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

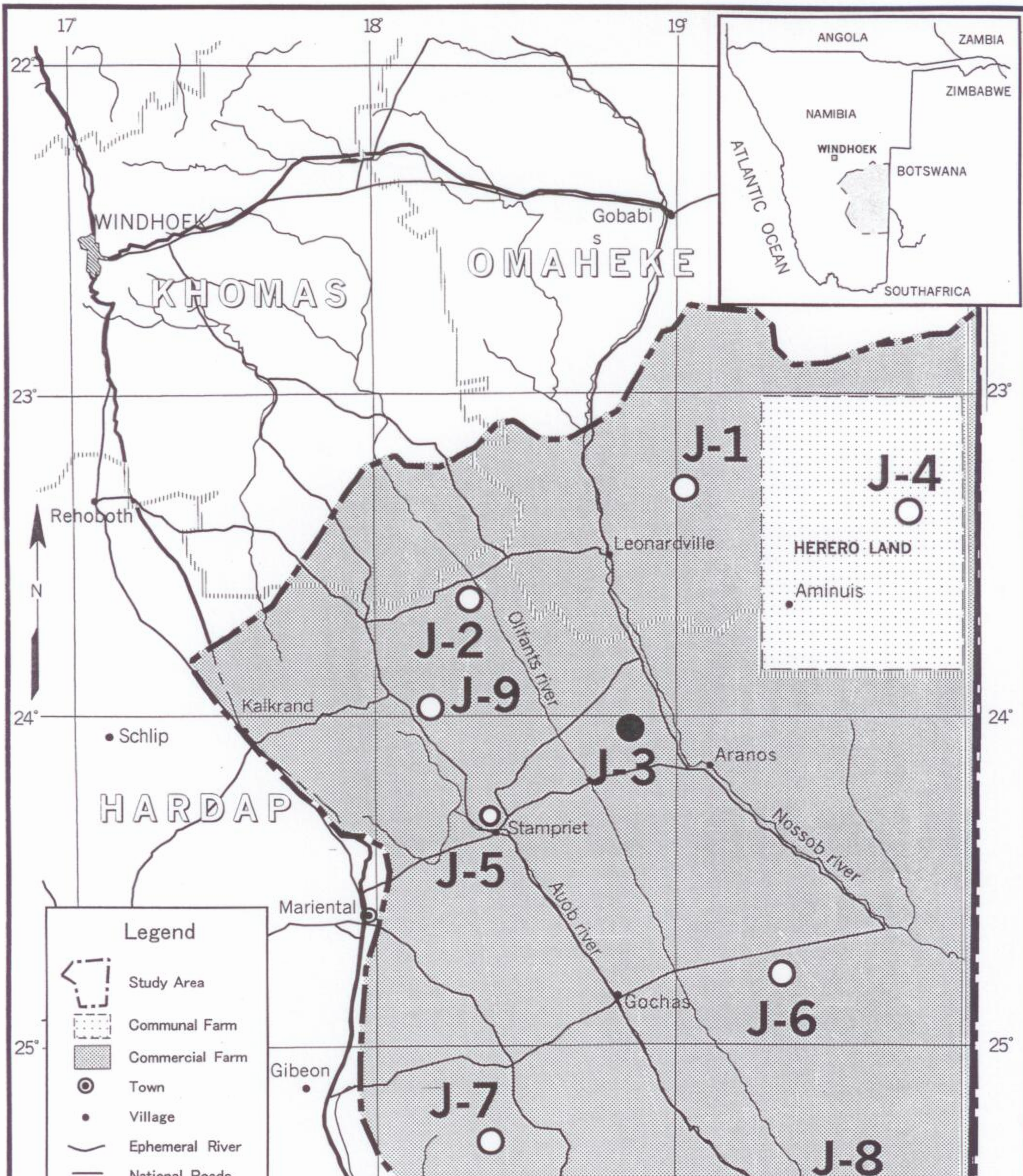
Japan International Cooperation Agency
Pacific Consultants International

BOREHOLE FINAL REPORT

Borehole
J3-N (WW 39844)
Choroaoheib R 300

METZGER PM DRILLING
P.O.Box 11733
Windhoek
Namibia

Windhoek
October 2000



Location Map of Test Boreholes

THE STUDY ON THE GROUNDWATER IN THE STAMPRIET ARTESIAN BASIN | JICA

Contents per Chapter

1. Geological Borehole Log

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

GEOLOGICAL BOREHOLE LOG

Farm Choroaoheib R 300 (Ptn Steynsrus) — **WW 39844**
Jica Reference: J - 3 - N — **S 24, 04858°**
Date completed: 3/6/2000 — **E 18, 79614°**
Collar elev.: 1205 m

Depth below surface (m)	Section (m)	Lithology	Stratigraphy
0 - 6	6	Karsted, light reddish brown sandy **calcrete**. Shallow cover of reddish brown medium to coarse sand. Karst cavities filled with dark reddish brown sand.	KALAHARI
6 - 7	1	Unsorted, mostly rounded to sub-rounded quartz **sand**, slightly calcareous.	
7 - 9	2	**Gravel bed**: coarsening downwards from slightly calcareous coarse grained sand to a partially calcretized unsorted gravel with pebbles up to 8 mm ∅. Colour brownish grey.	
9 - 11	2	Unsorted **gravel**, non-calcareous and not consolidated. Grains sub-rounded to rounded, ∅ up to 5 mm, light brown.	
11 - 14	3	**Conglomerate**: Mostly rounded quartz pebbles (- 10 mm) in a calcareous sandstone matrix. Light greyish brown.	
14 - 15	1	Light greyish brown coarse grained **sandstone**, calcareous.	
15 - 25	10	Poorly consolidated quartz **gravel**. With increasing depth gravel is progressively more cemented by white **calcrete**.	
25 - 31	6	Coarse **gravel**, quartz, rounded, in a orange clayey matrix. Colour changes to pale brown at 31 m.	
31 - 42	11	Pinkish white massive **calcrete**. At 33 - 35 m calcretized reworked calcrete.	
42 - 50	8	Calcretized quartz pebbles to small boulders. (= **conglomerate**) Samples highly ground by drilling action. Representative fraction esp. collected at 47 m. Pebbles well rounded.	
50 - 55	5	Pale orange brown fine to very fine-grained **sandstone**, calcareous at 51 m. Occasional scattered grains in sandstone very coarse.	RIETMOND
55 - 58	3	Pale yellowish brown intercalations of soft **shale** with calcareous fine-grained sandstone.	
58 - 64	6	Pale brown soft **shale**. (Contaminated sample with abundant collapse of cuttings from Kalahari layers.)	
64 - 71	7	Pale brown fine to medium grained calcareous **sandstone**. Occasional larger pebbles embedded in sandstone.	

71 - 74	3	Brown **sandstone**, medium to coarse-grained, porous. Calcareous with scattered occasional quartz pebbles.	RIETMOND
74 - 89	15	Light brownish fine to medium grained **sandstone**, calcareous. At 88-89 m abundant rounded pebbles of quartz and chert.	
89 - 93	4	Light reddish brown fine-grained **sandstone** and **shale** intercalated. Colour turns to yellowish brown at 93 m.	
93 - 108	15	Light reddish brown medium to coarse-grained **sandstone** with subordinate **shale** horizons. A coarse pebbly horizon was intersected at 105 m.	
108 - 118	10	Reddish brown fine to medium grained **sandstone**. Abundant washout from upper horizons in sample. (Washed sample not representative!)	
118 - 143	25	Light brown to white **sandstone**, medium to coarse grained to 134 m and fine to very fine grained, fining downwards to 143 m. Moderately calcareous in horizons. Porous. (Sample impure due to washout and re-drilling of Kalahari beds.)	**AUOB A5**
143 - 149	6	Yellowish to light red **shale**, soft. Shale ground up and lost in washed sample. Sample retained very impure. Soft shale observed during drilling only.	**AUOB A4**
149 - 151	2	Fine to very fine-grained calcareous light reddish brown calcareous **sandstone**.	**AUOB A3**
151 - 153	2	Sample lost due to change over to air rotary method required for water sample collection.	
153 - 158	5	Dark reddish to purple feldspathic, non-calcareous **sandstone**, fine to coarse grained. Grains mostly sub-rounded to sub-angular. At 158 m colour greyish brown.	
158 - 159	1	Pale grey brown soft **shale**, **sandy**.	
159 - 160	1	Pale reddish grey **shale**	
160 - 163	3	Pale brownish to grey **shale**	
163 - 165	2	Grey micaceous **shale**. Laminated. Biotite very small flakes evenly distributed / dispersed. Slightly calcareous.	
165 - 176	11	Light grey **sandy shale** (to very fine-grained sandstone), laminated with muscovite on laminations. Very thin very fine grained **sandstone / siltstone** horizons in laminae. Between 171 and 172 m micaceous grey shale only. Moderately calcareous above 170 m.	
176 - 178	2	Grey to dark grey **shale** with minor sandy micaceous horizons.	**AUOB A2**
178 - 180	2	Grey **shale**, poorly laminated with dispersed white calcareous nodules in drill-cuttings.	
180 - 226,5	46,5	Grey **shale**, moderately laminated. Non-calcareous. Colour gradually changing to dark grey or black.	
226,5 - 228	1,5	Pale grey fine-grained **sandstone**, calcareous and porous.	

