Appendix-6 Results of Scio-economic Survey

1. Survey and Methods

Three kinds of survey were conducted in the project communities as follows:

Survey and Methods

	Survey	Method	Survey Target	Contents/Topics
1	Community Survey	Questionnaire	All the project communities (total of 51 communities)	WSC, Sanitation, Hygiene and Health, Existing Water Source, Water Fetching, Expectations and Fears toward the Project, etc.
2	Household Survey	Questionnaire	2 households in each project community (total of 102 households)	Household Economy; income and expenditure Water Fetching
3	Supplementary Survey	Interview Discussion PRA Observation	Total of 6 project communities in 4 regions	WSC, Health and Hygiene, Existing Water Source, Social Conditions, Economic Conditions, Conditions of women, etc.

Four enumerators who were locally hired in Mbabane administered both Community Survey and Household Survey. The original survey questions were written in English, and the enumerators interpreted the questions into local languages when interviewing a subject. The Community Survey was conducted on those who knew much about the target community such as WSC executives or the elders (community leaders). The survey topics included number of times each household goes to fetch water in one day, distance and time to existing water source, and conditions of common sickness in community, which can be indicators for Project effects. In addition to such objective and quantitative questions, subjective and qualitative questions such as villagers' feeling and thoughts toward water fetching and water conditions were also asked, while taking account of participatory monitoring in the future.

Household Survey was conducted on one poor household and one rich household in every community so that this will give a balanced view of the community. "Poverty" and "richness" were not defined rigidly. Instead, what people in communities use in their everyday life as criteria to define each other's economic status were used. These include "number of cattle owned by household" and "house conditions and structure"

The Japanese expert on social development administered the Supplementary Survey through visits to 6 project communities with RWSB personnel who acted as guide and interpreter. In communities where the visits were announced beforehand, regular villagers as well as major members of the communities such as WSC executives, members of Village Development Committee, members of Women's Group, schoolteachers, and Rural Health Motivators got together for discussion and interviews. In communities where the visits were not announced, interviews and simplified PRA were conducted in places like community office and homesteads on the spot whenever villagers agreed to talk. Hence, Supplementary Survey was done by using survey methods most suitable to the circumstances to examine how villagers make their living and how they deal with water in everyday life. Listening to the real voices of villagers, which

questionnaires often fail to capture, visiting existing water sources, and seeing plastic containers and wheel barrows used for water fetching were also parts of the Supplementary Survey

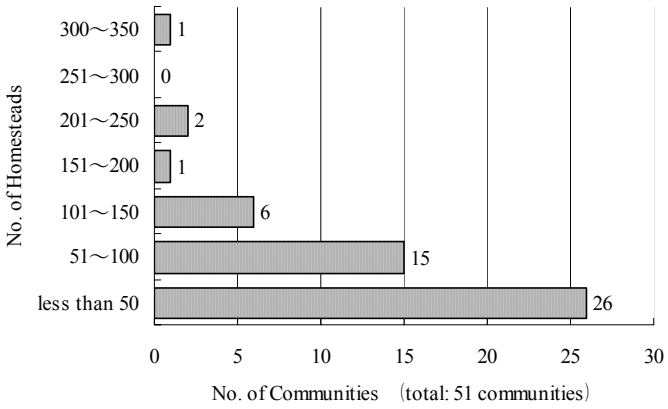
2. Village Society

(1) Community and Household

In Swaziland, traditional social structure and modern social structure with modern political and administrative bodies coexist. The traditional social structure centers around a chiefdom that is controlled by a powerful chief. The modern social structure, on the other hand, is made up of communities (equivalent of villages in other countries), Tinkhundla (= districts) and regions (= provinces). These two social structures do not fully match. In some cases, one chiefdom corresponds with one community, but in other cases, one chiefdom is divided into several communities, or parts of different chiefdoms make one community. People's sense of belonging to a chiefdom is qualitatively and quantitatively different from that of belonging to modern communities. Those who belong to the same chiefdom may cooperate and unite across different communities. On the other hand, people belonging to one community may not unite because their loyalty to chiefs are stronger than that to the community. Even if people in the same community are to share a hand pump, it does not necessarily mean that they share a strong sense of unity, a community bond.

If chiefs are not involved in mediation of a conflict or in decision making in communities, people often do not give support to such decisions, making the decisions ineffective. For this reason, to get support to WPC from members of community, it is important that the WPC is fully supported by not only community representatives in the modern political structure but also by chiefs and by the elders who assist the chiefs.

Each community in the project area covers a very wide area where groups of households called homesteads are scattered around. A homestead is sometimes made up of only one person-household. Other times, it is made up of 10 households of married brothers and sisters or of different wives of one man, living side by side. Among the project communities, the smallest community has only 10 homesteads, while the largest has 357 homesteads. The average number of homesteads is 74, although more than half of the project communities have less than 50 homesteads. Census of Swaziland does not include the size of population of communities. Instead, the number of homestead is recorded. Although accurate population figures do not exist, the size of population in a community is regarded as 10 times the number of homesteads. Hence, the average number of population in project communities is estimated as 740.



Size of Homestead per Community
(Average：1 community = 74 homesteads)

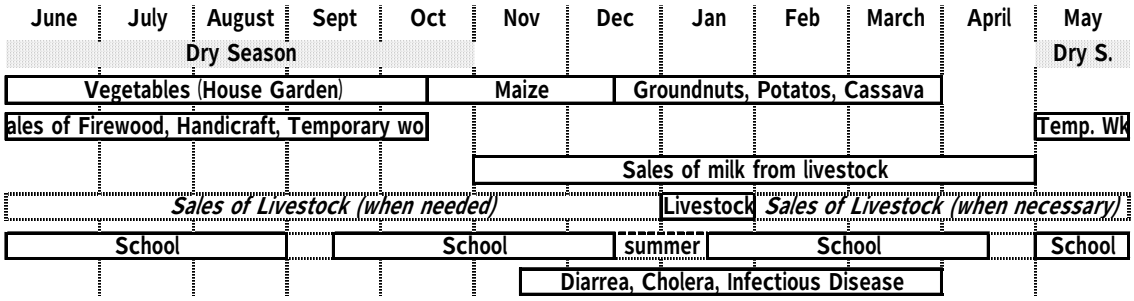
Large communities cutting across

different chiefdoms weakens a sense of belonging. People's sense of belonging to the same homestead is strong because members of a homestead are related by birth or marriage. Households belonging to the same homestead are economically independent of one another. Cooking and water fetching are done by each household.

(2) Seasonal Calendar Focusing on Livelihood

Although life ways of people in the project communities vary widely, people's lives are greatly affected by seasons: (i.e., by climatic changes). In the rainy season people grow maize, groundnuts, beans and potatoes. In the dry season they tend a small amount of vegetables near their houses or nearby rivers. In dry season when people are free from hard agricultural labor, they make their living by going to mountains to collect firewood (for sale, making and selling handicraft items such as wood carvings and baskets) and/or working as laborers in commercial farms nearby. As for health fluctuation, diarrhea and infectious diseases are more common in rainy season, making people unable to work on their farms when more labor is needed.

Not many households in the project communities have a large number of livestock nor sell livestock as a regular source of income. Livestock is sold only when money is needed for festivals and special ceremonial occasions including weddings, funerals, etc. In January when a school year starts, many households sell their livestock to pay expenses for education. Some households sell milk from cows and goats, and the income from such sales is greater in rainy season because those livestock produce more milk in the rainy season.



SEASONAL CALENDAR

(3) Women and Water

About one third of the communities (18 communities) have had women's groups whose activities included animal raising and sewing. Although many women's groups were organized throughout the country when the Swazi Government made a large effort to promote women's and other community self-help groups, many of these groups became less and less active as time went by and less assistance coming from outside.

Women's lives are closely connected with water. Women get up at or before dawn to fetch water for the family, clean their houses, and work in their field/garden. Before preparing for breakfast they bathe. During the day, women work on family farms. A small number of women in the project communities also work in schools and district offices. After such work, they go to fetch water, wash clothes, bathes, and prepare supper. As most of the project communities have no electricity, people go to bed early. Many women go to bed later than men and get up earlier.

Women's chores have something to do with water. Among these chores, water fetching is considered to be women's work of paramount importance. Men are rarely seen fetching water. Even if some men are seen fetching water, they are considered to be assisting women. Men's chores include taking care of livestock, erecting fences and building/repairing houses.

FETCHING WATER BY WOMEN

(4) Education

84% of the project communities (that is 43 communities) have one or more primary schools. Out of these, 3 communities have 4 primary schools each, 2 communities have 3 schools, and 4 communities have 2 schools, all of which show how large a community is. 24% of the project communities (that is 12 communities) have secondary schools.

Because Community Survey was conducted during summer holidays when schools were not in session, only half of the communities gave answers on children's school attendance rate. The school attendance rates are 78% for boys and 79% for girls. In community visits, some people said that children from poor households did not go to school, and that they worked in farms nearby to earn about E.50 per month.

(5) Economic Difference in Community: Household Income and Expenditure

Communities are not economically homogeneous as they are made up of poor and wealthy households. In everyday life, people use such criteria as number of cattle and house conditions / materials to distinguish economic conditions of households. According to those who were interviewed, "The rich live in big houses, get electricity and dig wells of their own in their yards" and "The rich send their kids to good schools. They get higher education and get good jobs with high pay, using the connections of their friends and relatives." For the poor, their answers were; "The poor cannot borrow money from banks (due to lack of property that can be mortgaged)" and "Kids from poor families cannot go to school unless they study very hard and get scholarships." As in any other countries, the rich in Swazi communities live in better conditions and have better chances to earn large income.

Household Survey targeted a group of rich households and a group of poor households. The average monthly household income is E. 1,449 for the rich, and E. 280 for the poor. The main sources of income in the project communities are: 1) agricultural products including maize, yams, peanuts, and cotton, 2) employment in mining industry in South Africa, employment in plantations and nearby farms, and in road construction, and 3) handicrafts such as wooden carvings, stone carving, baskets, etc. Some people sell firewood which they collected, sell sweets they made and vegetables to other members of their communities or in markets.

69% of the rich households and 35% of the poor households surveyed, own cattle. In addition

to cattle, many rich households own livestock such as pigs, chickens and goats. Generally speaking, livestock is not the source of regular income, but a solution for a cash emergency. People sell livestock when money for children's school is needed at the beginning of school year and money to pay expenses for various ceremonies such as weddings, funerals, etc. as needed.

Larger percentages of rich households earn income from sale of cattle and agricultural products. 28% and 47% of the rich get income from cattle and agricultural products, respectively, while only 10% and 19% of the poor get income from the same sources; cattle and agricultural products.

Percentage of Households with Source of Income (%)

	Cattle	Agri. product	Employment	Others
The Rich	28	47	40	23
The Poor	10	19	48	35

Average Monthly Income per Household* (Emalangeni)

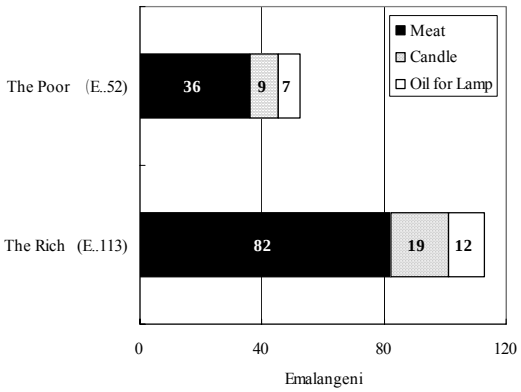
	Cattle	Agri. product	Employment	Others
The Rich	557	808	1,320	1,701
The Poor	270	330	252	196

* Households with no income from the particular source are excluded. This is not the average income for all the households.

Among the rich households with income from cattle, the average income from cattle is E. 557. (This means that average income of 28% of the households is E. 557) Among the poor, the average income from cattle is E. 270, less than half of that of the rich. As for income from sales of agricultural products, average income was E. 808 for the rich and 330 for the poor. From these we can conclude that the larger numbers of rich households earn income from sales of cattle and agricultural products, and among the households with income from those sources, the rich get more than twice the amount of what the poor get.

Percentages of households with employment income are rather similar between the rich and the poor (40% for the rich and 48% of the poor), but the average income of the rich is nearly 6 times that of the poor. Rich households, thus, own more cattle and bigger land, and their members have much higher-paying jobs than the poor.

Rich households spend more than twice as much money on meat, candles and oil for lamps which are consumed in every household in communities. In Household Survey it was found that the minimum total of E. 4 were spent on these items, which makes us conclude that no household is unable to pay O&M cost for hand pumps. However, poor households that depend on income from agricultural products do not get steady monthly income. A large portion of their income comes after the harvest season. Methods for water fee collection require much scrutiny, and, thus, hand pump users need to decide the



Average Monthly Household Expenditure
(Emalangeni)
- meat, candle, and oil -

amount of water fee and its collection method based on thorough discussion.

