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REPORT ON THE MINIPUITS IN THE GAMBIA

by

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November 1974

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Report No. WD/ST/74/26

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Exhibition Road
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Contents

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1. Introduction

Project: To install two Minipuits in The Gambia.

Modification of Project: Available hydrogeological and meteorological information on The Gambia indicated that October was not the best time of year to deepen wells as it was the end of the heaviest wet season for four years when one would expect water levels to be at their highest. It was agreed not to cancel an opportunity of inspecting local well conditions throughout The Gambia particularly as a consignment of Minipuits had already arrived and a water sampling survey could be done at the same time. In the event, one of the Minipuits was installed temporarily in order to demonstrate construction and mode of emplacement.

2. The Minipuit and its installation

The Minipuit is basically a 2-metre cylindrical section slotted fibreglass casing 36 inches inside diameter consisting of two half-shells bolted together with nylon nuts and bolts and the height of the cylinder may be increased by bolting on blank cylindrical extensions each of 1 metre in height. The walls of the 2m. cylinder are perforated by vertical rows of slots 1.4mm in width, this being the smallest feasible saw-cut size at present. A removable floor can be wedged into position. Where a gravel pack is desirable a slotted 2-metre cylindrical fibreglass section only 30 inches inside diameter may be inserted into the screen section and the annulus gravel-packed. Alternatively, this inner section may be 'telescoped' through the bottom of the outer screen in order to deepen an existing Minipuit well.

The Minipuit screen is emplaced by (a) excavating a pit as far as the water table then (b) standing the 2-metre wellscreen in the bottom of the pit and sinking it by digging out from inside and knocking it down with a wooden baulk, continuing as deep as feasible. The cylindrical 1-metre fibreglass casing sections are then bolted on top until surface ground level is reached, and the pit filled.

3. Trial installation of Minipuit

The chosen site was at Sukuta (Kombo) school, where a new well was to be sunk, using the Minipuit construction. The present school well, a 4-foot concrete shaft is of typical Area Council construction with three 2-foot tall concrete rings, each of 3-feet internal diameter, emplaced in the bottom to make a concentric concrete cylinder 6 feet high. Water therefore enters only from the bottom. The existing school well has a rest water level of 4.00m. below ground level, and a total depth of 6.65m.

The new well was sunk and concrete-lined 4-feet in diameter to 1.5 feet below water table. The aquifer is a sandy clay freestanding when dug with very low transmissibility. The well sinkers tried digging inside the Minipuit lowered to the bottom of the lined well but found it preferable to continue digging at 3½ ft. diameter. As the water level was high at the end of the best wet season for four years it was decided to make a temporary installation by first digging a pit in the free-standing clay to some 2m below water level and then lower the Minipuit into it, filling the resultant annulus with some of the sand used to make the concrete. The annulus would only be filled some 2 feet to locate the base of the Minipuit and the temporary well finished off by placing a half-height concrete ring (12 inches) on the flange at the top of the Minipuit (weight distribution approx. 9 lb. per inch of Minipuit circumference) and keeping the whole structure equidistant from the 4-foot lining by means of wooden wedges. The Minipuit casing was found to have exactly the same internal diameter as the concrete rings used in The Gambia. Thus, in April, when the water table is at its lowest just before the rains commence in May, the wedges and concrete ring may be removed, the Minipuit taken out, the sand removed, and the Minipuit plus two 1m. extra slotted sections bolted and sunk another 2m. The annulus would then be finally filled in, preferably with beach sand but not with laterite or crushed shell gravel, and topped with a triangular-sectioned fillet of concrete to protect the upper surface of the fibreglass and fair it to the concrete 4-foot lining.

A baling test found that the water level in the well when depressed by 1.5m. rose at the rate of 0.225m/hour. A report on a comparative test of the old concrete ring school well is awaited.

4. Well Surveys

A survey of existing village wells was organised in conjunction with a water-sampling tour for the Hydrometeorological Services Unit, and with the aid of one of the technical assistants to act as a guide, 61 well and borehole sites were visited, surveyed and sampled. Particular attention was paid to the state of the wells especially in the Basse area, said to be noted for the failure of the concrete ring well constructions on account of unconsolidated sands at water-table level.