228 - 236	8	Light grey fine-grained **sandstone**, calcareous and porous and intercalated with grey to dark grey shale at 229 - 233 m and at 235 - 236 m. Shale with biotite flakes on laminations. Sandstone well sorted.	**AUOB A1**
236 - 240	4	Light grey medium grained **sandstone**, moderately porous to porous in horizons, calcareous with soft, white calcitic specks disseminated throughout sample.	
240 - 246,5	6,5	As above, with subordinate thin grey shale layers.	
246,5 - 264,5	18,5	Light grey well **laminated shale** with minor horizons of lighter grey very fine sandstone at 250 m, and a medium grained sandstone horizon at 257 m. Calcareous at 257 and 258 m.	**UPPER MUKOROB**
264,5 - 270	5,5	Light grey to grey fine to very fine **sandstone / siltstone**, highly calcareous to 268 m. Porous. Laminated with shaly tops esp. at 270 m.	
270 - 275	5	Laminated light grey to grey **siltstone / shale**.	
275 - 300	25	Grey **shale**. Slightly darker grey at 290 -292 m and 298 - 299 m. Generally well laminated, except in dark grey horizons. Dark grey horizons carbonaceous.	**LOWER MUKOROB**
300 - 314	14	Dark grey soft, possibly hydrating carbonaceous **shale**. White calcitic concretions at 310 - 313 m.	
314 - 315	1	AS above, with 0,5 m fine to medium grained light grey calcareous sandstone horizon.	
315 - 323	8	Light grey to grey laminated **shale**.	
323 - 336	13	Dark grey to black bituminous **shale**, laminated in horizons. Clogging tri-cone drill-bit. (Fresh not drilled samples included in chip tray) Change over to clay cutting drill-bit resulted in simultaneous short core cuttings, also included in chip tray.	
336 - 345,5	9,5	Thin hard horizons of light grey calcareous **sandstone**, fine to medium-grained and micaceous, at 336 - 338 m. Well laminated shale at 340 - 341 m. Light grey, well laminated, fine grained sandstone, calcareous at 342 - 343 m , fining downwards to a non-calcareous siltstone, also well laminated.	**NOSSOB**
345,5 - 357,8	12,3	Grey well laminated **shale**. Very thin siltstone horizon at 351/352 m.	
357,8 - 360	2,2	Laminated fine-grained **sandstone**, light grey, intercalated with grey shale in very thin laminae. Calcareous at 360 m.	
360 - 366	6	As above, with **shale laminae** dominating with increasing depth.	
366 - 397	31	Hard, laminated grey **shale**. Homogenous.	**DWYKA**
397 - 409 EOH	12	Intercalated **siltstone/shale**. Shale grey with siltstone light grey. At 398 m a thin horizon of fine-grained sandstone was intersected. Siltstone dominating with depth.	

General Comment:

1. This borehole was cased and pressure-grouted to a depth of 270 m.
2. The lower portion of the Mukorob shale is clogging the tricone drill-bit. Very tacky and bituminous.
3. Re-drilled quartz grains contained in each sample up to 151 m indicates probable washout from upper Kalahari horizons.

This borehole was logged by F. Bockmühl on 10 June 2000.

2. Penetration Record

Penetration Record Borehole J 3 N WW 39844				
Depth (m)	Pen. rate (min /m)	Time	Date	Remarks
1				Start Drilling for conductor pipe
5				
10				
	2.8			
	3			
	5.6			
	1.9			
	2.1			
	2.9			
	2.35			
	2.7			
	4.9			
20	13.7			
	17.1			
	14.9			
	11.1			
	17.8			
	5.6			
	4.1			
	5.55			
	6.65			
	3.6			
30	3.5			
	5.8			
	8			
	6.6			
	6.6			
	7.6			
	10.2			
	10.8			
	16			
	7.8			
40	4.65			
	12.8			
	31			
	20.65			
	4.85			
	5.7			
	6.9			
	7.3			
	12.7			
	17.3			
50	4.7			
	10.95			
	8.95			
	8.75			
	2.5			

	8.3
	4.1
	9.75
	7.3
	3.4
60	3.4
	3
	3.1
	3.9
	10.7
	9.9
	8.35
	7.75
	9.1
	4.15
70	3.7
	3.8
	4.25
	5.65
	9
	6.6
	5.5
	6.8
	5.8
	7.2
80	3.1
	4.9
	2.9
	2.1
	9.2
	4.2
	3.1
	2.6
	5.5
	4.9
90	5.3
	5.8
	5.6
	5.5
	5.35
	5.2
	7.7
	1.7
	2.8
	6.8
100	6.7
	2.1
	2
	3.95
	6.95
	4.7
	4.7
	4
	7.6
	5.65
110	7.25

	6.6
	7.4
	8
	7.95
	8.6
	3.1
	3.2
	3.4
	4.75
120	5.2
	4.4
	6.15
	5.6
	6.2
	5.75
	5
	4.6
	4.65
	5.1
130	3.45
	3.2
	3.7
	3.4
	4.8
	2.6
	44.35
	5.5
	4.7
	5.45
140	3.1
	3.1
	5
	8.2
	10.15
	8.2
	4.4
	6.5
	7.1
	7.7
150	6.6
	7.9
	7.7
	8.5
	3.3
	9.7
	12.2
160	12.9
	13.7
	13.6
	6.2
	5.35
	9.2
	9.85

	6.7
	8.65
	10.75
170	6.1
	7.6
	7.9
	8.2
	9.5
	11.2
	6
	6.9
	4.6
	5.2
180	5.1
	5.75
	9.45
	4.3
	5.25
	4
	5.95
	5.4
	5.1
	5.45
190	5.85
	7.2
	5.25
	5.1
	4.35
	5.6
	5.2
	5.45
	6
	6.7
200	5.2
	5.8
	6.1
	6.3
	6
Depth (m)	**Pen. Rate (min/m)**
205	7
	5.4
	4.45
	5.2
	5.2
210	5.55
	5
	6.7
	6.15
	5.4
	5.4
	6.25
	6.1
	7.4
	5.75
220	5.8
	4.9

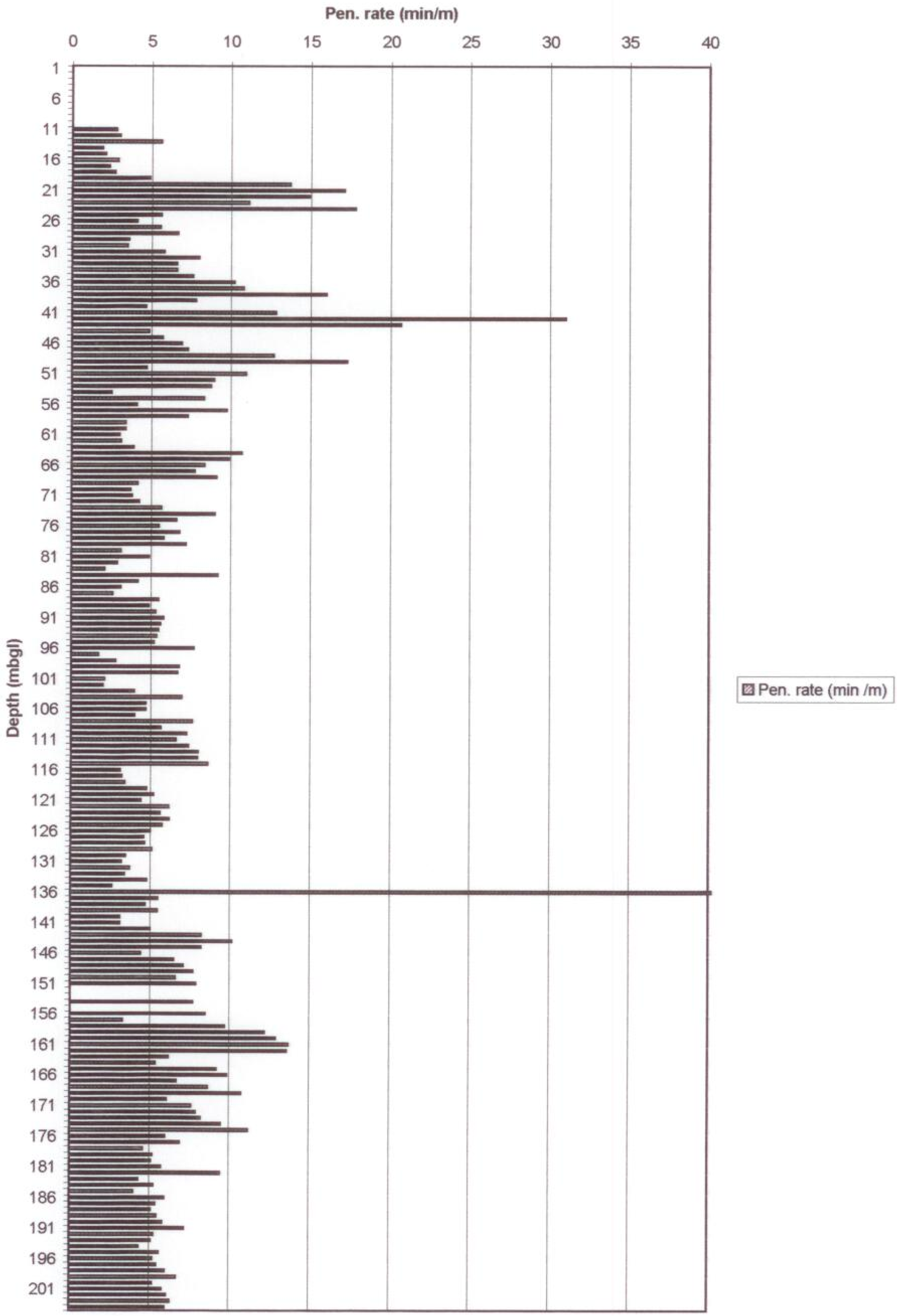
	4.75
	4.65
	5.25
	5.15
	6
	4.9
	3.75
	5.75
230	
	5.5
	2.7
	3.3
	26.6
	7.75
	4.6
	2.6
	2.65
	2.7
240	2.85
	2.85
	3.2
	2.6
	2.95
	4.85
	6.4
	8.35
	10.15
	8.7
250	7.7
	8.6
	7.3
	6.3
	7.8
	7
	5.2
	8.7
	9.6
	9
260	10
	7.6
	9.5
	9.75
	12.5
	26.85
	19.5
	5.5
	4.3
	5.7
270	6.5
	6.5
	6.15
	9
	9.1
	9.6
	8.8
	8.1