3. Water and People's Lives

(1) Existing Water Source

Existing water sources in project communities include rainwater, boreholes (including those with hand pumps), spring/fountain, pond/dam, and river. Most of these sources suffer from small amount and low quality of water as well as bad hygiene. In Supplementary Survey, ponds were witnessed with evident unclear and dirty water which had been dug by Ministry of Agriculture for livestock. Such ponds were used by people because they had no other alternatives. A fountain with too little water coming out, considering the number of households using the fountain, and rivers that dry up in dry season were also witnessed. Many water sources do not have fences to keep livestock out, and some people got water for drinking next to other people washing and bathing. Considering the size of communities, the number of water sources is rather small, and this shows how difficult it is to maintain good health under such living conditions in which access to water is difficult and people have no choice other than using low quality water.

Water Source

In about half of project communities, people use rainwater in jars which collect rain water from gutters. In Dry season people use water from fountains (65% of the communities), river (51%), boreholes (25%) and ponds (20%). In Household Survey, only 10% of all the households answered that they use rainwater. Aside from the rainwater, fountains and rivers are the most popular sources of water regardless of a state of household economy.

Existing Water Sources

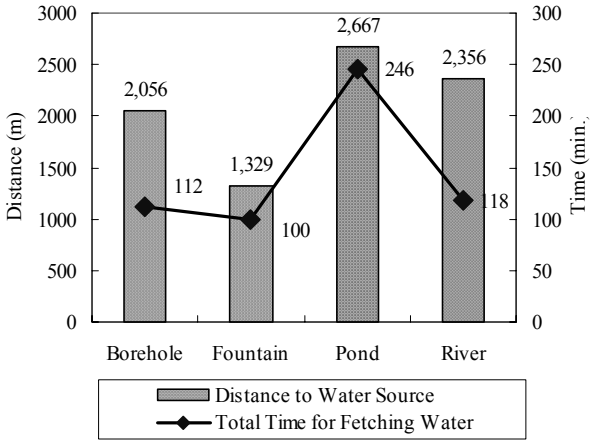
	Rainwater	Borehole	Fountain	Pond	River	(Average)
No. of Communities	24	13	33	10	26	—
Distance from Home (m)		2,056	1,329	2,667	2,356	1,893
Time Spent for Fetching Water Per Trip (minutes)		53	46	112	54	56
No. of Trips for Fetching Water Per Day		2	2	2	2	2
Total Time Spent for Fetching Water Per Day (minutes)		112	101	246	118	123

Total: 51 communities

It was found that O&M funds had been collected for the existing hand pumps in 8 communities. The amount of monthly contribution per homestead ranges between E.1 and E. 20. The average is 5.25 Emalangeni.

In project communities, the farthest water source from homes is the pond. On average, a pond is located 2,667m from home, and each household spend the total of 4.1 hours per day fetching

water, making two round trips. In project communities, an average household is slightly less than 2 kilometers away from a water source, and villagers spend 2 hours every day for 2 roundtrips of fetching water.



Time and Distance for Water Feching
Average Distance: 1,893m
Average Time: 123 minutes/day

Water fetching is mostly done by adult women by carrying a 25-liter plastic container on their head or using a wheelbarrow for several containers. Next to adult women, it is girls and then boys who fetch water most often. According to Supplementary Survey, an average household of 10 members fetch 155 liters of water every day. This water is used for drinking, cooking, washing plates and pots, washing and bathing. The amount of water that does not get into people's mouths is very small. Because of difficult availability of water, people have acquired ways for using water which matches their living conditions. In other words, people adapted to their external conditions. For this reason, the amount of water that a household needs is not an absolute amount, but it changes according to water availability.

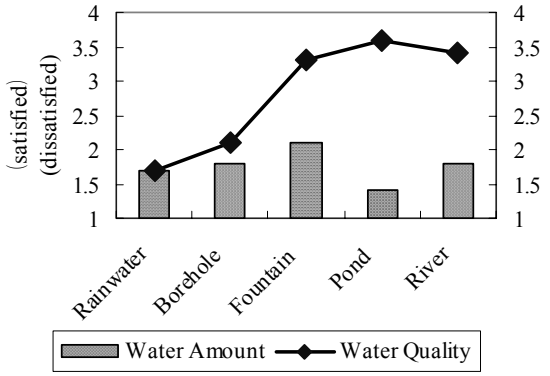
FETCHING WATER BY SCHOOL BOYS

Average distance from home to a water source is expected to shorten due to the new hand pump wells of this project, and people in the communities are expected to be healthier due to the use of safe water. Easier access to safe water, on the other hand, may increase water consumption as well as daily need for water so that people may fetch more water from nearer water sources. If this happens, it is questionable whether the new hand pump wells will reduce women's chores/daily workload. Effectiveness of the new wells may not be revealed only through simple calculation, but, instead, can be proved qualitatively through levels of women's satisfaction and increase in quality of life.

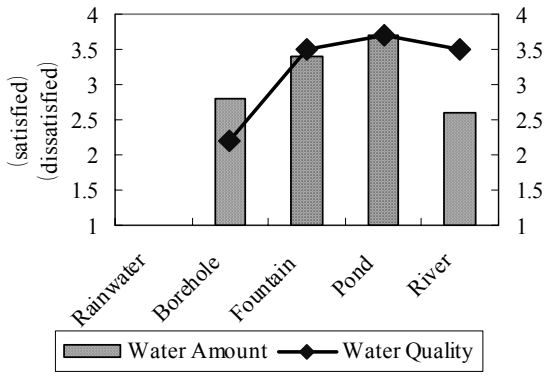
Conditions of the existing water sources are greatly different between the rainy and the dry seasons. It is easy to get water in rainy season. In dry season, some rivers dry up and amount of water from a fountain decreases, which makes people go to farther water sources and spend longer time fetching water. Women spend a greater part of their energy on water fetching during dry season. Whenever asked, women talked of difficulty of water fetching in dry season: "We hire donkeys, sometimes trucks in dry season to fetch water from a source (that is) 2 or 3 hours away from our houses," "In dry season, I get up at 3AM to go to fetch water from a fountain.

There, we must stand in line and wait for our turns," "Because the water source (river) is very far away, I take dirty clothes together with water containers for fetching water. At the river, I wash the clothes, dry them in the sun, and finally I go home. Water fetching takes a whole day, " "Water is very precious in dry season. The same water is used more than once. (water used for bathing is used for washing)"

Not only the amount of water, but also water quality get worse in dry season. Among all the water sources in the project communities, only 3 boreholes, one fountain and one river were found to have satisfactory amount of water and water quality during the dry season. Level of satisfaction with water amount is high in rainy season, but the levels of satisfaction with water quality are rather similar and steady in dry and rainy seasons. People are least satisfied with quality of water from ponds. Rivers are the next to the least that people are satisfied with, and fountains follow. In some communities, people answered that they use water from ponds and rivers for bathing and washing, but not for drinking or cooking.



Satisfaction with Existing Water Source (Rainy Season)



Satisfaction with Existing Water Source (Dry Season)

(2)Problems of Water / Expectations and Fear toward New Wells

Since so-called water activities such as water fetching, cooking, washing and bathing small children are all done by women in Swaziland, problems of water are serious issues that have direct influences on women and their way of life. In every community we visited, women talked of their dissatisfactions and worries about distance to water sources, water shortage in dry season, low water quality, contamination of water by livestock, and sickness due to dirty water. In Community Survey, more than 80% of communities considered the long distance to water sources and low water quality as major problems. Easy access to high quality / safe water from sources near one's home is the biggest desire of people in the project communities.

Water Problems

	Problem	Percentage of Communities that answered it as a problem
1	Distance to water source	86%
2	Water Quality	80%
3	Children's sickness	67%
4	Lack of pit latrines	57%
5	Too many people sharing the same water source	55%
6	Amount of water in dry season	49%

(100% = 51communities)

Concerning well construction in their communities, the highest expectation that 80% of all the project communities have is the combination of "safe water supply and better health". Following this, about a quarter of the communities hope for "shorter distance to water source from one's home" and "to be able to have house gardens."

Expectation and Fear toward Well Construction

	Expectation	%		Fear	%
1	Safe water / Good health	80	1	Breakdown of hand pump	33
2	Shorter distance to water source	29	2	Water source drying up	16
3	House garden	25	3	Theft of hand pump	10
4	Economy (water fee)	10	4	Repair cost	6
5	Sufficient water	8	5	Skill to repair hand pump	4
100% = 51communties					

Not many communities gave answers to the question of fear toward well construction. The most popular fear is "breakdown of hand pump" followed by "water source of hand pump drying up: not being able to draw water due to over-consumption," "the main body and parts of hand pump being stolen," "high cost for hand pump repair," and "need for knowledge and skills to repair hand pump." Thus, hoping for safer water from nearer source with shorter time for fetching, people in the project communities are aware of the importance and necessity for operation and maintenance to deal with hand pump breakdown and theft.

4. Water and Sanitation Committee (WSC)

In Swaziland, communities must provide proof of establishment of WSC and collection of water funds (initial funds of a project) when they request their government to construct a water supply scheme including hand pump wells. WSC is made up of a president, a vice-president, a treasurer and a secretary, who are democratically elected by all the people in a community. In interviews with CDOs and concerned officers at RWSB, it was emphasized that the success of WSC depends much on the amount of trust the committee draws from hand pump users. For example, if a community is divided into several groups or factions due to existence of friction among several chiefs or sub-chiefs, WSC cannot get equal support from every member of community as the committee is considered to represent only one group/faction. Because water and its activity is closely related to women, representation of women is also an important factor that contribute to success of WSC.

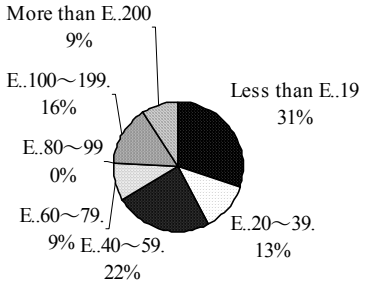
Six communities out of all the project communities answered that they had not establish WSC. Among 45 communities with WSC, 37 communities collected the initial funds. Five communities did not collected the initial funds while the state of initial funds in 3 communities was unknown. The table below shows the amount of the initial funds collected from each homestead, total amount collected, and the amount of water fee that will be collected every month from each homestead after hand pumps are installed.

WSC Fund (Emalangeni)

	Average	Minimum	Maximum
Initial fund per homestead	75	2	500
Initial fund total (per community)	4,123 (Median=950)	30	80,296
Monthly water fee per homestead	5.6	0.25	30

That the amount of initial fund is 500 Emalangeni per homestead is a very large sum for people

in communities. More than 80,000 Emalangeni was collected as the initial funds in a community, and this is considered to be too large a sum that WSC is to manage. Most communities answered that their initial funds was being kept at a bank or by a WSC treasurer.



Initial Fund per Homestead
(Average: 74 Emalangeni/homestead)

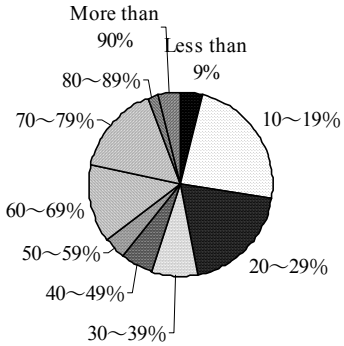
Collection of initial funds has not been completed in all the communities. This is because only certain number of homesteads have paid their shares of the funds. In a community where many households are poor, it is difficult to collect initial funds. Poor households sometimes must make a big economic sacrifice to get access to safe water.

Amount of monthly water fee per homestead was determined by people in the communities. Two communities are to collect E. 10 from each homestead, and in another two communities are to collect E. 20 and E. 30. Considering the amount each household spends on so-called daily necessities such as candles and oil, monthly charge of more than 10 Emalangeni might be too much of a burden for a poor household. In one community, WSC executives said, "We will take special measures such as extension of deadline for payment for poor households that cannot pay water fee so that they will still be able to use a hand pump without paying the charge on time." Deciding on specific amount of monthly water fee per homestead for hand pump operation and maintenance is easy, but in reality, collecting money from poor households whose income is small, unstable and irregular is as difficult as management of fund itself.

5. Health, Hygiene and Sanitation

Ministry of Health in Swaziland has been promoting pit latrine construction in rural areas. In the project communities, the rate of latrine coverage varies widely from 5 to 100% with average being 41% and median being 30%.

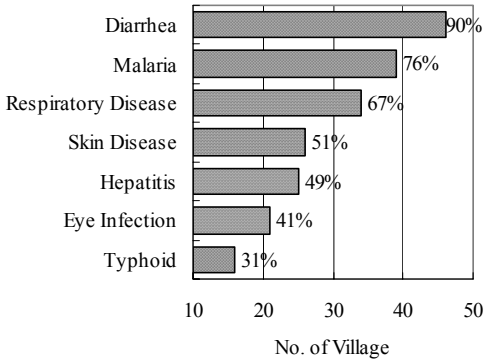
About a quarter of all the project communities (14 communities) have a clinic, and one community has a health center. The average distance from home to the nearest health facility is 10 kilometers among the communities. Even if a health facility is located in a community, it does not necessary mean that people have easy access because a community can be very large and in many cases, the distance to the nearest health facility is too large to walk.



