44.35	45m	
40m				40						2	50.35	50m	
45m	44	weathered rock	Green	44						1			
	45			48									
50m		Granitic fine Gneiss	Greenish Gray-White	50.4									

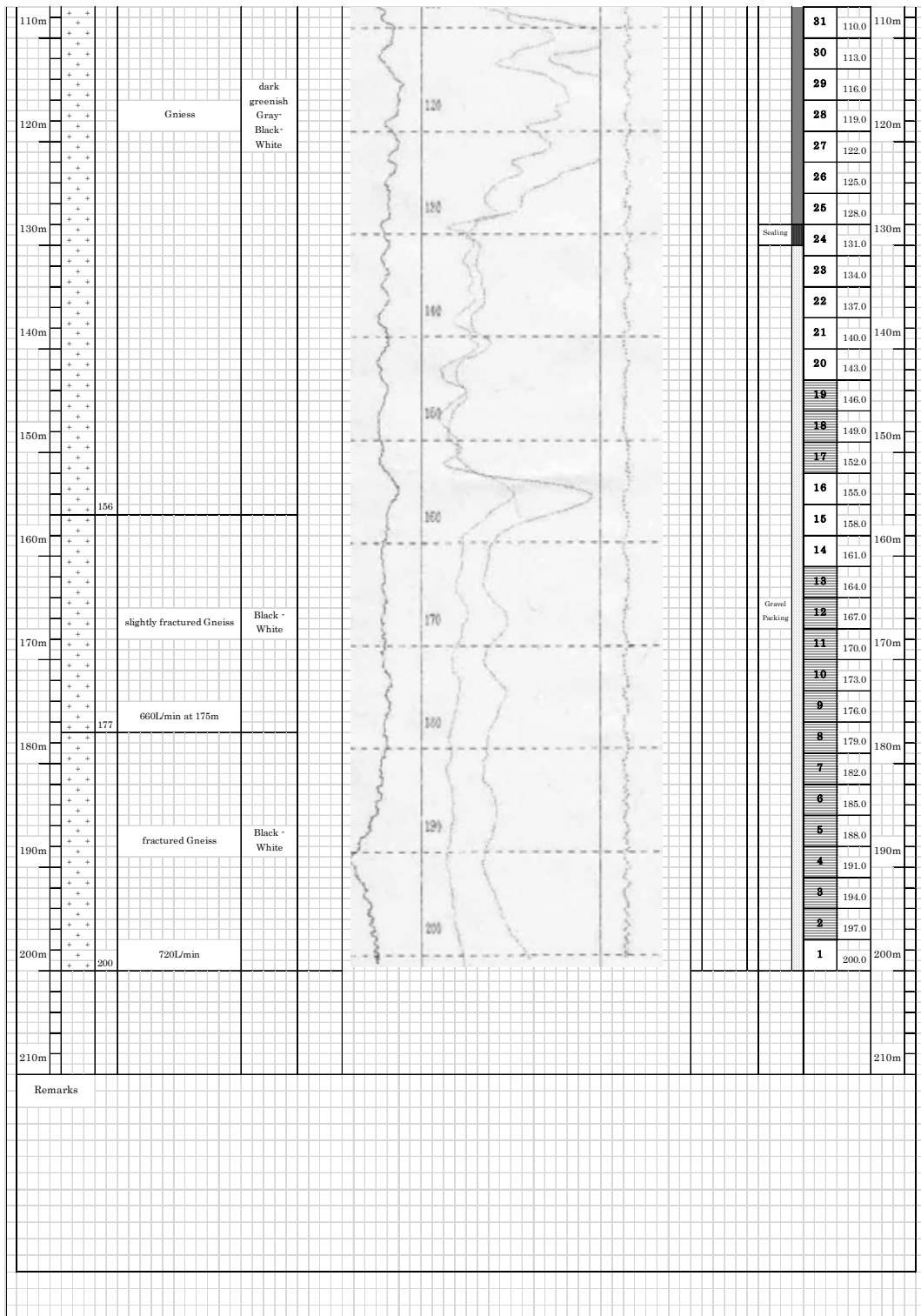
Test Well 1(Drilling Records)

Borehole Log (No.2)															
Project Name :				Juba Urban Water Supply and Capacity Development Study in Southern Sudan				Date :		27-Feb-09		9-Mar-09			
Borehole No. :		Test Well No.1		Drilling Depth :		50.00		m		Static water Level :		GL+ 2.60		m	
District :		Juba		Well Depth :		50.00		m		Dynamic water Level :		GL+ 4.59		m	
Village :		Tokiman		Drilling Diameter :		500 / 300		mm		Pumping Rate (by air lift) :		120		L/min	
Coordination :		N: 4° 47' 12.8"		E: 31° 35' 54.1"		Drilling Methods :		Mud / DTH		Limited Pumping Rate :		230		L/min	
Altitude :		H: 456		m		Drilling Machine :		TOP 750		Development :		26.5		hours	
Client :		JICA Study Team		Well Diameter :		200		mm		Gravel Size :		φ 3 ~ 8		mm	
Supervisor :		Mr.Koji Takahashi		Length of Screen :		15.00		m		Volume :		3.0		m ³	
Contractor :		Urban Tone Corporation		Type of Screen :		Slit		mm		Temperature of Water :		29.9		°C	
Hydro-geologist :		Mr. Katsuhiko ADACHI		Material of Casing :		Steel		mm		pH :		7.64			
										EC :		273		µS/cm	
Depth (m)	Lithology Data		Drilling Speed (min/m)						Conductivity (µS/cm)				Water Yield by Air Lifting	Depth (m)	
	Log	Description of Lithology	Drilling		Reaming				EC						
			12" 1/4	8" 1/2	9" 7/8	12" 1/4	14" 3/4	20"	50	100	EC	500	1000		
	1	Top Soil	3	-	-	2	1								
	3	fine - medium Sand	3	-	-	2	1								
	3		4	-	-	2	1								
	6	Midium - coarse Sand	2	-	-	2	1								
	6		7	-	-	4	1								
	7.5	Gravel with Sand	4	-	-	1	1								
	7.5		15	-	-	2	11								
	7.5		35	-	-	20	54								
	10	weathered Gneiss	30	-	-	20	-								
	10		45	-	-	30	-								
	10		55	-	-	45	-								
	13		58	-	10	55	-								
	13		-	4	25	10	-								
	13		-	4	23	30	-								
	13		-	3	16	15	-								
	19	slightly weathered Granitic fine Gneiss	-	2	8	5	-								
	19		-	7	30	40	-			275µS/cm					
	19		-	6	40	35	-			267µS/cm					
	19		-	6	20	20	-			267µS/cm					
	19		-	10	50	32	-			409µS/cm					
	19		-	6	20	63	-			409µS/cm					
	19		-	6	30	25	-			492µS/cm					
	19		-	4	20	25	-			492µS/cm					
	25		-	6	25	20	-			665µS/cm					
	25		-	6	23	20	-			665µS/cm			26.2L/min		
	25		-	5	40	20	-			509µS/cm					
	25		-	5	17	25	-			509µS/cm					
	25		-	7	20	15	-			619µS/cm					
	25		-	4	20	20	-			619µS/cm			19.9L/min		
	25		-	5	25	25	-			519µS/cm					
	25		-	5	20	30	-			519µS/cm					
	35		-	6	35	45	-			539µS/cm					
	35		-	5	45	35	-			601µS/cm				23.2L/min	
	35		-	5	30	30	-			540µS/cm					
	35		-	6	35	35	-			608µS/cm					
	35		-	4	20	35	-			770µS/cm					
	35		-	4	20	15	-			770µS/cm			22.5L/min		
	35		-	5	20	15	-			668µS/cm					
	35		-	7	40	60	-			734µS/cm					
	35		-	5	15	15	-			873µS/cm					
	44		-	5	15	15	-			873µS/cm			31.5L/min		
	45	weathered rock	-	4	20	30	-			935µS/cm					
	45		-	6	20	20	-			935µS/cm					
	45		-	5	10	20	-			31.5L/min					
	45		-	8	25	50	-			31.5L/min					
	45		-	8	65	93	-			33.5L/min					
	45		-	7	70	75	-			33.5L/min					
	45		-	10	-	100	-			33.5L/min					
	50.4		-	-	-	-	-								

Test Well 2 (Well Structure 0-100m)

Borehole Log (No.1)													
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan				Date :		12-Mar-09		6-Apr-09			
Borehole No. :	Test Well No.2		Drilling Depth :		200.00	m	Static water Level :		GL- 5.94	m			
District:	Juba		Well Depth :		200.00	m	Dynamic water Level :		GL- 69.35	m			
Village:	Tokiman		Drilling Diameter :		300	mm	Pumping Rate :		220	L/s			
Coordination :	N: 4° 46' 26.8"	E: 31° 35' 47.7"	Drilling Methods :		Mud / DTH		Limited Pumping Rate :		-	L/s			
Altitude :	H: 458	m	Drilling Machine :		TOP 750		Development :		46	hours			
Client :	JICA Study Team		Well Diameter :		200	mm	Gravel Size :		φ 3 ~ 8	mm			
Supervisor :	Mr.Komei OZAKI		Length of Screen :		45.00	m	Volume :		1.2	m³			
Contractor :	Urban Tone Corporation		Type of Screen :		Slit		Temperature of Water :		-	°C			
Hydro-geologist :	Mr. Katsuhiko ADACHI		Slot Size of Screen :		1.0	mm	pH :		-	-			
			Material of Casing :		uPVC		EC :		6.8	mS/cm			
Depth (m)	Lithology Data			Water level	Electrical Logging (ohm_m)				Drilling		Well Structure		Depth (m)
	Log	Description of Lithology	Color						Diameter (inch)	Gravel Packing	Casing Program		
10m	3	Top soil and Clay	Dark Brown	5.94m	Tricon Bit 14-3/4" Surface Casing 14"	Grout	67	2.0	10m				
	7	medium ~ coarse Sand	Brown				66	5.0					
20m	12	highly weathered Gniess	Brownish light Gray	65	8.0	20m							
	17	weathered Gniess	Brownish white	64	11.0								
30m	38	slightly weathered Gniess	light greenish Gray	63	14.0	30m							
				62	17.0								
40m	69	slightly weathered Gniess	greenish Gray	61	20.0	40m							
				60	23.0								
50m	43			59	26.0	50m							
				58	29.0								
60m	42			57	32.0	60m							
				56	35.0								
70m	41			55	38.0	70m							
				54	41.0								
80m	40			53	44.0	80m							
				52	47.0								
90m	39			51	50.0	90m							
				50	53.0								
100m	38			49	56.0	100m							
				48	59.0								
				47	62.0								
				46	65.0								
				45	68.0								
				44	71.0								
				43	74.0								
				42	77.0								
				41	80.0								
				40	83.0								
				39	86.0								
				38	89.0								
				37	92.0								
				36	95.0								
				35	98.0								
				34	101.0								
				33	104.0								
				32	107.0								

Test Well 2 (Well Structure 100-200m)



Test Well 2 (Drilling Records 100 - 200m)

Depth (m)	Remarks	Time (min)	Flow Rate (m³/sec)	Flow Rate (L/min)
110m	Gneiss	10 30 30	5.2 m³/sec	40.0 L/min
		10 25 30	5.4 m³/sec	
		10 25 30	5.4 m³/sec	
		12 25 40	5.4 m³/sec	
		12 27 35	5.3 m³/sec	26.8 L/min
		11 44 40	5.1 m³/sec	
		13 48 35	5.5 m³/sec	
		13 37 3	5.1 m³/sec	32.1 L/min
		11 34 49	5.4 m³/sec	
		8 37 39	5.1 m³/sec	
120m	Gneiss	11 41 50	5.3 m³/sec	
		11 38 44	5.3 m³/sec	
		11 36 42	5.2 m³/sec	27.3 L/min
		10 29 40	4.9 m³/sec	
		11 32 30	5.4 m³/sec	
		10 28 30	5.1 m³/sec	28.3 L/min
		12 32 38	5.1 m³/sec	
		13 40 47	4.9 m³/sec	
		14 24 32	5.4 m³/sec	
		14 28 24	5.4 m³/sec	
130m	Gneiss	13 30 28	5.4 m³/sec	
		14 25 28	5.4 m³/sec	28.3 L/min
		15 25 24	5.1 m³/sec	
		16 30 29	5.1 m³/sec	
		12 28 28	5.1 m³/sec	
		17 27 29	5.4 m³/sec	
		19 15 25	5.4 m³/sec	
		14 15 21	4.8 m³/sec	32.0 L/min
		11 22 35	4.8 m³/sec	
		10 24 35	3.9 m³/sec	
140m	Gneiss	11 25 29	4.0 m³/sec	27.5 L/min
		13 19 21	4.8 m³/sec	
		8 12 20	4.8 m³/sec	
		11 16 28	4.9 m³/sec	
		9 28 32	5.1 m³/sec	28.4 L/min
		12 20 30	4.9 m³/sec	
		10 11 23	4.6 m³/sec	27.5 L/min
		10 14 15	4.6 m³/sec	
		12 12 33	4.5 m³/sec	
		11 18 27	4.1 m³/sec	27.8 L/min
150m	Gneiss	14 2 29	4.1 m³/sec	
		8 16 26	4.8 m³/sec	117 L/min
		11 31 46	5.5 m³/sec	
		12 32 43	5.6 m³/sec	
		10 34 48	5.5 m³/sec	
		10 21 32	5.5 m³/sec	667 L/min
		12 22 39	6.6 m³/sec	
		14 19 33	6.4 m³/sec	690 L/min
		12 14 26	6.7 m³/sec	
		10 11 21	6.8 m³/sec	706 L/min
160m	slightly fractured Gneiss	12 12 23	6.9 m³/sec	
		9 11 24	6.8 m³/sec	705 L/min
		12 11 20	6.7 m³/sec	
		15 14 25	6.8 m³/sec	
		10 20 36	6.9 m³/sec	
		15 12 24	6.8 m³/sec	
		12 12 19	6.9 m³/sec	
		10 12 18	6.7 m³/sec	
		13 14 18	6.8 m³/sec	
		12 14 20	6.8 m³/sec	
170m	660L/min at 175m	25 14 28	6.9 m³/sec	
		30 17 41	6.9 m³/sec	
		21 17 26	6.8 m³/sec	
		20 14 32	6.8 m³/sec	
		18 10 26	6.6 m³/sec	
		11 10 25	6.6 m³/sec	
		14 9 30	6.7 m³/sec	
		1 14 32	6.8 m³/sec	
		14 13 31	6.8 m³/sec	
		13 10 20	6.9 m³/sec	
180m	fractured Gneiss	16 11 22	6.9 m³/sec	
		13 10 22	6.9 m³/sec	
		15 13 26	6.8 m³/sec	
		15 8 20	6.8 m³/sec	
		28 17 35	6.9 m³/sec	
		16 10 20	6.8 m³/sec	
		16 10 20	6.7 m³/sec	
		11 9 20	6.8 m³/sec	
		17 15 20	6.7 m³/sec	
		12 16 25	6.8 m³/sec	
190m	720L/min	17 11 20	6.7 m³/sec	
		19 15 25	6.8 m³/sec	
		22 13 25	6.8 m³/sec	
		17 12 25	6.9 m³/sec	
		20 9 22	6.9 m³/sec	
		20 25 71	6.9 m³/sec	
		22 16 27	6.9 m³/sec	
		20 19 32	6.9 m³/sec	
		20 18 31	6.9 m³/sec	
		15 16 29	6.8 m³/sec	
200m	720L/min	14 9 30	6.8 m³/sec	727 L/min
		14 9 30	6.8 m³/sec	
210m				

Test Well 3 (Well Structure)

Borehole Log (No.1)										
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan				Date :		7-Apr-09		20-Apr-09
Borehole No. :	Test Well No.3		Drilling Depth :	100.00	m	Static water Level :	GL+ 3.56	m		
District :	Juba		Well Depth :	100.00	m	Dynamic water Level :	GL- 6.23	m		
Village :	Tokiman		Drilling Diameter :	300	mm	Pumping Rate :	28	L/s		
Coordination :	N°	4°	46'	23.8"	Drilling Methods	Mud / DTH		Limited Pumping Rate :	30	L/s
	E°	31°	35'	45.6"		Drilling Machine	TOP 750		Development	24
Altitude :	H:	456		m	Well Diameter :	200	mm	Gravel Size	φ 3 ~ 8	mm
Client :	JICA Study Team		Length of Screen	27.00	m	Volume	4.7	m ³		
Supervisor	Mr.Komei OZAKI		Type of Screen	Slit		Temperature of Water	29.6	°C		
Contractor :	Urban Tone Corporation		Slot Size of Screen	1.0	mm	pH	-			
Hydro-geologist :	Mr. Katsuhiko ADACHI		Material of Casing	uPVC		EC	440	µS/cm		
Depth (m)	Lithology Data				Electrical Logging (ohm.m)	Drilling	Well Structure		Depth (m)	
	Log	Description of Lithology	Color	Water level			Diameter (Gnch)	Gravel Packing		Casing Program
10m	6	Fine ~ Midium Sand	Brown	3.56m		Tricon Bt 14-3/4" Surface Casing 14"	Grout	32	1.22	10m
	9	Fine Gravel	Brownish White	After remove out surface casing				81	3.90	
	12	weathered Gneiss	Brown					30	6.54	
	15	highly weathered Gneiss	Brownish Gray					29	9.50	
20m	18	weathered Gneiss	Brownish light Gray		28	12.48	Gravel Packing	27	15.40	20m
	20m				26	18.32				
	25				25	20.91				
	28				23	23.49				
30m	30	slightly weathered Gneiss	greenish Gray-Black-White		30	26.49	Gravel Packing	24	26.49	30m
	32				25	29.49				
	34				24	32.48				
	35				23	35.45				
40m	40m				40	38.02	Gravel Packing	22	38.02	40m
	41				21	40.58				
	43				20	43.52				
	46				19	46.45				
50m	50m	Fine Gneiss	greenish Gray-Black-White		50	49.42	Gravel Packing	18	49.42	50m
	52				17	52.41				
	55				16	55.33				
	58				15	58.31				
60m	60m				60	61.31	Gravel Packing	14	61.31	60m
	61				13	64.32				
	67				12	67.31				
	70				11	70.27				
70m	70m				70	73.26	Gravel Packing	10	73.26	70m
	76				9	76.22				
	80				8	79.16				
	82				7	82.14				
80m	80m	Gneiss	Gray-Black-White		80	85.13	Gravel Packing	6	85.13	80m
	85				5	88.11				
	91				4	91.11				
	94				3	94.05				
90m	90m				90	97.00	Gravel Packing	2	97.00	90m
	93				1	100.00				
	99									
	100									
100m	100			93.0m					100m	
				After Drilling by DTH						

