Chapter 4

Water Sources Potential

4 Water Sources Potential

4.1 General

The main concept of selecting the suitable water resources for the provision of water to the villages should satisfy the following items:

1) Sustainability for water use, 2) Availability through out the year and 3) Safety of water quality

4.1.1 River Water Evaluation

a. Potential Amount of River Water Development

It was revealed that Mara River is the potential water source to be developed considering its constant discharge. As shown in the following table, the monthly average discharge of Mara River is 38.2 m^3/s and monthly minimum discharge is 16.0 m^3/s.

Table 4.1-1: River Discharge

	Monthly Average Discharge of the Main Rivers (m^3/s)												Year Total	Averages m^3/s
	January	February	March	April	May	June	July	August	September	October	November	December		
Mara	27.1	24.2	33.9	75.2	88.7	62.3	35.8	26.6	23.8	17.4	16.0	27.6	458.5	38.2
Grumeti	32.6	16.6	17.5	24.0	21.0	2.6	1.1	0.5	0.8	1.6	3.9	18.7	141.0	11.8
Mbalageti	5.4	4.5	6.6	12.9	9.1	2.0	0.6	0.4	0.4	0.8	3.2	6.3	52.1	4.3
E. Shore Streams	24.7	16.9	22.8	44.8	41.6	13.8	4.0	3.2	3.5	5.2	14.5	32.2	227.3	18.9
Simyu	64.7	45.0	62.5	84.5	54.9	22.1	15.3	12.4	10.7	9.8	26.1	69.2	477.2	39.8
Magogo-Moame	30.3	10.0	9.6	14.4	10.0	0.6	0.2	0.1	0.1	0.2	2.1	24.2	101.7	8.5
Nyashishi	3.8	1.7	1.7	2.2	2.9	0.2	0.0	0.0	0.0	0.0	0.3	7.1	19.8	1.7
Issanga	11.5	10.2	17.1	9.8	9.0	1.9	0.5	0.4	0.3	0.4	5.1	307.7	373.8	31.1
S. Shore Streams	29.0	23.6	19.5	38.6	43.9	4.0	0.5	0.4	0.4	0.4	9.9	142.6	312.8	26.1

** compiled by the LVEMP for the year of 1950 to 2000*

b. Water Quality of River Water

The water quality of river water is represented by high color, turbidity, Hg, Fe, BOD and NH_4. Coliform and bacteria levels are high in the dry season, but concentrations are reduced to a drinkable level in the wet season. Mara River, the most reliable water source of river water has a discharge of toxic heavy metals such as Hg. Therefore, the river water development is risky in consideration of the rural water supply source.

4.1.2 Lake Victoria Potential

a. Potential Amount of Lake Water Development

According to the data of the Lake Victoria Environmental Management Project (LVEMP), the total sum of lake water has a surplus of $33m^3/s$. The current total development amount from the water supply plan is 1.6% of the total water balance (positive value) of the lake.

b. Water Quality of Lake Victoria

The analysis revealed that the water is high in coliforms and general bacteria at the lake shore. The result also indicates high values of turbidity, color, BOD and NH_4^+ throughout the year. There are some areas high in Ba, Fe, and NO_2^-. However, the supplementary survey revealed that the water quality of intake point is generally safe except few contaminations of bacteria.

4.1.3 Examination of Surface Water Development

Lake water is considered as a potential source of water for villages within some 9 km from the lake on the view point of cost effectiveness of the water supply projects. River water is

not considered for use as a rural water supply because of its unreliability due to seasonal variations in water volume, risks for the water quality and the high cost of the water supply facility.

4.2 Groundwater Potential

In general, the two groundwater sources identified in the area are stratum aquifers and fissure water. Stratum aquifers can be divided into two categories: shallow aquifers and medium aquifers.

