

The Madagascar Water Project

RECONNAISSANCE TRIP REPORT

Dec 2017



Mission Statement:

“To provide safe, sustainable and accessible water sources to rural communities in Madagascar; To build an enabling environment within communities to manage and operate their water resources and to use them to improve community-based sanitation and hygiene.”

Summary

The goals of the Reconnaissance Trip are to identify villages along the east coast in the area from Mahanoro in the north to Masomeloka in the south, where the need for clean water is high. The study includes infrastructure analysis, social organization, logistics and geology. The results of the study will be to plan The Madagascar Water Project 2018 Phase VI water well program, as well as to provide information needed to conduct the 2018 Fund Raising Campaign needed to finance the program

There are more than seventy villages between Mahanoro and Masomeloka and eighteen have been identified as candidates for the Phase VI Program. These villages have about 3,700 houses with more than 24,000 people, 60% of whom are under the age of 15 years old. The basis of their selection is their need for clean water, their assessed ability to manage the water wells we will build on their behalf, our ability to access their village and the underlying geology required to make a water well using the technology the MWP employs.

The primary sources of income are farming and fishing. All of them lack sources of clean water. Some villages have open bucket wells, which are often contaminated and cannot provide safe drinking water without boiling. Other villages rely on the Pangalana Channel for water or have no water source at all. Sanitation facilities are lacking and water borne diseases are common and have caused death in vulnerable segments of the population.

Moving south to north from Masomeloka to Mahanoro, the villages identified for the 2018 Phase VI Program are listed below:

- 01-Masomeloka
- 02-Manonilaza
- 03-Analila
- 04-Antsinanantseranana
- 05-Ambodirafia
- 06-Antaniambo
- 07-Antanandava
- 08-Andakorolava
- 09-Antaroby Andranomandry
- 10-Tsararivotra Sohihy I
- 11-Sohihy II
- 12-Ampanotoana
- 13-Andranotsara
- 14-Ampanalana
- 15-Ambodiharina
- 16-Salehy
- 17-Tsangambato
- 18-Ankazomirafy

A comprehensive webpage has been set up in Google Earth with much more information on each village, including videos.

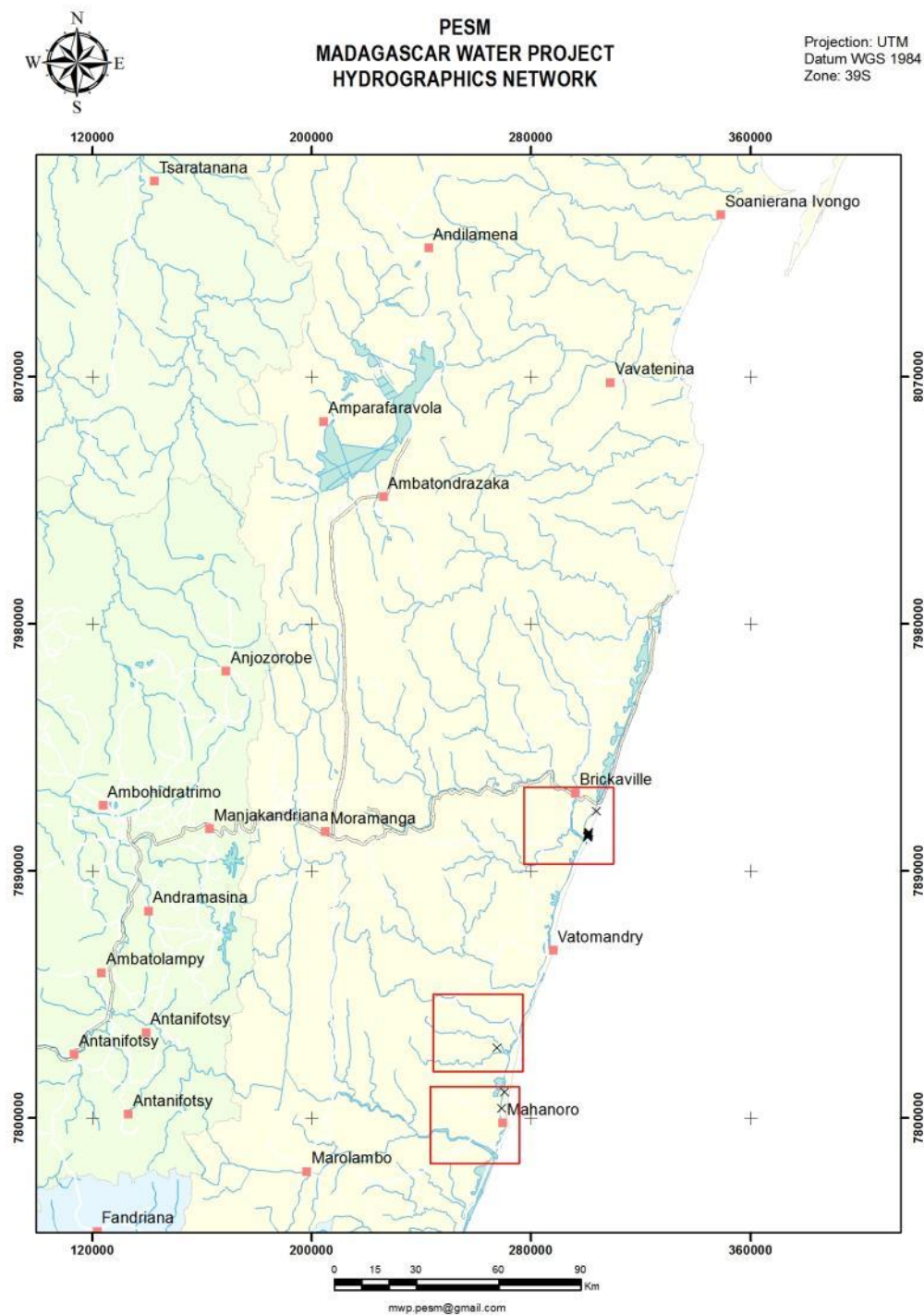
Please go to the link below to access this page. You will need to have Google Earth downloaded on your computer, which is free:

<https://www.google.com/maps/d/viewer?mid=154VkJRlUGN5rI0HcMiQ9-fJnzqlg&ll=-20.116662324022037%2C48.712280499999906&z=11>

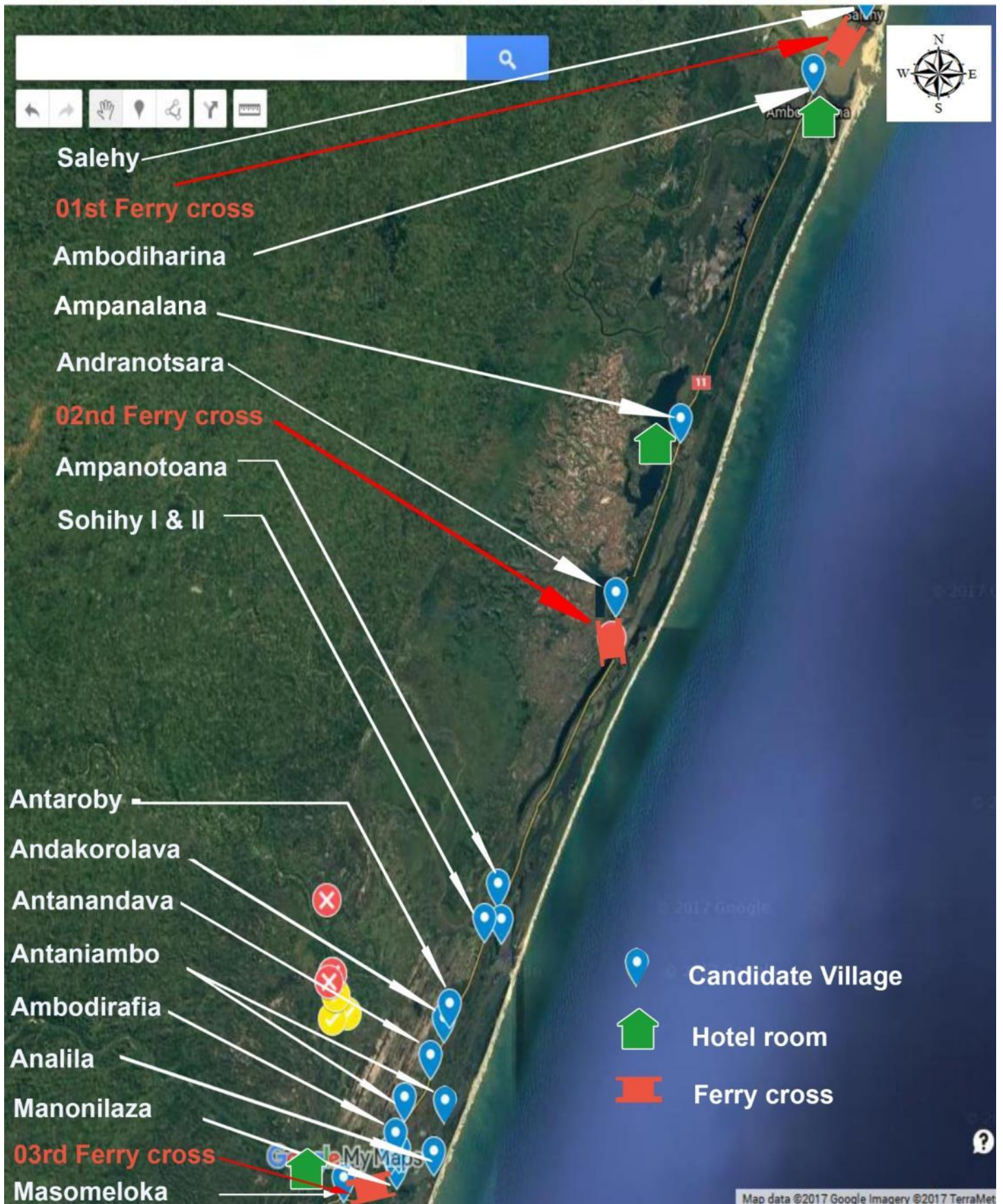
To go to The Madagascar Water Project website and to sponsor a well or make a contribution, please follow the link below:

<http://www.themadagascarwaterproject.org>

EAST COASTAL HYDROGRAPHIC MAP



Villages, Ferry crosses, Hotel room between Salehy and Masomeloka



A. GENERAL OVERVIEW OF EACH VILLAGE

Masomeloka village

Number of residents: 4,609

Number of Houses: 1,250

Occupation: Farming, Fishing

Source of water: Pangalana channel, 07 Bucket well

Toilet: without any latrine

Fonkontany: Masomeloka

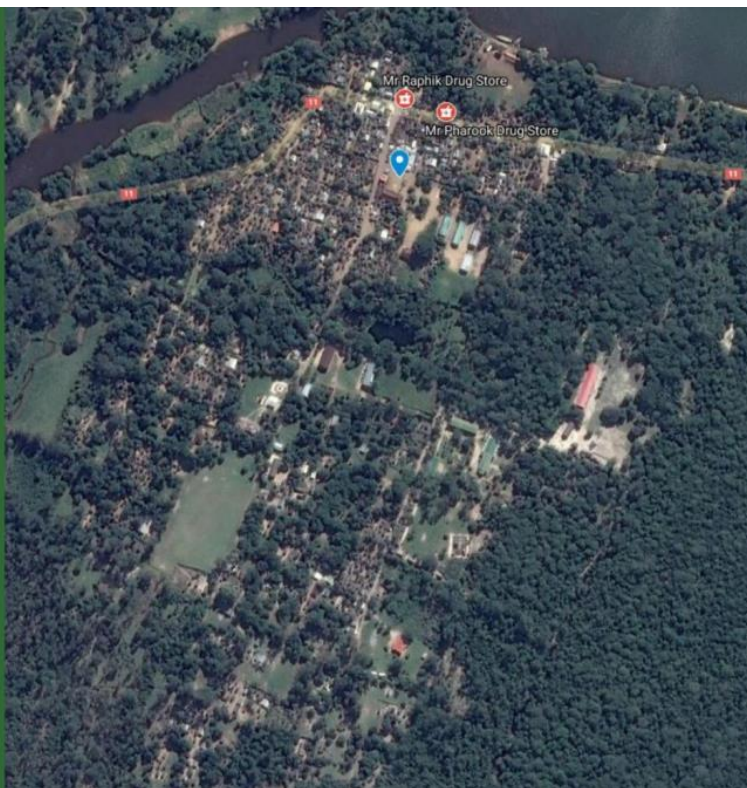
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