Test Well 3 (Drilling Records 0 - 100m)

Borehole Log (No.2)																		
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan							Date :		7-Apr-09		20-Apr-09					
Borehole No. :	Test Well No.3			Drilling Depth :			100.00			m		Static water Level :		GL: 3.56		m		
District :	Juba			Well Depth :			100.00			m		Dynamic water Level :		GL: 6.23		m		
Village :	Tokiman			Drilling Diameter :			300			mm		Pumping Rate :		28		L/s		
Coordination :	N:	4°	46'	23.8"	Drilling Methods				Mud / DTH				Limited Pumping Rate :		30		L/s	
	E:	31°	35'	45.6"	Drilling Machine				TOP 750				Development		24		hours	
Altitude	H: 456			Well Diameter :			200			mm		Gravel Size		φ 3 ~ 8		mm		
Client :	JICA Study Team			Length of Screen			27.00			m		Volume		4.7		m ³		
Supervisor	Mr. Komei OZAKI			Type of Screen			Slit					Temperature of Water		29.6		°C		
Contractor :	Urban Tone Corporation			Slot Size of Screen			1.0			mm		pH						
Hydro-geologist :	Mr. Katsuhiko ADACHI			Material of Casing			uPVC					EC		440		µS/cm		
Depth (m)	Lithology Data				Drilling Speed (min/m)							Conductivity (µS/cm)					Water Yield by Air Lifting	Depth (m)
	Log	Description of Lithology	Drilling				Reaming			200	400	EC	0	500	1000			
			Tricon	DTH	Tricon bit	Tricon bit	Tricon bit	Tricon bit										
12°-1/4	14°-3/4	8°-1/2	9°-7/8	12°-1/4	18°													
6	+	Fine - Midum Sand	9	7			3											
			10	10			3											
9	+	Fine Gravel	9				3											
			7	13			3											
12	+	weathered Gneiss	5				6											
			35	80			34											
15	+	highly weathered Gneiss	60				60											
			20															
18	+	weathered Gneiss	25															
			20															
21	+	slightly weathered Gneiss	5				25											
			5				27											
24	+	slightly weathered Gneiss	10				35											
			5				30											
27	+	slightly weathered Gneiss	5				60											
			9				45											
30	+	slightly weathered Gneiss	8				80											
			10				65											
33	+	slightly weathered Gneiss	8				40											
			11				45											
36	+	slightly weathered Gneiss	6				70											
			7				55											
39	+	slightly weathered Gneiss	5				50											
			9				136											
42	+	slightly weathered Gneiss	8				131											
			12				58											
45	+	slightly weathered Gneiss	5				125											
			11				210											
48	+	slightly weathered Gneiss	11				220											
			14				180											
51	+	slightly weathered Gneiss	13				210											
			10				181											
54	+	slightly weathered Gneiss	11				112											
			9				46											
57	+	slightly weathered Gneiss	12				48											
			10				43											
60	+	slightly weathered Gneiss	11				78											
			13				130											
63	+	slightly weathered Gneiss	12				60											
			10				45											
66	+	slightly weathered Gneiss	8				20											
			5				25											
69	+	slightly weathered Gneiss	9				20											
			5				35											
72	+	slightly weathered Gneiss	7				35											
			8				20											
75	+	slightly weathered Gneiss	8				30											
			8				30											
78	+	slightly weathered Gneiss	8				40											
			9				65											
81	+	slightly weathered Gneiss	8				45											
			8				30											
84	+	slightly weathered Gneiss	8				40											
			9				65											
87	+	slightly weathered Gneiss	8				30											
			6				35											
90	+	slightly weathered Gneiss	6				30											
			4				30											
93	+	slightly weathered Gneiss	5				25											
			6				25											
96	+	slightly weathered Gneiss	6				25											
			5				15											
99	+	slightly weathered Gneiss	5				25											
			6				49											
102	+	slightly weathered Gneiss	9				41											
			5				29											
105	+	slightly weathered Gneiss	5				27											
			5				28											
108	+	slightly weathered Gneiss	8				32											
			7				24											
111	+	slightly weathered Gneiss	8				23											
			8				23											
114	+	slightly weathered Gneiss	8				32											
			8				32											
117	+	slightly weathered Gneiss	8				32											
			9				47											
120	+	slightly weathered Gneiss	8				34											
			9				55											
123	+	slightly weathered Gneiss	10				60											
			11				60											
126	+	slightly weathered Gneiss	11				60											
			10				60											
129	+	slightly weathered Gneiss	8				40											
			9				60											
132	+	slightly weathered Gneiss	10				60											
			13				55											
135	+	slightly weathered Gneiss	11				55											
			10				45											
138	+	slightly weathered Gneiss	9				47											
			8				47											
141	+	slightly weathered Gneiss	8				47											
			9				44											

Observation 1 (Well Structure)

Borehole Log (No.1)													
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan				Date :		23-Feb-09		26-Feb-09			
Borehole No. :		Obseverion Well No.1		Drilling Depth :		50.00 m		Static water Level :		GL- 2.83 m			
District :		Juha		Well Depth :		50.00 m		Dynamic water Level :		GL- - m			
Village :		Tokiman		Drilling Diameter :		200 mm		Water yield by air lifting :		110 L/min			
Coordination :		N: 4° 47' 13.0"		Drilling Methods :		Mud / DTH		Development :		25 hours			
		E: 31° 35' 55.7"		Drilling Machine :		TOP 750		Gravel Size :		φ 3 ~ 8 mm			
Altitude :		H: 456 m		Well Diameter :		100 mm		Volume :		1.5 m ³			
Client :		JICA Study Team		Length of Screen :		15.0 m		Temperature of Water :		29.9 °C			
Supervisor :		Mr. Koji Takahashi		Type of Screen :		Slit		pH :		7.72			
Contractor :		Urban Tone Corporation		Slot Size of Screen :		1.0 mm		EC :		338 μS/cm			
Hydro-geologist :		Mr. Katsuhiko ADACHI		Material of Casing :		uPVC							
Depth (m)	Lithology Data				Electrical Logging				Drilling		Well Structure		Depth (m)
	Log	Description of Lithology	Color	Water level					Diameter (inch)	Gravel Packing	Casing Program		
5m	1	Top Soil	Black	2.83m					Tricon Bit 12-1/4"	Grout	17	2.10	5m
	3	medium-Fine Sand	Brownish										
10m		Midium-Coarse Sand	Brownish White							16	8.04	10m	
	8	weathered Gneiss	Brownish Gray							14	11.01		
15m		slightly weathered Granitic fine Gneiss	Brownish Gray-White							13	14.04	15m	
	11									12	17.07		
20m		Fist strike of water aroud 19m								11	20.09	20m	
	20									10	23.07		
25m		Granitic fine Gneiss	Greenish Gray-White					DTH 8"-1/2"		Gravel Packing	9	26.10	25m
											8	29.07	
30m										7	32.10	30m	
										6	35.08		
35m										5	38.08	35m	
										4	41.06		
40m										3	44.06	40m	
										2	47.08		
45m										1	50.00	45m	
50m												50m	

Observation Well 1(Drilling Records)

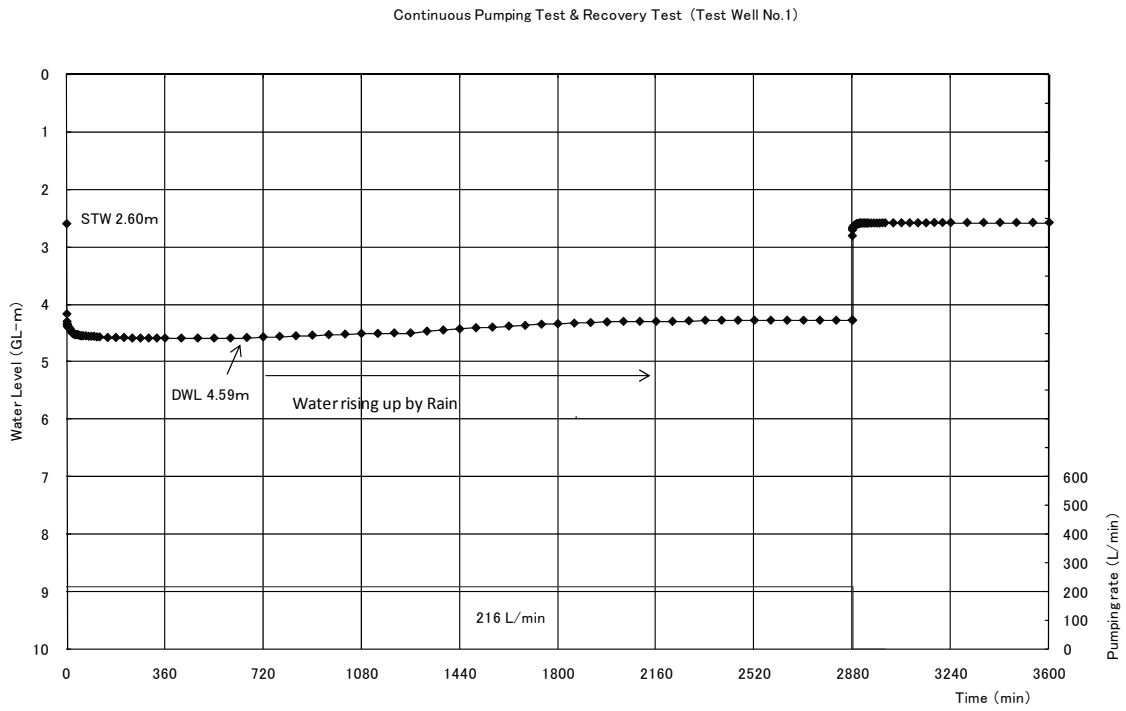
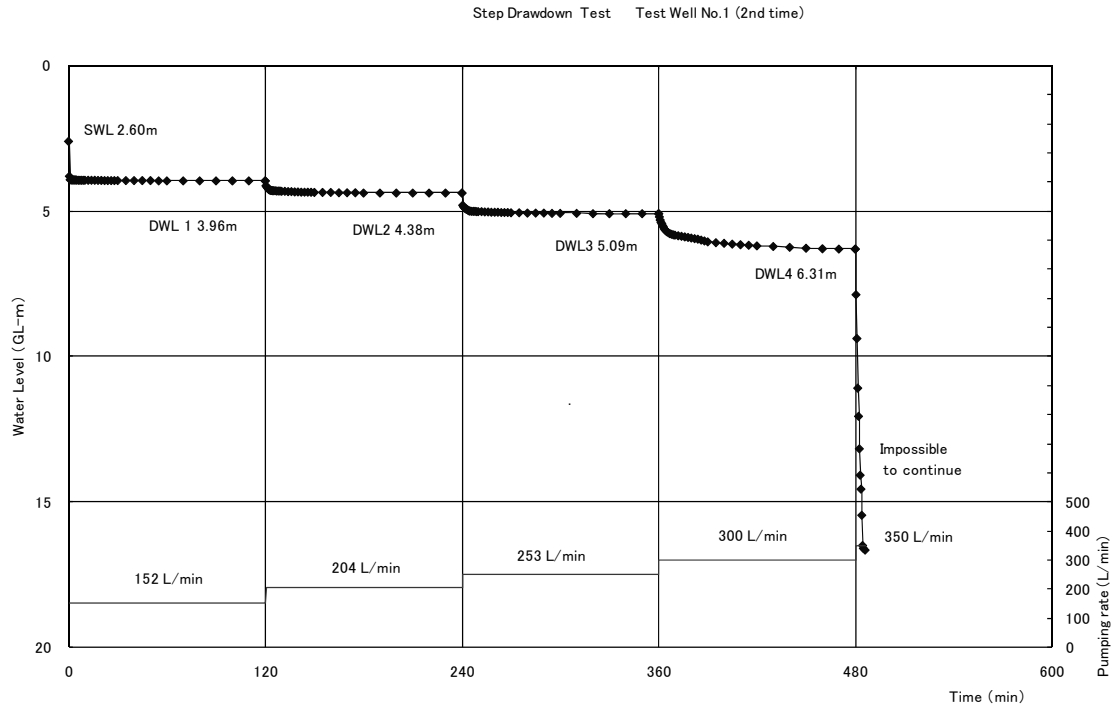
Borehole Log (No.2)																	
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan					Date :		23-Feb-09			26-Feb-09					
Borehole No. :		Obsevation Well No.1		Drilling Depth :		50.00		m		Static water Level :		GL- 2.83		m			
District :		Juba		Well Depth :		50.00		m		Dynamic water Level :		GL- -		m			
Village :		Tokiman		Drilling Diameter :		200		mm		Water yeild by air lifting		110		L/min			
Coordination :		N: 4° 47' 13.0"		Drilling Methods		Mad / DTH				Development		25		hours			
		E: 31° 35' 55.7"		Drilling Machine		TOP 750											
Altitude		H: 456		m		Well Diameter :		100		mm		Gravel Size		φ 3 ~ 8		mm	
Client :		JICA Study Team		Length of Screen		15.0		m		Volume		1.5		m³			
Supervisor		Mr.Koji Takahashi		Type of Screen		Slit				Temperature of Water		29.9		°C			
Contractor :		Urban Tone Corporation		Slot Size of Screen		1.0		mm		pH		7.72					
Hydro-geologist :		Mr. Katsuhiko ADACHI		Material of Casing		uPVC				EC		338		µS/cm			
Depth (m)	Lithology Data			Drilling Speed (min/m)				Conductivity (µS/cm)				Water Yield by Air Lifting	Depth (m)				
	Log	Description of Lithology		Tricon 12"-1/4	DTH 8"-1/2	Reaming Tri-con bit		EC									
5m	1	Top Soil	3	-	-	-	-										
	3	medium-Fine Sand	3	-	-	-	-										
			4	-	-	-	-										
	8	Midium-Coarse Sand	4	-	-	-	-										
			5	-	-	-	-										
			6	-	-	-	-										
			7	-	-	-	-										
	10m	weathered Gneiss	20	-	-	-	-										
11			-	-	-	-											
15m	shghtly weathered Granitic fine Gneiss	3	-	-	-	-		885µS/cm									
		4	-	-	-	-		962µS/cm									
		2	-	-	-	-		936µS/cm									
		2	-	-	-	-		1118µS/cm			52.0L/min						
20m	Fist strike of water around 19m	20	-	-	-	-		926µS/cm									
		4	-	-	-	-		958µS/cm									
25m	Granitic fine Gneiss	4	-	-	-	-		1085µS/cm			44.8L/min						
		7	-	-	-	-		948µS/cm									
		6	-	-	-	-		918µS/cm									
		4	-	-	-	-		1050µS/cm			48.5L/min						
30m	Granitic fine Gneiss	5	-	-	-	-		935µS/cm									
		3	-	-	-	-		943µS/cm									
		3	-	-	-	-		1020µS/cm			49.0L/min						
		5	-	-	-	-		925µS/cm									
35m	Granitic fine Gneiss	13	-	-	-	-		935µS/cm									
		12	-	-	-	-		997µS/cm			46.0L/min						
		20	-	-	-	-		878µS/cm									
		16	-	-	-	-		913µS/cm									
40m	Granitic fine Gneiss	5	-	-	-	-		823µS/cm			44.2L/min						
		3	-	-	-	-		927µS/cm			51.7L/min						
		8	-	-	-	-											
		12	-	-	-	-											
45m	Granitic fine Gneiss	10	-	-	-	-											
		8	-	-	-	-											
		13	-	-	-	-											
		12	-	-	-	-											
50m	Granitic fine Gneiss	51	-	-	-	-											
		12	-	-	-	-											

Observation Well 2(Drilling Records)