	8.65
	9.1
280	8.9
	9.7
	8.1
	9.75
	9.9
	8.95
	9.8
	9.8
	8.8
	7.5
290	7.1
	7.8
	10.4
	11.75
	11.55
	10.5
	10.6
	6.8
	8.3
	8.9
300	8.7
	9.15
	8.4
	8
	7.6
	8
	7.75
	8.4
	8.65
	8.35
310	8.75
	10
	Sep-25
	9.6
	8.75
	0.1
	8.5
	7.7
	8.6
	9.7
320	9.75
	9.45
	11.7
	10.1
	8.9
	8.9
	9.5
	3.6
	4
	4
330	4.6
	4.8
	4.6
	4.55

	5.75
	7.8
	6.9
	28.7
	10.75
	9.75
340	10.2
	12.6
	28.9
	16.7
	8.1
	11.1
	9.55
	10.4
	12.3
	1.7
350	14.6
	15.8
	14.45
	15
	13.9
	14
	12.65
	9.1
	9.8
	6.7
360	21.4
	9.1
	9.7
	10.4
	9.3
	11.8
	10.65
	10.2
	9.35
	10.4
370	8.35
	10.2
	10.1
	10.5
	11.2
	18.2
	11.7
	10.8
	11.55
	10.95
380	9.9
	10.7
	10.8
	11.2
	11.7
	13.1
	11.15
	11.5
	12.1
	11

390	
	11.7
	10.1
	10.6
	10.7
	11.7
	13.2
	16.9
	11.4
	22
400	15.7
	14.1
	11
	10
	13.45
	19.6
	12.6
	13.1
	11.66
409	11.66

Peneration Record J 3 (Part 1)



Pentration Record J 3 N (second part)

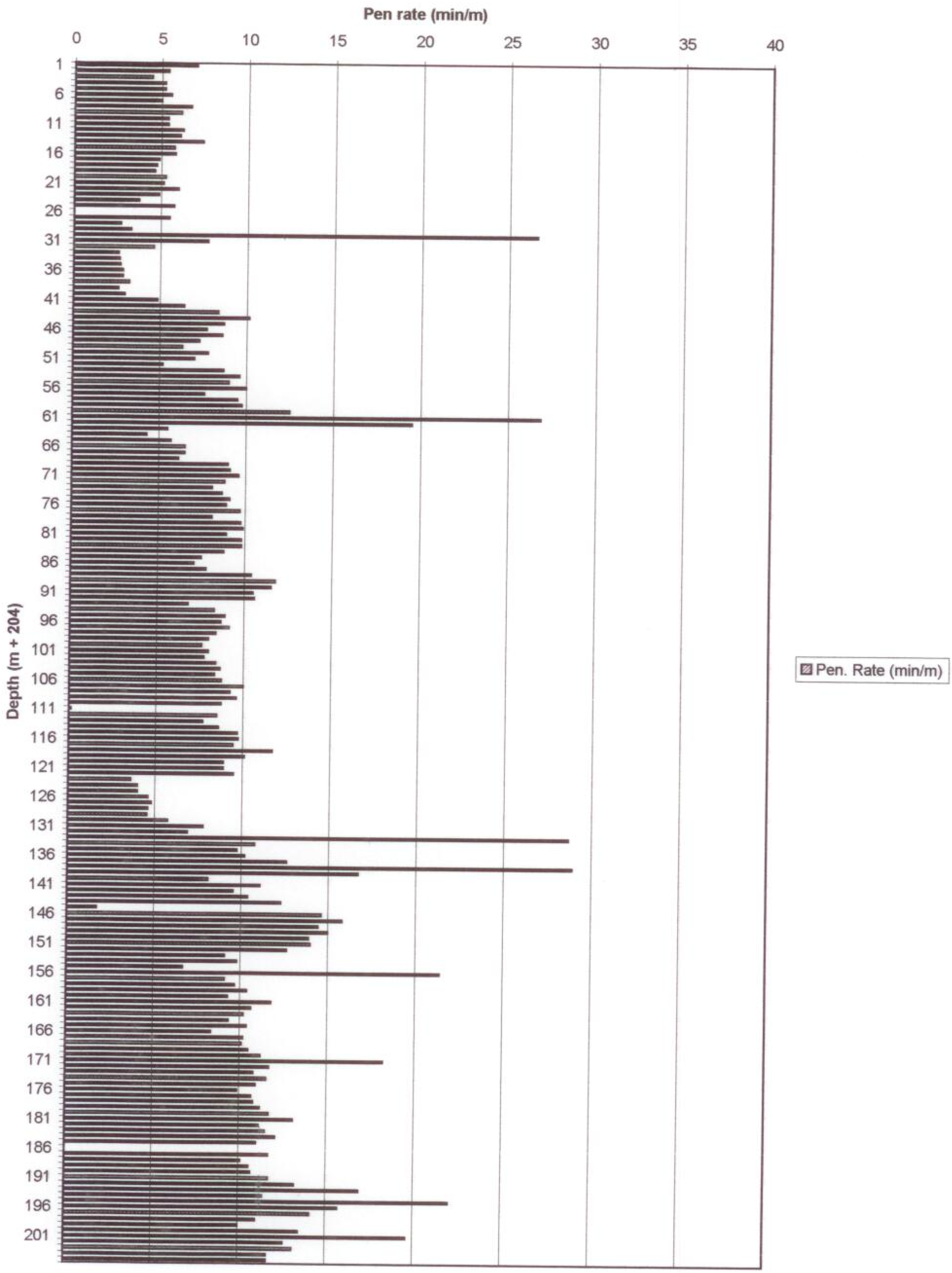
Depth (m)	Pen. Rate (min/m)
205	7
	5.4
	4.45
	5.2
	5.2
210	5.55
	5
	6.7
	6.15
	5.4
	5.4
	6.25
	6.1
	7.4
	5.75
220	5.8
	4.9
	4.75
	4.65
	5.25
	5.15
	6
	4.9
	3.75
	5.75
230	
	5.5
	2.7
	3.3
	26.6
	7.75
	4.6
	2.6
	2.65
	2.7
240	2.85
	2.85
	3.2
	2.6
	2.95
	4.85
	6.4
	8.35
	10.15
	8.7
250	7.7
	8.6
	7.3
	6.3
	7.8
	7
	5.2
	8.7
	9.6

	9
260	10
	7.6
	9.5
	9.75
	12.5
	26.85
	19.5
	5.5
	4.3
	5.7
270	6.5
	6.5
	6.15
	9
	9.1
	9.6
	8.8
	8.1
	8.65
	9.1
280	8.9
	9.7
	8.1
	9.75
	9.9
	8.95
	9.8
	9.8
	8.8
	7.5
290	7.1
	7.8
	10.4
	11.75
	11.55
	10.5
	10.6
	6.8
	8.3
	8.9
300	8.7
	9.15
	8.4
	8
	7.6
	8
	7.75
	8.4
	8.65
	8.35
310	8.75
	10
	9.25
	9.6
	8.75

	0.1
	8.5
	7.7
	8.6
	9.7
320	9.75
	9.45
	11.7
	10.1
	8.9
	8.9
	9.5
	3.6
	4
	4
330	4.6
	4.8
	4.6
	4.55
	5.75
	7.8
	6.9
	28.7
	10.75
	9.75
340	10.2
	12.6
	28.9
	16.7
	8.1
	11.1
	9.55
	10.4
	12.3
	1.7
350	14.6
	15.8
	14.45
	15
	13.9
	14
	12.65
	9.1
	9.8
	6.7
360	21.4
	9.1
	9.7
	10.4
	9.3
	11.8
	10.65
	10.2
	9.35
	10.4
370	8.35

	10.2
	10.1
	10.5
	11.2
	18.2
	11.7
	10.8
	11.55
	10.95
380	9.9
	10.7
	10.8
	11.2
	11.7
	13.1
	11.15
	11.5
	12.1
	11
390	
	11.7
	10.1
	10.6
	10.7
	11.7
	13.2
	16.9
	11.4
	22
400	15.7
	14.1
	11
	10
	13.45
	19.6
	12.6
	13.1
	11.66
409	11.66

Penetration Record J 3 N (Part 2)



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 3 N LOCALITY: Choroaoheib WW 39844 DATE: 21 May to 6 June 2000

