### STUDY ON THE GROUNDWATER POTENTIAL EVALUATION AND MANAGEMENT PLAN FOR THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN IN THE REPUBLIC OF NAMIBIA

Japan International Cooperation Agency Pacific Consultants International

BOREHOLE FINAL REPORT

Borehole J4-K (WW 39845) Okonyama L 330

### METZGER PM DRILLING

P.O.Box 11733 Windhoek Namibia

> Windhoek October 2000



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# 1. Geological Borehole Log



#### THE STUDY ON THE GROUNDWATER POTENTIAL EVALUATION AND MANAGEMENT PLAN IN THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN

#### AMINIUS NORTH EAST JICA Reference: J-4-K GEOLOGICAL BOREHOLE LOG WW 39845 S 23, 40098°

Date completed: 11 May 2000

WW 39845 S 23, 40098° E 19, 62489° Collar elev.: 1253 m

Depth below surface (m)	Section (m)	Lithology	Stratigraphy
0 - 2	2	Light orange to red, fine to coarse grained sand.	
2 - 6	4	Light brown to white, fine to <b>coarse sand</b> . Coarse grains rounded, ranging from clear to yellow and red to slightly milky white quartz.	
6 - 6,5	0,5	As above: with horizon of white clay and light grey and black chert.	
6,5 - 9	2,5	Reddish brown fine-grained sandstone with scattered coarse grains of rounded quartz. Non - calcareous, porous.	KALAHARI
9 - 10	1	Sandstone, medium to coarse grained, light green to light brown, well rounded. Porous.	
10 - 12,8	2,8	Medium grained light brown to reddish brown sandstone. Grains rounded.	
12,8 - 14,5	1,7	Calcrete, massive, white to light pink.	
14,5 - 16,5	2	Weathered dolerite, calcretized, light brown to greyish.	
16,5 - 28	11,5	Light brownish grey to grey fractured, slightly weathered <b>dolerite</b> . White non-calcareous (gypsum) coating on fracture plains. Moderately hard.	KAROO DOLERITES
28 - 38	10	Baked brittle shale (= chert ?). Colour ranging from brick red to greenish brown and pale yellow. Non calcareous (gypsum) coating on fracture plains/joints.	
38 - 53 EOH	38 - 53 EOH15Light greenish grey highly weathered basalt. Rounded reworked chert, sub-rounded at 44m. (≥ 20 mm ). At 44 - 46 m highly weathered and clay rich horizon. At 47 m a 1 meter horizon with abundant large pure calcite crystals. At 52 to 53 m weathered basalt amygdales filled with green and white zeolites.		KALKRAND BASALTS

### **REMARKS**:

- 1. The drilling method employed was mud-rotary.
- No aquitard exists between Kalahari and Karoo. Therefore the total intersected section in this borehole is considered as a potential aquifer.

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This borehole was logged by F. Bockmuhl.

# 2. Penetration Record



Penetratio	n Record J 4 K
Depth (m)	Pen. Rate (min/m)
1	1
	2.33
	3
	2.33
5	2,25
	4.5
	4.4
	4.55
10	3.9
	4.33
	4
	5
	8.1
15	
	79
	4 75
	4 95
	5.05
20	3.3
20	3 35
	3.1
	3.1
	5.1
25	2 7
25	2.16
	5.10
	4.1
	3.7
20	5.9
30	4.1
	4.85
	4.2
	5.55
	2.8
35	2.3
	3.4
	4.1
	3.33
	4.7
40	3

3	
4.85	
3.5	
4.4	
5.25	
4.5	
3.9	
9.2	
3.65	
5	
4.8	
10.2	
9.7	
5.8	



#### Penetration Record J 4 K

Pen. Rate (min/m)



# 3. Mud Rotary Drilling Log



#### THE STUDY ON THE GROUNDWATER POTENTIAL EVALUATION AND MANAGEMENT PLAN IN THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN

### MUD ROTARY DRILLING LOG

#### **LOCALITY:** Aminius JICA REFERENCE: J 4 K <u>WW</u> 39845

TIME	DEPTH mbgl	MARSH FUNNEL TEST 1000 ml (sec.)	MARSH FUNNEL TEST 500 ml (sec.)	E. C. mS/cm	DENSITY	рН	TEMPERATURE ° C	COMMENT
08:20	0	29	19	2,81	≤1.2	8	19.6	Before start of drilling
08:40	5	30	19	2.82		8	20.0	Install conductor pipe
11:40	11	32	21	2.86	≤ 1.2	8	26.0	Added 12.5   EEZIMIX
14:10	41	32	21	2.9		8	26.6	Drilling
16:00	53	32	22	2.9		8	26.6	End of drilling: Measurements before Geophysical logging
		28	17			8	18.8	Water used for mixing

#### **GENERAL REMARKS:**

- 1. Geophysical logging was done in one step in a borehole with diameter 12 1/4".
- 2. To obtain the electrical resistivity for the samples in  $\Omega$ -m., the E.C., expressed as S/m., should be inversed (1/x).