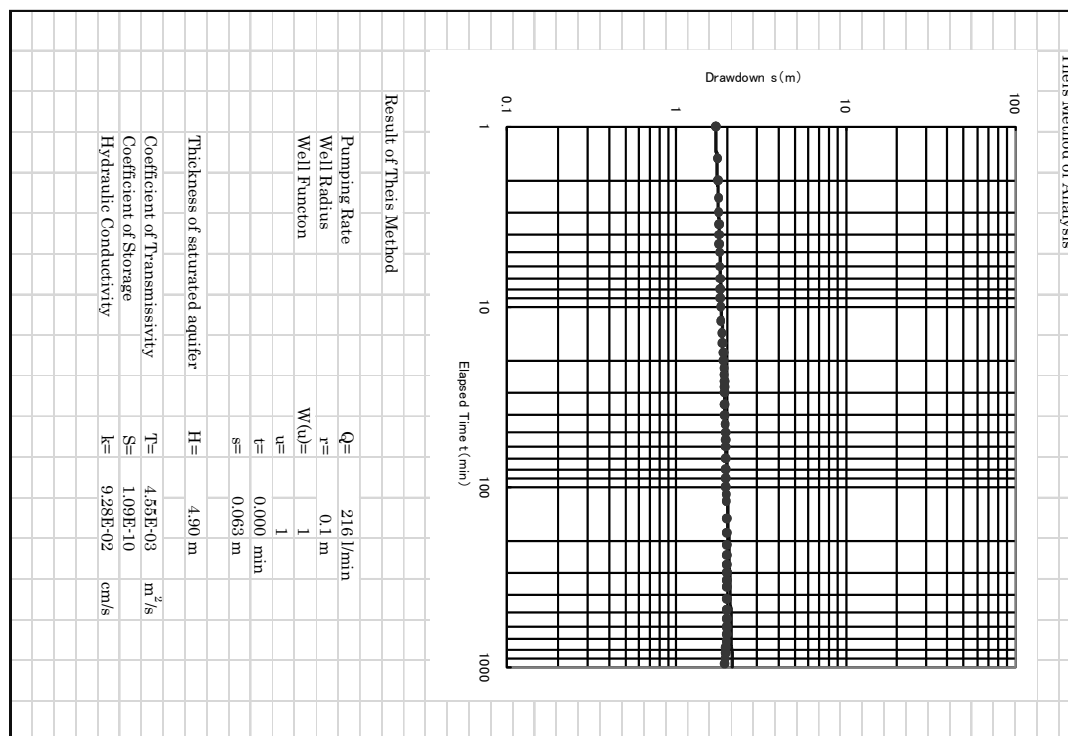
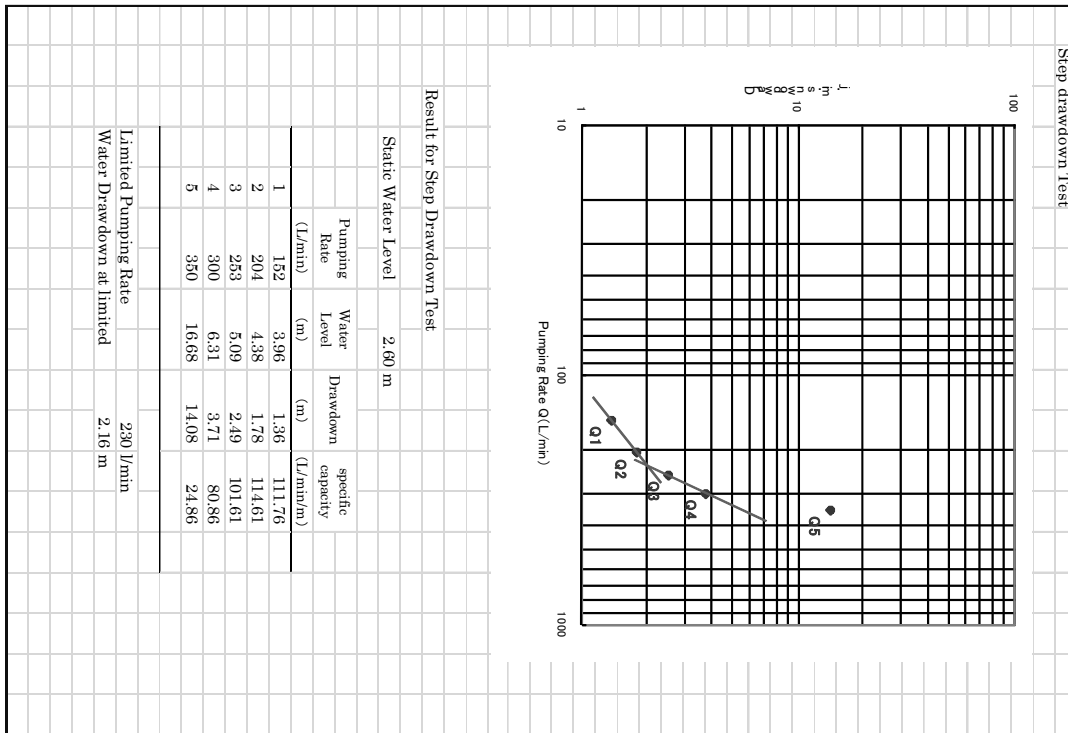
Borehole Log (No.2)																	
Project Name :		Juba Urban Water Supply and Capacity Development Study in Southern Sudan					Date :		9-Mar-09			12-Mar-09					
Borehole No. :		Obsevation Well No.2		Drilling Depth :		50.00		m		Static water Level :		GL: 2.45		m			
District :		Juba		Well Depth :		50.00		m		Dynamic water Level :		GL: 2.45		m			
Village :		Tokiman		Drilling Diameter :		200		mm		Water Yield by Air Lifting :		81.5		L/min			
Coordination :		N: 4° 47' 11.2"		E: 31° 35' 54.5"		Drilling Methods		Mud / DTH		Development		25.5		hours			
Altitude :		H: 455		m		Well Diameter :		100		mm		Gravel Size		φ 3 ~ 8		mm	
Client :		JICA Study Team		Length of Screen		15.00		m		Volume		1.9		m³			
Supervisor :		Mr.Koji Takahashi		Type of Screen		Slit		m		Temperature of Water		29.0		°C			
Contractor :		Urban Tone Corporation		Slot Size of Screen		1.0		mm		pH		7.62					
Hydro-geologist :		Mr. Katsuhiko ADACHI		Material of Casing		uPVC		m		EC		285		µS/cm			
Depth (m)	Lithology Data		Drilling Speed (min/m)						Conductivity (µS/cm)			Water Yield by Air Lifting	Depth (m)				
	Log	Description of Lithology	Tricon 12"=1/4	DTH 8"=1/2	Reaming Tri-con bit			EC									
5m	1	Top Soil	3	-	-	-	-	-	-	-	-	-	-	-	-		
		medium-Fine Sand	5	-	-	-	-	-	-	-	-	-	-	-	-		
5m	3	Midium-Coarse Sand	4	-	-	-	-	-	-	-	-	-	-	-	-		
			6	-	-	-	-	-	-	-	-	-	-	-			
			5	-	-	-	-	-	-	-	-	-	-	-			
			6	-	-	-	-	-	-	-	-	-	-	-			
10m	8	weathered Gneiss	16	-	-	-	-	-	-	-	-	-	-	-			
			37	-	-	-	-	-	-	-	-	-	-				
15m	11	slightly weathered Granitic fine Gneiss	6	-	-	-	-	-	-	-	-	-	-	-			
			4	-	-	-	-	-	-	-	-	-	-				
			4	-	-	-	-	-	-	-	-	-	-				
			7	-	-	-	-	-	-	-	-	-	-				
20m	20	Fist strike of water around 19m	5	-	-	-	-	-	-	-	-	-	-				
			6	-	-	-	-	-	-	-	-	-					
			9	-	-	-	-	-	-	-	-	-					
			9	-	-	-	-	-	-	-	-	-					
25m			8	-	-	-	-	-	-	-	-	-	-				
			9	-	-	-	-	-	-	-	-	-					
			7	-	-	-	-	-	-	-	-	-					
			6	-	-	-	-	-	-	-	-	-					
30m			6	-	-	-	-	-	-	-	-	-	-				
			6	-	-	-	-	-	-	-	-	-					
			7	-	-	-	-	-	-	-	-	-					
			11	-	-	-	-	-	-	-	-	-					
35m		Granitic fine Gneiss	10	-	-	-	-	-	-	-	-	-	-				
			10	-	-	-	-	-	-	-	-	-					
			13	-	-	-	-	-	-	-	-	-					
			10	-	-	-	-	-	-	-	-	-					
40m			10	-	-	-	-	-	-	-	-	-	-				
			10	-	-	-	-	-	-	-	-	-					
			9	-	-	-	-	-	-	-	-	-					
			10	-	-	-	-	-	-	-	-	-					
45m			9	-	-	-	-	-	-	-	-	-	-				
			9	-	-	-	-	-	-	-	-	-					
			10	-	-	-	-	-	-	-	-	-					
			9	-	-	-	-	-	-	-	-	-					
50m			8	-	-	-	-	-	-	-	-	-	-				
			9	-	-	-	-	-	-	-	-	-					
			9	-	-	-	-	-	-	-	-	-					
			10	-	-	-	-	-	-	-	-	-					
51			30	-	-	-	-	-	-	-	-	-	-				

Annex A-4 Result of Pumping Test

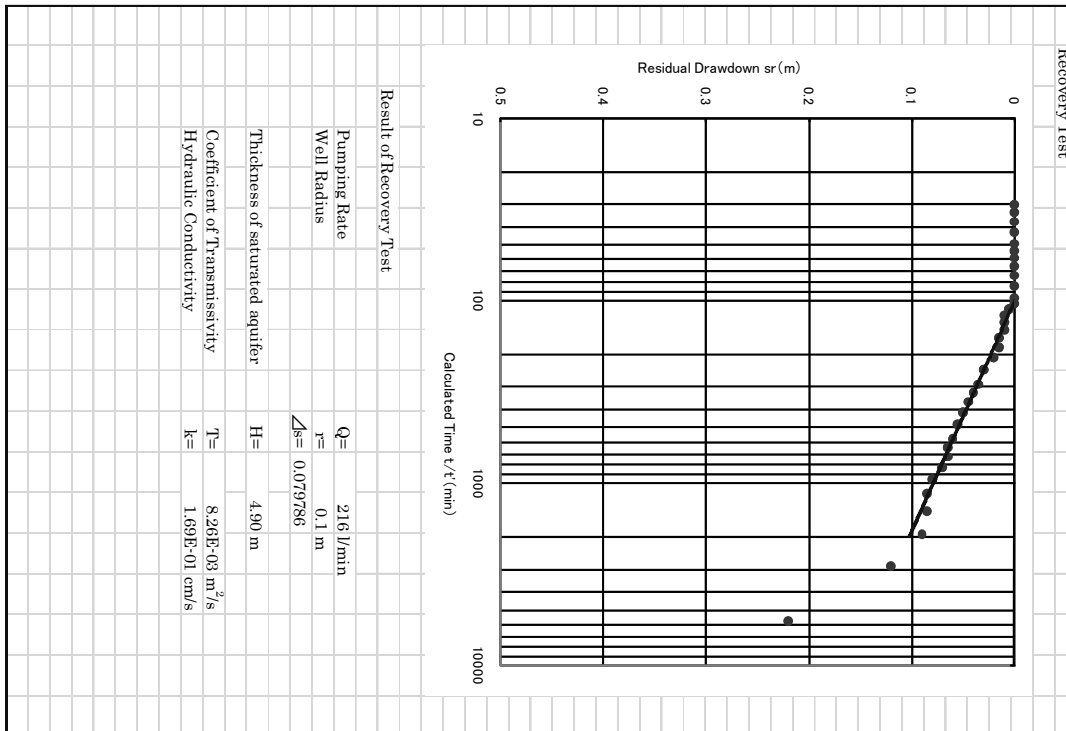
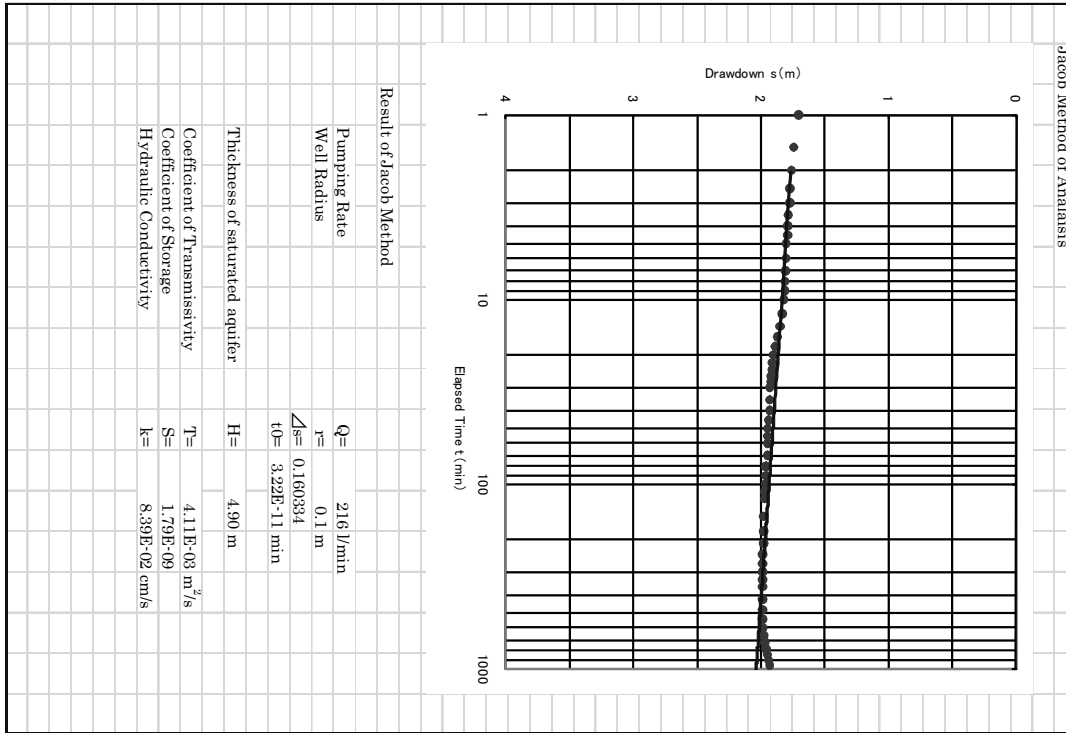
Test Well 1 (Sw-Q Curve)



Test Well 1 (Analysis)



Test Well 1 (Analysis)



Test Well 1 (Step Draw Down Test Record)