4.2.1 Classification of Aquifer Unit

The groundwater in the study area can be classified into three forms:

1) **Stratum aquifer**: unconfined aquifer within 10m below ground surface (bgsl) in the Neocene alluvial, lacustrine, terrestrial, fluvatile and marine deposits

2) **Stratum aquifer**: unconfined, semi-confined aquifer at a depth range of 20-50m bgsl in the decomposed (weathered) or secondary deposited Precambrian hard rocks (mainly granite)

3) **Fissure water**: semi-confined, confined aquifer at a depth range of 20–150m bgsl in the fractures and fissures distributed in the hard rocks (mainly granite).

The majority of water to be extracted from the ground will be water from medium stratum aquifers and fissure water. There are also shallow stratum aquifers in the area, but most of them dry up or the discharge is minimal in the dry season.

a. Relationship between Well Depth and Yield (Discharge)

The high yielding (more than 70 liters/min) depth ranges from 30m to 180m, but holes at these depths also include a lot of low yielding wells.

This is much due to its geological nature. The wells are highly affected by the existence of fissures and/or fractures as the aquifer, and the discharge (yield) depends on the storage capacity and continuity of the fissures and fractures.

b. Relationship between Aquifer (Geology Type) and Yield

Granite has the highest average yield at 53 l/min, followed by Nyanzan green rocks (38 l/min) and Decomposed Precambrian rocks (36 l/min). But the figures vary from less than 1 l/min to over 300 l/min. The relation between Aquifer type, yield and depth are shown in Table 4.1-1 and Figure 4.2-1.

Table 4.2-1: Aquifer and Yield, Depth

	Yield (litre/min)				Depth (GL-m)			
	sample no	maximum	minimum	average	sample no	maximum	minimum	average
Neocene	11	60.0	0.1	11.8	31	105.5	3.0	25.7
Secondary Deposits and Weathered portion of Pre Cambrian (Ngr)	53	267.8	0.1	28.7	106	195.3	4.0	35.5
Volcanics	1	2.4	2.4	2.4	6	91.0	7.0	33.8
Bukoban	0	0.0	0.0	-	4	86.0	7.0	32.5
Nyanzan (green rocks)	8	151.7	0.1	38.0	16	93.0	6.0	54.0
Nyanzan (banded ironstone)	8	11.9	0.3	4.4	14	90.2	6.0	49.7
Granite U	7	1.7	0.1	0.6	14	40.0	5.0	9.4
Granite	71	335.0	0.1	45.7	103	214.6	1.6	51.7

The high yielding area is distributed from north to south of Kwimba, the lakeside of Musoma and west of the boundary between Sengerema and Geita.