Latrine Coverage Rate

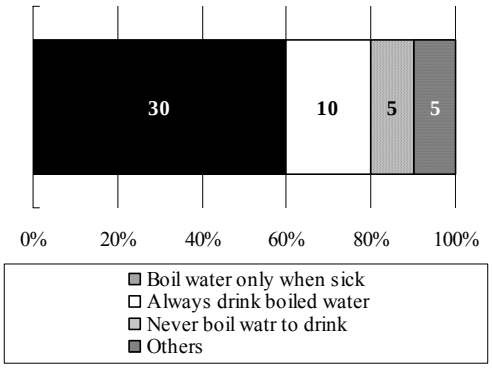
As for water-born disease, most communities answered that incidence of diarrhea is high or very high, followed by malaria, respiratory disease, skin disease, hepatitis, eye infection and

typhoid. Although some communities mentioned high incidence of HIV/AIDS in Community Survey, people gave an impression by giving non-specific, rather abstract answers that they did not talk about the subject.



Water-Born Disease
(Communties with high incidence)

Message from the Ministry Health that people should drink boiled water or use bleach has been widely spread, and is known to people in communities. 20% of the project communities answered that people always drink boiled water, and in 60% of the communities answered that people drink boiled water only when they are sick. Boiling water requires more firewood, which requires more energy for collecting firewood or money to buy firewood. Boiling water to drink, thus cannot be so easy for poor households.



Drinking and Boiling Water

Some people said that they had no other choice than using unclear water, smelly water, or water in which microbes / small creatures are moving. It is questionable how effective it is to boil or use bleach for such bad water. More men than women are said to suffer from cholera by drinking unboiled water. Some women criticized men's behavior as frivolous by saying "Men drink unboiled water to show off how tough they are. They say they are okay (the water does not harm them)."

<Questionnaires>

Community Survey Date_____

Community _____ Comm. number ____ Region_____

Enumerator (Interviewer)_____ Respondent (Interviewee)_____ (Respondent's) Position_____

* Does this community have a plan to move to a new location in the near future?: 1. Yes 2. No

A. Water and Sanitation Committee

A1	Water and Sanitation Committee (WSC);	1. was organized in _____ (year) 2. is not yet organized		A1
A2	(If organized) Has the WSC collected the initial water charge for well construction? If yes, how many Emalangeni did each homestead contribute?	1. Yes _____ E.	2. No	A2
A3	(If the charge was collected) How much money was collected totally?	1. _____ E.	2. don't know	A3
A4	(If the charge was collected) Does the money still exist today?	1. Yes	2. No	A4
A5	(If the money still exists) Where is the money kept?	Place:		A5
A6	After the construction of the well, how much money is the WSC going to collect from each homestead per month?	1. _____ E.	2. don't know	A6

B. Health and Sanitation in the Community

B1. Number of i) Primary Schools _____ ii) Secondary Schools_____

B2. Number of i) Clinics_____ ii) Health Centers_____

B3. Distance to the nearest medical facility i) Minimum distance: _____ m ii) Maximum distance : _____m

B4. Prevalence of Water-Borne Disease

a.	Diarrhea (Cholera?)	1. very common	2. common	3. rare	4. very rare	A
b.	Skin Infection	1. very common	2. common	3. rare	4. very rare	B
c.	Eye Infection	1. very common	2. common	3. rare	4. very rare	C
d.	Respiratory Disease	1. very common	2. common	3. rare	4. very rare	D
e.	Malaria	1. very common	2. common	3. rare	4. very rare	E
f.	Typhoid	1. very common	2. common	3. rare	4. very rare	F
g.	Hepatitis	1. very common	2. common	3. rare	4. very rare	G
h.	Other (Specify)	1. very common	2. common	3. rare	4. very rare	H

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B5. For what purposes do most people boil water?

1. to drink every day 2. to drink when sick 3. to give to babies 4. other; specify_____ 5. Nobody drinks boiled water

C. Existing Water Supply

	Source	Number (excluding those out of order)	Average distance from home (m)	Average time to fetch water; one round-trip (minutes)	Number of round-trips to fetch water in one day	Who are the main persons to fetch water? 1. men 2. women 3. boys 4. girls	How do they carry/fetch water? 1. on head 2. by hand(s) 3. on shoulder 4. wheel barrow 5. other (Specify)	Rainy Season: Water Amount	Rainy Season: Water Quality	Dry Season: Water Amount	Dry Season: Water Quality
								1. good 2. acceptable 3. o.k. 4. poor/bad/not-existent			
a	Handpump					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
b	Borehole					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
c	Fountain/Spring					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
d	Pond / Dam					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
e	River/Stream					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
f	Other (specify)					1 2 3 4	1 2 3 4 5 ( )	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4

		Year Constructed	Constructed By 1. Government 2. NGO 3. UNICEF 4. Individual 5. other (specify) 6. don't know	Use of Facility 1. all season 2. dry season only 3. rainy season only	O/M by 1. Government 2. NGO 3. UNICEF 4. Owner 5. Users 6. None 7. Don't know	Water Charge if any (E. per month)	Satisfaction 1. very satisfied 2. satisfied 3. o.k. 4. little/not satisfied
a	Handpump		1 2 3 4 5 ( ) 6	1 2 3	1 2 3 4 5 6 7		1 2 3 4
b	Borehole		1 2 3 4 5 ( ) 6	1 2 3	1 2 3 4 5 6 7		1 2 3 4

2

D. Water Source and Use (✔ check the ones that apply)

		drinking	bathing	cooking	washing	livestock	irrigation
a	Handpump						
b	Borehole						
c	Fountain/Spring						
d	Pond / Dam						
e	River/Stream						
f	Other (specify)						

E. Development Projects in Village

Organization	Activities	Year Started	Year Ended
UNICEF			
UNDP			
NGO (Specify)			
Government			
Other (Specify)			
Other (Specify)			

F. Community Organization / Association / Self-Help Group

	Organization/Group	Activities
1	Women's Organization	
2	Community Development	
3	Other: Specify_____	
4	Other: Specify_____	
5	Other: Specify_____	

3

G. Water and Sanitation Problems (Circle ○ the ones that apply. For the ranking, put "a" through "k")

a. Water source is too far
b. Little water at the source in dry season
c. Little water at the source even in rainy season
d. Water quality is bad; a. smell, b. color, c. taste, d. other: specify_____
e. Too many people use the same water source
f. Bad water drainage
g. Broken / stolen handpump
h. Many children are sick; a. diarrhea, b. malaria, c. respiratory dis., d. skin infection, e. eye infection, f. other: specify_____
i. Many adults are sick a. diarrhea, b. malaria, c. respiratory dis., d. skin infection, e. eye infection, f. other: specify_____
j. No / too few latrines
k. Other; specify_____

Rank (1=biggest problem)	1:	2:	3:

H. Expectation and Fear *(Please do not feed "the Right Answers" to the respondent. We want to know what people in communities think.)*

1. In what ways will a handpump improve people's lives in your village? What (good things) do you expect from a handpump?
2. What kind of difficulties/problems will a handpump bring to the villages? What do you fear about a handpump?

1. Expectation	2. Fear
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

4

VISITS TO SCHOOL & EXISTING WATER SOURCE

A. School

Name of School _____

Location: 1:in the community 2:outside the community

# of academic years / grades:_____

	boys	girls	Teachers
# in school			
# not in school			

B. Existing Water Source

Kind of water source: a. handpump b. borehole c. fountain/spring d. pond/dam e. river/stream f. other (specify_____)

	Description / Impressions / Comments
Water Quality	
Water Amount	
Drainage	
Protection from animals and other pollutants such as toilets, trash, etc.	
(If the water is used for drinking) Do people engage in water activities such as washing, bathing, etc. where others get water for drinking?	
Other remarks	

*Please take a picture of the water source.
*You may also take pictures of people doing "water activities" such as getting water, carrying water, washing clothes, etc.

5

Household Survey

Date_____

Community_____ Comm. number ____ Region_____

Enumerator_____ Respondent_____ Number of cattle owned by the respondent _____

A. Household Members

Number of adults: Men_____ Women_____

Number of children: Boys_____ Girls_____

B. Water-Related Issues

(Circle the ones that apply)

B1 What is the main source of water? (Circle the ones that apply)

Dry season: a. handpump b. borehole c. fountain/spring d. pond/dam e. river/stream f. other (specify_____)

Rainy season: a. handpump b. borehole c. fountain/spring d. pond/dam e. river/stream f. other (specify_____)

B2 Who goes to get water from the water source? Please rank 1 through 4 (or 5) for each season 1:most often ---- 5:least often

	Mother	Father	Daughter	Son	Other (specify)
Dry season					
Rainy season					

B3 What kind of container is used to fetch water? (Circle the ones that apply)

Dry season: a. bucket b. jerry cans c. other (specify_____)

Rainy season: a. bucket b. jerry cans c. other (specify_____)

1

C. Household Income Sources and Estimated Amount

Sources of Income	Average Annual Income (Emalangeni)
selling animals (specify:_____)	
selling agricultural crops (specify:_____)	
selling labor (specify:_____)	
other (specify:_____)	
other (specify:_____)	
other (specify:_____)	

D. On the average how many Emalangeni per month does your household spend on the following items?

meat _____ E. candles _____ E. oil (for lamps) _____

2

Appendix-7 Results of Geophysical Survey (Test Drilling)

1. Purpose of Test Borehole Drilling Program

The study area is considered as a hydrogeologically difficult area for groundwater development, since it is underlain by the Basement Rocks and sedimentary rocks intercalated with coal seams. The test borehole drilling program aims to evaluate the following four issues for groundwater development by the test drilling in the area where representative rocks are distributed.

Issues to be Testedby Drilling:

(1) Possibility of groundwater development in the fissured rock area
(2) Possibility of groundwater development in the area where the distribution of highly saline groundwater is anticipated
(3) Possibility of groundwater development in the volcanic rock with few fissures
(4) Possibility of changing scheme from macro scheme to micro-scheme in Lomahasha area.

2. Target Aquifer and Test Borehole Drilling Plan

The five rocks were selected as targets for the test borehole drilling because most recipient communities were underlain by the five types of rocks: (1) granite, (2) gneiss, (3) sandstone, (4) basalt and (5) rhyolite.

Two drilling sites per rock type were randomly selected to get objective hydrogeological information; thus the total number of locations is 10. In addition, five spare locations were provided in case of dry boreholes as shown in the following table.

Test Borehole Drilling Locations

Target Aquifer		Community	Number of borehole
Basement Rocks	Lochieli Granite（Lgt）	H2-3 (No.3) Luhlangotsini H2-4（No.4）Mawonbe	2
	Ngwane Gneiss（Ngw）	M2-1 (No.24) Moneni M2-10 (No.35) Emseni	2
Sedimentary Rocks	Karoo Formations（EC）	L2-3 (No.10) Mantjolini S2-7 (No.43) Hlabangamehlo	2
Volcanic Rocks	Sabie River Basalt（Lb）	L2-5 (No.12) Epitokweni S2-8 (No.44) Emaganyaneni	2
	Lubombo Rhyolite（Lr）	L2-22 (LS-15) Nhlambelo L2-8 (No.16) Maphungwane	2
Total		10 communities	10
Spare Boreholes			5
Grand Total		10 communities	15

3. Specifications of Borehole and Drilling Depth Planned

(1) Specifications of Borehole

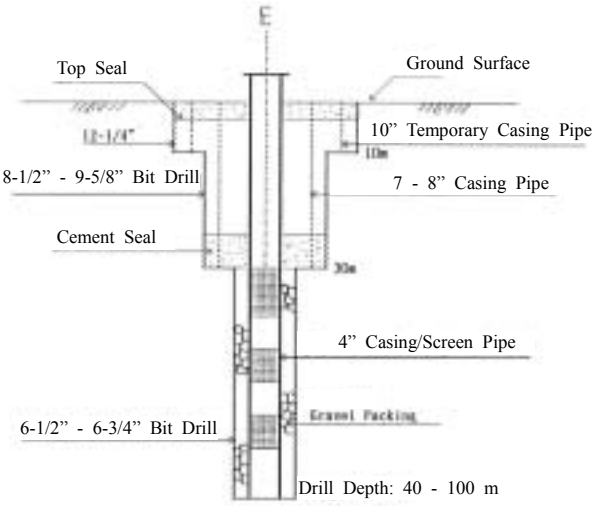
Specifications of borehole are as follows:

<Standard Borehole Structure>

Finishing diameter of borehole is 8-1/2”. 6” (inner diameter) of PVC casing and screen were installed in the borehole after the completion of drilling. Standard borehole structure is shown in the following figure.

