MADAGASCAR WATER PROJECT

2020 WINNER ENERGY GLOBE NATIONAL AWARD MADAGASCAR

Betroka, Madagascar Water Resource Assessment

Conducted on Behalf of

Friends of Madagascar Missions

February, 2021

FIELD TEAM

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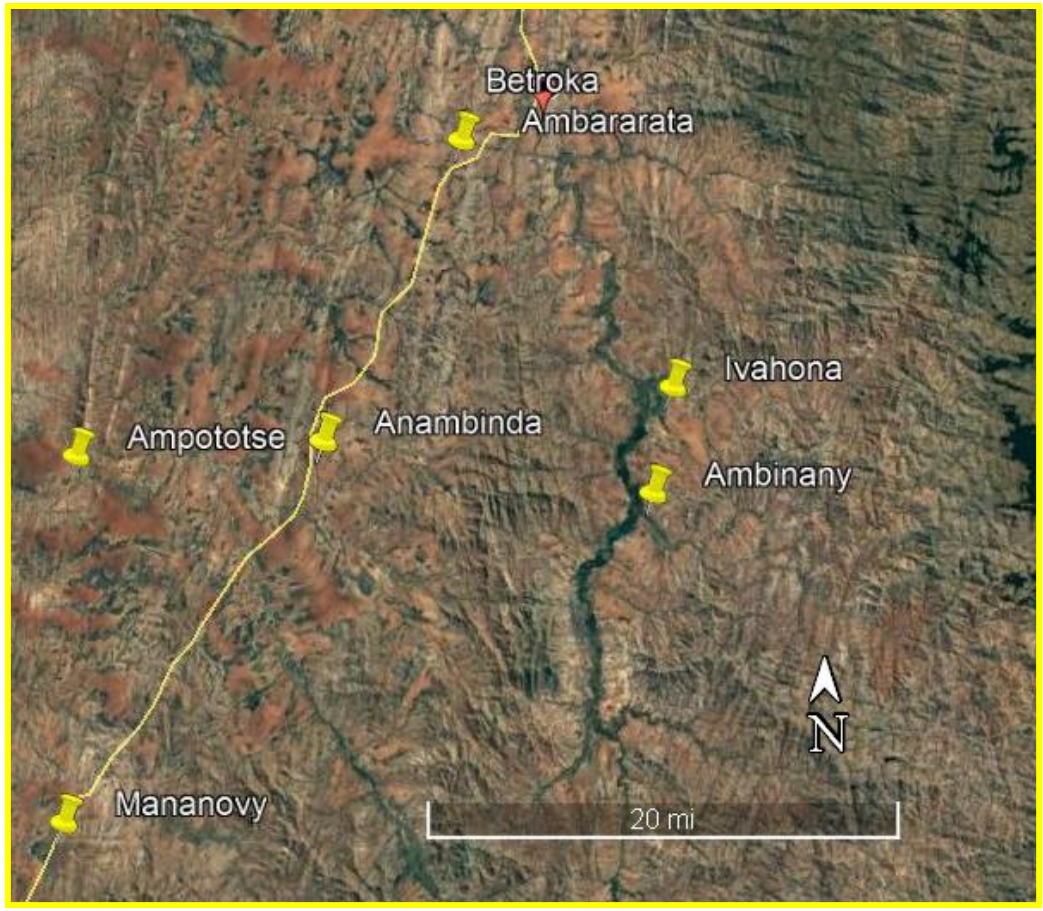

I – INTRODUCTION

I-A. Objectives

A reconnaissance trip was made to Betroka at the request of Friends of Madagascar Missions (FOMM) from Monday 15th to Friday 26th of February 2021 by the MWP Team.

The objective of the study:

- To identify areas in need of clean water
- To determine if the social organization and structure can manage a community-based resource
- To evaluate the subsurface geology to determine if shallow water resources can be developed using the methods & technology employed by the MWP / PESM. The evaluation includes the following:
  - Compilation of existing geologic maps & other data to identify potential aquifers;
  - Evaluation of geologic data available from existing wells, primarily through interviews with residents and data collected by earlier water development projects;
  - Drill stratigraphic test holes to determine the subsurface lithology and depth of the water table.

The Madagascar Water Project Field Team on Location

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I-B. GENERAL VIEW

The MWP Team visited nine villages. The Lutheran missionaries provide guidance and assistance in villages where they were active, including Betroka, Ambararata, Anambinda, Ampototse and Mananovy. The MWP Team also visited other villages including Ivahona, Ivahona-rova, Ankotobory, Ambinany and 3 unnamed hamlet villages.

The area suffers from extreme drought conditions. Water is a scarce resource for both agriculture and human consumption, resulting in widespread malnutrition and prevalence of water-borne disease. Rivers, some of which are intermittently dry, remain the only source of water for most people. Some have private bucket wells but they too go dry.