252074.00 7755757.00



Manonilaza Village

Number of residents: 850

Number of Houses: 120

Occupation: Farming, Fishing

Source of water: Pangalana channel

Toilet: without any latrine

Fonkontany: Manonilaza

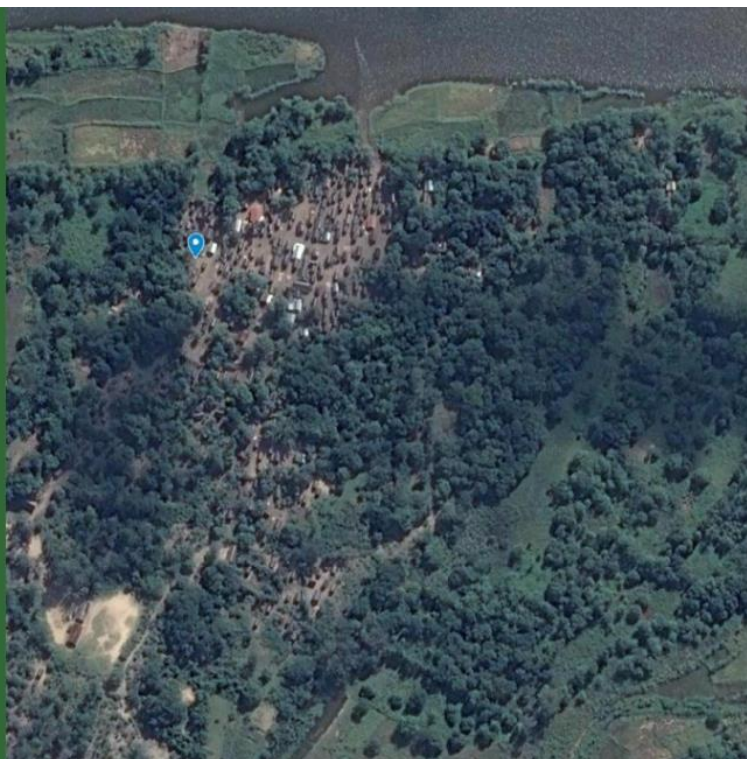
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

253797.00 7756162.00



Analila village

Number of residents: 700

Number of Houses: 90

Occupation: Farming, Fishing

Source of water: Pangalana Channel

Toilet: without any latrine

Fonkontany: Analila

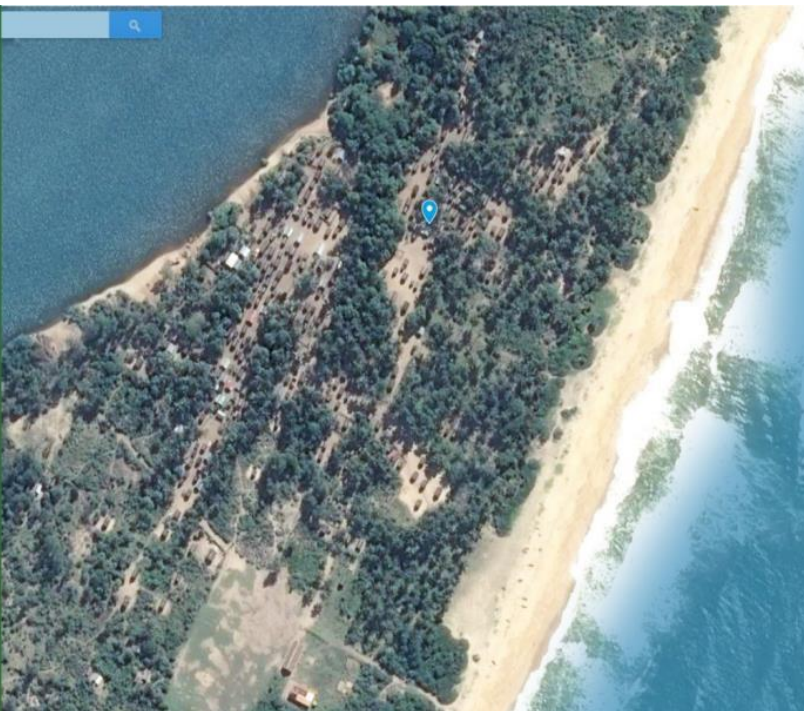
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

254860.00 7756516.00



Ambodirafia village

Number of residents: 840

Number of Houses: 120

Occupation: Farming, Fishing

Source of water: ricefield

Toilet: without any latrine

Fonkontany: Ambodirafia

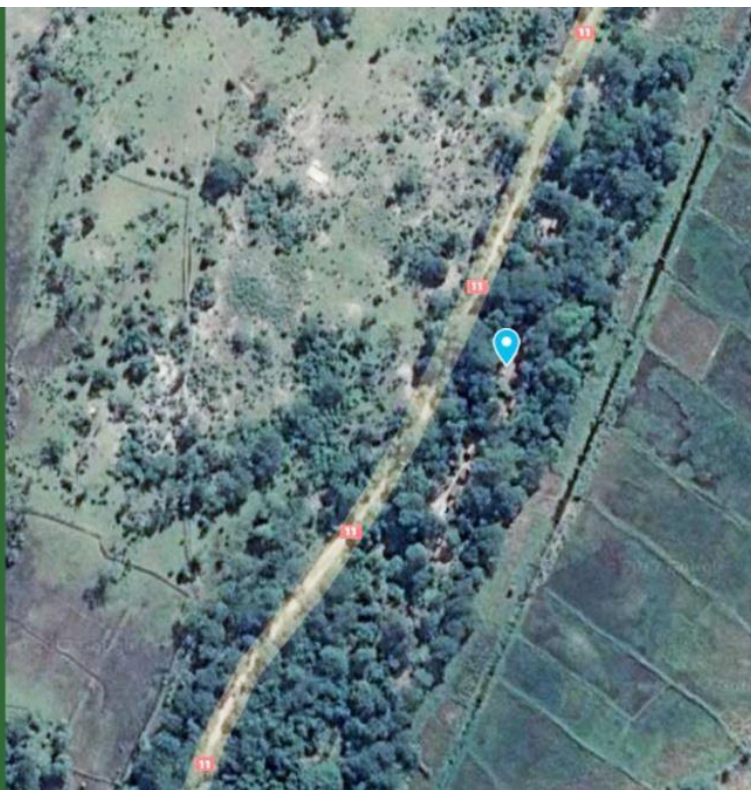
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

253711.00 7756990.00



Antaniambo village

Number of residents: 1,300

Number of Houses: 180

Occupation: Farming, Fishing

Source of water: Pangalana channel, 01 Bucket well

Toilet: without any latrine

Fonkontany: Antaniambo

Commune: Masameloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

256490.00 7762916.00



Antanandava village

Number of residents: 300

Number of Houses: 20

Occupation: Farming, Fishing

Source of water: Pangalana channel, ricefield

Toilet: without any latrine

Fonkontany: Antanandava

Commune: Masameloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

254771.00 7759117.00



Andakorolava village

Number of residents: 300

Number of Houses: 20

Occupation: Farming, Fishing

Source of water: Pangalana channel, ricefield

Toilet: without any latrine

Fonkontany: Andakorolava

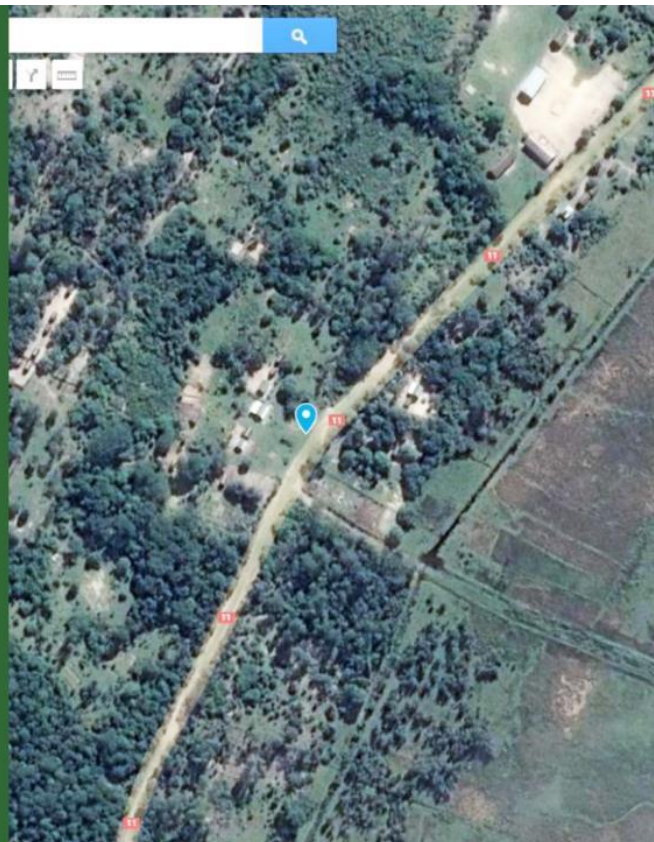
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

255118.00 7759971.00



Antaroby village

Number of residents: 1,200

Number of Houses: 250

Occupation: Farming, Fishing

Source of water: 01 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Antaroby

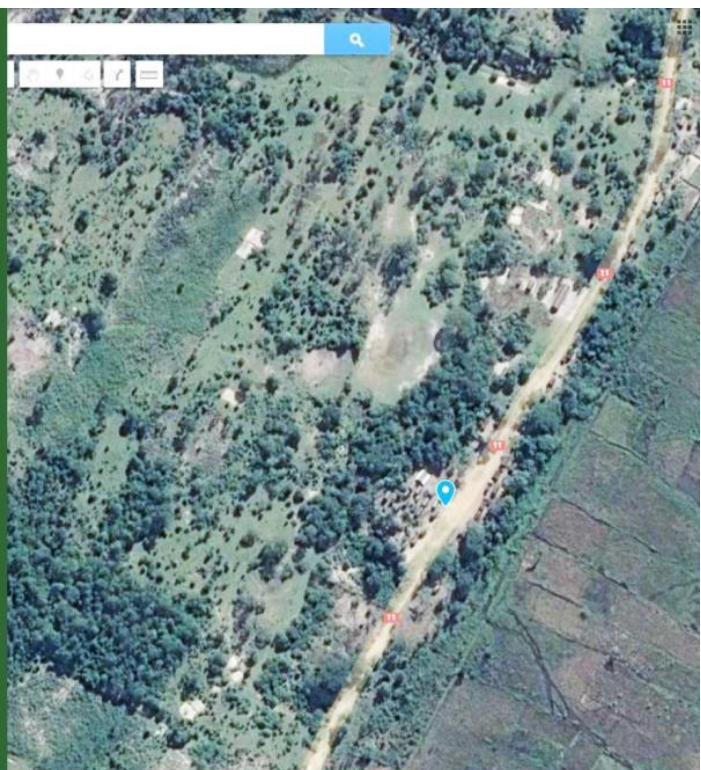
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

255403.00 7760513.00



Sohihy village

Number of residents: 1,250

Number of Houses: 170

Occupation: Farming, Fishing

Source of water: 03 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Sohihy

Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

256985.00 7762889.00



Ampanotoana village

Number of residents: 5,000

Number of Houses: 388

Occupation: Farming, Fishing

Source of water: 05 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Ampanotoana

