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 J8-A(WW 39855) Twee Reviere R481

METZGER PM DRILLING P.O.Box 11733 Windhoek Namibia

Windhoek December 2000



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

Introduction

The Joint Venture Contractors Metzger-PM Drilling were appointed by Pacific Consultants International to conduct a drilling investigation in the Stampriet Artesian Basin.

A total of 19 boreholes were constructed successfully on nine different localities. All boreholes were geophysically logged and pumping tests have been conducted.

The following Drilling Rigs were used during this operation:

- 1. Schramm 685: Used for all drilling and grouting as well as large diameter casing installation.
- Jaswell J 3500: Used for installation of final casing, placement of filters and filter gravel. This rig was also used for developing boreholes by double tube airlift and pumping test operations.
- 3. Hotline: Only used for conducting pumping tests.
- 4. Steyns Cable Tool Rig: Used for developing and conducting slug tests.

Drilling started on the 10th of April 2000 and was completed on the 16th August 2000. The drilling method employed was mostly Mud-rotary, but the air rotary method was also employed throughout the programme.

Due to supply problems, the final pumping test by pressure probe on the free flowing boreholes could only be conducted and the results evaluated during November 2000.

The data collected at each borehole is presented in a separate report. This report details the results and interpretation for borehole J 8 A at Twee Reviere.

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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

OLULUUICAL DU	MEHOLE LOG
Farm Twee Reviere	WW 3985
Jica Reference: J 8 A	S 25, 46174°
Date completed: 29 / 07 / 2000	E 19. 43373°

GEOLOGICAL BOREHOLE LOG

WW 39855 S 25. 46174° E 19. 43373° Collar elev.: 1015 m

Depth below surface (m)	Section (m)	Lithology	Stratigraphy
0 - 3	3	Calcrete, moderately karsted. Shallow cover of pale orange sand. Karst cavities filled with orange to pale red sand.	
3 - 12	9	Pinkish calcretized conglomerate . Matrix is a fine to medium grained pinkish grey calcareous sandstone, with pebbles and boulders of grey and brown quartzite and sandstone.	
12 - 14	2	Very light grey to white sandy calcrete.	KALAHARI
14 - 19	5	Pale grey to pale brown sandy calcrete . Drill-cuttings recovered in a clayey mass. Saline encrustations on dry cuttings. (= sulphate ?)	
19 - 30	11	Pale grey to white sandy calcrete with minor clayey horizons at 23, 28 m. At 21 m red sandstone pebbles in calcareous sandstone matrix.	
30 - 36	6	Sandstone very pale brown, mostly fine grained unsorted, calcareous. Grains sub-rounded. Saline coating on dry drill cuttings.	
36 - 141	105	Sandstone, generally pale reddish brown, gradually changing to reddish brown at depth. Grain-size unsorted very fine to medium, and generally finer grained at 135 to 141 m. Aquifer (saline!) Collected drill cuttings when dried before washing all develope a white saline coating.	
141 - 142	1	Sandstone, reddish brown, hard, unsorted fine to medium grained. Major FeO-staining.	
142 - 152	10	Light greyish brown sandstone, medium grained, sub- rounded and porous. Disseminated gypsum from 148 to 150 m. Moderately calcareous, but very calcareous at 149 to 152 m.	
152 - 155	3	Sandstone, gradually changing to quartzite, purplish to dark brown fine to medium grained, poorly porous.	AUOB A 5
155 - 156	1	Dark purplish brown quartzite. Non-porous. Very thin horizon of basalt (only one positively identified chip in J8N!) Calcareous.	
156 - 157	1	Quartzite / very hard baked calcareous sandstone, purplish brown.	
157 - 164	7	Sandstone, calcareous, purplish brown, medium to coarse grained.	
164 - 172	8	Sandstone with minor intercalated red shale layers,	