Farming is limited to cassava and most rice fields are dry. Starvation is widespread. Extreme poverty has caused a lot of crime and some of it can be quite violent. Safety is a big issue and the theft of existing pumps and water facilities make most efforts dangerous and futile.

Tribalism is strong and makes community organization difficult. The “Bara” and “Antandroy” cohabitate many villages but remain competitive and uncooperative among themselves.

Roads conditions are bad and sometimes become impassable. Infrastructure such as hospitals, clinics and schools don’t exist in remote villages. Jirama provides water in Betroka from a river source, with questionable quality.

The Lutheran Mission in Betroka provides aid in the area. They provide accommodations, food, schools and agricultural training. However, the lack of water remains an issue and there is still much work to do.

Family in Ambinany

Geologically, most villages are built on weathered basement and are not conducive to shallow water wells. Many existing wells had to be drilled outside of the villages and were subsequently stripped and are now unproductive. Some bucket wells have been hand-dug in villages to depths of around 13 meters, but they are not productive year-round.

II – DETAIL OF EACH VILLAGE

II-A. BETROKA VILLAGE 23° 16'8.86" S, 46° 5' 58.27" E

Betroka is a large commune with more than 1,200 households. There are two Tribes, the “Bara” and the “Antandroy”. Their cohabitation is problematic, and they accuse each other of all wrongs.

Betroka lies on the route to Tolagnaro. The economy is built on commerce, agriculture and livestock. It has basic infrastructure including schools, a small hospital, churches and city water.

The Lutheran mission has a “Toby” to help people due to drought. They provide accommodations, food, schools, agricultural training as well as spiritual guidance.

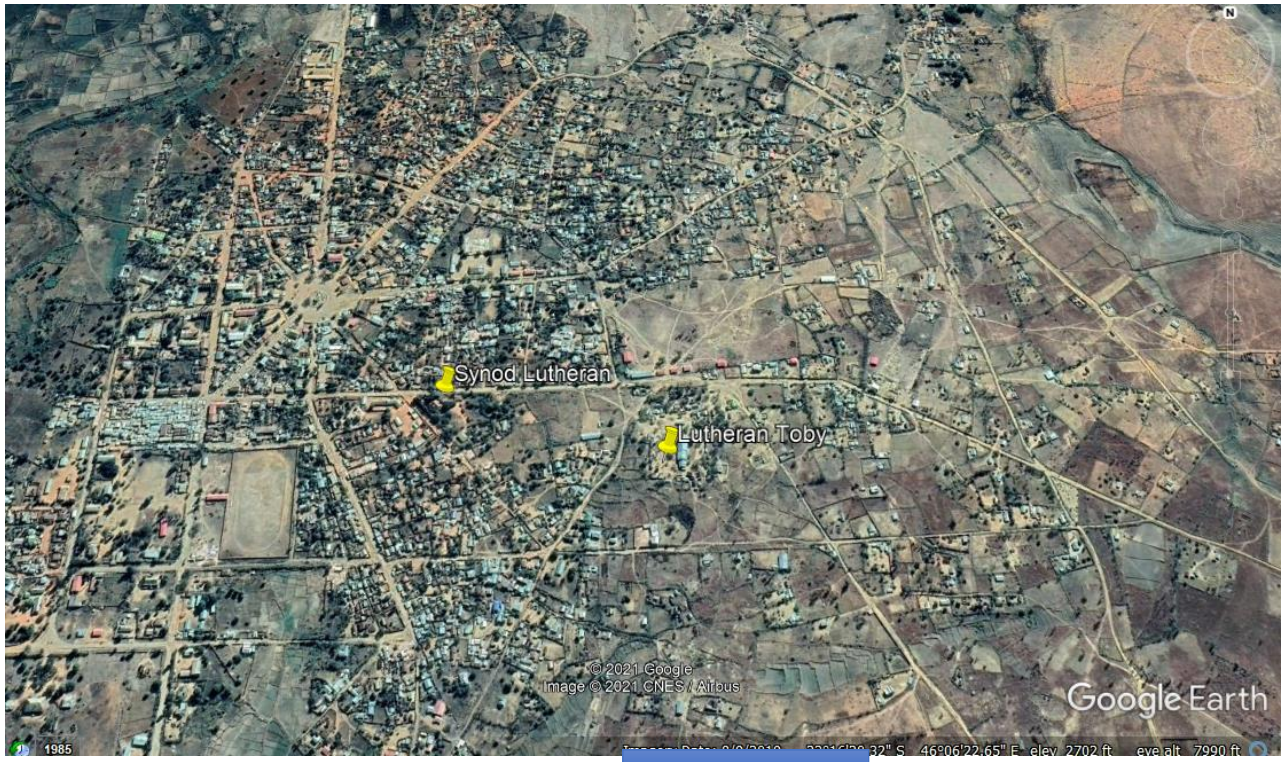
Existing water infrastructure

Jirama, a government company, provides water in the village. Since it is from a river and treatment is seen as unreliable, many people question and complain about the water quality.

