Ministry of Water and Irrigation
The Republic of Kenya

THE IMPLEMENTATION REVIEW STUDY REPORT ON THE PROJECT FOR RURAL WATER SUPPLY IN THE REPUBLIC OF KENYA

FEBRUARY 2011

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the implementation review study on the Project for Rural Water Supply in the Republic of Kenya, and organized a survey team headed by Mr. Hajime Kamo of Nippon Koei Co., Ltd. between October, 2009 to February, 2011.

The survey team held a series of discussions with the officials concerned of the Government of the Republic of Kenya, and conducted a field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kenya for their close cooperation extended to the survey team.

February, 2011

Shinya Ejima

Director General,
Global Environment Department
Japan International Cooperation Agency

Summary

Summary

1. Outline of the Country

The Republic of Kenya locates, striding the Equator in the eastern part of Africa. It is a large country with a land area of 583,000km^2 and a population of 38.6 million in the year of 2009. The Arid and Semi-Arid Lands (ASAL), where is classified as arid and semi-arid regions except the coast and southern hilly areas, occupies an area of 490,000km^2 or 83% of the overall land area of the country, and is inhabited by 25% of the overall population and 50% of livestock.

The economy of Kenya is largely dependent on the two major sectors of agriculture and tourism, which comprise approximately 24% and 52% of GDP. The Republic of Kenya is classified as one of the Least Developed Countries due to its low per capita Gross National Income of US$ 770 in 2008. The economic growth is presently in a state of deceleration with an annual average growth rate of 4.7%.

In order to improve this sluggish economic situation, the Government of Kenya (GOK), in the 9th National Development Plan (2002 to 2008), clarified its intention to promote industrialization and development of commercial sectors in addition to stabilization of agriculture. Provision of stable water supplies is indispensable to promote the above objectives and appropriate development of water resources and improvement of maintenance are targets of the water supply sector. In line with this priority, the "National Water Policy" was initiated in 1999. The Government of Kenya issued the Water Act 2002 in order to realize this poly, and the water supply sector is being re-formed in accordance with the act.

2. Background of the Project

The GOK made a request to the Government of Japan (GOJ) in August, 2002 to extend grant aid assistance for development of groundwater supply facilities in the four districts of Machakos, Makueni, Kitui and Mwingi in the Eastern Province, procurement of operation and maintenance equipment and provision of technical guidance for operation and maintenance. The request was based on the "Aftercare Study on the National Water Master Plan in the Republic of Kenya", a development program study conducted by Japan International Cooperation Agency (JICA) in 1998.

In response to this request, the GOJ decided to conduct the preliminary study in November, 2003, and the basic design study undertaken during the periods from June to October, 2004. The basic design study prepared the implementation plan of water supply for 155 target communities and population of 203,000, including construction of water supply facilities, procurement of operation and maintenance equipment and tools, and software program to develop capacity of communities for operation and maintenance. The Project was composed of 3 phases, namely Phase-1/3, 2/3 and 3/3.

Based on the aforesaid basic design study, the exchange of note has been signed on November 2, 2004. Tendering process was done at May 16, 2005 after completion of the detailed design works, but it did not reach to successful result. The second tendering also was done, reviewing pre-qualification criteria, construction period, and exchange rates, but the all the candidates did not submit their tenders.

The Government of Japan decided that works of the Project under the budget in 2004 fiscal year closed at the detailed design and pre-constriction works because of insufficient period for completing the scheduled construction works by the March, 2006, and that the implementation of Project should be re-evaluated by the Cabinet of the Government of Japan on the basis of result of the previous Implementation Review Study.

After the implementation study, the Project was recomposed of 2 phases, namely Phase-1/2 and 2/2. The exchange of note for Phase-1/2 was signed on September 1, 2006 and Phase-1/2 was implemented and completed in March, 2008. Further exchange of note for Phase-2/2 was signed on May 30, 2007 and the detailed design works for Phase-2/2 of the Project was commenced from August, 2007.

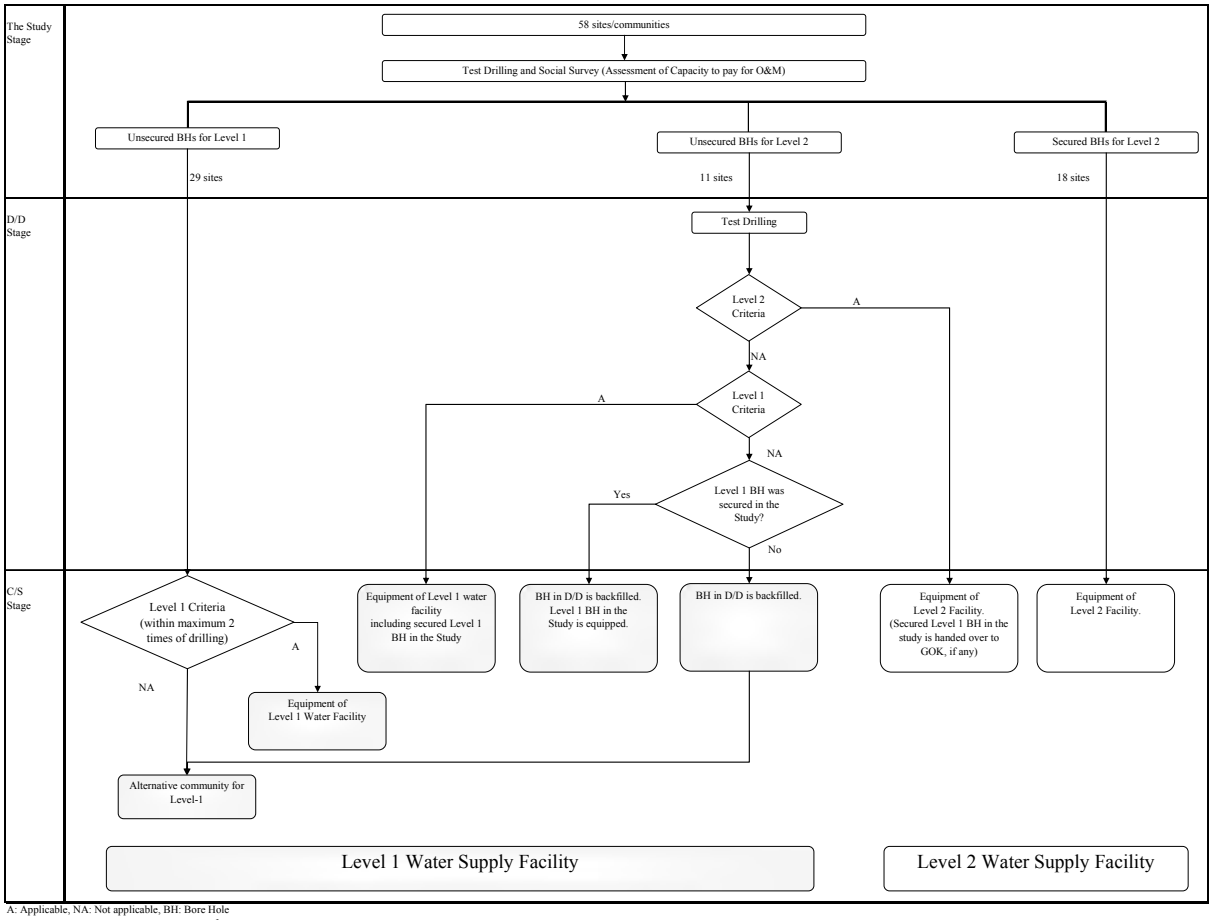
First tendering process for Phase-2/2 was done at February 26, 2008 after completion of the detailed design works, but it did not reach to successful result due to insufficient document submitted by the sole Tenderer. The second tendering also was done at March 18, 2008 on purpose to have completed Phase-2/2 till March, 2009 defined in the exchange of note, but it did not reach to successful result after price negotiation with the sole Tenderer. After the design change of Phase-2/2, the third tendering was scheduled at June 10, 2008 on the same purpose. However, the sole anticipated Tenderer declined before the tender. It was concluded that the reasons were exchange of rate (weakness of Japanese yen) and price escalation as a result of interview to him.

The Government of Japan decided that works of the Project under the budget in 2007 fiscal year closed at the detailed design and pre-constriction works because of insufficient period for completing the scheduled construction works by March, 2009, and that the implementation of the Project should be re-evaluated by the Cabinet of the Government of Japan on the basis of result of this Implementation review study (hereinafter referred to as “the Study”). The Study consisted of Phase-1 (October, 2009 - March, 2010) and Pahse-2 (June, 2010 - March, 2011), and test drilling was carried out in each phase.

3. Contents of the Project

Unit water consumption in the target communities is based on the criteria of the Practice manual for water supply services published by MOWI in October 2005. Water supply plan is prepared by using these criteria describing the unit water consumption of 15L/day/capita in ASAL area with an annual rainfall of 500m to 1,000mm. Water supply facility is selected in accordance with Basic design. When population within a radius of 2km from the borehole point is less than 500, hand pump is selected. When not less than 500, motorized pump is selected. Two (2) types of motorized pumps are planned in the Project. One is windmill pump which has been popularized in Kenya since 1990’s, and another is submergible pump. Further, types of submergible pumps are classified into three in each power source, namely generator, commercial power and solar panel. The submergible pump with solar panel requested by Kenyan government has been familiarized in Kenya because of present mode of clean energy. The types of water supply facilities are classified into two levels; level-1 is a facility equipped with a motorized pump, and level-2 is one with a hand pump. Type of water supply facility for ensured borehole as Level-2 in test drilling is selected on the basis of actual water yield and total head. Numbers of ensured borehole as Level-2 in test drilling are 5 in Larger Makueni (equals to former 'Makueni' before region reform in 2008) and 13 in Larger Machakos (equals to former 'Machakos' before 2008) districts and 18 in total. These boreholes will be equipped with water supply facilities in construction stage. On the other hand, all boreholes to be drilled in construction stage will be equipped with hand pump.

A borehole is principally constructed in a community. When a borehole drilled has less than water yield of $0.33m^3/h$, the Project backfills the borehole and does not construct water supply facility. When a borehole drilled has equal or more than water yield of $0.33m^3/h$ but does not have sufficient water quality, the Project caps the borehole and delivers it to the Government of Kenya. A maximum of 2 drillings by one target community are carried out in both of target communities for Level-1 (Hand pump) and Level-2 (Windmill and Submergible pumps), and water supply facility is constructed there if the drilled borehole satisfies the criteria set by the Project. When drilling is failed two times in a row in a target community, the community is excluded from the target of the Project. The alternative community in the same district area is selected in accordance with the List of alternative sites for Hand pump for Level-1. Principle of drilling of boreholes and handling of failed boreholes for Level-2 communities is as follows:



A: Applicable, NA: Not applicable, BH: Bore Hole
Level 1 Criteria: To secure the yield over 0.33m^3/hr and water quality
Level 2 Criteria: To secure the yield over 1.0 m^3/hr and water quality
Water Quality: To meet the criteria in the study report

Principle of drilling of boreholes and handling of failed boreholes (B/H) for Level-2 communities

The criteria for successful borehole, in accordance with basic design study and the previous implementation review study, are set up as follows: 1) 0.33m^3/hour and the above for Hand pump, 2) 0.6m^3/hour and the above for Windmill pump and 3) 1.0m^3/hour and the above for Submergible pump. In accordance with the above criteria, the judgment of successful borehole is made. The groundwater source in the Project areas indicates high level of fluoride and total dissolved solid (TDS). The following principles therefore are applied for the Study: 1) Boreholes with fluoride and arsenic exceeding health significance values are defined as failed and are capped. The boreholes are delivered to Kenyan Government under acceptance of Kenyan Government, 2) TDS level is proposed as 2,000mg/L. Boreholes with TDS exceeding the level are defined as failed and are capped. The boreholes are delivered to Kenyan Government under acceptance of Kenyan Government and 3) A borehole with aesthetic substances such as hardness, chloride, sodium etc. exceeding the health-based guideline values of Kenyan standard is defined as failed and is capped. The borehole is delivered to Kenyan Government under acceptance of Kenyan Government. If there is no guideline value in Kenyan guideline, WHO guideline is fulfilled.

Types of water supply facilities were selected on the basis of the result of the Study, and are described in the following table:

Type and No. of Water supply facilities to be constructed by the Project

District	Pump type					Total
	Level-1	Level-2				
	Hand pump	Windmill	Submergible pump			
			Generator	Commercial power	Solar	
Larger Makueni	17	1	4	1	3	26
Larger Machakos	12	0	17	1	2	32
Total	29	1	21	2	5	58

Source: JICA study team

Although TAWSB (TANATHI Water Service Board) has the policy that WSP (Water Service Provider) is substituted for WUA (Water Users Associations), this policy will not be realized promptly. Meanwhile, district water office of TAWSB has been assisting present WUAs. Therefore, this soft component targets DWST (District Water and Sanitation Team) which is composed of administration officers concerned at district level, and technical guidance is taken by DWST under the soft component.

The soft component aims “to establish the basis for a community-based operation and maintenance system”. The means of verification to assess the achievement set as expected output are outlined below:

1) Sense of ownership and participation is improved.

2) Capacity and skills of local administration to support communities to establish community-based operation and maintenance and to facilitate sanitation education are enhanced and retained by the concerned organization.

3) Capacity of the target communities in operation and maintenance of the improved water supply system is enhanced.

4) Awareness in individual health and sanitation and correlation with use of safe water is increased.

Activities planned for the soft component are based on the concept and methodology applied by NGOs activities in the Project area, so that consistency with SIDA/DANIDA cooperation can also be maintained. The planned activities are as follows:

1) Activities to improve community ownership and participation

2) Activities to enhance capacity and skills of local administration to support communities in establishment of community-based operation and maintenance system:

3) Activities to develop capacity of target communities in operation and maintenance of improved water supply system:

4) Activities to increase community awareness in personal health and sanitation, and understanding of correlation with safe water use:

5) Activities to measure the impact of the Project:

4. Implementation Schedule and Cost Estimation of the Project

The Project is implemented in one phase and in Larger Makueni (equals to former 'Makueni' before region reform in 2008) and Machakos (equals to former 'Machakos' before 2008) districts. Through the Project, Soft component is planned to be implemented (8 months for Detailed design and Tendering, 12.5 months for Construction and Inspection and 11.0 months for Soft component).

The cost estimation of the project for Japanese side is confidentiality and the Kenyan side is 72.3 million Japanese Yen.

5. Project Evaluation

The Project is justified for implementation under the Grant Aid Scheme from the following aspects:

1) The target communities of 58, which could not have stable and safe water source in vicinity area, enable to have safe and stable water supply in their community areas by implementation of the Project.
2) The Project aims to improvement of water service ratio by construction of water supply facilities with boreholes or spring water, and to shorten the long access distance to water points. The Project contributes to improvement of extremely poor water supply condition for population of 60,000.
3) It is possible for the Kenyan side to operate and maintain the water supply facilities because of no requirement for complicated engineering.
4) This Project contributes to ensure water and improved sanitation availability and access to all by 2030 in the VISION 2030 and consistent with the national policy of the Government of Kenya.
5) This Project is judged to have no significant adverse effects on environment.
6) The Project can be implemented under the Grant Aid Scheme of Japanese Government without any difficulties.

The estimated incremental population with safe drinking water source and the service ratio are improved as 60 thousand in population and 2.9% in service ratio, respectively. And the following are shown in the qualitative effectiveness of the project.

1) Decrease in diseases caused by polluted water in the target area
2) Improvement of community ownership and participation,
3) Transference of capacity and skills of local administration to support communities in establishment of community-based operation and maintenance system, and community awareness in personal health and sanitation, and understanding of correlation with safe water use,
4) Reduction of water drawing work by women and children

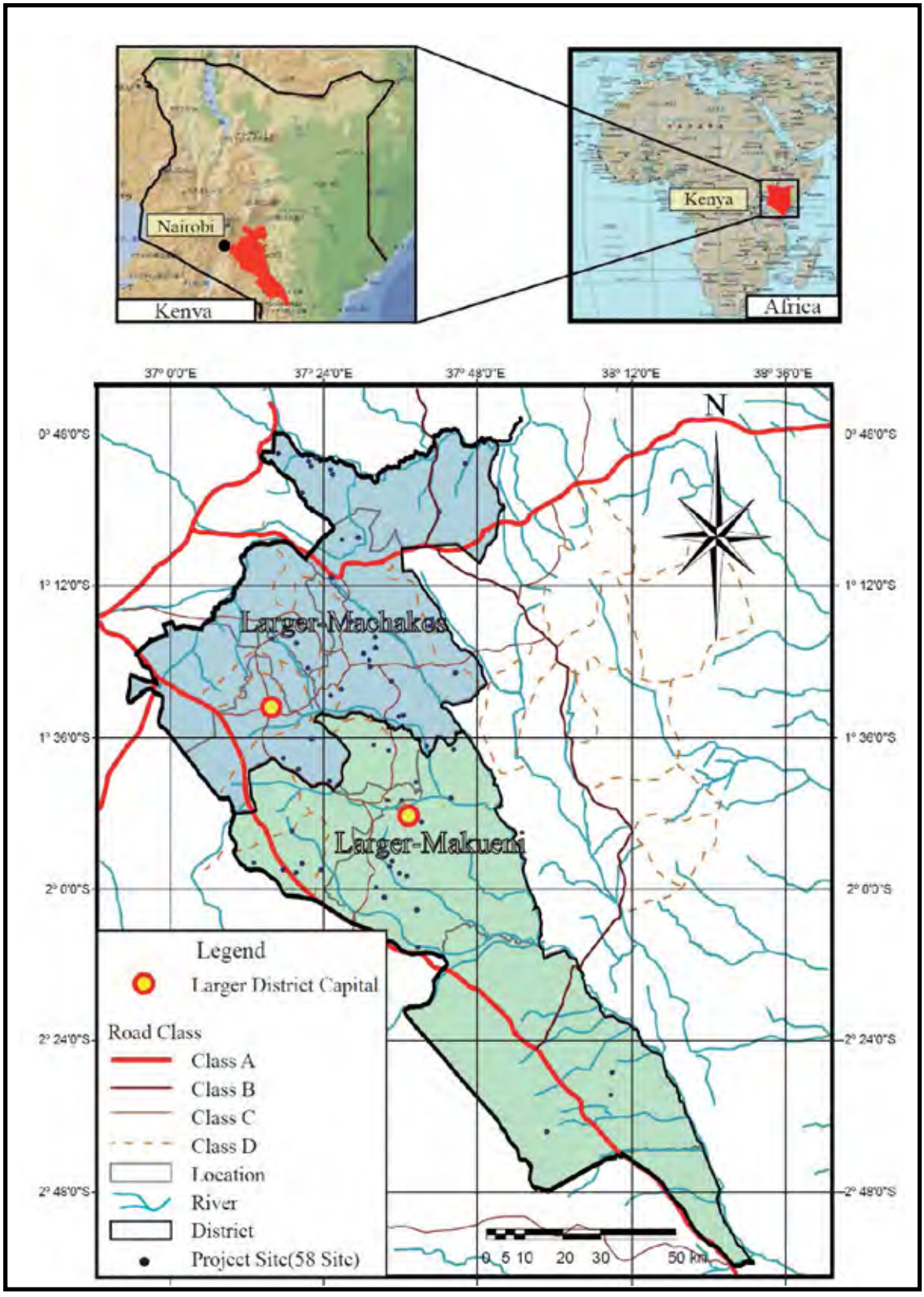
Therefore, this project is justified for having a high propriety and effectiveness.

The Implementation Review Study Report
on
The Project for Rural Water Supply
in
The Republic of Kenya

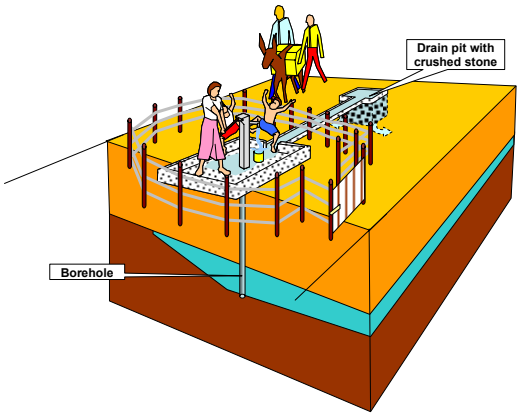
Preface
Summary
Contents
Location Map / Perspective
List of Figures & Tables
Abbreviations

Table of Contents

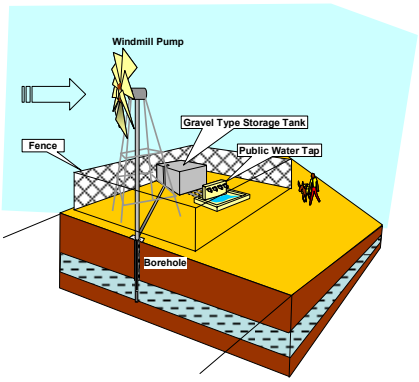
Appendices



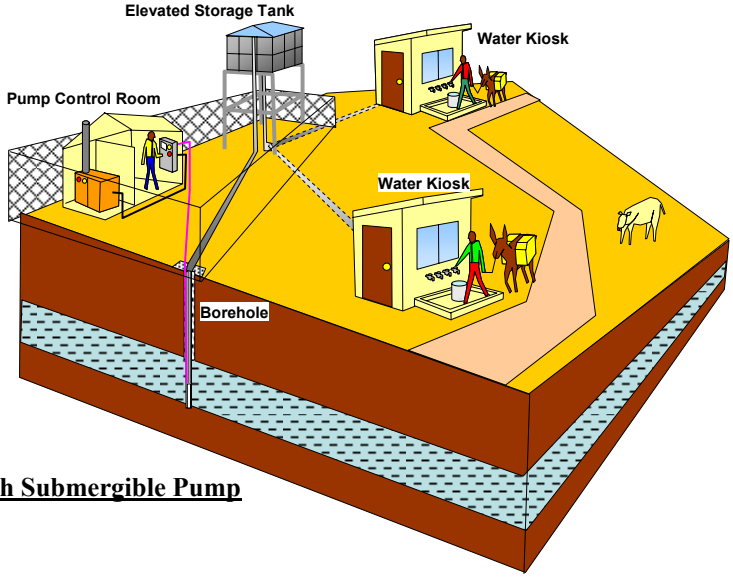
Location Map of the Project



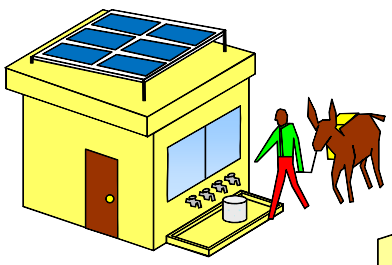
Water Supply Facility with Hand Pump



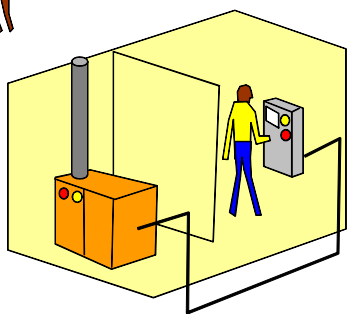
Water Supply Facility with Windmill Pump



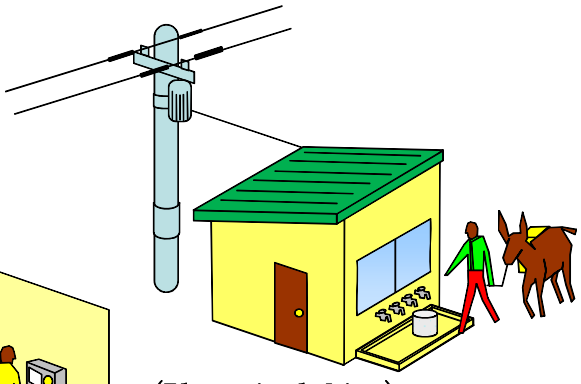
Water Supply Facility with Submergible Pump



(Solar)



(Generator)



(Electrical Line)

Power Source of Water Supply Facility with Submergible Pump

List of Figures & Tables

List of Figures

List of Tables

Abbreviations

ADRA	Adventist Development and Relief Agency
AfDB	African Development Bank
AMREF	African Medical and Research Foundation
ASAL	Arid and Semi-Arid Lands
BD	Basic Design
BTC	Belgian Technical Cooperation
CCF	Christian Children's Fund
CORP	Community Resource Person
DANIDA	Danish International Development Agency
DWO	District Water Office
DWST	District Water and Sanitation Team
EC	Electric Conductivity
E/N	Exchange of Note
GDP	Gross Domestic Product
GOK	Government of Kenya
GSP	Galvanized Steel Pipe
GTZ	German Technical Cooperation Agency
ICA	Institute of Cultural Affairs
JICA	Japan International Cooperation Agency
KAP	Kitui Agricultural Project
MoFP	Ministry of Finance and Planning
MoPND	Ministry of Planning and National Development
MoWI	Ministry of Water and Irrigation
NEWA	National Environment Management Authority
NGO	Non-governmental Organization
NWCPC	National Water Conservation and Pipeline Cooperation
O&M	Operation and Maintenance
OJT	On the Job Training
PHAST	Participatory Health and Sanitation Transformation
PMU	Project Management Unit
PRSP	Poverty Reduction Strategy Paper
SIDA	Swedish International Development Agency
TAWSB	TANATHI Water Service Board
TDS	Total Dissolved Solid
TOT	Training of Trainers
UNDP	United Nations Development Program
UNICEF	United Nation Children's Fund

uPVC	Unplasticised Polyvinyl Chloride
VES	Vertical Electrical Sounding
WHO	World Health Organization
WRMA	Water Resources Management Authority
WSB	Water Service Board
WSP	Water Service Provider
WSRB	Water Service Regulatory Board
WSRP	Water Sector Reform Project
WSS	Water Supply and Sanitation
WUA	Water Users Association
WUASP	Water Users Association Support Program

Units

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
ft	=	feet

Area

cm^2	=	square centimeter
m^2	=	square meter
km^2	=	square kilometer

Volume

cm^3	=	cubic centimeter
m^3	=	cubic meter
L, l or lit	=	liter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Time as denominator

/s	=	per second
/min	=	per minute
/hr.	=	per hour

Derived measures

mg/l	=	milligram per liter

Currency

Ksh	=	Kenyan Shilling

Others

%	=	percent
Ph	=	potential of hydrogen
°C	=	degrees Celsius
ppm	=	parts per million
micro S/cm	=	micro siemens per centimeter
kWh/m^2day	=	solar radiation
Wp	=	Watt peak
kVA	=	kilo volt ampere
PV		Photovoltaic

Currency

JPY	Japanese Yen
US$	US Dollar
Ksh	Kenyan Shilling

Exchange Rate as of the end of October 2010

1 US$ = Ksh 79.87 = JPY 89.91

Chapter 1
Background of the Project

CHAPTER 1
BACKGROUND OF THE PROJECT

1-1 Background of the Request

The Republic of Kenya is located striding the equator at the eastern part of Africa. It is a large country with a land area of 583,000 km^2 and a population of 38.6 million, as in the year of 2009. The arid and semi-arid lands (ASAL), which are classified as arid and semi-arid regions except along the coast and southern hilly areas, occupies an area of about 490,000 km^2, or 83% of the overall land area of the country, and is inhabited by 25% of the overall population with 50% of livestock.

The economy of Kenya is largely dependent on the two major sectors of agriculture and tourism, which comprise approximately 24% and 52% of GDP, respectively. The Republic of Kenya is classified as one of the least developed countries due to its low per capita gross national income of USD 770 in 2008. The economic growth is presently in a state of deceleration with an annual average growth rate of 4.7%.

In order to improve its economic situation, the Government of Kenya (GOK), in the 9th National Development Plan for 2002 to 2008, clarified its intention to promote industrialization and development of commercial sectors in addition to the stabilization of agriculture. Provision of stable water supply is indispensable to support the above objectives and the appropriate development of water resources and improvement of maintenance are targets of the water supply sector. In line with this priority, the National Water Policy was initiated in 1999. The GOK issued the Water Act 2002 in order to realize this policy, and the water supply sector is being reformed in accordance with the act.

Accordingly, the GOK requested the Government of Japan (GOJ) in August 2002 to extend grant aid assistance for the development of groundwater supply facilities in the four districts in the Eastern Province, procurement of operation and maintenance (O&M) equipment, and provision of technical guidance for O&M. Said districts include Machakos, Makueni, Kitui and Mwingi. The request was based on the "Aftercare Study on the National Water Master Plan in the Republic of Kenya", which is a development program study conducted by Japan International Cooperation Agency (JICA) in 1998.

In response to this request, the GOJ decided to conduct the preliminary study in November 2003, and the basic design study undertaken during from June to October 2004. The basic design study prepared the implementation plan of water supply for 155 target communities with a total population of 203,000; including construction of water supply facilities, procurement of O&M equipment and tools, and development of a software program to develop capacity of communities for O&M. The project was composed of three phases: namely Phases 1/3, 2/3, and 3/3.

Based on the aforesaid basic design study, the exchange of notes has been signed on November 2, 2004. Tendering process was done on May 16, 2005 after the completion of detailed design works, but did not reach a successful result. The second tendering also was done involving review of pre-qualification criteria, construction period, and exchange rates, but the all candidates was not able to submit their tenders.

The GOJ decided that works for the project under the budget in FY 2004 terminated after the detailed design and pre-constriction works because of insufficient period for completing the scheduled construction works by March 2006. Also, project implementation should be reevaluated by the Cabinet of GOJ based on the results of the previous implementation review study.

After the implementation study, the project was then divided into two phases: namely

Phase-1/2 and Phase-2/2. The exchange of notes for Phase-1/2 was signed on September 1, 2006, and its implementation was completed in March 2008. Meanwhile, exchange of notes for Phase-2/2 was signed on May 30, 2007 and the corresponding detailed design works commenced on August, 2007.

The first tendering process for Phase-2/2 was done on February 26, 2008 after completion of the detailed design works. However, it was unsuccessful due to insufficient documents submitted by the sole tenderer. The second tendering was done on March 18, 2008, which aims to complete Phase-2/2 up to March, 2009 defined in the exchange of notes, but again was unsuccessful after price negotiation with the sole tenderer. After the design change of Phase-2/2, the third tendering was scheduled on June 10, 2008 with the same purpose. However, the sole anticipated tenderer declined prior to the tender deadline. From an interview with the tenderer, it was concluded that the reasons were the exchange rates, particularly the weakness of Japanese yen at that time, and price escalation.

The GOJ decided that works for the project under the budget in FY 2007 be terminated after the detailed design and pre-constriction works because of insufficient period for completing the scheduled construction works by March 2009. Also, the Cabinet of GOJ should reevaluate the implementation of the Project based on the results of this implementation review study (hereinafter referred to as “the Study”).