Table 1 appended gives full data relating to all wells and boreholes visited in this particular survey.

Two separate days were spent in sampling and taking measurements in water supply boreholes in the Kombo district for the purpose of mineral analysis, age-dating, and checking for any change in salinity with depth. Table 2 summarises the data obtained.

Finally, a day was spent travelling to, sampling and surveying all the Gambian wells and waterholes on the alluvial 'island' of Jinnak, these wells and water holes all being in the villages of Kajata and Niji. Table 3 sets out the data obtained from this area.

5. The Minipuit Relative to The Gambia

There are two types of wells encountered in The Gambia:

1. Old dug wells, usually over 6 feet in diameter and of irregular section which when caved in above the water table, are usually inhabited by bats and therefore best abandoned. The bats, incidentally, will account for the high nitrate content of the water, a phenomenon which the authors of the Howard Humphries report consider requires a geological investigation. Where caving occurs only at, or below water table and the well is habitually repeatedly re-dug, e.g. as at Sare Malang - a single Minipuit slotted section should remedy the problem as concrete rings would be unstable on account of their weight and would also exclude entry of water except from the bottom.

2. The concrete 4-foot standard Area Council lined shaft with three 3-foot concrete rings in the bottom. If made at the end of the dry season they will line out the upper part of the aquifer, and in any case water can enter only from the bottom.

(a) In the usual clayey aquifer a Minipuit would make a more efficient well and could screen a 4-metre section of aquifer with one slotted screen and two casing sections slotted.

(b) Where the clayey strata give way to unconsolidated sands when the water table is reached, concrete rings are found to slip and/or collapse owing to their weight and here the light fibreglass Minipuit could be used to full advantage. It would not sink, and could be stayed to the 4-foot concrete shaft by an upward extension of unslotted casing bolted on if necessary. Minipuits must not be used in any well where there are already concrete rings present.

(c) Where the aquifer and superstrata are entirely of alluvial sand, as in the rice island of Jinnak, with the water table only 1m. or so below the surface, the Minipuit would be used to best advantage of all. The dug water holes are shallow and repeatedly collapse. Concrete ring wells are found to fail, presumably because of their instability in the unconsolidated sands, and in any case will only admit water from the bottom in a circumstance where, with a thin lens of fresh water overlying sea water it is essential to abstract from the upper part of the water body only.

Upon the installation of a Minipuit outer casing in any of the cases cited above, if fine sand should enter and silt up the well it will be necessary to fit the inner 30-inch slotted cylinder and fill the resultant annulus with a suitable gravel pack. Unfortunately there is no suitable gravel available in the Gambia as both laterite and crushed sea shells will consolidate and should on no account be used for this purpose. A medium to coarse grained siliceous beach sand would serve, but none was seen on my visit.

As this gravel pack section can extend vertically for a maximum of 6 feet it can only be used on sites where a limited section of aquifer is screened, any extension of the 6-foot outer slotted casing having to be made up of blank units only. Gravel packs should not be necessary where abstraction is by bucket.

The cost of the 2m. outer slotted Minipuit screen exactly comparable to the standard three 2-ft. high concrete rings used in The Gambia, is £195, including floor plates and locking bar. Each upward extension unit of 1m. added to this costs £120.20. Comparative costings of a set of three concrete rings and of the standard 4-foot concrete well lining per metre run are awaited from The Gambia.

6. Recommendations

The Minipuit should be tried in cases where the current concrete ring type of construction has been recorded as repeatedly failing, and the following scheme of priorities is recommended:

1. One completely fibreglass well at Kajata on the rice island of Jinnak in the Lower Niumi. As the water table is only 1 metre below ground surface there is at present enough Minipuit material in The Gambia to construct this. See Appendix.

2. One new well in the village of Sare Juley near Basse, with the usual Area Council 4-foot concrete well lining to water table and one 2-metre Minipuit screen (reinforced) below with the addition of one section of fibreglass casing to extend the screen up into the concrete.

3. Either one new village well at Kobotor near Basse with identical specification to 2. above or re-digging the bottom of the existing failed concrete-ring well and remaking screened section with Minipuit provided all of the concrete rings can be primarily removed.