Seven open bucket wells were dug for public consumption, but they go dry during the dry season. The water table can be as shallow as 4 meters at other times. Basement outcrops in much of the village and limits locations for potential shallow water wells.

Recommendation

The MWP does not compete with city-wide infrastructure such as Jirama.



Village of Betroka

Additional Information can be found in Figure 1

II-B. LUTHERAN "TOBY CENTER" in Betroka village 23° 16'12.79" S, 46° 6' 11.24" E

Toby Center

The Lutheran Mission built a Toby to help care for the desperately poor, victims of drought and those affected by banditry. There are more than 1,000 people, about 400 being children. The Mission provides accommodations, food, education and agricultural training and empowerment. The Mission uses water provided by Jirama but it is not practicable for agricultural use.

Geology and Water Well Potential

The Mission lies on weathered basement and has low potential for the shallow aquifers normally targeted by the MWP. They previously contracted a rig that found water at 30 meters. The Contractor believed it was a low-volume producer and plugged and abandoned the well. Attempts were made to find the hole without success.

An Electrical Resistivity Tomography (ERT) survey of the area exists. An examination of the data showed the possibility of a fracture zone and reprocessing and/or reinterpretation of the data may identify potential subsurface water targets.

Recommendation

There is a very low probability of success to drill a well with our current technology. It has been suggested an open bucket well could be dug and a pump could be placed on the surface. The MWP does not dig open bucket wells but we can assist in mounting a pump if a bucket well is built.

The MWP may assist in reinterpretation of the ERT data, but all interpretations have risk.

MWP Field Team with Lutheran Missionaries

II-C. MANANOVY 23° 43' 52.34" S, 45° 46' 20.46" E

Mananovy is a very large village with more than 350 households. Both the Lutheran mission and Catholic missions work there. The economy is supported by agriculture, with garlic, onions and rice forming a bulk of the crops. Since it hasn't rained in two years, crop production has dropped to nothing. The population is made up of Bara and Antandroy and tribalism is an obstacle to community planning.

Existing Water Source

The river remains the only source of public water, but it goes dry intermittently. There are five open bucket wells for public use, but they are all dry, plugged, broken or abandoned. A new one of unknown origin is locked.

The Lutheran Mission has a private bucket well in their compound, dug to a depth of 13 meters, which is still producing. They have a second well that was drilled by a rig. It is equipped with a submersible pump, solar panel, surface tank and four water stations inside the village. It is, however, not operational due to either a low water level and/or technical problems.

Geology

The surface consists of weathered basement transected by several faults. A small sedimentary channel was identified and tested for its water potential.

MWP Action

The MWP Team drilled two test wells, one of which found water at a depth of 6 meters. It was cased for future completion, although it is understood it may go dry at the height of the dry season or with further drought. GPS coordinate 23° 43' 44.54" S, 45° 46' 24.77" E .

Recommendations

Complete the well as drilled.

Investigate problems with the unproductive well in the compound and repair if possible

MWP Field Team doing stratigraphic hole test in Mananovy

Additional Information can be found in Figure 2

II-D. AMBARARATA 23° 18' 42.68" S, 46° 2' 26.60" E

Village

Ambararata is a small village with 60 households, made up primarily of people of the Antandroy Tribe. The economy is agricultural. The Lutheran Mission has a presence there.

Existing Water Source

Flooded fields are currently the only source of water. UNICEF drilled two wells in locations on the edge of the village, placed there for geologic reasons. Both wells are not functional. One well has downhole mechanical issues and thieves have taken the pump off the other.

Geology

Ambararata is located on weathered basement and any water potential would be in fractured basement.

MWP Action

The MWP Team looked at both wells to evaluate potential remediation options.

Recommendation

One or both of the UNICEF wells should be repaired. The pumps need to be secured, perhaps with the construction of a locking enclosure.

Drilling a new well or digging a bucket well are less attractive options.

Source of water in Ambararata

Additional Information can be found in Figure 3

II-E. ANAMBINDA 23° 29' 47.72" S, 45° 56' 41.04" E

Anambinda is a commune with more than 350 households. The economy is agricultural. With large components of both Bara and Antandroy, tribalism makes community-wide initiatives difficult

Existing Water source

The river, which at times goes dry, is the only public water source. A private bucket well with a limited production capacity is also available to some.