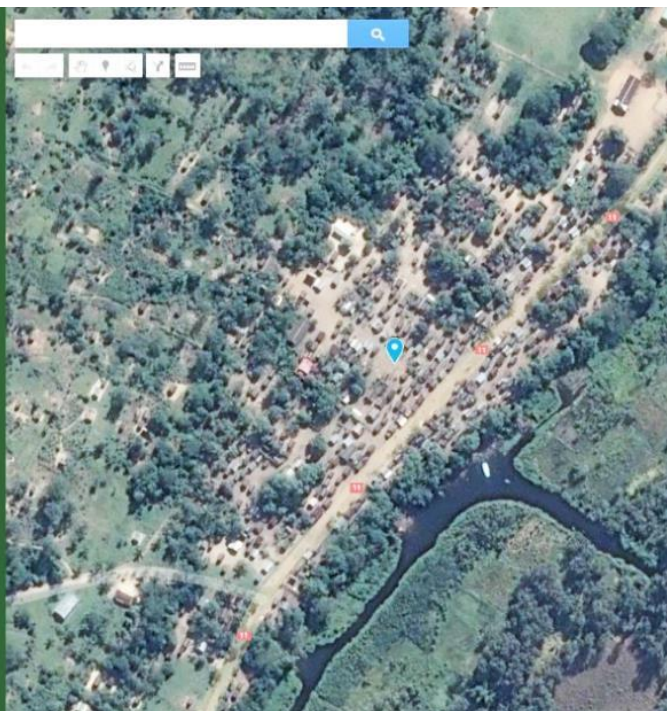
Commune: Masomeloka

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

256859.00 7763802.00



Andranotsara village

Number of residents: 1,325

Number of Houses: 160

Occupation: Farming, Fishing

Source of water: River, ricefield

Toilet: there is no any latrine

Fonkontany: Andranotsara

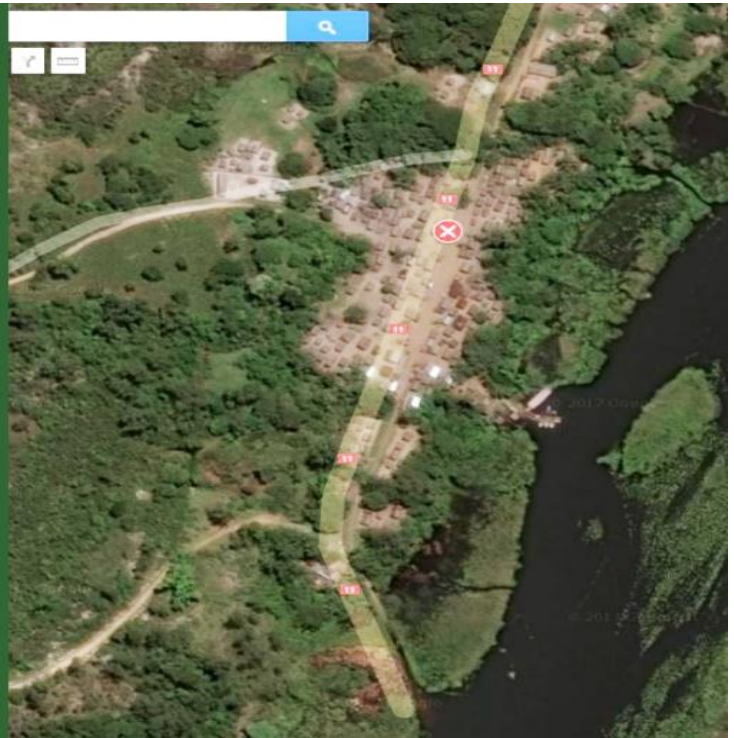
Commune: Ambodiharina

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

260365.00 7771113.00



Ampanalana village

Number of residents: 600

Number of Houses: 80

Occupation: Farming, Fishing

Source of water: 01 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Ampanalana

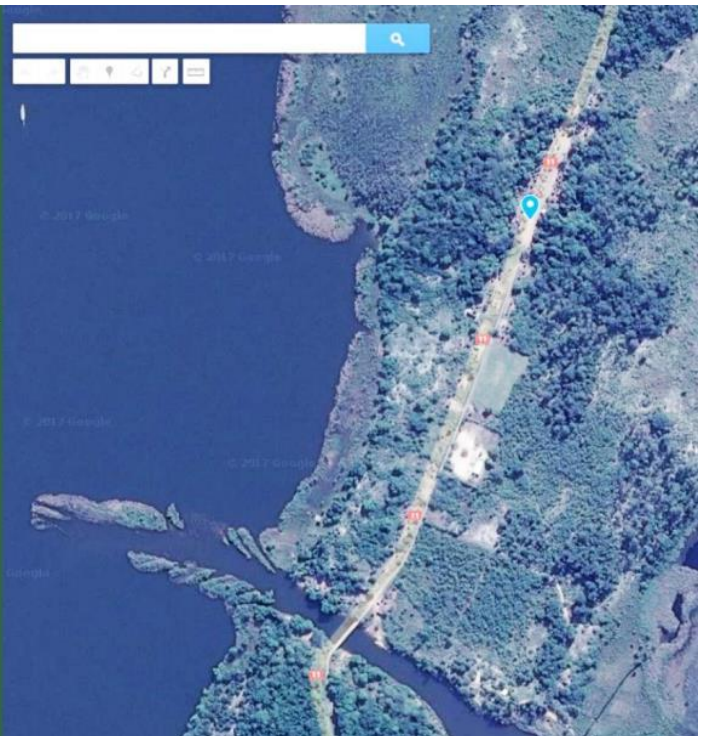
Commune: Ambodiharina

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

262531.00 7776508.00



Salehy village

Number of residents: 1,600

Number of Houses: 200

Occupation: Farming, Fishing

Source of water: 03 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Salehy

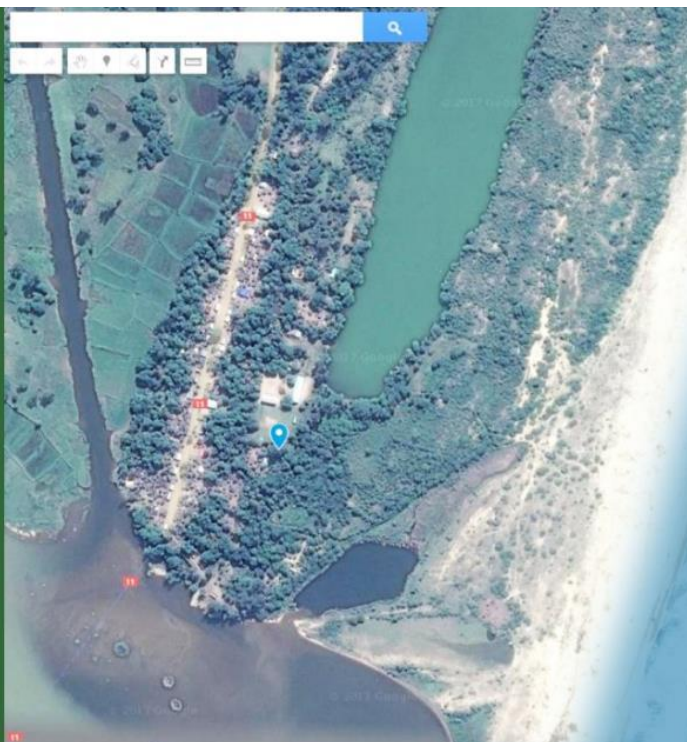
Commune: Betsizaraina

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

268199.00 7788091.00



Ambodiharina village

Number of residents: 3,769

Number of Houses: 542

Occupation: Farming, Fishing

Source of water: 04 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Ambodiharina

Commune: Ambodiharina

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

266631.00 7785738.00



Tsangambato village

Number of residents: 550

Number of Houses: 70

Occupation: Farming, Fishing

Source of water: 03 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Salehy

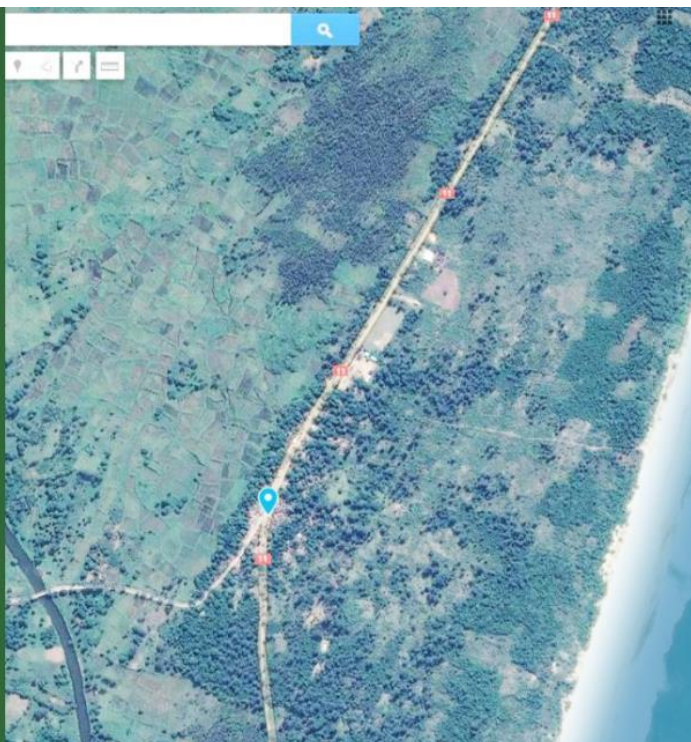
Commune: Betsizaraina

District: Mahanoro

Region: Antsinanana

GPS Coordonate:

268293.00 7789659.00



Ankazomirafy village

Number of residents: 400

Number of Houses: 60

Occupation: Farming, Fishing

Source of water: 03 Bucket well, Pangalana channel

Toilet: without any latrine

Fonkontany: Ankazomirafy

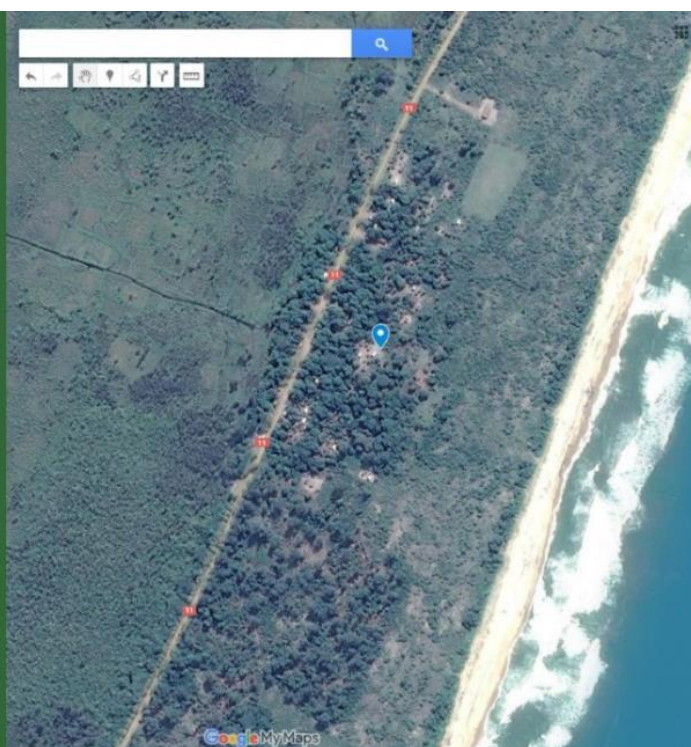
Commune: Betsizaraina

District: Mahanoro

Region: Antsinanana

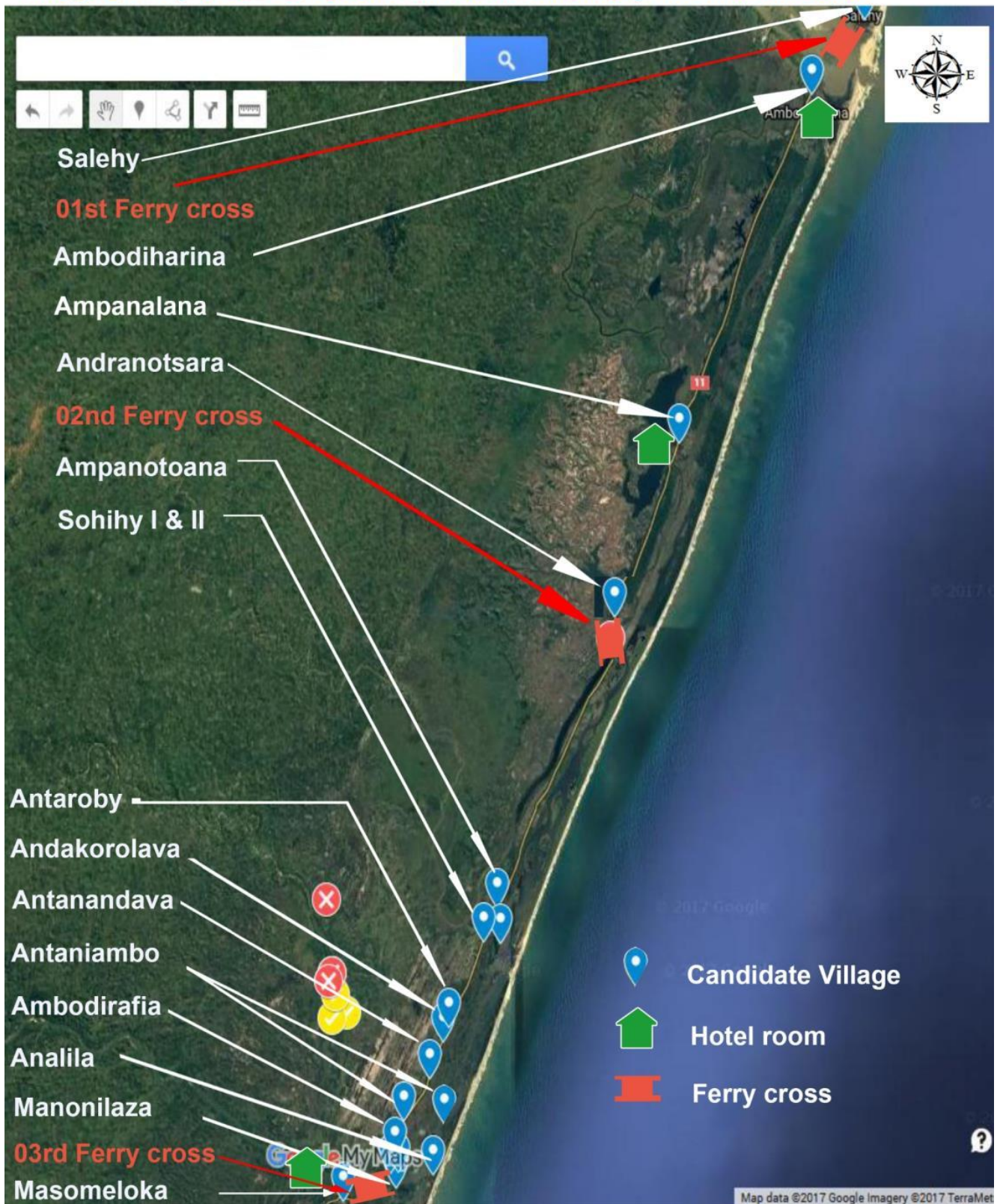
GPS Coordonate:

269587.00 7792187.00



B. LOGISTICS

Villages, Ferry crosses, Hotel room between Salehy and Masomeloka



Access Road:

The road between Mahanoro and Masomeloka, is in good condition although 3 ferry crossings are required to complete the trip. The Ferry crosses are normally working during the day, but there is a significant risk that mechanical problems could limit or stop service.

All of the villages can be reached by boat, although five villages require a walk of approximately 30 minutes. Two (2) of the 18 villages can only be reached by boat.

Driving Distances Between Villages:

Mahanoro – Ankazomirafy:	15mn
Ankazomirafy - Tsangambato:	15mn
Tsangambato - Salehy:	15mn
	Ferry crossing
Salehy - Ambodiharina:	45mn
Ambodiharina – Ampanalana:	30mn
Ampanalana – Andranotsara:	15mn
	Ferry crossing
Andranotsara –Ampanotoana:	30mn
Ampanotoana – Sohihy:	15mn
Sohihy-II cannot be reached by car, a walk of 10mn is required	
Sohihy – Antaroaby:	15mn
Antaroaby - Andakorolava:	15mn
Andakorolava – Antanandava:	15mn
Antanandava – Antaniambo:	15mn
Antaniambo-II cannot be reached by car, a walk of 15mn is required	
Antaniambo – Ambodirafia:	15mn
Ambodirafia - Antsinanantseranana:	15mn
	Ferry crossing
Antsinanantseranana – Masomeloka:	45mn

Accommodation:

There are hotel rooms in, Masomeloka, Ampanalana, and Ambodiharina. Accommodations are basic and daily rates range from MGA 15k – 30k.

There is Catholic mission in Masomeloka and the Priest has offered accommodations to the MWP Team.

Boats are available for rent in Masomeloka

Hotel Contact Information:

Hotel in Masomeloka: bungalows rent at MGA 15k
034 45 740 51 / 034 45 212 67 / 034 53 303 80

Catholic Priest in Masomeloka: 034 40 326 62

Hotel in Ampanalana: Hotel Liana: 034 50 715 98
One room large enough for 7 people, no toilet, MGA 25k

Hotel in Ampasimazava: 032 56 801 02 / 034 15 151 24
Six bungalows, outside toilet, MGA 30k

Hotel in Ambodiharina: 034 40 027 97
May accommodate up to 8 people

Note:

Analila and Manonilaza are not described because it was not accessible by car

Antsinanantseranana is not described because it has adequate sources of clean water

Photos of accommodation in Masomeloka



More photos of accommodation in Masomeloka



Photos of accommodation in Ampanalana



More photos of accommodation in Ampanalana



Photo of accommodation in Ambodiharina



Ferry Crossing

A. GEOLOGY

1. Location :

The Madagascar Water Project (MWP) Phase V Program drilled 15 wells between Andovoranto and Vatomandry. Ten wells were also completely rebuilt, including wells as far south as Mahanoro. Two new types of pumps (9m and 20meter pumps) were also tested in the program and their mechanical reliability had to be checked.

The Phase VI Program will extend the area of operation south to the village of Masomeloka. The Reconnaissance Trip will identify villages along RN11, the Pangalana Channel and the area between the coast and the inland highlands to the west; social, geologic and logistical studies will be conducted.

The physical geography of the region is that of a set of soft hills with notched steep valleys to the north and south. A sandy coastal plan laps on to weathered basement to the west, often in close proximity to the sea. The average elevation is between 5m to 20m.

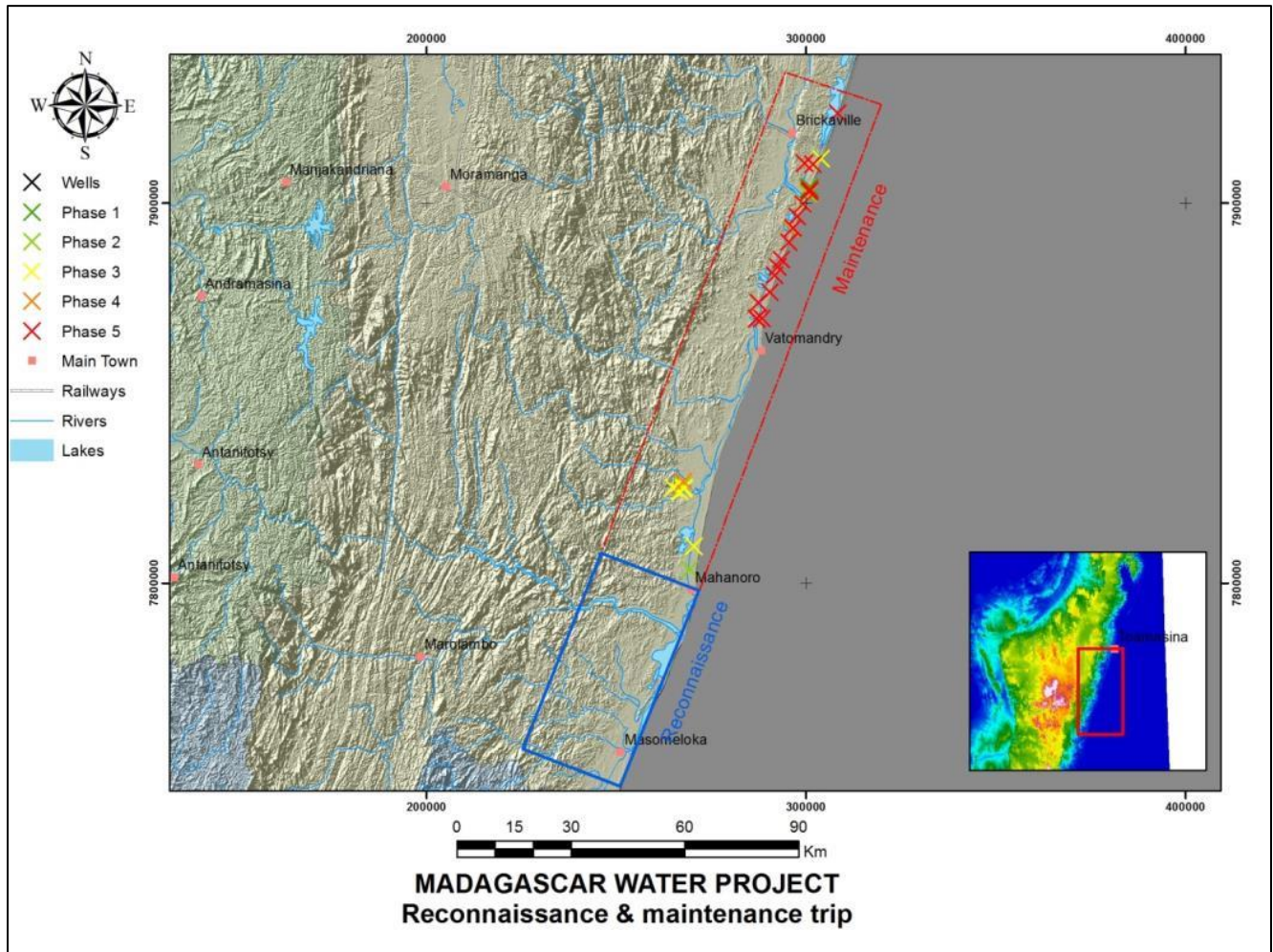
The Pangalana Channel and Indian Ocean coast dominate the hydrography and frequent rivers, water filled and seasonally dry, and large and small cross the terrain. Most wells drilled have had fresh, clean, potable water. Of the 42 wells completed by the Project, 1 or 2 wells have had dirty water similar to nearby streams and 1 had sea water.

2. Scope of Work :

This field investigation aims to:

1. Follow-up on the wells drilled and repaired during the September 2017 Phase V Program;
2. Evaluate the new pumps and new technologies employed during Phase V;
3. Identify gaps in sustainability and train people to fill the gaps.
4. Work with the Well Management Committees to manage and develop their resources;
5. Evaluate and prepare area south of Mahanoro to Masomeloka for the Phase VI Program:
 - a. Evaluate the current status of water, sanitation, health and hygiene in the village;
 - b. Identify and document current sources of village water and assess quality;
 - c. Meet with village political and social leaders and discuss water development options, determine if the village is capable and willing to manage a water well;
 - d. Assess logistics and identify resources for the MWP's operations;
 - e. Make a basic field geology study to assist in well planning
 - f. Collect demographic data, photos and videos for planning and fund raising campaign
6. Document the trip and distribute reports to the Madagascar Water Project Management Team to determine and plan the Phase VI Program.