4. At Dinguiri, near Basse, either four replacement new wells as 2. above or remaking the bottom of the four failed concrete wells as in 3. above.

5. Similar replacement or refurbishing of failed concrete wells at Sare Malang, Nyamanari and Kuntaur Fula Kunda.

6. There are known to be failed wells in the Wuli district but there was no time to visit them as three river crossings were out of order. Likewise any other localities in which concrete ring wells are known to fail repeatedly should be investigated with a view to suitability for Minipuit installation.

To cover recommendations 2 to 5 above, nine 2m Minipuit screens with nine 1m Minipuit blank casing extensions would be required at a total cost of £2836.80 plus sea freight.

7. Conclusions

1. Where dug wells and concrete rings repeatedly fail, the Minipuit would be likely to succeed. In any well deeper than 6 metres the currently-used-4-foot concrete well lining should be made, with the Minipuit forming the bottom section instead of the usual concrete rings

2. Minipuit screens will make a more efficient well than concrete rings and should preferentially be used although considerations of cost will probably weigh against this.

8. Acknowledgements

I am grateful to Mr. Sowe, Permanent Secretary to the Minister of Local Government, The Gambia, for his enthusiasm and help in making my field surveys possible, and to Mr. Malik John, Director of Hydrometeorological Services and his staff for invaluable assistance in the major survey. The results of the chemical and age-determination analyses of the many samples collected will be forwarded to Mr. John as soon as they are available. I am also indebted to Mr. F.S. Batty, General Manager of The Gambia Utilities Corporation, for a sight of engineering reports and analyses and for field assistance ably guided by Mr. J.A. Manga. Finally but not least, thanks to Mr. J.P. Moran, Director of Public Works, for containing me and the Minipuits in his Department, and to Mr. Duell for his ever willing help with the work and his practical guidance to working in The Gambia, which helped to ensure that feet were usually planted in the proper places.

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APPENDIX

Local Conditions in The Gambia

On arrival in The Gambia there was a U.S. Peace Corps Engineer, Mr. M.D. Duell, awaiting me in order to assist with and note details of the Minipuit installation. As a team of local well-diggers and transport were immediately available, a start was made with the new school well at Sukuta. Once the well was started, I was introduced to The Hydrometeorological Services unit, run by Mr. John Malik, whose staff provided invaluable information concerning the whereabouts of well sites and water table conditions, etc. throughout The Gambia. With the aid of one of the Unit's technical assistants I was able to make a 700-mile survey in 4 days in the course of which I was fortunate to meet the Basse Area Council member responsible for village water supplies, Mr. M.A. Sarr, who was able to give details of particular areas where the concrete-ring method of well construction failed repeatedly. As a consequence i was able to make comprehensive well surveys in the villages of Kobotor,Dinguiri and Sare Juley where well failures were causing considerable local hardship, particularly at the latter (see Table 1) where none of the wells are near to the village and the water table is deeper than at any of the sites visited in The Gambia. Here, the only usable well out of three (see Table 1) had well-head gear in very poor condition, there was only 0.5m. of water in the well, 33m. below ground level, and the well site was some considerable distance from the village it was to serve. At Kobotor it was only 18m. to what little water there was, and the well is in the village, while the five wells at Dinguiri, all in and around this considerable village and with water levels at around 30m. down, were all in a very poor state. It was hoped to visit the Wuli district on the north Bank but failure of river ferries made this impracticable. A comprehensive well survey in that area would seem advisable in view of reports of repeated well failure there.

Having received reports of failure of alluvial wells at Kajata on the rice island of Jinnak before I left London, I made a point of visiting these relatively inaccessible parts, as the terrain would seem ideal for an entirely fibreglass well construction. Fortunately, I met the Serfa Landing Sonko at Essau whom I interested in the possibilities and he kindly agreed to arrange guide and canoes for Wednesday 13th November, when the tide would be sufficiently high in the morning. With his help I was therefore able to make a survey of all the water holes and wells in the villages of Kajata and Niji where some 500 people live and work. The results, in Table 3, show the urgent need for a new well at Kajata.