Two Indian Pumps have been installed outside the village because of geologic reasons. One has been stripped by thieves and is now plugged. The other is 26 meters deep, is partially stripped by thieves, and has mechanical problems that are likely repairable (see photo to right).

Geology and capability

The village is built on weathered basement and is not a good location to drill shallow water wells using the existing MWP drilling technology.

MWP Action

The MWP compiled existing geologic maps and other data to identify potential depocenters. Geologic data from existing wells were also evaluated. No new drilling locations were identified.

Both existing wells were evaluated to determine possible remediation measures.

Recommendation

The broken Indian Pump should be repaired and secured with a locking enclosure.

Broken Indian pump in Anambinda

Additional Information can be found in Figure 4

Village of Ampototse

II-F. AMPOTOTSE _23° 30' 29.73" S, 45° 46' 45.38" E

Ampototse is a Fonkotany with about 80 households. The economy is agricultural. Being a relatively small village, community-wide planning is possible.

Existing Water source

There are no public water sources in the village. There is a private open bucket well, dug to a depth of about 10 meters. Two Indian Pumps were drilled outside of the village for geologic reasons. Both have been stripped by thieves and plugged. The need for a new public water source is very high.

Geology and capability

The village is built on weathered basement. The surface is very hard and drilling through this interval with hand tools to reach the water table at 8 meters will be difficult.

MWP Action

Existing geologic maps and other data were evaluated with data from bucket wells to identify optimal drilling locations.

Recommendation

Drill a well with hand tools or as a bucket well and install a pump.

Additional Information can be found in Figure 5

II-G. IVAHONA 23° 27' 23.85" S, 46° 10' 21.13" E

Ivahona is a Commune with 450 households. In the past it has been a prosperous agricultural center with rice being the dominant crop. The drought has significantly reduced the agricultural production.

The population is made up of both Bara and Antandroy and tribal tensions make community planning difficult. Security is an issue.

Existing Water source

The only public water source is the River Mangoky. Some private open buck wells exist, with most dug to about 12 meters. Four Indian Pumps were drilled outside of the village for geologic reasons but have since been stripped by thieves and plugged.

Geology

The village is located on basement.

MWP Action

The MWP drilled a stratigraphic test on the edge of the village. The water table was found at 2.6 meters although local opinion is it will drop to 10 meters during the dry season. The hole was cased with the possibility of completing it at later.

Recommendation

Complete the existing hole and evaluate other locations as needed.

Village of Ivahona

Note, the Lutheran Mission does not have a presence in Ivahona

Additional Information can be found in Figure 6

II-H. IVAHONA-ROVA 23° 27' 32.58" S, 46° 12' 1.28" E

Ivahona-rova is an extension of Ivahona village, with about 200 households.

Existing Water source

The River Mangoky is the only source of water in the village.

Geology

The geology is the same as Ivahona.

MWP Action

A geologic study is included with Ivahona and further data needs to be obtained.

Recommendation

Evaluate locations for drilling potential.

Note, the Lutheran Mission does not have a presence in Ivahona -Rova

Village of Ivahona-rova

II-I. AMBINANY 23° 31' 54.67" S, 46° 10' 12.00" E

Ambinany is a small village with about 80 households. There are also three small hamlets nearby. It has an agricultural economy but the drought has stopped all production. The population is Bara so tribal tensions are not present.

The village is extremely poor and starvation is widespread. Casava dominates their diet because it doesn't require a lot of water.

Existing Water source

The only source of water is the River Mangoky.

Geology and capability

The village is located on weathered basement, which is hard and difficult to drill with hand tools. The potential for shallow aquifers is low.

MWP Action

The MWP drilled three stratigraphic test holes. The water table was not reached.

The MWP purchased and distributed 350 kg of rice to about 700 residents.

Recommendation

Water can be pumped from the river to the rice fields with the use of a high capacity "Trash Pump". However, security issues make this unsustainable without significant changes to improve the security outside of the village.