The Study consisted of Phase 1 and Phase 2, and test drills were carried out in each phase.

1-2 Outline of the Request

Table-1.1 lists the requests of GOK based on the basic design study of JICA for the Project for Groundwater Development in Rural Districts (Machakos, Kitui, Makueni and Mwingi), which was done by JICA from May to December 2004, and the previous implementation review study from December 2005 to June 2006.

Table-1.1 Request of the GOK

Request issues	Basic Design Study (2004) (original request)	Previous Implementation Review Study (2006)	At the Beginning of the Study*1
1. Construction of water supply facilities			(nos. of communities)
1.1 Construction of borehole	Machakos Dist.: 44	Machakos Dist.: 38	(Larger) Machakos Dist.*2:32
	Kitui Dist.: 45	Kitui Dist.*1: 25	-
	Mwingi Dist.: 35	Mwingi Dist.*1: 33	-
	Makueni Dist.: 31	Makueni Dist.: 27	(Larger) Makueni Dist.*2: 26
	Total: 154	Total: 123	Total: 58
1.2 Water supply facilities with spring water	Larger Mwingi Dist.: 1	Larger Mwingi Dist.: 1	-
1.3 Type of water supply facilities with boreholes	Hand pump: 56 Submergible pump: 88 Windmill pump: 10 Gravity system of spring water: 1 Total: 155	Hand pump: 49 Submergible pump: 67 Windmill pump: 7 Gravity system of spring water: 1 Total: 124	Hand pump: 18 Submergible pump: 33 Windmill pump: 7 Total: 58
2. Procurement of equipment for operation & maintenance (O&M)			
2.1 Vehicles	5 units	5 units	-
2.2 Motor bikes	8 units	8 units	-
2.3 Electrical sounding equipment	1 set	1 set	-
2.4 Water quality test kit	4 sets	4 sets	-
2.5 O&M tools	1 lot	1 lot	-
3. Technical guidance			
3.1 Type of cooperation	Technical guidance for capacity building of communities for O&M	Technical guidance for capacity building of communities for O&M	Technical guidance for capacity building of communities for O&M
4. Required project cost			
4.1 Project cost	JPY 1.05 billion	JPY 1.01 billion	-

*1: After the previous implementation review study, construction in Mwingi and Kitui districts was completed in March 2003.
Source: JICA study team

*2: 'Larger Makueni' equals to former 'Makueni' and 'Larger Machakos' equals to former 'Machakos' before region reform in 2008.

Furthermore, requests confirmed by the GOK at the beginning of the Study are also listed in the Table-1.1.

1-3 Natural Situations

1-3-1 Meteorology and Hydrology (Temperature, Rainfall, and Wind Velocity)

Climate of Kenya greatly varies with respect to area. There are three typical climates: One is ocean climate with mildness along the Indian Ocean side. The next is arid climate in low and inland area. The last is cool climate in highlands. Such varying climate is due to the location of the country, which is just under the equator with monsoon coming from the Indian Ocean. Around two-thirds of the country are ASAL, and the target area of the Project belongs to semi-arid lands, as seen in the photos below.


Figure-1.1 Semi-Arid Lands

Annual rainfall is 400 to 800 mm in the larger Makueni District and 500 to 1,000 mm in the larger Machakos District. However, recent records tend to decrease annually. It is said that rainy season is mainly from March to May and sub-rainy season is from October to December. The period between these rainy seasons is the dry season. Monthly rainfall in the target area since 2005 is described in Table-1.2.

Table-1.2 Monthly and Annual Rainfall in the Target area

Area	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Comparison with Basic Design
Larger Makueni District	(1)Data in Basic Design	46.1	32.8	76.3	129.5	36.2	6.1	1.6	2.9	3.5	42.5	188.8	110.1	676.4	100%
	(2) 2005	13.4	12.0	47.2	126.1	120.7	0.0	0.0	0.0	7.5	67.1	124.9	11.6	530.5	78%
	(3) 2006	2.2	0.2	42.5	81.3	45.1	0.1	0.0	0.0	6.8	57.2	252.8	363.3	851.5	126%
	(4) 2007	103.2	5.6	51.7	44.7	5.9	1.0	0.3	0.0	0.0	12.0	130.5	112.9	467.8	69%
	(5) 2008	57.7	7.3	222.4	13.4	1.0	0.0	0.0	0.0	1.3	14.2	82.5	5.8	405.6	60%
	(6) 2009	29.3	13.6	1.2	38.2	13.1	0.3	0.0	0.0	0.0	57.6	54.5	161.1	368.9	55%
Larger Machakos District	(1)Data in Basic Design	44.7	39.3	102.4	199.7	54.0	10.1	3.1	3.8	6.4	58.7	201.5	107.0	830.7	100%
	(2) 2005	12.2	19.2	101.7	165.1	100.5	0.0	0.0	1.5	0.0	8.4	93.4	12.8	514.8	62%
	(3) 2006	30.9	53.1	105.0	175.9	107.5	2.4	0.6	17.5	2.1	10.7	328.4	321.3	1,155.4	139%
	(4) 2007	61.4	44.8	20.5	143.9	41.7	2.7	26.8	5.0	4.3	18.3	128.2	82.1	579.7	70%
	(5) 2008	117.4	7.3	73.0	129.3	4.5	0.3	1.3	0.2	9.1	23.9	122.8	39.9	529.0	64%
	(6) 2009	74.2	26.3	3.2	145.4	29.7	5.2	0.0	0.0	1.2	41.3	34.4	136.7	497.6	60%

Source : Implementation Review Study Report in July 2006 and the JICA Study Team (Data from Kenya Meteorological Station)

Monthly temperature in the target area is shown in Table-1.3.

Table-1.3 Monthly Temperature

Larger district	Maximum/ Minimum	Monthly Temperature(^{o}C)												Annual Average
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Makueni	Maximum	29.1	30.8	29.9	28.5	27.6	26.6	26.7	28.3	28.6	29.8	28.5	27.6	28.5
	Minimum	17.3	17.9	18.4	18.5	17.0	14.8	13.9	14.3	15.2	17.0	18.1	17.9	16.7
Machakos	Maximum	25.8	27.3	26.7	25.1	24.1	23.0	22.1	22.6	25.0	26.3	24.2	24.2	24.7
	Minimum	13.7	14.1	15.1	15.5	14.2	11.9	11.4	11.5	12.1	13.7	15.0	14.2	13.5

Source: Implementation Review Study Report in July 2006

Temperature is inversely proportional to altitude. It is recognized that there is an obvious tendency that the western area of the country experiences low temperature, from 18 to 20^{o}C degrees per year; while the eastern area has high temperature, from 26 to 28^{o}C per year. There is no significant difference between monthly maximum and minimum

temperatures. However, monthly temperatures from June to August are slightly low, while from February to March are high.

Wind velocity in the target area is described in Table-1.4.

Table-1.4 Daily Wind Velocity in the Target Area

(Unit: km/day)

District	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Makueni	129.8	145.3	154.3	127.5	118.4	118.7	130.4	152.3	180.4	193.3	151.2	123.6	143.8
Machakos	153.0	159.9	159.8	123.1	103.9	99.6	109.7	128.1	158.7	179.6	149.6	137.2	138.5

Source: Implementation Review Study Report in July 2006

1-3-2 Geology and Hydrogeology

The study area consists of Precambrian granotoids, Neogene volcanics (phonorites) and unclassified sedimentary rocks, Holocene volcanics, and Pleistocene sediments.

The hydrogeological characteristics of these rocks are as follows:

(1) Precambrian Basement Rocks

Gneiss is the widely distributed rock in the basement of the study area, and these huge rocks make it difficult to locate potential aquifers. Groundwater can be found at faults fissured or weathered zones of the basement rock, therefore, wells are to be drilled. However, groundwater was found at random and no stable aquifers were recognized. Groundwater source in the target area might depend on faults and fissured or weathered zones.

(2) Volcanic Rocks

1) Neogene Volcanics (Phonorite Series)

Neogene volcanics, mainly consisted of phonorites, are narrowly distributed from the northwestern part of the larger Machakos District and toward south of southeast to larger Kitui District, composing the basement of Yatta Plateau. Same rock classification is also distributed partly in the southwestern part of the larger Machakos District, where high contents of fluoride in groundwater were detected. Target villages located in this area were avoided as requested.

2) Holocene Volcanics

Holocene volcanics are distributed in the central and southeastern part of larger Makueni District. The volcanic rock consists of basalt, which composes Chululu Hill where high contents of fluoride in groundwater were detected. Target villages located in this area were avoided.

(3) Neogene Unclassified Sedimentary Rocks

These sedimentary rocks are mainly distributed in the western part of the larger Machakos District. The rocks mainly consist of sandstones, mudstones, and tuffs. Because the boundary between these rocks and Neogene volcanics are unclear, stratigraphic unit has not been classified. Also, high contents of fluoride in groundwater were detected on the distribution area. Target villages located in this area were avoided.

(4) Pleistocene Sediments

The sediments are present in the flood plain toward the recent river and so on. Groundwater potential in those areas depends on the rainfall and thickness of sediments. Groundwater level is relatively low in dry season, but rises during rainy season. making it valuable in seasonal conditions. Groundwater in this aquifer is not safe because it is shallow and can be easily contaminated from above ground.

1-3-3 Topography

Altitude in the target area is from 500 m in the eastern part to 1,500 m in the western area. In general, the area has interspersed gradual and isolated hills. This situation is particular to Africa. The difference between the top of hills and the bottom of valleys is from 10 to 30 m, which is relatively small.

On the other hand, steep mountains are seen in the larger Machakos District. The difference in elevation between the top of mountains and the bottom of valleys is more than several hundred meters. Yatta Plateau is located from east of Machakos District and to southeast of Makueni District, the profile is linear all throughout. The width of the plateau is 3 to 4 km, and its length is around 300 km. The top of the plateau appears to be flat, and the difference between the top and adjacent river is several ten meters in the western part and 200 m in the eastern part. A basaltic plateau similar with the adjacent Yatta Plateau expands from west to north of Machakos District.

1-4 Environmental and Social Considerations

Since the facilities to be constructed under the Project are small, environmental and social considerations are also small, and particular countermeasures are not necessary. However, environmental impact assessment by National Environment Management Authority (NEMA) is necessary prior to the drilling works, which the Kenyan counterpart needs to consider. For test drilling under the Study, Tanathi Water Services Board (TAWSB), which is the frontline of the implementing agency, carried out the application and obtained necessary clearances.

Chapter 2
Contents of the Project

CHAPTER 2
CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

The purpose of the Study is to confirm the present condition of the target communities more than one and half year after the unsuccessful third tender in June 2008. The Study also aims to implement test drilling for Level-2 (windmill and submersible pump sites) in order to decrease the risk of the Project and shorten its duration. The Study consists of Phases 1 and 2. Phase 1 was implemented from October 2009 to March 2010 while Phase 2 is from June 2010 to March 2011.

As a result of the confirmation of the target sites' present condition, it was realized that 11 sites in Phase 1 and three sites in Phase 2 (14 sites in total) were either drilled or equipped with water supply facilities, or are planned to be equipped with water supply facilities by the Government of Kenya or NGOs.

Alternative sites to the above affected ones, however, were selected, since the Government of Kenya insists on ensuring 58 sites with boreholes and water supply facilities. Numbers of target communities are 26 and 32 (58 in total) in larger Makueni and Machakos districts, respectively. An estimated population of 60,000 is planned to be served by water facilities.

In the test drilling during Phase 1, 18 boreholes were drilled wherein six boreholes can be successfully considered as Level-2 sites. On the other hand, pumping and water quality tests were only conducted for four existing boreholes that were drilled but were either insufficient or not equipped with water supply facilities. Since all of these can be considered as Level-2 sites, a total of ten successful boreholes were confirmed.

In the test drilling of Phase 2, 18 boreholes were drilled wherein eight were successfully considered as Level-2 sites. In addition, one borehole is considered as Level-1 (hand pump site).

Types of water supply facilities were selected on the basis of the result of the Study, and are described in the following Table 2.1:

Table 2.1 Types and Quantity of Water Supply Facilities to be Constructed under the Project

District	Pump type					Total
	Level-1	Level-2				
	Hand pump	Windmill	Submersible pump			
			Generator	Commercial power	Solar	
Larger Makueni	17	1	4	1	3	26
Larger Machakos	12	0	17	1	2	32
Total	29	1	21	2	5	58

Source: JICA Study Team

Twenty nine boreholes for Level-2 are planned to be drilled in the Project. Out of these, 11 have not been subject to test drilling in the Study. Said test drilling will therefore be carried out in the detailed design stage. When boreholes obtained in the detailed design can be successfully considered as Level-2, the pump type with generator or solar system will be selected.

Project design matrix (PDM) is described in the following Table 2.2:

Table 2.2 PDM

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal Sanitation condition of inhabitants in larger Maklueni and Machakos districts is improved.	a) Number of patients from waterborne disease in target communities b) Number of water supply facilities working normally	a) Result of monitoring survey b) Data from Ministry of Health c) Statistical data	Basic policy and organization framework are not changed.
Project Purpose Population served with safe and stable drinking water increases in the target area.	a) Population served with water (More than 60,000) b) Number of communities which maintain well water supply facilities	a) Monitoring result after implementation of the Project b) Data of district water offices (DWOs) c) Operation records of WUA for water supply facilities d) Financial records of WUA	O&M system and responsibilities of concerned parties are not changed largely
Outputs a) Water supply facilities with boreholes are constructed in target area. b) Water users associations (WUAs) are established in order to sustainably maintain the facilities.	a) Number of constructed water supply facilities b) Number of established WUAs	a) As-built drawings b) Report on training c) Monitoring records on O&M	a) Supporting system for WUA in O&M by DWOs is not changed. b) WUA system in O&M is not changed.
Activities Japanese side Construction of water supply facilities Borehole water supply facilities with hand pumps, windmill pumps and submersible pumps Kenyan side Construction of facilities Construction of fence surrounding important facilities and drainage trench Support for communities in O&M by TAWSB a) Explanation of the Project and Sensitization for Communities b) Organization of Water Users Association (WUA) c) Training for WUA d) Monitoring of the Project	Input Japanese side Experts for Construction Supervision and Guidance Japanese: Operation and Maintenance/Sanitation Education (2.63 M/M) Local: Program Coordinator (9.57 M/M) Local: Community Facilitator (9.27 M/M) Facilities Water supply facilities with hand pump (29 communities), with windmill pump (1 community) and submersible pumps (28 communities)	Kenyan Side Staff of MOWI, TAWSBI and DWO a) Project Manager (1 person) b) Project Coordinator (2 persons) c) Supervisor (4 persons) d) Experts for Soft Component Scheme (44 persons, 4 teams in 11 districts) Construction of facilities and Sensitization a) Construction of fence surrounding important facilities and drainage trench b) Support to communities in O&M by district water office	Trained staff of DWOs is not shifted to other organization within a short time. Precondition a) Economic condition should not significantly change. b) Groundwater source does not decrease or does not dry up. c) No large migration.

Source: JICA study team

2-2 Outline of the Japanese Assistance

2-2-1 Design Policy

The assistance that was agreed between the Kenyan Government and JICA at the beginning of the Study included drilling of 58 boreholes and construction of associated water supply facilities consisting of 18 hand pumps, seven windmill pumps and 33 submersible pumps. It also includes technical guidance for capacity building of communities in larger Makueni and Machakos districts.

Scope of the Study covers confirmation of existing site conditions, test drilling and other field works, as well as conducting necessary reviews of the Project contents. It is also supposed to formulate implementation plan to realize the prompt commencement of the Project.

Taking into account the above matters, the review is done on the basis of the following basic principles.

2-2-1-1 Design Policy

(1) Selection of Target Communities

In the basic design stage, target communities were selected in accordance with the following points. which were considered in the Study:

1) Target communities selected are not to be duplicated by other donors and organizations including NGOs and MOWI.
2) There are many existing boreholes drilled for the purpose of obtaining water supply. Some of these are not operating due to lack of capacity of communities in terms of operation and maintenance (O&M) skills or inability to meet the costs for O&M. In order to establish a sustainable project, the capacity of communities with regard to O&M is evaluated from the viewpoint of cost affordability when the communities are selected as targets of the Project.
3) The major groundwater source in the study area is expected to be fissure water, as a widespread aquifer is not present in said area. In order to develop fissure water, it is necessary to carefully evaluate groundwater potential in the respective communities. When borehole sites with no groundwater potential or less than the minimum water yield are identified during evaluation, these communities are in principle excluded from those targeted.
4) The groundwater source in the Project areas also indicates high level of fluoride and total dissolved solids (TDS). Therefore, appropriate criteria for water quality shall be set up, and communities in the area with unacceptably high level of fluoride or TDS for drinking water shall be beforehand excluded.

(2) Confirmation of Water Supply Situation in the Target Communities

The Study commenced after more than a year since the unsuccessful tender has been carried out. Thus, it is possible that the Kenyan government or other donors are currently constructing or have already constructed water supply facilities. Further, natural and social conditions may have already changed.

In this connection, it should be confirmed whether site conditions have changed or not. If water supply facilities have been constructed in target communities by the Kenyan government, NGOs or other institutions, and if the grade of the facilities are insufficient and the O&M activities are inappropriate, review of the involvement of the communities in the Project should be undertaken.

(3) List of Alternative Sites for Hand Pump

A maximum of two drillings in the same community is carried out during and after the Study. If the first drilling is successful for the planned pump type, it will no longer be carried out in the community. Otherwise, a second drilling is carried out in the same community. If this still fails, drilling is ultimately not carried out in the same community. Instead, it will be carried out at other designated alternative sites listed for hand pumps (Refer to Appendix-6).

(4) Selection of Water Supply Facilities at Detailed Design Stage

In the detailed design stage, test drilling for 11 boreholes of Level-2, design work for the facilities and cost reestimation are carried out in accordance with the result of the test drilling and current economic situation. If successful borehole is obtained, review on whether solar system or generator is suitable for the borehole and the community is carried out. However, review on commercial power is not carried out, since introduction of commercial power has been confirmed in the Study.

(5) Planning Principles for Groundwater Development Plan

(a) Drilling of boreholes in a target community and handling of failed boreholes

A borehole is principally constructed in a community, since there is a concern that the measure for problems and O&M may be neglected in case several boreholes are initiated in a community.

When a borehole drilled has water yield of less than 0.33 m^3/hour, the Project requires backfilling of the borehole and construction of water supply facility will not take place at the site. Meanwhile, if a borehole drilled has water yield equal or more than 0.33 m^3/hour but does not have sufficient water quality, the Project requires capping of the borehole and delivering it to the Government of Kenya.

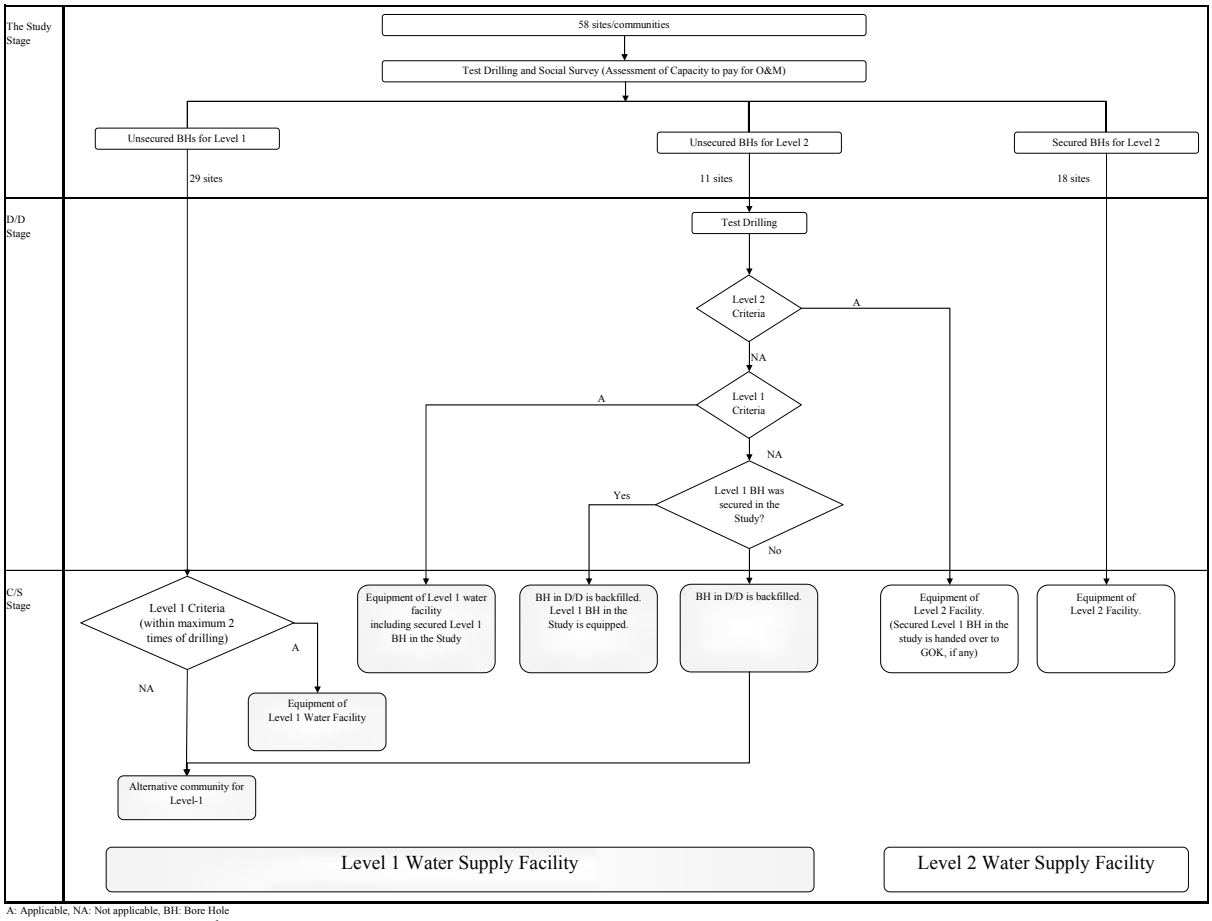
A maximum of two drillings for each target community are carried out at communities targeted for Level-1 (hand pump) and Level-2 (windmill and submersible pumps). Furthermore, water supply facility is constructed at corresponding sites if the drilled borehole satisfies the criteria set under the Project.

1) Target community for Level-1

When drilling fails twice in a row in a target community, the community will be excluded from the Project. The alternative community in the same district area is selected then based on the list of alternative sites for hand pump construction (Refer to Appendix-6).

2) Target community for Level-2

The principle of drilling of boreholes and handling of failed boreholes for Level-2 communities is as shown in Figure 2.1:



A: Applicable, NA: Not applicable, BH: Bore Hole
Level 1 Criteria: To secure the yield over 0.33m^3/hr and water quality
Level 2 Criteria: To secure the yield over 1.0 m^3/hr and water quality
Water Quality: To meet the criteria in the study report

Figure 2.1 Principle of Drilling Boreholes and Handling of Failed Boreholes for Level-2 Communities

(b) Selection of type of water supply facilities in respective target community

Unit water consumption in the target communities is based on the criteria under the Practice Manual for Water Supply Services published by MOWI in October 2005. Water supply plan is prepared using these criteria, which describe a unit water consumption of 15 L/day/capita in ASAL area, with an annual rainfall of 500 mm to 1,000 mm.

Water supply facility is selected in accordance with the basic design and the amount of water supply. When population within a radius of 2 km from the borehole location is less than 500, hand pump type is selected. Otherwise, motorized pump will be adopted.

Two types of motorized pumps are planned in the Project. One is the windmill pump which has been popularized in Kenya since 1990s, and the other is submersible pump. Furthermore, types of submersible pumps are classified into three for each power source, namely: generator, commercial power and solar panel. Kenyan government is familiar with their requested submersible pump with solar panel as this is their present mode of clean energy.

Type of water supply facility for boreholes identified as Level-2 in test drilling is selected on the basis of actual water yield and total head. Quantities of such Level-2 boreholes are five in larger Makueni and 13 in larger Machakos districts (18 in total). These boreholes will be equipped with water supply facilities during the construction stage. Moreover, all boreholes to be drilled during the construction stage will be equipped with hand pump equipment.

2-2-1-2 Natural Conditions (Criteria for Successful Borehole)

In the Practice Manual for Water Supply Service in Kenya, the criterion for successful borehole in water yield is defined as not less than 0.33 m^3/hour. No other criteria for each pump type are specified in the manual. Therefore, the criteria set for successful borehole, in accordance with the basic design study and previous implementation review study, are as follows:

Water yield: 0.33 m^3/hour and above for hand pump
0.6 m^3/hour and above for windmill pump
1.0 m^3/hour and above for submersible pump

The groundwater source in the Project areas indicates high level of fluoride and TDS. The following principles therefore are applied for the Study:

- Boreholes with fluoride and arsenic exceeding health significance values are classified as failed and are capped. The boreholes are delivered to the Kenyan government for their acceptance.
- TDS level is proposed at 2,000 mg/L. Boreholes with TDS exceeding this level are classified as failed and are capped. The boreholes are then delivered to the Kenyan government for their acceptance.
- Any borehole with aesthetic substances such as hardness, chloride, sodium, etc. exceeding the health-based guideline values of Kenyan standard is classified as failed and is capped. The borehole is then delivered to the Kenyan government for their acceptance. If there is no such specified value in the Kenyan guideline, WHO guideline should be complied with.

2-2-1-3 Social Conditions

Water supply facilities to be constructed are operated and maintained by the WUA of the target communities. The two larger districts are classified as extreme poverty areas of Kenya. Therefore, it is essential to support their communities by conducting training of WUA in terms of O&M, and to grant them the ownership responsibilities for the facilities in order to realize a sustainable project.

As above issues are realized, construction of fence around the boreholel facilities and drainage trenches is undertaken by the target community. Staffs of water district offices of TAWSB, after being trained under a soft component, shall be tasked to guide the target communities.

2-2-1-4 Construction Method and Period

The Project is planned to be implemented as one fiscal year type in Japanese system and consist of detailed design and construction stages.

In the detailed design stage, electrical sounding survey and test drilling for 11 target communities are planned. The obtained results will be analyzed and reflected into the success rates of boreholes.

In the construction stage, borehole drilling commences first, and the ensuring of successful boreholes is then prioritized. During such stage, only Level-1 boreholes are drilled. Construction of water supply facilities at said sites will then take place. The commencement of the construction for Level-1 shall be set up in such a way that the progress for the drilling work will not fall behind.

2-2-1-5 Procurement of Construction Material

Design methodology adopted in the Study generally follows the Practice Manual for Water Supply Services published by MOWI. From the viewpoint of O&M with ease and lower costs including procurement of spare parts, type and specification of facilities and equipment such as pumps and generators to be adopted in the Project should be those which are locally available in the Kenyan market.

Construction materials and equipment for the Project available in Kenya will be procured and used for the construction of water supply facilities. These include hand pumps, windmill pumps, casing pipes for boreholes, uPVC pipe and galvanized steel pipe for transmission and distribution pipelines, structural steel material, reinforcement bars, cement, timber, fuel, and painting materials.

Although submersible pumps, diesel generators and solar panels are not manufactured in Kenya and are imported, these are usually available in the local market. It is therefore planned that these will be procured from other countries through the local dealers in Kenya.

2-2-1-6 O&M

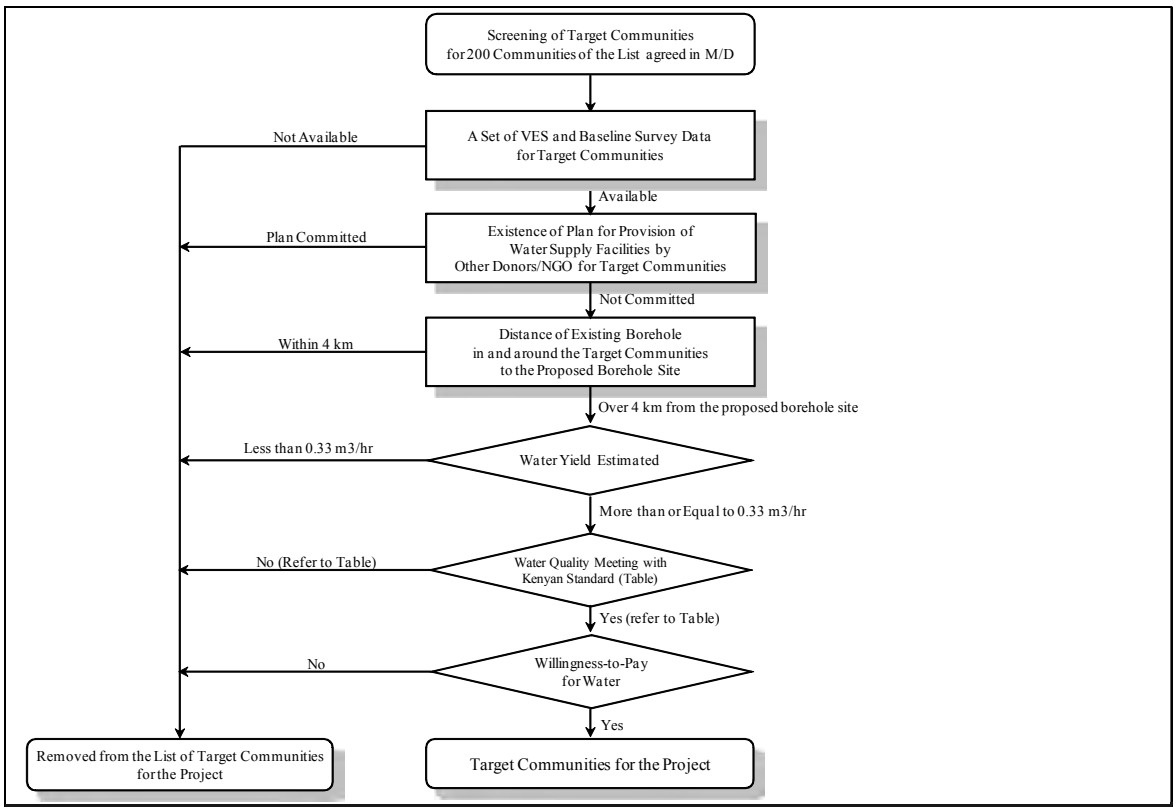
There are several issues pertaining to inadequate O&M in the Project area including: 1) a less mature sense of ownership and willingness to participate in O&M based on the users-pay-principle, 2) lack of knowledge and skills for community-based O&M, 3) lack of awareness in health and sanitation, and poor understanding of the correlation between personal health and use of safe water, and 4) inadequate support to the communities by the local administration for the establishment of community-based O&M systems.