		sandstone purplish brown, calcareous, coarse grained.	
172 - 176	4	Lost sample due to cross over to air-rotary as requested for collection of water samples.	AUOB A 5
176 - 183	7	Sandstone, purplish to purplish-brown with abundant muscovite. Sandstone increasingly laminated with depth. FeO staining on laminations. Slightly feldspathic.	
183 - 191	8	Intercalated laminated sandstone / shale, purplish. Laminations in sandstone well developed. Muscovite in sample.	
191 - 194	3	Shale, black/dark grey, intercalated with dark purplish sandstone. Shale is sandy and micaceous.	AUOB A 4
194 - 209	15	Dark grey well laminated shale . Minor calcite at 207 m. Regular pyrite in cuttings. Pyrite occurs in thin laminae of piritiferous sandstone.	
209 - 221 12 Grey sandstone with intercalations of darker grey siltstone, apparently cyclic. Muscovite on laminations. Sandstone fine to medium grained. Abundant pyrite at 214 m.		AUOB A 3	
221 - 233	12	Grey to dark grey laminated shale with minor piritiferous sandstone horizons.	AUOB A 2
233 - 241	8	Medium grained pale grey sandstone, non-calcareous. Sandstone laminated with muscovite.	AUOB A 1
241 – 250 EOH	9	Intercalations of pale grey siltstone/shale.	MUKOROB

REMARKS:

- 1. Placement of screens from 234.10 m to 242.80 m only in A 1.
- 2. Upper Auob sandstone horizons are yielding saline water.
- At 141 to 142 m FeO-staining indicates probable erosional surface and therefore contact between Auob and Kalahari was interpreted here.
- 4. Water Conductivity and Resistivity logs support this division of strata.
- This borehole was drilled by air-rotary initially, down to the Auob horizons, and then by mud-rotary to the end of the borehole.

This borehole was logged by F. Bockmuhl



2. Penetration Record



Penetration Record J 8 A						
Depth (m)	Pen. Rate (min/m)					
1						
E						
5						
10						
	2.45					
	3.3					
	4.05					
	5					
	1 05					
	4.85					
	3.00					
	3.5					
	3.65					
	3.7					
20	3.35					
	4.5					
	6.3					
	4.25					
	2.9					
	3.6					
	5 45					
	3.1					
	2.7					
	J.1 4.25					
20	4.30					
30	3.9					
	3.65					
	3.7					
	4.2					
	3.4					
	3.7					
	2.25					
	3.1					
	3.7					
	3.3					
40	3 75					
10	4 1					
	4.1					
	2.05					
	3.03					
	3.75					
	3.3					
	3					
	3.2					
	3.5					
	4.05					
50	4					
	3.3					
	4.5					
	4.2					
	4.65					
and the second						

Page 1

	3.55
	2.75
	3.5
	4.1
	4
60	3.5
	3.05
	3.3
	3.3
	3.7
	3.0
	3.2
	3.6
	3.15
	3.45
	3.85
70	3.85
	3.75
	3.25
	2.95
	3.1
	2.5
	2.5
	2.05
	2.55
	2.3
	2.35
80	2.2
	1.75
	1.9
	3.7
	3.85
	1.45
	2.7
	3.2
	27
	12
00	1.65
30	1.05
	1.55
	1.2
	0.8
	2.3
	1.65
	0.95
	1.2
	0.95
	0.8
100	1.4
	1.95
	1 15
	1 1
	0.0
	0.9
	0.7
	0.85
	1.5
	1.25
	0.95
110	0.8

Page 2

	0.9
	1.3
	1.1
	0.85
	0.9
	1.55
	0.8
	1 1
	0.75
120	2.4
120	2.4
	0.0
	0.9
	0.75
	1.2
	0.95
	1
	0.7
	1.05
	0.5
130	1.1
	0.95
	0.85
	1
	1
	0.85
	0.00
	0.9
	1.1
	2.45
	1.7
140	1.1
	1.1
	4.9
	4.6
	5.9
	6.25
	6.1
	6
	7
	7
150	5.4
	7.6
	6.85
	6.15
	7.7
	1.1
	0.0
	0.4
	12.85
	7.95
	6.5
160	5.5
	6.75
	6.6
	6
	7
	5.15
	6.55

Page 3

	6.55
	4
	6.05
170	8.15
	9.25
	6.55
	6.95
	6
	10.55
	10.7
	10.15
	24.15
	18.6
180	3.9
100	10.75
	18.65
	10.05
	12 55
	9.75
	0.75
	0.7
	0.00
	0.0
100	6.2
190	5
	4.9
	9.95
	5.85
	5.2
	4.15
	4.85
	4.25
	4.6
	5.7
200	6.25
	6.6
	6.4
	5.9
	9
	4.75
	5.8
	6.1
	6.25
	6.3
210	8
	9.6
	7
	6.7
	6.75
	7.4
	6.7
	8.2
	7.45
	5.6
220	9.65
	5.85
	7.85