Figure 1: Location of the Maintenance & Phase VI Reconnaissance Trip



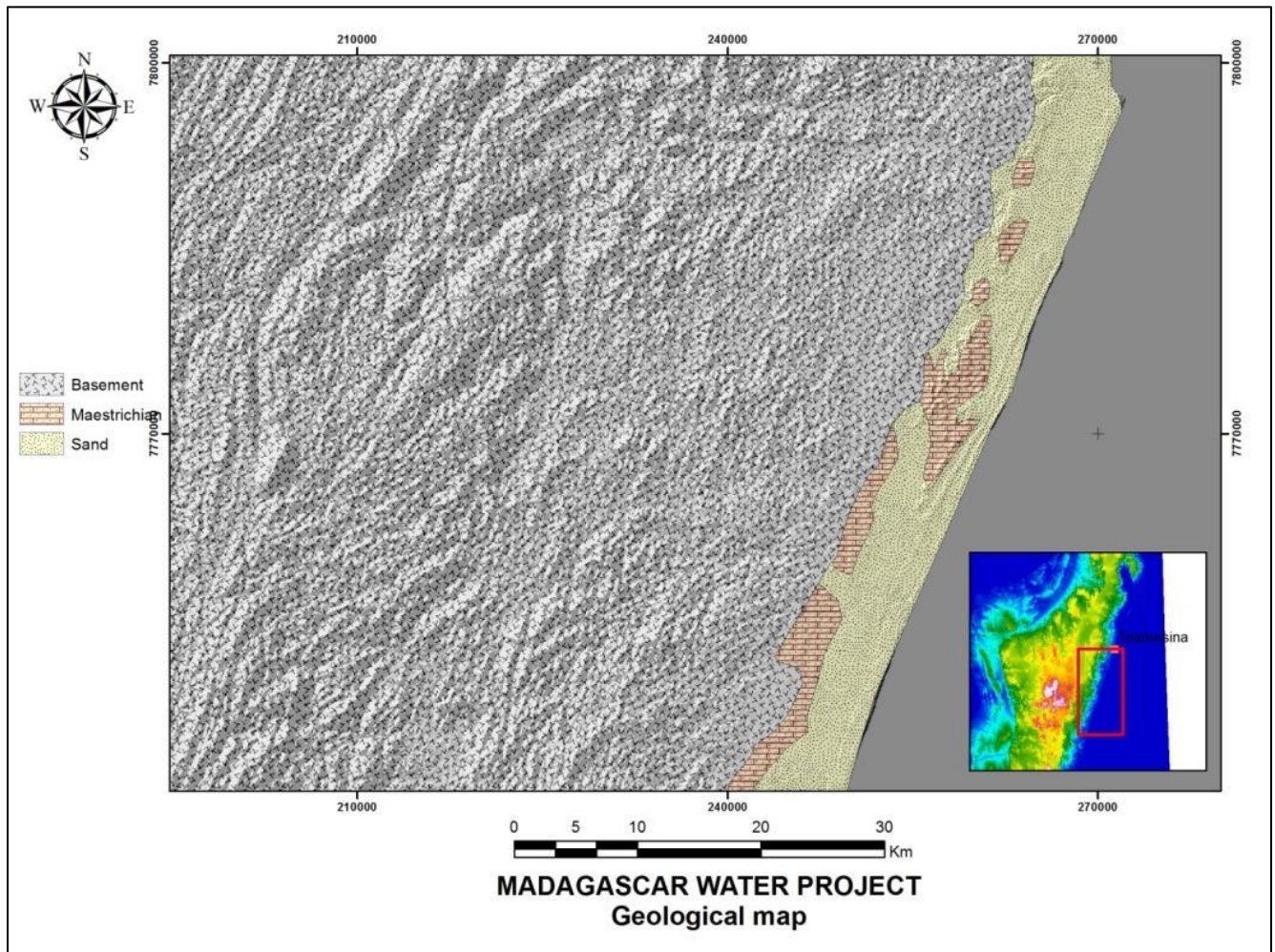
- Existing Madagascar Water Project wells are marked with an X
- Area for the Phase VI Reconnaissance Study is outlined in blue

3. Observations and Analysis:

The study area is a 7 to 10 km strip of sedimentary deposits located between the ocean to the east and red weathered basement to the west. Cretaceous volcanic events have left a network of dikes and sills along this narrow sedimentary terrain.

The sedimentary lithology consists of shoreline deposits with beach and aeolian sandstones providing the best aquifers for development. Alluvial, fluvial, and nearshore backwater deposits are also found and largely provide poor quality aquifers. Bed dips are generally towards the coast to the east and locally to the south.

Figure 2: Geologic Map



a. Masomeloka:

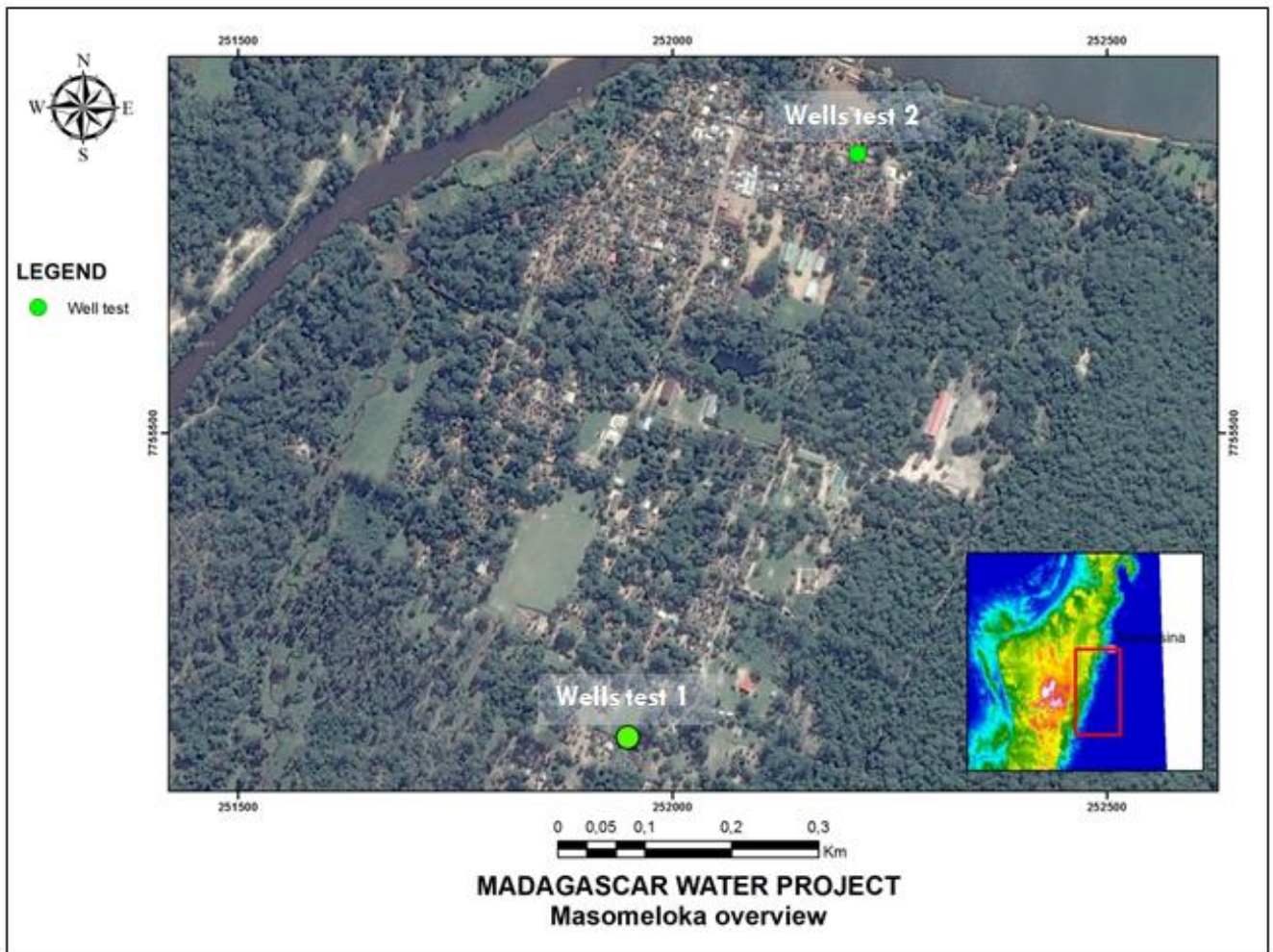
Masomeloka is the southern extent of the reconnaissance study. It is bound on the north by the Masora River and the Pangalana Channel and Indian Ocean on the west and east respectively.

The village is built on loose sand with no visible outcrops. Information from the villagers indicated the deepest hole drilled in the village is about 8m and it never encountered hard rock. Seven bucket wells, mostly located in the center of the village, indicate a static water level of about 4 meters below ground level.

The Madagascar Water Project drilled two stratigraphic holes. It indicated the static water level may shallow to the south. They both encountered a continuous layer of hard cemented sandstone at an average depth of 4 meters. A few rare rounded pebbles were also encountered. No indications of Basement were seen.

The study indicates the shallow subsurface geology is ideal for the drilling of water wells.

Figure 3: Masomeloka with stratigraphic tests marked in green.



Masomeloka Stratigraphic Test 1:

The first well test drilled in Masomeloka is located on the south side of the village close to CEG School. The objectives were to confirm the subsurface geology and to measure the static water level where no data existed.

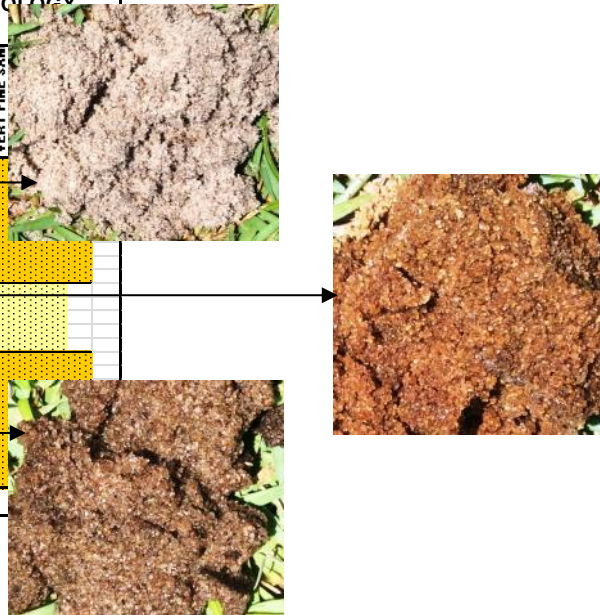
Met with the CEG Director, drilled well to 2 meters below ground level, no mechanical or safety incidents occurred.

Surface is soft from the top soil to 70cm, encountered a thin layer of hard cemented sandstone, commonly medium-fine grained, moderately to well cemented in part. Yellowish color, becoming brown to brownish black due to the presence of the cement that we assumed to be ferruginous oxide, this thin layer appears to be low perm and tight, encountered the water table at the base of this layer at 1.5 meters in clear friable sand. Well released at total depth of 2 meters.

Figure 4: Masomeloka Strat Test 1 Log

PROJECT:	PESM MADGASCAR WATER PROJECT				
COUNTRY:	MADAGASCAR				
AREA:	MASOMELOKA				
CLASSIFICATION:	WATER WELL TEST				
COORDINATES (GPS):	251 852				
	7 754 981				
ELEVATION:	11 m / MSL				
TOTAL DEPTH	2 m				
WATER TABLE	1,5 m				
SPUD DATE:	Dec 11, 2017 @ 8:13 AM				
COMPLETE:	Dec 11, 2017 @ 8:35 AM				
WELL NAME:					
OPERATOR:	Larry/ Sadera				
DEPTH	ROP	DESCRIPTION	LITHOLOGY		
			CLAY	SILT	VERY FINE SAND
0		SAND: wh, yellsh wh, fri, mL-mU gr, wll srted			
0,5					
1		SST: yellsh orn, bcmg brnsh blk, hd, mL gr, abdnt ferrug ox cmt			
1,5		SAND: wh, yellsh wh, fri, mL-mU gr, wll srted			
2					

- Lithology: from 0-0.7m sand off wh, fri, mly mL-mU, rr crs gr, sbang-ang, gd perm. From 0.7-1.2 SST, yells horn, bcmg reddish blk du to the cmt ferrug, mod hd, mL gr, pr perm. From 1.2-2m, yellsh, brnsh, fri, mL-mU gr, wll srted.
- Remark: the lithology on the water level is still red with high amount of iron oxide content but seems decreasing with the depth.