From the viewpoint of countermeasures against these problems and issues, the software component program aims to establish the basis for a community-based O&M system.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

2-2-2-1 Selection of Target Communities

The target communities were selected in the basic design study. Figure 2.2 shows the flow diagram for selection of target communities for the Project.



Source: Prepared by JICA Study Team on the basis of basic design study report (Oct. 2004)

Figiure-2.2 Flow Diagram for the Selection of Target Communities

The requested 200 communities in Kitui, Mwingi, Makueni and Machakos districts were screened during the basic design study, based on issues in the above flow diagram, including: 1) availability of data on vertical electrical sounding and social conditions, 2) duplication of water supply plan with other donors, 3) water supply conditions of existing boreholes, 4) estimated water yield, 5) water quality, and 6) willingness to pay for water.

As a result of the screening, 31 communities in Makueni and 44 in Machakos (75 in total) were selected.

2-2-2-2 Confirmation of the Target Communities

As a result of site confirmation in the previous implementation review study (December 2005 to June 2006), four sites in larger Makueni District were drilled by the Kenyan government and were under other water supply projects. Furthermore, six sites in larger Machakos District were drilled by the Kenyan Government and NGOs and were also under other water supply projects.

These ten communities mentioned in the technical discussion notes dated March 8, 2006 were excluded from the targets of the Project. Thus, number of target communities reduced to 65.

In the previous implementation review study, the Project was divided into two phases, namely, Phase 1/2 and Phase 2/2. The former commenced in December 2006 and was

completed in March 2008. During this period, detailed design, first tendering and second tendering of Phase 2/2 were carried out. As a result of site confirmation for the second tendering of Phase 2/2, it was confirmed that one site in larger Makueni District and six sites in larger Machakos District were drilled and are either under construction or are already equipped with water supply facilities. The Kenyan government requested the Japanese government to exclude these seven communities from the target and to aim for the implementation for the remaining 58 communities. The request was approved by the Japanese government.

Third tendering in June 2008, however, was unsuccessful. The Study commenced in October 2009. During the inception meeting on November 4, 2009, it was confirmed that number of target sites was 58.

2-2-2-3 Groundwater Development Plan

(1) Success Rate of Boreholes

Success rates of boreholes are obtained by multiplying the success rates on water yield and the water quality on the basis of results of test drilling in Phases 1 and 2 of the Study. Success rates of boreholes are finally obtained in combination with the success rates of Phases 1 and 2.

Since only submersible pump and hand pump are targeted after the Study, success rate is calculated for these two types of water supply facility.

Success rates of boreholes are presented in the following Table 2.3.

Table 2.3 Success Rates of Boreholes

Facility	Larger Makueni	Larger Machakos	Total
Hand pump (≥ 0.33 m^3/hour)	22.8%	60.0%	41.4%
Submersible pump (≥ 1.0 m^3/hour)	18.2%	55.0%	36.6%

Remark: "≥" means more than or equal to.
Source: JICA Study team

(2) Water Quality

It is considered that some groundwater in the Study areas indicates high levels of fluoride and TDS. In the Study, these parameters and also arsenic contents are selected as key items.

In consideration of standard values for these three items in the Practice Manual for Water Supply Services by MOWI and present water use conditions, the following criteria in Table 2.4 are proposed:

Table 2.4 Proposed Parameters and Standard Values of Water Quality

Parameters	Standard value (mg/L)
Arsenic (As)	0.05
Fluoride (F)	3
Total Dissolved Solids (TDS)	2,000

Source: JICA Study Team

1) Fluoride and Arsenic

The permissible level of 3 mg/L for fluoride under the practice manual of MOWI is applied as the proposed standard value in the Project. For arsenic, a standard value of 0.05 mg/L is adopted, taking into account its toxicity.

2) TDS

There are many existing boreholes with concentrations exceeding 1,500 mg/L, which is stated as the permissible level in the practice manual of MOWI. It is expected that the

number of failed boreholes would increase when this value is applied.

During the field survey in the basic design study, it was identified that residents often use groundwater with TDS of 2,200 mg/L to 2,600 mg/L for drinking. Kenyan authorities therefore desired a modification of the standard value for defining a successful borehole. Thus, 2,000 mg/L was proposed to be adopted for the Project.

(3) Borehole Depth and Number of Boreholes

In consideration of the success rates of boreholes, numbers of boreholes to be drilled are indicated in the following Tables 2.5 and 2.6:

Table 2.5 No. of Proposed Boreholes for Submersible Pump (Water yield of ≥ 1.0 m^3/hour)

Larger district	Average borehole depth (m)	Range of borehole depth (m)	No. of planned boreholes	Success rate	Total no. of boreholes
Machakos	105	100-130	7	55.0	7
Makueni	100	100	4	18.2	4
Total	-	-	11	-	11

Source: JICA Study Team

Table 2.6 No. of Proposed Boreholes for Hand Pump (Water yield of ≥ 0.33 m^3/hour)

Larger district	Average borehole depth (m)	Range of borehole depth (m)	No. of planned boreholes	Success rate	Total no. of boreholes
Machakos	123	100-150	16	60.0	27
Makueni	103	100-130	21	22.8	93
Total	-	-	37	-	120

Source: JICA Study Team

Depths of undrilled boreholes in these tables are estimated by adding 10% of the depth based on the results of analysis of vertical electrical sounding data in basic design study, and then rounded up to the nearest 5 m.

The 11 planned boreholes in Table 2.5 will be drilled in the detailed design stage. With the success rate of borehole in this table, it is estimated that number of failed boreholes are 4 in larger Makueni and 4 in larger Machakos (8 in total). Level-1 sites will be substituted for these failed boreholes and will be drilled during construction stage. Table 2.6 indicates the number of proposed boreholes to be drilled during said stage.

(4) Design of Boreholes

4-1) Borehole Design

The geology of the Study area mainly consists of volcanic rocks represented by Precambrian gneisses and volcanic rocks. Most of the target 58 communities are located in Precambrian gneissic rocks where the geology can be considered as similar. Therefore, a standard borehole structural design has been prepared and is attached to this report.

4-2) Diameters of Casing and Screen

Casing with DN150 mm is inserted at the bottom of the borehole in order to ensure their long-term stability and quality. No engineering problems are expected since this diameter is generally used in Kenya (for around 54% of existing boreholes).

4-3) Drilling Diameter

Drilling diameter with sufficient clearance for casing work is designed to be 220 mm in consideration of the above casing diameter.

The adopted material for casing screen pipe is uPVC. This has been used previously in Kenya and its long-term stability has been proven in the existing boreholes. This material

also has an advantage in terms of rust prevention in saline groundwater.

The screen is designed to be a slot-type, which is common in Kenya. Aquifers in the study area exist in the weathered rock layers, cracks of massive rock, or sedimentary deposits, which are thin layers and have fine grain sizes. Therefore, it is planned to adopt a continuous slit screen with wider openings in order to reduce hydraulic loss. This will also prevent large drawdowns in groundwater levels.

4-4) Electrical Logging

After drilling of boreholes, electrical logging is planned for execution. With electrical logging, the position of aquifer is accurately identified, and screen pipes are installed at proper position.

4-5) Gravel Packing, Slime Packing and Concreting

Gravel packing is provided with gaps between the casing and inside of the drilled hole, from the bottom to 10 m above static water level. The section up to 10 m of the ground surface will be packed with slime produced by the drilling, while the upper part to the ground surface will be filled with concrete. This concreting aims to prevent intrusion of rainwater and wastewater near the borehole. A bottom plug and temporary top cover will be provided.

4-6) Pumping Test

A pumping test will be undertaken after completion of borehole construction in order to identify the water yield. Schedule of tests are as follows:

- Trial test: not less than 8 hours and by identification of clean water
- Step drawdown test: more than 3 steps, more than 2 hours for each step
- Constant discharge test: more than 24 hours
- Recovery test: more than 8 hours

4-7) Water Quality Analysis

Water sampling is done during the pumping test and undertaken by public laboratories in Kenya. Parameters to be defined include: 1) pH, 2) TDS, 3) turbidity, 4) color, 5) total hardness, 6) chloride, 7) copper, 8) iron, 9) manganese, 10) sodium, 11) sulfate, 12) zinc, 13) water temperature, as aesthetic substances, and 14) arsenic, 15) lead, 16) fluoride, 17) nitrate, 18) nitrous acid, as health substances.

2-2-2-4 Plan for Water Supply Facilities with Groundwater

(1) Target Year of the Project

The Project is planned to be completed in March 2013 and the target year is set to 2013.

(2) Unit Water Consumption Rate

Unit water consumption for water kiosk in rural areas, shown in Table 2.7, under the practice manual of MOWI is applied as the design condition of water supply facilities.

Table 2.7 Unit Water Consumption for Water Kiosk in Rural Areas

Potential area	Annual mean rainfall	Unit rate
High	More than 1,000 mm	20 L/person/day
Medium	500 to 1,000 mm	15 L/person/day
Low	Less than 500 mm	10 L/person/day

Source: JICA Study Team
Data from Practice Manual for Water Supply Services published by MOWI, Oct. 2005

The mean annual rainfall of the two larger districts ranges from 500 mm to 1,000 mm. Therefore, 15 L/person/day is adopted as water consumption rate in the design of water supply facilities.

(3) Planned Population to be Served with Water

The following Table 2.8 indicates the planned population to be served. Said population belongs to sites with confirmed water yield from successful boreholes after test drilling and/or estimated water yield of undrilled boreholes. These are also located within a 2 km radius from the boreholes.

Table 2.8 Planned Population to be Served with Water

Larger district	Planned served population(x 1,000)					
	Hand pump	Windmill pump	Submersible pump			Total
			Generator	Commercial power	Solar	
No. of communities	29	1	21	2	5	58
Makueni	8.7	0.8	6.9	1.9	2.3	20.6
Machakos	7.8	0.0	29.0	1.9	0.7	39.4
Total	16.5	0.8	35.9	3.8	3.1	60.0

Source: JICA Study Team

A borehole is basically constructed in a community. However, actual water supply capacity is restricted by the actual water yield after drilling, and does not always satisfy water demand in the community. On the other hand, actual water yield may exceed the demand.

(4) Design Water Demand

Design water demand is estimated by multiplying the planned served population and unit water consumption rate.

(5) Introduction of Commercial Power

On the introduction of commercial power, MOWI implied their intention to exclude the sites which need installation of new transformers and are located more than 600 m away from the existing transformer sites. Consequently, site confirmation with staff of Kenya Power and Lighting Company (KPLC) was conducted while the cost estimate for the introduction was prepared by KPLC.

As a result, one site in larger Makueni and one site in larger Machakos (2 sites in total) were identified for the provision of commercial power. MOWI agreed that the cost for the works, estimated at Ksh 0.8 million, will be budgeted by them (Refer to Appendix-4).

(6) Solar Pump

Introduction of solar pump was requested by the Kenyan government. As a result of the review on existing solar pump systems, the proposal is reviewed on the condition that photovoltaic (PV) capacity is not more than 1,440 W, etc.

In Kenya, familiarization on solar pump is recently introduced and it has been realized that there are no technical constraints on the above condition.

(7) Power Source of Water Supply Facility and Pump Operation Time

Operation of hand pump and submersible pump with generator and commercial power are determined to be 8 hours/day.

Meanwhile, operation (average effective operation time) of windmill pump is 12.3 hours/day based on the wind measurement survey in the basic design study.

Finally, operation of solar pump is 5 hours/day, which is expected to be sufficient in July as radiation during this month is the lowest.

(8) Selection of Type of Water Supply facilities

In the basic design study, three types of water supply facility, namely: hand pump, windmill pump and submersible pump, were adopted.

Hand pump water supply facility was applied to communities with a population of less than 500, taking into account the fact that the communities are entrusted with O&M of the facilities.

Windmill pump and submersible pump were assessed for communities with a population of more than 500 from the viewpoint of natural and topographical conditions, situation of population distribution and capacity for O&M of facilities. As regards to water supply facility with windmill pump, storage tank to be provided should be of surface type and installed at drilled location. Therefore, the borehole drilling elevation shall be higher than that of the water service area, and there shall be no obstacle against wind within its vicinity.

On the basis of the result of the wind velocity survey and existing borehole record, windmill pump was selected if it can extract groundwater considering the estimated water level. Otherwise, a submersible pump was planned for the communities.

The capacity of the community to cover O&M costs was evaluated by comparing the capacity to pay for water with required O&M cost. The capacity of community was estimated based on the population and unit water price in each community obtained from socioeconomic survey. In the basic design and previous implementation review study, unit water price was Ksh 1.8 per 20 L in Machakos and Makueni districts. It is noted that hand pumps were planned to be installed at communities with insufficient capacity to cover the O&M cost. The process of selection of water supply facilities in the basic design study and the previous implementation review study is the same.

In this Study, there are basically three types of water supply facility, namely: hand pump, windmill pump and submersible pump, which are similar to those considered in the basic design and previous implementation review study. In addition, introduction of solar system and commercial power is reviewed in the Study in consideration of their applicability. Therefore, five types of water supply facilities are considered in the Project.

In Phase 1 of the Study, target sites for test drilling were selected from the result of the previous implementation review study. In accordance with the minutes of meeting on November 4, 2009, windmill pump sites were targeted for test drilling. When such sites fail during test drilling, alternative sites for hand pump were substituted. Social survey was also carried out. Consequently, hand pump water supply facility was applied to communities with a population of less than 500 and submersible pump to those with more than 500.

On the basis of confirmed borehole characteristic after test drilling and estimated in the basic design study, applicability of type of water supply facility was reviewed. Considering the result of social survey, O&M costs were approximated. Further, capacity of the target community to pay for O&M cost was assessed based on the result of social survey in the Study. By comparing the O&M cost and capacity to pay, the type of water supply facility was finally selected for the target community. The capacity to pay was calculated using the unit water price on the basis of household income and expenses. The unit water price was redetermined based on the result of social survey in the Study. The prices in larger Makueni and Machakos districts were Ksh 1.4 and Ksh 2.0 per 20 L of jerry can, respectively. It is noted that hand pump is planned to be installed at communities with insufficient capacity to pay for the O&M cost.

Figure 2.3 below describes the flow diagram for the selection of type of water supply

facilities in the Study.

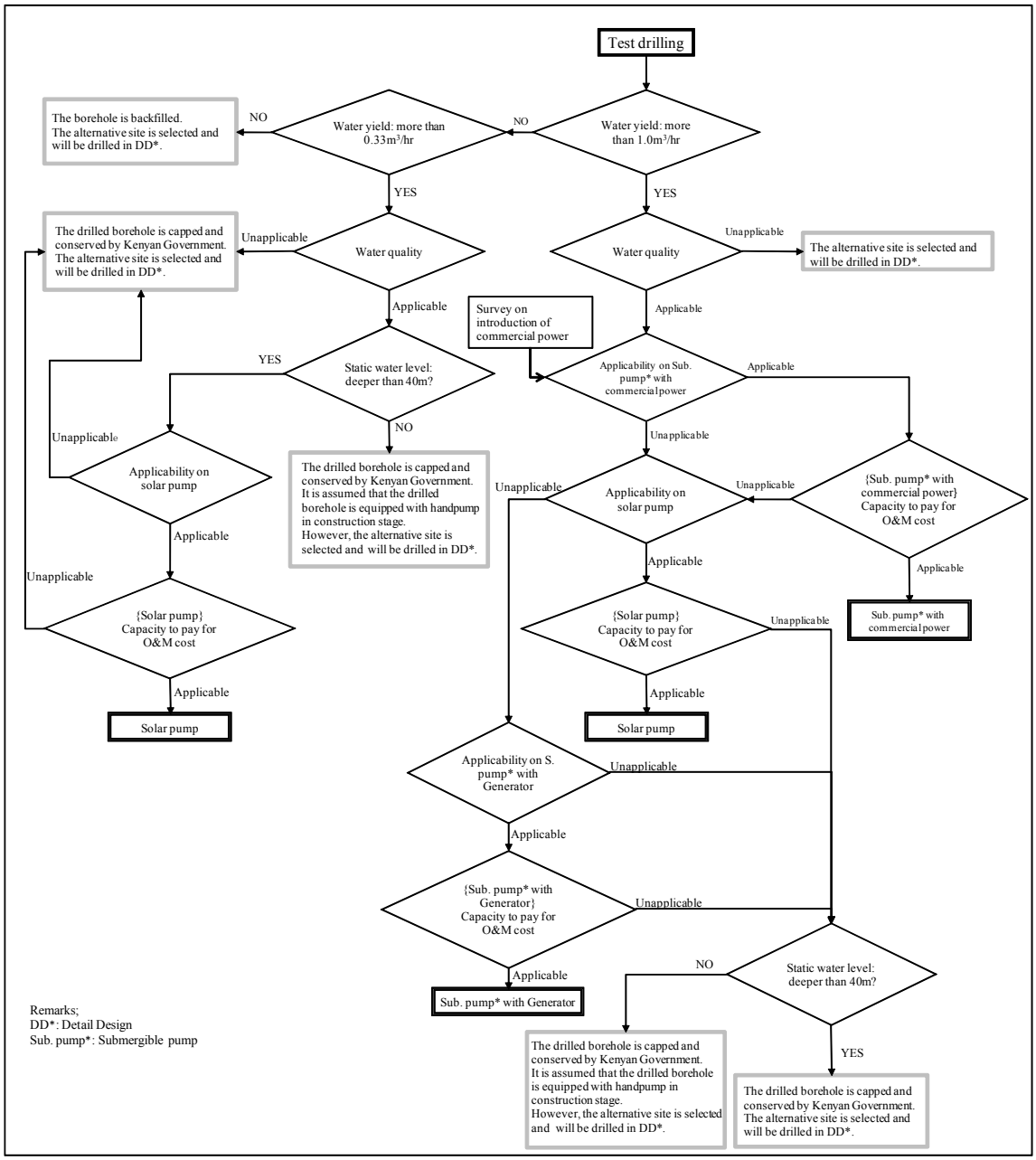


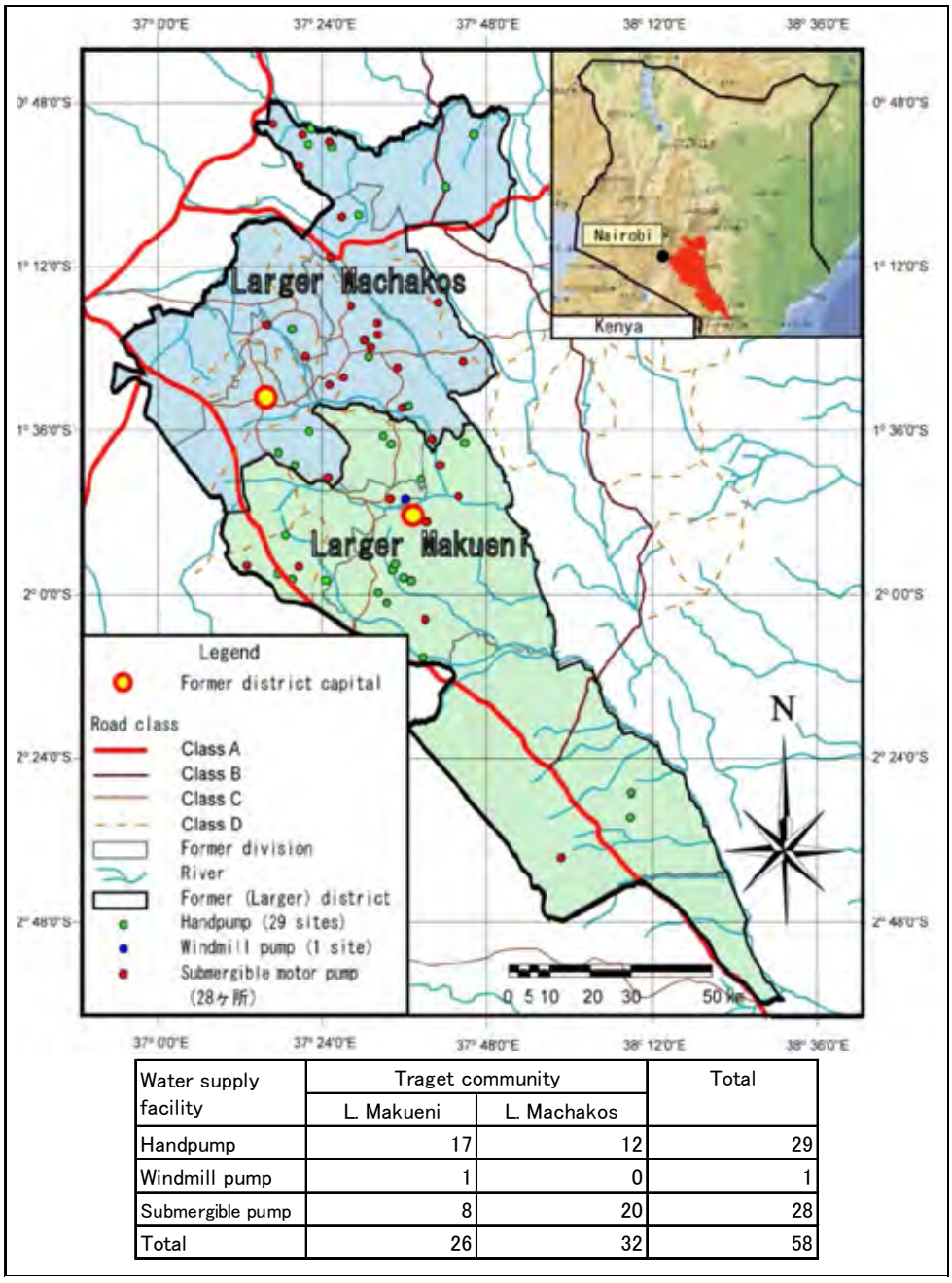
Figure 2.3 Flow Diagram for Selection of Type of Water Supply Facilities in the Study

In the flow diagram, types of submersible pump with commercial power, solar and generator are selected in sequential order. The reason is that the type with cheaper life cycle cost is prioritized as described in Table 2.9. In the table, costs for construction, O&M and life cycle for each type are compared considering same scale of facility and nine-year durability of generator.

Table 2.9 Comparison of Costs for Water Supply Facilities

Power Source	Construction cost	O&M cost	Life cycle cost
Submersible pump with generator	Medium to High	High	High
Submersible pump with commercial power	Low	Low	Low
Solar pump	High	Low to Medium	Low to Medium

Source: JICA Study Team



Water supply facility	Traget community		Total
	L. Makueni	L. Machakos	
Handpump	17	12	29
Windmill pump	1	0	1
Submergible pump	8	20	28
Total	26	32	58

Figure 2.4 Target Communities and Type of Water Supply Facilities

Fifty eight target communities and selected water supply facilities in the Study are shown in the above Figure 2.4.

Components of water supply facility with windmill and submersible pump consist of a borehole, transmission and/or distribution pipelines, storage tank and water kiosk. The

following Table 2.10 describes water distribution types of water supply facility and the numbers of target communities.

Table 2.10 Water Distribution Types of Water Supply Facilities with Submersible and Windmill Pumps

Larger district	Type S0, S1	Type S2	Type S3, S9	Type S4	Type S6	Type W1	Total
	Borehole, Storage tank, 1 Water kiosk, Solar (S0), Generator or commercial power (S1)	Borehole, Storage tank, 1 Water kiosk, Transmission pipeline, Generator	Borehole, Storage tank, 1 Water kiosk (S3), 2 Water kiosks (S9), Transmission and distribution pipeline, Generator or commercial power	Borehole, Storage tank, 3 Water kiosks, Transmission and distribution pipeline, Generator	Borehole, Storage tank, 1 Water kiosk, Transmission and distribution pipeline, Generator	Borehole, Storage tank, 1 Water kiosk, Windmill pump	
Makueni	8	-	-	-	-	1	9
Machakos	10	5	2	2	1	-	20
Total	18	5	2	2	1	1	29

Source: JICA Study Team

(9) Basic Design of Water Supply Facilities

9-1) Hand Pump

The served population by hand pump facility is basically less than 500. The following conditions were applied to its basic design:

- Water consumption : 15 L/person/day
- Operation time : 8 hours per day

In order to design a hand pump facility, it is necessary to consider hydraulic head and water yield. The water extracted from one stroke is the same under different hydraulic heads, but larger hydraulic head requires greater power for a stroke. Therefore, larger hydraulic head causes low groundwater abstraction because of necessity for more power.

A hand pump is designed to have a maximum hydraulic head equivalent to extracting 0.33 m^3/hour, which is the minimum water requirement.

Afridev type hand pump has been designed based on theoretical curves showing the relationship between hydraulic head and water to be pumped, as determined from site tests. This was also confirmed in the groundwater development project in Kenya executed under a Japanese grant aid scheme. In said project, it was further identified that taking water by hand pump becomes difficult for ladies or children when the hydraulic head exceeds 45 m.

Taking into account the above and drawdown water levels of 10%, the design static level adopted was 40 m. Specification of hand pump facility is given in Table 2.11 below.

Table 2.11 Specifications and Number of Planned Hand Pumps

No. of target communities and planned hand pumps			Specification		
No. of communities	:	29	Minimum discharge	:	0.33 m^3/hour
No. of planned hand pumps	:	29	Maximum hydraulic head	:	45 m
			Diameter of casing pipe	:	150 mm
			Internal diameter of cylinder	:	50 mm
			Water amount taken by one stroke	:	0.44 L

Source: JICA Study Team

9-2) Submersible Pump

The three types of submersible pump depend on power sources which include generator, commercial power and solar panel.

(i) Submersible pump with generator or commercial power

Submersible pumps available in Kenya are designed with a minimum discharge of 1.0 m^3/hour under continuous operation. This value is also the minimum water yield. Commercial power is applied to one site in larger Makueni and one site in larger Machakos (two sites in total), which were confirmed during the survey with KPLC on the introduction of commercial power. Kenyan government is requested to provide the power and corresponding budget.

It is assumed that submersible pumps and generators are procured in Kenya. Specifications and number of submersible pumps and generators are shown in the following Table 2.12:

Table 2.12 Specifications and Quantity of Submersible Pumps

Discharge rate (m^3/hour)	Hydraulic head (m)	No. of pumps	Power (Generator)	
			4.5 (kVA)	5.8 (kVA)
< 3.0	< 100	6	6	
	≥ 100	4	3	1
≥ 3.0 and < 4.0	< 100	4	4	
	≥ 100	3	2	1
≥ 4.0 and < 5.0	< 100	2	2	-
	≥ 100	2	-	2
≥ 5.0	< 100	2	2	-
Total	-	23	19	4

Source: JICA Study Team

(ii) Solar pump

(a) Assumed solar radiation

In the target area, solar radiation during the period from June to August is lower than other months, with the lowest in July. The average amount of solar radiation in July in Machakos District from 1998 to 2003 is 5.1 kWh/m^2·day. Meanwhile the minimum amount of solar radiation within said period is 4.0 kWh/m^2·day in 1999. Therefore, the solar pump system is designed to function at a solar radiation of 4.0 kWh/m^2·day.

The monthly solar radiation curves from 1998 to 2003 are presented in Figure 2.5.

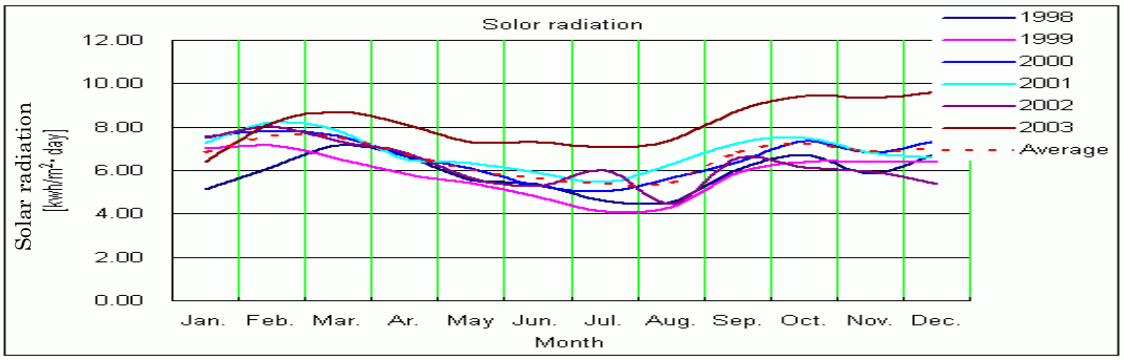


Figure 2.5 Monthly Solar Radiation in Machakos District

(c) Pump operation hours

It is assumed that solar pump functions approximately for 7.5 hours from 9:00 AM to 4:30 PM under sufficient solar radiation. However, pump operation hours are set at 5 hours per day in order to ensure more reliable solar radiation.

(d) Driving method

There are two different system configurations in solar pump system. One is direct current (DC) system driven by DC motor, and the other is the inverter system driven by alternative current (AC) motor.

Inverter system has complex components and needs more advanced technology for its maintenance. Further, its installation cost is costlier. DC system is therefore adopted for the Project considering ease of O&M and less costly construction.

(e) PV array

Solar pump system is being used in Kenya at present. PV array consists of PV modules, which is obtainable in Kenya.

(f) Conditions of solar pump introduction

As a result of the review on the output of DC motor and installation of PV array above pump houses based on existing solar pump systems in rural areas of Kenya, conditions of solar pump introduction are set as described in Table 2.13.

Table 2.13 Conditions of Solar Pump Introduction

Criterion	Value of criterion
1. Capacity of PV array:	Not more than 1,440 Wp
2. Hydraulic head (m):	Not more than 100 m (depending on the discharge rate)
3. Distance from control panel to storage tank:	Not more than 100 m

Source: JICA Study Team

(g) Specifications and number of solar pumps

Specifications and quantity of solar pumps are described in Tables 2.14 and 2.15.

Table 2.14 Specifications of Solar Pump

Pump	Type:	Submersible pump
	Motor:	DC brushless motor
	Range of input voltage:	From 30 to 300 Vdc
	Range of input power:	Not more than 1,400 W
	Maximum hydraulic head:	Not more than 100 m (depending on the head)
PV array	Maximum capacity:	1,440 Wp
	Efficiency:	More than 12%
	Type of PV module:	Mono-crystalline or Multi-crystalline

Source: JICA Study Team

Table 2.15 Quantity of Solar Pumps

Larger district	No. of communities	No. of sets
Makueni	3	3 sets (1 set/each community)
Machakos	2	2 sets (1 set/each community)
Total	5	5 sets

Source: JICA Study Team

9-3) Windmill Pump

The minimum water yield for windmill pump was estimated by assuming a population of 500, a unit water consumption of 15 L/person/day and average effective operation time of 12.3 hours. As a result, a minimum water yield of 0.6 m^3/hour (500 x 15 / 12.3 / 1,000) is recommended.