TIME	DEPTH mbgl	MARSH FUNNEL TEST 1000 ml (sec)	MARSH FUNNEL TEST 500 ml (sec)	E. C. mS/cm	DENSITY	pH	TEMPERATURE °C	COMMENT
17:50	8	35	24	10.13	≤ 1.16	8	27.5	Drilling for conductor pipe
	42	33	22	10.53		8		
	101	35	23	10.5	≤ 1.16	8		
17:30 (25/05)	151	35 *29*	24	10.13 *11.00*		8 *8*	27.5 *22*	Drillfluid *Water used for mixing drillfluid*
14:40	158	33	22	10.5		8	27.3	After air rotary drilling on 27/05/00
	180	35	24	10:53		8	26.8	27/05/00
16:20 (28/05)	270 271	34 *29*	22	10.1 *11.00*		8 *8*	27.4 *21.5*	At end of 9 7/8",start of log. *Water used for mixing*
18:00 (31/05)	320	34	22	12.35	≤ 1.16	8	28.3	Drilling 7 7/8"
21:30 (02/06)	409	33 *29*	22	12.6 *11.8*		8 *8*	26.3 *20.3*	At end of trip, before logging. *Water from tanker.*

GENERAL REMARKS:

1. Geophysical logging took place in three steps: at ϕ 12 ¼" to 151 m, followed by the second step at ϕ 9 7/8" to a depth of 271 m and finally in a borehole diameter of 7 7/8"to 409 m.
2. To obtain the electrical resistivity for the samples, the E.C., expressed in S/m, should be inversed.

4. Geophysical Log and Casing Design

5. Borehole Development Data

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

BOREHOLE DEVELOPMENT DATA

JICA REFERENCE: J 3 N LOCALITY: Choroaoheib R 300 WW 39844 DATE: 08/06/2000 (starting)

TIME (actual)	P.I.D. (mbsu)	½ 90° V-Notch (mm)	Yield (m^3/h)	E.C. (mS/m)	Remarks
16:00	360				Start developing above plug and above lower open screen. Date 08/06/2000
16:07		75	4	486	
16:30		30	0.36	463	
16:45		35	0.6	433	Still only drill-fluid.
17:05	360	32	0.4	426	
18:05		32	0.4		
18:50		32	0.4	417	Water very grey muddy dirty.
19:40		35	0.6	426	
20:05		35	0.6	426	
22:10	360	32	0.4		Continue throughout the night.
06:46		32	0.4	467	Pale grey drill fluid. Date 09/06/2000.
08:05		32	0.4		Stop to allow water to recover.
14:00					Re-start airlift.
14:20		30	0.36		Drill-fluid.
15:45		35	0.6	435	Increase airflow.
16:30		32	0.4		Grey, dirty drill-fluid.
18:00	360	32	0.4		Muddy
19:10		32	0.4		Continue through the night.
08:00		32	0.4		Date 10/06/2000
09:00		30	0.36		Level 62.56 m

TIME (actual)	P.I.D. (mbsu)	½ 90° V-Notch (mm)	Yield (m^3/h)	E.C. (mS/m)	Remarks
10:00	360	28	0.3		Level 62.55 m.
11:00		40	0.72		Level 71.30 m. Increased airflow.
12:00		28	0.3		Level 66.20 m.
13:00		28	0.3		Level 65.75 m.
14:00		32	0.4		Level 66.70 m.
15:00		30	0.36		Level 65.90 m.
16:00		30	0.36		Level 63.50 m.
17:00	360	30	0.36		Level 65.80 m.
18:00		32	0.4		Level 73.80 m.
19:00		30	0.36		Level 72.43 m.
20:00		32	0.4		Level 67.84 m.
21:00		30	0.36		Level 67.60 m. Water still very milky with drill fluids.
22:00		32	0.4		Level 66.63 m. Stop airlift for the day to recover.
08:00					Start compressor again. Date 11/06/2000.
08:30		32	0.4		Water milky.
09:00		28	0.3		
10:00		32	0.4		
11:00		28	0.3		
12:00		32	0.4		
13:00		28	0.3		Water milky.
14:00		32	0.4		
15:00		28	0.3		
16:00		28			
17:00		32	0.4		
18:00		32			Water slightly milky.
19:00		28	0.3		
20:00		32	0.4		

TIME (actual)	P.I.D. (mbsu)	½ 90° V-Notch (mm)	Yield (m^3/h)	E.C. (mS/m)	Remarks
21:00	360	28	0.3		Water slightly milky. Continue to airlift through the night.
06:00	360	28	0.3	427	Water cloudy. Stop airlift. Date 12/06/2000.

Remarks:

1. A total of 77 hours airlift has been conducted. This deep and low-yielding borehole took a very long time to be cleared of drilling fluids.
2. Development was continued by electrical submersible pump.

6. Evaluation of Pumping Test

1. FREE FLOW - PRESSURE PROBE TEST ANALYSIS

J3-N (WW39847) – Free flowing artesian well

1.1. Well Efficiency (Step draw down test) (Annex 1)

Well Efficiency was analysed by making use of the Jacob method for draw down data. Aquifer parameters used for the calculation of well efficiency were obtained from the evaluation results of the constant discharge test, which is discussed in **Section 1.2** below.

The well efficiencies at the range of flow rates used during the step draw down test are summarised in **Table 1** below. At the very low flow rates the well efficiency is obviously very high and the main contributor to the draw down is the linear aquifer loss.

Table 1: J3-N; Borehole efficiency at various flow rates

Borehole number	Step	Abstraction Rate [m^3/h]	Draw Down* [m]	Borehole Efficiency [%]
J3-N	1	0.06	6.9	86.8
	2	0.08	10.6	85.1
	3	0.15	19.6	79.4

* at cut-off time Δt, after which well bore storage has no affect on the well performance

Data on the linear and non-linear well losses and skin factors as well as the efficient well radius are presented in **Annex 1.**

1.2. Constant Discharge Test Analysis (Annex 2 - 4)

The constant discharge draw down curve of abstraction borehole **J3-N** indicates confined aquifer conditions. It was attempted to keep a constant flow rate of 0.1 m^3/h by adjusting a valve at the outlet. During the second part of the test, however, the flow rate declined to rates of 0.4 m^3/h, thereby allowing the borehole to recover. The draw down curve could therefore not be evaluated. The Theis recovery method with data from the step test and the constant discharge test was used to calculate the hydraulic conductivity of the aquifer **(Annex 2 & 3)**.

The aquifer storativity was estimated due to the lack of observation boreholes. The results of the constant discharge analysis are summarised in **Table 2** below.

Table 2: Aquifer Parameters calculated for J3-N; Nossob sandstone

Borehole number	Analysis method	T $[m^2/day]$	s [m]	k [cm/sec]	S [-]	Simulation model
J3-N	Theis recovery CD - test	1.30	30	5.0×10^{-5}	*2×10^{-5}	Theis
	Theis recovery Step - test	1.72	30	6.6×10^{-5}	*2×10^{-5}	

* estimated

The Theis model for confined aquifer conditions was used to simulate and verify the actual data and analysis approach of the constant discharge test. Simulation parameters summarised in **Table 2** were used in simulation of the actual free flow test data (See **Annex 4** for simulation results).

The radius of influence (R) was estimated after SICHARDT (1928) using the equation:

$R = 3000 \times s \times K_f^{\ 1/2}$

$R = 3000 \times 12.7 \times 7.6 \times 10^{-4} = \underline{29\ m}$

where

R = Radius of influence

s = Draw down in abstraction borehole at end of pumping

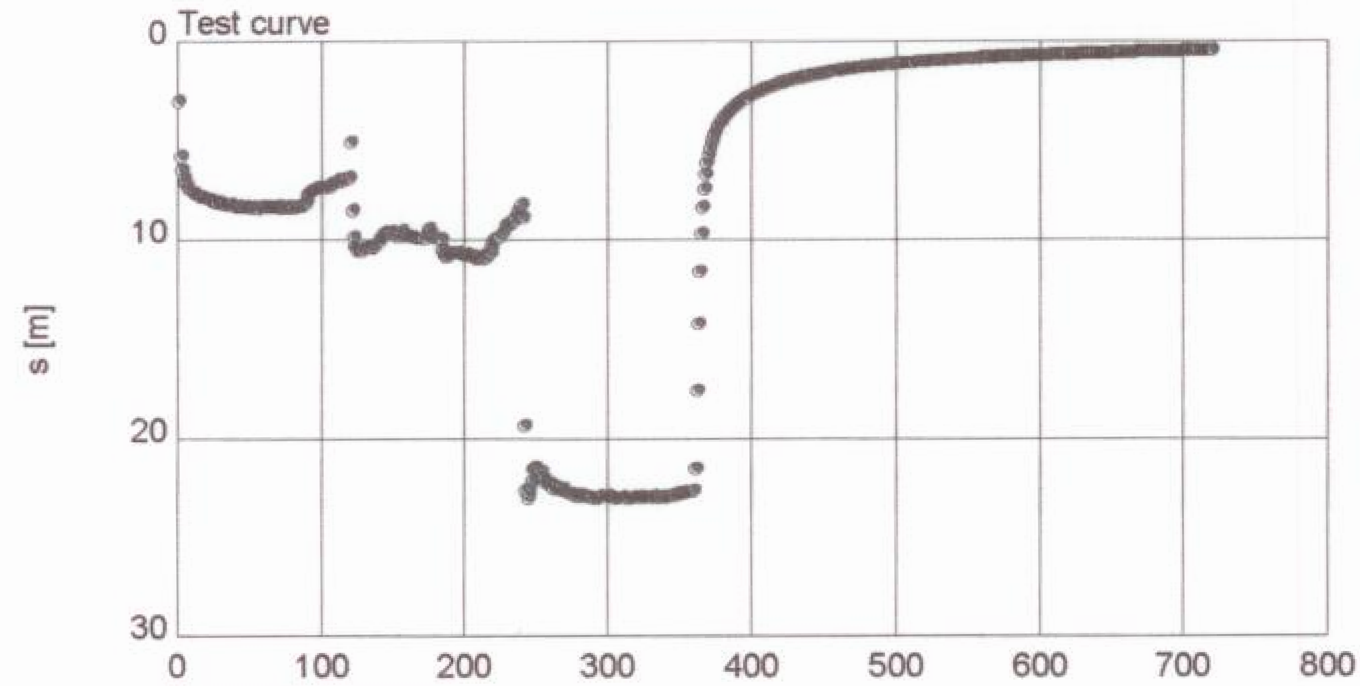
K_f = Permeability of the aquifer

The equation is approximately correct for unconfined aquifers. In case of a confined aquifer the radius of influence most probably larger and the 29 m are considered to be the minimum value.