Drilling Depth Planned

Target Aquifer	Drilling Depth (m)	No. of Boreholes	No. of Spare Boreholes	Total Depth of Test Borehole (m)	Total Drilling Depth of Spare Borehole (m)	Total Drilling Depth (m)
Volcanic Rocks	100	4	2	400	200	600
Other Rocks	80	6	3	480	240	720
Total	180	10	5	880	440	1,320



STANDARD BOREHOLE STRUCTURE

Drilling depth is planned as 100 m in the volcanic rocks area and 80 m in other area as shown in the above table.

i) Geophysical Logging

Four items of geophysical logging were carried out to obtain hydrogeological information just after the completion of drilling. Based on the results of geophysical logging and observation of cutting samples of rocks, the casing program for the borehole was decided.

Logging items: Spontaneous Potential (SP)、Resistivity (Short and long normal)、Natural Gamma

ii) Casing and Screen Pipe

- Inner diameter: 6”(150mm) of PVC pipe
- Screen: horizontal slot with 1 mm of width
- Opening ratio: not less than 5%
- Type of connection: screw type with flash joint

iii) Gravel Packing and Cement Grouting

After the installation of casing/screen pipes, annular space between wall of borehole and pipes was filled with quartz sand (diameter: 2 - 4 mm) from the bottom of the borehole up to 3 m above the top of the screen pipe. Then, the top of the packed gravel was sealed with clay or bentonite. Then, the annular space was filled with cement milk up to the surface in order to avoid deterioration by polluted surface water.

iv) Pumping Test

Three kinds of pumping test were carried out after airlifting and development of borehole as follows: step drawdown test, constant discharge test and recovery test.

v) Water Quality Analyses

Temperature, pH and electric conductivity were measured during the constant discharge test. The following 17 items were analyzed in the laboratory:

pH, turbidity, color, EC, SO_4, Cl, NO_3, NO_2, Fe, Mn, F, HCO_3, alkalinity, hardness, TDS, Total Coliform, Fical Coliform

4. Procedure of Site Selection for Test Borehole

Location of test borehole was decided by the following procedures.

(1) A geophysical survey center was decided from the hydrogeological point of view near the place where community people want to drill borehole.
(2) Geophysical survey lines were allocated considering the hydrogeological conditions in the target community.
(3) Horizontal resistivity survey by Wenner method and electro-magnetic surrey were carried out along the allocated survey lines.
(4) Vertical resistivity survey by Schlumberger method was applied, if anomaly which shows the existence of fissures or intrusive rocks.
(5) The location of drilling site was finally decided through the procedures mentioned above.

5. Results of Test Borehole Drilling

A total of 15 boreholes were drilled including spare boreholes. Their locations are shown in Fig.-2.1. Groundwater was confirmed at 8 boreholes out of 15 boreholes; they are considered as successful boreholes. Remaining seven boreholes were unsuccessful boreholes. The successful rate of boreholes was calculated as 53.3 % because eight boreholes were successful borehole against a total of 15 boreholes. This is almost the same as that of the result in the Phase 1 project.

Success Rate

Geology	Number of Borehole	Successful Borehole	Unsuccessful Borehole	Success Rate
Granite	3	1	2	33.3%
Gneiss	3	3	0	100.0%
Sandstone	3	1	2	33.3%
Basalt	2	2	0	100.0%
Rhyolite	4	1	3	25.0%
Total	15	8	7	53.3%

Results of the test borehole drilling and successful rate are shown in the tables below.

Results of Test Borehole Drilling

No.	Region	Community	Target Aquifer	Drilling Depth (m)	Result Successful (o)	Pumping Test	
						Yield	S.W.L
1	Hhohho	Luhlangotsini	granite	80	X	-	-
2			granite	80	X	-	-
3	Hhohho	Mawombe	granite	80	○	1.6 l/sec	6.05m
4	Manzini	Moneni	gneiss	80	○	3.0 l/sec	24.24m
5	Manzini	Ntabamhloshana	gneiss	80	○	1.1 l/sec	17.61m
6	Manzini	Emseni/Mfangibhekile	gneiss	80	○	3.3 l/sec	28.31m
7	Lubombo	Mantjolini	sandstone	80	X	-	-
8			sandstone	80	○	0.5 l/sec	7.49m
9	Shiselweni	Hlabanyaneni	sandstone	100	X	-	-
10	Lubombo	Etipokweni	basalt	100	○	0.8 l/sec	10.36m
11	Shiselweni	Emaganyaneni	basalt	100	○	0.1 l/sec	23.31m
12	Lubombo	Maphungane	rhyolite	100	○	0.8 l/sec	11.77m
13	Lubombo	Nhlambelo	rhyolite	100	X	0.01 l/sec	52.12m
14			rhyolite	100	X	-	-
15			rhyolite	105	X	-	-

6. Evaluation of Aquifers

Five types of aquifers were evaluated from the hydrogeological view point using the results of observation of cutting samples, test borehole drilling, geophysical logging, pumping test.

(1) Granite

Three test boreholes were sunken in the granite area. Results are shown in the following table.

Test Drilling Results in Granite Area

Site Location No.	Region	Community	Drilled Depth	Air Lifting		Remarks
				Yield	S.W.L.	
H2-3	Hhohho	Luhlangotsini	80 m	Dry		
H2-4	Hhohho	Mawombe	80 m	1.60 l/s	6.05 m	
L2-6	Lubombo	Mphanganyeti	80 m	Dry		

One borehole was evaluated as successful borehole and pumping test was carried out in the successful borehole. Results are shown in the following table.

Pumping Test Results in Granite Area

Site Location No.	S.W.L. (m)	Step Test Data		Constant Discharge Test		Remarks
		Yield (l/s)	Draw down (m)	Yield (l/s)	Draw down (m)	
H2-4	5.04	1.00	5.79	2.00	19.84	Constant discharge test duration 8 hrs. Available draw down 29.15 m.
		1.50	12.50			
		2.00	19.39			

In general, granite distributed in Swaziland seems to be considerably good aquifers in terms of hydrogeology. However, the groundwater potential is very low in case it is mass granite without deep weathering. Although there is a relatively high correlation between the test drilling results and the geophysical survey results for site selection of boreholes in this study, it is not always realized. For example, a good result was gained by test drilling at L2-6 which has low groundwater potential based on geophysical survey. Therefore, it is necessary to conduct a more accurate horizontal geophysical survey at the implementation stage of the project in an extensive area to decide the appropriate borehole sites which have a high groundwater potential.

(2) Gneiss Area

Three test boreholes in the gneiss area resulted in success and pumping test was conducted at each borehole. The results of the test are listed in the table below.

Test Drilling Results in Gneiss Area

Site Location No.	Region	Community	Drilled Depth	Air Lifting		Remarks
				Yield	S.W.L.	
M2-1	Manzini	Moneni	80 m	3.00 l/s	24.24 m	
M2-7	Manzini	Ntamamhlosana	80 m	1.20 l/s	16.96 m	
M2-10	Manzini	Emseni / Mfangibhekile	80 m	3.30 l/s	28.31 m	

Pumping Test Results in Gneiss Area

Site Location No.	S.W.L. (m)	Step Test Data		Constant Discharge Test		Remarks
		Yield (l/s)	Draw down (m)	Yield (l/s)	Draw down (m)	
M2-1	5.63	1.20	24.18	2.00	25.13	Constant discharge test duration 12 hrs. Available drawdown 27.00 m.
		1.63	26.01			
		2.30	29.68			
M2-7	17.03	2.00	11.61	2.20	15.31	Constant discharge test duration 12 hrs. Available drawdown 18.49 m.
		2.20	15.10			
		2.40	16.16			
M2-10	26.81	1.00	2.44	1.53	5.19	Constant discharge test duration 12 hrs. Available drawdown 5.82 m.
		1.43	3.87			
		1.80	4.56			

Gneiss distributed in Swaziland has been regarded as good aquifers with high potential for groundwater development from hydrogeological point of view. Both results of the test borehole drilling and the geophysical survey show very high correlation. On the other hand, preparation of enough surface casing pipes, combination of Mud-Drilling and DTH (Down the Hole Hammer Drilling) and high drilling techniques are needed for implementation of the project. Because some serious accidents happened at M2-1 and M2-7 caused by strong shearing and weathering over good aquifers.

(3) Sandstone Area

Three test boreholes in the sandstone area were drilled. One of them resulted in success and pumping test was conducted there. The results are shown in the following table.

Test Drilling Results in Sandstone Area

Site Location No	Region	Community	Drilled Depth	Air Lifting		Remarks
				Yield	S.W.L.	
L2-3	Lubombo	Mantjolini	80 m	Dry		1st.borehole
L2-3	Lubombo	Mantjolini	100 m	0.50 l/s	7.49 m	2nd.borehole
S2-7	Lubombo	Hlabanyaneni	100 m	Dry		

Pumping Test Results in Sandstone Area

Site Location No.	S.W.L. (m)	Step Test Data		Constant Discharge Test		Remarks
		Yield (l/s)	Draw down (m)	Yield (l/s)	Draw down (m)	
L2-3	7.75	0.30	2.73	0.30	5.61	Constant discharge test duration 12 hours. Available drawdown 6.70 m.
		0.40	4.06			
		-	-			

Since the sandstone distributed in Swaziland is extremely consolidated and not porous in general, it seems to have very low groundwater potential. The test drilling results suggest that there is a groundwater potential in the sandstone which is intruded by dolerite. Geophysical inspection conducted at the site selection stage of this study also supports this. Therefore, it is necessary to conduct a more accurate horizontal geophysical survey considering the existence of the dolerite intrusions at the implementation stage of the project in an extensive area to increase success rate of boreholes and to decide the appropriate sites which have a high groundwater potential.

(4) Basalt Area

Two test borehole drillings were conducted in basalt area. Both resulted in success. The pumping test was conducted at each site. The results of pumping test at each site are listed below.

Results of Test Borehole Drilling in Basalt Area

Site Location No.	Region	Community	Drilled Depth	Air Lifting		Remarks
				Yield	S.W.L.	
L2-5	Lubombo	Etipokweni	100 m	0.80 l/s	10.36 m	
S2.8	Shiselweni	Emaganyaneni	100 m	0.10 l/s	23.31 m	

Results of Pumping Test in Basalt Area

Site Location No.	S.W.L. (m)	Step Test Data		Constant Discharge Test		Remarks
		Yield (l/s)	Draw down (m)	Yield (l/s)	Draw down (m)	
L2-5	8.81	0.30	2.10	0.35	7.02	Constant discharge test duration 12 hours. Available drawdown
		0.50	6.91			
		0.70	10.63			
S2-8	-	-	-	0.10	8.56	Constant discharge test duration 12 hours. Available drawdown
		-	-			
		-	-			

It is considered that the basalt in Swaziland has a high potentiality of groundwater in terms of hydrogeological points and the test borehole drillings support it. There is a good correlation between both results of borehole drilling and geophysical prospecting. It shows very strong correlation when shallow shear zone is encountered.

(5) Rhyolite

Of four test borehole drillings in the rhyolite area, one was positive and three were negative. Pumping test was conducted at the positive one. The results are shown in the following tables.

Results of Test Drilling in Rhyolite Area

Site Location No.		Region	Community	Drilled Depth	Air Lifting		Remarks
Old	New				Yield	S.W.L.	
16	L2-8	Lubombo	Maphungane	100 m	0.60 l/s	21.12 m	
LS11	L2-20	Lubombo	Buloyini	100 m	Dry		
LS15	L2-22	Lubombo	Nhlambelo	100 m	Dry		1st borehole
LS15	L2-22	Lubombo	Nhlambelo	100 m	Dry		2nd borehole

Results of Pumping Test in Rhyolite Area

Site Location No.	S.W.L. (m)	Step Test Data		Constant Discharge Test		Remarks
		Yield (l/s)	Draw down (m)	Yield (l/s)	Draw down (m)	
L2-8	15.68	0.20	4.41	0.30	19.54	Constant discharge test duration 12 hours. Available drawdown
		0.30	10.60			
		0.40	19.58			

Rhyolite in Swaziland generally seems to have a low potentiality of groundwater development in terms of hydrogeological points because it has weak weathering zone and very limited shear zone due it being massive, with few intrusive rocks and so on. However, there is an exception:

for example, at L2-8, both results of test borehole drilling and geophysical prospecting are positive. Therefore, it is necessary to conduct a more accurate horizontal geophysical survey at the implementation stage of the project in an extensive area to be able to increase success rate of boreholes and to decide the appropriate sites which have a high groundwater potential.

7. Guidelines of Site Selection of Borehole Location Based on Test Borehole Drilling

The whole project area covers bedrock zone and its groundwater is not stratum water but fissure water. Groundwater survey is considerably effective for stratum water investigation but not for fissure water. Therefore, it is necessary in this plan to search for the existence of fissure zone by geomorphological and geological information and to analyze them from hydrogeological point of view.

The guidelines of site selection of boreholes in this plan are shown as follows on the basis of the results of test borehole drillings in this study.