As a result of the test drilling in the Study, only one borehole was found successful for windmill pump. On the basis of the result of test drilling, the specifications and number of windmill pump are shown in the following Table 2.16:

Table 2.16 Specifications and Quantity of Windmill Pumps

Hydraulic head (m)	No.	Discharge rate (m^3/day)	Diameter of windmill (m)	Diameter of discharge pipe (mm)
80-100	1	26	7.9	DN 100

Source: JICA Study Team

9-4) Other Components of Water Supply Facilities

(a) Storage tank

Storage tanks are designed to be of steel type with galvanized coating for prevention of rust. The structure of the tank consists of panels for ease of construction. A ball float valve is to be installed at the inlet of tank. Meanwhile, pressure sensor is installed on the transmission pipeline just after the pump. With this system, pump is automatically controlled and consumption of power and fuel is minimized. The type and number of storage tanks are shown in Table 2.17:

Table 2.17 Type and Number of Storage Tanks

Storage volume					Total
4 m^3	8 m^3	15 m^3	24 m^3	50 m^3	
1	3	1	13	11	29

Source: JICA Study Team

(b) Transmission and distribution pipelines

Transmission and distribution pipelines consist of galvanized steel or uPVC pipes, which are available in Kenya. The surface soil depth in the Project area averages around 2 m and consists of laterite with fine to medium sand. Therefore, excavated materials can be utilized for backfilling after pipe laying. Concrete thrust blocks will be provided at elbows and tees of pipelines in order to support the pipes. The minimum covering depth for pipes is 0.6 m. It is noted that transmission and distribution pipelines are those installed between the pump and storage tank, and between storage tank and water kiosk.

The total lengths of these pipelines are given in Table 2.18 below. Steel pipe is assumed for pipelines exposed to open air or between the borehole and pump control room, while uPVC pipes are adopted for underground sections.

Table 2.18 Length of Pipelines

Pipelines	Material	Diameter (mm)	Length (m)
Pump control room including riser pipes for borehole	Galvanized steel pipe (GSP)	32	526
		40	65
		50	1,505
		65	98
Transmission or distribution pipelines	uPVC	40	1,483
		50	9,631
		63	2,656

Source: JICA Study Team

Total length of transmission and distribution pipelines is 13.8 km.

In order to measure water consumption, transmission pipeline is provided with a water flow meter at the discharge side of the pump, while water meter is provided for water kiosk. The total number of water flow meters and water meters to be installed under the Project is listed in Table 2.19 below.

Table 2.19 Number of Water Flow Meters Including Water Meter

Diameter of Pipeline	20 mm	40 mm	50 mm	65 mm
No. of flow meter	35	7	20	2

Source: JICA Study Team

(c) Water kiosk

A standard design for this facility, which is indicated in the practice manual of MOWI, was applied. A water kiosk having four water taps with a diameter of 20 mm are constructed at 35 sites. Infiltration-type drain pits will also be constructed at the water kiosks.

2-2-3 Outline Design Drawing

The following drawings in Table 2.20 were prepared in the Study and are attached as Appendix 8 in this report.

Table 2.20 List of Outline Design Drawings

No.	Title	No.	Title
GE001	Location Map	SP045	Layout of Cable System
BW001	Details of Borehole Structure	SP046	AC Electric Pump
BW002	Hand pump	SP047	Solar Pump
SP001	Layout Plan of Type S0 and S1	SP048	Mobilized Gantry Crane
SP002	Layout Plan of Type S2	SP049	Branch, Blow off and Air valve chamber
SP003	Layout Plan of Type S3	SP051	Pipe Installation, Line Marker and Thrust Block
SP004	Layout Plan of Type S4	SP052	River and Road Crossing of Pipe
SP006	Layout Plan of Type S6	SP062	Storage Tank (1/2)
SP009	Layout Plan of Type S9	SP063	Storage Tank (2/2)
SP042	Submersible Motor Pump	SP068	Water Kiosk B
SP043	Pipe Work of Pump Control Room	WP001	Layout Plan of Windmill Pump
SP044	Layout Plan of Pump Control Room	WP002	Windmill Pump

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

On the premise that the Project is executed under Japanese grant aid scheme, the following principles should be applied for its implementation:

1) The responsible agency of the Kenyan government is MOWI and the implementing agency is TANATHI Water Service Board (TAWSB).
2) Upon signing of exchange of notes between the Japanese and Kenyan governments, MOWI together with TAWSB should commence the preparation works and proceed with the necessary actions for the implementation of the Project.
3) After signing of exchange of notes for the implementation of the Project between Japanese and Kenyan governments, a Japanese consulting firm will sign a contract with MOWI, and will prepare the detailed design and tender documents, and commence with the tendering procedure.
4) A Japanese contractor will sign a contract with MOWI and execute construction works under the supervision of the consultant.
5) A Japanese contractor will establish site management office for construction works.
6) The Project to be implemented for 58 communities, consists of construction of 40 boreholes and 58 water supply facilities in 58 communities.
7) Construction method for boreholes involves mud circulation drilling method for sedimentary layers and DTH/air hammer for basement rocks.
8) Failed boreholes with water yield of less than 0.33 m^3/hour should be completely backfilled to ensure safety.
9) At the completion of construction works, responsibility for the constructed facilities shall be handed over to MOWI.
10) Construction materials for the Project shall be procured in Kenya. This includes hand pumps, windmill pumps, galvanized steel pipe, uPVC pipe, steel plates, structural steel, reinforcement, cement, timber, fuel, oils, painting materials, and so on.

2-2-4-2 Implementation Conditions

(1) Tax Exemption

Necessary procedures for tax exemption are the concerns of many organizations including MOWI. Therefore, it is assumed that these will take a significant period because of complicated application and approval system.

Responsibility for the tax exemption procedure is taken by MOWI, although the consultant and contractor should understand the local laws and regulations, prepare required documents, and apply/proceed with them.

(2) Environmental Protection

Environmental impacts due to construction works are related to: 1) noise, 2) dust, 3) vibration by heavy construction equipment, and 4) traffic accidents in general. Since schools and health centers are located in the 58 target communities, impacts due to noise and vibration shall be considered. Pasturage is one of the industries in the Study area and thus, it is essential to prevent traffic accidents caused by these animals, including the wild species. This could be achieved by implementing strict management of traffic rules and restraining driving speed, application of a registration system for drivers, restriction of private vehicle use, safety education of drivers, creation of awareness through periodic

meetings, control of traffic, and so on.

2-2-4-3 Scope of Works

(1) Scope of Works to be Executed by Japanese Side

1) Preparation of detailed design

2) Preparation of tender documents, evaluation and support for tendering process on behalf of MOWI

3) Construction of boreholes and water supply facilities based on the terms of reference stipulated in the Study

(2) Undertakings by the Government of Kenya and/or Communities

1) Provision and arrangement of land necessary for the implementation of the Project

2) Construction of access roads, including cutting of bushes

3) Building of fences and drainage trench for the facilities through community participation during the construction of water supply facilities in order to motivate community ownership.

4) Budget arrangement and payment of import tax, internal tax, and other levies

5) Introduction of commercial power to two sites and corresponding budget arrangement

6) Arrangement of necessary counterpart personnel

7) Application and acquisition/clearance for drilling/construction/building permit and environmental impact assessment by NEMA, and payment for related costs

2-2-4-4 Consultant Supervision

(1) Detailed Design and Tendering

1-1) Detailed Design

In accordance with the result of the Study, detailed design and preparation of tender documents will be carried out, which include the following works:

- Hydrogeological survey at test drilling sites and other sites, if necessary
- Test drilling
- Detailed design for water supply facilities
- Preparation of design report and drawings
- Calculation of work quantities and cost estimate
- Preparation of construction plan and tender documents

1-2) Tender Assistance

Prior to the tender, pre-qualification of potential bidders will be done. This announcement will appear under the name of MOWI, in major Japanese construction-related newspapers. The pre-qualification documents will be prepared and distributed by the consultant. Tender documents will then be distributed to qualified contractors. The proposals of the contractors will be received by the consultant and opened in the presence of MOWI staff. The proposals will be evaluated by the consultant and staff of MOWI immediately after they are opened. The contract document will be drafted and finalized upon discussion with the selected contractor. The consultant will assist MOWI in the following works:

- Tender announcement

- Preparation, distribution, and evaluation of pre-qualification documents
- Distribution and evaluation of tender documents and contract negotiation

(2) Construction Supervision

After verification of the contract by the Japanese government, the consultant will publish notification for the commencement of the works. Upon commencement, a resident engineer will be designated at the site. He will supervise the construction works and report work progress to the Embassy of Japan, JICA Kenya Office, and MOWI. He will also facilitate communication among concerned agencies including the contractor.

The following are the major items of the supervision works:

1)	Approval of construction drawings	:	Evaluation and approval of construction and shop drawings, granting of permission for construction works, use of materials, specifications of equipment and machinery, and so on
2)	Supervision of construction works	:	Instruction on construction schedule, overseeing progress of works, shop inspection for materials, and other required works
3)	Inspection for completion	:	Inspection of works accomplished and confirmation of necessary documents for completion
4)	Approval for payment	:	Issuance of certificate for payment and completion of works
5)	Inspection at the end of defects liability period	:	Inspection of constructed facilities

2-2-4-5 Quality Control Plan

The quality control plan for the Project covers drilling work, concrete work, pipe laying and manufacturing of equipment such as pipes, steel storage tanks, pumps, generators and so on. The quality control items are described in the following Table 2.21:

Table 2.21 Quality Control Items

Items	Tests	Method
1. Drilling of boreholes	Shop inspection Electrical logging Preliminary pumping test	Witness of inspection Check and review of test records Ditto
2. Concrete works	Slump test Compression test	Each 20 m^3 in total (as a standard) Ditto (7-day/28-day strength)
3. Pipe laying	Water flow test	Sealing with water and Witness of inspection
4. Equipment	Shop inspection	Witness of inspection Check and review of test records

Source: JICA Study Team

2-2-4-6 Procurement Plan

(1) Construction Materials, Local Contractor and Construction Equipment

1-1) Construction Materials

Most of the materials required for the Project such as motorized pumps, galvanized steel pipe, uPVC pipe, steel plate, structural steel, reinforcement, cement, timber, fuel, oil, and

paint can be procured in Kenya. The required quantity will not be so large and thus will not affect local demand conditions.

(a) Hand pumps

Afridev type hand pumps are most popular in Kenya and its neighboring countries. There are several Afridev hand pump manufacturers in Nairobi. Most of the spare parts are also produced by local manufacturers.

(b) Submersible pumps

Submersible pumps can be procured through the Kenyan dealers of European manufacturers, considering that the size of the equipment is small and has the common specifications of adopted pumps. Spare parts indispensable for the O&M of pumps can also be procured through these agents. Therefore, submersible pumps are planned to be procured from Kenyan dealers.

(c) Windmill pump

Windmill pumps in Kenya have been manufactured only by a Kenyan company, Kijito, having headquarters in Thika. The advantage of windmill pumps manufactured by this company is the simple structural mechanism adopted and the less costly O&M required. Associated spare parts can be procured from the same company. They also have training courses on O&M of the equipment.

Taking into account these advantages of windmill pumps manufactured in Kenya, these pumps are planned to be procured in the country.

(d) Storage tank

Storage tanks made of steel, masonry and concrete are commonly used in Kenya. In this Project, it is proposed to use steel tanks because of their low cost, wide range of Project sites, short period of installation works and common quality.

However, it is planned that galvanized steel panels will be adopted in consideration of water quality requirements.

(e) Galvanized steel pipe and uPVC pipe

Galvanized steel pipe and uPVC pipe and their fittings are manufactured in Kenya and can be procured locally.

(f) Galvanized steel plate and iron material

Galvanized steel plates and iron materials are imported from South Africa and the Middle East. Thus, these materials will be procured through Kenyan agencies.

(g) Valves

Valves are procured from Europe and South Africa through Kenyan agencies.

(h) Reinforcement bar and form work

Reinforcement bar is manufactured in Kenya and can be easily procured from Kenyan agencies. Domestic products shall be procured for formworks.

(i) Concrete blocks

Concrete blocks for building walls are manufactured by small and medium scale manufacturers in Kenya. Therefore, it is planned that the blocks to be procured should be subject to quality check.

(j) Sand and aggregates

There are small quarries of fine and course aggregates, and stones in the target districts. These materials can therefore be obtained locally.

(k) Cement

Cement will be procured from Kenya.

(l) Fuel

Fuel can be procured through the Kenyan agency of a major international oil company in the target districts.

(m) Fittings for doors, etc.

Fittings for pump houses and water kiosks can be procured at a market in Nairobi.

(n) Paints

Paints can be procured in Kenya.

Sources for the procurement of materials are summarized in Table 2.22:

Table 2.22 Procurement Source of the Main Construction Materials

Item	Kenya	Japan	Third Country	Reason
Hand Pump	○			Available from Domestic Product
Windmill Pump	○			Available from Domestic Product
Motorized Pump			○	Reliability of Quality and Supply
Storage Tank	○			Available from Domestic Product
Galvanized Steel Pipe	○			Available from Domestic Product
uPVC Pipe	○			Available from Domestic Product
Iron Materials	○			Available from Domestic Product
Reinforcement Bar	○			Available from Domestic Product
Sand, Gravel	○			Available from Domestic Product
Cement	○			Available from Domestic Product
Formwork	○			Available from Domestic Product
Wood	○			Available from Domestic Product
Fuel	○			Available from Domestic Product
Oil	○			Available from Domestic Product
Paint	○			Available from Domestic Product

Source: JICA Study Team

1-2) Local Contractors and Construction Equipment

(a) Local contractor

In Kenya, local contractors are registered by the ministries for each category of main works. Contractors in Kenya have accumulated experience and technology through domestic projects conducted by joint venture with foreign firms, mainly from European countries, for many years since the country's independence in 1963.

Therefore, local engineers and laborers for the Project will be procured from Kenyan contractors with experience on similar projects with MOWI or with similar levels of engineering skills and experience.

(b) Construction equipment

Major local contractors have their own drilling rigs and supporting equipment. Most construction equipment, excluding drilling and large-scale equipment, can be procured from Kenyan companies under a lease contract.

(2) Procurement Plan for O&M Tools

The Project does not include procurement of operation and maintenance tools.

2-2-4-7 Operation Guidance Plan

The Project does not include procurement of O&M tools. Therefore, this clause is not applicable.

2-2-4-8 Soft Component (Technical Assistance) Plan

(1) Project Component

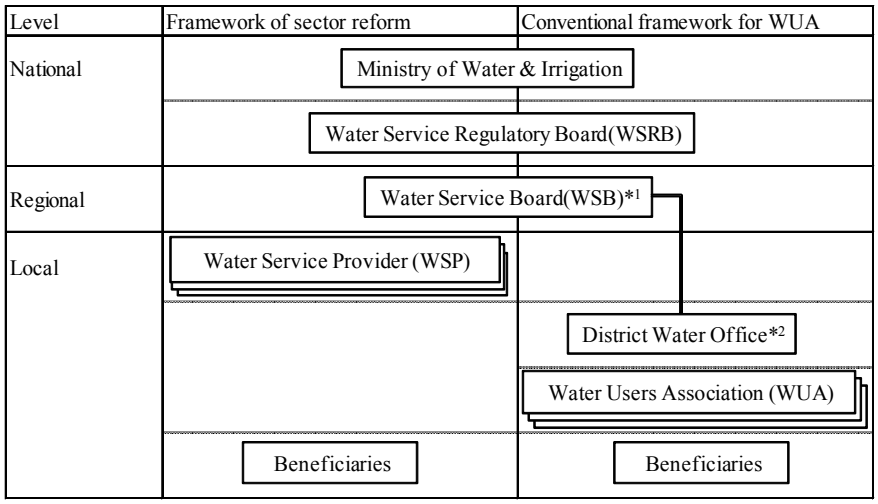
The Project aims to construct 58 sites of water supply facilities with boreholes in order to supply safe and stable water to the target area and to implement assistance for the establishment of WUAs in order to manage and maintain the facilities. Water supply facilities consist of 29 sites for hand pump, one site for windmill pump and 28 sites for submersible pump.

(2) Background

For the improvement of inefficiencies of water/hygiene sector, it was proposed to initiate sector reforms by establishing an organization for decision-making on water resources development/management and water supply service, which are separate from the functions of the Ministry of Water and Irrigation under the National Water Policy in 1999. Afterward, the framework of the said sector reforms was constituted in Water Act 2002.

Water service boards (WSBs), which were established under Water Act 2002, are promoting contracts for water supply projects in accordance with new framework on water sector reform. Thus, they are arranging contracts with water service providers (WSPs) instead of the conventional framework where district water offices have been directing and assisting WUAs. The Project area is covered by TAWSB and consists of 11 WSPs in the area.

The main duties of WSBs under the new framework are: 1) to prepare a development plan on water supply and sewerage services and set up performance target, 2) to examine application of potential WSPs, and 3) to enforce regulation and tariffs on water services. WSPs shall obtain a business license from WSBs on service provision, through the preparation of a business plan. In the rural water supply service, NGOs, community-based organizations, and private sector organizations could become WSPs. The following Figure 2.6 shows the described framework:



*1: 8 WSBs in Kenya

*2: affiliated to WSB

Figure 2.6 New Framework on Sector reform and Conventional Framework for WUAs

The water supply facilities to be constructed by the Project will be basically transferred to

the WSB including ownership in the same manner as with other water supply facilities owned by the Government of Kenya. Then, WSP, which concluded contract with the WSB, will operate and maintain these water supply facilities and services.

However, it is difficult, in terms of low profitability and public welfare, for private enterprises as WSPs to manage isolated water supply facilities in rural areas. Such facilities, therefore, have mostly been taken out of the above new framework. WUAs have been still operating them while district water office of WSB provides them with necessary assistance. District water office with its special budget distributes, repairs, purchases and installs pumps, generators etc., for the water supply facilities which are operated by WUAs. District water office is also conducting countermeasures against drought, supplying free fuel to WUAs and contributing to reduction of water fees.

TAWSB has a policy that WSPs operate all water supply facilities through the transition from WUAs to WSPs or WUAs' affiliation with WSPs. However, the implementation method remains undecided. This situation has not been changed since the completion of construction of Phase 1/2 in March 2008. Therefore, in the soft component of the construction work for Phase 1/2, it was proposed that O&M bodies of water supply facilities shall be clarified.

As for rural water supply facilities, they may be difficult to be operated and maintained by a private sector, taking into account their low profitability and public undertaking of water supply services. Therefore, cooperation among WSB, WSP licensed by WSB and WUA will be necessary to realize sustainable O&M of the facilities.

As a result of the social condition survey in the Study, 100% of the villagers in the target community exhibit willingness to pay for water and participate in O&M activities through WUA. It appears that their intention to participate in the activity is high. However, it was observed that some community members lack willingness to pay for water, an understanding of users-pay-principle, and willingness to participate in O&M. Most of the target communities have no supply facilities, and therefore, have little experience on operation and maintenance of water supply facilities in a systematic or organized manner. In addition, water supply facilities to be constructed under the Project include hand pump, windmill pump, submersible pump with generator, commercial power and solar panel, and with or without pipeline. Thus, required knowledge, capacity and techniques are different.

It is therefore recognized that intervention to increase participation in and capacity of independent O&M, through implementation of this soft component, is indispensable to enhance sustainability of the Project.

It is further noted that lack of awareness among target communities on water quality of existing water sources was revealed in the socioeconomic survey. It was noted that there was a considerable number of respondents preferring the existing/traditional water sources during the rainy season, even if improved water supply facilities are provided under the Project.

(3) Issues for Planning Soft Component

3-1) Local Administration

TAWSB's policy on substituting WSP with WUA is not immediately realized. Meanwhile, district water office of TAWSB has been assisting the present WUAs. Therefore, this soft component targets district water and sanitation team (DWST), which is composed of administration officers concerned at the district level. Hence, technical guidance is undertaken by DWST under the soft component.

3-2) Target Communities

Soft component at community level focuses on capacity building of WUA. However, transition from WUA to WSP shall be noted, and cooperation among aforementioned WSB, WSP and WUA shall be examined in order to facilitate adjustment to the new institutional framework under the sector reform.

3-3) Willingness and Ability of Community to Participate in O&M

For achieving expected output on health and sanitation improvement by the Project, enhancement of community awareness on water quality is necessary. In addition, the number of users for the improved water supply facilities would decrease in the rainy season, which will result in the decrease of fee collection and could affect sustainable operation of the facilities. Therefore, from the viewpoint of sustainability of the Project, implementation of activities to increase awareness of communities on health and sanitation aspects shall be essential.

Soft Component Plan, which considered the above, is presented in Appendix 5.

2-2-4-9 Implementation Schedule

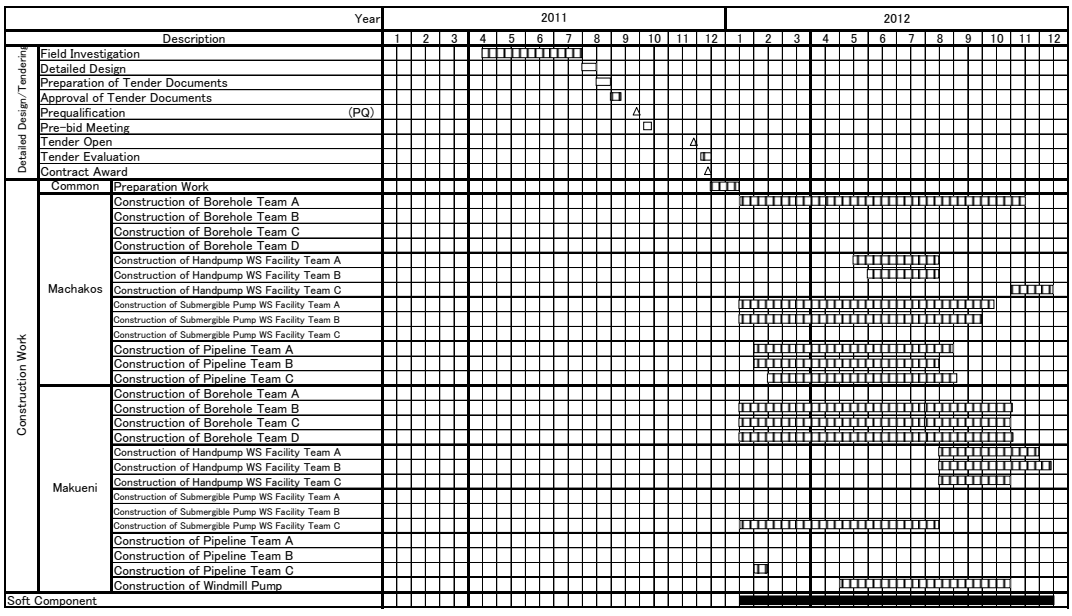
The Project is implemented under one phase in larger Makueni and Machakos districts. Through the Project, soft component is planned to be implemented.

Table 2.23 Implementation Periods

Item	Period (month)
Detailed Design and Tendering	8.0
Construction and Inspection	12.5
Soft Component	11.0

Source: JICA Study Team

The above implementation periods are detailed in Figure 2.7 below.



Source: JICA Study team

Figure 2.7 Detailed Implementation Schedule

2-3 Obligations of the Recipient Country

Undertakings of the Government of Kenya are drafted as follows:

(1) To secure the site for proposed water supply facilities.

(2) To clear, level and reclaim the site prior to commencement of construction.

(3) To provide data and information necessary for the Project.

(4) To provide the land for access road, temporary site office, warehouse and stockyard during the implementation of the Project.

(5) To provide warehouse for storing spare parts and other equipment procured under the Project.

(6) To undertake incidental outdoor works such as security of the sites, fencing, gates, and exterior lighting in and surrounding the borehole sites, if necessary.

(7) To construct access road to the site prior to commencement of construction.

(8) To bear the commissions of the Japanese bank for banking services based on banking arrangement.

(9) To exempt taxes and to take necessary measures for customs clearance of materials and equipment procured under the Project, at the port of disembarkation.

(10) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies, which may be imposed in Kenya for the supply of products and services under the verified contracts.

(11) To accord Japanese nationals, whose services may be required in connection with supply of the products and services under the verified contracts, such facilities as may be necessary for their entry into Kenya and stay therein for the performance of their works.

(12) To assign necessary staff and secure the necessary budget for O&M of the equipment purchased under the grant aid.

(13) To maintain and use properly and effectively the equipment procured under the grant aid.

(14) To bear all the expenses other than those borne by the grant aid, which are necessary for the construction of the facilities as well as for the transportation and installation of the equipment.

(15) To maintain the control of tools and spare parts purchased under the grant aid

(16) To support the establishment of WUA for target communities.

(17) To establish and manage the project management unit, and to cooperate with relevant ministries.

(18) To bear all the expenses and arrange staff for establishment of the trainer's team.

(19) To apply and acquire/clear drilling/construction/building permits and environmental impact assessment by NEMA and pay for these costs

(20) To introduce commercial power to two sites and arrange for the budget

MOWI has conducted the abovementioned works properly through the project for groundwater development in rural districts, previously funded by the Japan Grant Aid. Therefore, it is expected that MOWI will again be able to undertake similar tasks.

2-4 Project Operation Plan

2-4-1 Organization for O&M

The framework of O&M plan is composed of: 1) promotion of the active participation of community-based organizations in operation and maintenance, and 2) support service provided by the administration agencies. The concept of the O&M system in this plan is shown in Figure 2.8 as follows:

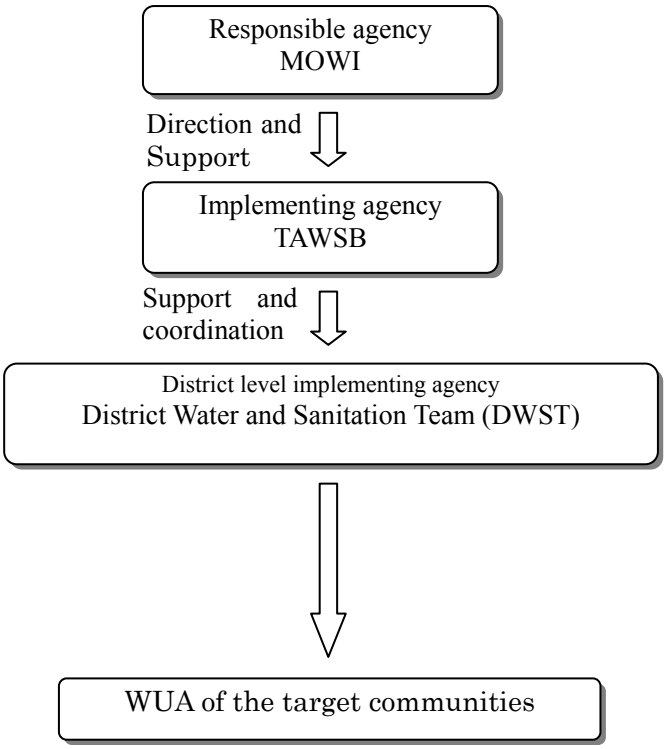


Figure 2.8 Organization for O&M Plan

2-4-2 O&M Plan

Based on the issues raised during the review on the current O&M situation of the existing water supply facilities in the target areas as well as from the socioeconomic survey, the main approach in the O&M plan is explained in this section.

(1) Basic Policy Relevant to O&M at Administration Level

A participatory model for a community-based O&M system has been adopted to carry out water supply and sanitation projects in rural areas of Kenya. Through this approach, community-based organizations have been encouraged to participate actively in O&M, and have been provided with support services by administrative agencies.

In this system, community members are required to form self-governing organizations as well as to acquire and apply knowledge, skills and capability to independently operate and maintain the water supply facilities to be constructed.

On the other hand, TAWSB as the implementing agency of the Project is expected to provide administrative support services to local communities through district water officers designated in each district, so that the participatory O&M system can be

established smoothly. The administrative support service is planned to include training for capacity building of community-based organizations, monitoring, and technical support for matters beyond the current communities' capability.

Therefore, part of the soft component program, such as TOT, which aims to improve the participatory facilitation skills towards community-based O&M systems, targets the district officers of TAWSB.

(2) Basic Policy Relevant to O&M at Community Level

In the current O&M system at the community level, each community is obligated to form community-based organizations prior to construction work, with the guidance and support from district water offices of TAWSB. Communities are in charge of drafting constitutions as well as application and registration at district social program offices. Furthermore, they are required to carry out O&M activities, such as operation of water supply facilities, daily maintenance, collection of user charges and accounting, and small-scale repairs.

Reflecting the results of socioeconomic survey as well as learning from the O&M situation of the existing water supply facilities, the plan examines the training package for the participatory O&M system, which is carried out as part of the soft component program. Also, NGOs with experience in the same area are planned to be in charge of training.

The O&M at the community level is aimed principally at establishing the participatory O&M system for water supply and sanitation, in which the scope of the soft component program is limited. An integrated approach is required, however, for effective and sustainable O&M in this plan. Fields such as income generation, expansion of educational opportunity, food security, and education to improve nutrition, reproductive and health aspects, and HIV/AIDS prevention, need to be included and integrated in this plan. Local NGOs have possibly accumulated relevant methods and experiences in introducing the integrated approach in the above fields.

(3) O&M Plan

3-1) Strengthening Community Support by Rural Administrative Agencies

The present participatory O&M system essentially requires target communities to improve their capabilities on O&M. The system cannot work without support services to the communities from administrative agencies. Such support services, which include training, monitoring and guidance aimed at capacity building, are expected to be provided by the district water offices and local branches of TAWSB to the communities.

The district water offices are required to provide the following: 1) support for organizing WUAs that primarily operate and maintain the newly constructed water supply facilities as community-based organizations, 2) guidance and advice to formulate regulations of WUAs, and support for registering them as WUAs, 3) technical guidance regarding operation of water supply facilities and daily maintenance, 4) guidance and advice for setting the user fee and methods for its collection, 5) guidance on accounting, and fund employment and control, and 6) follow-up and monitoring.

Moreover, a multi-sectoral approach is adopted in establishing a participatory O&M system in this plan. This approach is based on organizing DWST mainly composed of officers from government departments related to the water and sanitation sector, as each district has a branch of said government departments apart from TAWSB. With this approach, technical transfer is carried out by DWSTs in their soft component program.

For the formation of DWSTs, led by a district executive officer, TAWSB is required to coordinate the various government departments such as the Ministry of Health and Ministry of Gender, Sports, Culture and Social Services. The district offices of these

government departments have carried out direct traveling guidance at community level, and experienced various activities in the fields of health and sanitation, community development and organizing support, etc. Therefore, these experiences and know-how of the district offices of government departments are expected to be practically applied.

3-2) Improving Awareness of Local Communities for Participation

The participatory O&M system basically requires target communities to foster awareness and willingness to participate in O&M, based on their ownership and users-pay-principle. Therefore, the plan initiates expanding of the scope of activities and is aimed at fostering their sense of ownership and willingness to participate in O&M at the target communities. This involves organizing the abovementioned DWSTs with the district water offices as the central aim.