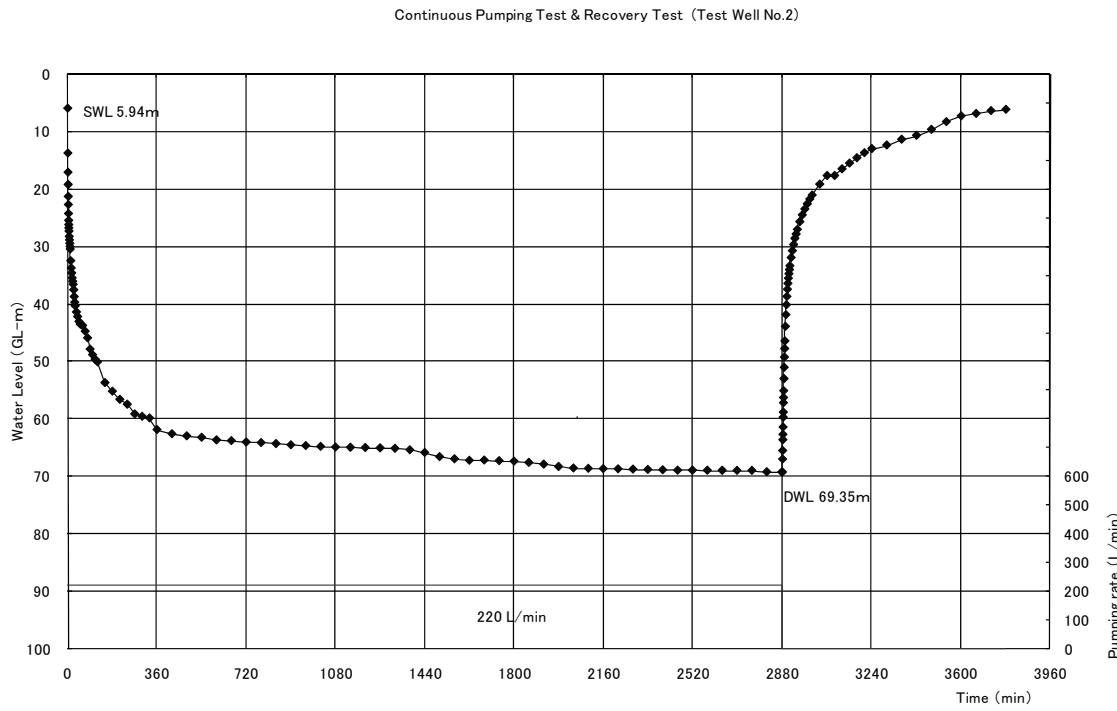
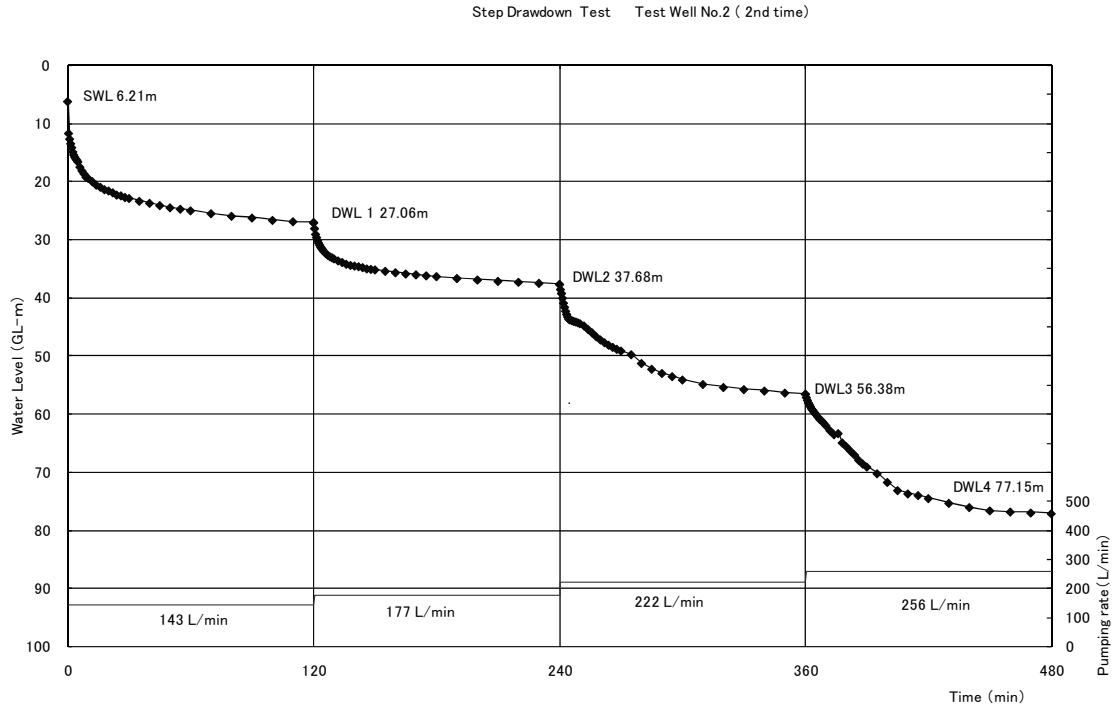
Project										Juba Urban Water Supply and Capacity Development Study															
Test Well No.		Test Well No.1		Date		15-April-09 ~ 15-April-09						12:00		240.5		98		253		4.80		2.20		Step 3	
Well	Depth	21.0 m		Pump	Type	GRUNDFOS SP30-8						12:01	241.0		98		253		4.85		2.25				
	Diameter	200 A			Output	7.5 kW		Voltage		400 V		12:01	241.5		98		253		4.88		2.28				
	Casing Material	Steel			Diameter	75 A		Depth <td colspan="2">19.0 m</td> <th>12:02</th> <td colspan="2">242.0</td> <td colspan="2">98</td> <td colspan="2">253</td> <td colspan="2">4.91</td> <td colspan="2">2.31</td> <td colspan="2"></td>		19.0 m		12:02	242.0		98		253		4.91		2.31				
	Type of Screen	Wire Wound			Measurement of yield				V-Notch		12:02	242.5		98		253		4.93		2.33					
	Length of Screen	9.0 m			Static Water Level				2.600 m		12:03	243.0		98		253		4.94		2.34					
Time		Notch	Pumping Rate	Water Level	Draw down	Remarks																			
Clock	Elapsed (min)	(mm)	(L/min)	(m)	(m)																				
8:00	0.0	80	152	2.60	0.00	Step 1																			
8:00	0.5	80	152	3.80	1.20																				
8:01	1.0	80	152	3.92	1.32																				
8:01	1.5	80	152	3.93	1.33																				
8:02	2.0	80	152	3.93	1.33																				
8:02	2.5	80	152	3.93	1.33																				
8:03	3.0	80	152	3.93	1.33																				
8:03	3.5	80	152	3.93	1.33																				
8:04	4.0	80	152	3.93	1.33																				
8:04	4.5	80	152	3.93	1.33																				
8:05	5	80	152	3.94	1.34																				
8:06	6	80	152	3.94	1.34																				
8:07	7	80	152	3.94	1.34																				
8:08	8	80	152	3.94	1.34																				
8:09	9	80	152	3.94	1.34																				
8:10	10	80	152	3.94	1.34																				
8:12	12	80	152	3.94	1.34																				
8:14	14	80	152	3.94	1.34																				
8:16	16	80	152	3.94	1.34																				
8:18	18	80	152	3.95	1.35																				
8:20	20	80	152	3.95	1.35																				
8:22	22	80	152	3.95	1.35																				
8:24	24	80	152	3.95	1.35																				
8:26	26	80	152	3.95	1.35																				
8:28	28	80	152	3.95	1.35																				
8:30	30	80	152	3.95	1.35																				
8:35	35	80	152	3.95	1.35																				
8:40	40	80	152	3.95	1.35																				
8:45	45	80	152	3.95	1.35																				
8:50	50	80	152	3.95	1.35																				
8:55	55	80	152	3.96	1.36																				
9:00	60	80	152	3.96	1.36																				
9:10	70	80	152	3.96	1.36																				
9:20	80	80	152	3.96	1.36																				
9:30	90	80	152	3.96	1.36																				
9:40	100	80	152	3.96	1.36	pH: 6.50																			
9:50	110	80	152	3.96	1.36	EC: 188 µ S/cm																			
10:00	120	80	152	3.96	1.36	TDS: 92 ppm																			
10:00	120.5	90	204	4.13	1.53	Step 2																			
10:01	121.0	90	204	4.17	1.57																				
10:01	121.5	90	204	4.21	1.61																				
10:02	122.0	90	204	4.25	1.65																				
10:02	122.5	90	204	4.27	1.67																				
10:03	123.0	90	204	4.28	1.68																				
10:03	123.5	90	204	4.29	1.69																				
10:04	124.0	90	204	4.29	1.69																				
10:04	124.5	90	204	4.30	1.70																				
10:05	125	90	204	4.30	1.70																				
10:06	126	90	204	4.30	1.70																				
10:07	127	90	204	4.31	1.71																				
10:08	128	90	204	4.31	1.71																				
10:09	129	90	204	4.31	1.71																				
10:10	130	90	204	4.32	1.72																				
10:12	132	90	204	4.32	1.72																				
10:14	134	90	204	4.33	1.73																				
10:16	136	90	204	4.33	1.73																				
10:18	138	90	204	4.34	1.74																				
10:20	140	90	204	4.34	1.74																				
10:22	142	90	204	4.35	1.75																				
10:24	144	90	204	4.35	1.75																				
10:26	146	90	204	4.35	1.75																				
10:28	148	90	204	4.36	1.76																				
10:30	150	90	204	4.36	1.76																				
10:35	155	90	204	4.36	1.76																				
10:40	160	90	204	4.36	1.76																				
10:45	165	90	204	4.37	1.77																				
10:50	170	90	204	4.37	1.77																				
10:55	175	90	204	4.37	1.77																				
11:00	180	90	204	4.38	1.78																				
11:10	190	90	204	4.38	1.78																				
11:20	200	90	204	4.38	1.78																				
11:30	210	90	204	4.38	1.78																				
11:40	220	90	204	4.38	1.78	pH: 6.31																			
11:50	230	90	204	4.38	1.78	EC: 180 µ S/cm																			
12:00	240	90	204	4.38	1.78	TDS: 90 ppm																			
12:00	240.5	98	253	4.80	2.20	Step 3																			
12:01	241.0	98	253	4.85	2.25																				
12:01	241.5	98	253	4.88	2.28																				
12:02	242.0	98	253	4.91	2.31																				
12:02	242.5	98	253	4.93	2.33																				
12:03	243.0	98	253	4.94	2.34																				
12:03	243.5	98	253	4.96	2.36																				
12:04	244.0	98	253	4.98	2.38																				
12:04	244.5	98	253	5.00	2.40																				
12:05	245	98	253	5.00	2.40																				
12:06	246	98	253	5.01	2.41																				
12:07	247	98	253	5.01	2.41																				
12:08	248	98	253	5.01	2.41																				
12:09	249	98	253	5.02	2.42																				
12:10	250	98	253	5.02	2.42																				
12:12	252	98	253	5.02	2.42																				
12:14	254	98	253	5.03	2.43																				
12:16	256	98	253	5.03	2.43																				
12:18	258	98	253	5.04	2.44																				
12:20	260	98	253	5.04	2.44																				
12:22	262	98	253	5.04	2.44																				
12:24	264	98	253	5.05	2.45																				
12:26	266	98	253	5.05	2.45																				
12:28	268	98	253	5.05	2.45																				
12:30	270	98	253	5.06	2.46																				
12:35	275	98	253	5.06	2.46																				
12:40	280	98	253	5.07	2.47																				
12:45	285	98	253	5.07	2.47																				
12:50	290	98	253	5.07	2.47																				
12:55	295	98	253	5.08	2.48																				
13:00	300	98	253	5.08	2.48																				
13:10	310	98	253	5.08	2.48																				
13:20	320	98	253	5.09	2.49																				
13:30	330	98	253	5.09	2.49																				
13:40	340	98	253	5.09	2.49	pH: 6.25																			
13:50	350	98	253	5.09	2.49	EC: 180 µ S/cm																			
14:00	360	98	253	5.09	2.49	TDS: 86 ppm																			
14:00	360.5	105	300	5.20	2.60	Step 4																			
14:01	361.0	105	300	5.31	2.71																				
14:01	361.5	105	300	5.39	2.79																				
14:02	362.0	105	300	5.44	2.84																				
14:02	362.5	105	300	5.50	2.90																				
14:03	363.0	105	300	5.55	2.95																				
14:03	363.5	105	300	5.61	3.01																				
14:04	364.0	105	300	5.65	3.05																				
14:04	364.5	105	300	5.68	3.08																				
14:05	365	105	300	5.71	3.11																				
14:06	366	105	300	5.75	3.15																				
14:07	367	105	300	5.78	3.18																				
14:08	368	105	300	5.80	3.20																				
14:09	369	105	300	5.82	3.22																				
14:10	370	105	300	5.83	3.23																				
14:12	372	105	300	5.85	3.25																				
14:14	374	105	300	5.87	3.27																				
14:16	376	105	300	5.89	3.29																				
14:18	378	105	300	5.91	3.31																				
14:20	380	105	300	5.93	3.33																				
14:22	382	105	300	5.95	3.35																				
14:24	384	105	300	5.97	3.37																				
14:26	386	105	300	6.00	3.40																				
14:28	388	105	300	6.03	3.43																				
14:30	390	105	300	6.06	3.46																				
14:35	395	105	300	6.09	3.49																				
14:40	400	105	300	6.11	3.51																				
14:45	405	105	300	6.14	3.54																				
14:50	410	105	300	6.16	3.56																				
14:55	415	105	300	6.18	3.58																				
15:00	420	105	300	6.20	3.60																				
15:10	430	105	300	6.22	3.62																				
15:20	440	105	300	6.25	3.65																				
15:30	450	105	300	6.28	3.68																				
15:40	460	105	300	6.30	3.70	pH: 6.10																			
15:50	470	105	300	6.31	3.71	EC: 177 µ S/cm																			
16:00	480	105	300	6.31	3.71	TDS: 89 ppm																			
16:00	480.5	112	350	7.88	5.28	Step 5																			
16:01	481.0	112	350	9.39	6.79																				
16:01	481.5	112	350	11.10	8.50																				
16:02	482.0	112	350	12.07	9.47																				
16:02	482.5	112	350	13.19	10.59																				
16:03	483.0	112	350	14.10	11.50																				
16:03	483.5	112	350	14.58	11.98																				
16:04	484.0	112	350	15.48	12.88																				
16:04	484.5	112	350	16.52	13.92																				
16:05	485	112	350	16.62	14.02																				
16:06	486	112	350	16.68	14.08																				

Test Well 1 (Constant Rate Pumping Test Record)

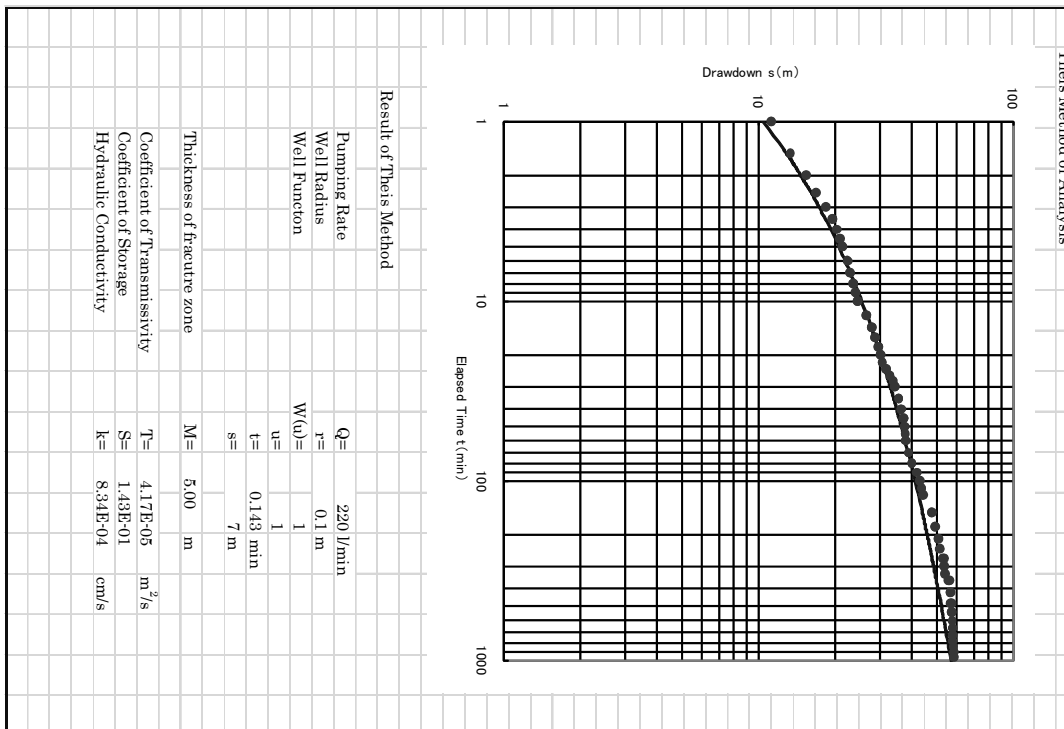
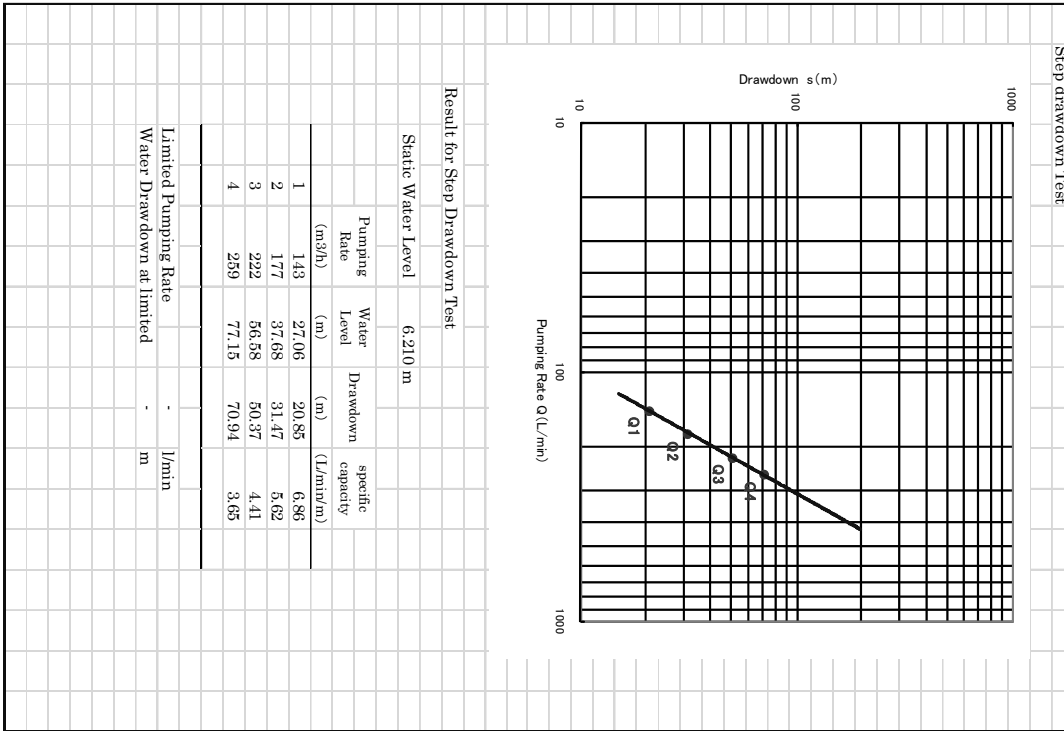
Project								Juba Urban Water Supply and Capacity Development Study									
Test Well No.				Test Well No.1				Date				15-April-09 ~ 17-April-09					
Well	Depth			21.0 m			Pump	Type			GRUNDFOS SP30-8						
	Diameter			200 A				Output			7.5 kW	Voltage		400 V			
	Casing Material			Steel				Diameter			75 A	Depth		19.0 m			
	Type of Screen			Wire Wound				Measurement of yield			V-Notch						
	Length of Screen			9.0 m				Static Water Level			2.600 m						
Time		Notch (mm)	Pumping Rate (L/min)	Water Level (m)	Draw down (m)	Remarks											
Clock	Elapsed (min)																
18:00	0.0			2.60	0.00												
18:00	0.5		216	4.17	1.57												
18:01	1.0		216	4.30	1.70												
18:01	1.5		216	4.34	1.74												
18:02	2.0		216	4.36	1.76												
18:02	2.5		216	4.37	1.77												
18:03	3.0		216	4.37	1.77												
18:03	3.5		216	4.39	1.79												
18:04	4.0		216	4.39	1.79												
18:04	4.5		216	4.39	1.79												
18:05	5		216	4.40	1.80												
18:06	6		216	4.40	1.80												
18:07	7		216	4.41	1.81												
18:08	8		216	4.41	1.81												
18:09	9		216	4.41	1.81												
18:10	10		216	4.42	1.82												
18:12	12		216	4.43	1.83												
18:14	14		216	4.45	1.85												
18:16	16		216	4.47	1.87												
18:18	18		216	4.49	1.89												
18:20	20		216	4.50	1.90												
18:22	22		216	4.51	1.91												
18:24	24		216	4.51	1.91												
18:26	26		216	4.52	1.92												
18:28	28		216	4.52	1.92												
18:30	30		216	4.53	1.93												
18:35	35		216	4.53	1.93												
18:40	40		216	4.53	1.93												
18:45	45		216	4.54	1.94												
18:50	50		216	4.55	1.95												
18:55	55		216	4.55	1.95												
19:00	60		216	4.55	1.95				pH: 6.20								
19:10	70		216	4.55	1.95				EC: 180 µ S/cm								
19:20	80		216	4.56	1.96				TDS: 94ppm								
19:30	90		216	4.56	1.96												
19:40	100		216	4.56	1.96												
19:50	110		216	4.57	1.97												
20:00	120		216	4.57	1.97												
20:30	150		216	4.58	1.98												
21:00	180		216	4.58	1.98												
21:30	210		216	4.58	1.98												
22:00	240		216	4.59	1.99												
22:30	270		216	4.59	1.99												
23:00	300		216	4.59	1.99												
23:30	330		216	4.59	1.99												
0:00	360		216	4.59	1.99												
1:00	420		216	4.59	1.99												
2:00	480		216	4.59	1.99				Rain started								
3:00	540		216	4.59	1.99												
4:00	600		216	4.59	1.99												
5:00	660		216	4.58	1.98				Water Level was rose during pumping								
6:00	720		216	4.57	1.97												
7:00	780		216	4.56	1.96												
8:00	840		216	4.55	1.95												
9:00	900		216	4.54	1.94												
10:00	960		216	4.53	1.93												
11:00	1020		216	4.52	1.92												
12:00	1080		216	4.51	1.91												
13:00	1140		216	4.51	1.91												
14:00	1200		216	4.50	1.90												