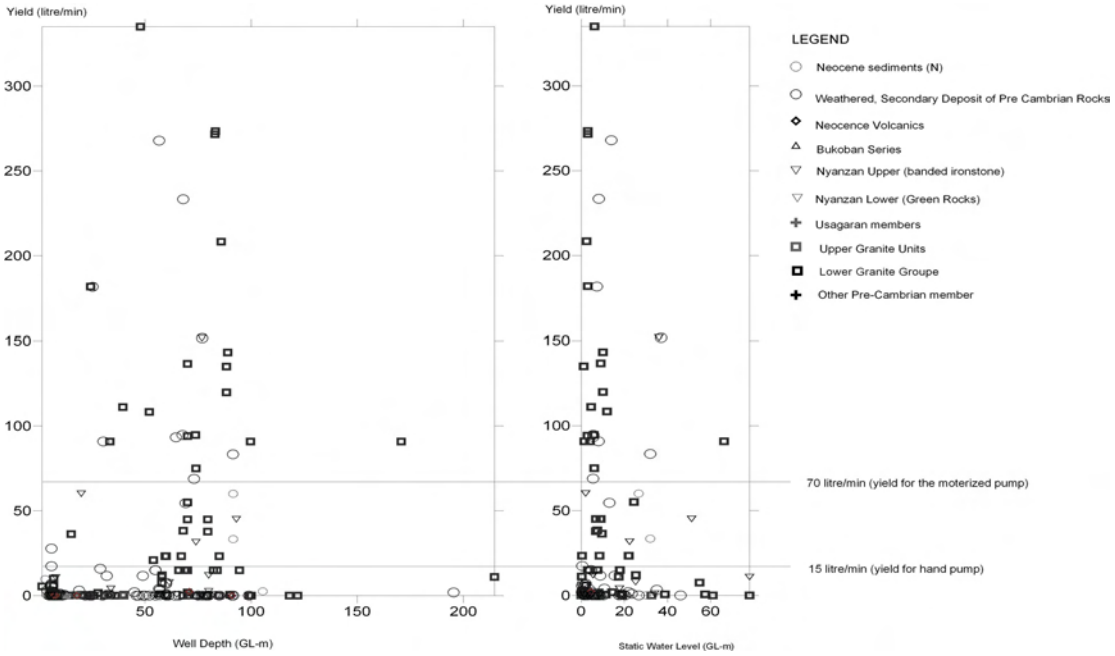

Figure 4.2-1: Relation between Yield (litres/min) and Well Depth, Static Water Level by Geology

c. Relationship between Well Depth and Water Level

The relationship between well depth and water level is examined in Figure 4.2-2.

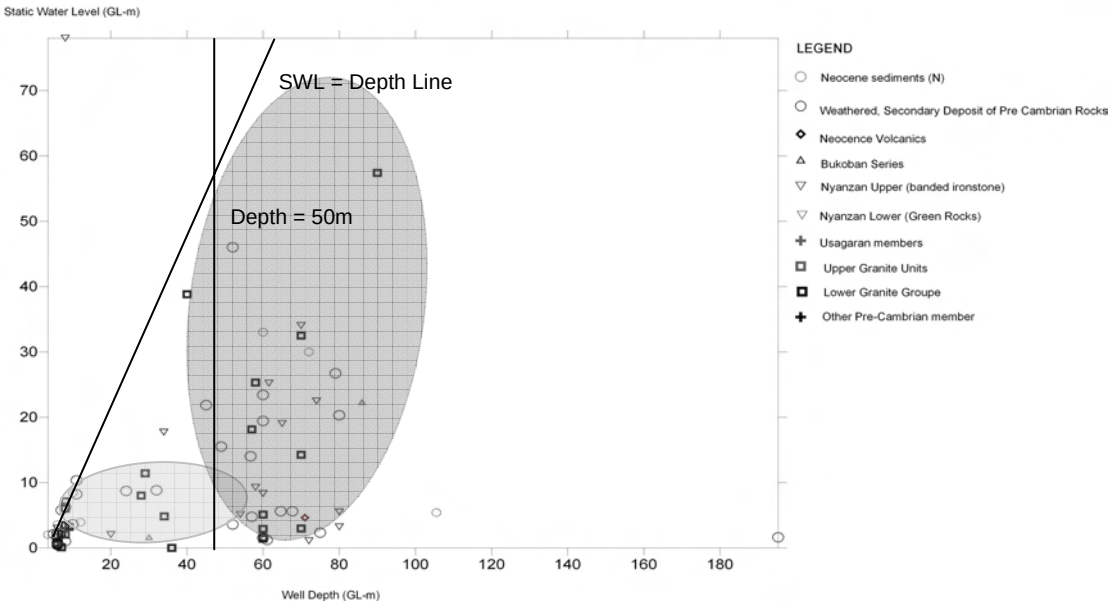

Figure 4.2-2: Well Depth and Static Water Level

The aquifer unit in the depth from 10 to 50 is weathered Precambrian and granite members. This may indicate that unconfined – semi confined aquifers are present until a depth of around 50 meters, and as the depth increases, the variation of the yield increases.

The difference of massive rocks and the decomposed zone can hardly be identified from the surface. From a depth of 30m to 80m bgsl, there is the possibility of two rock units existing.