3-3) Capacity Building of Communities

The target communities have higher needs for capacity building towards establishing participatory O&M systems. These needs are found particularly in terms of the aspects below. Thus, it is planned to provide training to them and to establish self-reliant operation system.

- Improvement of leadership skills,
- Improvement of management skills to be used in community-based organizations,
- Decision-making on the amount of user fee and method for its collection,
- Establishing budget, accounts, and fund control,
- Operation of facilities, maintenance and repair, and trouble shooting,
- Establishing monitoring checklists, and participatory monitoring activities, and
- Review meetings.

3-4) Hygiene Education on “Water”

The sustainable use of water supply facilities cannot improve the living environment without community members’ sense of ownership as well as their practice based on understanding of appropriate use and management of safe water. Therefore, the concept of sanitation and custom (what users of the water sources and facilities apply) needs to be carefully taken into account in the O&M of water supply facilities. In order to ensure a self-sustaining project, the district water offices and DWST members need to support the local communities in positively transforming their awareness and behavior on water use.

3-5) Institutional Strengthening and Capacity Building of Stakeholders on O&M

In order to realize sustainable water supply from the newly constructed facilities as well as to hasten the expected effects, the activities for institutional strengthening and capacity building of stakeholders on O&M need to be implemented in the soft component program. These activities are also needed based on the principle that Kenya is primarily responsible for this international cooperation project with Japan, in line with the general rules of Japanese Grant Aid assistance.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

(1) Japanese Side

Estimated project cost: confidential

(2) Kenyan Side

The Government of Kenya has executed several projects under the grant aid from the Japanese government such as the "Groundwater Development in Rural Area", "Meru Water Supply", and so on, by managing their staff and budget properly. Therefore, they could perform these arrangements of staff and budget in order not to induce any delays in the execution of the Project. The following are the proposed undertakings of the Government of Kenya:

Item	Description	Cost	
		Thousand Ksh	Million ¥
1. Site	Land acquisition/compensation (for public land) of drilling site, pipe installation, storage tank, water kiosk, spring water supply facilities, etc.	-	-
2. Land acquisition	Land acquisition/compensation (for private land) of drilling site, pipe installation, storage tank, water kiosk, etc.	-	-
3. Organization of WUA	Organization of 58 WUAs	-	-
4. Community participation	Fences (58 sites) Drain ditch (21 sites)	45,778	51.73
5. Tree	Cutting/compensation	-	-
6. Construction	Quality and progress control for construction of fences (58 sites) Quality and progress control for construction of drain ditch (58 units)	522	0.59
7. Storage house/place	Storage place for construction material and equipment	-	-
8. Project manager/ coordinator	Staffing of project manager and project coordinator	2,454	2.77
9. Establishment of WUA & follow-up	Establishment of WUAs for 58 communities Staff for training on O&M and sanitary education	1,899	2.15
10. Supervisory team	Staffing for supervisory team on the construction of boreholes and civil works (each 4 people)	1,020	1.15
11. Operation cost	Arrangement for allowance of abovementioned staff	10,909	12.33
12. Introduction of commercial power	One site in larger Machakos Province and one site in larger Makueni Province	800	0.90
13. Bank charge	1 unit	581	0.65
Total		63,963	72.27

(3) Condition of Cost Estimate

1) Time of cost estimate: October 2010

2) Exchange rates: US$1 = ¥89.91

Ksh 1 = ¥1.13

3) Schedule: Refer to Section 2-2-4-9 for the implementation schedule

4) Others: The Project shall be implemented in accordance with the regulations and system of Japan's Grant Aid Scheme.

2-5-2 O&M Cost

In accordance with Water Act 2002, WUA carries out the O&M for the facilities. Therefore, WUA shall collect the water fee from respective members to cover necessary costs for O&M of water supply facilities.

As a result of the socioeconomic survey, 100% of the beneficiaries in larger Machakos District and 90% in larger Makueni District are willing to pay the water fees. Furthermore, almost all beneficiaries are willing to participate in O&M activities through WUA.

Regarding capacity to pay, beneficiaries in larger Machakos District and larger Makueni District are able to pay Ksh 2.0 per 20 L and Ksh 1.4 per 20 L, respectively, based on the results of income/expense levels in each district.

In consideration of the above, O&M cost could be estimated as follows:

(1) Water Supply Facility Equipment with Hand Pump

Because the structure is quite simple and maintenance is easy, the maintenance and repair of hand pumps should be done by WUA's trained technicians. They are supposed to inspect hand pumps every six months and replace any damaged parts.

According to the interview with pump manufacturers/agents in Kenya, the operational life of hand pumps is eight years if proper maintenance is executed. Furthermore, replacement of moving parts, which highly depends on the condition of use, is estimated to be every six months to one year based on experience.

The highest water production cost equivalent to the O&M cost for the hand pump is estimated in Table 2.25 below.

Table 2.24 Water Production Cost for Hand Pump

Larger district	No.	Community	Annual O&M cost (Ksh)	Annual water production (m^3)	Water production cost (Ksh/m^3)	Affordable price (Ksh/m^3)
Makueni	107	Kyang'ondu Primary	39,590	876	45	70
Machakos	198	Kavete	39,590	1,168	34	100

Source: JICA Study Team

It is judged that 29 communities (12 communities in large Machakos District and 17 in large Makueni District) are able to bear the cost through collection of water fees.

(2) Water Supply Facility equipped with Submersible Pump

There will be 28 water supply facilities with submersible pump for construction. Power sources for these consist of generator (21 sites), commercial power (2 sites) and solar power (5 sites).

The life span of submersible pumps is about nine years, depending on various conditions such as operation time, water quality, etc. The life span of diesel generators, meanwhile, is also nine years. Finally, the lifespan of solar panel is estimated to be around 15 years since it has no movable parts.

Based on the above conditions, annual O&M costs for water supply facility with submersible pumps are estimated as follows:

1) Water supply facility equipped with submersible pump and generator

As a result of the assessment of capacity to pay O&M cost for water supply facility with submersible pump and generator, it is judged that 21 communities could bear the cost through collection of water fees. The highest water production cost equivalent to the O&M

cost for the submersible pump and generator is estimated in Table 2.25 below.

Table 2.25 Water Production Cost for Submersible Pump and Generator

Larger district	No.	Community	Annual O&M cost (Ksh)	Annual water production (m^3)	Water production cost (Ksh/m^3)	Affordable price (Ksh/m^3)
Makueni	127A	Kalembwani (Uvunye)	410,182	7,300	56	70
Machakos	167	Mukukuni	444,028	5,840	76	100

Source: JICA Study Team

2) Water supply facility equipped with submersible pump and commercial power

As result of assessment of capacity to pay O&M cost for water supply facility with submergible pump and commercial power adjacent to the existing commercial power network, it is judged that two communities could bear the cost through collection of water fees. The water production cost equivalent to the O&M cost for the submersible pump and commercial power is estimated in Table 2.26 below.

Table 2.26 Water Production Cost for Submersible Pump and Commercial Power

Larger district	No.	Community	Annual O&M cost (Ksh)	Annual water production (m^3)	Water production cost (Ksh/m^3)	Affordable price (Ksh/m^3)
Makueni	133	Mangala	106,976	10,129	11	70
Machakos	189	Ndithini Sec. School	141,058	10,512	13	100

Source: JICA Study Team

3) Water supply facility equipped with submersible pump and solar system

As a result of the assessment of capacity to pay O&M cost for water supply facility with submersible pump and solar system, it is judged that five communities could bear the cost through collection of water fees. The highest water production cost equivalent to the O&M cost for the submersible pump and solar system is estimated in Table 2.27 below.

Table 2.27 Water Production Cost for Submersible Pump and Solar System

Larger district	No.	Community	Annual O&M cost (Ksh)	Annual water production (m^3)	Water production cost (Ksh/m^3)	Affordable price (Ksh/m^3)
Makueni	123	Ngunini	114,641	1,796	64	70
Machakos	200	Kyamutheke	114,641	1,314	87	100

Source: JICA Study Team

(3) Water supply facility equipped with windmill pump

According to interviews and studies with windmill pump manufacturers in Kenya, regular maintenance for such type of pump only requires greasing of rotors and gear box every six months. From the site survey, it was also confirmed that there were no reports of damage of blades, rotor and gear, apart from deterioration of cylinders and rubber, which are replaced every three to ten years.

According to wind pump manufacturers in Kenya, overhauls are recommended once every ten years even if there is no damage. This overhaul is generally carried out to extend the life span of the pumping system. It is noted that the life span of windmill pumps in Japan is 10 to 15 years. However, wind pump manufacturers in Kenya do not imply a fixed life span, with most of the windmill pumps operating for more than 20 years already.

Based on this, the life span for windmill pump was fixed at 15 years, while the

maintenance period at community level is every six months. The water production cost equivalent to the O&M cost for the windmill pump is estimated in Table 2.28 below.

Table 2.28 Water Production Cost for Windmill Pump

Larger district	No.	Community	Annual O&M cost (Ksh)	Annual water production (m^3)	Water production cost (Ksh/m^3)	Affordable price (Ksh/m^3)
Makueni	102	Kithunzi	306,347	4,588	67	70

Source: JICA Study Team

As a result of the above, it is judged that the community could bear the cost through collection of water fees.

2-6 Other Relevant Issues

In order to facilitate the undertakings of the Government of Kenya, the following issues, which directly affect the implementation of the Project, shall be taken into consideration:

(1) Establishment of organization for the implementation and O&M of the Project, as well as arrangement of necessary staff and budget for the Project,

(2) Coordination with agencies concerned in organizing the DWST,

(3) Organization of WUAs of 58 target communities, and

(4) Land acquisition for the construction of water supply facilities.

Chapter 3
Project Evaluation

CHAPTER 3
PROJECT EVALUATION

3-1 Recommendations

3-1-1 Precondition for Execution of the Project

The precondition for execution of the Project is described in Clause 2.3.

3-1-2 Precondition and External Condition for Achievement of the Project

The following issues should be the precondition and external condition for the achievement of the Project:

1) Basic policy and organization framework are not changed.

2) O&M system and responsibilities of concerned parties are not changed totally.

3) Supporting system for WUA in O&M by DWOs is not changed.

4) WUA system in O&M is not changed.

3-2 Project Evaluation

3-2-1 Propriety

The Project is justified for implementation under grant aid scheme from the following aspects:

1) The 58 target communities, which do not have stable and safe water sources in their vicinity, must have access to safe and stable water supply in their community areas through the implementation of the Project.

2) The Project aims to improve water service ratio through the construction of water supply facilities with boreholes and spring water, and to shorten the long access distance to water sources. The Project contributes to the improvement of extremely poor water supply condition for a population of approximately 60,000.

3) It is possible for the Kenyan counterpart to operate and maintain the water supply facilities as complicated engineering is not required.

4) This Project contributes in ensuring improved water and sanitation availability and access to all by 2030 in the VISION 2030 while being consistent with the national policy of the GOK.

5) This Project is judged to have no significant adverse effects to the environment.

6) The Project can be implemented under the grant aid scheme of the GOJ without any difficulties.

3-2-2 Effectiveness

(1) Quantitative Effects

The estimated incremental population with safe drinking water source and the served ratios are expected to be improved as described in Table-3.1.

Table-3.1 Incremental Population with Safe Drinking Water Source and Service Ratios

Parameters	Existing Condition in 2010		Planned Condition in 2013	
Served Population (1,000 persons)	Large Makueni District	343	Large Makueni district	364
	Large Machakos District	465	Large Machakos district	504
	Total	808	Total	868
Served Ratio (%)	Large Makueni district	38.2	Large Makueni district	40.5
	Large Machakos district	41.5	Large Machakos district	45.0
	Average	39.9	Average	42.8

(2) Qualitative Effects

The following shows the benefits from the Project:

1) Minimize risks of diseases caused by polluted water in the target area

2) Improvement of community ownership and participation.

3) Transfer of capacity and skills from the local administration to support communities in the establishment of community-based O&M system, community awareness in personal health and sanitation, and understanding of correlation with safe water use.

4) Reduction of manual water fetching by women and children

Therefore, this Project is considered to be of high priority and is supposed to bring about effective results.

Appendices

Appendix-1
Member List of Study Team

Appendix-1: Member List of the Study Team

Name	Position	Affiliation
MARUO Yuji	Team Leader	Sinner Adviser, JICA
INOUE Hiromu	Planning Management	Assistant Director for Disaster Management Division 2, Global Environment Department, JICA
USUKURA Hajime	Planning Management	Grant and Project Management Division 3,Financing Facilitation and Procurement Supervision Department, JICA
KAMO Hajime	Chief Consultant/Water Supply Plan/Test drilling	Nippon Koei Co., Ltd.
HOSODA Toshiaki	Social Survey/Operation and Maintenance plan	Nippon Koei Co., Ltd.
YAMADERA Akira	Water Supply Design/Construction Plan/Cost Estimate	Nippon Koei Co., Ltd.
MICHIZUKI Hiromichi	Electrical and Mechanical design	Nippon Koei Co., Ltd.
YAMAGUCHI Haruka	Hydrogeologist-1	Nippon Koei Co., Ltd.
SAKAI Toshiaki	Hydrogeologist-2	Nippon Koei Co., Ltd.

Appendix-2
Study Schedule

Appendix-2: Study Schedule

1. 1st Field Survey (October 26, 2009 to February 28, 2010)

No	Date	Member	Stay	Activities
1	Oct.26 (Mon)	Kamo		Move (Tokyo-Doha)
2	27 (Tue)	Kamo	Nairobi	Move (Doha-Nairobi), Courtesy Call to Kenya JICA Office
3	28 (Wed)	Maruo, Inoue Kamo	 Kitui	Move (Tokyo-Dubai) Courtesy Call to MOWI
4	29 (Thu)	Maruo, Inoue Kamo	Nairobi	Move (Dubai-Nairobi), Courtesy Call to Kenya JICA Office Explanation of Inception Report to TAWSB and Makueni District Water Office
5	30 (Fri)	Maruo, Inoue, Kamo	Makueni	Courtesy Call to the Embassy of Japan, MOWI, Makueni District Water Office
6	31 (Sat)	Maruo, Inoue, Kamo	Nairobi	Investigation of Makueni and Machakos Districts
7	Nov.1 (Sun)	Maruo, Inoue, Kamo	Nairobi	Preparation of the Minutes of Discussion
8	2 (Mon)	Maruo, Inoue, Kamo	Nairobi	Discussion of the Minuets of Discussion
9	3 (Tue)	Maruo, Inoue, Kamo	Nairobi	Courtesy Call and Discussion with TAWSB, Investigation of Stage 1/2 site
10	4 (Wed)	Maruo, Inoue, Kamo	Nairobi	Signing of the Minutes of Discussion
11	5 (Thu)	Maruo, Inoue, Kamo Maruo, Inoue Kamo	 Machakos	Country Call to Minister of Water and Irrigation, Report to the Embassy of Japan and Kenya JICA Office Move (Nairobi-Dubai) Investigation and Analysis
12	6 (Fri)	Maruo, Inoue Kamo	 Machakos	Move (Dubai-Tokyo) Investigation and Analysis
...				Investigation and Analysis
46	10 (Thu)	Yamadera Kamo	 Machakos	Move (Tokyo-Doha) Investigation and Analysis
47	11 (Fri)	Yamadera Kamo	Nairobi Nairobi	Move (Doha-Nairobi) Investigation and Analysis
...				Investigation and Analysis
73	Jan.6 (Wed)	Mochizuki		Move (Tokyo-Doha)
		Yamadera Kamo	Nairobi Machakos	Investigation and Analysis Investigation and Analysis
74	7 (Thu)	Mochizuki Yamadera Kamo	Nairobi Nairobi Machakos	Move (Doha-Nairobi) Investigation and Analysis Investigation and Analysis
...				Investigation and Analysis
77	10 (Sun)	Hosoda Yamadera, Mochizuki Kamo	 Nairobi Machakos	Move (Tokyo-Doha) Investigation and Analysis Investigation and Analysis
78	11 (Mon)	Hosoda Yamadera, Mochizuki Kamo	 Nairobi Machakos	Move (Doha-Nairobi) Investigation and Analysis Investigation and Analysis
...				Investigation and Analysis
97	30 (Sat)	Kamo Yamadera, Mochizuki, Hosoda	 Nairobi	Move (Nairobi-Doha) Investigation and Analysis
98	31 (Sun)	Kamo Yamadera, Mochizuki, Hosoda	 Nairobi	Move (Doha-Tokyo) Investigation and Analysis
...				Investigation and Analysis
101	Feb.3 (Wed)	Mochizuki Hosoda Yamadera	 Nairobi	Move (Nairobi-Doha) Move (Nairobi-Kigali) Investigation and Analysis
102	4 (Thu)	Mochizuki Yamadera	 Nairobi	Move (Doha-Tokyo) Investigation and Analysis

No	Date	Member	Stay	Activities
...				Investigation and Analysis
125	27 (Sat)	Yamadera		Move (Nairobi-Doha)
126	28 (Sun)	Yamadera		Move (Doha-Tokyo)

2. 2nd Field Survey (June 26, 2010 to October 14 2010)

No	Date	Member	Stay	Activities
1	Jun.26 (Sat)	Kamo, Yamaguchi		Move (Tokyo-Doha)
2	27 (Sun)	Kamo, Yamaguchi Maruo, Inoue	Nairobi	Move (Doha-Nairobi) Move (Tokyo-Dubai)
3	28 (Mon)	Maruo, Inoue Kamo, Yamaguchi	Nairobi Machakos	Move (Dubai-Nairobi) Courtesy Call to Kenya JICA Office, Investigation and Analysis
4	29 (Tue)	Maruo, Inoue Kamo, Yamaguchi	Nairobi Machakos	Courtesy Call to Kenya JICA Office, Preparation of the Minuets of Discussion Investigation and Analysis
5	30 (Wed)	Maruo, Inoue Kamo, Yamaguchi	Nairobi Machakos	Explanation of the Inception Report and Discussion with MOWI and Kenya JICA Office, Preparation of the Minuets of Discussion Investigation and Analysis
6	Jul.1 (Thu)	Maruo, Inoue Kamo, Yamaguchi Sakai	Nairobi Machakos	Discussion and signing of the Minuets of Discussion Investigation and Analysis Move (Tokyo-Doha)
7	2 (Fri)	Maruo, Inoue Kamo, Yamaguchi Sakai	Nairobi Machakos Machakos	Report to the Embassy of Japan and Kenya JICA Office, Move (Nairobi-Dubai) Investigation and Analysis Move (Doha-Nairobi)
8	3 (Sat)	Maruo, Inoue Kamo, Yamaguchi、Sakai	Nairobi Machakos/ Makueni	Move (Dubai-Tokyo) Investigation and Analysis
...				Investigation and Analysis
14	9 (Fri)	Kamo, Sakai Yamaguchi	Machakos/ Makueni	Investigation and Analysis Move (Nairobi-Doha)
15	10 (Wed)	Kamo, Sakai Yamaguchi	Machakos/ Makueni	Investigation and Analysis Move (Doha-Tokyo)
...				Investigation and Analysis
35	30 (Fri)	Kamo Sakai	Machakos	Investigation and Analysis Move (Nairobi-Doha)
36	31 (Sat)	Kamo Sakai	Machakos	Investigation and Analysis Move (Doha-Tokyo)
...				Investigation and Analysis
51	Aug.15 (Sun)	Kamo Yamadera	Machakos	Investigation and Analysis Move (Tokyo-Doha)
52	16 (Mon)	Kamo Yamadera	Nairobi	Investigation and Analysis Move (Doha-Nairobi)
...				Investigation and Analysis
77	Sep.10 (Fri)	Yamadera Kamo	Nairobi	Investigation and Analysis Move (Nairobi-Doha)
78	11 (Sat)	Yamadera Kamo	Nairobi	Investigation and Analysis Move (Doha-Tokyo)
...				Investigation and Analysis
80	13 (Mon)	Yamadera Mochizuki	Nairobi	Investigation and Analysis Move (Tokyo-Doha)
81	14 (Tue)	Yamadera Mochizuki	Nairobi Nairobi	Investigation and Analysis Move (Doha-Nairobi)
82	15 (Mon)	Yamadera, Mochizuki	Nairobi	Investigation and Analysis
...				Investigation and Analysis

No	Date	Member	Stay	Activities
93	26 (Sun)	Yamadera Mochizuki		Investigation and Analysis Move (Nairobi-Doha)
94	27 (Mon)	Yamadera Mochizuki		Investigation and Analysis Move (Doha-Tokyo)
...				Investigation and Analysis
110	Oct.13 (Wed)	Yamadera		Move (Nairobi-Doha)
111	14 (Thu)	Yamadera		Move (Doha-Tokyo)

3. Explanation of Draft Final Report (December 12, 2010 to December 18, 2010)

No	Date	Member	Stay	Activities
1	Dec.12 (Sun)	Usukura Kamo, Yamadera		Move (Tokyo-Dubai) Move (Tokyo-Doha)
2	13 (Mon)	Usukura Kamo, Yamadera	Nairobi Nairobi	Move (Dubai-Nairobi) Move (Doha-Nairobi)
3	14 (Tue)	Maruo Usukura, Kamo, Yamadera	Nairobi Nairobi	Move (Lusaka-Nairobi) Internal Meeting and Discussion with Kenya JICA Office, Courtesy Call to MOWI, Submission of the Draft Final Report
4	15 (Wed)	Maruo, Usukura, Kamo. Yamadera	Nairobi	Explanation of the Draft Final Report and Discussion of the Minuets of the Discussion
5	16 (Thu)	Maruo, Usukura, Kamo. Yamadera	Nairobi	Explanation of the Draft Final Report and Discussion of the Minuets of the Discussion
6	17 (Fri)	Maruo, Usukura, Kamo. Yamadera Maruo, Usukura		Explanation of the Draft Final Report, and Discussion and Signing of the Minuets of the Discussion Report to the Kenya JICA Office and the Embassy of Japan
		Maruo, Usukura		Move (Nairobi-Dubai)
		Kamo, Yamadera		Move (Nairobi-Doha)
7	18 (Sat)	Maruo, Usukura Kamo, Yamadera		Move (Dubai-Tokyo/Kansai) Move (Doha-Tokyo)

Appendix-3
List of Parties Concerned in the Recipient Country

Appendix-3: List of Parties Concerned in the Recipient Country

Ministry of Water and Irrigation (MOWI)

Hon. Charity Kaluki Ngilu	Minister
Eng. David Stower	Permanent Secretary
Eng. Peter O. Mangiti	Head, Donor Coordination
Eng. Lawrence N. Simitu	Director, Water Services
Mr. F. K. KYENGO	Deputy Director, Water Services Programmes
Mr. I. G. Kimani	Japan Desk officer, Donor coordination Unit

TANATHI Water Service Board (TAWSB)

Eng. Nicholas K. Muthui	Chief Executive Officer
Mr. Martin M. Ng'aa	Chief Manager, Infrastructure Development
Mr. NDINGO	Manager, Community Development Programme Division

Makueni District Water Office

Mr. Allan MUTUWA	District Water Officer
Mr. Oyier Stephen	Deputy District Water Officer

Kibwezi District Water Office

Mr. Jough P. MBUR	District Water Officer

Nzaui District Water Office

Mr. James K. MUKUMBU	District Water Officer
Mr. David M. MASAKU	Deputy District Water Officer

Mukaa District Water Office

Mr. MULINGE	District Water Officer
Mr. Samuel MPARU	Water Engineer

Mbooni East District Water Office

Mr. NDETO	District Water Officer
Mr. Maurice M. MUNGUTI	Deputy District Water Officer

Kilungu District Water Office

Mr. OCHANDA	District Water Officer

Kathonzweni District Water Office

Mr. Munyao	Acting District Water Officer

Machakos District Water Office

Mr. James M. KATIMU	District Water Officer
Mr. Thiongo Robert	Deputy District Water Officer

Mwala District of Water Office

Ms. Patricia MUTUWA	District Water Officer

Yatta District Water Office

Mr. WAWERU	District Water Officer
Mr. Detto MULEI	Divisional Water office-Katangi division

Kathiani District Water Office
Mr. John Bosco MALELU District Water Officer

Kangundo District Water Office
Mr. Jones NWAKA District Water Officer

Masinga District Water Office
Ms. Janice District Water Officer

WARMA-Athi
Mr. NZYUKO Deputy Managing Director

Kenya Power and Lighting Co., Ltd.
Eng. Solomon Kilonzo Branch Business Head

NGO
<Grundfos LIFELINK>
Mr. Poul Due Jensen Communication Adviser

Embassy of Japan in Kenya
Iwatani, Shigeo Ambassador
Suzuki, Takehiko First Secretary
Matuura, Hiroshi Secretary

Kenya JICA Office
Kato, Masaaki Resident Representative
Kawazumi, Kyosuke Senior Representative
Inoue, Yoichi Assistant Resident Representative
Mr. John N. Ngugi Senior Programme Officer (Environment & Water)
Mr. Benson Gakere Administration Officer (Procurement)

Appendix-4
Minutes of Discussions

MINUTES OF DISCUSSIONS
ON
THE SECOND IMPREMENTATION REVIEW STUDY ON
THE PROJECT FOR RURAL WATER SUPPLY
IN
THE REPUBLIC OF KENYA
(Explanation of Draft Final Report)

In December 2010, the Japan International Cooperation Agency (hereinafter referred to as 'JICA') dispatched the Second Implementation Review Study Team (hereinafter referred to as the 'Team') on the Project for Rural Water Supply (hereinafter referred to as the 'Project') to the Republic of Kenya (hereinafter referred to as 'Kenya'), in order to explain and to consult with the officials concerned of the Government of Kenya on the components of the Draft Final Report. The Team is headed by Dr. Yuji MARUO, Senior Advisor of JICA from December 14th to 17th, 2010.

Through discussion, field survey, and technical examination of the results of the survey in Japan, JICA prepared a Draft Final Report of the Second Implementation Review Study.

As a result of the discussions, both sides confirmed the main items described on the attached sheets of this minutes.

Nairobi, December 17th, 2010

Dr. Yuji MARUO
Leader
Implementation Review Study Team
Japan International Cooperation Agency (JICA)

Eng. David STOWER, CBS, OGW
Permanent Secretary
Ministry of Water and Irrigation
Republic of Kenya

Eng. Nicholas K. MUTHUI
Ag. Chief Executive Officer
Tanathi Water Services Board
Republic of Kenya

ATTACHMENT

1. Acceptance of the Draft Final Report

The Kenyan side agreed and accepted in principle the contents and concepts of the Draft Final Report explained by the Team.

2. Japan's Grant Aid scheme

The Kenyan side understood Japan's Grant Aid Scheme and will undertake necessary measures and allocate necessary budget properly to secure the smooth implementation of the Project, as a preconditions for the Project to be implemented. Japan's Grant Aid Scheme and measures required are described in Annex 3 of the Minutes of Discussions signed by Japanese and Kenyan side (hereinafter referred to as the 'both sides') on November, 2009, which is also attached to the Draft Final Report of the Second Implementation Review Study.

3. Schedule of the Study

JICA will complete the final report in accordance with the items confirmed and send it to the Kenyan side by the end of March, 2011.

4. Responsible and Implementing Agencies

The responsible agency is the Ministry of Water and Irrigation (MOWI) and the implementing agency is Tanathi Water Services Board (TAWSB).

5. Other Relevant Issues

(1) Project Cost Estimate

The Team explained to the Kenyan side the project cost estimate as is attached in Annex 1. Both sides confirmed that the estimated cost was provisional and would be examined further by the Government of Japan for its final approval.

Furthermore, both sides confirmed that the estimated project cost should never be duplicated in any form nor disclosed to any other party(s) until the relevant contracts are awarded by the Ministry of Water and Irrigation. This confinement must be abided by for securing the fairness of tender procedure.

The Team also explained the estimated project cost to be borne by the Kenyan side as is shown in Annex 1(B). JICA then requested the Kenyan side to secure necessary counterpart budget for the project implementation and the Kenyan side accepted it.

(2) Final Components of the Project

The Team explained that the Government of Japan would examine the components of the Final Report of the Second Implementation Review Study of the Project and the final components would be decided afterwards by the Government of Japan.

The Kenyan side understood and agreed to the explanation above.

(3) Operation and Maintenance of the Project

Although the Kenyan side has a plan to delegate the operation and maintenance of water supply facilities to Water Service Providers (WSP), the plan has not been completed yet in the project site. The soft-component of the Project will, therefore, aim to fortify the operation and maintenance ability of the Water Users Associations (WUA) and TAWSB in the Project sites concerned.

The estimated cost of the operation and maintenance of the water supply facilities constructed by the Project is shown in Annex 2 and the Kenyan side agreed to bear all the cost on its own responsibility.

(4) Well Construction Procedure in the Detailed Design and Implementation Stage

The Team explained to the Kenyan side the selection criteria of handpump facilities (level 1) and motorised facilities (level 2) which would be applied in the implementation stage (detailed design study and construction). The criteria are shown in Annex 3 and the Kenyan side agreed to it.

(5) Study Title

The Team explained that the Study title has changed from the 'Implementation Review Study on the Project for Rural Water Supply' to the 'Second Implementation Review Study on the Project for Rural Water Supply', and the Kenyan side accepted it.

(6) Other Obligations of the Kenyan Side

In addition to the relevant issues above, both sides confirmed the obligations of the Government of Kenya and the Kenyan side committed to undertake the responsibility for the respective items as attached in Annex 4.

(7) Tentative Schedule of the Project

The Team explained that the final project schedule will be determined in accordance with Japanese Government and both sides confirmed the tentative schedule as contained in attached Annex 5.

End

Annex 1: Project cost estimation
Annex 2: Operation and Maintenance Cost
Annex 3: Well Construction Procedure in the Detailed Design and Implementation Stage
Annex 4: Obligations of the Kenyan Side
Annex 5: Tentative Schedule of the Project

Annex-1: Project cost estimation

This Page is closed due to the confidentiality.

Annex 2: Operation and Maintenance Cost

The operation and maintenance (O&M) costs for the level 1 facilities with handpump and level 2 facilities with windmill, generator, commercial power and solar system are shown in the following tables. Those costs shall be borne by WUAs, WSP, or TAWSB.

Operation and Maintenance Cost and Replacement Cost for Each Afridev Handpump Facility (Level-1)

Item	Life span	Price (Ksh)	Annual cost* (Ksh/year)
Replacement Cost			
Assemble parts for main body (Handles, Riser pipes etc)	8	53,950	6,750
O&M			
Spare parts for cylinder (Plunger rods etc.)	4	8,422	2,110
Movable spare parts (U-seal, O-ring etc.)	1	1,930	1,930
Item	Unit	Price (Ksh)	Annual cost* (Ksh/year)
Personnel and miscellaneous			
Handpump operator	Year	2,000	24,000
Miscellaneous	Year	400	4,800
Total			39,590

* : Annual inflation is not considered.