A proper evaluation of R (and storativity S) will only be possible once reliable data from observation wells, penetrating the same aquifer as the pumped well, are available.

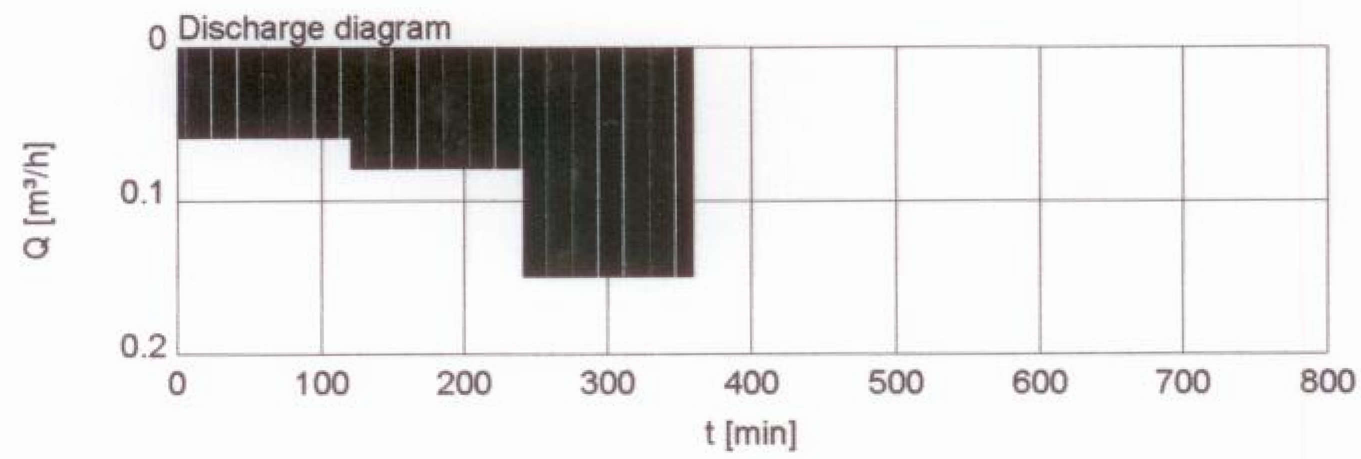
Pressure probe step test analysis

Tested well J3_N



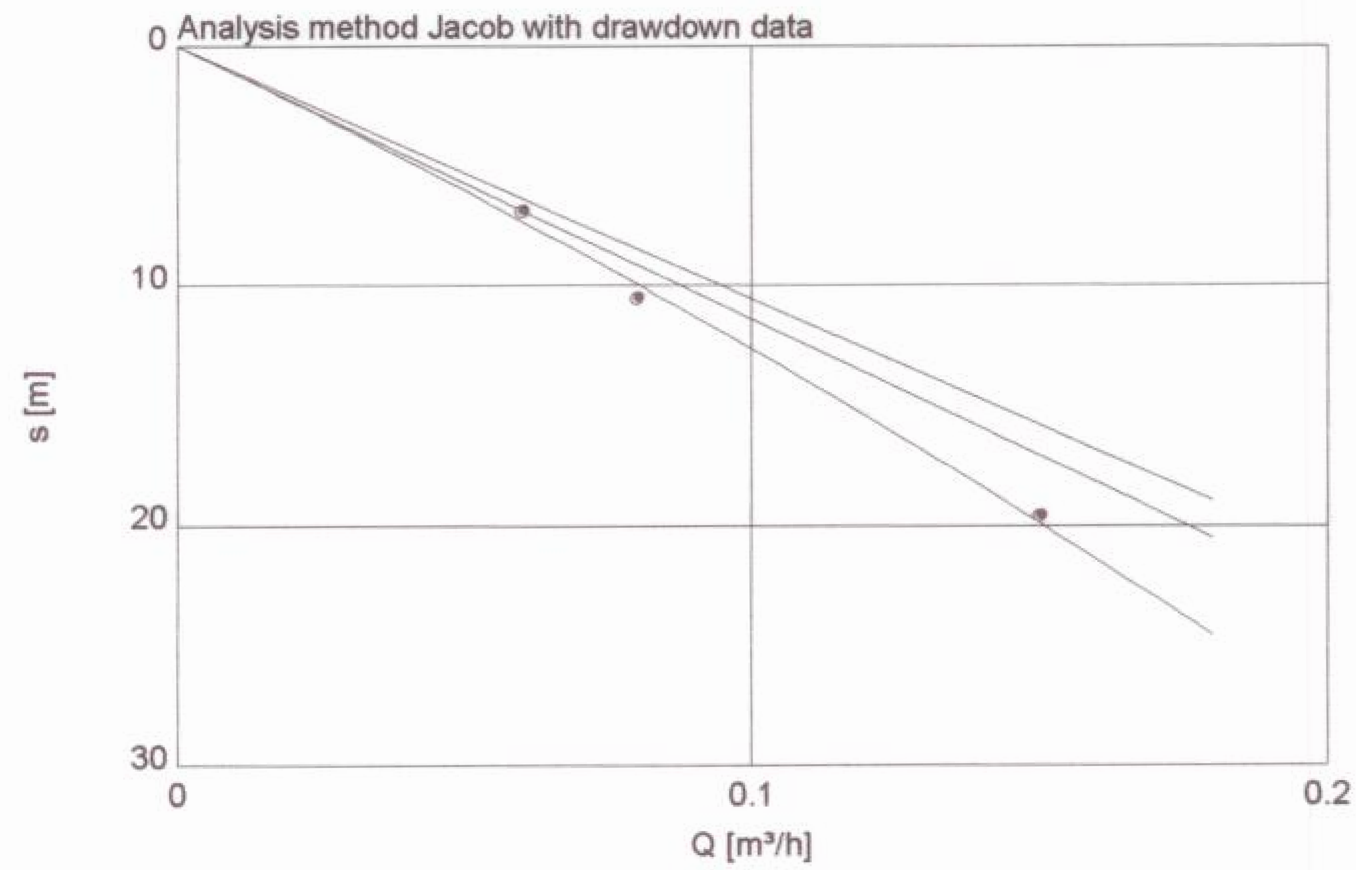
Borehole, well & aquifer

Drilled:	3.6.2000
Latitude:	24.04858
Longitude:	18.79614
Elevation:	1205 [m]
Depth:	409 [m]
Stick up:	1.00 [m]
Bh. radius:	0.1 [m]
Casing radius:	0.076 [m]
RWL:	0.00 [m]
max.drawdown:	23.08 [m]
Aq.type:	confined
Aq.thickness:	30.00 [m]
Stratigraphy:	Nossob
Lithology:	Sandstone



Test running

Start:	07/09/2000 07:00:00
Dis.dur.:	360 [min]
Av.dis.:	0.0964 [m³/h]
Max.dis.:	0.15 [m³/h]
Min.dis.:	0.06 [m³/h]
Total dis.:	0.578 [m³]
Crew:	Metzger_PM
Supervisor:	PCI



Results

Well performance:

s: (B1+B2)*Q+C*Q²

Linear aquifer loss B1: 105

Linear well loss B2: 8.47

Non-linear well loss C: 125

	Q [m³/h]	s [m]	Eff [%]
Step 1:	0.06	6.90	86.8
Step 2:	0.08	10.6	85.1
Step 3:	0.15	19.6	79.4

Linear skin factor: 0.31 [-]

Non-linear skin factor: 110 [d/m³]