#### DATE: 8/05/00

# 4. Geophysical Log and Casing Design



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(	CONSULTANT PACIFIC CONSULTANTS INTERNATIONAL			
c	COMPANY METZGER PM DRILLING			
P	<b>ROJECT</b> The Study on the Groundwater Potential Evaluation and Management Plan in the Southeast Kalahari (Stampriet) Artesian Basin			
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CU. Pos WELLJHR PROJ. LCN. An STE. J FILING N	COUNTRY REPUBLIC OF NAMIBIA			
BH COORDINATES	S 23.4009 E 19.62489			
COLLAR ELEVATION OG MEAS. FROM Gro	1253m pundlevel			
DRILLING MEAS. FROM	Groundlevel			
DATE	09 May 2000			
YPE LOG	Physical Properties			
EPTH-DRILLER	54m			
EFTH-LOGGER TM LOGGED INTERVA	53.70m			
OP LOGGED INTER VAL	L 0.60m			
EDMANENT DATINA	Groundlevel			
ECORDED BY	Clemence Kambewa			
WITNESSED DV Frank Bokmubl				
	JAPAN INTERNATIONAL COOPERATION			



## 5. Borehole Development Data

#### THE STUDY ON THE GROUNDWATER POTENTIAL EVALUATION AND MANAGEMENT PLAN IN THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN

#### **BOREHOLE DEVELOPMENT DATA**

#### LOCALITY: Okonyama, Aminius NE **JICA REFERENCE: J4K** DATE: 14/05/2000 (starting) WW 39845

#### **Remarks:**

The following activities took place:

- 1. Date 14/05/2000: Plunging by Cable Tool in order to settle gravel pack. This was followed by bailing to clean the borehole of accumulated sediments. Total time 12 hours.
- 2. Date 16/05/2000: Airlifting at various depths. Very low yield resulted in limited flow over V-Notch weir. Continually declining water level in borehole necessitated termination of activities after 12 hours.
- 3. Date 31/05/2000: Cable Tool Rig was re-established over J 4 K. The borehole was filled with fresh water and plunged for continuous 16.5 hours. This was done in order to effectively flush out any residual drilling mud and formation cuttings.
- 4. Date 01/06/2000: The activity described under ¶ 3. above was continued, with the regular addition of water to the borehole. Time spent actively plunging: 16,5 hours.
- 5. Date 02/06/2000: Plunging was continued for 3,5 hours, after which the borehole was bailed for another 5 hours. The recovery was measured, with only minimal reaction. Total time plunged and bailed: 8,5 hours.
- 6. Bailing was again attempted on 4/6/2000 for continuous 2 hours, after which development by cable tool was terminated.
- 7. Development by electrical submersible pump was not attempted.

# 6. Evaluation of Pumping Test



#### 1. PUMPING TEST ANALYSIS

#### J4-K (WW39845) - Pumping well

#### 1.1. Constant Discharge Test Analysis (Annex 1)

The borehole is screened in dolerite, baked shale and Kalkrand Basalt and not in the upper Kalahari sediments. Transmissivity of the underlying Karoo Formation is very low, in the order of 0,5 m<sup>2</sup>/day and can be regarded as an aquitard. The borehole is virtually dry and water is only pumped from storage in the aquifer. Only a slight recovery in the water level is observed.

The simulation results of the pumping tests are displayed in Annex 1.





#### 1. EVALUATION OF SLUG TEST

Borehole J4-K was tested using a 3 m long slug (2.5 m were lowered below the water level). The first test was done after the slug was lowered (See Figure 1), while the second test was done after the slug was pulled out of the borehole (See Figure 2). The saturated thickness of the unconfined borehole was only about 2.7 m.

The Bouwer-Rice (straight line) solution for unconfined aquifers was used to evaluate the hydraulic conductivity of the aquifer (**See Table 1**). Borehole J4-K was also pump tested but the borehole was pumped dry and did not recover. The results of the slug test are not considered reliable as only some rest water from the drilling was left in the borehole. The original water level after drilling was 44.5 m.

Test	Solution	T [m²/day]	K [cm/sec]	Y₀ [m]
Lower slug	Bouwer-Rice	N/A	2.1 x 10 <sup>-6</sup>	0.50
Pull slug	Bouwer-Rice	N/A	1.2 x 10 <sup>-6</sup>	0.06

Table 1: Solutions for slug test J4-K (unconfined Kalahari aquifer)

T = transmissivity [m<sup>2</sup>/day]

K = hydraulic conductivity [cm/sec]

- Y<sub>0</sub> = original displacement [m]
- S\* = estimated storativity [--]





Figure 1: Lower slug; Bouwer-Rice Solution



Figure 2: Pull slug; Bouwer-Rice Solution

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### 7. Water Level Recorder Installation



### THE STUDY ON THE GROUNDWATER POTENTIAL EVALUATION AND MANAGEMENT PLAN IN THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN

### **INSTALLATION OF SEBA FLOATERS**

### JICA REFERENCE: J 4 K LOCALITY: Okonyama, Aminuis

#### WW 39845

1.	Serial Number of floater:	4490
2.	Date installed:	18/09/00
3.	Rest Water Level when installed:	50.71 mbsu
4.	Distance from stick-up to logger:	43.0 m
5.	Distance from logger to water level:	7.71
6.	Cut off:	43.0 m (0.91 + 42.110