Operation and Maintenance Cost for Each Water Supply Facility with Submergible Pumps and Generators (Level-2)

No.	District	Division	Location	Sub-location	Community	Annual cost*
Larger Makueni						
96A	Makueni	Wote	Kikumini	Kambimawe	Muambani	411,724
98A	Makueni	Wote	Muvau	Kitonyoni	Kyuswani	410,182
127A	Mukaa	Malili	Ngaamba	Itumbule	Kalembwani (Uvunye)	410,182
137A	Nzaui	Nguu	Kikulumi	Ndunguni	Mbulutini	412,846
Larger Machakos						
151A	Masinga	Masinga	Kivaa	Kivaa	Kamunyu Primary School	410,182
156A	Yatta	Yatta	Kithimani	Kithimani	Kithayoni (Kwakoko Pri. Sch)	411,724
158	Yatta	Yatta	Mavoloni	Kisiiki	Mavoloni-Kisiiiki	600,664
163	Yatta	Katangi	Kyua	Syo Kisinga	Matinga	494,540
167	Kathiani	Kathiani	Mitaboni	Kinyau	Mukukuni	444,028
172	Mwala	Mwala	Uvaini	Embui	Mumbuni	413,406
173A	Machakos	Mwala	Kathama	Katitu	Kalama	411,023
177	Mwala	Mwala	Mwala	Myanyani	Kwendana S/H/Group	438,982

No.	District	Division	Location	Sub-location	Community	Annual cost*
178A	Machakos	Mwala	Kyawango	Kyawango	Misuuni	444,169
180	Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyandu(Meka)	629,464
183	Mwala	Yathui	Miu	Makuhimo	Miu Sec School	571,723
186	Mwala	Yathui	Miu	Kyawikyo	Nzeveni	415,228
187A	Mwala	Yathui	Wamunyu	Kilembwa	Mikameni	444,169
188A	Masinga	Ndithine	Muthesya	Kikule	Muambani	441,646
191A	Masinga	Ndithini	Mananja	Mananja	Kyaume	444,169
195A	Machakos	Ndithini	Mananja	Mananja	Ndela	410,182
197	Masinga	Ndithini	Ndithini	Milaani	Militani	410,883
Total						9,481,116

* : Annual inflation is not considered.

Operation and Maintenance Cost for Each Water Supply Facility with Submergible Pumps and Commercial Power (Level-2)

No.	District	Division	Location	Sub-location	Community	Annual cost*
Larger Makueni						
133	Mukaa	Kasikeu	Kasikeu	Wathini	Mangala	106,976
Larger Machakos						
189	Masinga	Ndithine	Ndithini	Ndithini	Ndithini Sec School	141,058
Total						248,034

* : Annual inflation is not considered.

Operation and Maintenance Cost for Each Water Supply facility with Submergible Pump and Solar System (Level-2)

No.	District	Division	Location	Sub-location	Community	Annual cost*
Larger Makueni						
121	Mbooni east	Kalawa	Katengine	Ititu	Ititu	114,641
123	Mbooni east	Kalawa	Kawala	Mbukoni	Ngunini	114,641
142	Kibwezi	Mtito Adei	Nthunguni	Nthingumi	Utu	114,641
Larger Machakos						
162	Yatta	Katangi	Kyua	Kyua	Kikeneani	114,641
200	Machakos	Central	Kalama	Nziuni	Kyamutheke	114,641
Total						573,205

* : Annual inflation is not considered.

Operation and Maintenance Cost for Water Supply Facility with a Windmill Pump (Level-2)

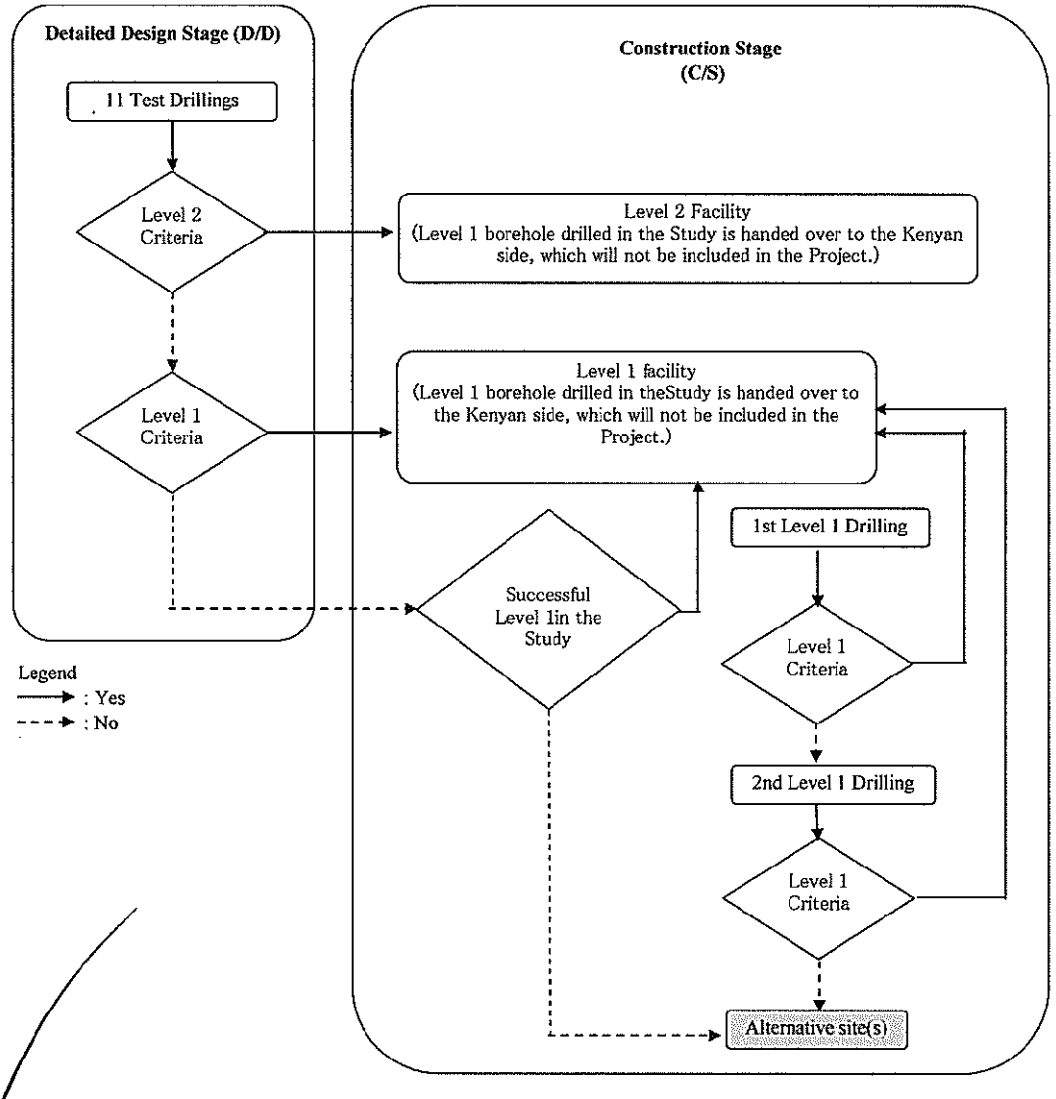
Item	Annual cost* (Ksh/year)
Windmill pump for replacement (Reserve)	222,036
Spare parts for windmill pump	26,711
Personnel and miscellounenous	
Kiosk attendant and guard for pump house	48,000
Miscellounenous	9,600
Total	306,347

* : Annual inflation is not considered.

Annex 3: Well Construction Procedure in the Detailed Design and Implementation Stage

Through the implementation review studies, eighteen (18) wells for motorised facilities and one (1) well for handpump facility have been secured. During the detailed design, eleven (11) wells will be test-drilled. The following diagram shows the well construction procedure in the detailed design study and implementation stage.

Twenty nine (29) Level 1 sites originally requested by the Kenyan side will be drilled in the construction stage. The number of Level 1 sited might increase according to the number of unsuccessful Level 2 test drilling.



Annex 4: Obligations of the Kenyan side

(a) to secure lots of land (e.g. wells, reservoir tanks, water kiosks, transmission and distribution pipes, pump facilities, public taps, access roads, warehouse, stockyards, etc.) necessary for the implementation of the Project and to clear the sites;

(b) to provide facilities for distribution of electricity (one in Larger Machakos and one in Larger Makueni), water supply and drainage and other incidental facilities necessary such as fencing, gates, and exterior lighting for the implementation of the Project outside the sites referred to in (a) above;

(c) to ensure prompt unloading and customs clearance of the products at ports of disembarkation in Kenya and to assist internal transportation of the products therein;

(d) to ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Kenya with respect to the purchase of the products and the services be exempted without delay;

(e) to accord Japanese nationals whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into Kenya and stay therein for the performance of their work;

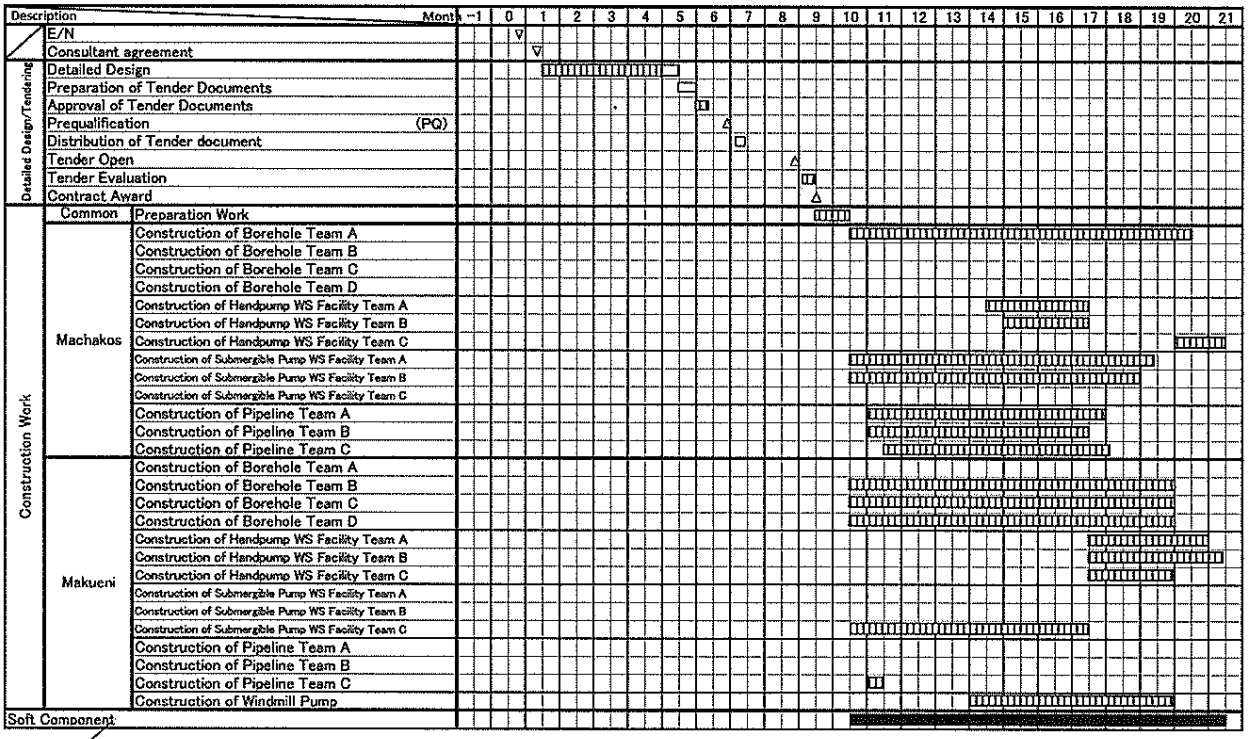
(f) to ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project;

(g) to obtain any permissions for environmental impact analysis from the National Environment Management Authority and for construction matters from an authority concerned;

(h) to bear all the expenses above except for those covered by the Grant, which are written in Chapter 3 of the Draft Final Report of the Project as the necessities for its implementation; and

(i) to give due environmental and social consideration in the implementation of the Project.

Annex 5: Tentative Schedule of the Project



Minutes of Discussion on Technical Note
for Implementation Review Study
on the Project for Rural Water Supply
in the Republic of Kenya
(2nd Year)

The JICA Study Team has explained the contents of Technical Note, and the contents were accepted by Ministry of Water and Irrigation (MoWI). The MoWI and JICA Study Team agreed through the discussion that these contents should be finalized on the basis of further studies and analysis in Japan for data and information collected through the field survey.

The following issues were discussed in the Meeting:

(1) Affected borehole sites

After this field survey was commenced, it was confirmed that three sites were drilled by NGOs and Government of Kenya.

The site numbers are 131, 140 and 190, and 190 was one of Test drilling site. The number of Test drilling sites in 2nd year was therefore changed from 19 to 18. The alternative sites to these three (3) were set up, and all of them were determined as Handpump sites to avoid risk of design change in implementation stage.

(2) Introduction of Commercial power supply

The JICA Study team carried out cost estimate for introduction of commercial power supply at the suitable sites in cooperation with Kenya Power and Lighting Company (KPLC). According to KPLC 's cost estimate, it costs around Ksh 0.8 million at present.
The amount for the introduction can be budgeted by MoWI.

(3) Status of constructed boreholes in Test drilling

Through 1st and 2nd year of the implementation review study, test drilling including pumping test to existent boreholes was carried out. In 1st year, eight (8) boreholes were drilled and capped, and four (4) existent boreholes were subjected to test pumping. In 2nd year, 10 boreholes were drilled and capped. These boreholes are

handed over to MoWI. and MoWI is requested to conserve them. Out of them, boreholes considered as "Success" will be equipped with water supply facilities in implementation stage. Japanese side does not take responsibility of defects of these constructed boreholes in test drilling.

(4) Role of Tanathi Water Service Boards (TAWSB)

Under the Project for Rural Water Supply, TAWSB fills the role of the implementation agency. TAWSB is requested to take the necessary measures including involvement of his district water offices concerned for smooth operation of the Project

(5) Assessment by National Environment Management Authority (NEMA) and Drilling permit

Kenyan side should ensure the Project is cleared by NEMA and the drilling permits obtained.

(6) Access road to drilling points

Kenyan side should ensure access roads to drilling sites are prepared in time.

Nairobi, September 10, 2010

Mr. Hajime KAMO
Chief Consultant,
Implementation Review Study Team,
The project for Rural Water Supply

Eng. David Stower. CBS, OGW
Permanent Secretary
Ministry of Water and Irrigation

MINUTES OF DISCUSSIONS
IMPLEMENTATION REVIEW STUDY ON THE PROJECT FOR RURAL WATER SUPPLY IN THE REPUBLIC OF KENYA
(2^{nd} Year)

The Government of Japan decided to conduct an Implementation Review Study on the Project for Rural Water Supply in the Republic of Kenya (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Kenya the Implementation Review Study Team (hereinafter referred to as "the Team"), which is headed by Dr. Yuji MARUO, Senior Advisor, JICA, and is scheduled to stay in the country from June 28, 2010 to September 30, 2010.

The Team has held series of discussions with concerned officials of the Governments of Kenya and conducted a field survey in the study area.

In the course of discussions and field survey, both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Implementation Review Study Report.

Nairobi, July 1, 2010

丸尾祐治

Dr. Yuji MARUO
Leader,
Implementation Review Study Team,
Japan International Cooperation Agency (JICA)

Eng. David Stower, CBS, OGW
Permanent Secretary
Ministry of Water and Irrigation

Eng. Joseph Mutuku Nzesya
Chief Executive Officer,
Tanathi Water Services Board

ATTACHMENT

1. Inception Report

The contents of Inception Report, which the Team explained to the Kenyan side, was understood and accepted in principle by the Kenyan side.

2. Number of the Total Water Supply Schemes

The Team explained that the number of water supply schemes to be constructed in this project would be fifty eight (58) which consisted of both hand pump and motorized schemes. Those candidate sites are shown in Annex-1.

3. Study Framework

1) Site Investigation

The Team will conduct electric resistivity survey at selective sites out of nineteen (19) motorized scheme sites where borehole drillings were not conducted in the first year of the Study, and identify the exact locations for the test drilling. The Team will also conduct hydrogeological study at the twenty four (24) hand pump scheme sites as well.

2) Test Well Drillings for Motorized Schemes

The Team will drill the boreholes at nineteen (19) motorized scheme sites. The Team will proceed to design and cost estimation works at each successful well, which is defined in Table-1. The successful wells will be capped and handed over to the Kenyan authority after the Study.

The Kenyan side is responsible for the proper preservation of these wells until the implementation stage. While those wells with yield of less than 1,000 ℓ/hour but more than 330 ℓ/hour and suitable water quality for drinking will be developed for hand pump wells. These wells will be also capped and handed over to the Kenyan side.

No alternative village for motorized schemes will be considered for the unsuccessful motorized scheme sites.

3) Assignment of Counterpart Personnel

Water Resources Department, the Ministry of Water and Irrigation, will assign two hydrogeologist to work together with consultant members of the Team for the siting works of 19 test drilling and additional candidate sites.

Table-1 Handling of Drilled Boreholes

Yield (ℓ/hour)	Water Quality	Status
1,000 ≦ Yield	Suitable	**Successful** It will be utilized as a production well for motorized water facility in the implementation stage.
	Conditionally Suitable (*1)	**Successful** It will be utilized as a production well for motorized water facility with removal equipment in the implementation stage.
	Not suitable	**Unsuccessful** It will be backfilled and abandoned.
330 ≦ Yield < 1,000	Suitable	**Successful** It will be utilized as a production well for hand pump in the implementation stage.

	Conditionally Suitable	**Successful** (it will be utilized as a production well for hand pump with removal equipment in the implementation stage)
	Not suitable	**Unsuccessful**
Yield < 330	-	**Unsuccessful**

*1: If some chemical items (ex. Fe, Mn) are detected at more than WHO guideline's level, the well will be considered as the successful one as long as the water is treatable with simple supplementary facilities which the community is able to manage.

4) Choice of Power Source for Motorized Schemes

The most suitable power source for the motorized schemes will be selected from ①commercial grid, ②solar cell and ③diesel generator in accordance with following conditions;

(i) Beneficiary's ability and/or willingness to pay for the Operation and Maintenance (O/M),
(ii) Capacity of well (head, safe yield),
(iii) Availability of technical support in O/M,
(iv) Availability of spare parts,
(v) Cost/Benefit Ratio (considering life-cycle cost, etc)
(vi) Population to be covered
(vii) and others.

4. A List of Alternative Villages for Hand Pump Schemes

If any successful wells are not found at candidate villages, the drilling work will be implemented at the alternative villages. Therefore the Team requested the Kenyan side to prepare a list of ten (10) alternative villages with priority 1 to 10 picked from Larger[1] Machakos District and also another list of twenty (20) alternative villages with priority 1 to 20 picked from Larger Makueni District.
The Kenyan side agreed with that and committed to submit the list to JICA Kenya Office by August 31st, 2010.
The Kenyan side explained that the Tana-Athi Water Services Board is responsible for putting priorities on the alternative village lists.

5. Schedule of the Study

(1) The consultant members of the Team will proceed to do further studies in Kenya until September 30, 2010.
(2) JICA will prepare the draft Implementation Review Study Report in English and dispatch a mission in order to explain its contents to the Kenyan side around December 2010.
(3) In case that the contents of the report are accepted in principle by the Kenyan side, JICA will finalize the report and send it to the Kenyan side around February 2011.

END

Annex-1: Candidate Sites of the Project

[1] Former "Makueni District" and "Machakos District" have since been subdivided into many districts after 2007. In this M/D, those districts have been referred to as "Larger Makueni District" and "Larger Machakos District" for convenience.

Annex-1: Candidate Sites of the Project

Candidate Sites of the Project

"IRS" Implementation Review Study, 1st IRS (Dec. 2005 to Jul. 2006), 2nd IRS (Oct 2009 to date)
"A". Alternative site to failed borehole in TD of 1st Phase
"TD". Test Drilling

" 1st Phase": 2nd IRS (Oct. 2009 to Mar. 2010) and "2nd Phase": 2nd IRS (Jun. 2010 to Feb. 2011)
"E": Commercial electricity, "G" : Generator, "H". Handpump, "S": Solar, "W": Windmill
"A": Applicable, "N/A": Not applicable

No.	S/N	Larger District	District	Division	Location	Sub-location	Village/Community Name	Coordinates		Population in 2nd IRS	TD in 1st Phase			TD in 2nd Phase of 2nd IRS (Targeted site)
											Drill'g	Pum'g	Result	
1	96A	Makueni	Makueni	Wote	Kikumini	Kambimawe	Muambani	S1°48'33"	E37°39'43"	730	●	●	N/A	
2	98	Makueni	Makueni	Wote	Muvau	Muvau	Nguumo	S1°53'58"	E37°39'09"	1,500				✔
3	100	Makueni	Makueni	Wote	Kako	Kako	Kyaume	S01°43'05.6"	E37°39'51.6"	1,751				
4	102	Makueni	Makueni	Kaiti	Ukia	Kikila	Kithunzi	S01°45'50.4"	E37°33'25.1"	833	●	●	A	
5	107	Makueni	Mbooni east	Kisau	Waia	Usalala	Kyang'ondu Primary	S01°37'54.2"	E37°35'31.9"	1,513				
6	108	Makueni	Mbooni east	Kisau	Kisau	Usalala	Kisau Health Centre	S01°37'52.9"	E37°33'46.9"	1,261				
7	110A	Makueni	Nzaui	Matiliku	Kilili	Wee	Kanzili	S1°56'32"	E37°36'24"	735	●	Dry	N/A	
8	111A	Makueni	Nzaui	Matiliku	Kilili	Kilili	Syaolwe	S1°53'45"	E37°35'16"	350	●	Dry	N/A	
9	112A	Makueni	Nzaui	Matiliku	Kilili	Mulenyu	Loyal turban	S1°57'12"	E37°37'49"	1,555	●	Dry	N/A	
10	113	Makueni	Nzaui	Matiliko	Kilili	Mulenyu	Mboani	S01°55'16.2"	E37°34'36.5"	723				
11	114	Makueni	Nzaui	Mbitini	Mulala	Ng'ethe	Kitandi	S1°58'20"	E37°31'06"	3,000				
12	118	Makueni	Nzaui	Mbitini	Mulala	Ngetha	Kitandi	S01°58'04.7"	E37°31'06.5"	4,308				
13	121	Makueni	Mbooni east	Kalawa	Katengme	Ititu	Ititu	S01°44'22.5"	E37°43'35.3"	1,681				✔
14	123	Makueni	Mbooni east	Kalawa	Kawala	Mbukoni	Ngunmi	S01°37'34.0"	E37°40'17.6"	326	-	●	A	
15	124	Makueni	Mbooni east	Kalawa	Athi	Miangeni	Kyamutuku	S01°37'23.9"	E37°45'06.2"	630				
16	127	Makueni	Mkaa	Malili	Kiima-Kiu	Ngaamba	Kwekolya	S01°54'10.9"	E37°10'02.6"	3,131				✔
17	128A	Makueni	Mukaa	Kilome	Mukaa	Mukaa	Enzae-Maiani	S1°50'16.7"	E37°19'13.2"	2,558	●	Dry	N/A	
18	130	Makueni	Mukaa	Kiou	Kwale	Kwale	Kima	S1°57'25"	E37°15'35"	2,502				
19	131	Makueni	Mkaa	Kiou	Kiou	Sultan	Kiou Village	S01°59'37.4"	E37°19'45.1"	1,569				
20	133	Makueni	Mkaa	Kasikeu	Kasikeu	Wathmi	Mangala	S01°54'59.6"	E37°19'58.7"	1,839	●	●	A	
21	134A	Makueni	Mukaa	Kiou	Muani	Muani	Nguuni	S1°57'46.9"	E37°24'20.2"	2,598	●	Dry	N/A	
22	137	Makueni	Nzaui	Nguu	Nguu	Thungui	Muangeni	S02°04'37.7"	E37°36'09.1"	1,681				✔
23	140	Makueni	Nzaui	Nguu	Wdwa	Wolwa	Mbukani	S02°09'21.4"	E37°38'15.3"	236				
24	142	Makueni	Kibwezi	Mtito Adei	Nthunguni	Nthingumi	Utu	S02°36'43.5"	E37°58'12.7"	328	-	●	A	
25	145	Makueni	Kibwezi	Mtito Adei	Ngnata	Mukange	Katulie S/Help Group	S02°28'26.6"	E38°09'24.3"	289				
26	146A	Makueni	Kibwezi	Mtito Andei	Kambu	Kitengei	Kietengei/Nguuswini	S2°32'50"	E38°09'01"	357	●	●	N/A	
27	148A	Machakos	Masinga	Masinga	Kangonde	Kangonde	Kangonde-Kyaani	S1°4'7.6"	E37°38'56.1"	1,174	●	Dry	N/A	
28	151	Machakos	Masinga	Masinga	Kivaa	Kivaa	Kamunyu Primary School	S00°50'36.4"	E037°44'33.5"	1,506				✔
29	152	Machakos	Masinga	Masinga	Kivaa	Ilani	City Cotton Village	S00°50'32.9"	E037°45'36.8"	581				
30	156	Machakos	Yatta	Yatta	Kithimani	Kithimani	Nguumo	S1°10'22.6"	E37°25'32.9"	2,907				✔
31	158	Machakos	Yatta	Yatta	Mavoloni	Kisiki	Mavoloni-Kisiiki	S1°4'46.8"	E37°26'52.0"	2,837				✔
32	162	Machakos	Yatta	Katangi	Kyua	Kyua	Kikeneani	S01°25'58.2"	E37°45'18.2"	3,012	●	●	A	
33	163	Machakos	Yatta	Katangi	Kyua	Syo Kisinga	Matinga	S01°26'42.2"	E37°42'04.1"	1,471	●	●	A	
34	164	Machakos	Yatta	Katangi	Kyua	Kyua	Ithithini Primary School	S01°28'08.5"	E37°43'59.1"	2,949				
35	165A	Machakos	Yatta	Yatta	Ndalani	Ndalani	Ndalani (Sec. School)	S1°5'56.1"	E37°29'10.9"	2,522	●	Dry	N/A	
36	166	Machakos	Kathiani	Kathiani	Mitaboni	Mumbuni	Miwani	S01°20'58"	E37°16'18"	2,592				
37	167	Machakos	Kathiani	Kathiani	Mitaboni	Kinyau	Mukukuni	S01°20'11.8"	E37°16'30.8"	3,362	●	●	A	
38	172	Machakos	Mwala	Mwala	Masii	Embui	Mbele	S01°23'29.6"	E37°31'33.2"	2,766				✔
39	173	Machakos	Mwala	Mwala	Masii	Mbaani	Kathama	S01°12'10.6"	E37°22'38.8"	1,663				✔
40	175	Machakos	Mwala	Mwala	Mango	Wetaa	Mango Sec School	S01°23'38.9"	E37°25'26.5"	1,996				✔
41	177	Machakos	Mwala	Mwala	Mwala	Myanyani	Kwendana S/H/Group	S01°13'52.2"	E37°23'04.0"	1,576	●	●	A	
42	178	Machakos	Mwala	Mwala	Kyawango	Kyawango	Kyawango	S1°18'58.7"	E37°29'10.1"	1,962				✔
43	180	Machakos	Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyamuanyani(Meka)	S01°24'23.9"	E37°20'40.9"	2,206				✔
44	183	Machakos	Yathui	Mwala	Miu	Makuhimo	Miu Sec School	S01°31'29.0"	E37°34'51.5"	1,663	-	●	A	
45	184	Machakos	Mwala	Yathui	Wamunyu	Kambiti	Munyuni	S01°30'25.9"	E37°35'12.4"	1,786				
46	185A	Machakos	Mwala	Yathui	Miu	Kikulumi	Kikulumi	S01°31'37"	E37°35'12"	3,748	●	Dry	N/A	
47	186	Machakos	Mwala	Yathui	Yathui	Kyamatula	Lema Girls Sec School	S01°27'23.7"	E37°34'36.5"	1,436				✔
48	187	Machakos	Mwala	Yathui	Wamunyu	Kilembwa	Kilembwa	S01°20'31.9"	E37°32'03.0"	1,611				✔
49	188	Machakos	Masinga	Ndithine	Muthesya	Kikule	Muambani	S00°58'00.4"	E037°25'12.4"	1,135				✔
50	189	Machakos	Masinga	Ndithine	Ndithini	Ndithini	Ndithini Sec School	S00°56'44.3"	E37°19'54.9"	2,364				✔
51	190	Machakos	Masinga	Ndithine	Muthesya	Muthesya	Munyiiki	S00°58'33.7"	E37°22'49.6"	1,576				✔
52	191A	Machakos	Masinga	Ndithini	Mananja	Mananja	Mananja-Ndeka	S0°51'02.6"	E37°17'17.3"	2,871	●	Dry	N/A	
53	195	Machakos	Masinga	Ndithine	Mananja	Mananja	Thayu wa Ndeka	S00°51'30.5"	E37°16'38.2"	1,716				✔
54	196A	Machakos	Masinga	Ndithini	Ndithini	Mikaani	Mikaani-Ngweye	S0°52'44.7"	S37°23'05.3"	1,156	●	Dry	N/A	
55	197	Machakos	Masinga	Ndithini	Ndithini	Mikaani	Militani	S0°52'47.7"	E37°24'35.8"	2,819				✔
56	198	Machakos	Machakos	Kalama	Kombo	Muumandu	Kavete	S1°40'45"	E37°16'42"	2,119				
57	199	Machakos	Machakos	Kalama	Kola	Iyuni	Iyuni	S01°41'13.3"	E37°19'44.5"	2,101				
58	200	Machakos	Machakos	Central	Kalama	Nziuni	Kyamutheke	S01°32'08.5"	E37°10'12.6"	2,346	-	●	A	

MINUTES OF DISCUSSIONS
IMPLEMENTATION REVIEW STUDY ON THE
PROJECT FOR RURAL WATER SUPPLY
IN THE REPUBLIC OF KENYA

The Government of Japan decided to conduct an Implementation Review Study on the Project for Rural Water Supply in the Republic of Kenya (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Kenya the Implementation Review Study Team (hereinafter referred to as "the Team"), which is headed by Dr. Yuji MARUO, Senior Advisor, JICA, and is scheduled to stay in the country from October 27, 2009 to February 14, 2010.