Masomeloka Stratigraphic Test 2:

The second Masomeloka well test is located on the north side of the village, on the main road near the entrance to the village from the dock. The location is located between two existing bucket wells 300 meters to the east and west. The static water level of the well to the west is about 4.5m and the level in the well to the east is 3.4m. The objective of this well is to confirm the lithology and measure the static water level for modelling purposes.

In summary, the stratigraphy is similar to the first well:

- surface – 2.5m: loose sand, yellowish white, friable;
- 2.5 - 3.0m: reddish layer, ferruginous cement, less cemented, mod hard;
- 3.0 – 4.0m: soft sand, yellowish white to TD at 4m
- The water table was reached at 3.8m.

Figure 5: Masomeloka Strat Test 2 Log

PROJECT:	PESM MADGASCAR WATER PROJECT									
COUNTRY:	MADAGASCAR									
AREA:	MASOMELOKA									
CLASSIFICATION:	WATER WELL TEST									
COORDINATES (GPS):	252 213									
	7 755 821									
ELEVATION:	6 m / MSL									
TOTAL DEPTH	4 m									
TD :	3,8 m									
SPUD DATE:	Dec 11, 2017 @ 09:30 AM									
RIG DOWN:	Dec 11, 2017 @ 10:15 AM									
WELL NAME:										
OPERATOR:	Larry/ Sedera									
DEPTH	ROP	DESCRIPTION	LITHOLOGY							
			CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	VERY COARSE	
0		SAND: wh, yellsh wh, fri, mL-mU gr, wll srted								
0,5										
1										
1,5										
2		SAND: yellsh orn, bcmg brnsh blk, hd, mL gr, abdnt ferrug ox cmt								
2,5										
3		SAND: wh, yellsh wh, fri, mL-mU gr, wll srted								
3,5										
4										
WATER LEVEL										

- Lithology: from 0-2.5m sand off wh, fri, mly mL-mU, rr crs gr, sbang-ang, gd perm. From 2.5-3 SAND, yells horn, bcmg reddish blk du to the cmt ferrug, mod hd, mL gr, pr perm. From 3-4m, yellsh, brnsh, fri, mL-mU gr, wll srtd.
- Remark: very friable loose sand, need to pay more attention about the caving that can block the drilling tools.



Masomeloka Static Water Level Modelling:

The model is based on the static water levels seen in the seven existing bucket wells and the two stratigraphic tests. The Inverse Distance Weighted (IDW) method was used, which calculates linear mid-points between data points and contours accordingly.

The model show a clear shallowing trend of the static water level towards the south. Figure 6. The reason for this trend is unknown but may be related to the ferruginous layer that may have a northerly dip.

Figure 6: Model of Masomeloka Static Water Level

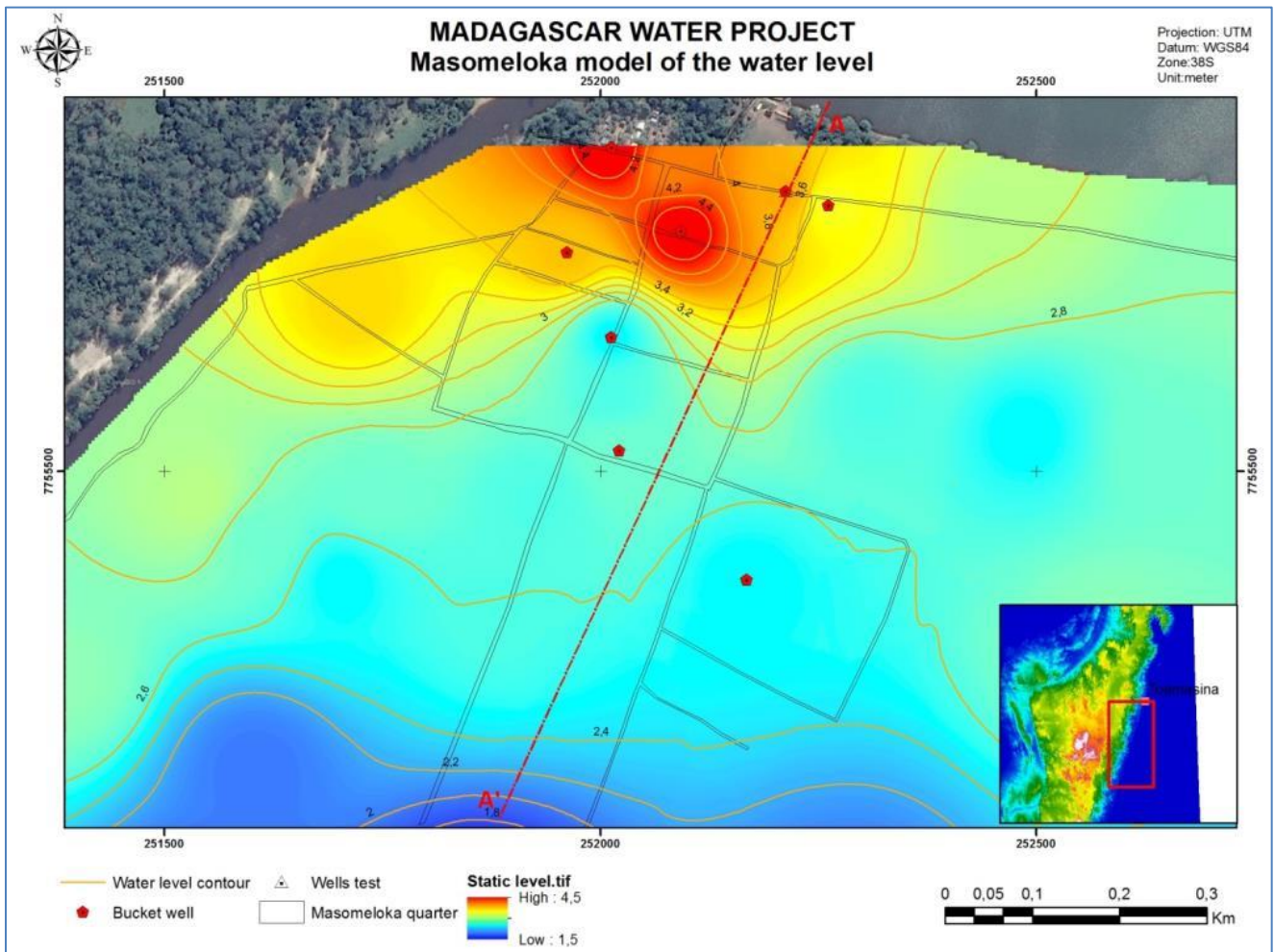
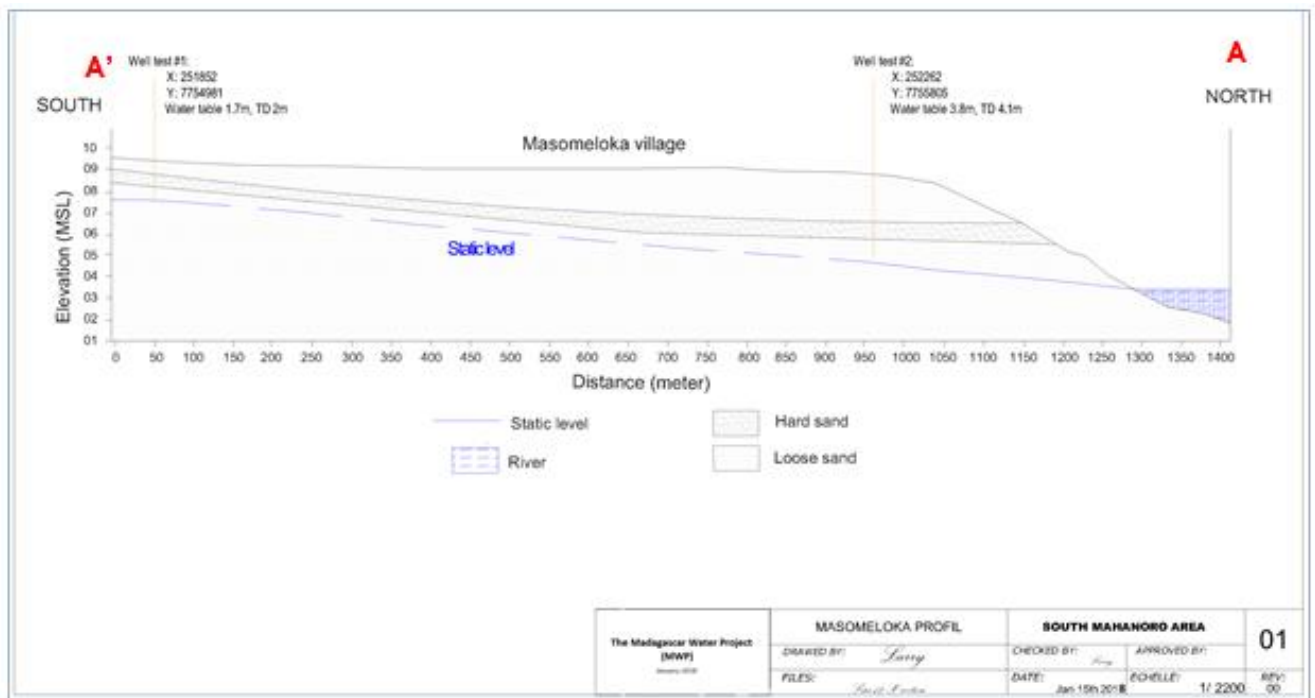


Figure 7: Cross Section A – A', crossing Masomeloka from north to south



b. Manonilaza:

Manonilaza is a village east of Masomeloka on an island formed by the Masora River, Pangalana Channel and the Indian Ocean. No stratigraphic tests were drilled.

The lithology is assumed to be similar to Masomeloka which is a sand bar. Based on the Masomeloka modelling, the static water level is assumed to be similar at a depth of about 4 meters or less.

c. Analila:

Analila is a village on the same island as Manonilaza but closer to the ocean shoreline. The geology is assumed to be similar to that of Masomeloka but the risk of salt water intrusion is higher.

d. Ambodirafia:

Ambodirafia is on the north side of the Masora River. The surface is sand. Based on surface geology, as one goes east, soil and clay may be present to a depth of 2 meters before crossing into a sandy aquifer with a static water level estimated to be at of depth of 2 – 3 meters.

e. Antaniambo:

Antaniambo lies between the Pangalana Channel and the coast. Two villages are present, Antaniambo-I near the channel (and road) and Antaniambo-II near the coast.

The surface was sand and remained consistent to the static water level at 1.7 meters. No geologic risks indicated.

- Lithology: from 0-2m sand off wh, fri, mly mL-mU, rr crs gr, sbang-ang, gd perm.
- Remark: toward to the east the geology could change by crossing from the top soil 1 or 2m clay before reaching sand.



PAGE 25

The surface was sand and remained consistent to the static water level at 3.7 meters. The hole became exceptionally unstable near the water table indicating casing may be needed while drilling. No geologic risks indicated

- Lithology: from 0-4m sand off wh, yellsh wh, med-crs gr, loose sand.
- Remark: toward to the west the geology could change by crossing from the top soil 1 or 2m clay before reaching sand.



f. Antanadava & Andakorolava:

Set on sand, to the east may have 1 to 2 meters of clay before reaching sand aquifer, static water level assumed to be similar to water table in Antaniambo, between 2 – 4 meters. No bucket wells.

g. Andranomandry AntaroBy:

Set on sand, to the east may have 1 to 2 meters of clay before reaching sand aquifer. One Stratigraphic Test drilled, static water level found at 3.1 meters. No volcanics.

