J & M FAST ENGINEERING COMPANY LTD

DEALERS IN WATER AND ENGINEERING WORKS

REPORT

Groundwater Survey at Marumba village

Nanyumbu district – Mtwara region

October 2015

ABSTRACT

Resistivity survey was conducted in Otober 2015 at Marumba village as requested by Client or simply beneficiaries i.e Village government of Marumba. This whole groundwater survey and later on drilling project up to the final stage of pump-fixing is under the helping-hand or donarship of TDT and EU CAN AID .

Marumba village which is located at about 4 from Ruvuma River is currently in a very serious water shortage. Few indigneous water sources found South-West and North-East are either not reliable or give salty water.

Following this situations a groundwater-survey request was made to J & M Fast Engineering Company Limited in order to find potential areas for drilling a deep well.

Total of 4 VESs (Vertical Electrical Sounding) were conducted in four pre-selected survey sites. After survey was done it was observed that out of all four areas only 3 shows good prospect for groundwater occurence.

Field data (VES-data) interpretation shows that there are three areas can be drilled exploratory borehole up to recommended dephs. In these three selected VES points groundwater seems to be in fractures (with resistivities values ranging from 37 – 199 Ohm-M.

The recommendation for drilling was made basing on one and foremost important which is “the expected borehole discharges”.

This study recommends test drilling of exploratory borehole to start at VES number 3 located in the Eastern side of the village. Second selection was given to VES 3 located in Namashapwe valley and the third and last selection should be at VES 2 located at Lilungu area (about 100m East of dispensary building) and within the village centre. The results that will be obtained from any selected drilling point will guide on wether or not it is necessary to continue drilling another borehole for Marumba village in order to meet water supply demand or not.

Summarized results and choices for drilling exploratory boreholes at Marumba village is as follows:-

First Choice: VES No. 3 located in Namihalau valley, Drilling depth recommended is 90m;

Second Choice: VES No. 4 located in Namashapwe valley, Drilling depth is 50m;

Third Choices: VESs Nos. 2 located at about 100m East of Dispensary (Lilungu area).

1. INTRODUCTION

1.1 General

Marumba village is located at about 60 kilometers from Mangaka town (Head Quater of Nanyumbu District) through Mtambaswala main road before turning left at Nanyumbu village. Administratively it belong to Mkonona Ward, Nanyumbu Division and finally in Nanyumbu District and Mtwara region.

This village is located at about 4 kilometers from Ruvuma River that makes a border between United Republic of Tanzania and Mozambique.

There is currently NO water supply source at this remote village. The nearest reliable water source is Ruvuma River whereby its water is NOT safe.

There is surely increasing water demand at this village due to increased population each year. Thus the successiful drilling of water well at this village is of paramount important for sustainable growth of its population.

But availability of domestic water supply at reasonable distance will also serve time losted by this community to search for water from Ruvuma and other traditional sources. Bearing in mind that “the national design standard of distance to water-source” for rural population is 400m (Ministry of Water, United Republic of Tanzania). Due this fact then somebody can say that identification of potential drilling point that fulfill this designed distance is also an important, although it can happen sometimes that there is absolutely NO potential drilling site at recommended distance (design standard). In such case three options has to be followed; 1) To locate drilling point at any location then convey its water to community (depending on financial capability) 2) To look for other water sources (dam and rain water harvesting, this second option is also expensive and not reliable since its reliability is a function of availability of enough annual-rainfall). 3) Not to consider at all “the national design standard”.

Therefore for this case of Marumba village only after the survey work one can be able to know which option to go about. And it should be well understood that for any groundwater investigation work the last stage is drilling of exploratory borehole i.e. geophysical survey conducted this week is an approximation of the reality but drilling of exploratory borehole will be the actual stage of knowing the groundwater situation at this village.

1.2 Topography and Climate

Marumba village area is characterized by intermediate topography. It is generally flat land with some exptional hills and valleys. The overall fall of elevation is torward Ruvuma River located in the South-Eastern side. Therefore the drainage system as well as surface run-off due to rainfalls follow the same trend.

The survey area is within tropical climate with an annual average rainfall of about 800mm. In summer time maximum daily temperature can go as high as 35 ºC and minimum (night temperature) is as low as 20 ºC. While in the winter period the daily maximum and minimum temperature ranges from 30ºC to 15 ºC. The variation in temperature is therefore minimum.