Distribution of rice in Ambinany

Note, the Lutheran Mission does not have a presence in Ambinany

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Figure 1: Betroka

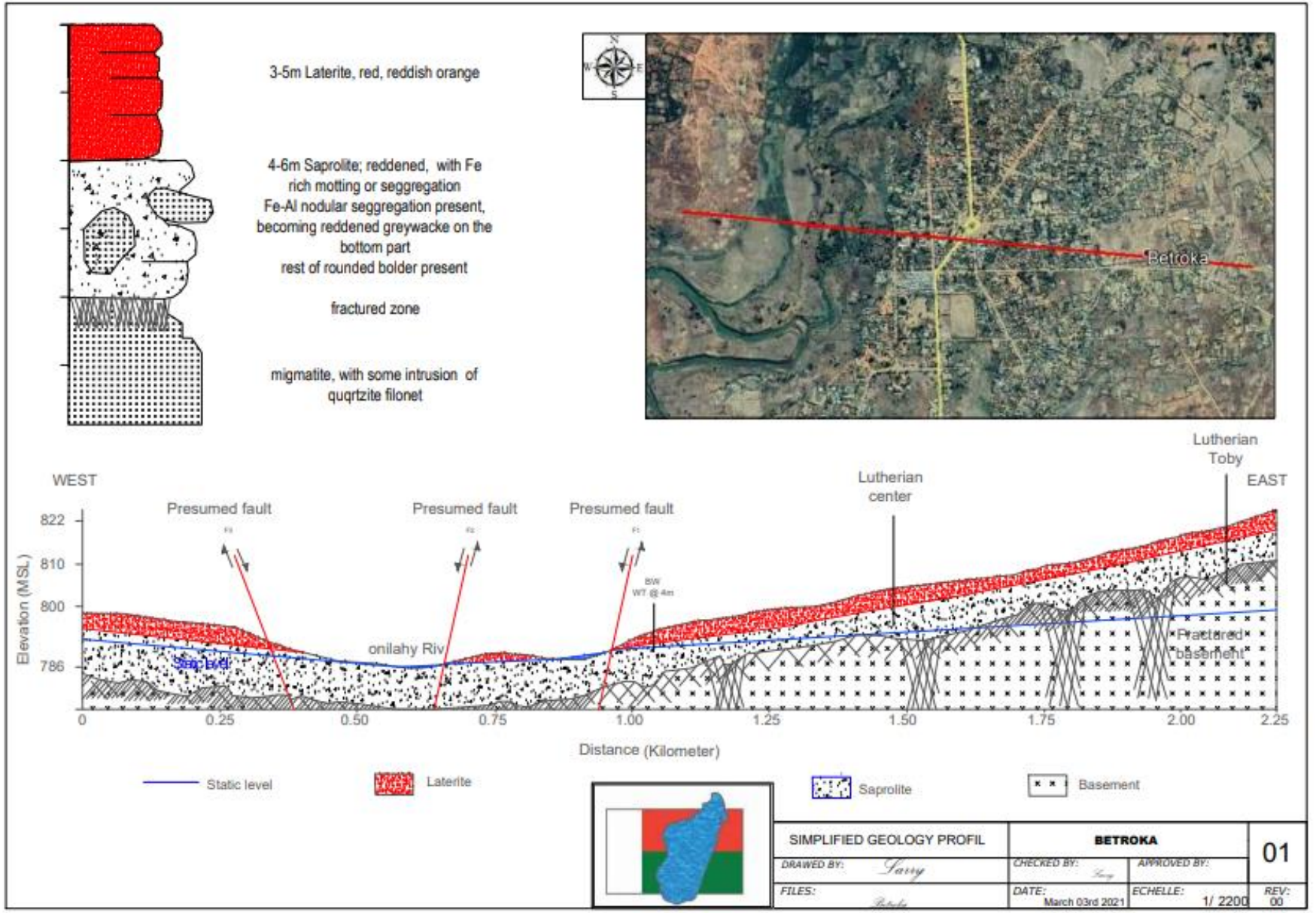

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Figure 1: Mananovy

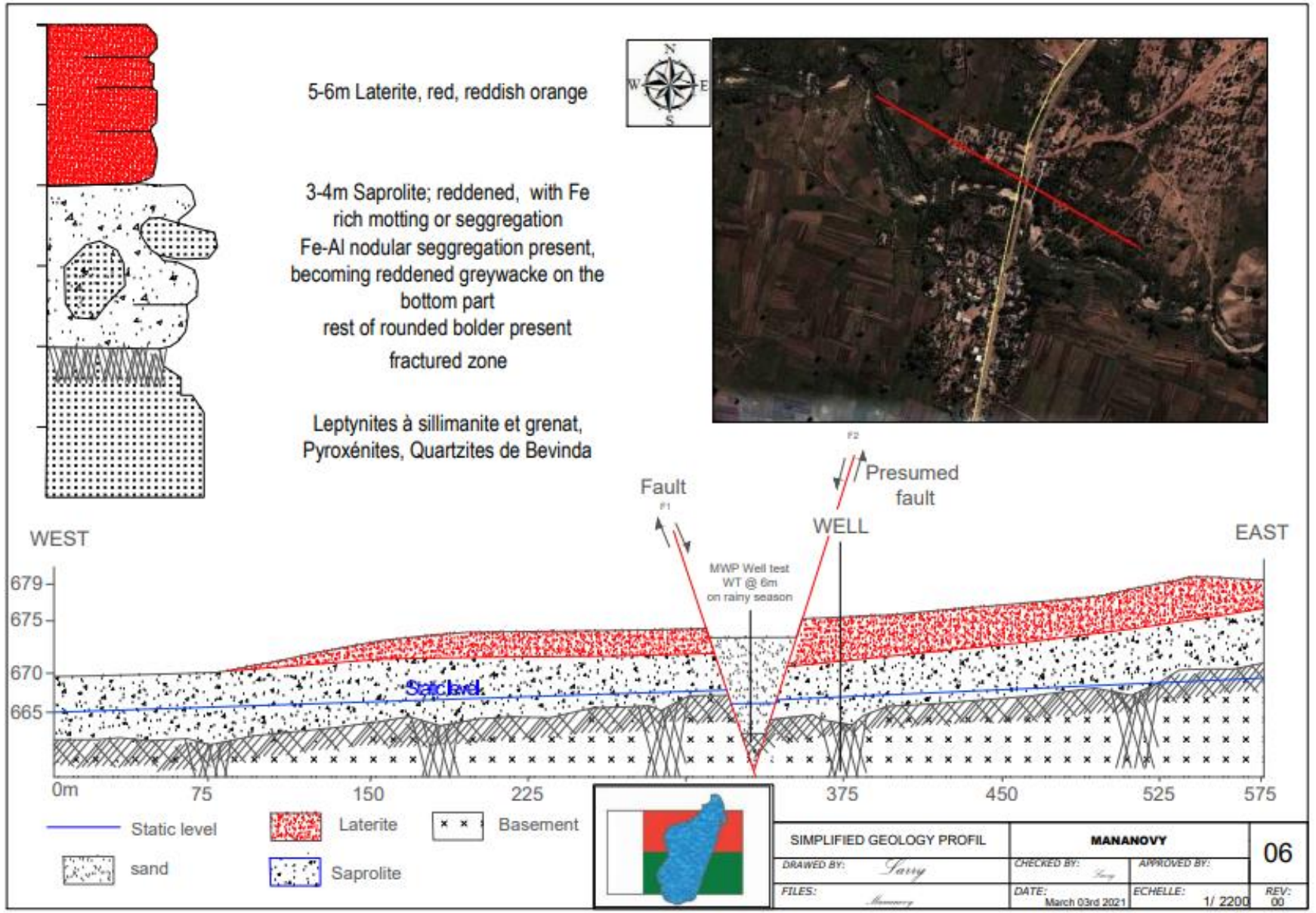