Figure 11: Andranomandry Bucket Well



Figure 12: Andranomandry Strat Test Log

PROJECT:	PESM MADAGASCAR WATER PROJECT									
COUNTRY:	MADAGASCAR									
AREA:	ANTAROBY									
CLASSIFICATION:	WATER WELL									
COORDINATES (GPS):	255 415									
	7 760 529									
ELEVATION:	14,9 m / MSL									
TOTAL DEPTH	3,3 m									
WATER TABLE	3,1 m									
SPUD DATE:										
RIG DOWN:										
WELL NAME:										
OPERATOR:	Larry/ Sadera									
DEPTH	ROP	DESCRIPTION	LITHOLOGY							
			CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND		
0		SAND: yellsh Orn sand, med-Crs mod srtd, bright yellsh wh, water table @ 3.7m no penetration. a/a TD 4m								
0,5										
1										
1,5										
2										
2,5										
3										
3,1										
3,3										

- Lithology: Same lithology from the top to the bottom 0-3.3m sand off wh, yellsh wh, med-crs gr, loose sand.
- Remark: toward to the west the geology could change by crossing from the top soil 1 or 2m clay before reaching sand.

h. Sohihy:

Set on loose coarse sand, the water table measured from these 3 bucket wells has an average depth of 2.5 meters. All of the buckets wells are located on the east side of the village. A 1 - 2m clay layer may over lay the aquifer to the west.



Figure 13: Sohihy-II Bucket Wells

i. Ampanotoana:

Ampanotoana lies on a high position on the coastal plain along the Pangalana Chanel. Five bucket wells are present in the village and have static water levels ranging from 3.5m to 7.0m. A stratigraphic test was drilled where no well existed to verify the lithology and gain another point for static water modelling. The hole became exceptionally unstable near the water table indicating casing may be needed while drilling.

The depth of the static water level was observed as follows:

- Wells (3) located near the Pangalana Channel: 3.5 meters
- Well located in the extreme western part of the village: 5.0 meters
- Well in the school yard near the northwest entrance to the village: 4.8 meters
- Stratigraphic Test: 7.5 meters

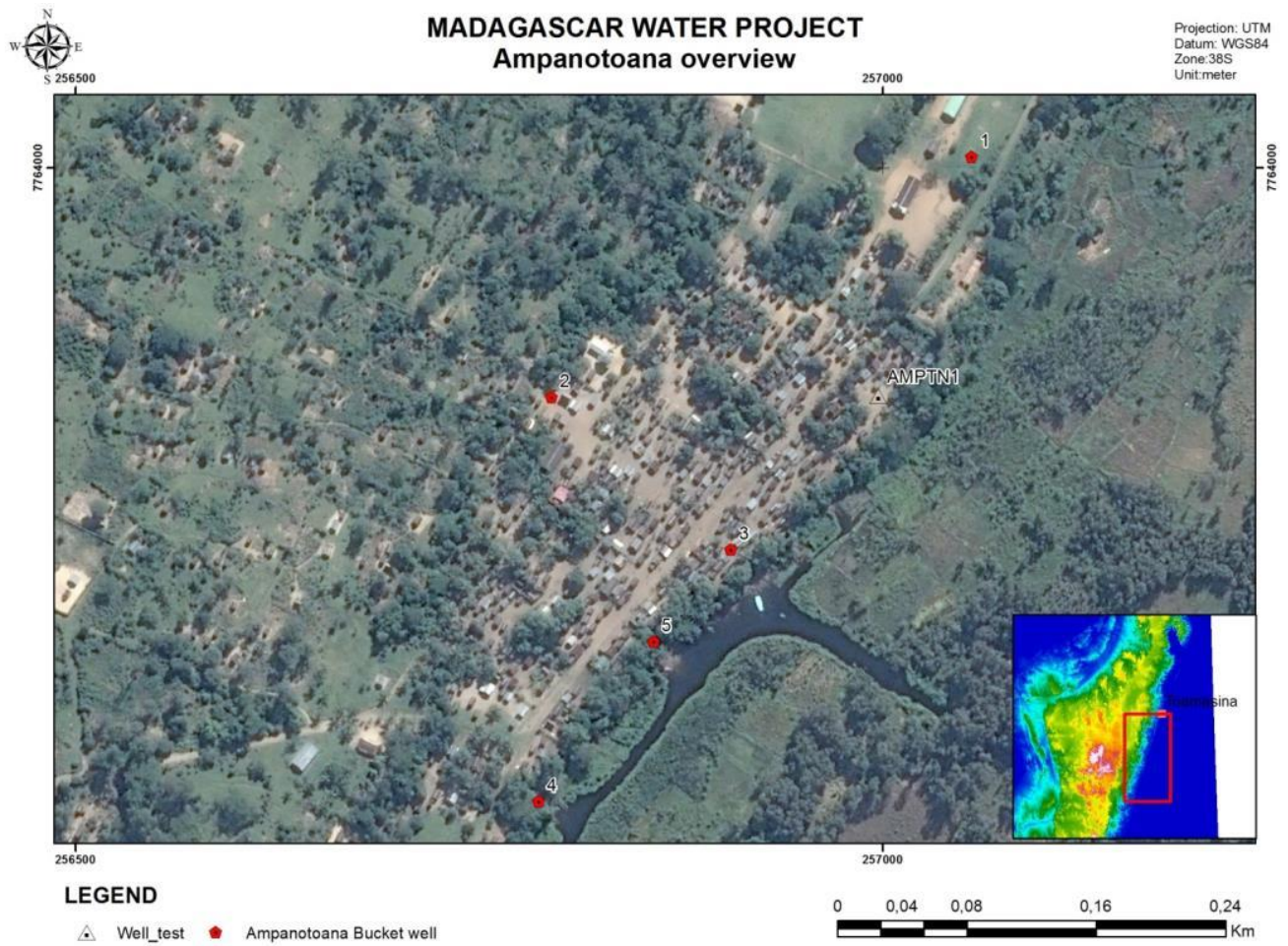


Figure 14: Ampanotoana with well locations

Ampanotoana Stratigraphic Test

The surface consists of loose sand and the lithology remained consistent to total depth of 7 meters. Hole stability was an issue near the top of the water table.

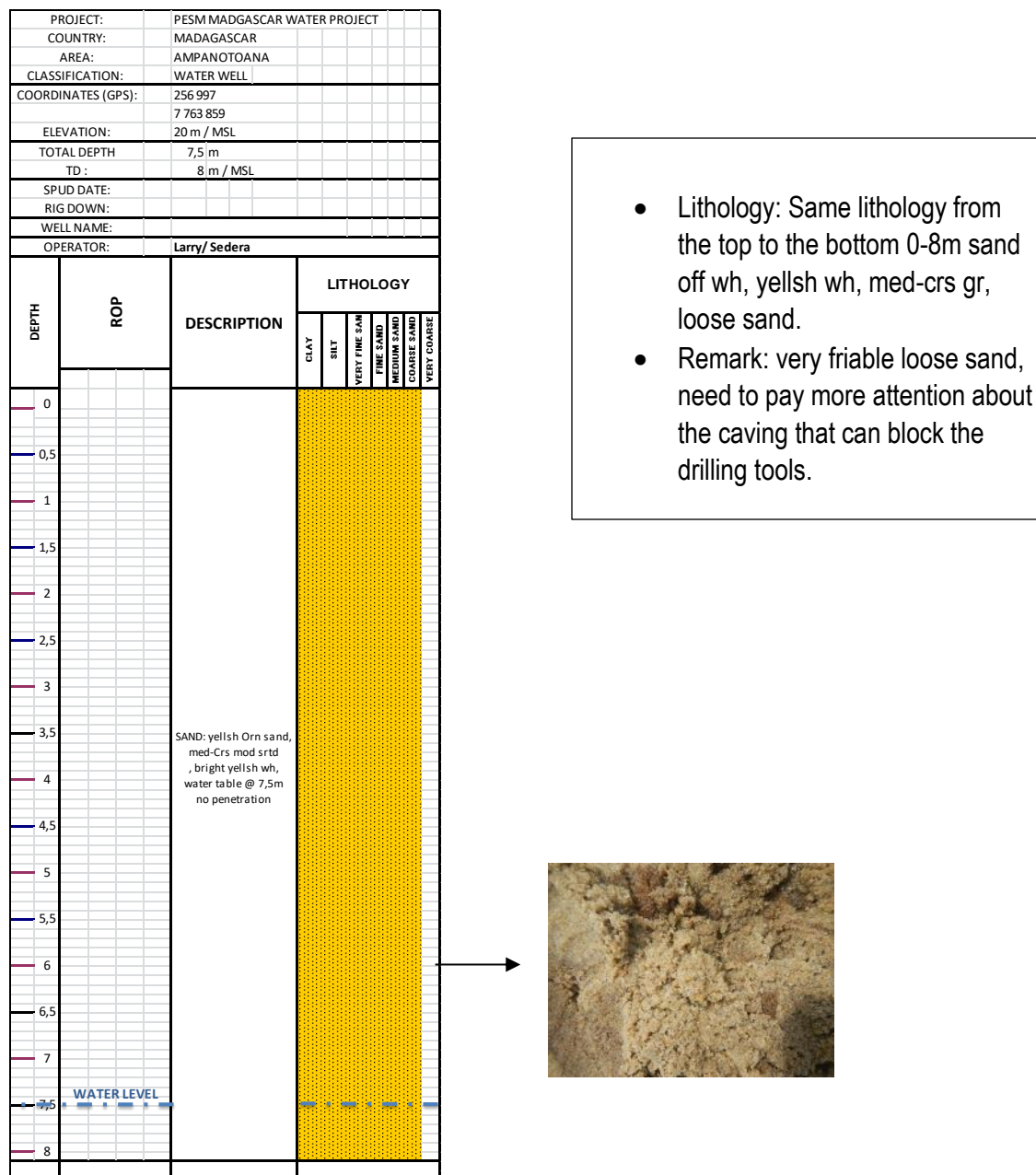


Figure 14: Ampanotoana Stratigraphic Test Log

Ampanotoana static water level modelling

The model was generated using the static water levels from the 5 existing bucket wells, out stratigraphic test data abd from conversations with some of the villagers. For interpolation, the Inverse Distance Weighted (IDW) was used, which calculates the value of the middle point between two known points and creates the grid accordingly.

The model shows a definitive high water table along the village axis i.e. NE-SW gently sloping to the west and being quite steep to the southeast along the Pangalana Channel. The maximum depth is about 8m.

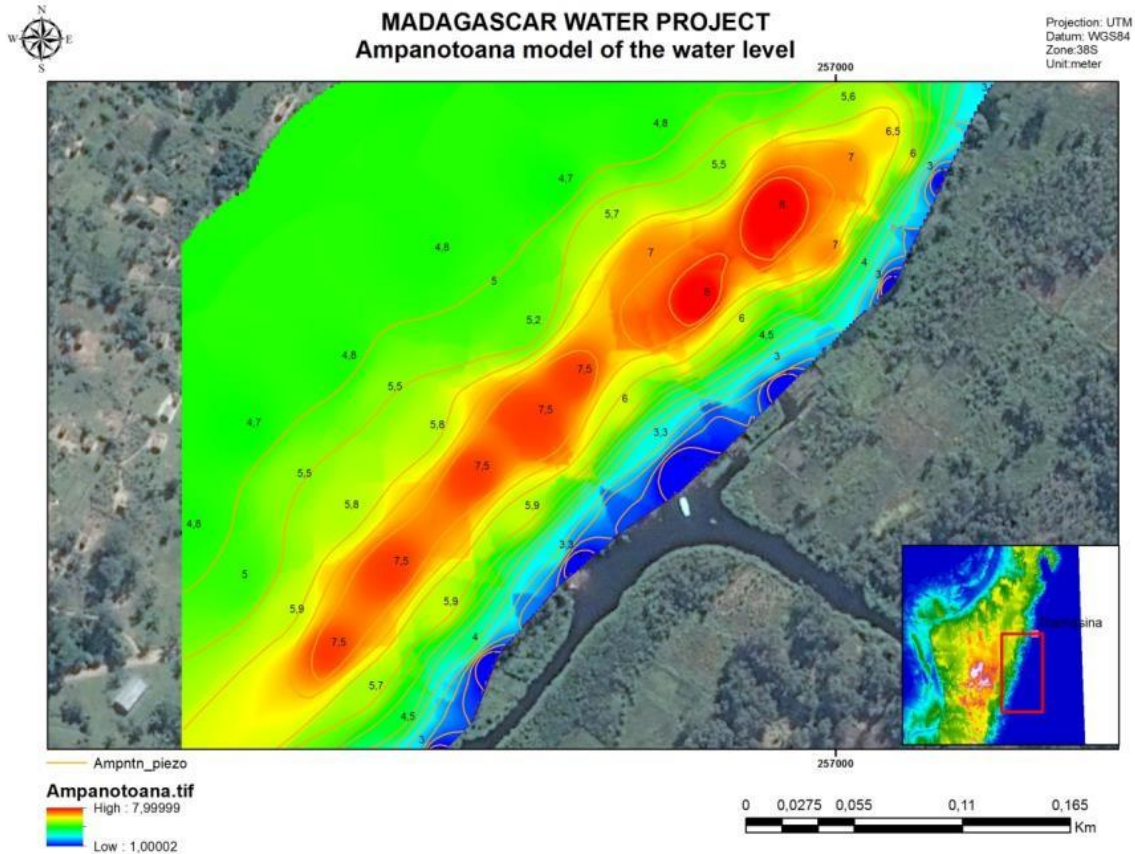


Figure 15: Ampanotoana Static Water Level Model

j. Andranotsara:

Andranotsara is a medium village with about 160 houses and 1325 people. One Indian Pump is present. It was built by UNICEF in 1998 but has not been operational for over a year. The village lies on sand and it is believed it will continue through the subsurface. According the villagers, the water table is at a depth of 6 meters. There are no indications of geologic risk.