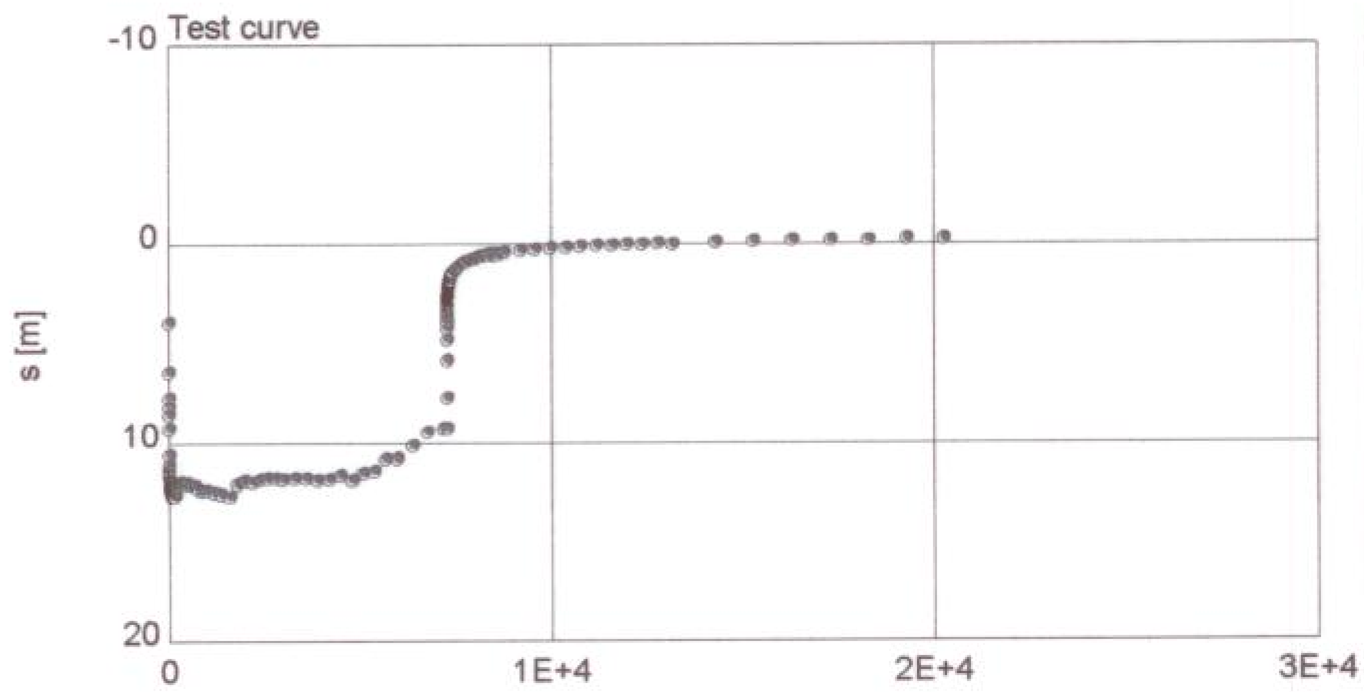
Effective well radius: 3.7E-2 [m]

Groundwater Study in the Stampriet Artesian Basin

Evaluation of Test Pumping Data

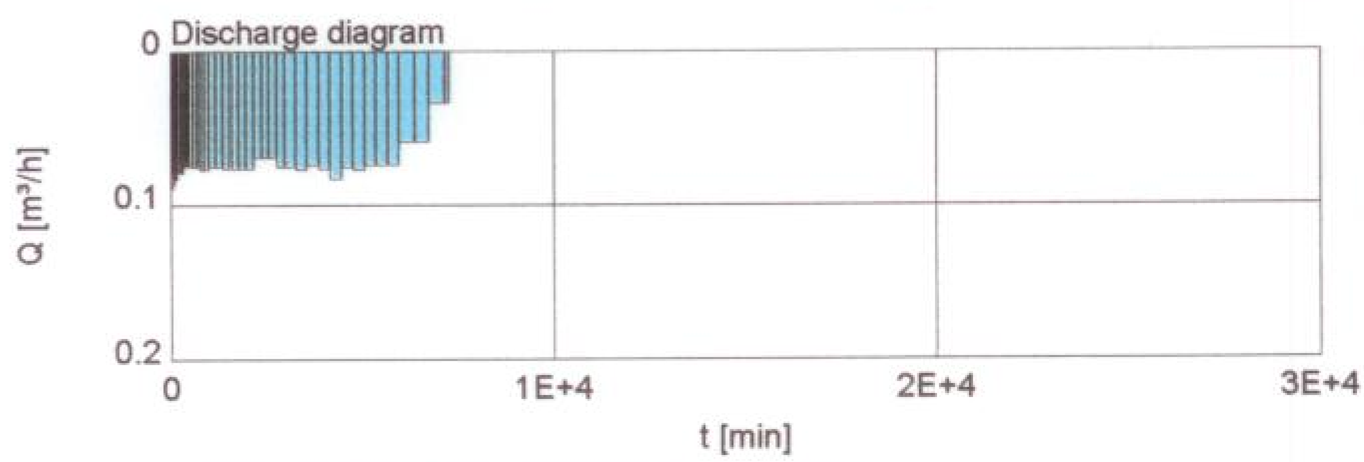
Pressure probe constant discharge test

Tested well J3_N



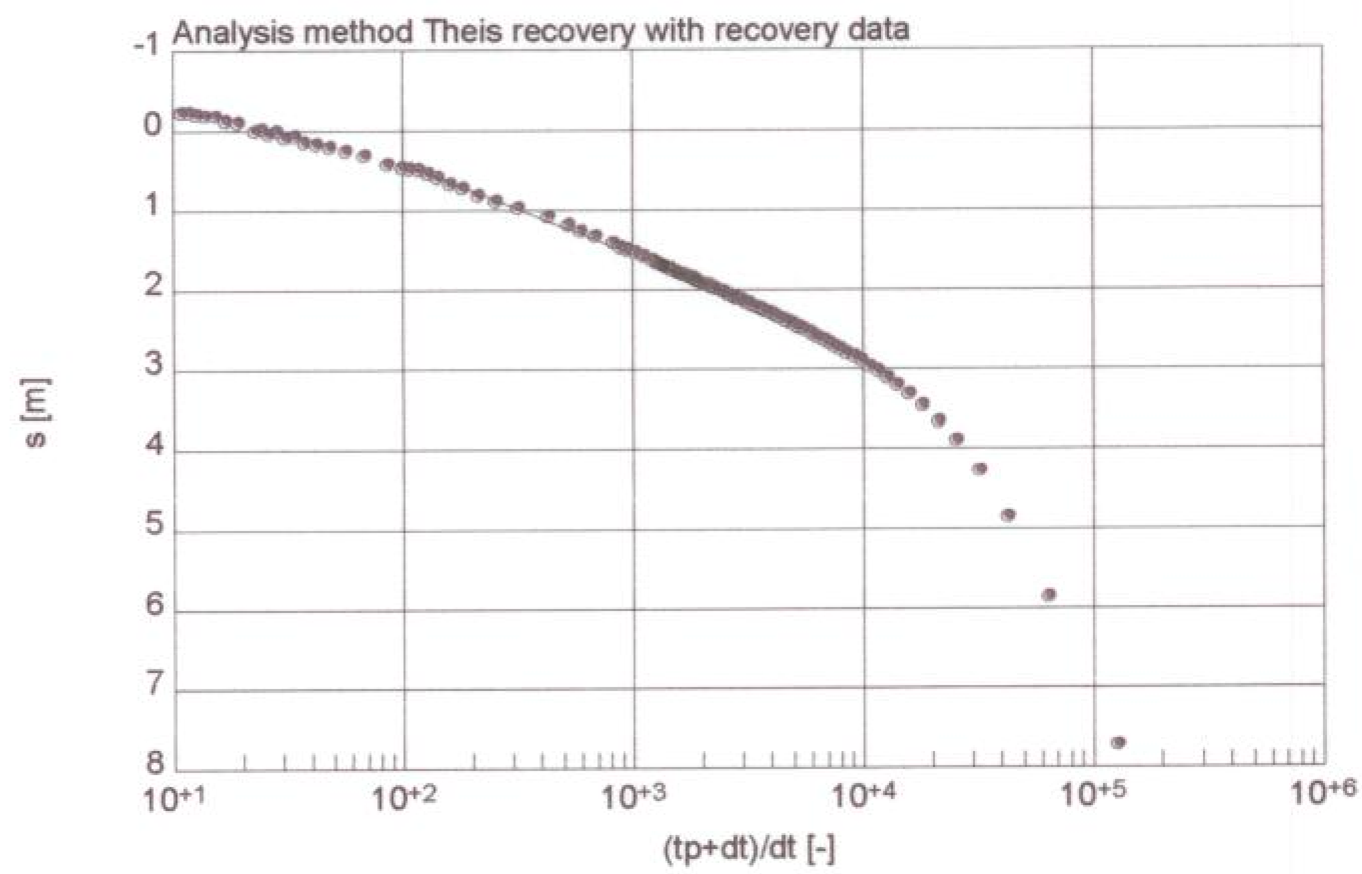
Borehole, well & aquifer

Drilled:	3.6.2000
Latitude:	24.04858
Longitude:	18.79614
Elevation:	1205 [m]
Depth:	409 [m]
Stick up:	1.00 [m]
Bh. radius:	0.1 [m]
Casing radius:	0.076 [m]
RWL:	0.00 [m]
max.drawdown:	12.72 [m]
Aq.type:	confined
Aq.thickness:	30.00 [m]
Stratigraphy:	Nossob
Lithology:	Sandstone



Test running

Start:08/09/2000 08:00:00	
Dis.dur.:	7276 [min]
Av.dis.:	0.0717 [m³/h]
Max.dis.:	0.106 [m³/h]
Min.dis.:	0.034 [m³/h]
Total dis.:	8.69 [m³]
Crew:	Metzger_PM
Supervisor:	PCI