1.3 Present and future Water Supply Demand at Marumba village

There is currently no reliable water supply at this village. According to village excutive officer (VEO) and communities who gathered around during the day of survey, it was revealed that people get what they consider sweat-water supply from the Ruvuma River several kilometers away. But during rain season and few months after it the can at least get their domestic water supply from traditional-water-ponds located near the village. However both water-sources just mentioned above are not safe and not reliable. In addition to this they said test of water from traditional water-sources located near the village is salty. Given below is the current and future water demand for this village calculated by using number of population, design water demand for rural communities (as provided by Ministry of Water) and estimated growth ratio (r). Value for "r" obtained from 2012 United Republic of Tanzania Census data is 1.2 i.e value for Mtwara region

Table: 1 Current and 20 years's Water demand for Marumba village community

YEAR	POPULATION	WATER DEMAND (in Lts/day)	PROVISION FOR INSTITUTION (Lts/day)	TOTAL VILLAGE WATER DEMAND
2015	2043	61,290	6,129	67,419
2025	2302	69,060	6,906	75,966
2035	2594	77,820	7,782	85,602

To calculate present and future population (that was later used to get water demand is;

$$P_n = P_0(1 + r)^n$$

Where; P_n = Population after n years, P_o = Present population, r = current growth ratio

Provision for institutions (school & dispensary) = 10% of current water demand

Current population (2043 Nos) obtained from village VEO (In October 2015)

1.4, Geology and Hydrogeology of the study areas

The whole study areas is covered by geological formations of metamorphic rocks. There are many exposed rock-outcrops throughout the village area. Sand (medium to course grained) are seen in or near valleys. Thicknesses of weathered top rock-layes seems to be medium. According to this survey data it seems that the top saturated rock-layers can start at a depth 10 in silty-sand layers but the most suitable and potential layers are found deep below this depth where there is great chance of hitting fractured aquifers.

Hydrogeologically the observed top-soil-cover of sand and course sand indicates that there is less problem in rain-water infiltration and therefore groundwater recharge in this area is medium. However, in most areas of this nature of top-soil-cover water percolation is usually moderate and therefore moderate-potential aquifers can be obtained after drilling.

2. Geophysical survey

In order to identify suitable or potential aquifer (to achieve our survey objective) a detailed hydrogeological and geophysical survey was conducted at four (4) selected points. Two points were selected at Lilungu area and one in the South-Eastern end of the village. The fourth surveyed point was in the Northern end of the village. Geophysical survey was done by using geo-electric method and especially resistivity method. The Vertical Electrical Sounding (VES) was opted by applying Werner electrode spreading (equally spaced electrode spreading techniques). At each VES point selection was carefully done using hydrogeologic and geomorphology criteria.

Geo-electric data was collected using Mac-Ohm resistivity instrument and for data quality purpose all field curves or graphs were plotted right on the spot (field). Below are data-tables and VES-curves that shows the VES numbers, location (GPS) and its local/site name where the detail survey was conducted.

Interpretation of field curve was carried out by using W-GeoSoft / Win-Sev 6 software program.

FIELD DATA COLLECTED AT ALL 4 SITES/POINTS SURVEYED AT MARUMBA VILLAGE AREA

Electrical sounding Wenner - VES1 MARUMBA.WS3

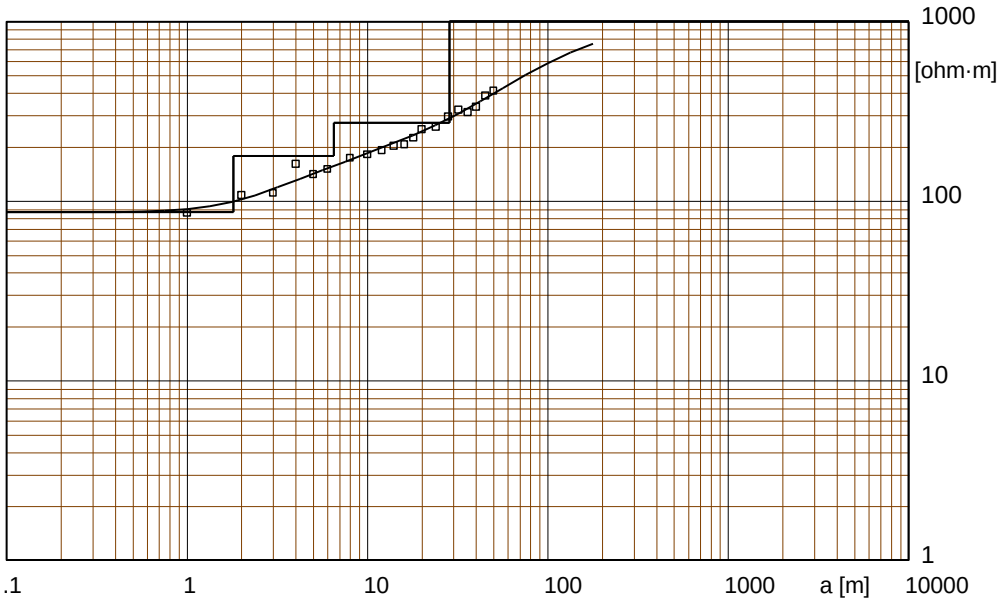
GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.