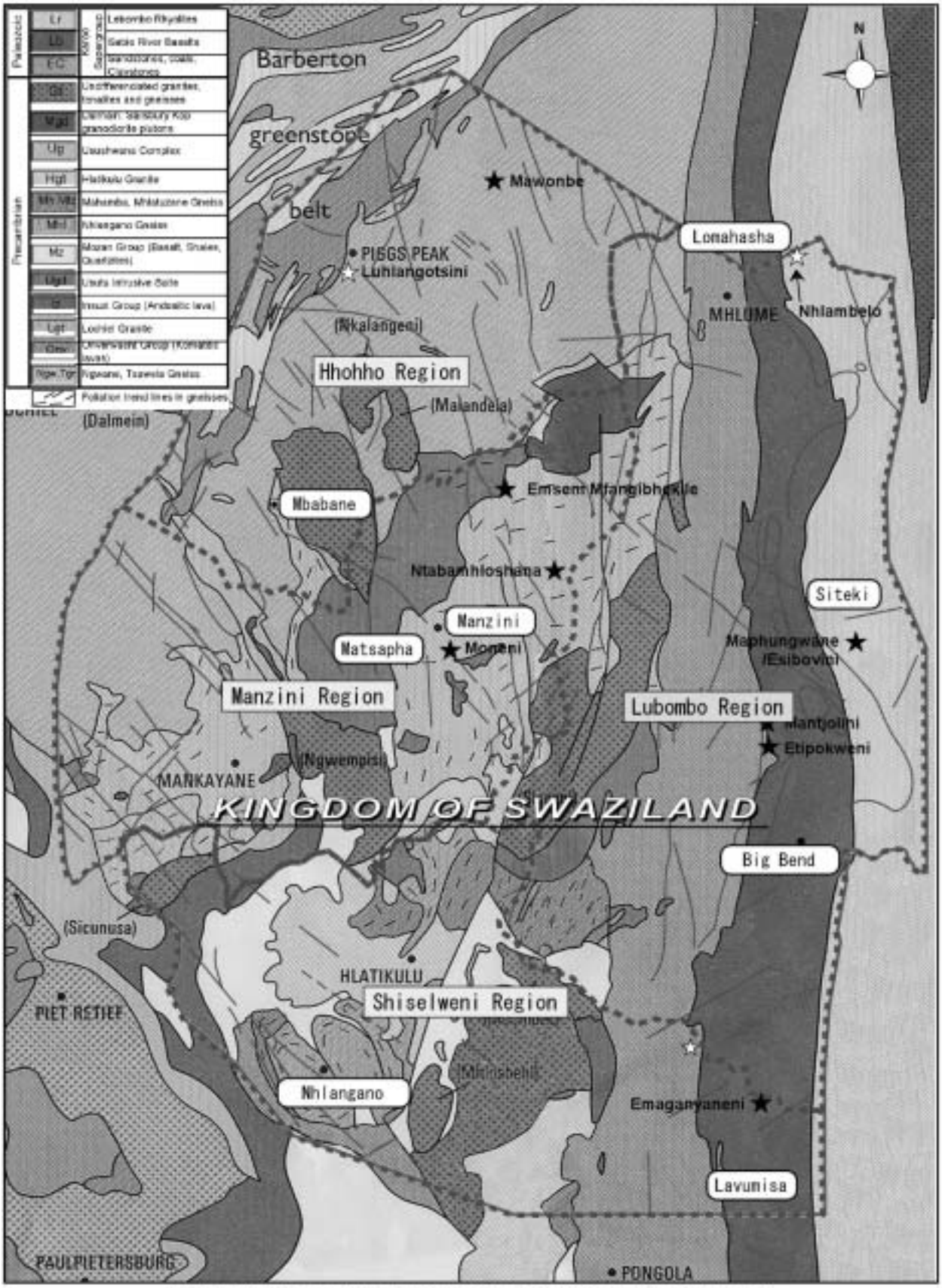
<General Guidelines for Site Selection>

(1) To pick out feature of major lineaments including faults and at drilling site and in its adjacent area by geomorphological and geological maps with a scale of one to 50,000 and 250,000 respectively.
(2) To conduct field reconnaissance around borehole sites and confirm item (1) above. When lineament clearly exists, the borehole site should be located near it as much as possible. On the contrary, when it is unclear, the site should be located in a watershed area as large as possible.
(3) To decide the borehole location near intrusive rocks (for example, dolerite) when their outcrops are found in the field reconnaissance.
(4) To conduct geophysical survey at the selected site in item (2) or (3) above. Electrical prospecting with Wenner's layout of four electrodes and electromagnetic survey should be applied horizontally to explore fissure water and to search for intrusive rocks respectively.
(5) To add electrical prospecting with Schlumberger's layout of electrodes to confirm the thickness of weathering part of the bedrocks vertically at the borehole sites, if necessary, which have positive results from above-mentioned item (4) above.

<Guidelines for Site Selection by Geological Units>

(1) In case of sandstone, electromagnetic survey should be applied for checking intrusive rocks because most of the sandstone is massive except for near faults or dykes.
(2) In case of basalt, electromagnetic survey should be mainly applied for checking intrusive rocks which are distributed like many streaks from north to south in geological map, since most of the sandstone is massive and negative to groundwater except for near faults or dykes.
(3) In case of rhyolite, lineament seems to be develops poorly from geomorphological and geological maps. Then, the borehole location should be situated considering geomorphology, geology; waster shed area and some other indications of groundwater.
(4) In case of granite or gneiss, the methodology of survey for fissure waster should be applied likewise other geology. However, electrical prospecting for vertical analysis should be applied if weathering zone in them seems to be thick and the borehole location should be

selected in the site whose weathering zone is as very thick.



LOCATION OF TARGET COMMUNITIES FOR TEST DRILLING

<Results of Test Drilling: Geological Logs>

GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	**Basic Design Study for the 2nd Rural Water Supply Project**				
Site Number	R3 043-31	Latitude	026° 03' 07"	SWL	0.00 m	pH	:
Community	Lulilangalepini	Longitude	031° 11' 42"	DWL	0.00 m	Temperature	: C
Region	Hhohho	Drilled depth	81 m	Quantity	0.00 l/min	Conductivity	: mS/cm
Completed Date	March 1, 2002	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	: [illegible] Pty Ltd

SCALE (GL-m)	DEPTH (GL-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS	SYMBOL	CASING PROGRAM (GL-m)
	3.0	3.0	Overburden	Dark brown	Dry soil		
	15.0	12.0	Granite	Light grey & grey brown	Occasional thin moderately weathered medium fractured zones.		
	81.0	66.0	Granite	Light grey	Some very minor moderately weathered very slightly fractured zones at 56, 62, 74, 80 and 84 m. Fresh & unfractured		

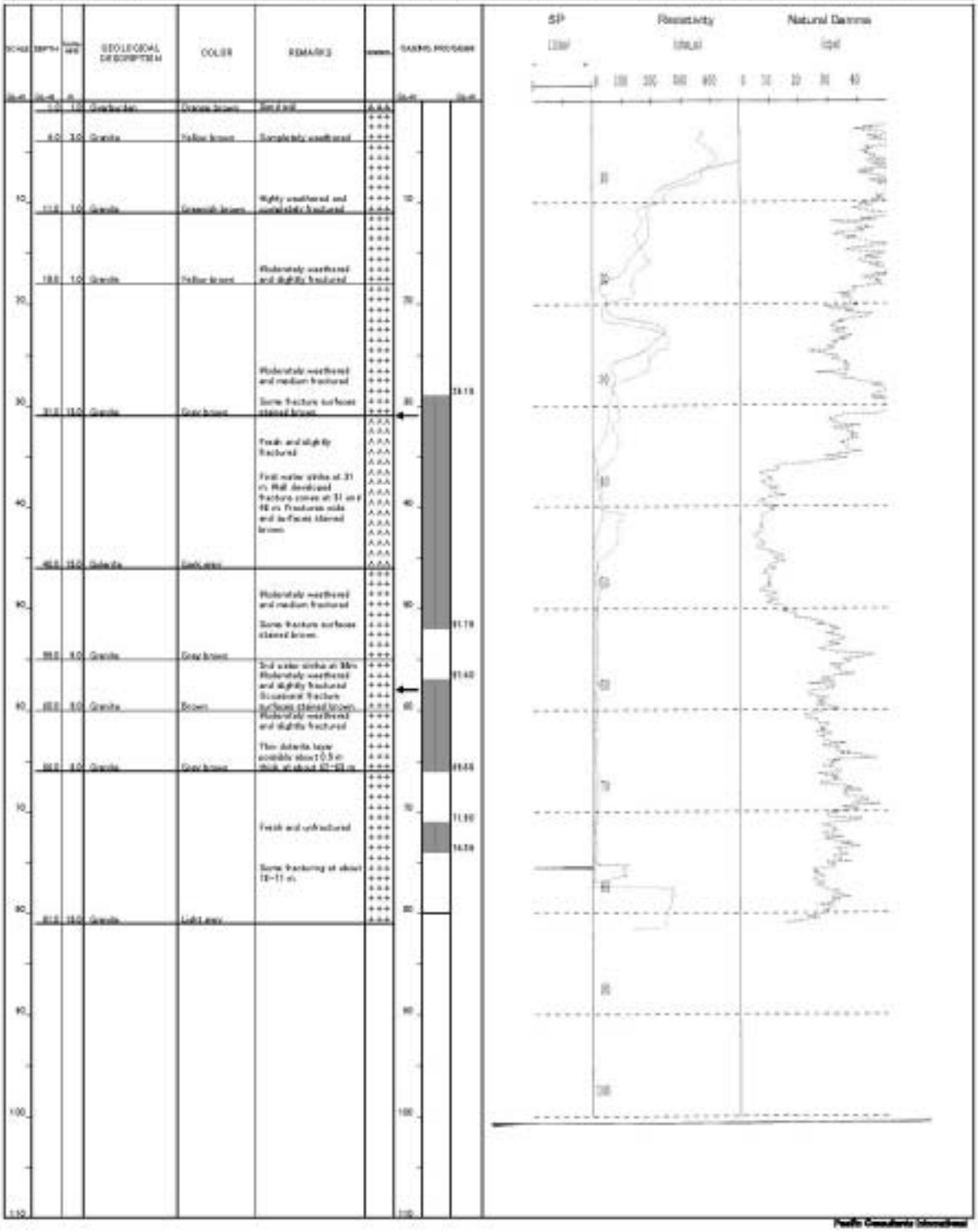
Scale: 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110

GEOPHYSICAL LOGGING DATA

Pacific Consultants International

GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	64-043-41	Latitude	5°25' 54' 18"	SWL	3.55 m	pH	
Community	Wawereka	Longitude	031° 30' 09"	DWL	24.65 m	Temperature	C
Region	Hinterland	Drilled depth	81.00 m	Quantity	3.00 l/sec	Conductivity	mS/cm
Completed Date : 05/06/02		Completed depth	80.00 m	Casing height	0.47 m	Construction by	Mohammed&Sons



GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	#10 (L3-3)	Latitude	S26° 34' 14"	SWL	0.00 m	pH	
Community	Mantjolo	Longitude	E31° 53' 18"	DWL	0.00 m	Temperature	C
Region	Lubombo	Drilled depth	81 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	January 31, 2003	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

SCALE (G.L-m)	DEPTH (G.L-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS	SYMBOL	CASING PROGRAM	GEOPHYSICAL LOGGING DATA
	1.0	1.0	Overburden	Light brown	Sandy soil			
10	10.0	9.0	Sandstone	Light brown	Moderately weathered and slightly fractured			
	13.0	3.0	Dolerite	Grey and brown	Moderately weathered and fractured			
	14.0	1.0	Sandstone	Dark grey	Fresh & unfractured fine grained carbonaceous			
20								
	24.0	10.0	Sandstone	Light brown and light grey	Fresh & unfractured fine grained slightly carbonaceous			
30								
40								
50								
60								
70								
80	81.0	57.0	Sandstone	Medium grey	Fresh & unfractured fine grained carbonaceous			
90								
100								
110								