Results

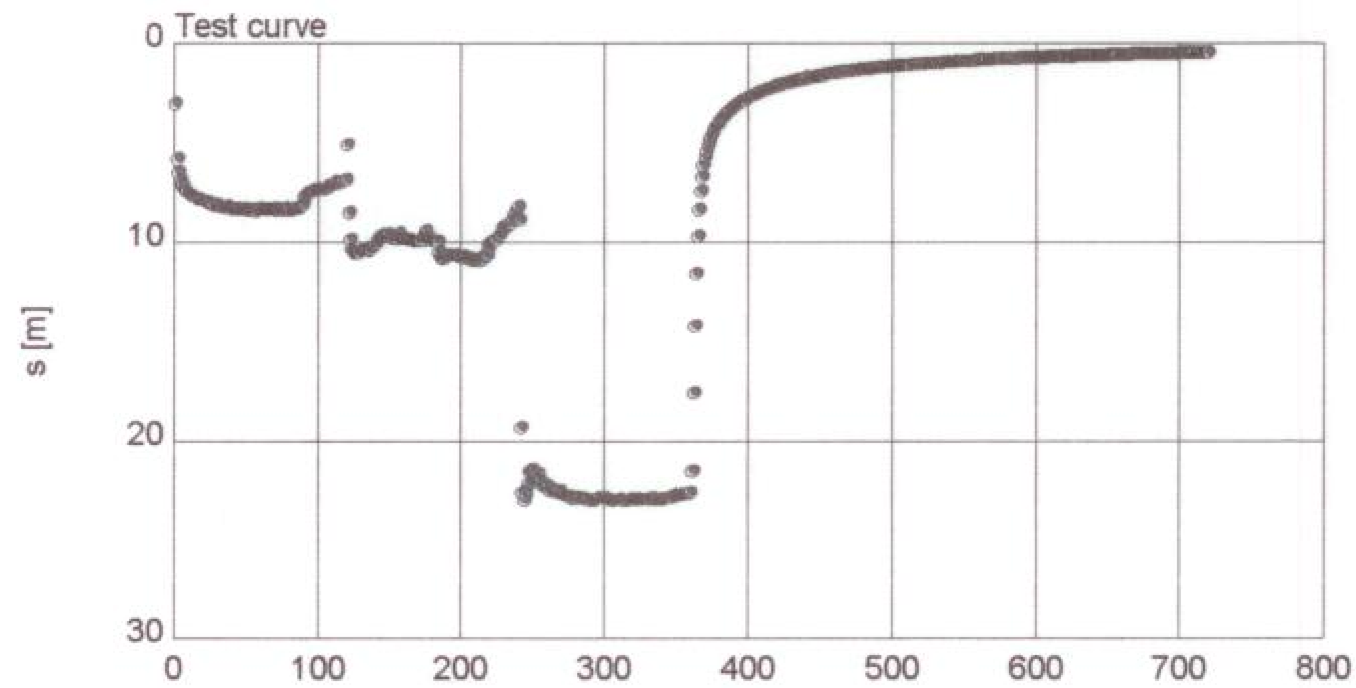
Match parameter:	
Q:	0.034 [m³/h]
b:	1.15 [m]
tcorr:	127299 [min]
to:	43.2 [-]
Aquifer parameter:	
T:	0.13 [m²/d]
k:	0.00435 [m/d]
est.S:	0.005 [-]
Well performance:	
Skin factor:	2.74 [-]
Skin loss:	2.73 [m]
Efficiency index:	0.71 [-]
Clogging index:	4.89 [-]
Clogging factor:	0.294 [-]
Effective well radius	0.00643 [m]

Groundwater Study in the Stampriet Artesian Basin

Evaluation of Test Pumping Data

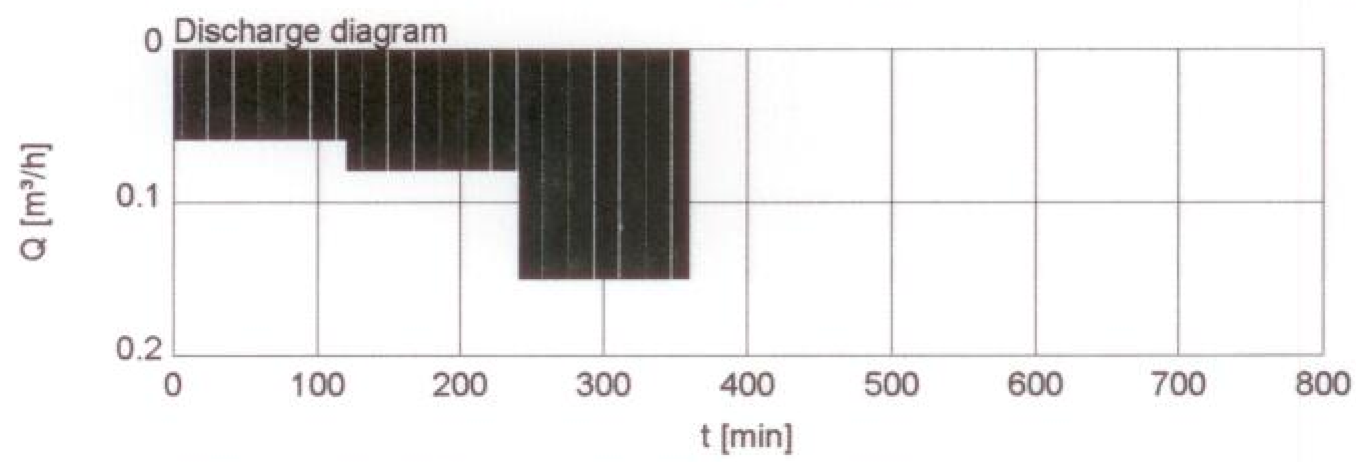
Step test recovery analysis

Tested well J3_N



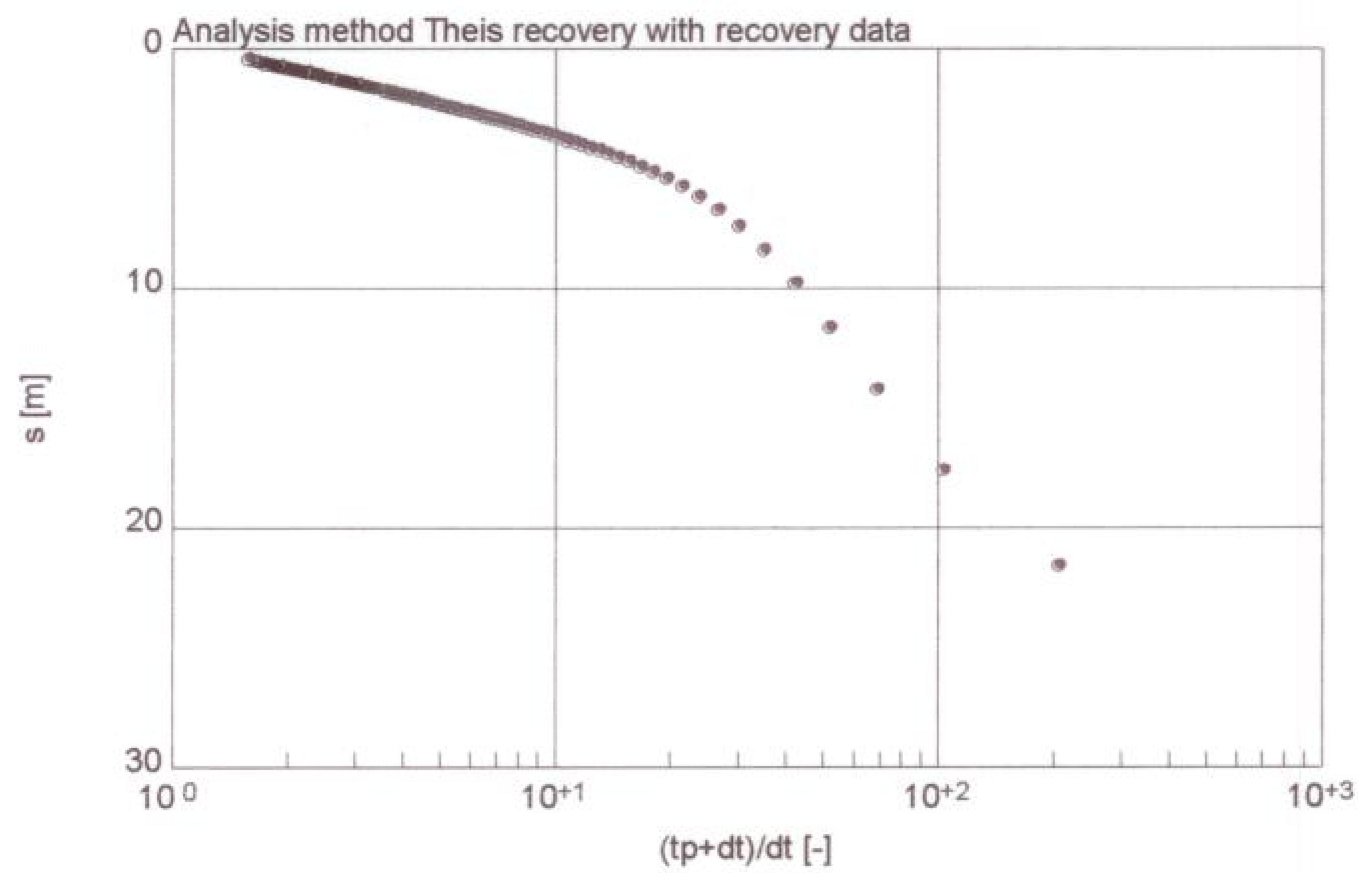
Borehole, well & aquifer

Drilled:	3.6.2000
Latitude:	24.04858
Longitude:	18.79614
Elevation:	1205 [m]
Depth:	409 [m]
Stick up:	1.00 [m]
Bh. radius:	0.1 [m]
Casing radius:	0.076 [m]
RWL:	0.00 [m]
max.drawdown:	23.08 [m]
Aq.type:	confined
Aq.thickness:	30.00 [m]
Stratigraphy:	Nossob
Lithology:	Sandstone