As the water level on this sandbank is some 3 feet below ground level it is almost certainly controlled by sea level and there should be no undue seasonal fluctuation, the only necessary precaution being to ensure that the well does not go deep enough to encounter saline water. In the well at Niji with 1.52m. of water, quality at the top is the same as at the bottom - i.e. no trace of salinity.

Apart from these specialised areas, isolated wells such as the observation well at Sare Malang and Nyamanari are reported to need frequent re-digging. An urgent request for deepening of failing wells at Kuntaur Fula Kunda was noted, which would seem to indicate some manner of well collapse as a shaft in good condition should not fail immediately after a good wet season.

The existing fibreglass materials in The Gambia are stored in the moulding shed in the Public Works Department yard in Banjul. The Peace Corps engineer, Mr. M.D. Duell, at present working with the Public Works Department engineers, has charge of these Minipuits and their accessories. The materials in The Gambia comprise:

2 slotted outer screen sections each 2m in length, both with floors

2 slotted inner screen sections each 2m in length, both with floors

5 slotted outer screen extensions, each 1m. in length

One of the outer screens (2m with floor) is at present installed in Sukuta School new well and two of the flanged casing extensions should be reserved for the completion of this well when the water level has fallen sufficiently.

This will leave:

1 slotted outer screen section 2m in length with floor
2 slotted inner screen sections each 2m in length with floors
3 slotted outer screen extensions, each 1m in length

I have recommended that a new well entirely of fibreglass construction be sunk at Kajata. This will require the use of the remaining outer slotted screen section (2m) plus one or two of the remaining outer screen extensions. The total depth to which the well will be sunk will depend on the salinity of the water at the bottom as well as upon the rest water level.

Mr. Duell has supervised all work on the fibreglass installations so far done in The Gambia and has full instructions for the deepening of the Minipuit well at Sukuta School when the time comes for this to be done. In addition, Mr. Duell has details of the Minipuit construction required at Kajata so that this can be put in hand immediately. One of the narrow inner screens (2m) should be kept to deepen the Sukuta School well still further if necessary in future while the other can be retained to deepen the new Kajata well should ever this be feasible.