15:00	1260		216	4.50	1.90												
16:00	1320		216	4.47	1.87												
17:00	1380		216	4.45	1.85												
18:00	1440		216	4.43	1.83												
19:00	1500		216	4.41	1.81												
20:00	1560		216	4.40	1.80												
21:00	1620		216	4.38	1.78												
22:00	1680		216	4.37	1.77												
23:00	1740		216	4.35	1.75												
0:00	1800		216	4.34	1.74												
1:00	1860		216	4.33	1.73												
2:00	1920		216	4.32	1.72												
3:00	1980		216	4.31	1.71												
4:00	2040		216	4.30	1.70												
5:00	2100		216	4.30	1.70												
6:00	2160		216	4.30	1.70												
7:00	2220		216	4.30	1.70												
8:00	2280		216	4.29	1.69												
9:00	2340		216	4.28	1.68												
10:00	2400		216	4.28	1.68												
11:00	2460		216	4.28	1.68												
12:00	2520		216	4.28	1.68												
13:00	2580		216	4.28	1.68												
14:00	2640		216	4.28	1.68												
15:00	2700		216	4.28	1.68												
16:00	2760		216	4.28	1.68												
17:00	2820		216	4.28	1.68												
18:00	2880		216	4.28	1.68												

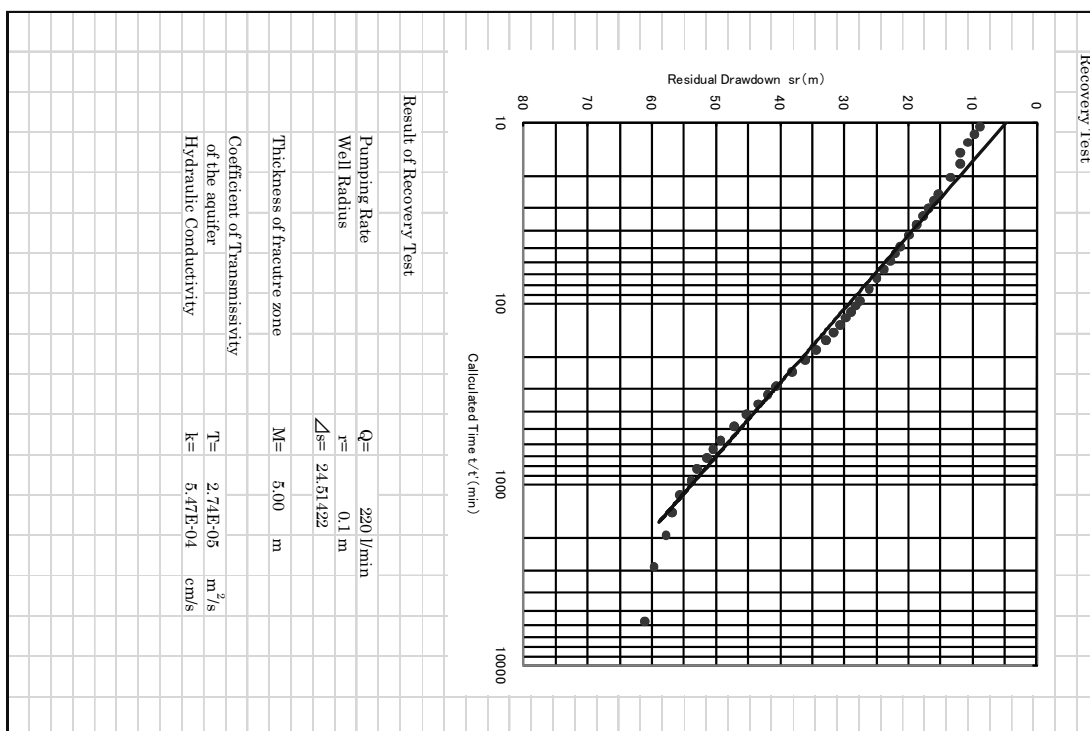
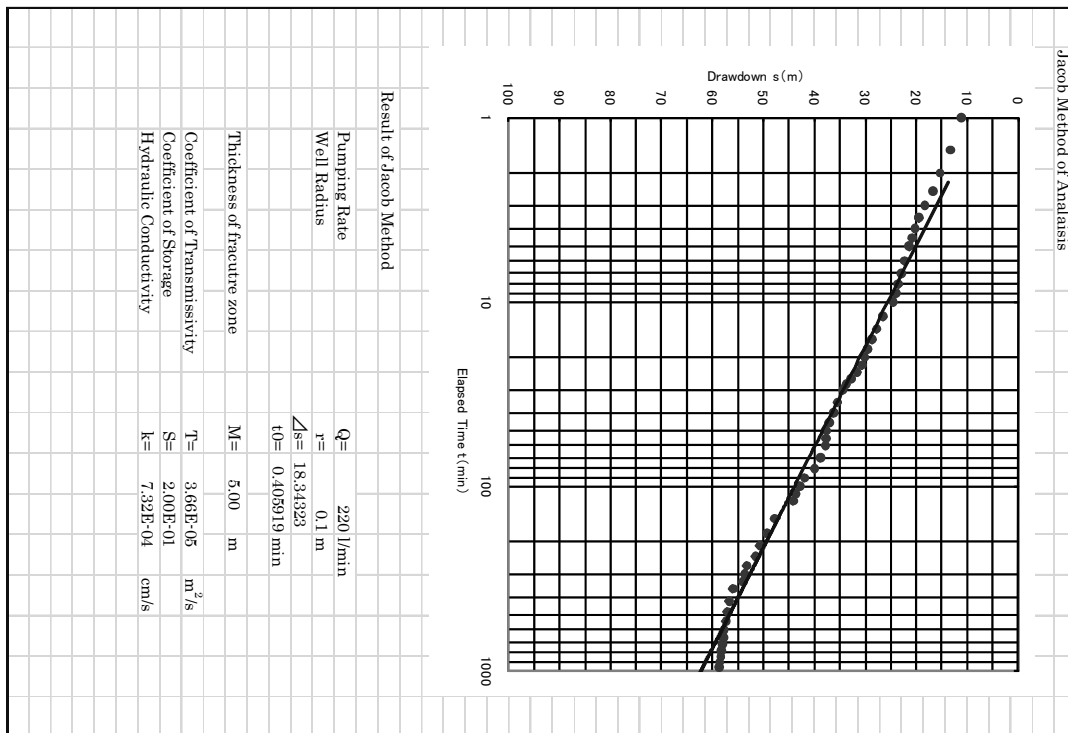
Test Well 2 (Sw-Q Curve)



Test Well 2 (Analysis)



Test Well 2 (Analysis)



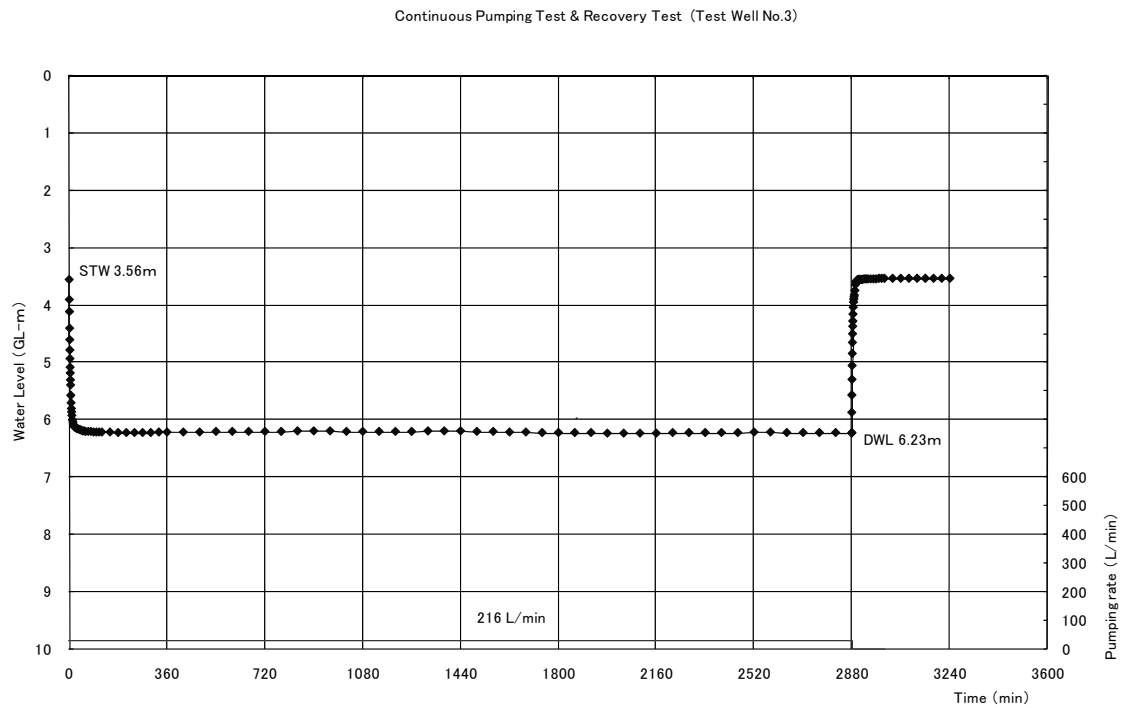
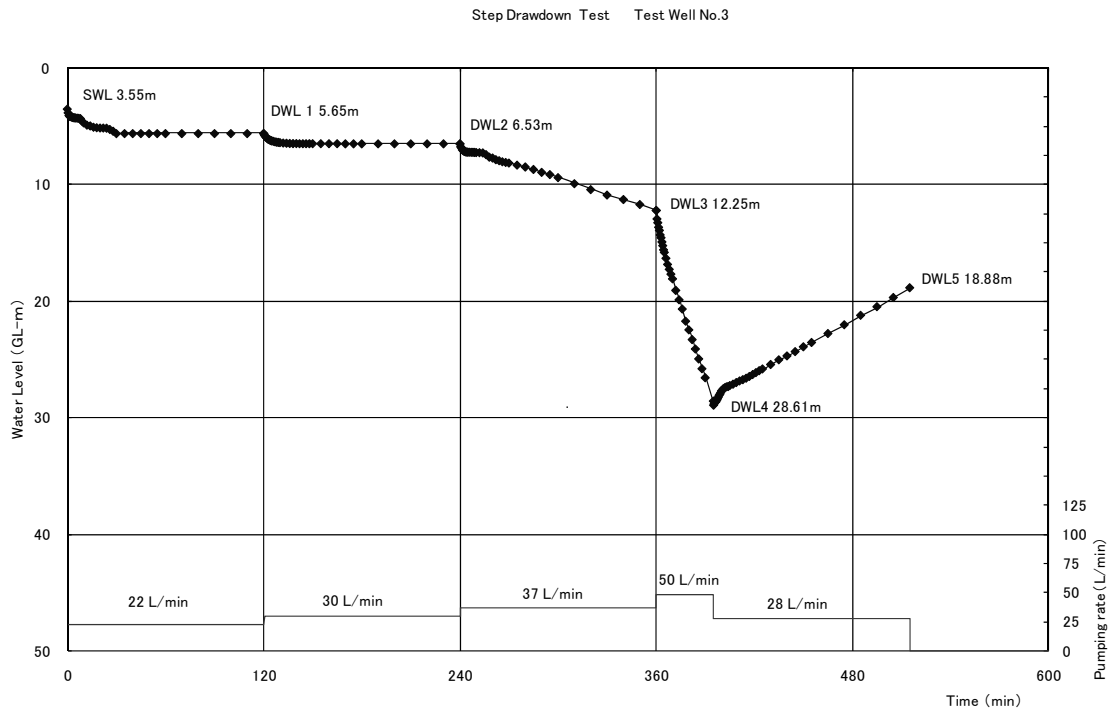
Test Well 2 (Constant Rate Pumping Test Record)

Project										Juba Urban Water Supply and Capacity Development Study									
Test Well No.					Test Well No.2					Date					25-April-09 ~ 27-April-09				
Well	Depth		200.0 m			Pump	Type				GRUNDFOS SP30-8								
	Diameter		200 A				Output		7.5 kW		Voltage		400 V						
	Casing Material		uPVC				Diameter		75 A		Depth		84.0 m						
	Type of Screen		Slit				Measurement of yield				V-Notch								
	Length of Screen		45.0 m				Static Water Level				5.940 m								
Time		Notch	Pumping Rate	Water Level	Draw down	Remarks				Time		Time		Time		Time			
Clock	Elapsed									Elapsed	Elapsed	Elapsed	Elapsed	Elapsed	Elapsed				
	(min)	(mm)	(L/min)	(m)	(m)														
8:00	0		5.94	0.00															
8:00	0.5	91	220	13.76	7.82														
8:01	1	91	220	17.11	11.17														
8:01	1.5	91	220	19.24	13.30														
8:02	2	91	220	21.31	15.37														
8:02	2.5	91	220	22.73	16.79														
8:03	3	91	220	24.30	18.36														
8:03	3.5	91	220	25.49	19.55														
8:04	4	91	220	26.22	20.28														
8:04	4.5	91	220	26.80	20.86														
8:05	5	91	220	27.36	21.42														
8:06	6	91	220	28.30	22.36														
8:07	7	91	220	28.90	22.96														
8:08	8	91	220	29.50	23.56														
8:09	9	91	220	30.05	24.11														
8:10	10	91	220	30.50	24.56	5.9mS/cm													
8:12	12	91	220	32.52	26.58														
8:14	14	91	220	33.78	27.84														
8:16	16	91	220	34.66	28.72														
8:18	18	91	220	35.52	29.58														
8:20	20	91	220	36.11	30.17														
8:22	22	91	220	36.63	30.69														
8:24	24	91	220	37.59	31.65														
8:26	26	91	220	38.78	32.84														
8:28	28	91	220	39.75	33.81														
8:30	30	91	220	40.38	34.44														
8:35	35	91	220	41.45	35.51														
8:40	40	91	220	42.25	36.31														
8:45	45	91	220	43.10	37.16														
8:50	50	91	220	43.57	37.63														
8:55	55	91	220	43.68	37.74														
9:00	60	91	220	43.81	37.87														
9:10	70	91	220	44.80	38.86														
9:20	80	91	220	45.97	40.03														
9:30	90	91	220	47.92	41.98														
9:40	100	91	220	48.91	42.97														
9:50	110	91	220	49.68	43.74														
10:00	120	91	220	50.16	44.22														
10:30	150	91	220	53.77	47.83														
11:00	180	91	220	55.27	49.33	6.5mS/cm													
11:30	210	91	220	56.69	50.75														
12:00	240	91	220	57.54	51.60														
12:30	270	91	220	59.23	53.29														
13:00	300	91	220	59.65	53.71														
13:30	330	91	220	59.93	53.99														
14:00	360	91	220	61.95	56.01														
15:00	420	91	220	62.68	56.74														
16:00	480	91	220	63.05	57.11														
17:00	540	91	220	63.30	57.36														
18:00	600	91	220	63.76	57.82	6.3mS/cm													
19:00	660	91	220	63.88	57.94														
20:00	720	91	220	64.12	58.18														
21:00	780	91	220	64.23	58.29														
22:00	840	91	220	64.40	58.46														
23:00	900	91	220	64.60	58.66														
0:00	960	91	220	64.74	58.80														
1:00	1020	91	220	64.88	58.94														
2:00	1080	91	220	65.00	59.06														
3:00	1140	91	220	65.04	59.10														
4:00	1200	91	220	65.09	59.15														

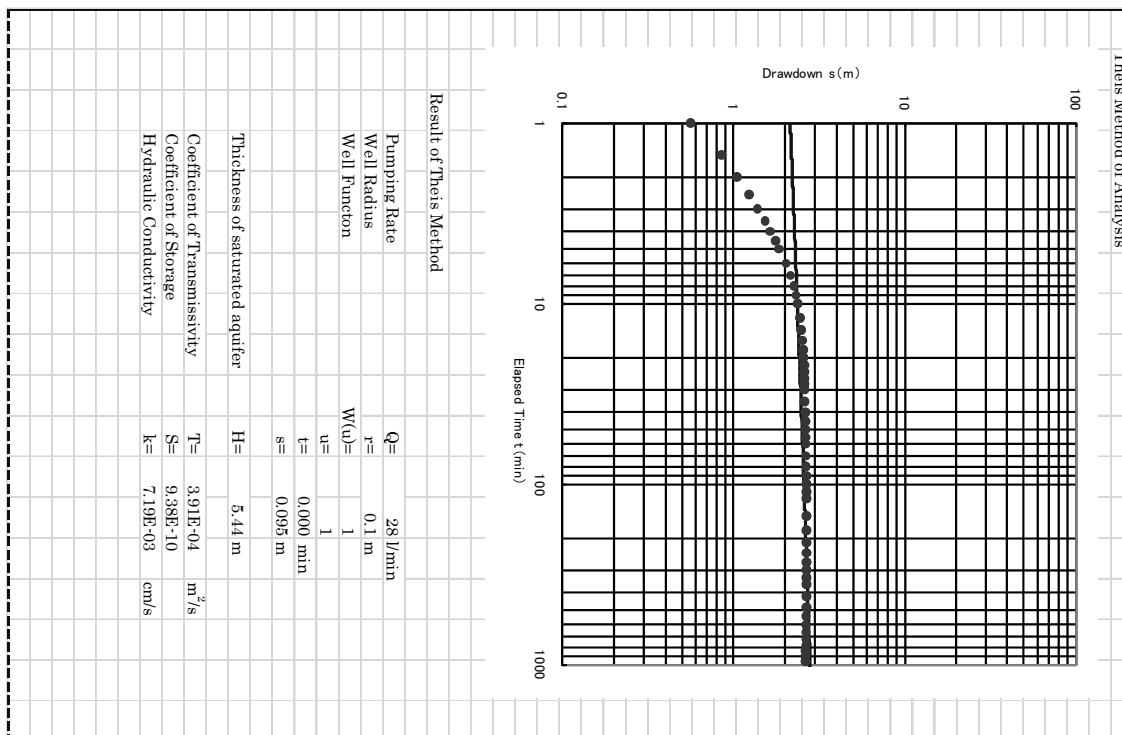
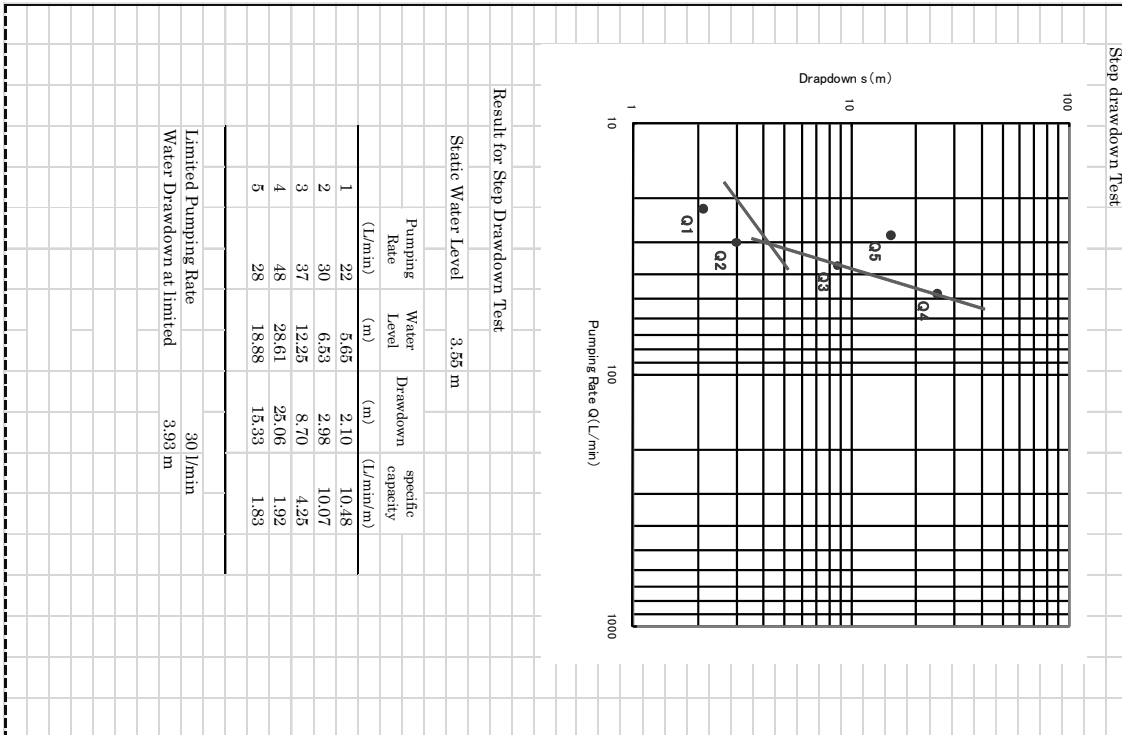
Test Well 2 (Recovery Test Record)