Figure 3: Ambararata

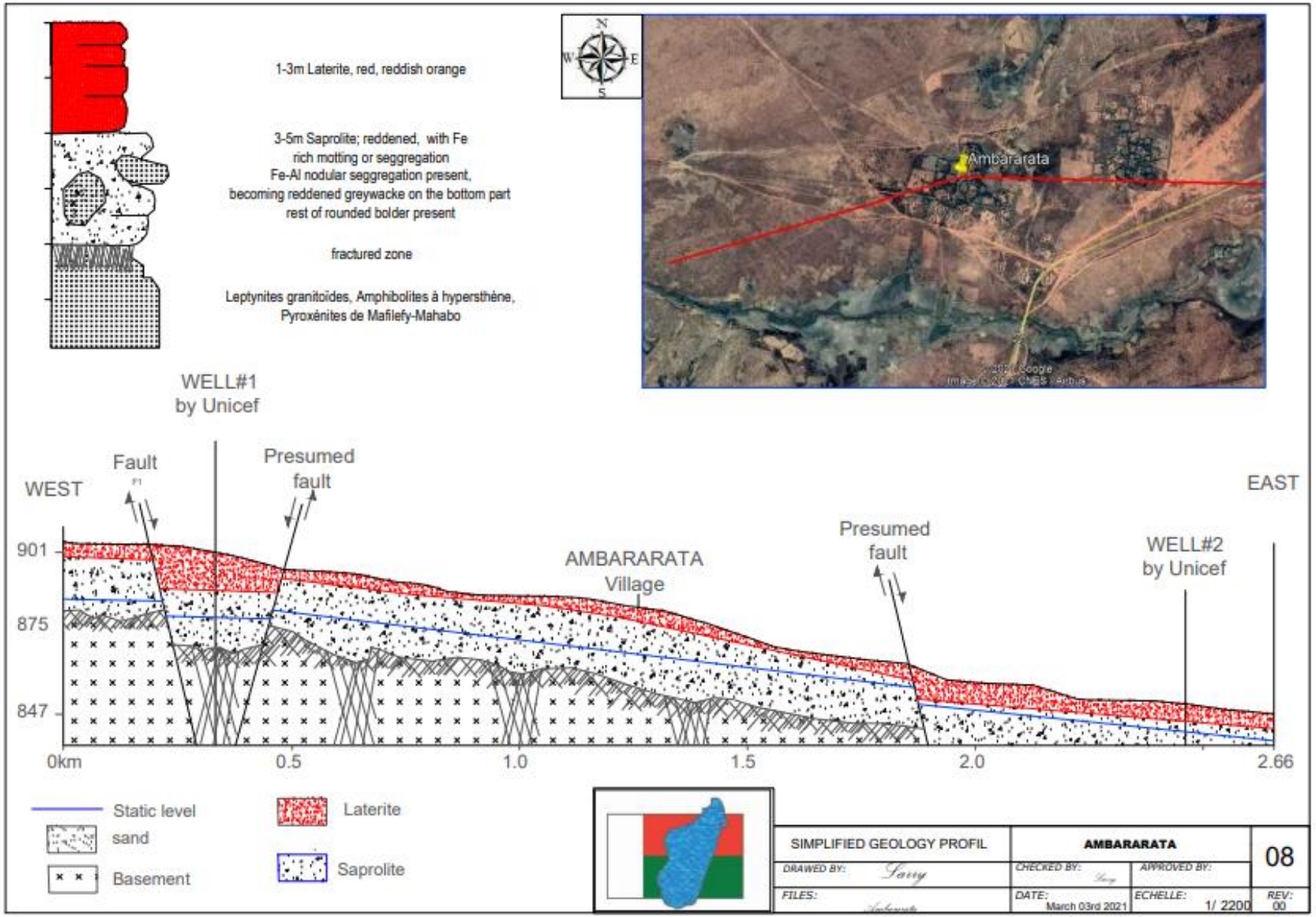

Figure 4: Anabinda

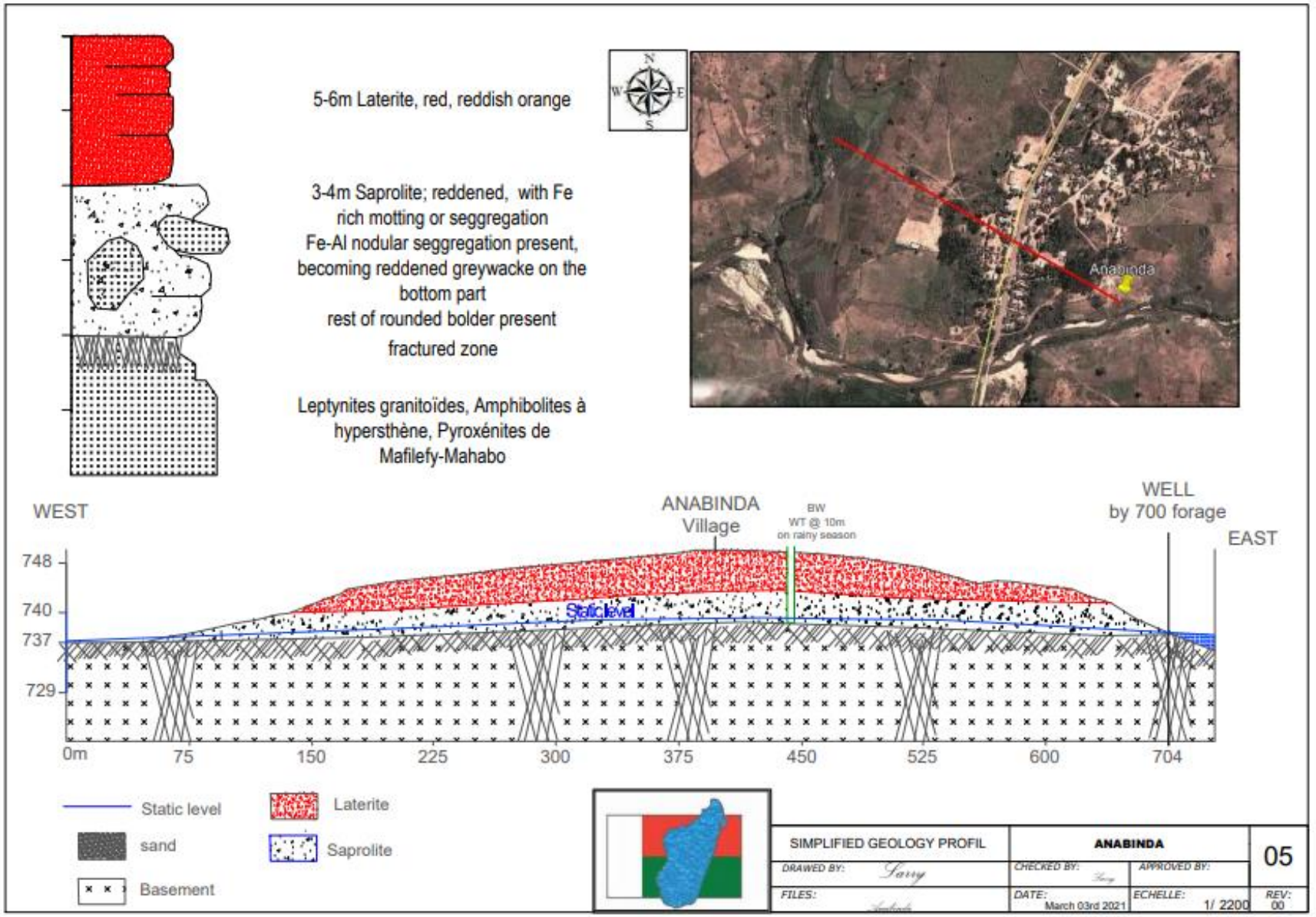