Field data and calculated values

a	DeltaV	I	K	Resistivity
[m]	[mV]	[mA]	[-]	[ohm·m]
1	0	0	0	85.9
2	0	0	0	108
3	0	0	0	111
4	0	0	0	161
5	0	0	0	141
6	0	0	0	151
8	0	0	0	174
10	0	0	0	182
12	0	0	0	192
14	0	0	0	203
16	0	0	0	207
18	0	0	0	225
20	0	0	0	251
24	0	0	0	259
28	0	0	0	295
32	0	0	0	323
36	0	0	0	313
40	0	0	0	335
45	0	0	0	386
50	0	0	0	412

Electrical sounding Wenner - VES1 MARUMBA.WS3

GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.



Location X = 0463027 Y = 8737697 Z = 170m

Model Resistivity	Thickness	Depth	Altitude
[ohm·m]	[m]	[m]	[m]
87	1.8		170
179	4.7	1.8	168.2
274	22	6.5	163.5
1045		28	142

VES No. 1 At 60m North of Zahanati, NOT SELECTED

Electrical sounding Wenner - VES2 MARUMBA 2015.WS3

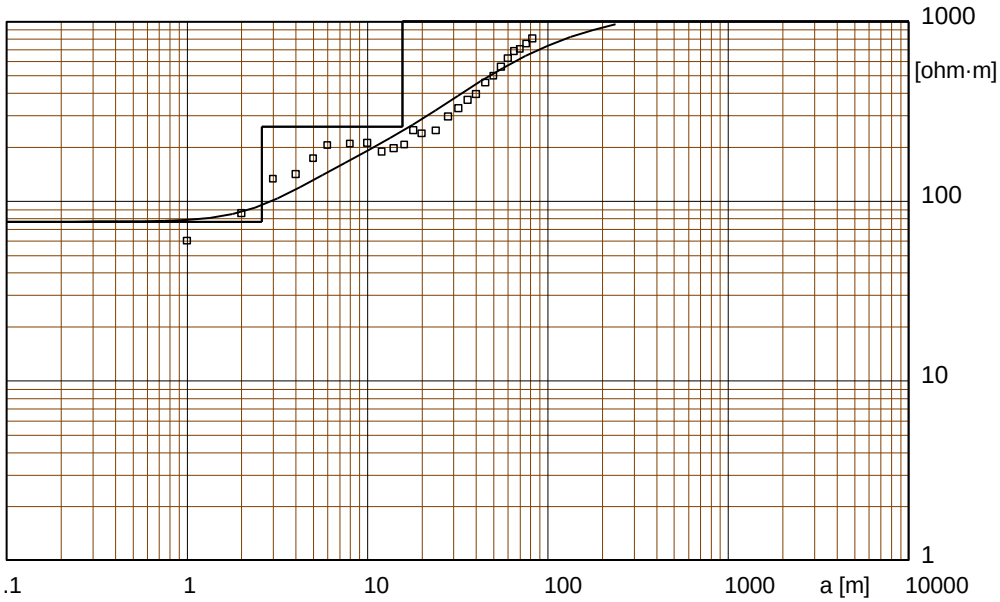
GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.

Field data and calculated values

a	DeltaV	I	K	Resistivity
[m]	[mV]	[mA]	[-]	[ohm·m]
1	0	0	0	60.2
2	0	0	0	85.7
3	0	0	0	133
4	0	0	0	141
5	0	0	0	173
6	0	0	0	205
8	0	0	0	209
10	0	0	0	211
12	0	0	0	188
14	0	0	0	197
16	0	0	0	206
18	0	0	0	248
20	0	0	0	238
24	0	0	0	247
28	0	0	0	295
32	0	0	0	329
36	0	0	0	366
40	0	0	0	394
45	0	0	0	456
50	0	0	0	498
55	0	0	0	559
60	0	0	0	623
65	0	0	0	682
70	0	0	0	703
76	0	0	0	752
82	0	0	0	804

Electrical sounding Wenner - VES2 MARUMBA 2015.WS3

GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.