Project										
Juba Urban Water Supply and Capacity Development Study										
Test Well No.		Test Well No.2		Date		27-Apr-09 ~ 27-Apr-09				
Well	Depth		200.0 m		Pump	Type GRUNDFOSS SP30-8				
	Diameter		200 A			Output		7.5 kW		400 V
	Casing Material		uPVC		Diameter		75 A	Depth	84.0 m	
	Type of Screen		Slit		Measurement of yeild			V-Notch		
	Length of Screen		45.0 m		Static Water Level			5.940 m		
Clock	Time			Water Level (m)	Residual Drawdown Sr (m)	Water Recovery (m)	Remarks			
	Elapsed (min)	Accumurated (min)	Residual (t/t')							
8:00	0	2880		69.35	63.41					
8:00	0.5	2881	5761	67.10	61.16	2.25				
8:01	1	2881	2881	65.62	59.68	3.73				
8:01	1.5	2882	1921	63.74	57.80	5.61				
8:02	2	2882	1441	62.81	56.87	6.54				
8:02	2.5	2883	1153	61.54	55.60	7.81				
8:03	3	2883	961	59.82	53.88	9.53				
8:03	3.5	2884	824	58.94	53.00	10.41				
8:04	4	2884	721	57.31	51.37	12.04				
8:04	4.5	2885	641	56.40	50.46	12.95				
8:05	5	2885	577	55.22	49.28	14.13				
8:06	6	2886	481	53.11	47.17	16.24				
8:07	7	2887	412	51.15	45.21	18.20				
8:08	8	2888	361	49.37	43.43	19.98				
8:09	9	2889	321	47.88	41.94	21.47				
8:10	10	2890	289	46.55	40.61	22.80				
8:12	12	2892	241	44.02	38.08	25.33				
8:14	14	2894	207	41.99	36.05	27.36				
8:16	16	2896	181	40.26	34.32	29.09				
8:18	18	2898	161	38.81	32.87	30.54				
8:20	20	2900	145	37.57	31.63	31.78				
8:22	22	2902	132	36.55	30.61	32.80				
8:24	24	2904	121	35.65	29.71	33.70				
8:26	26	2906	112	34.87	28.93	34.48				
8:28	28	2908	104	34.16	28.22	35.19				
8:30	30	2910	97	33.48	27.54	35.87				
8:35	35	2915	83	32.06	26.12	37.29				
8:40	40	2920	73	30.87	24.93	38.48				
8:45	45	2925	65	29.79	23.85	39.56				
8:50	50	2930	59	28.72	22.78	40.63				
8:55	55	2935	53	27.97	22.03	41.38				
9:00	60	2940	49	27.15	21.21	42.20				
9:10	70	2950	42	25.81	19.87	43.54				
9:20	80	2960	37	24.64	18.70	44.71				
9:30	90	2970	33	23.61	17.67	45.74				
9:40	100	2980	30	22.72	16.78	46.63				
9:50	110	2990	27	21.87	15.93	47.48				
10:00	120	3000	25	21.18	15.24	48.17				
10:30	150	3030	20	19.29	13.35	50.06				
11:00	180	3060	17	17.79	11.85	51.56				
11:30	210	3090	15	17.79	11.85	51.56				
12:00	240	3120	13	16.62	10.68	52.73				
12:30	270	3150	12	15.63	9.69	53.72				
13:00	300	3180	11	14.70	8.76	54.65				
13:30	330	3210	10	13.82	7.88	55.53				
14:00	360	3240	9	13.11	7.17	56.24				
15:00	420	3300	8	12.48	6.54	56.87				
16:00	480	3360	7	11.48	5.54	57.87				
17:00	540	3420	6	10.80	4.86	58.55				
18:00	600	3480	6	9.77	3.83	59.58				
19:00	660	3540	5	8.42	2.48	60.93				
20:00	720	3600	5	7.42	1.48	61.93				
21:00	780	3660	5	7.00	1.06	62.35				
22:00	840	3720	4	6.50	0.56	62.85				
23:00	900	3780	4	6.29	0.35	63.06				

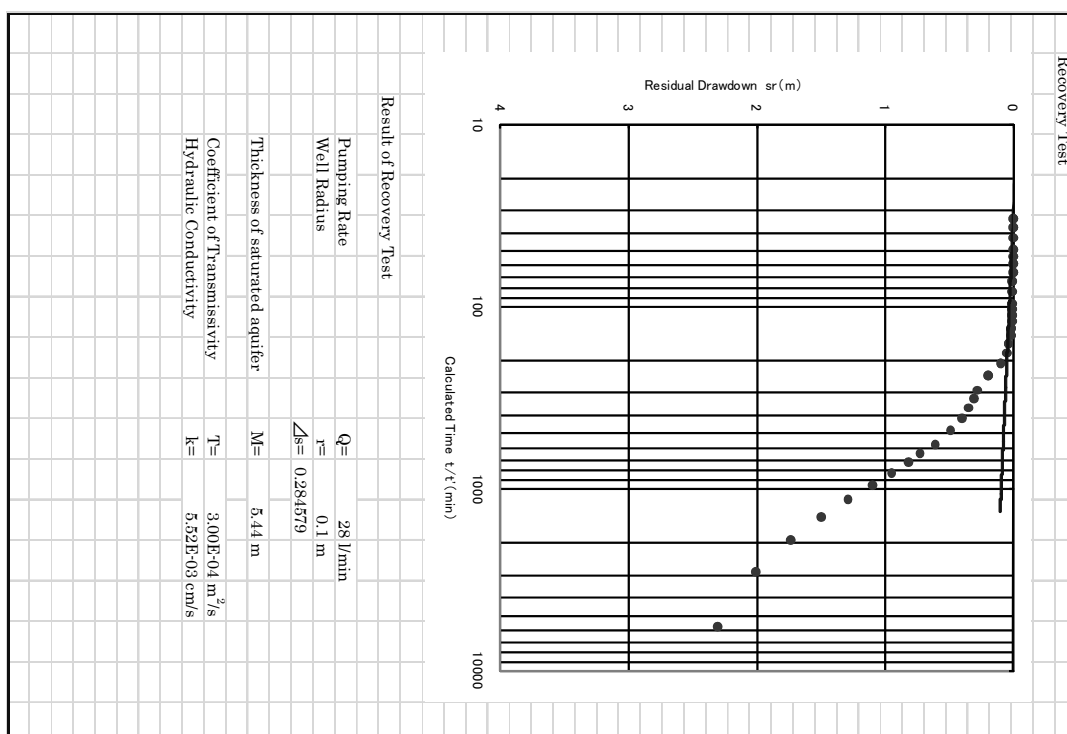
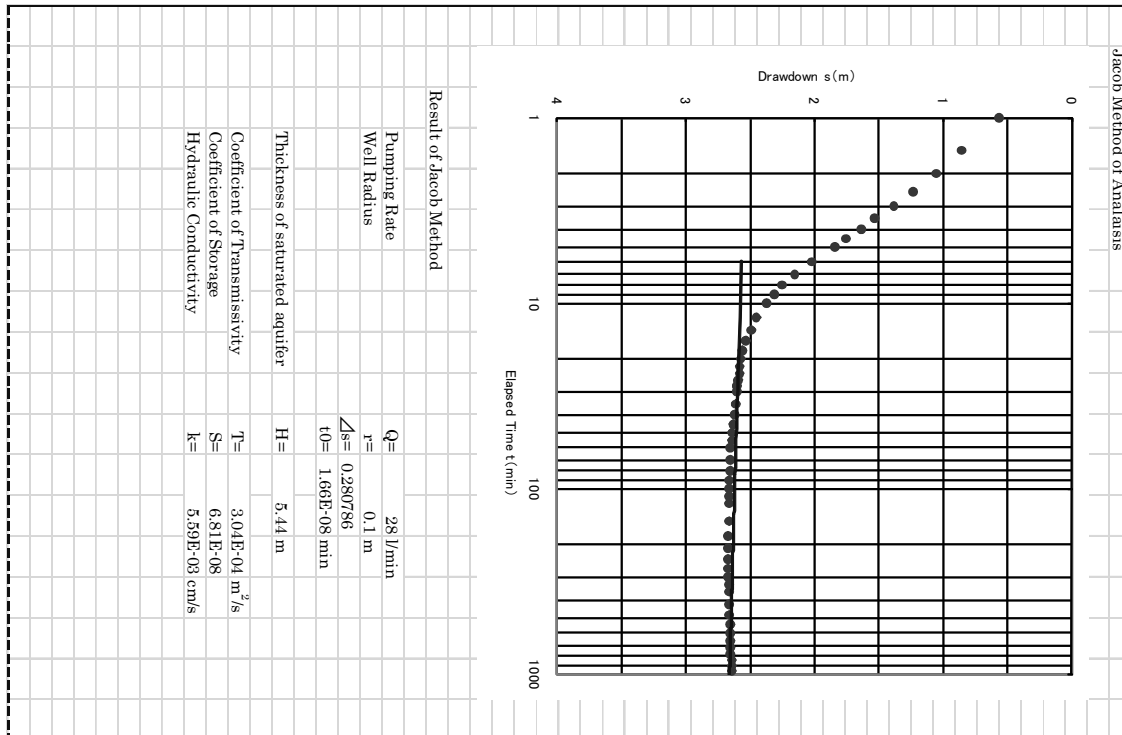
Test Well 3 (Sw-Q Curve)



Test Well 3 (Analysis)



Test Well 3 (Analysis)



Test Well 3 (Constant Rate Pumping Test Record)

Project		Juba Urban Water Supply and Capacity Development Study						
Test Well No.		Test Well No.3			Date		29-April-09 ~ 1-May-09	
Well	Depth	100.0 m			Pump	GRUNDFOS SP8A-25		
	Diameter	200 A				Output	4 kW	Voltage
	Casing Material	uPVC			Diameter	50A	Depth	34.0 m
	Type of Screen	Silt			Measurement of yield		V-Notch	
Length of Screen	27.0 m			Static Water Level		3.56 m		
Time		Notch (mm)	Pumping Rate (L/min)	Water Level (m)	Draw down (m)	Remarks		
Clock	Elapsed (min)							
9:00	0.0		3.56		0.00			
9:00	0.5	40	28	3.91	0.35	6:00	1260	40 28 6.21 2.65
9:01	1.0	40	28	4.12	0.56	7:00	1320	40 28 6.20 2.64
9:01	1.5	40	28	4.41	0.85	8:00	1380	40 28 6.20 2.64
9:02	2.0	40	28	4.61	1.05	9:00	1440	40 28 6.20 2.64
9:02	2.5	40	28	4.79	1.23	10:00	1500	40 28 6.21 2.65 440 u S/cm
9:03	3.0	40	28	4.94	1.38	11:00	1560	40 28 6.21 2.65
9:03	3.5	40	28	5.09	1.53	12:00	1620	40 28 6.22 2.66
9:04	4.0	40	28	5.19	1.63	13:00	1680	40 28 6.22 2.66
9:04	4.5	40	28	5.31	1.75	14:00	1740	40 28 6.23 2.67
9:05	5	40	28	5.40	1.84	15:00	1800	40 28 6.23 2.67
9:06	6	40	28	5.58	2.02	16:00	1860	40 28 6.23 2.67
9:07	7	40	28	5.71	2.15	17:00	1920	40 28 6.23 2.67
9:08	8	40	28	5.81	2.25	18:00	1980	40 28 6.24 2.68
9:09	9	40	28	5.87	2.31	19:00	2040	40 28 6.24 2.68
9:10	10	40	28	5.93	2.37	20:00	2100	40 28 6.24 2.68
9:12	12	40	28	6.01	2.45	21:00	2160	40 28 6.24 2.68
9:14	14	40	28	6.05	2.49	22:00	2220	40 28 6.23 2.67
9:16	16	40	28	6.09	2.53	23:00	2280	40 28 6.23 2.67
9:18	18	40	28	6.12	2.56	0:00	2340	40 28 6.23 2.67
9:20	20	40	28	6.13	2.57	1:00	2400	40 28 6.23 2.67
9:22	22	40	28	6.14	2.58	2:00	2460	40 28 6.23 2.67
9:24	24	40	28	6.14	2.58	3:00	2520	40 28 6.22 2.66
9:26	26	40	28	6.15	2.59	4:00	2580	40 28 6.22 2.66
9:28	28	40	28	6.16	2.60	5:00	2640	40 28 6.23 2.67
9:30	30	40	28	6.16	2.60	6:00	2700	40 28 6.23 2.67
9:35	35	40	28	6.17	2.61	7:00	2760	40 28 6.23 2.67
9:40	40	40	28	6.18	2.62	8:00	2820	40 28 6.23 2.67
9:45	45	40	28	6.19	2.63	9:00	2880	40 28 6.23 2.67
9:50	50	40	28	6.20	2.64			
9:55	55	40	28	6.20	2.64			
10:00	60	40	28	6.21	2.65			
10:10	70	40	28	6.21	2.65			
10:20	80	40	28	6.21	2.65			
10:30	90	40	28	6.22	2.66			
10:40	100	40	28	6.22	2.66			
10:50	110	40	28	6.22	2.66			
11:00	120	40	28	6.22	2.66			
11:30	150	40	28	6.22	2.66			
12:00	180	40	28	6.23	2.67			
12:30	210	40	28	6.23	2.67			
13:00	240	40	28	6.23	2.67			
13:30	270	40	28	6.23	2.67			
14:00	300	40	28	6.23	2.67			
14:30	330	40	28	6.22	2.66			
15:00	360	40	28	6.22	2.66			
16:00	420	40	28	6.22	2.66			
17:00	480	40	28	6.22	2.66			
18:00	540	40	28	6.21	2.65			
19:00	600	40	28	6.21	2.65			
20:00	660	40	28	6.21	2.65			
21:00	720	40	28	6.21	2.65			
22:00	780	40	28	6.21	2.65			
23:00	840	40	28	6.20	2.64			
0:00	900	40	28	6.20	2.64			
1:00	960	40	28	6.20	2.64			
2:00	1020	40	28	6.21	2.65			
3:00	1080	40	28	6.21	2.65			
4:00	1140	40	28	6.21	2.65			
5:00	1200	40	28	6.21	2.65			

Test Well 3 (Recovery Test Record)

Project								Juba Urban Water Supply and Capacity Development Study							
Test Well No.		Test Well No.3		Date		1-May-09 ~ 1-May-09									
Well	Depth		100.0 m		Pump	Type				GRUNDFOS SP8A-25					
	Diameter		200 A			Output		4. kW	Voltage		400 V				
	Casing Material		uPVC			Diameter		50A	Depth		34.0 m				
	Type of Screen		Slit			Measurement of yeild				V-Notch					
	Length of Screen		27.0 m			Static Water Level				3.56 m					
Time				Water Level	Residual Drawdown	Water Recovery	Remarks								
Clock	Elapsed	Accumurated	Residual												
	(min)	(min)	(t/t')	(m)	Sr (m)	(m)									
9:00	0	2880		6.23	2.67										
9:00	0.5	2881	5761	5.87	2.31	0.36									
9:01	1	2881	2881	5.57	2.01	0.66									
9:01	1.5	2882	1921	5.30	1.74	0.93									
9:02	2	2882	1441	5.06	1.50	1.17									
9:02	2.5	2883	1153	4.85	1.29	1.38									
9:03	3	2883	961	4.66	1.10	1.57									
9:03	3.5	2884	824	4.51	0.95	1.72									
9:04	4	2884	721	4.38	0.82	1.85									
9:04	4.5	2885	641	4.29	0.73	1.94									
9:05	5	2885	577	4.17	0.61	2.06									
9:06	6	2886	481	4.05	0.49	2.18									
9:07	7	2887	412	3.96	0.40	2.27									
9:08	8	2888	361	3.91	0.35	2.32									
9:09	9	2889	321	3.87	0.31	2.36									
9:10	10	2890	289	3.84	0.28	2.39									
9:12	12	2892	241	3.76	0.20	2.47									
9:14	14	2894	207	3.66	0.10	2.57									
9:16	16	2896	181	3.61	0.05	2.62									
9:18	18	2898	161	3.60	0.04	2.63									
9:20	20	2900	145	3.58	0.02	2.65									
9:22	22	2902	132	3.58	0.02	2.65									
9:24	24	2904	121	3.57	0.01	2.66									
9:26	26	2906	112	3.57	0.01	2.66									
9:28	28	2908	104	3.57	0.01	2.66									
9:30	30	2910	97	3.57	0.01	2.66									
9:35	35	2915	83	3.57	0.01	2.66									
9:40	40	2920	73	3.57	0.01	2.66									
9:45	45	2925	65	3.56	(0.00)	2.67									
9:50	50	2930	59	3.56	(0.00)	2.67									
9:55	55	2935	53	3.56	(0.00)	2.67									
10:00	60	2940	49	3.56	(0.00)	2.67									
10:10	70	2950	42	3.56	(0.00)	2.67									
10:20	80	2960	37	3.56	(0.00)	2.67									
10:30	90	2970	33	3.56	(0.00)	2.67									
10:40	100	2980	30	3.55	(0.01)	2.68									
10:50	110	2990	27	3.55	(0.01)	2.68									
11:00	120	3000	25	3.55	(0.01)	2.68									
11:30	150	3030	20	3.55	(0.01)	2.68									
12:00	180	3060	17	3.55	(0.01)	2.68									
12:30	210	3090	15	3.55	(0.01)	2.68									
13:00	240	3120	13	3.55	(0.01)	2.68									
13:30	270	3150	12	3.55	(0.01)	2.68									
14:00	300	3180	11	3.55	(0.01)	2.68									
14:30	330	3210	10	3.55	(0.01)	2.68									
15:00	360	3240	9	3.55	(0.01)	2.68									