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Figure 5: Ampototse

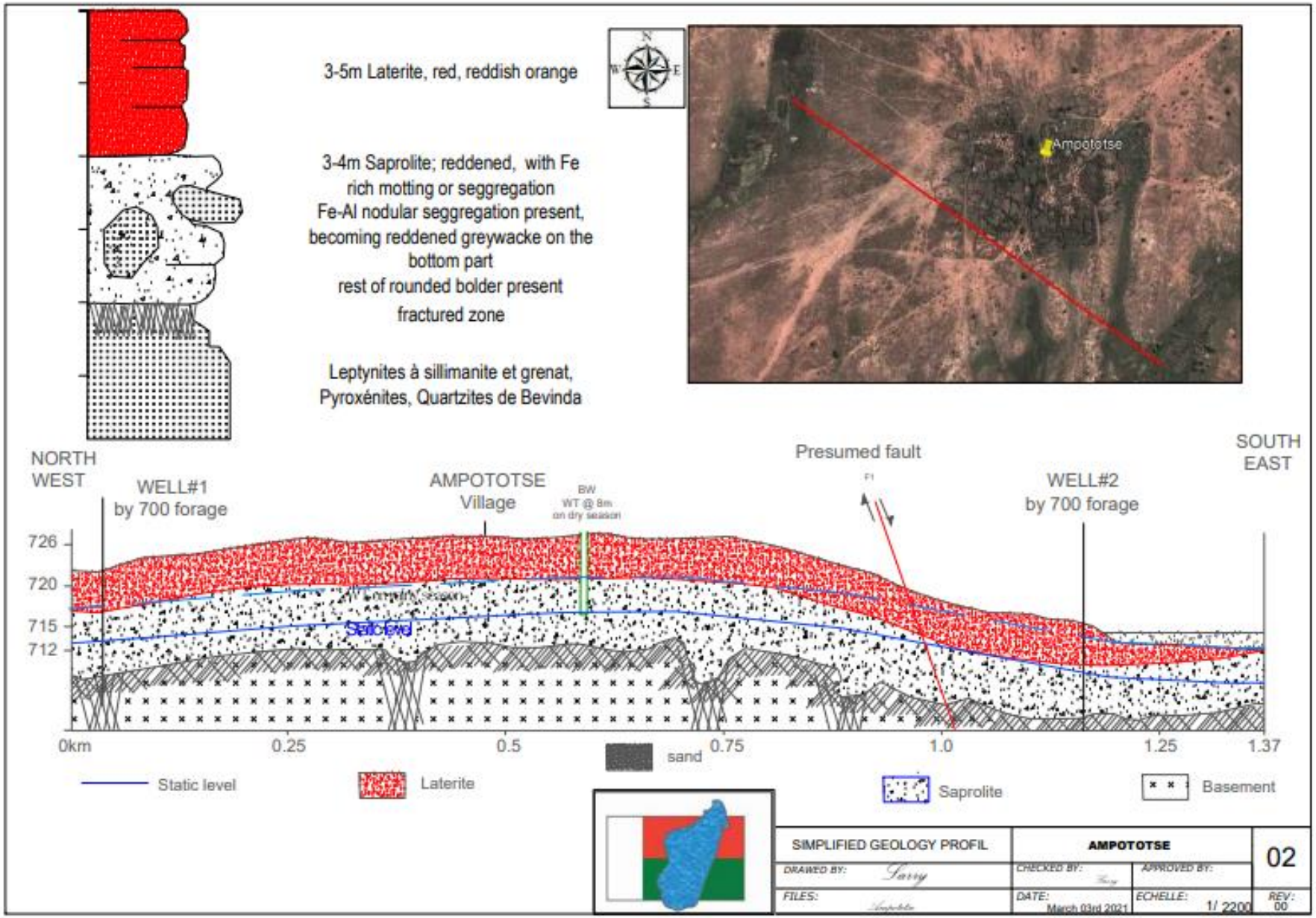

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Figure 6: Ivahona