Figure 16: Andranotsara Bucket Well

k. Ampanalana:

Ampanalana lies on a 20-meter bluff above the Pangalana Chanel. The surface is sand and it is believed it continues through the subsurface. There are two bucket wells in the village with an average static water level of 10 meters and an Indian Pump with a reported water level of 8 meters.



Figure 17: Ampanalana non-operational bucket well (a) and MEN PAUET Indian Pump (b), with well depth of 10.5m, water at 8m and production of 25 liters/min.

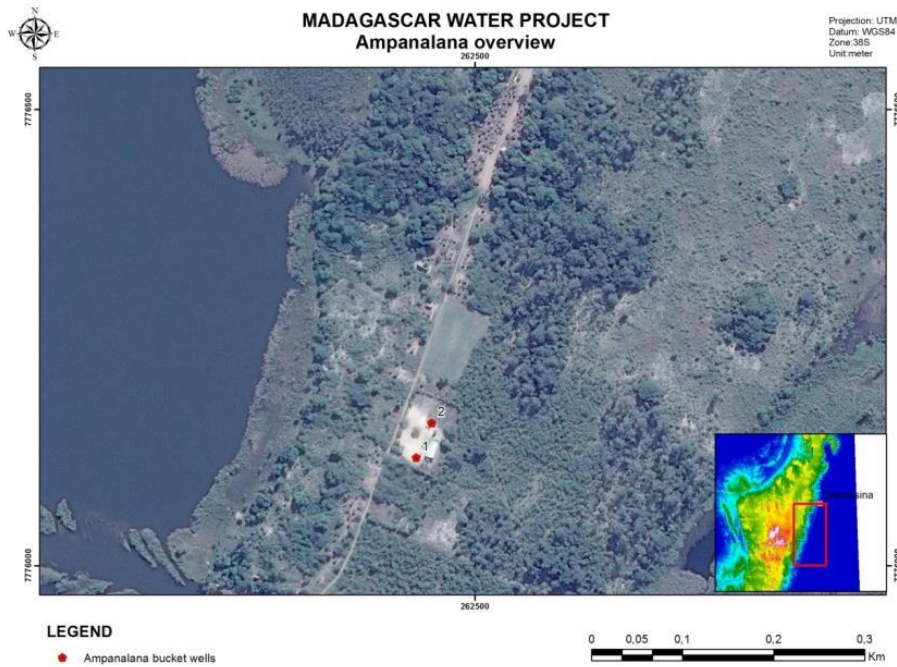


Figure 18: Ampanalana with well locations

I. Ambodiharina:

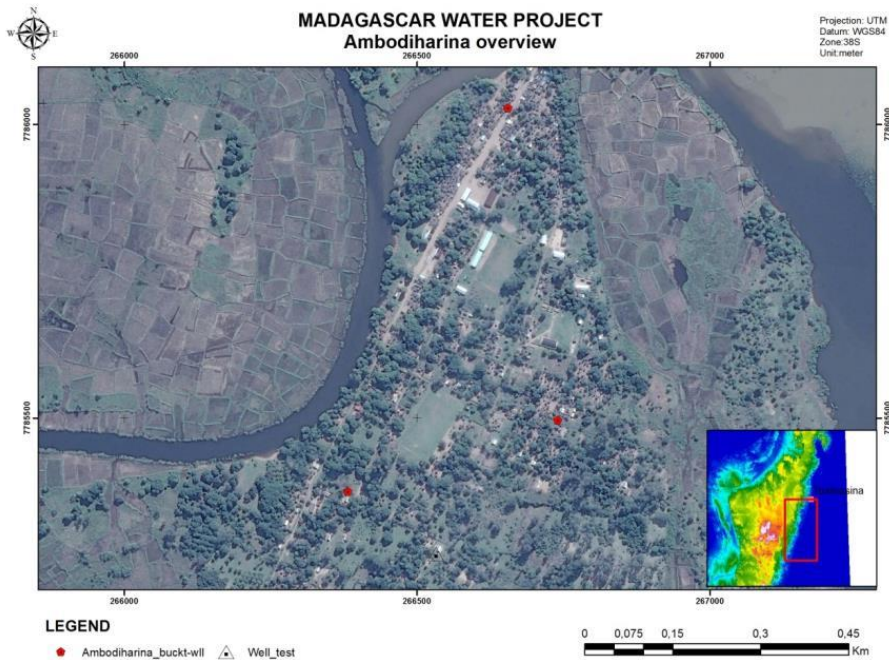


Figure 19: Ambodiharina with well locations

Ambodiharina Stratigraphic Test

The surface is sandy, surface geology indicates average sand thickness in village is 5 to 6 meters with hard rock at base, sand cemented in part, marl present in part.

A stratigraphic test was drilled to confirm lithology. Static water table reached at a depth of 3.4 meters, which is consistent with the existing four bucket wells.

PROJECT:	PESM MADGASCAR WATER PROJECT
COUNTRY:	MADAGASCAR
AREA:	AMBODIHARINA
CLASSIFICATION:	WATER WELL
COORDINATES (GPS):	266 342 7 784 876
ELEVATION:	12 m / MSL
TOTAL DEPTH	4 m
WATER TABLE	3,4 m
SPUD DATE:	
RIG DOWN:	
WELL NAME:	
OPERATOR:	Larry/Sedera

DEPTH	ROP	DESCRIPTION	LITHOLOGY					
			CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND
0		SAND: yellsh Orn sand, med-Crs mod srtd , bright yellsh wh, water table @ 3.4m no penetration. a/a TD 4m						
0,5								
1								
1,5								
2								
2,5								
3								
3,5	WATER LEVEL							
4								

- Lithology: Same lithology from the top to the bottom 0-4m sand off wh, yellsh wh, med-crs gr, loose sand.



m. Salehy:

A stratigraphic test was drilled to confirm lithology and the water table was reached at a depth of 3.8m. No geologic risks are indicated.

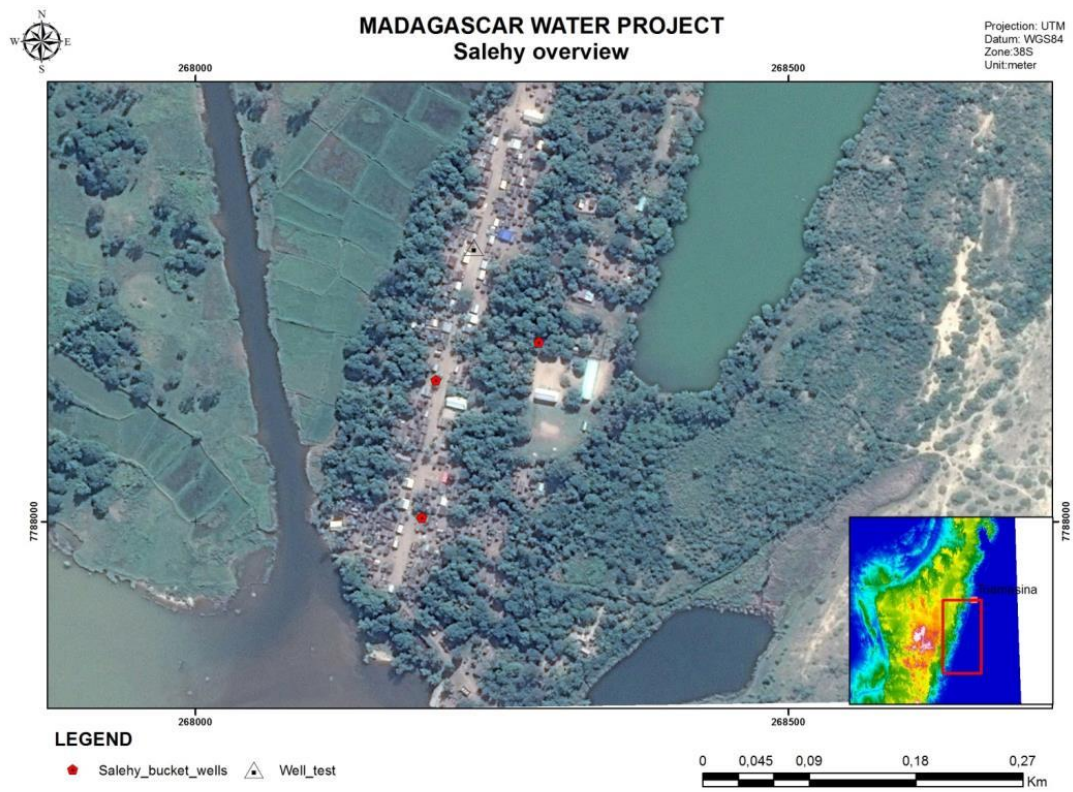
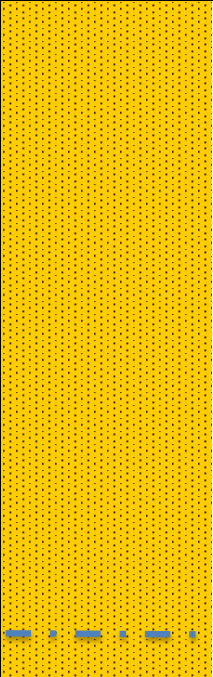


Figure 22: Sahely with well locations



Figure 23: Sahely bucket wells

Figure 24: Sahely Stratigraphic Well Test Log

PROJECT:	PESM MADAGASCAR WATER PROJECT									
COUNTRY:	MADAGASCAR									
AREA:	SALEHY									
CLASSIFICATION:	WATER WELL									
COORDINATES (GPS):	268229.73									
	7788209.07									
ELEVATION:	8 m / MSL									
TOTAL DEPTH	3,9 m									
WATER TABLE	3,8 m									
SPUD DATE:										
RIG DOWN:										
WELL NAME:										
OPERATOR:	Larry/ Sedera									
DEPTH	ROP	DESCRIPTION	LITHOLOGY							
			CLAY	SILT	VERY FINE SAND	FINE SAND	MEDIUM SAND	COARSE SAND	VERY COARSE	
0		SAND: yellsh Orn sand, med-Crs mod srted , bright yellsh wh, water table @ 3.8m no penetration. a/a TD 3,9m								
0,5										
1										
1,5										
2										
2,5										
3										
3,5										
4										

- Lithology: loose sand yellowish brown, crs –v crs gr, mod srted, finning up sequence.

n. Tsangambato

Tsangambato is a medium-size village with about 70 houses and 550 persons. Three bucket wells are present. The village lies on sand which is estimated to be 7 – 8 meters thick before hard rock is encountered. There is some risk if finding clay towards the west. The static water table lies at 4.5 meters.

o. Ankazomirafy

Ankazomirafy is a small village with 60 houses and a population of 400 people. Three bucket wells are present on the west side of the village. The static water level appears to be 7 meters in the center of the village and shallowing to about 4 meters elsewhere



Figure 25: Ankazomirafy bucket well