Test running

Start:07/09/2000 07:00:00	
Dis.dur.:	360 [min]
Av.dis.:	0.0964 [m³/h]
Max.dis.:	0.15 [m³/h]
Min.dis.:	0.06 [m³/h]
Total dis.:	0.578 [m³]
Crew:	Metzger_PM
Supervisor:	PCI

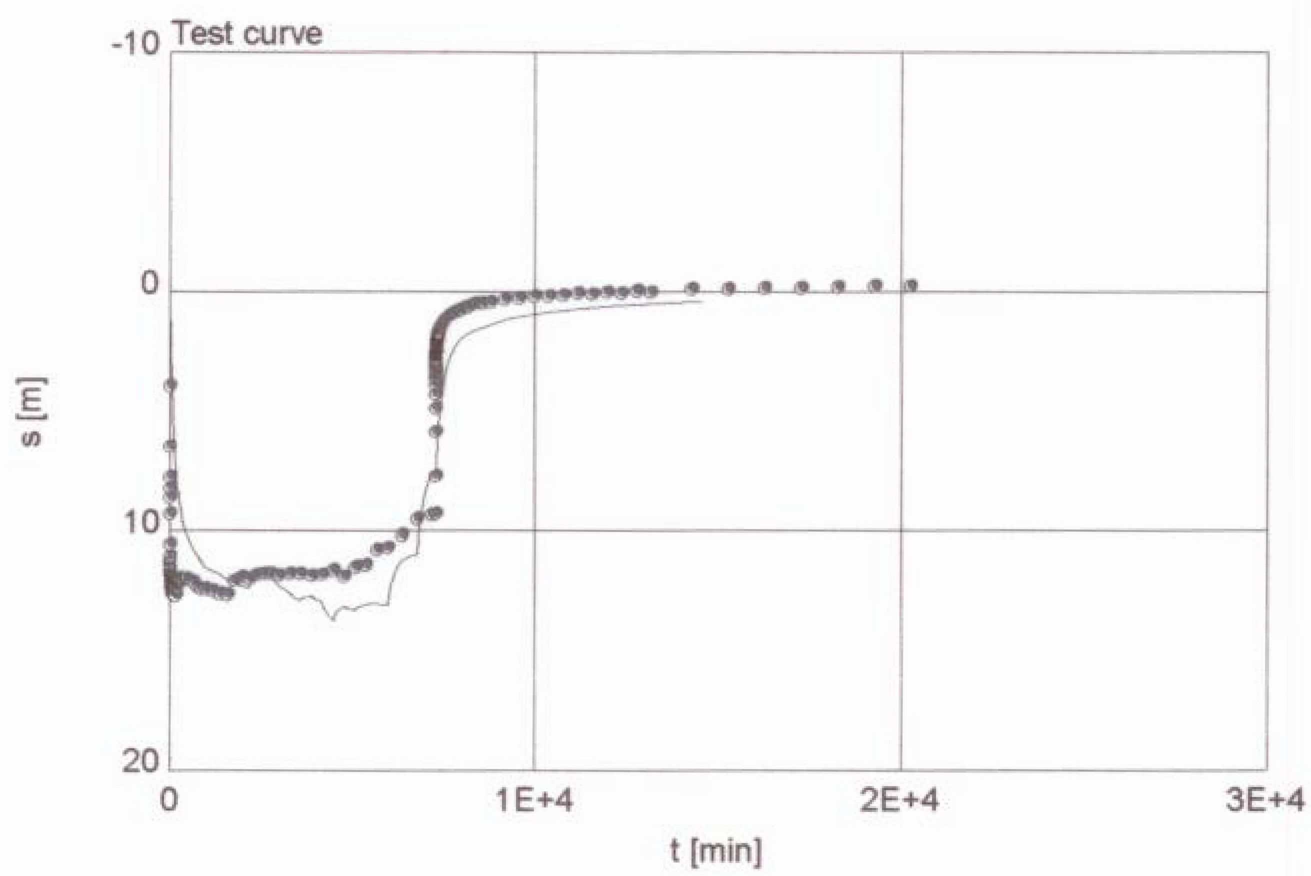


Results

Match parameter:	
Q:	0.15 [m³/h]
b:	3.83 [m]
tcorr:	204 [min]
to:	1.19 [-]
Aquifer parameter:	
T:	0.172 [m²/d]
k:	0.00574 [m/d]

Constant discharge test diagnosis

Tested well J3_N

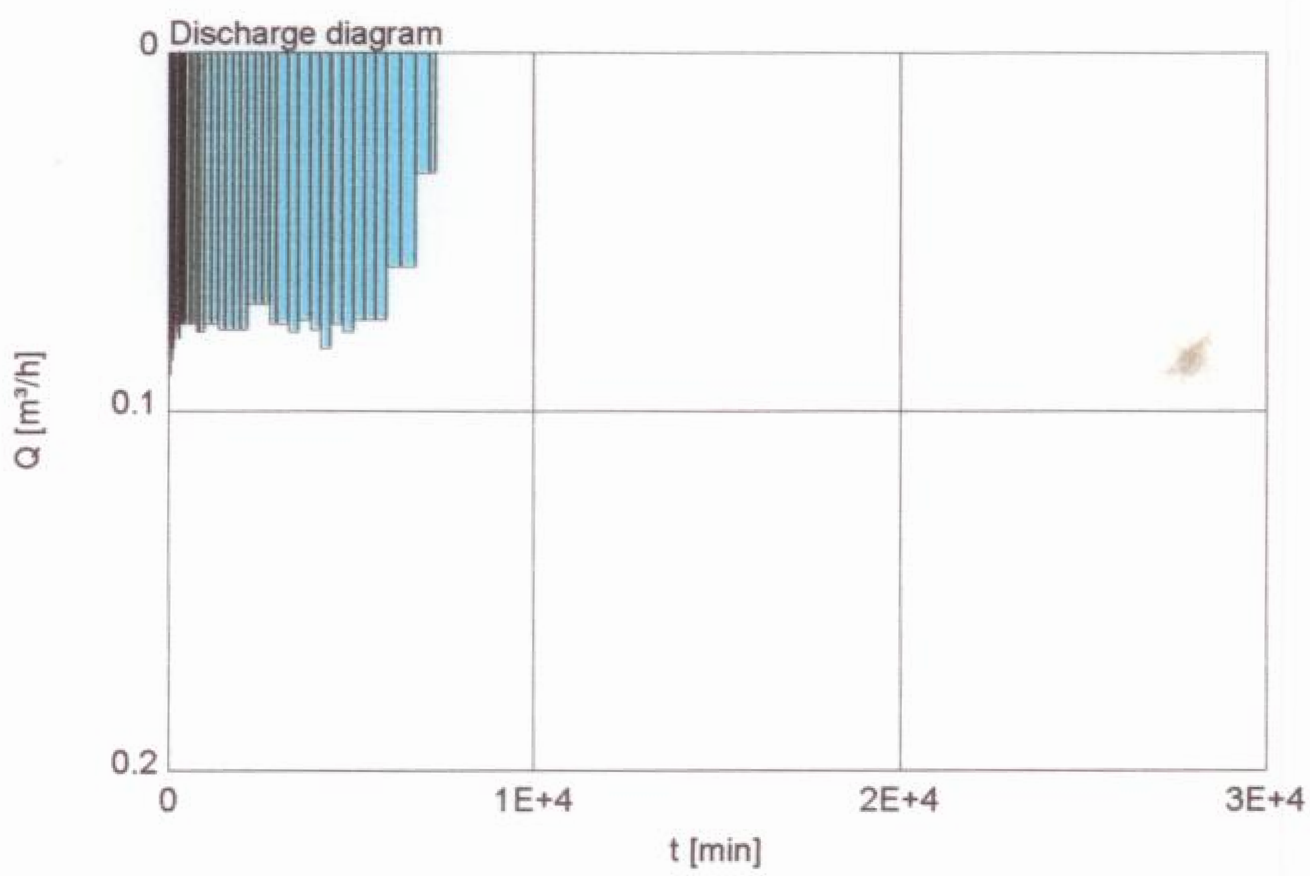


Remarks

Simulated draw down / recovery curve applying the Theis method for confined aquifers.

T = 1.7 m2/day

S = 0.00002



Discharge info

Dis.dur.:7276 [min]
tcorr: 127299 [min]

Av.dis.: 7.17E-02 [m³/h]
max.dis.:0.11 [m³/h]
min.dis.:3.40E-02 [m³/h]
Qn: 3.40E-02 [m³/h]

Dis.sum: 8.69 [m³]

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 3 N LOCALITY: Choroaoheib R 300

WW 39844

1. **Serial Number of floater**: F 20223
2. **Date installed**:
3. **Rest Water Level when installed**: artesian
4. **Distance from stick-up to logger**: n/a
5. **Distance from logger to water level**: n/a
6. **Cut off**: n/a