The Team has held series of discussions with concerned officials of the Governments of Kenya and conducted a field survey in the study area.

In the course of discussions and field survey, both sides confirmed the main items described on the attached sheets. The Team will proceed to further works and prepare the Implementation Review Study Report.

Nairobi, November 4, 2009

丸尾祐治

Dr. Yuji MARUO
Leader,
Implementation Review Study Team,
Japan International Cooperation Agency (JICA)

Eng. David Stower, CBS, OGW
Permanent Secretary
Ministry of Water and Irrigation

Eng. Joseph Mutuku Nzesya
Chief Executive Officer,
Tanathi Water Services Board

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve the health and living conditions of the people of Kenya by providing potable water through the construction of water supply facilities.

2. Responsible and Implementing Agencies

(1) The Responsible Agency is the Ministry of Water and Irrigation (MoWI).
(2) The Implementing Agency of the Project is Tanathi Water Services Board (WSB)

3. Study Sites

The Kenyan side explained that the original target sites of the Study were thirty one (31) submersible pump schemes, Seven (7) windmill pump schemes, Eighteen (18) hand pump schemes and installation of submersible pump for Two (2) existing boreholes in Larger Machakos and Larger Makueni Districts[1] which is shown in Annex-1.
The Kenyan side and the Team (hereinafter referred to as "both sides") confirmed that, the Project Sites to be implemented would be examined in accordance with the further studies and analysis in Japan. The final components of the Project would be confirmed by both sides later when JICA send the Draft Report Explanation Team to Kenya and the finalized component of the Project would be submitted to the Government of Japan for approval.
The Team requested the Kenyan side to revise the list of original alternative sites which is shown in Annex-2 and submit the revised list to JICA Kenya Office by the end of November, 2009.

4. Japan's Grant Aid Scheme

The Kenyan side understood that the Japan's Grant Aid Scheme and the necessary measures to be taken by the Kenyan side as explained by the Team and described in Annex-3.

5. Schedule of the Study

(1) The consultant members of the Team will proceed to do further studies in Kenya until February 14, 2010.
(2) JICA will prepare the draft Implementation Review Study Report in English and dispatch a mission in order to explain its contents to the Kenyan side around May 2010.
(3) In case that the contents of the report are accepted in principle by the Kenyan side, JICA will finalize the report and send it to the Kenyan side around July 2010.

6. Other Relevant Issues

(1) Inception Report
The contents of Inception Report, which the Team explained to the Kenyan side, was understood and accepted in principle by the Kenyan side.

(2) Handling of drilled boreholes
1) Test Drilling during the Study

[1] Former "Makueni District" and "Machakos District" have since been subdivided into many districts after 2007. In this M/D. those districts have been referred to as "Larger Makueni District" and "Larger Machakos District" for convenience.

2/11

Eighteen (18) test drilling will be carried out during the Study at the candidate sites for windmill and submersible pumps.
Both side agreed that all the seven (7) candidate sites for windmill would be prioritized for the test drilling, and remaining eleven (11) test drilling sites would be selected according to following criteria;

a) Larger target population
b) Severe hydrogeological condition

A balance will be maintained as much as possible for the testing sites between Larger Machakos and Larger Makueni districts.

Successful boreholes will go for designing and cost estimation and they will be capped and maintained well by the Kenyan side until the implementation stage.

Failed boreholes will be handled as follows;

a) if the yield is less than 330ℓ/hour, it will be backfilled and abandoned.
b) if the yield is more than 330ℓ/hour and less than 600 ℓ/hour, the borehole will be earmarked for hand pump installation and will be completed in the implementation stage. The borehole will be capped and handed over to the Kenyan side in the Study stage.
c) if the yields is more than 600 ℓ/hour and less than 1,000 ℓ/hour, it will be examined whether it is suitable for solar pump system or not (the study policy of solar pump system is described hereunder) . If the borehole is not suitable for solar pump, the borehole will be earmarked for hand pump installation and will be completed in the implementation stage.

If test drilling failed at the windmill site, no further drilling for windmill would be carried out in the implementation stage then a) and b) above would be applied since the period required to do research on wind strength is longer than the Study period.

2) Principle of handling drilled borehole in the implementation stage.
The Team explained that the policy for handling drilled boreholes in the implementation stage as follows;

- A maximum of two drillings will be carried out at both submersible pump and hand pump sites in the implementation stage.
- If the first drilling cannot satisfy the criteria described in the Inception Report, the second drilling will be carried out. However, no further drilling will be conducted when the second borehole also fails to satisfy the criteria.
- Those failed boreholes will be designed for hand pump well if the yields are more than 330ℓ/hour.
- No alternative site for submersible pump will be considered. However, as for the hand pump candidate sites, alternative site from the same district will be taken from the revised list of the alternative sites.
- If the yield of the two boreholes for submersible scheme is less than 330 ℓ/hour, an alternative site will be drilled and installed with hand pump.

(3) Modification of existing design of the Project
The Team explained that existing design might be modified in accordance with current conditions of target villages.
The Team also explained that among eighteen (18) test drilling sites, if any sites were recognized to

be suitable for installing solar pumps, the design would be converted to solar pumps. However, no solar pumps are assumed in the remaining candidate sites during the implementation stage.
The Kenyan side requested to install as many solar pumps as hydrogeological, social and budgetary conditions allows to do so.
In response to the request, the Team replied that the decision whether to install more solar pumps or not would be made after analyzing the result of the test drilling.

(4) Target year of the Project
The Team explained that the target year of population projection would be 2011.
The Kenyan side understood it.

(5) Modality of Operation and Maintenance (O&M)
The Team recognized that under the conditions of Water Sector Reform which started in 2002, O&M of water supply schemes would be supposedly carried out by Water Services Providers (WSPs) which is entrusted by Water Services Board. However, since no WSP is established in the target area, Water Users Associations (WUAs) organized by village people are actually taking responsibilities for O&M of rural water supply schemes.
Considering that situation, the Team explained that technical assistance (so called "Soft Component") of the Project for O&M would be designed for WUAs.
The Kenyan side agreed with it.

(6)Arrangements of the Kenyan side
As a response to the request by the Team, the Kenyan side agreed to provide necessary number of counterpart personnel for the study if and when required and also provide all the data and information relevant to the Project for the smooth implementation of the study.

(7) Avoidance of duplication with other projects.
The Team requested the Kenyan side that any of the candidate sites would not be overlapped with any other project supported by other donor agencies, NGOs and Kenyan official organization(s).
The Kenyan side explained that the Study results would determine the most appropriate areas of intervention to avoid unnecessary overlap.

(8) Careful Handling of the Study Reports
The Team explained that certain information in both the draft and the final reports of the Study should be dealt with confidentially until the tender would be closed when the project would proceed to actual implementation stage, since disclosure of the information would affect fairness of tender procedure.
The Kenyan side understood the sensitivity in dealing with the study reports and agreed on careful handling of the reports for achieving fair tendering.

END

Annex-1: Original Target Sites of the Study
Annex-2: Original Alternative Sites of the Project
Annex-3: Japan's Grant Aid Scheme / Major Undertakings to be taken by Each Government

Annex-1

Target Sites of the Study

List of Target communities

This list does not include planned B/H to be drilled or presence of water supply plan by other parties.
"Beneficiary" is derived from Basic design in 2004.

No.	S/N	Village/Community Name	Larger District	Old division	Beneficiary	Pump type	Status (by TANATHI WSB as of Oct. 2009)	Note
1	96	Muambani	Makueni	Wote	2,100	S/P	Not Drilled	Kiosk 50m away from scheduled B/H point
2	98	Kithundi	Makueni	Kaiti	1,000	S/P	Not Drilled	Drilled B/H by NWC&PC, 1.1km away from scheduled B/H point
3	100	Kyaume	Makueni	Wote	300	H/P	Not Drilled	
4	102	Kithundi	Makueni	Kaiti	1,000	W/P	Not Drilled	
5	107	Kyang' ondu Primary	Makueni	Kisau	300	H/P	Not Drilled	
6	108	Kisau Health Centre	Makueni	Kisau	660	H/P	Not Drilled	
7	110	Kanzili	Makueni	Matiliku	800	S/P	Not Drilled	
8	111	Kilili Secondary School	Makueni	Matiliku	700	W/P	Not Drilled	Kilili Sec. school is provided with stream water and Water tank for the community was constructed.
9	112	Mulenyu	Makueni	Matiliku	1,300	S/P	Not Drilled	
10	113	Mbooni	Makueni	Matiliku	600	H/P	Not Drilled	
11	114	Wemyatu	Makueni	Matiliku	4,500	S/P	Not Drilled	
12	118	Kiumoni Market	Makueni	Mbitini	360	H/P	Not Drilled	
13	121	Ititu Sec School	Makueni	Kalawa	1,360	S/P	Not Drilled	Marked point by other party around 5m away from scheduled B/H point
14	123	Ngunini	Makueni	Kalawa	500	H/P	Not Drilled	
15	124	Kyamutuku	Makueni	Kalawa	1,260	S/P	Not Drilled	
16	127	Kwekolya	Makueni	Kiome	1,500	S/P	Not Drilled	
17	128	Enzae	Makueni	Kilungu	850	S/P	Not Drilled	
18	130	Kwale Health Centre	Makueni	Kasikeu	800	W/P	Not Drilled	
19	131	Kiou Village	Makueni	Kasikeu	600	S/P	Not Drilled	
20	133	Mangala	Makueni	Kasikeu	2,100	S/P	Not Drilled	
21	134	Nguuni	Makueni	Kasikeu	1,800	S/P	Not Drilled	
22	137	Muangeni	Makueni	Nguu	300	H/P	Not Drilled	
23	140	Mbukoni	Makueni	Nguu	270	H/P	Not Drilled	
24	142	Utu	Makueni	Mtito Adei	275	H/P	Not Drilled	
25	145	Katulie S/Help Group	Makueni	Mtito Adei	280	H/P	Not Drilled	
26	146	Kitengei	Makueni	Mtito Adei	1,400	S/P	Not Drilled	
27	148	Kangonde Primary School	Machakos	Masinga	1,000	W/P	Not Drilled	
28	151	Kamunyu Primary School	Machakos	Masinga	1,500	S/P	Not Drilled	
29	152	City Cotton Village	Machakos	Masinga	800	S/P	Not Drilled	
30	156	Nguumo Primary School	Machakos	Yatta	700	S/P	Not Drilled	
31	158	Mavoloni Sec School	Machakos	Yatta	2,000	S/P	Not Drilled	
32	162	Kikeneani	Machakos	Katangi	1,800	S/P	Not Drilled	
33	163	Matinga	Machakos	Katangi	872	S/P	Not Drilled	
34	164	Utithini Primary School	Machakos	Katangi	800	H/P	Not Drilled	
35	165	Ndalani	Machakos	Yaata	2,400	S/P	Not Drilled	
36	166	Kwale Public	Machakos	Kathiani	600	W/P	Not Drilled	
37	167	Mukukuni Wp	Machakos	Kathiani	1,200	S/P	Not Drilled	
38	172	Mbele wp	Machakos	Mwala	1,380	S/P	Not Drilled	
39	173	Iembeni S/H/Group	Machakos	Mwala	1,800	H/P	Not Drilled	
40	175	Mango Sec School	Machakos	Mwala	595	H/P	Not Drilled	
41	177	Kwendana S/H/Group	Machakos	Mwala	1,000	S/P	Not Drilled	
42	178	Kyawango S/H/Group	Machakos	Mwala	1,800	S/P	Not Drilled	
43	180	Meka S/H/Group	Machakos	Kangundo	4,100	S/P	Not Drilled	
44	183	Mau Sec School	Machakos	Yathui	1,500	S/P	Drilled	Drilled but no facility as of Mar. 2008
45	184	Munyuni	Machakos	Yathui	600	H/P	Not Drilled	
46	185	Makulumi	Machakos	Yathui	800	W/P	Not Drilled	
47	186	Lema Girls Sec School	Machakos	Yathui	304	H/P	Not Drilled	
48	187	Kilembwa	Machakos	Yathui	700	S/P	Not Drilled	
49	188	Kyususioti	Machakos	Ndithini	800	S/P	Not Drilled	
50	189	Ndithini Sec School	Machakos	Ndithini	1,500	S/P	Not Drilled	
51	190	Munyiiki	Machakos	Ndithini	2,500	S/P	Not Drilled	
52	191	Manja Sec School	Machakos	Ndithini	1,260	S/P	Not Drilled	
53	195	Thayu wa Ndela	Machakos	Ndithini	600	H/P	Not Drilled	
54	196	Mitaani	Machakos	Ndithini	700	W/P	Not Drilled	
55	197	Manonja Centre	Machakos	Ndithini	1,200	S/P	Not Drilled	
56	198	Kya Walia Dispensary	Machakos	Kalama	2,000	H/P	Not Drilled	
57	199	Iyuni	Machakos	Kalama	1,000	H/P	Not Drilled	
58	200	Kyamutheke	Machakos	Kalama	2,250	S/P	Drilled	Drilled but no facility as of Mar. 2008

Annex-2

Alternative Sites of the Project

Series No	Data Sheet No	Alternative site for	Administration					Population	Pump Type
			District	Division	Location	Sub Location	Village Name		
1	Macha-1	Makukuni wp (No 167)	Machakos	Kathiani	Mitaboni	Kinyau	Syukinguni	2,250	Motor/Wind Pump
2	Macha-2	Makuliani (No 185)	Machakos	Yathui	Yathui	Kwakoli	Kwakavili	1,250	Motor/Wind Pump
3	Macha-3	Kilembwa (No 187)	Machakos	Yathui	Wamunyu	Kyawango	Mwasua	2,250	Motor/Wind Pump
4	Macha-4	Iyuu (No 199)	Machakos	Kalimo	Kola	Iyuu	Muvuu	1,800	Motor/Wind Pump
5	Macha-5	Kyuwalu Dispensary (No 198)	Machakos	Kalimo	Muumandu	Kyuwalu	Kyawalu	300	Hand Pump
6	Macha-6	Kakongo Village (No 159)	Machakos	Masinga	Ekalakala	Nzukini	Nzukini	1,750	Motor/Wind Pump
7	Macha-7	Ekalakala (No 150)	Machakos	Masinga	Ekalakala	Nzukini	Wendano	1,800	Motor/Wind Pump
8	Macha-8	Utithi Primary School (No 164)	Machakos	Kangundo	Kyua	Kyua	Itithini	800	Hand Pump
9	Macha-9	Kyumutheke (No 200)	Machakos	Kalama	Kathekakai	Kisanga	Kyumutheke	2,400	Motor/Wind Pump
10	Macha-10	Kwandini (No 153)	Machakos	Yatta	Matuu	Kanzalu	Kwandini	2,400	Motor/Wind Pump
11	Macha-11	Ndalani (No 163)	Machakos	Yatta	Ndalani	Ndalani	Ndalani Centre	2,500	Motor/Wind Pump
12	Macha-12	Ikombe (No 160)	Machakos	Yatta	Ikombe	Ikombe	Ikombe	1,500	Motor/Wind Pump
13	Macha-13	Utithi Primary School (No 164)	Machakos	Mwala	Mwala	Kivandini	Kivandini	4,000	Motor/Wind Pump
14	Macha-14	Masii Girls School (No 176)	Machakos	Mwala	Masii	Mbaani	Kawaa	2,400	Motor/Wind Pump
15	Macha-15	Lema Girls Secondary School (No 186)	Machakos	Mwala	Wamunyu	Mbaikini	Mbaikini	900	Hand Pump
16	Macha-16	Kyawango SHG (No 178)	Machakos	Mwala	Kyawango	Kanga	Kanga	2,000	Motor/Wind Pump
17	Macha-17	Newly added on 3rd Nov. 2009 by TANATHI WSB	Machakos				Kyangala market	3,200	
18	Maku-1	Uuu (No 125)	Makueni	Kalama	Kathukumbi	Kathukumbi	Kitoto	3,500	Motor/Wind Pump
19	Maku-2	Kiili Sec School (No 111)	Makueni	Matiliko	Nzau	Matiliko	Kukui	3,000	Motor/Wind Pump
20	Maku-3	Sukai (No 109)	Makueni	Kwale	Kiteta	Kakuswi	Ndethai	1,600	Motor/Wind Pump
21	Maku-4	Kambeani (No 103)	Makueni	Kathonzweni	Kanthuni	Kanthuni	Yeembondo	1,800	Motor/Wind Pump
22	Maku-5	Kasiku Market (No 129)	Makueni	Kasiku	Kasiku	Uvalani	Masaani	1,300	Motor/Wind Pump
23	Maku-6	Kisu Village (No 131)	Makueni	Kasiku	Kisu	Kisu	Ikuuni	1,500	Motor/Wind Pump
24	Maku-7	Ngaani (No 134)	Makueni	Kasiku	Kisu	Kisu	Mvuu	600	Hand Pump
25	Maku-8	Kwekeya (No 127)	Makueni	Kilome	Kiimaku	Ngaamba	Ngondu/Lamba	3,500	Motor/Wind Pump
26	Maku-9	Enzuu (No 128)	Makueni	Kilome	Kiimaku	Ngaamba	Kwa Ikeli	2,000	Motor/Wind Pump
27	Maku-10	Kithundi (No 98)	Makueni	Wote	Wote	Kasuu-Mawe	Kamba-Mawe	4,800	Motor/Wind Pump
28	Maku-11	Uuu Wa Wote (No 99)	Makueni	Wote	Wote	Mumbuni	Kathuuni	3,500	Motor/Wind Pump
29	Maku-12	Nthungu Pri School (No 108)	Makueni	Wote	Wote	Unoa	Nthungu Village	1,800	Motor/Wind Pump
30	Maku-13	Yindundu (No 141)	Makueni	Mtito Andei	Nzambani	Muthunguu	Mangukiu	1,800	Motor/Wind Pump
31	Maku-14	Nthungunu SHG (No 144)	Makueni	Mtito Andei	Nzambani	Muthunguu	Kwa Matundo	2,400	Motor/Wind Pump
32	Maku-15	Kaengei (No 146)	Makueni	Mtito Andei	Kambu	Kaengei	Kikumbo	1,400	Motor/Wind Pump
33	Maku-16	Kikumuu (No 138)	Makueni	Nguu	Mweini	Kiuu	Yikivumbu	2,500	Motor/Wind Pump
34	Maku-17	Newly added on 3rd Nov. 2009 by TANATHI WSB	Makueni				Kaungunu Pri School	2,450	
35	Maku-18	Newly added on 3rd Nov. 2009 by TANATHI WSB	Makueni				Kisau market	2,750	

Annex-3

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as part of this realignment, JICA was reborn on October 1, 2008. After the reborn of JICA, following the GOJ, Grant Aid for General Project is extended by JICA.

Grant Aid is non-reimbursable fund to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

Japanese Grant Aid is conducted as follows-

- Preparatory Survey (hereinafter referred to as "the Survey")
  - the Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by The GOJ and JICA, and Approval by the Japanese Cabinet
- Determination of Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- Implementation -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide a basic document necessary for the appraisal of the Project by JICA and the GOJ. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of agencies.concerned of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- Preparation of a basic design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA uses (a) registered consulting firm(s). JICA

selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

The Report on the Survey is reviewed by JICA, and after the appropriateness of the Project is confirmed, JICA recommends the GOJ to appraise the implementation of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the E/N will be signed between the GOJ and the Government of the recipient country to make a plead for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

The consultant firm(s) used for the Survey will be recommended by JICA to the recipient country to also work on the Project's implementation after the E/N and the G/A, in order to maintain technical consistency.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(4) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

The Government of recipient country is required to maintain and use the facilities constructed and the equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Export and Re-export"

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to

as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.

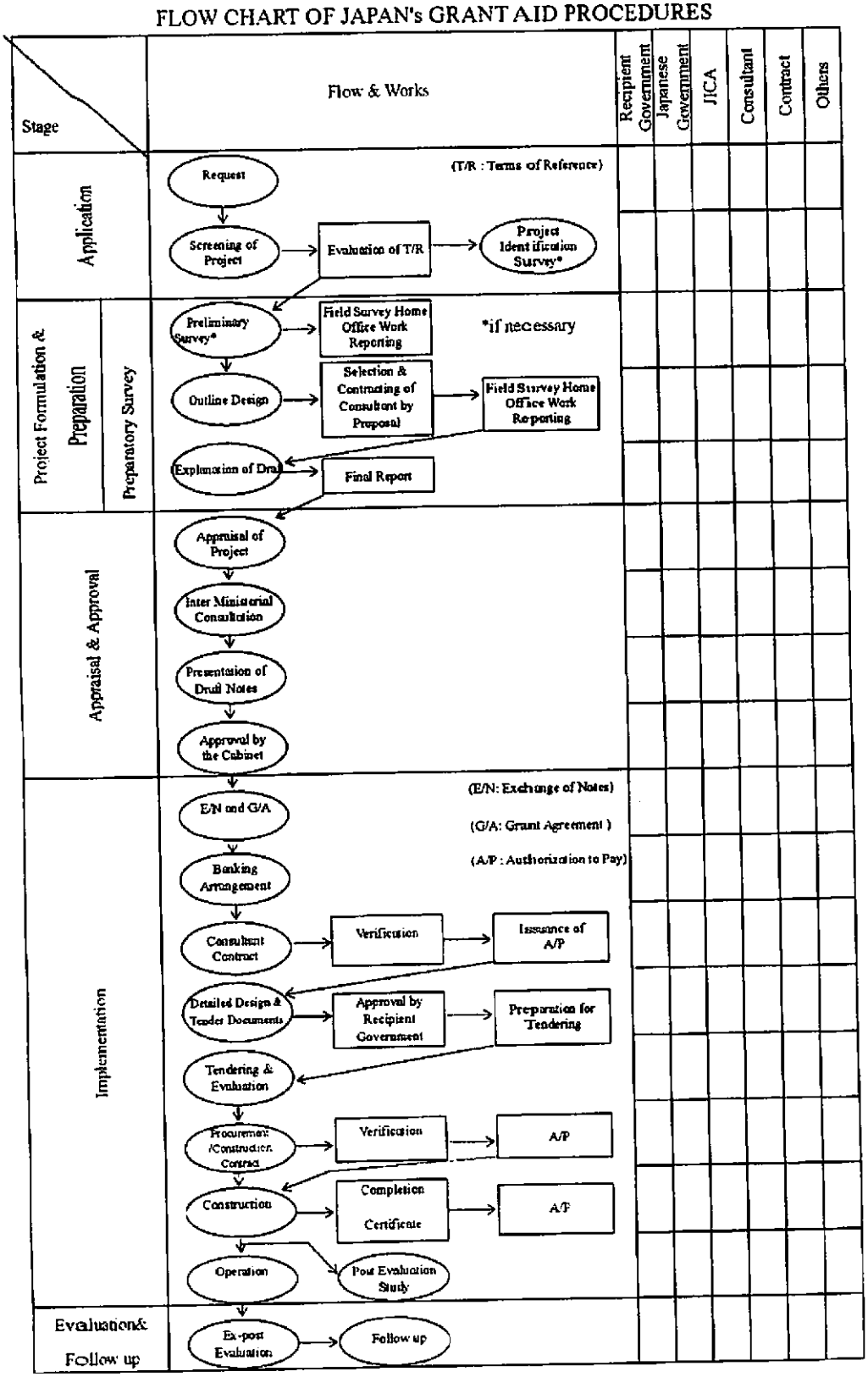
(10) Social and Environmental Considerations

A recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

(End)

Attachment 1 FLOW CHART OF JAPAN's GRANT AID PROCEDURES

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



Attachement-2

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the site		●
4	To construct the parking lot	●	
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the building	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the product site	(●)	(●)
10	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment.		●

Note

B/A : Banking Arrangement

A/P : Authorization to Pay

( ): To be discussed between the Study Team and Government of Kenya

Appendix-5
Soft Component (Technical Assistance) Plan

Soft Component (Technical Assistance) Plan

(1) Background of Soft Component

1) Project Component

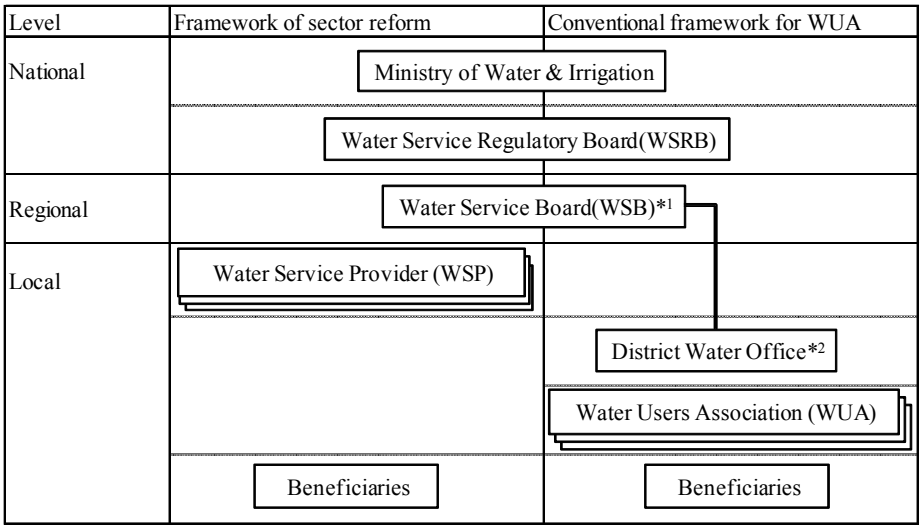
The Project aims to construct 58 sites of water supply facilities with boreholes in order to supply safe and stable water to the target area and to implement assistance for the establishment of WUAs in order to manage and maintain the facilities. Water supply facilities consist of 29 sites for hand pump, one site for windmill pump and 28 sites for submersible pump.

2) Background

For the improvement of inefficiencies of water/hygiene sector, it was proposed to initiate sector reforms by establishing an organization for decision-making on water resources development/management and water supply service, which are separate from the functions of the Ministry of Water and Irrigation under the National Water Policy in 1999. Afterward, the framework of the said sector reforms was constituted in Water Act 2002.

Water service boards (WSBs), which were established under Water Act 2002, are promoting contracts for water supply projects in accordance with new framework on water sector reform. Thus, they are arranging contracts with water service providers (WSPs) instead of the conventional framework where district water offices have been directing and assisting WUAs. The Project area is covered by TAWSB and consists of 11 WSPs in the area.

The main duties of WSBs under the new framework are: 1) to prepare a development plan on water supply and sewerage services and set up performance target, 2) to examine application of potential WSPs, and 3) to enforce regulation and tariffs on water services. WSPs shall obtain a business license from WSBs on service provision, through the preparation of a business plan. In the rural water supply service, NGOs, community-based organizations, and private sector organizations could become WSPs. The following Figure 1 shows the described framework:



***1**: 8 WSBs in Kenya

***2**: affiliated to WSB

Figure 1 New Framework on Sector reform and Conventional Framework for WUAs

The water supply facilities to be constructed by the Project will be basically transferred to

the WSB including ownership in the same manner as with other water supply facilities owned by the Government of Kenya. Then, WSP, which concluded contract with the WSB, will operate and maintain these water supply facilities and services.

However, it is difficult, in terms of low profitability and public welfare, for private enterprises as WSPs to manage isolated water supply facilities in rural areas. Such facilities, therefore, have mostly been taken out of the above new framework. WUAs have been still operating them while district water office of WSB provides them with necessary assistance. District water office with its special budget distributes, repairs, purchases and installs pumps, generators etc., for the water supply facilities which are operated by WUAs. District water office is also conducting countermeasures against drought, supplying free fuel to WUAs and contributing to reduction of water fees.

TAWSB has a policy that WSPs operate all water supply facilities through the transition from WUAs to WSPs or WUAs' affiliation with WSPs. However, the implementation method remains undecided. This situation has not been changed since the completion of construction of Phase 1/2 in March 2008. Therefore, in the soft component of the construction work for Phase 1/2, it was proposed that O&M bodies of water supply facilities shall be clarified.

As for rural water supply facilities, they may be difficult to be operated and maintained by a private sector, taking into account their low profitability and public undertaking of water supply services. Therefore, cooperation among WSB, WSP licensed by WSB and WUA will be necessary to realize sustainable O&M of the facilities.

As a result of the social survey in the Study, 100% of the villagers in the target community exhibit willingness to pay for water and participate in O&M activities through WUA. It appears that their intention to participate in the activity is high. However, it was observed that some community members lack willingness to pay for water, an understanding of users-pay-principle, and willingness to participate in O&M. Most of the target communities have no supply facilities, and therefore, have little experience on operation and maintenance of water supply facilities in a systematic or organized manner. In addition, water supply facilities to be constructed under the Project include hand pump, windmill pump, submersible pump with generator, commercial power and solar panel, and with or without pipeline. Thus, required knowledge, capacity and techniques are different.

It is therefore recognized that intervention to increase participation in and capacity of independent O&M, through implementation of this soft component, is indispensable to enhance sustainability of the Project.

It is further noted that lack of awareness among target communities on water quality of existing water sources was revealed in the socioeconomic survey. It was noted that there was a considerable number of respondents preferring the existing/traditional water sources during the rainy season, even if improved water supply facilities are provided under the Project.

3) Issues for Planning Soft Component

3-1) Local Administration

TAWSB's policy on substituting WSP with WUA is not immediately realized. Meanwhile, district water office of TAWSB has been assisting the present WUAs. Therefore, this soft component targets district water and sanitation team (DWST), which is composed of administration officers concerned at the district level. Hence, technical guidance is undertaken by DWST under the soft component.

3-2) Target Communities

Soft component at community level focuses on capacity building of WUA. However, transition from WUA to WSP shall be noted, and cooperation among aforementioned WSB, WSP and WUA shall be examined in order to facilitate adjustment to the new institutional framework under the sector reform.

3-3) Willingness and Ability of Community to Participate in O&M

For achieving expected output on health and sanitation improvement by the Project, enhancement of community awareness on water quality is necessary. In addition, the number of users for the improved water supply facilities would decrease in the rainy season, which will result in the decrease of fee collection and could affect sustainable operation of the facilities. Therefore, from the viewpoint of sustainability of the Project, implementation of activities to increase awareness of communities on health and sanitation aspects shall be essential.

(2) Target of the Soft Component Program

There are several issues pertaining to inadequate O&M in the Project area, including: 1) a less mature sense of ownership and willingness to participate in O&M based on the users-pay-principle, 2) lack of knowledge and skills for community-based O&M, 3) lack of awareness in health and sanitation, and poorer understanding of the correlation between personal health and use of safe water, and 4) inadequate support to the communities by the local administration for establishment of community-based O&M systems.

In undertaking countermeasures for these problems and issues, the soft component aims to establish the basis for a community-based O&M system.