4.2.2 Character of Aquifer Unit and Wells

a. Character of Aquifer

The character of potential aquifers in the study area can be described as follows:1) Potential (productive) aquifers can be divided into major two types: a) stratum aquifers and b) fracture type aquifers, 2) High yield areas or aquifers are not identified as a zone, but some limited locations, 3) There is quite a high variation of yield by depth and type of aquifer, 4) Granite are the main fissure water sources and productive aquifers in the area and 5)The static water level varies even in aquifers of the same geology.

b. Water Quality of the Groundwater

Shallow Wells: large variation by area. The shallow well at Bunda (Tamau Borehole) is extracting water from an aquifer in the Neocene deposits; it has an extremely high concentration of Cl^-, SO_4^{2-}, Cd, Na^+, and K^+, and the EC value exceeds 40,000 μ S/m. The well shall not be used as a drinking water source. Shallow wells also have high contaminations of coliform and bacteria, and indicate high EC values. This largely depends on the well structure and nature of the aquifer.

Deep – Medium wells: not so much affected by bacteria but contain a series of metal ions such as Fe, Pb, Cr, Se, Ba and F. Based on the water quality standards of Tanzania and WHO, some of the parameters exceed the allowable value (but not exceeds the limit value). The granite fissure type aquifer at Kwimba and Magu indicated a high content of Fluoride.

c. Geological Structure and the Groundwater

It was revealed that one of the potential aquifers is fissure water extracted from the fissures and fractures distributed in the Precambrian hard rock formations.

4.2.3 Aquifer Potential Evaluation

Two types of aquifers are considered as potential groundwater sources based on the yield, geological structure and water quality.

a. Medium depth stratum aquifer

Consist of decomposed Precambrian rock units (mainly secondary deposits or weathered granite and distributes from 20m to 50m in depth from the surface. They are distributed at 1) Hillside of Geita, East Sengerema, West Misungwi, East Kwimba and Magu, Ukerewe Island in the Mwanza Region and 2) Hillside of North Bunda, Central Tarime, South Tarime and West Serengeti in the Mara Region. An Estimated Yield of between 5 to 15 l/min is most common. High values of more than 70 l/min can be achieved if it captures the coarse grained fissure zone.

Water Quality is good in general. Some wells are sensitive to the rain and seasonal fluctuation of the quality can be observed.

b. Deep depth fissure water

Consist of Granite, Nyanzan rock units (Precambrian rock units) and at depth of 20 m to 100m. It is distributed mainly along the valley on 1) NNE-SSW, WNW-ESE lineaments in Sengerema and Geita, 2)NW-SE lineaments in Misungwi and Kwimba, 3) WNW-ESE lineaments in Bunda and Musoma, 4) NNW-SSE lineaments in Musoma, Serengeti and Tarime and 5) EW to WSW-ENE lineaments in Tarime. The only measure to estimate the yield is the inventory of surrounding wells. High values of more than 70 l/min can be achieved if it captures water bearing coarse grained fissure zone.

Water Quality is characterized by a high EC value and it contains various ions. Most of the values of substances are not more than the allowable limit of the WHO, but some exceed the acceptable limit of Tanzania (not exceeds the limit value). Fluoride and NO3 concentrations are high in south Kwimba, Misungwi and Magu. This is also a trial and error process to obtain safer aquifers.

4.2.4 Examination of Groundwater Availability Map

A groundwater availability map is shown in Figure 4.2-3. Potential for development of the water source is mainly concentrated at the granite area, with high density of the lineament.

The grey area is considered as the target area of stratum aquifer in relation with fissure water. The light grey area on the map is considered as fissure water area. Therefore it is essential to examine the potential with the density or intensity of the lineaments. The yellow area is defined as recent deposits which consist of loose material such as sand, clay and gravels.

Although the recent deposit is defined as low potential for high yield, there is possibility to intrude the basement rock area as actually found in the Kwimba District.

4.2.5 Potential Area for Groundwater Development

The high potential area is marked as orange zone in the water availability map. The zone is defined as the area where;

1. High density lineament area.
2. Existence of medium – high yielding well
3. Geological discontinuity such as fault and/or geological boundary

However, it is difficult to find out just the point to capture the good aquifer and fissures from the past efforts and experiences made by the field survey. Therefore, additional investigation such as resistivity sounding is required for further accuracy of the drilling site.