TABLE I

WELLS VISITED NOVEMBER 1974

Site	Grid No	Datum Level	RWL BD	RWL Abs	Total Depth BD	T. Dep. Abs	Sampled EC/Cl	Sampled Min.Age	Diam	Type/Condition of Well	General Remarks	Suggest Minipuit Needed //
Bwiam	38-46	12.904	11.51	+ 1.394	12.35	+ 0.45	✓		4ft	Concrete. Good.		
Kwinella	41-48	2.005	22.54		22.65	-20.65	✓		4ft	Concrete. Good.	Very busy.	
Kolior	42-48	6.314	10.21	- 3.896	13.00	- 7.69			6ft	Dug well. Good.	Many BATS dwell under concrete dome over well.	
Massembe	43-48	23.466	20.37	+ 3.096	20.51	+ 2.96			5ft	Dug well.	Many BATS in well.	
Tonlataba	43-48	- 6.392	5.95	-12.342	8.15	-14.54	✓		4ft	Concrete. Good.		
Kani Kunda	44-48	21.561	13.26	+ 8.311	13.70	+ 7.86			+6ft	Dug much caved in.	Many BATS in caved section. Water filthy, unusable.	
Jappeni	45-48	14.436	14.30	+ 0.136	14.97	- 0.53	✓		4ft	Concrete. Good.		
Bureng	47-48	23.687	13.83		13.97	+ 9.72	✓		6ft	Dug. Good.	Very busy. Dug shaft with concrete staging and 4x4 aperture down well.	
Sukuta	47-49	8.880	9.77	- 0.890	10.37	- 1.49			8-10ft	Dug.Muddy bottom.	Needs cleaning. High conductivity water.	
Dankunku	45-50	21.408	15.95		16.00	+ 5.41			4ft	Concrete. Good.	Very busy.	
Jossadi			14.74		14.78				4ft	Concrete. Good.	Very busy.	
Choya			13.55		14.08				4ft	Concrete. Good.		
Kudang	49-51	7.721	12.78	- 5.059	14.03	- 6.31	✓		4ft	Concrete 1968.Good.		
Sare Malang	49-49	0.574	24.00		24.11				4ft	Shaft said to be collapsing. Very busy. Water cloudy.		//
Basse B/h	Borehole sampled from pump.						✓	✓				
Girobo Kunda	58-47	0.865	6.00	- 5.135	8.90	- 8.04			4ft	Concrete.	Very good order.	
Kulari	59-48	- 1.365	14.11	-15.475	15.38	-16.74			4ft	Concrete.	Seems good.	
Kobotor-New			18.00		18.37				4ft	Concrete.	Rings broken. Only well in village-dried up April'74.	//
Kobotor-Old			DRY		16.85				6ft	Dug shaft. DRY.	Total depth 2m above water level in new well.	
Dinguiri-Dug	60-47	23.576	28.00		28.10	- 4.52			6ft	Dug.	Little water in bottom (busy). Probably part collapsed.	//
" -Seling			29.25						4ft	Concrete.	Very busy. Very little water in bottom. Probably rings slipped.	//
" -Makna			31.00		31.40				4ft	Concrete.	Very busy. Ellipse of water indicates rings slipped.	//
" -Gribgidon			30.62		30.75				4ft	Concrete.	Very busy. Ellipse of water indicates rings slipped.	//
" -South									4ft	Concrete.	Ellipse of water indicates rings slipped.	
Sare Juley 1			DRY		30.30				4ft	Concrete.	DRY 5 years. Presumably rings slipped.	
" " -Mucen			DRY		30.00				6ft	Dug shaft.	DRY. Many BATS in shaft	
" " -N'Gima			33.25		33.86				4ft	Concrete.	Only working well near village. Dries up.	//
Dinbugu	60-47	21.433	7.07	+14.363	8.50	+12.93			4ft	Concrete. Good.		
Kusun	61-47	5.068	7.74	- 2.672	10.52	- 5.45			5ft	Irregular Dug Shaft.	Condemned water surface dirty.	
Fatoto	61-48	28.543	9.72	+18.827	11.60	+16.95			4ft	Concrete.	Very good.	
Nyamanari	62-47	51.144	24.53		25.75	+25.39	✓	✓	6ft	Dug shaft.	Very busy. Yearly redigging	//
Sabi	58-46	36.905	12.00	+24.905	12.85	+24.06			6ft	Dug shaft.	If sulphurous have cleaned out.	
Dembo Kunda	57-46	20.898	12.75	+ 8.148	13.03	+ 7.87			6ft	Dug shaft.	Little water.	
Jum Hankama	55-49	1.155	8.98	- 7.825	11.43	+10.28	✓	✓	4ft	Concrete.	Good condition.	
Jabel Kunda	53-48	14.632	7.32	+ 7.312	7.90	+ 6.73			4ft	Concrete.	Good.	
Banang Compound	55-48	11.283	8.73	+ 2.553	9.25	+ 2.03	✓	✓	3ft	Dug.	In private compound.	
Sankuli Kunda	52-49	26.805	6.15	+20.655	7.32	+19.55			4ft	Concrete.	Abandoned. Frogs live in well. Foul stench. Unusable.	