	6.6
	6.5
	9.55
	12.75
	23.05
	14.2
	8.9
230	10
	6.25
	6.4
	6.4
	6.4
	6.1
	7.8
	7.2
	6.95
240	6.2
	6.3
	6.05
	5.7
	5.4
	5.6
	4.75
	4.25
	4.4
	4.3
250	4.85
	and the second se



Penetration Record J 8 A



1

Chart1

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

JICA REFERENCE: J 8 A LOCALITY: Twee Reviere R 481 WW 39855 DATE: 21/7 to 26/07/2000

TIME	DEPTH mbgl	MARSH FUNNEL TEST 1000 ml	MARSH FUNNEL TEST 500 ml	E. C. mS/cm	DENSITY	рН	TEMPERATURE ° C	
18:00 23/07	230	39	26	7.25		9	25.7	
				5.76				

Remarks:

This borehole was drilled air-rotary and filled with drill fluid at the end of the drilling for geophysical surveying only.

COMMENT

At start of logging

Water used for mixing

4. Geophysical Log and Casing Design



5. Borehole Development Data



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BOREHOLE DEVELOPMENT DATA

JICA REFERENCE: J 8 A LOCALITY: Twee Reviere R 481 WW 39855 DATE: 31/07/2000 (starting)

TIME	P.I.D.	½ 90° V-	Yield	E.C.	Water Level	
(actual)	(mbsu)	Notch (mm)	(m^3/h)	(mS/m)	(mbsu)	
16:00	234			1068	62.34	Date 31/07/00: Star
03:00		20			100.56	1
07:00					105.36	
09:00					118.26	
12:00					122.30	
17:00				709	138.53	
19:00		20	0.144			L
01:00		20			124.57]
04:00						L
05:00	234	20			136.42	
07:00			1		139.26	
09:00	240				120.26	
12:00					139.52	
16:00					139.62	
19:00	240	10	0.036		142.37	Pum
07;00	240				144.30	
12:00					142.36	
16:00					142.55	
17:00		10	0.036		142.64	

Remarks
t and pump through the night.
Date1/8/00.
ower air pipe
Date 2/8/00.
ower air pipe
p through night
Date 3/8/00
Stop airlift.
A

6. Evaluation of Pumping Test



1. EVALUATION OF SLUG TEST

Borehole J8-A was tested using a 3 m long slug. The first test was done after the slug was lowered (See Figures 1 and 2), while the second test was done after the slug was pulled out of the borehole (See Figures 3 and 4).

The Cooper Bredenhoeft-Papadopulos (type curve) and Bouwer-Rice (straight line) solutions for confined aquifers were used to evaluate the transmissivity and hydraulic conductivity of the sandstone aquifer (See Table 1).

The borehole is virtually dry and no aquifer parameter could be evaluated from the lowering of the slug. A very low transmissivity was calculated from the recovery test (pull slug).

Test	Solution	T [m²/day]	K [cm/sec]	Y₀ [m]	S* []
Lower Slug	Cooper-Bredehoeft-Papadopulos	N/A			N/A
	Bouwer-Rice		N/A	N/A	
Pull Slug	Cooper-Bredehoeft-Papadopulos	0.006			1 x 10 ⁻¹⁰
	Bouwer-Rice		2.3 x 10 ⁻⁷	0.29	

Table 1: Solutions for slug test J8-A

* estimated

T = transmissivity [m²/day]

K = hydraulic conductivity [cm/sec]

Y₀ = original displacement [m]

S* = estimated storativity [--]



Figure 1: Lower slug; Cooper-Bredehoeft-Papadopulos Solution





Figure 2: Lower slug; Bouwer-Rice Solution



Figure 3: Pull slug; Cooper-Bredehoeft-Papadopulos Solution



Figure 4: Pull slug; Bouwer-Rice Solution

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 8 A LOCALITY: Twee Reviere R 481

WW 39855

1.	Serial Number of floater:	4489
2.	Date installed:	07/11/00
3.	Rest Water Level when installed:	≥ 185.16 mbsu
4.	Distance from stick-up to logger:	185.16 m (150 m + 15.15 m beaded rope + 20.01 steel cable)
5.	Distance from logger to water level:	15.15 m
6.	Cut off:	0 m