Observation Well 1 (Constant Rate Pumping Test Water Level Record)

Project							Juba Urban Water Supply and Capacity Development Study						
Pumping Well No.		Test Well No.1			Date		15-April-09 ~ 17-April-09						
Measuring Well No.		Observation Well No.1			Static Water Level		2.83 m						
Time		Notch (mm)	Pumping Rate (L/min)	Water Level (m)	Draw down (m)	Remarks							
Clock	Elapsed (min)												
18:00	0.0			2.830	0.000								
18:00	0.5			2.830	0.000								
18:01	1.0			2.830	0.000								
18:01	1.5			2.830	0.000								
18:02	2.0			2.835	0.005								
18:02	2.5			2.835	0.005								
18:03	3.0			2.835	0.005								
18:03	3.5			2.835	0.005								
18:04	4.0			2.835	0.005								
18:04	4.5			2.840	0.010								
18:05	5			2.840	0.010								
18:06	6			2.840	0.010								
18:07	7			2.840	0.010								
18:08	8			2.840	0.010								
18:09	9			2.840	0.010								
18:10	10			2.840	0.010								
18:12	12			2.845	0.015								
18:14	14			2.845	0.015								
18:16	16			2.845	0.015								
18:18	18			2.845	0.015								
18:20	20			2.845	0.015								
18:22	22			2.845	0.015								
18:24	24			2.845	0.015								
18:26	26			2.845	0.015								
18:28	28			2.845	0.015								
18:30	30			2.845	0.015								
18:35	35			2.845	0.015								
18:40	40			2.845	0.015								
18:45	45			2.845	0.015								
18:50	50			2.845	0.015								
18:55	55			2.845	0.015								
19:00	60			2.845	0.015								
19:10	70			2.850	0.020								
19:20	80			2.850	0.020								
19:30	90			2.850	0.020								
19:40	100			2.850	0.020								
19:50	110			2.850	0.020								
20:00	120			2.850	0.020								
20:30	150			2.850	0.020								
21:00	180			2.850	0.020								
21:30	210			2.850	0.020								
22:00	240			2.850	0.020								
22:30	270			2.850	0.020								
23:00	300			2.850	0.020								
23:30	330			2.850	0.020								
0:00	360			2.850	0.020								
1:00	420			2.850	0.020								
2:00	480			2.850	0.020								
3:00	540			2.850	0.020								
4:00	600			2.850	0.020								
5:00	660			2.850	0.020								
6:00	720			2.840	0.010								
7:00	780			2.840	0.010								
8:00	840			2.830	0.000								
9:00	900			2.830	0.000								
10:00	960			2.830	0.000								
11:00	1020			2.830	0.000								
12:00	1080			2.830	0.000								
13:00	1140			2.820	-0.010								
14:00	1200			2.820	-0.010								
15:00	1260			2.820	-0.010								
16:00	1320			2.810	-0.020								
17:00	1380			2.810	-0.020								
18:00	1440			2.810	-0.020								
19:00	1500			2.810	-0.020								
20:00	1560			2.810	-0.020								

Observation Well 2 (Constant Rate Pumping Test Water Level Record)

Project Juba Urban Water Supply and Capacity Development Study						
Pumping Well No.		Test Well No.1		Date 15-April-09 ~ 17-April-09		
Measuring Well No.		Observation Well No.2		Static Water Level 2.45 m		
Time		Notch (mm)	Pumping Rate (L/min)	Water Level (m)	Draw down (m)	Remarks
Clock	Elapsed (min)					
18:00	0.0			2.450	0.000	
18:00	0.5			2.450	0.000	
18:01	1.0			2.455	0.005	
18:01	1.5			2.455	0.005	
18:02	2.0			2.455	0.005	
18:02	2.5			2.455	0.005	
18:03	3.0			2.455	0.005	
18:03	3.5			2.455	0.005	
18:04	4.0			2.455	0.005	
18:04	4.5			2.455	0.005	
18:05	5			2.460	0.010	
18:06	6			2.460	0.010	
18:07	7			2.460	0.010	
18:08	8			2.460	0.010	
18:09	9			2.460	0.010	
18:10	10			2.460	0.010	
18:12	12			2.460	0.010	
18:14	14			2.460	0.010	
18:16	16			2.460	0.010	
18:18	18			2.460	0.010	
18:20	20			2.460	0.010	
18:22	22			2.460	0.010	
18:24	24			2.460	0.010	
18:26	26			2.460	0.010	
18:28	28			2.460	0.010	
18:30	30			2.465	0.015	
18:35	35			2.465	0.015	
18:40	40			2.465	0.015	
18:45	45			2.465	0.015	
18:50	50			2.465	0.015	
18:55	55			2.465	0.015	
19:00	60			2.465	0.015	
19:10	70			2.465	0.015	
19:20	80			2.465	0.015	
19:30	90			2.465	0.015	
19:40	100			2.465	0.015	
19:50	110			2.465	0.015	
20:00	120			2.465	0.015	
20:30	150			2.470	0.020	
21:00	180			2.470	0.020	
21:30	210			2.470	0.020	
22:00	240			2.470	0.020	
22:30	270			2.470	0.020	
23:00	300			2.470	0.020	
23:30	330			2.470	0.020	
0:00	360			2.470	0.020	
1:00	420			2.480	0.030	
2:00	480			2.480	0.030	
3:00	540			2.480	0.030	
4:00	600			2.480	0.030	
5:00	660			2.480	0.030	Water Level was rose during pumping
6:00	720			2.470	0.020	
7:00	780			2.470	0.020	
8:00	840			2.470	0.020	
9:00	900			2.470	0.020	
10:00	960			2.470	0.020	
11:00	1020			2.460	0.010	
12:00	1080			2.460	0.010	
13:00	1140			2.460	0.010	
14:00	1200			2.460	0.010	
15:00	1260			2.450	0.000	
16:00	1320			2.440	-0.010	
17:00	1380			2.440	-0.010	
18:00	1440			2.430	-0.020	
19:00	1500			2.430	-0.020	
20:00	1560			2.430	-0.020	

21:00	1620			2.430	-0.020			
22:00	1680			2.430	-0.020			
23:00	1740			2.430	-0.020			
0:00	1800			2.430	-0.020			
1:00	1860			2.430	-0.020			
2:00	1920			2.430	-0.020			
3:00	1980			2.430	-0.020			
4:00	2040			2.430	-0.020			
5:00	2100			2.430	-0.020			
6:00	2160			2.430	-0.020			
7:00	2220			2.420	-0.030			
8:00	2280			2.420	-0.030			
9:00	2340			2.420	-0.030			
10:00	2400			2.420	-0.030			
11:00	2460			2.420	-0.030			
12:00	2520			2.420	-0.030			
13:00	2580			2.420	-0.030			
14:00	2640			2.420	-0.030			
15:00	2700			2.420	-0.030			
16:00	2760			2.420	-0.030			
17:00	2820			2.420	-0.030			
18:00	2880			2.420	-0.030			

Annex A-5 Result of Groundwater Quality Analysis

Result of Groundwater Quality Analysis of Test Well 1 (Laboratory Test)

REPUBLIC OF KENYA



MINISTRY OF WATER AND IRRIGATION

Central Water Testing Laboratories

Tel. No (020) 553834, 553665
P.O. Box 30521-00100,
NAIROBI.

PHYSICAL/CHEMICAL WATER ANALYSIS REPORT

Sample No**3059**.....
Source...**Juba Test Well 1 – S/Sudan**
Purpose of Sampling...**Monitoring**.....

Date of Sampling...**01 – 05 – 09**
Date Received..... **13 – 05 – 09**
Submitted by...**Tokyo Engineering Consultants**
Co. Ltd....
Address.....

PARAMETERS	UNIT	RESULTS	REMARKS
Aluminium	mg/l	0.10	
Ammonia	mg/l	< 0.01	
Antimony	mg/l	0.01	
Arsenic	mg/l	Nil	
Barium	mg/l	Nil	
Boron	mg/l	Nil	
Cadmium	mg/l	Nil	
Chloride	mg/l	26	
Chromium	mg/l	Nil	
Copper	mg/l	Nil	
Cyanide	mg/l	Nil	
Fluoride	mg/l	0.1	
Hardness	mg/l	32	
Sulfides	mg/l	0.1	
Iron	mg/l	2.96	
Manganese	mg/l	1.2	
Lead	mg/l	Nil	
Mercury	mg/l	Nil	
Molybdenum	mg/l	Nil	
Nickel	mg/l	Nil	
Nitrate	mg/l	4.1	
Nitrite	mg/l	0.25	
Selenium	mg/l	Nil	
Sodium	mg/l	488	
Sulfate	mg/l	0.3	
Total Dissolved Solids	mg/l	1358	
Zinc	mg/l	0.02	

COMMENTS:
Monitoring.

O/c**J. N. MUASYA**.....
CENTRAL WATER TESTING LABORATORIES

WATER QUALITY LABORATORY
P.O. BOX 30521, NAIROBI

Result of Groundwater Quality Analysis of Test Well 2 (Laboratory Test)

REPUBLIC OF KENYA



MINISTRY OF WATER AND IRRIGATION

Central Water Testing Laboratories

Tel No (020) 553834, 553665
P.O. Box 30521-00100,
NAIROBI

PHYSICAL/CHEMICAL WATER ANALYSIS REPORT

Sample No**3060**.....
Source...**Juba Test Well 2 – S/Sudan**
Purpose of Sampling...**Monitoring**.....

Date of Sampling...**27 – 04 – 09**
Date Received..... **13 – 05 – 09**
Submitted by...**Tokyo Engineering Consultants**
Co. Ltd....
Address.....

PARAMETERS	UNIT	RESULTS	REMARKS
Aluminium	mg/l	0.10	
Ammonia	mg/l	0.4	
Antimony	mg/l	0.01	
Arsenic	mg/l	Nil	
Barium	mg/l	Nil	
Boron	mg/l	Nil	
Cadmium	mg/l	Nil	
Chloride	mg/l	410	
Chromium	mg/l	Nil	
Copper	mg/l	Nil	
Cyanide	mg/l	Nil	
Fluoride	mg/l	0.52	
Hardness	mg/l	660	
Sulfides	mg/l	1	
Iron	mg/l	0.02	
Manganese	mg/l	0.08	
Lead	mg/l	Nil	
Mercury	mg/l	Nil	
Molybdenum	mg/l	Nil	
Nickel	mg/l	Nil	
Nitrate	mg/l	5.2	
Nitrite	mg/l	0.01	
Selenium	mg/l	Nil	
Sodium	mg/l	775	
Sulfate	mg/l	491	
Total Dissolved Solids	mg/l	3677	
Zinc	mg/l	0.04	

COMMENTS:
Monitoring.

O/c**J. N. MUASYA**.....
CENTRAL WATER TESTING LABORATORIES
WATER QUALITY LABORATORIES
P.O. BOX 30521, NAIROBI

Result of Groundwater Quality Analysis of Test Well 3 (Laboratory Test)

REPUBLIC OF KENYA



MINISTRY OF WATER AND IRRIGATION

Central Water Testing Laboratories

Tel No. (020) 553834, 553665
P.O. Box 30521-00100,
NAIROBI

PHYSICAL/CHEMICAL WATER ANALYSIS REPORT

Sample No3061.....
Source..Juba Test Well 3 – S/Sudan
Purpose of Sampling...Monitoring.....

Date of Sampling...01 – 05 – 09
Date Received..... 13 – 05 – 09
Submitted by...Tokyo Engineering Consultants
Co. Ltd...
Address.....

PARAMETERS	UNIT	RESULTS	REMARKS
Aluminium	mg/l	0.05	
Ammonia	mg/l	0.3	
Antimony	mg/l	0.01	
Arsenic	mg/l	Nil	
Barium	mg/l	Nil	
Boron	mg/l	Nil	
Cadmium	mg/l	Nil	
Chloride	mg/l	26	
Chromium	mg/l	Nil	
Copper	mg/l	Nil	
Cyanide	mg/l	Nil	
Fluoride	mg/l	0.39	
Hardness	mg/l	120	
Sulfides	mg/l	0.2	
Iron	mg/l	0.52	
Manganese	mg/l	0.06	
Lead	mg/l	Nil	
Mercury	mg/l	Nil	
Molybdenum	mg/l	Nil	
Nickel	mg/l	Nil	
Nitrate	mg/l	1.3	
Nitrite	mg/l	0.59	
Selenium	mg/l	Nil	
Sodium	mg/l	20	
Sulfate	mg/l	7.8	
Total Dissolved Solids	mg/l	197	
Zinc	mg/l	0.02	

COMMENTS:
Monitoring.


 O/c**J. N. MUASYA**.....
 CENTRAL WATER TESTING LABORATORIES
 WATER QUALITY LABORATORY
 P.O. BOX 30521, NAIROBI.

Result of Bacteriological Analysis of Test Well (Laboratory Test)

1-4 Results:-

No	No of sample	sample	Total coliform	APC-37C	E. Coli	WHO standards
1-	T-1	Water (BH)	180+ coli per 100ml	980	+	Must not be detectable in any 100ml sample
2-	T-2	Water(BH)	25coli per 100ml	258	+	-----
3-	T-3	Water(BH)	180+ coli per100ml	116	+	-----

- (+) = positive means there is E. coli in water.
- (APC) = Aerobic plate count
- (BH) = Borehole water.

The results relate to samples above.

Note:-

The sample which were collected from Bore hole (T-1-2-3) showed higher contamination, so we diluted 100ml from the sample in 100ml distal water.

- I didn't count the E. coli because there no procedure that includes membrane Filtration methods.

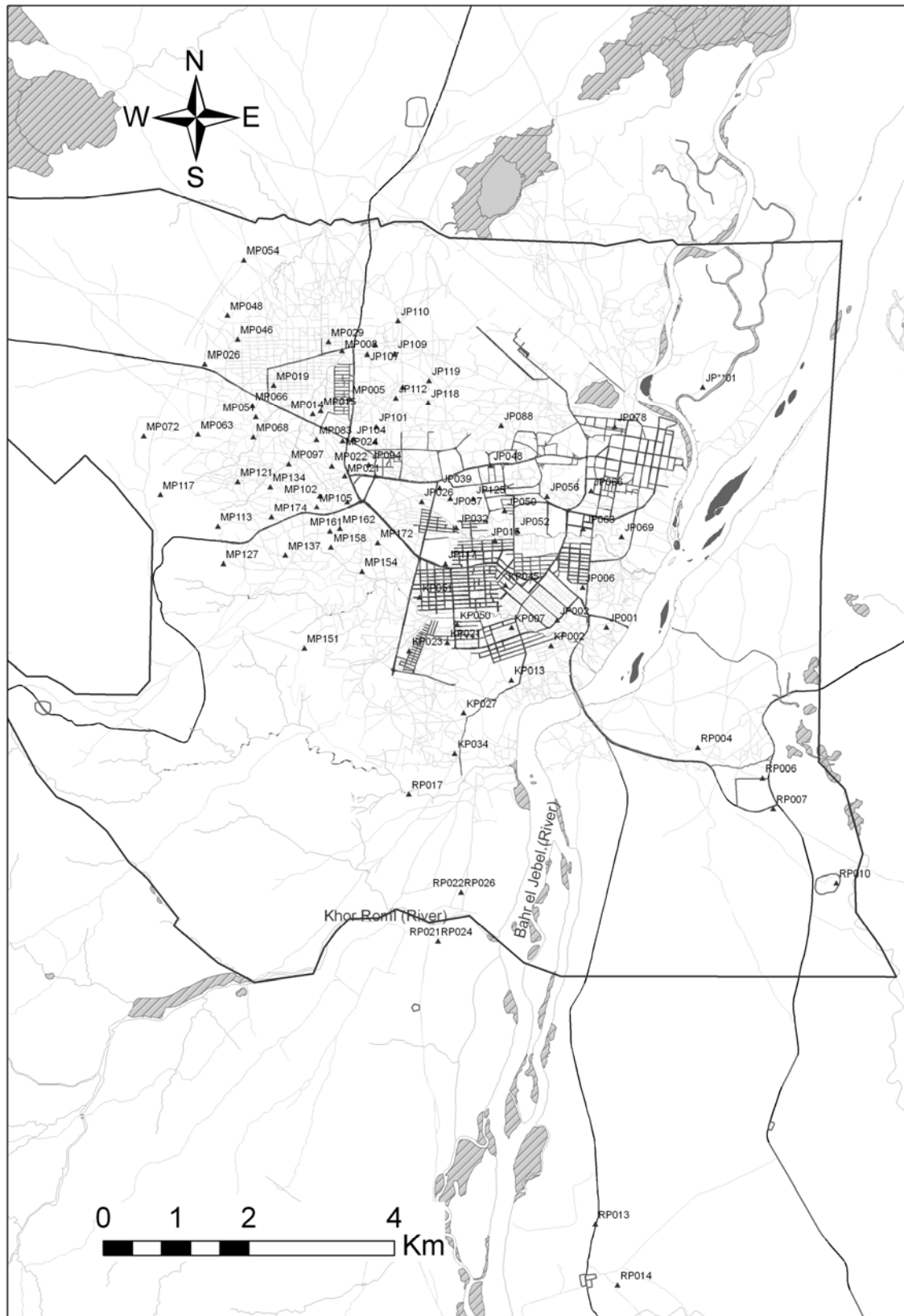
Marko Makur Showar Marial
Microbiology unit


Majak Deng Kual
Director of SSMO – Juba.