Location X = 0463123 Y = 875763 Z = 167m

Model Resistivity	Thickness	Depth	Altitude
[ohm·m]	[m]	[m]	[m]
77	2.6		167
260	13	2.6	164.4
1121		16	151

VES No. 2 At 150m East of Zahanati. Selected as 3rd Choice. Drill 50m

Electrical sounding Wenner - VES3 MARUMBA 2015.WS3

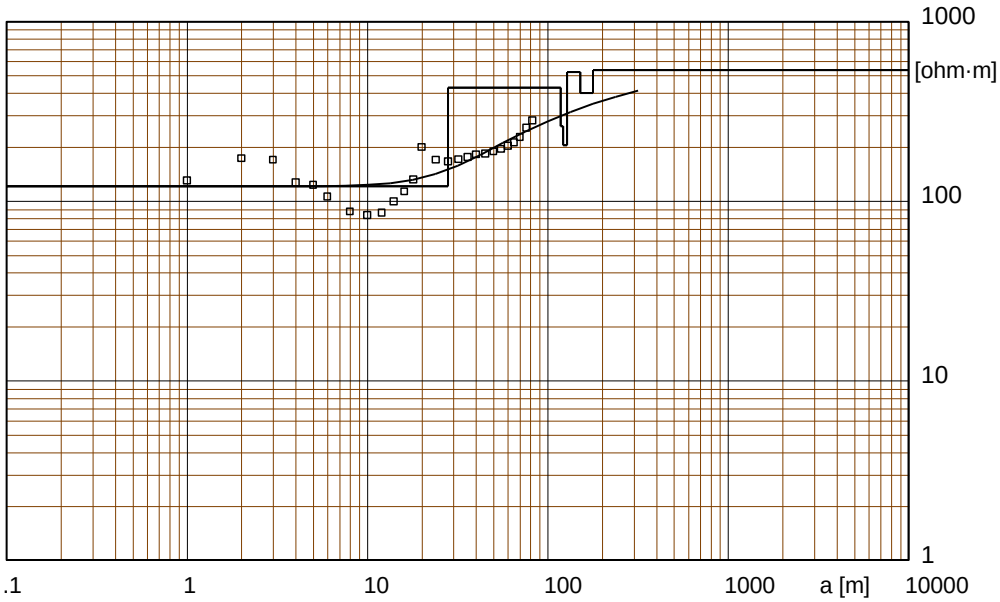
GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUNMBU DISTR

Field data and calculated values

a	DeltaV	I	K	Resistivity
[m]	[mV]	[mA]	[-]	[ohm·m]
1	0	0	0	130
2	0	0	0	173
3	0	0	0	170
4	0	0	0	127
5	0	0	0	123
6	0	0	0	106
8	0	0	0	87.6
10	0	0	0	83.6
12	0	0	0	86.2
14	0	0	0	99.7
16	0	0	0	113
18	0	0	0	132
20	0	0	0	200
24	0	0	0	170
28	0	0	0	166
32	0	0	0	171
36	0	0	0	176
40	0	0	0	182
45	0	0	0	184
50	0	0	0	189
55	0	0	0	195
60	0	0	0	203
65	0	0	0	212
70	0	0	0	227
76	0	0	0	256
82	0	0	0	281

Electrical sounding Wenner - VES3 MARUMBA 2015.WS3

GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUNMBU DISTR



Location X = 0464632 Y = 8757041 Z = 140m

Model Resistivity	Thickness	Depth	Altitude
[ohm·m]	[m]	[m]	[m]
121	28		140
429	90	28	112
261	3.2	118	22
205	6.1	121	19
525	24	127	13
401	26	151	-11
536		177	-37