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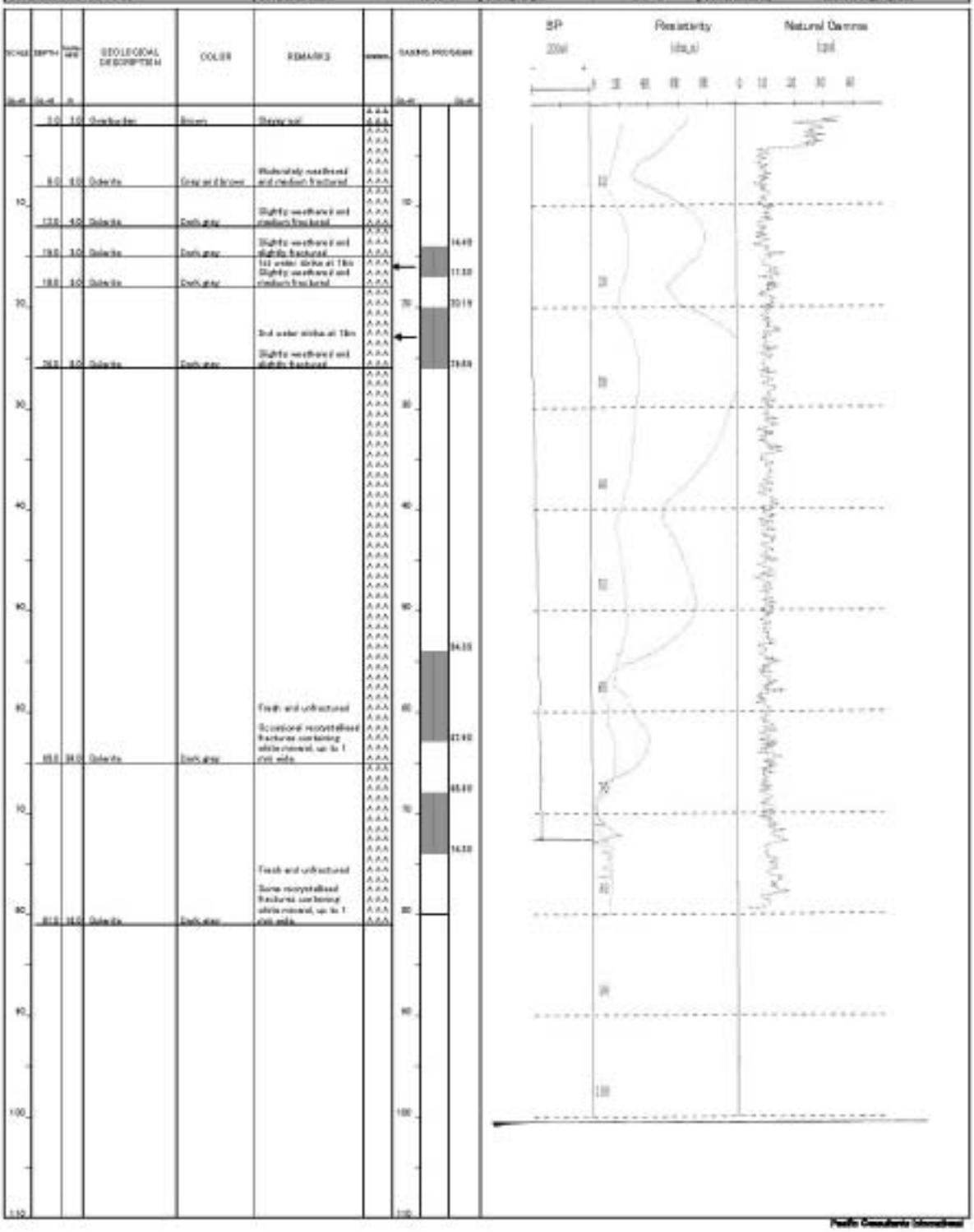
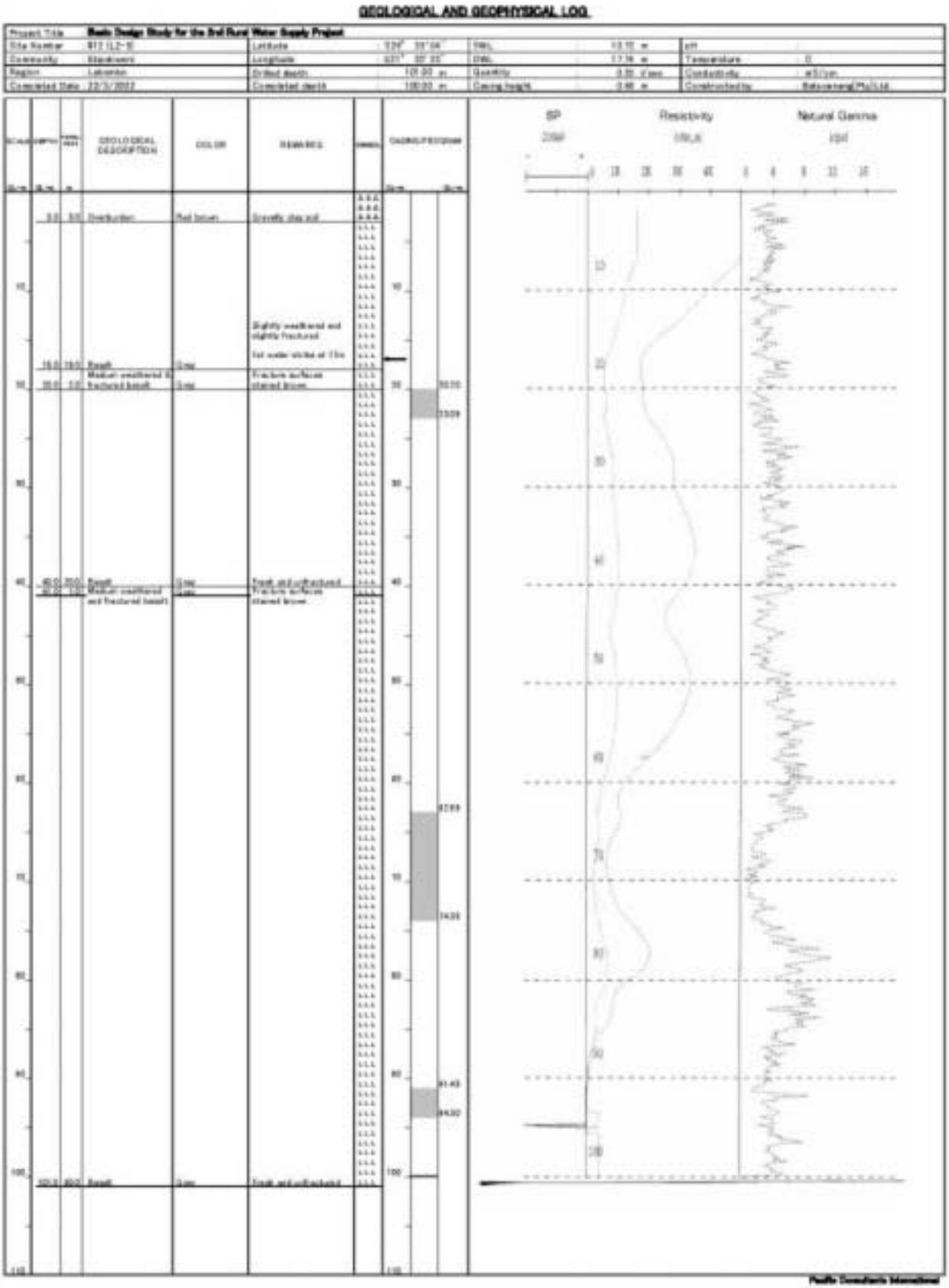
GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	**Basic Design Study for the 2nd Rural Water Supply Project**						
Site Number	RWSCD 0.3–0.03	Latitude	5.25° 34' 10"	SWL	1.21 m	pH	
Community	Wankyidiri	Longitude	033° 53' 13"	DWL	13.80 m	Temperature	C
Region	Lawra No	Drilled depth	81.00 m	Quantity	0.20 l/sec	Conductivity	mS/cm
Completed Date	03/10/02	Completed depth	80.00 m	Casing height	0.51 m	Constructed by	Ministries/DPs/Unit




GEOLOGICAL AND GEOPHYSICAL LOG
SP
Resistivity
Natural Gamma

GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	W3 (L3-4)	Latitude	26° 21' 14"	SWL	0.00 m	pH	
Community	Mahlangatsha	Longitude	031° 47' 57"	DWL	0.00 m	Temperature	C
Region	Lubombo	Drilled depth	81 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	March 13, 2002	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

SCALE (G.L.-m)	DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS	SYMBOL	CASING PROGRAM (G.L.-m)
	3.0	3.0	Overburden	Red brown	Clay soil		
	7.0	4.0	Granite	Brown	Slightly weathered and fractured		
10, 20	28.0	21.0	Granite	Brown and red	Moderately weathered and medium fractured. Red feldspar phenocrysts. Some fracture surfaces stained		
30	31.0	3.0	Slightly weathered and fractured fine grained diorite	Black	Fracture planes green. Below diorite granite		
40	41.0	10.0	Granite	Red and grey	Slightly weathered red and grey slightly fractured granite. Red feldspar phenocrysts.		
	47.0	6.0	Granite	Grey and red	Slightly weathered red and grey slightly fractured granite. Red feldspar phenocrysts.		
50, 60, 70, 80	81.0	34.0	Granite	Grey and red	Fresh & unfractured. Red feldspar phenocrysts. Occasional quartz and diorite.		
90, 100, 110							

GEOPHYSICAL LOGGING DATA

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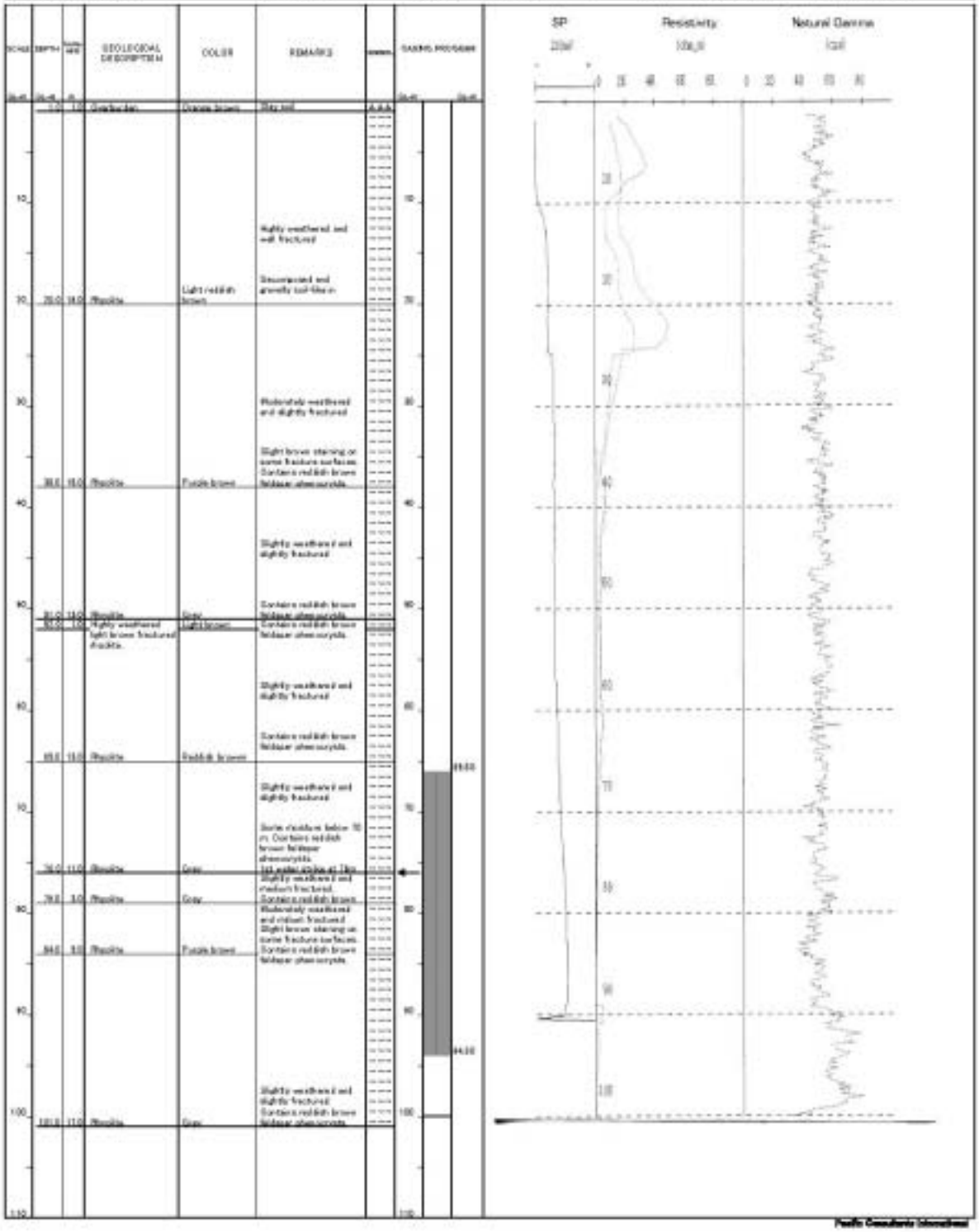
GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	916 (L2-6)	Latitude	5°25' 21'48"	SWL	18.97 m	pH	
Community	Wachungana	Longitude	032° 07'31"	DWL	58.53 m	Temperature	C
Region	Lubombo	Drilled depth	108.00 m	Quantity	8.30 l/sec	Conductivity	mS/cm
Completed Date : 05/21/02		Completed depth	100.00 m	Casing height	0.65 m	Constructed by	Mahlanya&Dlamini



GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	L3[illegible] (L3-08)	Latitude	26° 00' 37"	SWL	0.00 m	pH	
Community	[illegible]	Longitude	031° 59' 31"	DWL	0.00 m	Temperature	C
Region	Lubombo	Drilled depth	106 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	March 15, 2002	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS
3.0	3.0	Overburden	Reddish brown	Clay soil
8.0	5.0	Rhyolite	Light red gray	Slightly weathered
31.0	23.0	Rhyolite	Light gray	Moderately weathered and slightly fractured
63.0	32.0	Rhyolite	Light red and gray black	Dampness at 51~53m; Slightly weathered and very slightly fractured; Dampness at 59~63m; Scattered quartz veins
97.0	34.0	Rhyolite	Gray black	Dampness at 79~83m; Mainly fresh and unfractured
106.0	9.0	Rhyolite	Light red gray	Very little dampness at 101m; Mainly fresh and unfractured