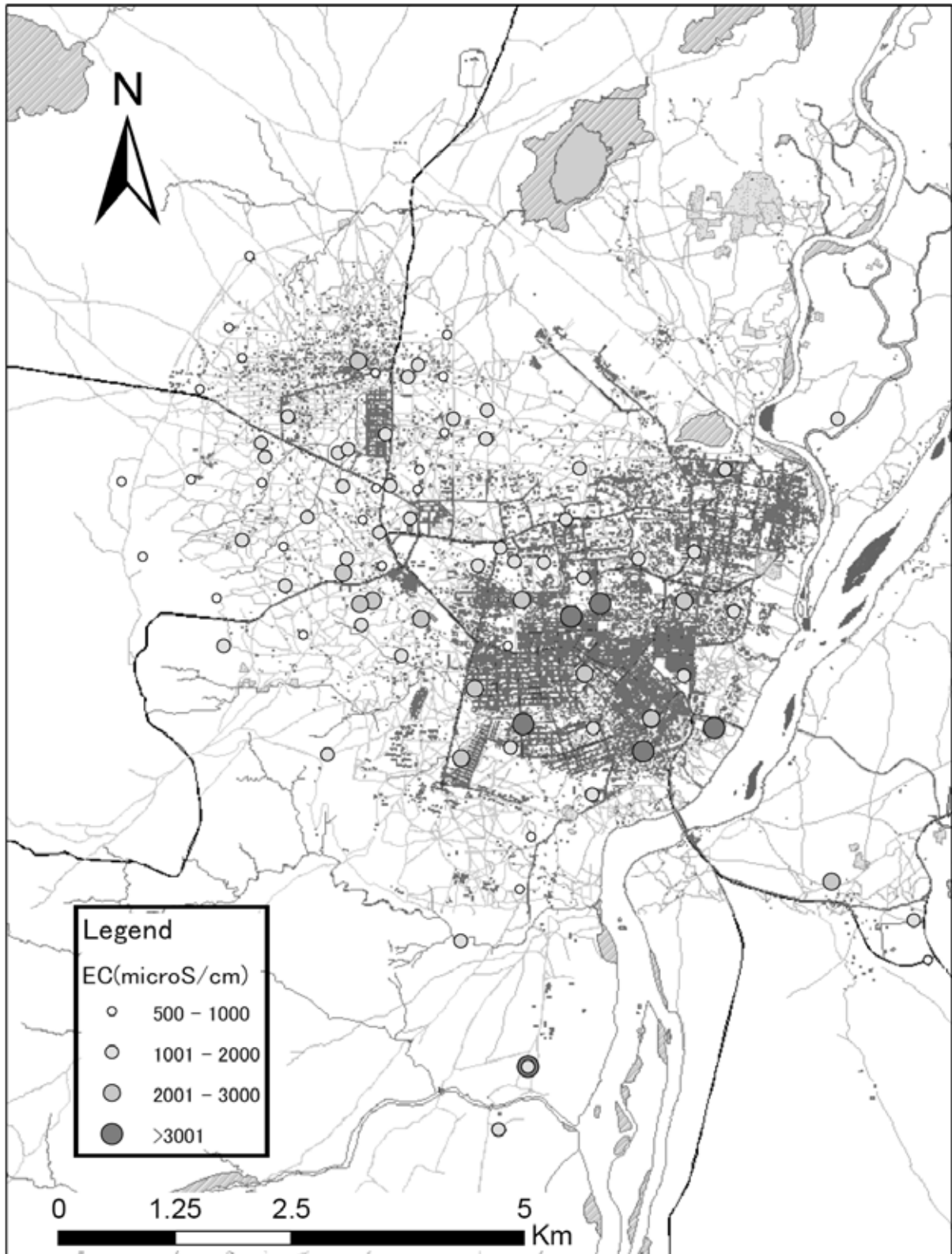
On-Site Test Result of Existing Wells in Study Area

No	Well No	Payam	Boma	Village	Site	X(Long)	Y(Lat)	X(UTM)	Y(UTM)	Date of completion	Project or donor	Date of survey	Water committee.	Operation	Number of user	Change	Depth	Temp. (°C)	pH	EC µS/cm	TDS mg/L	Salinity mg/L	Color	Obor	Taste
1	JP001	JUBA	JUBA NABARI	MADARA	RESIDENT	31.612156	4.831792	346097.029	534227.912	0/01/1998	RDA	2009/9/5	YES	all season	N/A	N/A	N/A	33.40	7.41	31.80	2.120	1.590	clear	NO	good
2	JP002	JUBA	JUBA NABARI	KONYKONYO	MOSQUIT	31.60605	4.83266667	345420.882	534326.01	8/9/2001	SFM	2009/9/22	YES	all season	N/A	NO	N/A	29.10	7.21	2.930	1.950	1.460	clear	NO	salty
3	JP006	JUBA	JUBA NABARI	HAI MALAKAL	SCHOOL	31.609189	4.836806	345769.98	534782.984	8/8/2001	SFM	2009/9/19	YES	all season	N/A	NO	N/A	30.80	7.24	1.234	822	616	clear	NO	salty
4	JP015	JUBA	JUBA NABARI	HAI MAYO	RESIDENT	31.598304	4.84254	345633.989	535419.478	N/A	N/A	2009/9/26	YES	all season	N/A	NO	N/A	34.40	7.14	3.010	2.010	1.500	clear	NO	salty
5	JP026	JUBA	JUBA NABARI	BULUK	JCC SCHOOL	31.589241	4.84742	345599.914	535966.988	5/8/2005	RWD	2009/9/26	YES	all season	N/A	NO	N/A	35.60	7.11	1.445	964	739	clear	NO	good
6	JP032	JUBA	JUBA NABARI	BULUK	RESIDENT	31.5935	4.84415	344031.53	535598.6	N/A	ACF	2009/9/26	YES	all season	N/A	10PST	56.0	7.26	2.310	1.370	1.160	clear	NO	good	
7	JP037	JUBA	JUBA NABARI	BULUK	CHURCH	31.592775	4.84789	343951.971	536089.98	N/A	CRS	2009/9/27	YES	all season	N/A	NO	32.0	31.90	7.22	1.585	1.060	791	clear	NO	good
8	JP039	JUBA	JUBA NABARI	BULUK	BOLUK POLICE	31.59142	4.849186	343801.987	536155.915	N/A	CRS	2009/9/26	YES	all season	N/A	NO	N/A	33.80	7.26	1.881	1.255	938	clear	NO	salty
9	JP048	JUBA	JUBA NABARI	BULUK	ROAD SIDE	31.59716667	4.851983333	344506.552	536463.758	7/1/2008	N/A	2008/12/11	YES	all season	N/A	NO	N/A	33.30	7.09	1.929	1.286	964	clear	NO	salty
10	JP050	JUBA	JUBA NABARI	BULUK	RESIDENT	31.59948333	4.846316667	344695.655	535856.797	N/A	ACF	2008/12/12	YES	all season	N/A	N/A	N/A	32.90	7.05	1.644	1.192	920	clear	NO	salty
11	JP052	JUBA	JUBA NABARI	BULUK	SCHOOL	31.60109	4.84378	344873.277	535555.948	2/01/10/3	SFM	2009/9/21	YES	all season	N/A	NO	N/A	30.60	7.20	3.090	2.050	1.520	clear	NO	salty
12	JP056	JUBA	JUBA NABARI	BULUK	SCHOOL	31.60476667	4.84816667	345822.844	536440.14	5/1/2/007	CRS	2008/12/7	YES	all season	N/A	NO	32.8	33.10	7.32	1.505	1.097	820	clear	NO	good
13	JP063	JUBA	JUBA NABARI	MOBIL	RESIDENT	31.609228	4.844077	345755.952	535886.931	6/2/1989	SFM	2009/9/19	YES	all season	N/A	NO	N/A	31.70	7.11	2.370	1.580	1.180	clear	NO	salty
14	JP066	JUBA	JUBA NABARI	BULUK	ST. JOSE SCHOOL	31.61021	4.848836	345885.947	536112.912	13/3/2007	IFRC	2009/9/5	YES	all season	N/A	NO	44.0	34.10	7.07	1.946	1.296	973	clear	NO	salty
15	JP069	JUBA	JUBA NABARI	MOBIL	SCHOOL	31.61401667	4.843083333	346306.851	535475.975	2/6/2005	N/A	2008/12/13	YES	all season	N/A	N/A	N/A	34.10	7.41	1.440	919	709	clear	NO	good
16	JP078	JUBA	JUBA NABARI	HAIJALABA	RESIDENT	31.613142	4.854828	346212.95	536995.922	14/2/2003	IFRC	2009/9/26	YES	all season	N/A	NO	N/A	30.60	7.26	1.170	774	583	clear	NO	salty
17	JP088	JUBA	JUBA NABARI	HAIAMART	RESIDENT	31.599049	4.854944	344649.913	537011.969	4/2/2005	SFM	2009/9/21	YES	all season	N/A	NO	N/A	32.00	7.20	1.170	781	586	clear	NO	salty
18	JP094	JUBA	JUBA NABARI	NAKASONGALA	RESIDENT	31.5826667	4.85205	342831.793	536474.616	N/A	IFRC	2009/10/12	YES	all season	N/A	NO	N/A	34.10	7.03	1.845	1.240	897	clear	NO	good
19	JP100	JUBA	JUBA NABARI	JUBA NABARI	EPATA PSCHOOL	31.5834	4.85486667	342913.781	536785.889	0/01/1997	NA	2008/12/3	YES	all season	N/A	NO	N/A	36.80	7.13	888	620	455	clear	NO	salty
20	JP101	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.58356667	4.85676667	342932.706	536995.936	0/02/2006	RDA	2008/12/3	YES	all season	N/A	NO	N/A	31.80	7.26	761	639	377	clear	NO	good
21	JP104	JUBA	JUBA NABARI	SEVEN DAY	RESIDENT	31.58078333	4.855216667	342623.842	536825.197	17/9/2001	SFM	2008/12/12	YES	all season	N/A	N/A	N/A	34.50	7.07	1.589	1.064	788	clear	NO	salty
22	JP107	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.582441	4.865781	342889.946	537992.927	0/02/2004	NCA	2009/9/21	YES	all season	N/A	NO	N/A	32.80	7.19	1.499	996	748	clear	NO	good
23	JP108	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.583421	4.864941	342918.907	538120.962	0/01/1998	SFM	2009/9/26	YES	all season	N/A	NO	N/A	34.10	7.32	1.192	650	594	clear	NO	salty
24	JP109	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.586228	4.869913	343230.92	538448.927	N/A	N/A	2009/9/26	YES	all season	N/A	NO	N/A	34.50	7.33	879	589	438	clear	NO	good
25	JP111	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.58685	4.86175	343298.017	537546.189	N/A	N/A	2008/12/3	YES	all season	N/A	NO	N/A	34.80	7.30	1.031	704	566	clear	NO	salty
26	JP112	JUBA	JUBA NABARI	JUBA NABARI	YEI PI SCHOOL	31.58598333	4.86036667	343201.574	537393.433	0/01/1993	COMMUNITY	2008/12/3	YES	APRIL-DEC.	N/A	NO	20.0	32.50	7.17	943	628	469	clear	NO	good
27	JP117	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.59216667	4.83966667	343882.817	535103.18	0/01/1999	SFM	2008/12/3	YES	all season	N/A	NO	N/A	31.90	7.32	816	582	439	not clear	NO	salty
28	JP118	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.590009	4.859774	343847.928	537226.968	0/01/1999	SFM	2009/9/26	YES	all season	N/A	NO	N/A	33.00	7.22	1.322	834	624	clear	NO	salty
29	JP119	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.59011667	4.86256667	343660.514	537635.732	0/01/1999	SFM	2009/9/21	YES	all season	N/A	NO	N/A	31.60	7.20	1.688	1.136	843	clear	NO	good
30	JP125	JUBA	JUBA NABARI	MADARA	RESIDENT	31.59561667	4.847816667	344207.136	536003.54	21/9/2006	ACF	2009/9/22	YES	all season	N/A	N/A	N/A	30.20	7.80	2.000	1.330	1.000	clear	NO	good
31	JP*01	JUBA	JUBA NABARI	HAI GABAT	SCHOOL	31.62405	4.861816667	347423.079	537545.047	N/A	N/A	2008/12/7	YES	all season	N/A	NO	N/A	31.70	7.35	1.441	926	615	clear	NO	salty
32	JP*02	JUBA	JUBA NABARI	JUBA NABARI	RESIDENT	31.58885	4.865833333	343188.051	537997.921	0/02/2004	SFM	2009/9/25	YES	all season	N/A	NO	N/A	34.80	7.19	974	644	484	clear	NO	good
33	KP002	KATOR	KATOR	KATOR	RESIDENT	4.829472	343535.974	539722.947	539722.947	2009/9/219	N/A	2009/9/219	YES	all season	N/A	NO	N/A	32.60	7.01	3.910	2.610	1.940	clear	NO	salty
34	KP007	KATOR	KATOR	KATOR	RESIDENT	4.831716667	344795.847	534222.251	534222.251	3/01/1995	N/A	2008/12/8	YES	all season	N/A	10PST	N/A	31.90	7.36	1.620	1.014	815	clear	NO	good
35	KP013	KATOR	KATOR	KATOR	SCHOOL	31.60036667	4.82526667	344788.834	533509.082	29/11/2007	CRS	2009/9/28	YES	all season	N/A	NO	33.10	7.25	1.379	922	691	clear	NO	good	
36	KP021	KATOR	KATOR	AITBARA	RESIDENT	31.592424	4.829825	343908.906	534014.917	27/11/2007	CRS	2009/9/21	YES	all season	N/A	10PST	18.0	29.20	7.59	1.732	1.148	858	clear	NO	salty
37	KP023	KATOR	KATOR	HAI SALAH	SCHOOL	31.58768333	4.828783333	343382.882	533900.828	17/11/2005	UNICEF	2009/9/31	YES	all season	N/A	NO	N/A	33.10	7.12	2.290	1.510	1.140	clear	NO	salty

Location Map of 89 Existing Wells (On-Site Test)



Distribution Map of EC Value of 89 Existing Wells



Result of Groundwater Quality Analysis of 18 Existing Wells (Laboratory Test)

Parameters	Unit	S. Sudan																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
1	Aluminum	mg/L	0.1	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2	Ammonia	mg/L	0.03	0.03	0.08	0.08	0.08	0.05	0.05	0.03	0.03	0.05	0.05	0.03	0.03	0.08	0.08	0.08	0.08	0.05
3	Antimony	mg/L	0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
4	Arsenic	mg/L	0.05	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
5	Barium	mg/L	0.7	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6	Boron	mg/L	0.5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
7	Cadmium	mg/L	0.003-0.005	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
8	Chloride	mg/L	200	385	115	125	155	120	130	35	260	39	170	25	405	50	31	26	3	20
9	Chromium	mg/L	0.05	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
10	Copper	mg/L	1.5	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
11	Cyanide	mg/L	0.05	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
12	Fluoride	mg/L	1	0.36	0.42	0.41	0.6	0.42	0.4	1.1	0.42	0.34	0.3	0.29	0.45	1.6	0.36	0.66	0.25	0.49
13	Hardness	mg/L	-	446	370	230	296	202	310	132	340	308	104	218	426	226	234	220	322	532
14	Sulfides	mg/L	-	1	1	2	1	1	2	1	1	1	2	1	2	1	1	1	1	1
15	Iron	mg/L	0.5	0.25	0.12	0.08	0.12	0.08	0.15	0.18	0.2	0.18	0.24	0.12	0.38	0.11	0.14	0.11	0.16	0.21
16	Manganese	mg/L	0.4	0.01	0.01	Nil	Nil	Nil	0.01	0.02	0.01	Nil	0.02	Nil	0.08	Nil	Nil	Nil	0.01	0.02
17	Lead	mg/L	0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
18	Mercury	mg/L	0.006	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
19	Molybdenum	mg/L	0.07	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
20	Nickel	mg/L	0.07	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
21	Nitrate	mg/L	30	50	18.5	20	25	8	5.4	9.8	245	9	0.44	0.64	260	22.1	3.3	0.9	0.12	0.14
22	Nitrite	mg/L	0.5	0.04	0.12	0.41	0.25	0.02	0.15	0.03	0.2	0.03	0.26	0.23	0.62	0.22	0.02	0.04	0.22	0.03
23	Selenium	mg/L	0.01	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
24	Sodium	mg/L	100	406	171	248	199	64.3	200	210	497	50.7	754	35.5	652	181	127	110	36.8	114
25	Sulfate	mg/L	-	129	60	68.8	65.7	18.3	54.3	22.9	109	23.4	243	13.7	91.4	24.3	15.7	15.7	1.71	12.6
26	TDS	mg/L	1000	1655	929	961	911	425	929	732	1773	521	2176	369	2300	771	637	575	505	662
27	Zinc	mg/L	3	0.02	0.01	0.02	0.04	0.04	0.02	0.04	0.1	0.02	0.05	0.01	0.11	0.02	0.01	0.01	0.01	0.01

Note: Samples exceeds the Souteren Sudan Guideline Value is shown in a colored cell.

Laboratory: Kenya Central Water Laboratory

Location Map of 18 Existing Wells (Laboratory Test)