VES No. 3 At Namihalau valley. Selected as 1st Choice. Drill 50m deep

Electrical sounding Wenner - VES4 MARUMBA 2015.WS3

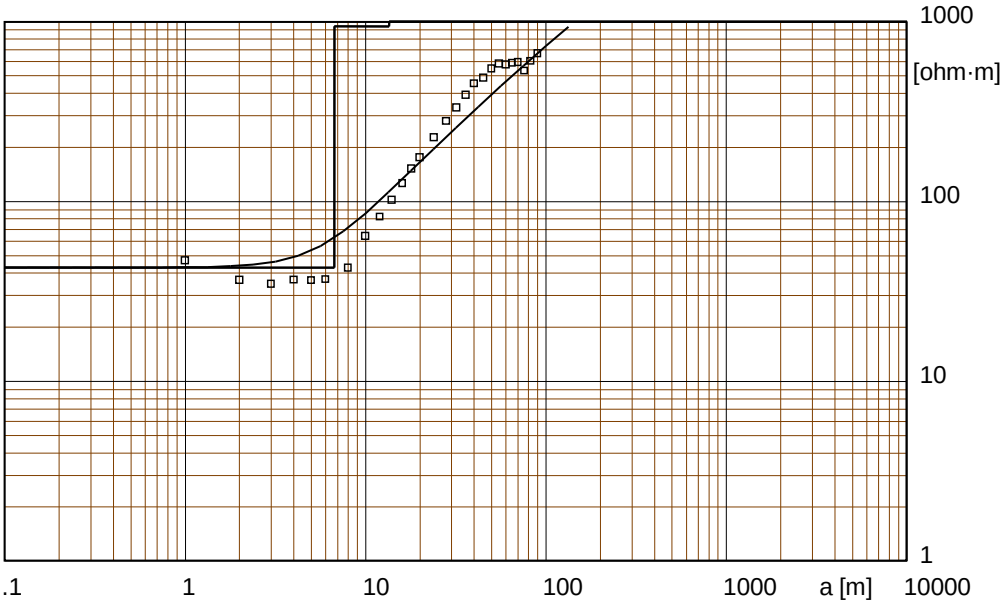
GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.

Field data and calculated values

a	DeltaV	I	K	Resistivity
[m]	[mV]	[mA]	[-]	[ohm·m]
1	0	0	0	47
2	0	0	0	36.6
3	0	0	0	34.8
4	0	0	0	36.7
5	0	0	0	36.5
6	0	0	0	36.9
8	0	0	0	42.8
10	0	0	0	64.2
12	0	0	0	82.2
14	0	0	0	102
16	0	0	0	126
18	0	0	0	152
20	0	0	0	176
24	0	0	0	227
28	0	0	0	280
32	0	0	0	333
36	0	0	0	391
40	0	0	0	453
45	0	0	0	488
50	0	0	0	548
55	0	0	0	585
60	0	0	0	576
65	0	0	0	589
70	0	0	0	595
76	0	0	0	534
82	0	0	0	604
90	0	0	0	667

Electrical sounding Wenner - VES4 MARUMBA 2015.WS3

GROUNDWATER SURVEY AT MARUMBA VILLAGE - NANYUMBU DISTR.



Location X = 0463384 Y = 8757949 Z = 158m

Model Resistivity	Thickness	Depth	Altitude
[ohm·m]	[m]	[m]	[m]
43	6.7		158
943	6.8	6.7	151.3
4984		14	144

VES No. 4 Namashapwe valley. 2nd Choice. Drill 100m

CONCLUSION AND RECOMMENDATIONS

- Present and Future Water Demand for this village is high as it can be seen from the table 1. There is a great need to serve them with safe and reliable domestic water supply. If this done surely very positive impact will be obtained. i.e Time used to search for water will be served hence shifted to other development activities, water-borne diseases reduced, school increased e.t.c

- Geophysical survey data interpretation shows that only three out of 4 surveyed points can be drilled exploratory boreholes.

- The choices (i.e first, second . . . .) classify the most preferred in terms of groundwater potential starting from most-potential up to the least-potential site.

- Drilling depths recommended at each surveyed site differs i.e it is 50m, 50m and 100m for first, second and third drilling-choices respectivelly below the ground level.

- However, this indicated/recommended drilling depths may be slightly reduced or increased by site hydrogeologist after examining rock cuttings and or water quantity /quality strucked on the course of drilling work.

- Air-circulation drilling (Hammer drilling method) is recommended at any of these surveyed and selected points since the whole area of Marumba village belong to basement rock type.

- The actual quantity and quality of water from each drilling point will be determined after drilling.

- Recommended final borehole diameter (after pipe/screen installation process) should be not less than 5''.The initial drilling diameter can therefore be 7" or 8" in order have enough annular space between well-wall and uPVC

- The borehole should be tested (water quantity and quality) before being commissioned for uses.

- Drilling processes must be closely supervised by Hydrogeologist in order to analyse rock cuttings and water samples and therefore be able to providing necessary on-site assistance whenever required.