SCALE (G.L.-m): 10, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110

SYMBOL

CASING PROGRAM (G.L.-m)

GEOPHYSICAL LOGGING DATA

Pacific Consultants International

GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	**Basic Design Study for the 2nd Rural Water Supply Project**						
Site Number	[illegible]	Latitude	S26° 38' 21"	SWL	0.00 m	pH	
Community	[illegible]	Longitude	E31° 57' 18"	DWL	0.00 m	Temperature	C
Region	[illegible]	Drilled depth	101 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	February [illegible], 2003	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

SCALE (G.L.-m)	DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS	SYMBOL	CASING PROGRAM
	3.0	3.0	Overburden	Brown	Clay soil		
10	14.0	11.0	Rhyolite	Yellow-brown	Slightly weathered and fractured		
20	20.0	6.0	Rhyolite	Gray-brown	Moderately weathered and medium fractured		
	29.0	9.0	Rhyolite	Gray	Very slight seepage (0.04 l/s) at 21 m. Slightly weathered and slightly fractured		
30	34.0	5.0	Rhyolite	Gray and speckled white	Slightly weathered and slightly fractured. Contains feldspar phenocrysts.		
40							
50							
60							
70							
80							
90							
100	101.0	67.0	Rhyolite	Gray and speckled green	Fresh & unfractured. Contains feldspar phenocrysts.		
110							

GEOPHYSICAL LOGGING DATA

Pacific Consultants International

GEOLOGICAL AND GEOPHYSICAL LOG

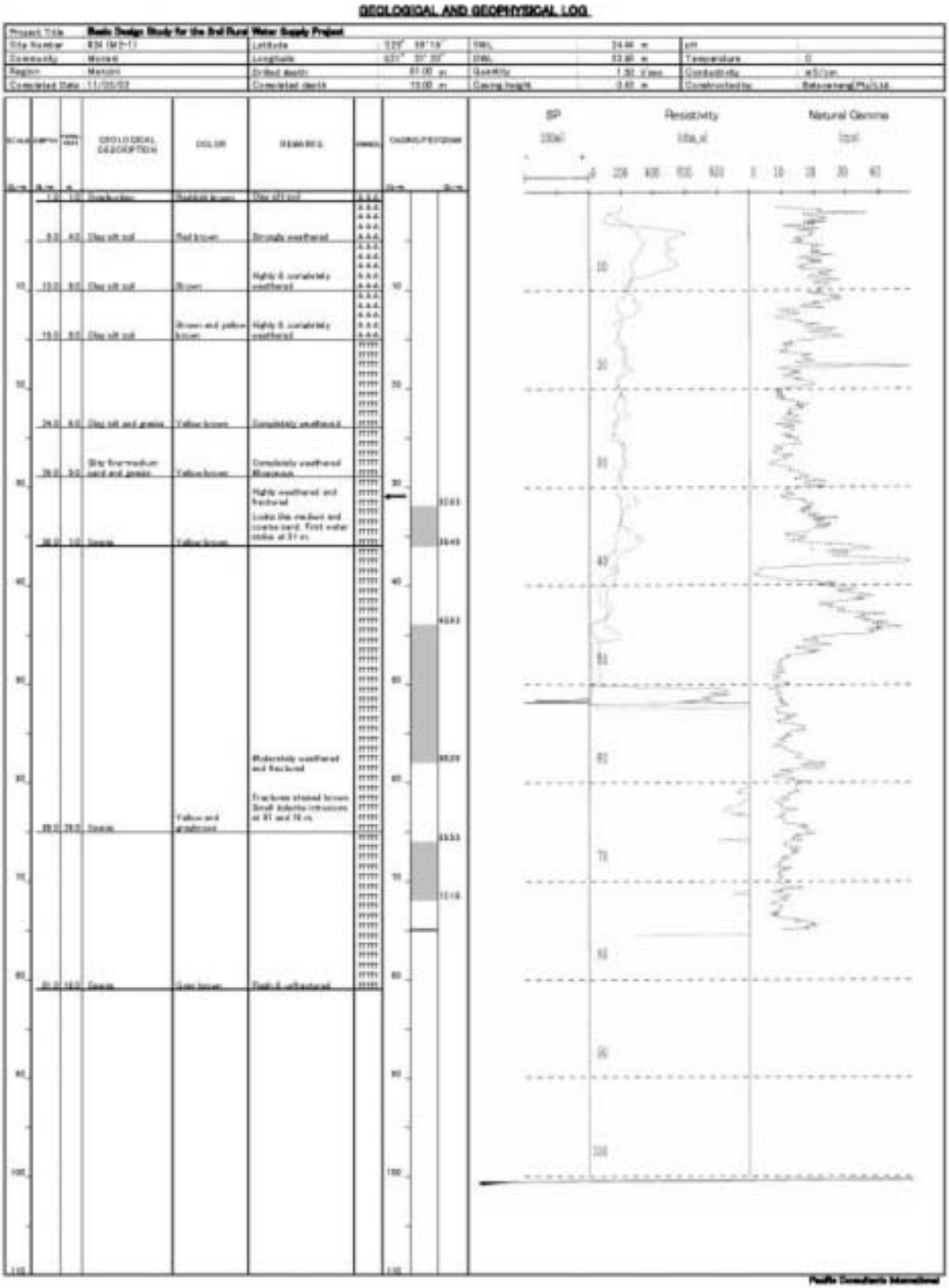
Project Title	**Basic Design Study for the 2nd Rural Water Supply Project**						
Site Number	L31 X37 (L3-33C20)	Latitude	26° 30' 1x"	SWL	0.00 m	pH	
Community	Nhlambalo	Longitude	031° 57' 32"	DWL	0.00 m	Temperature	C
Region	Lubombo	Drilled depth	101 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	February 12, 2002	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS
3.0	3.0	Overburden	Red brown	Clay soil
6.0	3.0	Rhyolite	Yellow brown	Completely weathered
10.0	4.0	Rhyolite	Yellow and grey brown	Moderately weathered and medium fractured
48.0	38.0	Rhyolite	Grey and speckled white	Slightly weathered and slightly fractured. Slight brown staining on some fractures.
72.0	24.0	Rhyolite	Grey	Fresh medium and slightly fractured. Contains feldspar phenocrysts. Fractures recrystallized with white mineral.
101.0	29.0	Rhyolite	Grey speckled white and area speckled red brown	Mainly fresh and unfractured. Contains feldspar phenocrysts. Some occasional small fractures. Seepage at 78 m.

SCALE (G.L.-m) · SYMBOL · CASING PROGRAM (G.L.-m)

GEOPHYSICAL LOGGING DATA

Pacific Consultants International

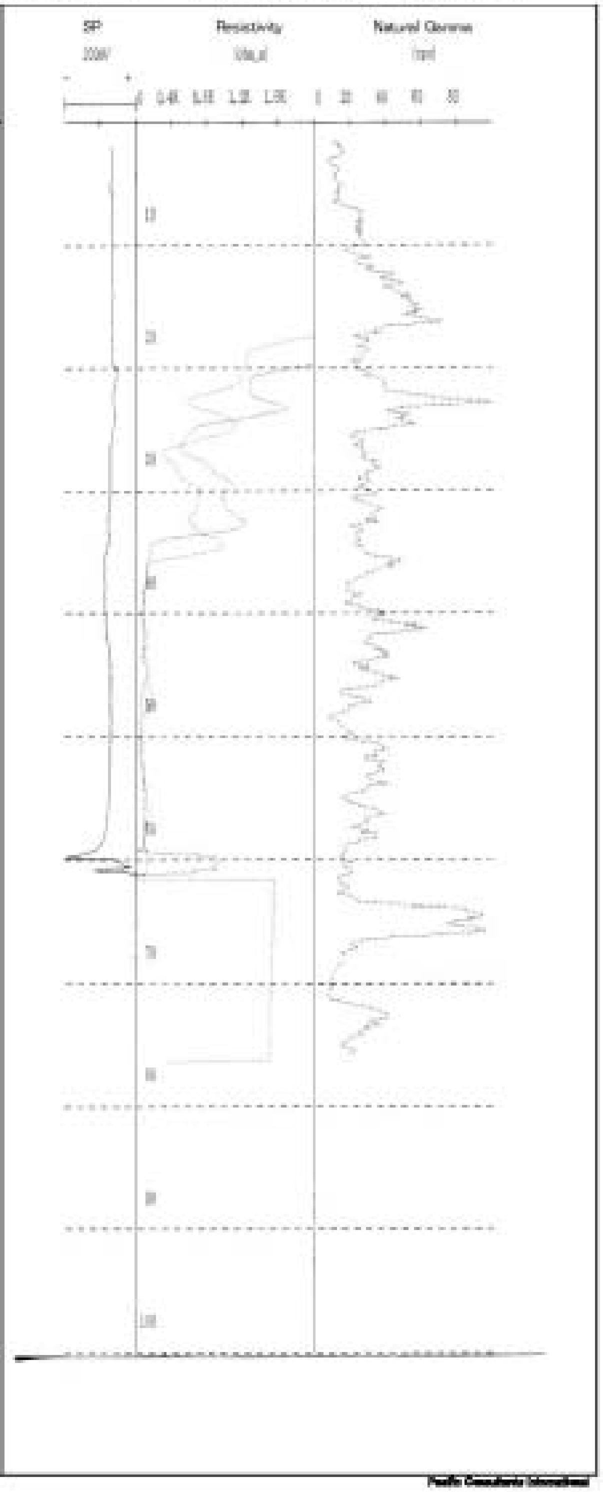

GEOLOGICAL AND GEOPHYSICAL LOG
Project Title
Site Number
Community
Region
Completed Date
Latitude
Longitude
Drilled depth
Completed depth
SWL
DWL
Quantity
Casing height
pH
Temperature
Conductivity
Constructed by
GEOLOGICAL DESCRIPTION
COLOR
REMARKS
SP
Resistivity
Natural Gamma

GEOLOGICAL AND GEOPHYSICAL LOG

Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	#22 (M3-11)	Latitude	026° 31' 00"	SWL	17.19 m	pH	
Community	Makambikabana	Longitude	031° 37' 27"	DWL	52.34 m	Temperature	C
Region	Manzini	Drilled depth	81.00 m	Quantity	2.30 l/sec	Conductivity	mS/cm
Completed Date	14/3/2003	Completed depth	75.00 m	Casing height	0.55 m	Constructed by	[illegible]

DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS
4.0	4.0	Overburden	Dark brown	Clay soil
8.0	4.0	Gneiss	Brown & gray	Moderately weathered and fractured
11.0	3.0	Gneiss	Dark gray	Moderately fractured and slightly fractured
14.0	3.0	Gneiss	Light brown	Moderately fractured. Very micaceous. Some amphibolite fragments
20.0	6.0	Gneiss	Dark gray	Slightly weathered and fractured
22.0	2.0	Gneiss	Light brown	Slightly weathered and fractured
24.0	2.0	Gneiss	Dark gray	Slightly weathered and fractured
28.0	4.0	Gneiss	Light brown	Slightly weathered and fractured
31.0	3.0	Gneiss	Dark gray	Slightly weathered. Very micaceous. Thin pelite layer at 30 m
36.0	5.0	Gneiss	Dark gray and white	1st water strike at 33m. Large quartz fragments. Some dolerite fragments. Fracture surfaces stained brown
43.0	7.0	Gneiss	Dark gray and white	Slightly weathered and fractured. Fracture surfaces stained brown. Some green mineralization
53.0	10.0	Gneiss	Dark gray	Fresh and slightly fractured
57.0	4.0	Gneiss	Light gray	Slightly weathered and fr... Large feldspar fragments. 2nd water strike at 55-57m
81.0	24.0	Gneiss	Dark gray	Slightly weathered and slightly fractured from ... Fresh and slightly fractured

CASING PROGRAM (screen intervals, G.L.-m): 35.40 – 41.15; 44.85 – 53.55; 55.40 – 61.10; 65.60 – 72.10