Site	Grid No	Datum Level	RWL BD	RWL Abs	Total Depth BD	T. Dep. Abs	Sampled EC/Cl	Sampled Min.Ave	Diam	Type/Condition of Well	General Remarks	Suggest Minipuit Needed //
Centre of River			Surface							Sample taken from centre of river while crossing on ferry.		
McCarthy Island			5.47		5.83		✓			Oil drum cased well in private compound. High conductivity water.		
Georgetown B/h	Borehole sampled from pump						✓	✓				
Jarume Koto	52-50	4.372	14.41	-10.038	16.85	-12.48			4ft	Concrete. Good.		
Nema	51-50	8.184	14.44	- 6.256					4 ft	Concrete	Stagnant, abandoned.	
Kuntaur Fula Kunda			10.37		10.74				6 ft	Dug shaft.	Almost dry. Busy village in need of new well.	//
Tuba Kuta	51-50	10.346	8.82	+ 1.526	9.50	+ 0.85			6ft	Dug shaft.	Busy. Dirty water.	
Niani Bantang			13.52		14.00				6 ft	Dug.	Reasonable.	
Kau-Ur	46-51	2.755	6.71	- 3.955			✓	✓	4 ft	Concrete.	Disused. Looks dirty.	
Kau-Ur School	Well sampled from pump.											
Simbora Hai	46-51	18.773	22.16	- 3.387	23.25	- 4.48			6 ft	Dug shaft.	BATS.	
Sara Kunda	45-49	11.687	19.42	- 7.773	19.65	- 7.96			4ft	Concrete. Good.		
Farafenni	43-50	15.711	14.32	+ 1.391	15.69	+ 0.02			4ft	Concrete. Good.		
Mansa Konko	Borehole sampled from pump.						✓	✓				
Balingho	43-49	10.325	5.44	+ 4.885	14.90	- 4.58			6ft	Dug shaft.	Very good. Unusually deep well. Sampled top and bottom.	
Illiasea	41-49	16.652	10.12	+ 6.532						Dug shaft.	Abandoned dug shaft with dirty water.	
No Kunda	41-49	13.057	10.96	+ 2.097	13.28	- 0.22			5ft	Dug shaft.	Good.	
Saba	38-49	3.127	11.70	- 8.573	12.65	- 9.52			4ft	Concrete. Good.		
Kerewan	38-49	21.726	11.97	+ 9.756	14.13	+ 7.60			4ft	Concrete. Good.		
Kuntair	36-49	3.737	18.76	-15.023	20.00	-16.26			4ft	Concrete. Good.	Busy	
Chamen			10.00		11.90				4ft	Concrete. Good.		
Medina Soring Mass	34-49	15.087	13.96	+ 1.127	15.83	- 0.74			6ft	Dug. Good.		
Buniadu			5.12		6.90				3ft	Square timber lined shaft. Good.		
M'Bollet	37-49	17.540	12.64	+ 4.900	14.18	+ 3.36			4ft	Concrete. Good.		
Brikama			7.71		11.90				6ft	Dug shaft.	Good condition.	

TABLE 2

SCHEDULE OF KOMBO BOREHOLES VISITED

B/h	Datum	Total Depth	Screened From	Rest Water Level	Suction Depth	Depth Sample From	Conductivity (Micromhos)	SAMPLED Mineral	Age	Cl
1A		66m	17m	6,000gph	16m	TAP	120	✓	✓	
1B		56m	24m	10,000gph	20m	TAP	220			
4		20m owing to collapse of screened section from 20m								
5		52m	21m	8.57m	-	50m	100			
6		47m	30m	-	-	Pumping	60			
8		60m	11m	-	34m	TAP	110	✓	✓	
9		60m	14m	-	-	TAP	45			
10		53m	11m	5.18m	Removed	50m	50			
11		47m	7m	-	-	TAP	65			
Site 3		44m	18m	18.37m	Removed	40m	40			
TTC		73m	21m	16.20m	Removed	60m	45			
Yundum Airport		85m	53m	-	-	Output	25		✓	
Brikama		58m	24m	-	-	TAP	75	✓	✓	
Half Die		349m	294m	Artesian Flow - 38°C			3,200	✓	✓	

Pumped groundwater temperature normally 30°C

TABLE 3

Wells and waterholes at Kajata and Niji.

Site	Total depth (present)	Total depth (original)	Rest water level	State of well/waterhole
Kajata old well	2.0m.	?	0.91m.	Concrete broken, water stagnant, filled in to 2.0m.
Kajata new well	1.8m.	3.86m.	1.09m.	Concrete surround good. Well silted up - rings probably slipped. The only well in use for village.
Kajata waterhole	c.2.0m.		c.1.00m.	Water green with algae, but still used for drinking.
Niji well	3.2m.	4.11m.	1.68m.	Good condition. Part silted up and said to go dry in the dry season.
Niji waterhole behind village	c.2.0m.		c.1.00m.	Shallow water hole - brownish water with mudfish.
Niji second waterhole on track to Kajata	c.2.0m.		c.1.00m.	Shallow waterhole with dark brown water.

Water samples taken from:
Top of Kajata new well
Bottom of Kajata new well
Kajata waterhole
Top of Niji well
Bottom of Niji well
Niji waterhole behind village