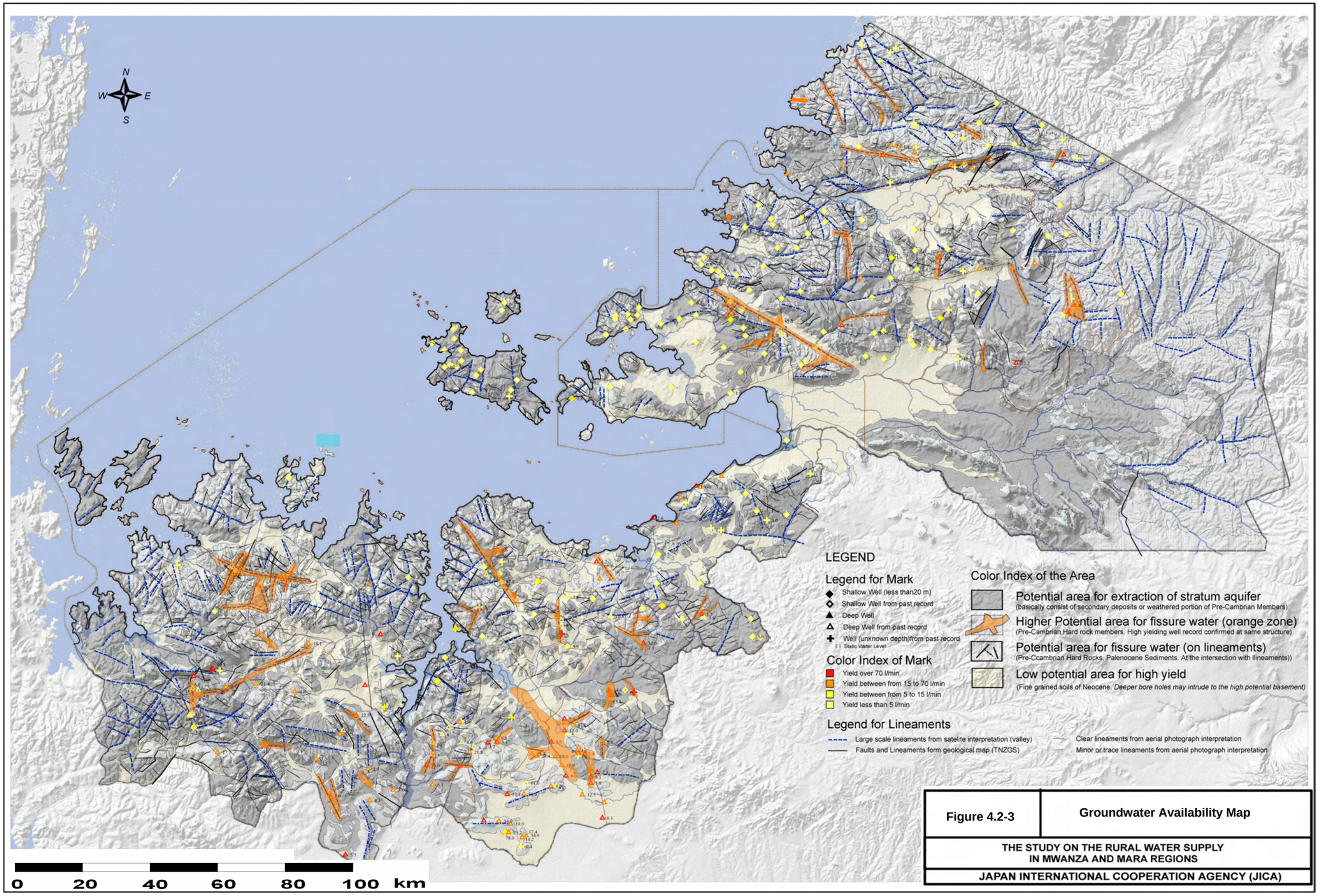

Figure 4.2-3	Groundwater Availability Map
THE STUDY ON THE RURAL WATER SUPPLY IN MWANZA AND MARA REGIONS	
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