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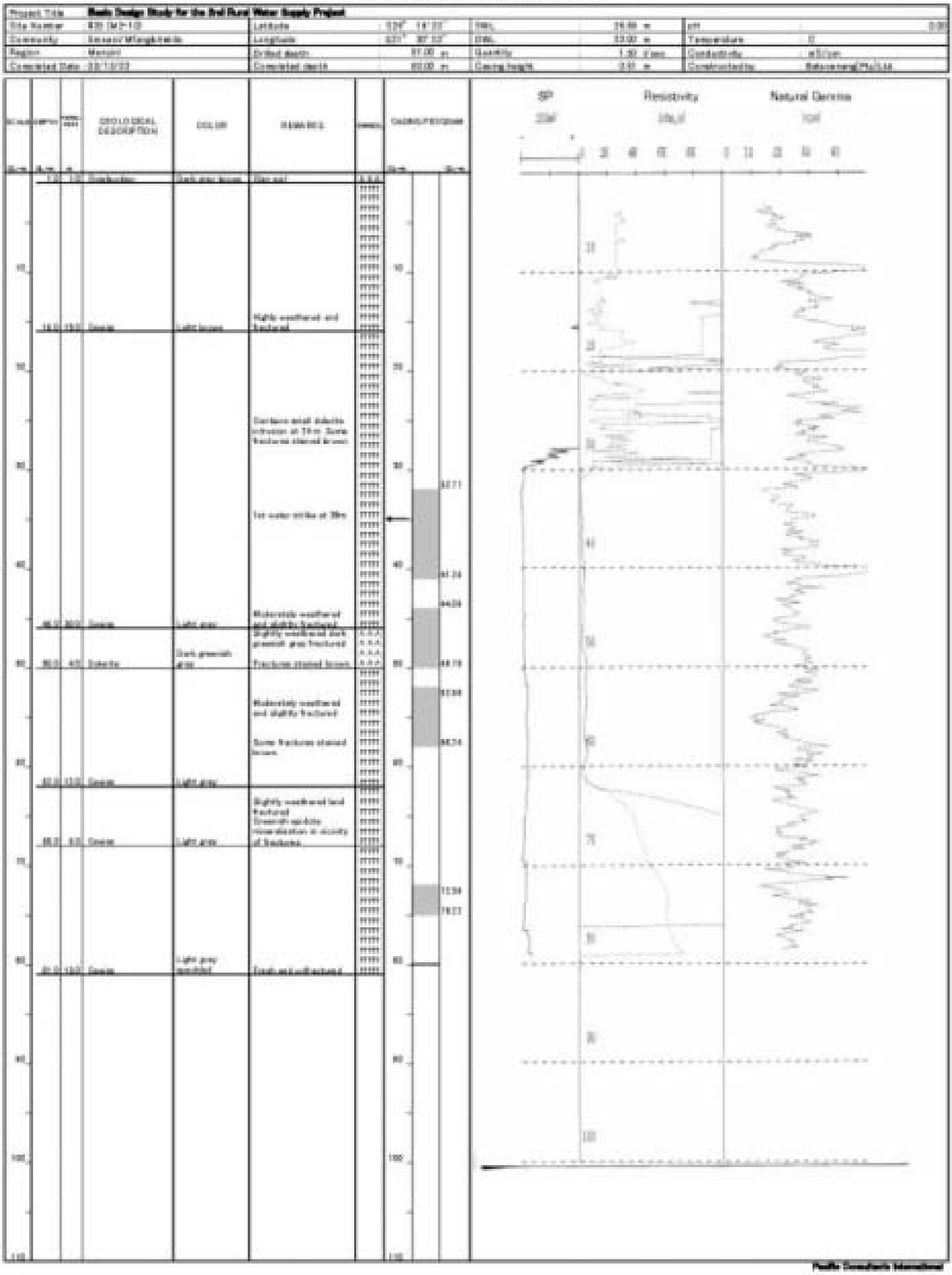
GEOLOGICAL AND GEOPHYSICAL LOG



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GEOLOGICAL AND GEOPHYSICAL LOG

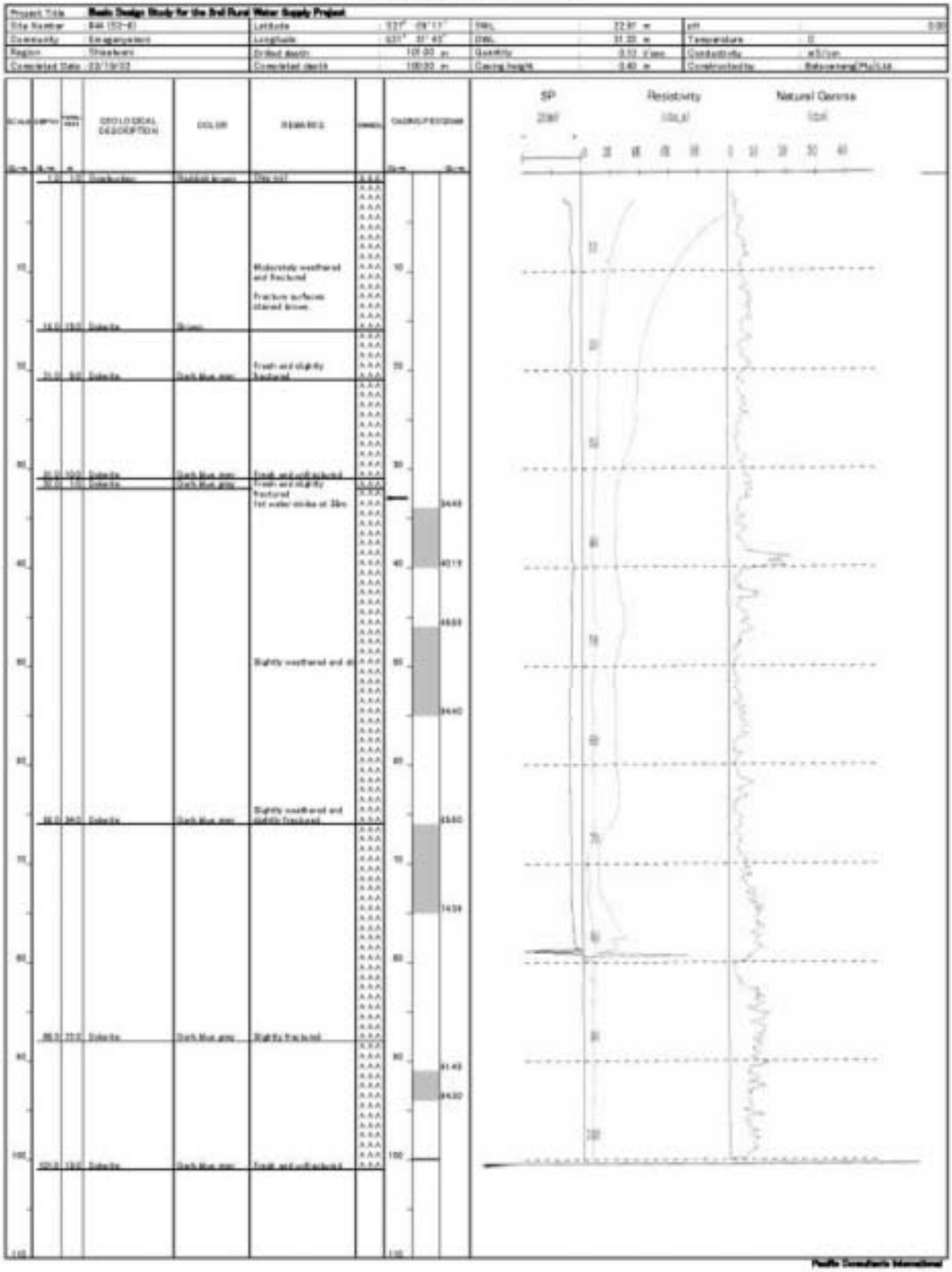
Project Title	Basic Design Study for the 2nd Rural Water Supply Project						
Site Number	#43 (33-1)	Latitude	S27° 18' 18"	SWL	0.00 m	pH	
Community	Hlakangweni	Longitude	E31° 49' 55"	DWL	0.00 m	Temperature	C
Region	Shiselweni	Drilled depth	101 m	Quantity	0.00 l/min	Conductivity	mS/cm
Completed Date	February 19, 2002	Completed depth	Abandoned	Casing height	0.00 m	Constructed by	[illegible]

SCALE (G.L.-m)	DEPTH (G.L.-m)	THICKNESS (m)	GEOLOGICAL DESCRIPTION	COLOR	REMARKS	SYMBOL	CASING PROGRAM (G.L.-m)
	3.0	3.0	Overburden	Reddish brown	Clay soil		
10	13.0	10.0	Dolerite	Brown	Moderately weathered and fractured. Fracture surfaces stained brown		10
20	20.0	7.0	Dolerite	Brown and dark blue gray	Moderately weathered and fractured		20
30							30
40					At 38 m recrystallized fractures filled with white mineral up to 3 mm wide		40
50							50
60							60
70							70
80							80
90							90
100	101.0	81.0	Dolerite	Dark gray and dark greenish	Fresh and unfractured		100
110							110

GEOPHYSICAL LOGGING DATA

Pacific Consultants International

GEOLOGICAL AND GEOPHYSICAL LOG



Result of Water Quality Analyses

Serial No.	Site Location No. Previous	Site Location No. Present	Region	Community	Item	pH	Turbidity	Colour	Conductivity (μS/cm)	SO4 (mg/l)	Cl (mg/l)	NO3 (mg/l)	NO2 (mg/l)	Fe (mg/l)	Mn (mg/l)	F (mg/l)	Alkalinity (mg/l)	HCO3 (mg/l)	Hardness (mg/l)	TDS (mg/l)	Total Coliform	Fecal Coliform	Remarks
					WHO Guideline		5NTU	15TCU			250	50	3	0.3	0.5	1.5				1,000	Undetected	Undetected	
1	#2	H2-3	Hhohho	Lohlangotini		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2	#4	H2-4	Hhohho	[illegible]		6.8	8	49	79	4	30	16	0	0.1	0.4	ND	130	92	ND	28	ND	ND	
3	#10	L2-3	Lubombo	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4	#10(2)	L2-3(2)	Lubombo	[illegible]		6.4	9	43	126	7	147	22	0	0.2	0.5	ND	1,290	848	140	72	ND	ND	
5	#12	L2-5	Lubombo	[illegible]		6.6	30	54	140	67	1,269	78	0	0.1	0.6	ND	1,800	1,125	292	72	ND	ND	
6	#13	L2-6	Lubombo	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7	#16	L2-8	Lubombo	[illegible]		6.5	29	94	98	3	9	24	0	0.1	0.3	ND	415	212	ND	72	ND	ND	
8	L011	L2-29	Lubombo	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9	L022	L2-32	Lubombo	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10	[illegible]	[illegible]	Lubombo	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11	#28	M2-1	Manzini	[illegible]		6.9	9	31	31	4	20	10	0	0.1	0.4	ND	200	122	ND	29	ND	ND	
12	#32	M2-7	Manzini	[illegible]		6.8	9	27	118	8	42	30	0	0.1	0.3	ND	400	244	131	75	ND	ND	
13	#35	M2-10	Manzini	[illegible]		6.6	7	25	125	3	77	27	0	0.1	0.3	ND	200	212	112	79	ND	ND	
14	#43	S2-7	Shiselweni	[illegible]		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
15	#44	S2-8	Shiselweni	[illegible]		6.6	11	41	67	<73	745	138	0	0.1	16.9	ND	1,450	815	312	72	ND	ND	

Appendix-8 References

No.	Title	Organization
1	Annual Statistical Bulletin 1998	Central Statistical Office, Mbabane
2	Swaziland Population and Housing Census vol. 1: Statistical Tables (1996)	Central Statistical Office, Mbabane
3	Swaziland Annual Agriculture Survey 1999-2000	Central Statistical Office, Mbabane
4	Swaziland Household Income and Expenditure Survey 1995: Main Report	Central Statistical Office, Mbabane
5	Procedures for the Approval of Rural Water Schemes in Swaziland	RWSB
6	Guidelines for Drinking Water Quality in Rural Areas	Laboratory in Matsapha, RWSB
7	Institutional Study on Road Management and Financing	Road Department, Ministry of Public Works and Transport
8	Design and Supervision of the Feeder Roads Network Rehabilitation in line with Labor Intensive Methods of Construction	Road Department, Ministry of Public Works and Transport
9	Topographical Map (1/250,000)	Map Sells Office, Ministry of Public Works and Transport
10	Topographical Map (1/50,000) (Total: 31 sheets)	Map Sells Office, Ministry of Public Works and Transport
11	Occupational Safety and Health Act 2001	Department of Labor, Ministry of Enterprise and Employment
12	The Workmen's Compensation Act, 1983	Department of Labor, Ministry of Enterprise and Employment
13	The Regulation of Wages (Building and Construction Industry) Order	Department of Labor, Ministry of Enterprise and Employment
14	Employment Statistics Report 1998	Department of Labor, Ministry of Enterprise and Employment
15	Microprojects Programme GUIDE (1999)	EU/Microprojects Programme
16	Social Studies Atlas for Swaziland (1991)	National Curriculum Center, Manzini, Swaziland
17	Master Plan of Operation: Programme of Cooperation 2001-2005 of the Government of Swaziland and the United Nations Children's Fund	UNICEF
18	Health Statistical Report 1999	Ministry of Health and Social Welfare
19	Swaziland Human Development Report 2000	UNDP
20	Guidance Manual on Water Supply and Sanitation Programs	UNDP
21	Human Resources Development Assessment for the Rural Water Supply Branch	UNDP
22	Socio-Economic Survey on Community Resource and Attitudes	UNDP