(3) Expected Output of the Soft Component Program

Outputs expected through the implementation of the program are as follows:

1) Improved sense of ownership and participation
2) Enhanced capacity and skills of local administration to support communities for establishment of community-based O&M and retention of these skills in the concerned organizations
3) Enhanced capacity of the target communities in the O&M of the improved water supply system
4) Increased awareness on personal health and sanitation, and understanding of correlation between personal health and use of safe water

(4) Means of Verification to Assess the Achievement Set as Output

The means of verification to assess the achievement set as expected output are outlined below:

Output 1) Sense of ownership and participation are improved.

Participatory community assessment is undertaken in each target community under the Project after drilling work is deemed successful. This will employ participatory methods such as participatory rapid appraisal (PRA) to identify and analyze the problem of communities in health and sanitation aspects, and O&M.

This community assessment results in the preparation of a community action plan (CAP), which determines required actions and input, time framework, and indicators to verify achievements. Degree of improved community awareness can be confirmed through the achievement of CAP based on quarterly reports prepared by DWST.

In addition, the Project plans that the construction of fences surrounding the pump house, storage tank and hand pump, and the drainage trench surrounding the pump house and storage tank should be undertaken by the user communities themselves in order to increase their sense of ownership and participation. Due attention shall also be paid to the progress and achievement of construction works carried out by user communities in order to assess the issue.

Index for confirmation of Output 1 is described as follows:

Index for Confirmation of Output 1

Index for confirmation of output	Activity for output (No. in Table 1)
Minutes of meeting	5-1-1
Workshop report and community action plan (CAP)	5-1-2-1
Agreed CAP	5-1-2-2
Training report	5-1-3
Site guidance report	5-1-4

Output 2) Capacity and skills of local administration to support communities in establishing community-based O&M and to facilitate sanitation education are enhanced and retained by the concerned organization.

DWST, which is composed of the district level staff of water office and other district officers in concerned agencies involved in the water and sanitation sector, is formed to apply multi-sector approach on the implementation of O&M plan for the Project.

On the initial stage of the soft component, a field implementation manual for DWST will be prepared for the establishment of community-based O&M, and implementation of health and sanitation education. Training of trainers (TOT) is provided to DWST for utilizing the field manual. DWST, which is trained as the trainer, will undertake activities to establish community-based O&M systems at the community level, in collaboration with an NGO sub-contracted under the Japanese consultant. On-the-job-training (OJT) is also provided to DWST by NGOs during the implementation of field activities. Degree of acquisition of skills through both TOT and OJT can be confirmed in the workshop reports and quarterly reports prepared by NGO.

Index for confirmation of Output 2 is described as follows:

Index for Confirmation of Output 2

Index for confirmation of output	Activity for output (No. in Table 1)
Revised field manual	5-2-1
Member list of DWST	5-2-2
Workshop report and DWST action plan	5-2-3
Training report	5-2-4
Monitoring and follow-up report	5-2-5

Output 3) Capacity of the target communities in the O&M of the improved water supply system is enhanced.

It is a prerequisite for the construction of improved water supply facilities that a WUA, which is the community-based organization taking the lead role and responsibility in O&M, is formed in each target community and registered with a prepared constitution. In the formation and provision of training to a WUA, participation of women in the decision-making process shall be enhanced, which can be accessed from quarterly reports prepared by NGO/DWST, and minutes of village meetings.

Capacity and skills that WUA shall acquire and enhance can be categorized as follows: 1) leadership skills, 2) organization management skills, 3) financial management skills

including tariff setting, collection, budgeting, accounting, 4) technical skills such as O&M, and trouble shooting of supply facilities, and 5) monitoring and evaluation skills. These skills are monitored and assessed by DWST by applying uniform monitoring sheets. In addition, operation and accounting records by WUA shall be checked for assessment.

In case that WSP is established in the target community, operation and accounting records will be checked based on the framework of cooperation between WSP and WUA.

Index for confirmation of Output 3 is described as follows:

Index for Confirmation of Output 3

Index for confirmation of output	Activity for output (No. in Table 1)
Revised WUA constitution and workshop report	5-3-1, 5-3-5
Training report	5-3-2
Training report	5-3-3
Monitoring report	5-3-4

Output 4) Increase in awareness on individual health and sanitation in relation with the use of safe water

This soft component includes activities to improve community awareness on health and sanitation in relation with the use of safe water, through which communities are expected to change their attitude towards more improved hygiene practices. In the implementation of health and sanitation education, Participatory Health and Sanitation Transformation (PHAST), a tool for participatory health education adopted by many NGO in Kenya, is introduced.

This is an efficient and effective means of enhancing understanding of communities on the correlation between unhygienic practices and waterborne diseases, and improving personal hygiene practices. Community resource persons (CORPs) shall be trained under the program regarding PHAST concept and skills. These CORPs are expected to provide health and sanitation education to their communities. Frequency and contents of health and sanitation education provided by CORPs shall be confirmed for assessment purposes, through quarterly reports prepared by NGOs/DWST.

Moreover, the achievement of the issues shall be evaluated through a post-baseline survey at the completion of the Project. This will measure and compare the results of the baseline survey conducted in the basic design study and focus on the degree of understanding on the causes of waterborne diseases, incidents of water-related diseases, improvement in personal hygiene practices, and degree of satisfaction/dissatisfaction on water quality and quantity.

Index for confirmation of Output 4 is described as follows:

Index for Confirmation of Output 4

Index for confirmation of output	Activity for output (No. in Table 1)
Training report	5-4-1, 5-4-2, 5-4-3

(5) Activities of Soft Component Program

Activities planned for the soft component are based on the concept and methodology applied in NGOs' activities in the Project area, so that consistency with SIDA/DANIDA cooperation can also be maintained. The planned activities are as follows:

5-1) Activities to improve community ownership and participation:

5-1-1 Community consultative meetings

5-1-2 Participatory community assessment, preparation of and consensus building on community action plan

5-1-3 Activities to facilitate community participation

5-1-4 Participation of community in supervising construction of fences surrounding pump house, storage tank and hand pumps and of drainage trench surrounding pump house and storage tank

5-2) Activities to enhance capacity and skills of local administration to support communities in the establishment of community-based O&M system:

5-2-1 Development of field implementation manual

5-2-2 Formation of DWST

5-2-3 Provision of TOT for DWST, and development of DWST action plan

5-2-4 Provision of OJT through the implementation of field-level activities

5-2-5 Preparation of monitoring/follow-up checklist

5-3) Activities to develop capacity of target communities in the O&M of improved water supply system:

5-3-1 Review and revision of WUA constitution, and conduct of consultation meeting to introduce water supply and sanitation (WSS) management option under the sector reform

5-3-2 Implementation of activities to develop the capacity of communities in O&M, and health and sanitation education

5-3-3 Provision of follow-up training for WUAs to strengthen their capacity in O&M

5-3-4 Monitoring and follow-up

5-3-5 Acquisition of knowledge for smooth transition to WSP

5-4) Activities to increase community awareness on personal health and sanitation, and understanding of correlation with safe water use:

5-4-1 Community human resource development for health and sanitation education

5-4-2 Provision of training for CORPs considering PHAST methods

5-4-3 Implementation of health and sanitation education by CORPs

5-5) Activities to measure the impact of the Project:

5-5-1 Monitoring and follow-up by DWST

5-5-2 Post-baseline survey

Details of activities are described in the following Table 1, indicating the contents of activities and their output, target of activities, means and period of implementation, human resources for implementation, and output of submission:

Table 1　Contents of Soft Component Activities (1/4)

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
Stage 1: Pre-planning Stage						
5-2-1 Development of field implementation manual 【Contents】 ➢ Leadership Skills ➢ Organization Management Skills ➢ Financial Management ➢ Technical O&M ➢ PHAST ➢ Participatory Monitoring and Evaluation	Field implementation manual for trainers, which is utilized in the implementation of field activities, is confirmed and revised. (Draft was prepared during the 1st stage in the previous grant aid scheme with consideration of sector reform, which will be revised concordant with recent situation)	All 11 Districts*	Consultation, confirmation and needs assessment with implementing agency, preparation and development	10 days/project	Japanese Consultant NGO 【Japanese Side】	Revised Field Manual
5-2-2 Formation of DWST	DWST, which composed with staffs of district water office and district staffs from the ministries involved in water and sanitation sector, is formed in each district, and sector-wide approaches can be introduced.	All 11 Districts*	Request to each district by implementing agency	3 day/district	MWI, WSB 【Kenyan Side】	Member list of DWST
5-2-3 Provision of TOT for DWST, and development of DWST action plan 【Contents】 ➢ Leadership Skills ➢ Organization Management Skills ➢ Financial Management ➢ Technical O&M ➢ PHAST ➢ Participatory Monitoring and Evaluation	Utilizing field manual, facilitation skills of DWST are improved, and DWST Action Plan for the implementation of the soft component is prepared.	All DWST in each of the 11 districts*	Workshop seminar	2 day/district (5-day training was carried out in Mwingi and Kitui districts during the 1st stage in the previous grant aid scheme)	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Workshop Report DWST Action Plan

* Former Machakos and Makueni districts are divided into 11 target districts by administrative reorganization in 2008.

Table 1　Contents of Soft Component Activities (2/4)

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
Stage 2: Participatory Planning						
5-1-1 Community consultative meetings	Communities' understanding on the project purpose, expected outputs, and detailed activities and willingness to collaborate for the project are enhanced. In particular, users-pay-principle is understood. Preconditions, including community undertakings, for the construction of improved water supply system are confirmed.	All target communities	Meetings	0.5 day/community	Japanese Consultant NGO 【Japanese Side】 DWST 【Kenyan Side】	Minutes of Meeting
5-1-2-1 Participatory community assessment, and preparation of community action plan (CAP)	Problems and concerns in O&M of improved water supply system are identified and analyzed, and CAP, which indicates community task and means of implementation, is developed in participatory manner	All target communities	Participatory field workshop	1.0 day/community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Workshop Report Community Action Plan (CAP)
5-1-2-2 Community consultative meeting (consensus building for CAP)	Community consensus on CAP is made.	All target communities	Meeting	0.5 day/community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Agreed CAP
Stage 3: Construction/Implementation						
5-3-1 Review and revision of WUA constitution, and consultation meeting to introduce WSS (water supply and sanitation) management option under the sector reform 5-3-5 Acquisition of knowledge for smooth transition to WSP	Constitution of WUA, which is prepared by community prior to the implementation of the program, is reviewed and revised in the viewpoints of feasibility and efficiency. Various WSS management option is introduced to the community, and the community is prepared for the sector reform.	All target communities	Participatory field workshop	0.5 day/Community	NGO 【Japanese Side】 DWST 【Kenyan Side】	Revised WUA Constitution Workshop Report

Table 1　Contents of Soft Component Activities (3/4)

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
5-1-3 Activities to facilitate community participation 5-2-4 Provision of on-the-job-training (OJT) through the implementation of field-level activities 5-3-2 Implementation of activities to develop capacity of communities in operation and maintenance, and health and sanitation education 5-4-1 Community human resource development for health and sanitation education 5-4-2 Provision of training for community resource persons (CORPs) in Participatory Health and Sanitation Transformation (PHAST) methods 5-4-3 Implementation of health and sanitation education by CORPs	Capacity of community in management, O&M of improved water scheme and awareness in health and sanitation are improved. Facilitation skills of DWST are enhanced through OJT.	All target communities, DWST, CORPs	Participatory field workshop	4.0 days/community (Level-1 Site) 6.0 days/community (Level-2 Site)	NGO【Japanese Side】 DWST【Kenyan Side】	Training Report
5-3-4 Follow-up activities for capacity building, and health and sanitation education (5-1-3, 5-3-2, 5-4-1, 5-4-2, 5-4-3)	Sense of community ownership, capacity of community in O&M, and awareness in health and sanitation are affirmed.	All target communities	Participatory field workshop	3.0 days/Community	DWST【Kenyan Side】	Minutes of Meeting
5-1-4 Participation of community in supervising construction of fences surrounding the pump house, storage tank and hand pump, and of drainage trench surrounding the pump house and storage tank	Fences and trenches are constructed and installed by communities, and sense of community ownership is enhanced.	All target communities	Supervision	2.0 days/community (Level-1 Site)	DWST【Kenyan Side】	Site Guidance Report

Table 1　Contents of Soft Component Activities (4/4)

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
Stage 4: Operation and Maintenance						
5-3-3 Follow-up training for WUA (Strengthening community capacity in operation and maintenance)	Through the actual O&M of improved water supply scheme, training needs are identified, and training package to strengthen community capacity is provided.	All target communities	Participatory field workshop	2.0 days/community	DWST【Kenyan Side】	Training Report
5-2-5 Preparation of monitoring and follow-up check list	Issues for monitoring and follow-up are identified, and monitoring and follow-up checklist, which include indicators and means of verification, is developed.	All 11 districts*	Workshop	2 days/district	Japanese Consultant NGO【Japanese Side】 DWST【Kenyan Side】	Monitoring and Follow-up Checklist
5-5-1 Monitoring and follow-up	Monitoring and follow-up activities are conducted by DWST.	All target communities	Field Investigation	2 days / each 3 month / community	DWST【Kenyan Side】	Monitoring Report
5-5-2 Post-baseline survey	Impact of the Project is assessed	All 11 districts*	Socioeconomic survey with interviews	0.5 month	Japanese Consultant NGO【Japanese Side】 DWST【Kenyan Side】	Post-baseline Survey Report

* Former Machakos and Makueni districts are divided into 11 target districts by administrative reorganization in 2008.

In addition, responsibilities and duties to undertake each activity either by Japanese or Kenyan authorities are determined and indicated in the chart. This means that the realization of output set in the program depends on the efforts undertaken by both authorities.

Communities with a piped water scheme (Level-2) shall be provided with a more intensive and lengthy training package on organization management, financial management, and technical O&M, than communities with hand pump water supply schemes (Level-1).

(6) Assignment of Personnel

Activities of the soft component are implemented for 58 communities scattered within an area of 14,000 km^2. DWSTs based at 11 district water offices of TAWSB are then targeted as key bodies. Meanwhile, WUAs are trained by DWSTs.

In the Project area, there are more than five active NGOs which have experience on construction of water supply facilities and training of communities on soft components such as enlightenment and know-how. During construction work of Phase 1/2, local NGO staffs were employed by the consultant, which carried out the soft component.

Local NGO staffs together with a Japanese expert train DWST to improve their capacity. DWST meanwhile provides training to WUAs. Thus, the soft component is implemented taking advantage of local resources (local NGOs) and counterpart staffs.

One Japanese expert is designated in order to supervise the entire soft component activities and liaise with and report to the client and Japanese authorities concerned. The Japanese expert shall have skills in providing technical guidance to local resources.

Personnel to be assigned for the soft component are as follows:

6-1） Japanese Consultant (O&M/Health and Sanitation Education): one person

One Japanese consultant is responsible for: 1) formulation and supervision of the soft component, 2) reporting to the implementing agency, Japanese agencies and coordinating parties concerned in the program, and 3) coordination of the implementation of the program with construction schedule. Also, technical advice and capacity building will be given to the local staff of the implementing agency.

6-2） Counterparts from Implementing Agency

One staff from TAWSB will participate as a project manager to coordinate water office in each district. Two staffs from larger Machakos and larger Makueni districts will participate as project coordinators who will liaise with the Japanese consultant to cooperate on supervisory activities.

6-3） Local NGO

Involvement of NGO in the establishment of a community-based O&M system is promoted in Kenya as national sector policy and strategy. Thus, in the implementation of the soft component, staffs from NGO with knowledge and experience on capacity building of communities in similar programs are employed.

NGO staff will implement activities introduced by the Japanese side as described above, under the supervision of a Japanese consultant. Also, NGO staff will collaborate with the Japanese consultant in the preparation of a field implementation manual, provision of TOT and OJT to DWST, and implementation of field-level activities.

NGO staff to be deployed are as follows, considering the scale and schedule of activities involved in the soft component. Each staff member shall be experienced in conducting a similar program and shall be fluent in the local language.

(i) Program Coordinator: one person

Under the supervision of the Japanese consultant, one program coordinator will take the lead role in the implementation of field-level activities and manage the schedule, methodology and output in the implementation of the program. Moreover, he will be reporting to the Japanese consultant. The program coordinator shall have experience in acting as a team leader in similar programs.

(ii) Community Facilitator: one person

Under the supervision of the program coordinator, one community facilitator will conduct field-level activities to support the program coordinator. The community facilitator shall have experience in establishing community-based O&M, participatory planning, monitoring and evaluation, capacity building, and health and sanitation education in the water and sanitation sector.

6-4） DWST

DWST will be formed in each target district of the Project. This will be composed of WSB staff and other district staff from the ministries involved in the development of the water and sanitation sector. Prior to the implementation of the soft component, the district water office will take the lead role in coordinating with each district executive officer for the formation of DWST. DWST will be provided with TOT and OJT through the implementation of field activities, in order to establish community-based O&M systems and health and sanitation education. This is intended so that knowledge and skills are improved and retained in the institutions.

(7) Implementation Schedule

The implementation schedule is shown in the Attachment.

(8) Expected Outputs

Expected outputs are shown in Table 1. Submission items include a field implementation manual for DWST, DWST action plan, community action plan, training reports, monitoring checklists, post-baseline report, etc. In addition, the Japanese consultant will prepare the activity progress report on a quarterly basis (quarterly progress report), which will be submitted to the implementing agency and Japanese authorities concerned. On the completion of each phase of the program, a completion report will be prepared and submitted to the institution concerned.

(9) Cost of Soft Component

Total Cost of Soft Component	: 21,214 thousand Japanese Yen (JPY)
Direct Personnel Expenditure	: 1,646 thousand JPY
Direct Expenditure	: 17,461 thousand JPY
Indirect Expenditure	: 2,107 thousand JPY

(10) Undertakings by Kenyan Authorities

On the implementation of the soft component, the following activities shall be undertaken by the Kenyan side:

- Formation of DWST
- Field-level follow-up activities (capacity building of community on O&M, improvement of health and sanitation awareness and practices) [During construction stage]

- Supervision of community's construction of fences and drainage trench
- Provision of follow-up training for WUAs [During O&M stage]
- Monitoring activities [After completion of construction]

Technical cooperation under the soft component covers only establishment and capacity building of WUA as well as preparation of WUA to be transformed to WSP. However, transformation from WUA to WSP will be realized under the direction of MOWI and TAWSB upon completion of the sector reform.

Attachment

Year						2010						2011												2012		
Japanese Fiscal year						FY 2010						FY 2011														
Item						7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Detail Design	Detail Design Study and Preparation of Tender Document																									
	Confirmation on Tender Document																									
	PQ								▲																	
	Explanation of Tender								□																	
	Tender										▲															
	Contractor Contract											▲														
	Approval of Contract																									
Construction	Construction of hand Pump Facilities					Machakos																				
						Makueni																				
	Construction of Level 2 Facilities					Machakos																				
						Makueni																				
	Construction of Windmill Pump					Makueni																				

Activity of Software Component	Days Required		No. of Target		Total days	
Stage 1) Pre-Planning						
Development of Field Implementation Manual	10	day /proj	1	Proj	10	
【Undertakings by Kenyan Side】 Formation of DWST (District Water and Sanitation Team)	3	day /Dist	6	Dist	18	Machakos
	3		5		15	Makueni
Provision of TOT (Training of Trainers) for DWST, and Preparation of DWST Action Plan	2	day /Dist	6	Dist	12	Machakos
	2		5		10	Makueni
Stage 2) Participatory Planning						
Community Consultative Meeting, and Confirmation of Pre-Conditions for Construction	0.5	day /Village	58	Village	29	Machakos
						Makueni
Participatory Community Assessment, and Preparation of Community Action Plan (CAP)	1.0	day /Village	58	Village	58	Machakos
						Makueni
Community Consultative Meeting, and Consent of Communities for Action Plan	0.5	day /Village	58	Village	29	Machakos
						Makueni
Stage 3) Construction/Implementation						
Review on Constitution of WUA (Water Users Association), and Orientation on the WSS Management Option under the Sector Reform	0.5	day /Village	58	Village	29	Machakos
						Makueni
Capacity Building of Communities in Operation and Maintenance, Implementation of Health and Sanitation Education, and OJT for DWST (Level-1 Package)	4.0	day /Village	29	Village	116	Machakos
						Makueni
Ditto (Level-2 Package)	6.0	day /Village	29	Village	174	Machakos
						Makueni
【Undertakings by Kenyan Side】 Follow-up Activities for Capacity Building, and Health and Sanitation	3.0	day /Village	58	Village	174	Machakos
						Makueni
【Undertakings by Kenyan Side】 Supervision on Community for Construction of Fence (Level-1 Sites)	2.0	day /Village	29	Village	58	Machakos
						Makueni
Supervision on Community for Construction of Fence and Dranage trench (Level-2 Sites)	5.0	day /Village	29	Village	145	Machakos
						Makueni
Stage 4) Operation and Maintenance						
【Undertakings by Kenyan Side】 Follow-up Training for WUA (Strengthening Community Capacity in Operation and Maintenance)	2.0	day /Village	58	Village	116	Machakos
						Makueni
Preparation of Monitoring and Follow-up Check List, support for monitoring	2.0	day /Dist	11	Dist	22	
【Undertakings by Kenyan Side】 Monitoring and Follow-up (3 months/community)	2.0	day /Dist				
Post-Baseline Survey	15.0	day /Proj	1	Proj	15	

Assignment			
1. Japanese Consultant	1 Staff	M/M	
(Operation and Maintenance, Health Education: Grade 3)		2.63	
2. Local NGO/Consultant		M/M	
Program Coordinator	1 Staff	9.57	
Community Facilitator	1 Staff	9.27	

Implementation Schedule

Appendix-6
List of Alternative Communities for Hand Pump

Alternatvive sites for hand pumps

	S.No.	Name of site	Priority	District	Division	Location	Sub-location	Village
Larger Makueni	1	Itaa	3	Makueni	Wote	Muvau	Itaa	Itaa
	2	Ngosini west	1	Makueni	Wote	Kikumini	Ngosini	Ngosini
	3	Unoa	5	Makueni	Wote	Wote	Unoa	Unoa
	4	Syandoo	2	Kathonzweni	Mavindini	Muusini	Muusini	Syandoo
	5	Kinganga	4	Makueni	Kee	Kee	Kyamwalye	Kinganga
	6	Ngondini	4	Mukaa	Malili	Ngaamba	Ngaamba	Ngondini
	7	Kitonguni	1	Mukaa	Kilome	Kitango	Kitango	Kitonguni
	8	Usiunene	5	Mukaa	Kilome	Mukaa	Maiani	Maiani
	9	Kwa mulela	3	Mukaa	Malili	Malili	Kiima kiu	Kwa aimi
	10	Kitumbini	2	Mukaa	Kasikeu	Kasikeu	Kasikeu	Kitumbini
	11	Nthongoni	2	Mbooni east	Kisau	Waia	Sakai	Nthongoni
	12	Nzeeni	3	Mbooni east	Kisau	Kisau	Kisau	Nzeeni
	13	Syokilati	1	Mbooni east	Kalawa	Katangini	Kathongo	Syokilati
	14	Mutomo	3	Kibwezi	Mitio Andei	Nthongoni	Mangelete	Mutomo
	15	Kamunyuni	2	Kibwezi	Mitio Andei	Nzambani	Nzambani	Kamunyuni
	16	Katulani	1	Kibwezi	Kibwezi	Kikumbulyu	Kalungu	Katulani
	17	Mavumbuni	3	Nzaui	Matiliku	Kilili	Mulenyu	Mavumbuni
	18	Mulenyu	1	Nzaui	Matiliku	Kilili	Mulenyu	Mulenyu
	19	Kawanyaa	2	Nzaui	Nguu	Nguu	Masamukye	Kawanyaa
	20	Muuwani	4	Nzaui	Kalamba	Kalamba	Kalamba	Muuwani
Larger Machakos	1	Kakoi	1	Mwala	Masii	Vyulya	Katheka	Kakoi
	2	Mwasua	2	Mwala	Yathui	Wamunyu	Kyawango	Mwasua
	3	Miwani	1	Machakos	Kalama	Kalama	Kalama	Miwani
	4	Utooni community water project	3	Machakos	Machakos	Kamuthanga	Kamuthanga	Utooni
	5	Kaathi	2	Machakos	Central	Kimutwa	Kaathi	Kaathi
	6	Ikombe water project	2	Yatta	Ikombe	Ikombe	Ikombe	Ikombe
	7	Ndua water project	1	Yatta	Matuu	Matuu	Matuu	Ndua
	8	Ukuswini	1	Kathiani	Kathiani	Kaani	Mbuni	Ukuswini
	9	Kithuia community water project	1	Masinga	Masinga	Kivaa	Kivaa	Kithuia
	10	Mambila	2	Masinga	Masinga	Kangonde	Musingini	Mambila

Appendix-7
Other Relevant Data

Appendix-7: Other Relevant Data

No.	Title	original/ copy	Issue Organization	Year
1	WELL-BEING IN KENYA	original	Kenya National Bureau of Statistics	2008
2	VISION 2030	original	Government of Kenya	2007
3	FIRST MEDIUM TERM PLAN (2008-2012)	original	Government of Kenya	2008
4	STATISTICAL ABSTRACT 2009	original	Kenya National Bureau of Statistics	2009
5	STATISTICAL ABSTRACT 2008	original	Kenya National Bureau of Statistics	2008
6	2009/2010 ESTIMATE OF RECURRENT EXPENDITURE	original	Government of Kenya	2009
7	2009/2010 ESTIMATE OF DEVELOPMENT EXPENDITURE	original	Government of Kenya	2009
8	STRATEGIC PLAN 2008-2013	original	TAWSB	2008
9	LICENCE for the Provision of Water Services	original	Water Service Regulatory Board	2002
10	ANNUAL WATER SECTOR REVIEW 2009	copy	MOWI	2010
11	STRATEGIC PLAN 2009-2012	copy	WRMA	2009
12	RAINFALL DATA	original	Kenya Meteorological Department	2010
13	TAWSB BUISINESS PLAN FOR THE PRIOD 2009 TO 2014 (FINAL DRAFT REPORT)	copy	TAWSB	2009
14	MINISTERIAL STRATEGIC PLAN 2009-2012	copy	MOWI	2008

Appendix-8 References

8.1 Existing Borehole Database

8.2 Standards for Water Quality in Kenya

8.3 Result of Power Source for Water Supply Facility

8.4 Success Rate of Borehole

8.5 Result of Electric Sounding Survey for 40 Communities

8.6 Borehole Columnar Sections in 40 Communities

8.7 Result of Test Drilling at 36 Communities

8.8 Result of Wind Velocity Survey

8.9 Water fee as a result of Social survey

8.10 Hydro-geological Data of the Target Communities

8.11 Outline Design Drawings

8.12 Baseline data by Social survey

8.1
Existing Borehole Database

No.	District	BH No.	Location Name	Map sheet	Longitude E	Latitude N	X grid (m)	Y grid (m)	X grid (km)	Y grid (km)	Altitude (m)	Completion date	Litho-logy	Drilling depth (GL-m)	Depth of Aquifer (GL-m)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Pumping rate (m3/h)	Level Type
MC-001	Machakos	C401	KANGUNDO	149/4			316415	9858106	316.4	9858.1	1560	1946/1/20	3	34.0	29.0				17.04	
MC-002	Machakos	C436	TALA TOWNSHIP	149/4			310849	9859938	310.8	9859.9	1520	1946/3/3	3	122.0	23.0	7.0			10.50	
MC-003	Machakos	C473	POTHA	163/4			368381	9802861	368.4	9802.9	1722	1946/9/22	2	61.0	14.0	8.0			6.54	
MC-004	Machakos	C492	ATHI RIVER	182/2			377715	9710739	377.7	9710.7	1219	1946/10/8	2	28.0						
MC-005	Machakos	C1133	YATTA	149/2			325679	9869169	325.7	9869.2	1280	1950/6/10	3	153.0	121.0	23.0			14.40	
MC-006	Machakos	C1430	KINYATTA	150/3			348799	9851499	348.8	9851.5	1301	19519	3	98.0	70.0	19.0			7.50	
MC-007	Machakos	C1493	YATTA	149/2			327537	9869170	327.5	9869.2	1341	1951/7/14	3	64.0	30.0	24.0			4.56	
MC-008	Machakos	C1507	YATTA	150/2			364622	9885771	364.6	9885.8	1228	1951/8/14	3	111.0	44.0	38.0			0.72	
MC-009	Machakos	C1508	YATTA	150/1			357215	9874713	357.2	9874.7	1249	1951/8/20	3	113.0	98.0	49.0			3.90	
MC-010	Machakos	C1571	YATTA	136/3			347926	9893127	347.9	9893.1	1067	1951/10/16	9	34.0	29.0	23.0			4.56	
MC-011	Machakos	C1572	YATTA	150/4			368351	9856289	368.4	9856.3	1155	1951/9/28	9	91.0						
MC-012	Machakos	C1595	YATTA	150/1			351649	9878391	351.6	9878.4	1264	1951/9/29	9	82.0	64.0	30.0			10.92	
MC-013	Machakos	C1632		149/4			311280	9859760	311.3	9859.8										
MC-014	Machakos	C1864	KANGUNDO	149/4			318276	9854415	318.3	9854.4	1615	1952/11/15	3	98.0	55.0	26.0			3.78	
MC-015	Machakos	C1949	KANGUNDO	149/4			318273	9858108	318.3	9858.1	1615	1953/4/30	3	119.0	119.0	47.0		60.0	4.08	
MC-016	Machakos	C1972	MUMBUNI	150/3			355369	9848909	355.4	9848.9	1176	1953/5/9	3	92.0	64.0	62.0		28.0	0.12	
MC-017	Machakos	C1973	YATTA	150/1			344225	9882070	344.2	9882.1	1189	1953/5/27	3	121.0	111.0	16.0		92.0	2.82	
MC-018	Machakos	C1989		149/2			315080	9875100	315.1	9875.1			9	104.0	68.0	37.0			9.00	
MC-019	Machakos	C2019	YATTA	150/1			334961	9867327	335.0	9867.3	1311	1953/8/26	3	160.0	110.0	17.0		120.0	0.60	
MC-020	Machakos	C2024	MAKAPEZI	150/1			338667	9867329	338.7	9867.3	1226	1953/7/30	3	138.0	90.0	9.0		83.0	1.44	
MC-021	Machakos	C2041	KATHINGIRI	136/3			357206	9896823	357.2	9896.8	1067	1953/10/15	3	122.0	117.0	76.0		41.0	0.18	
MC-022	Machakos	C2132		149/2			310320	9873280	310.3	9873.3			9	122.0	120.0	55.0			9.00	
MC-023	Machakos	C2266	KAPITI	149/4			325697	9839681	325.7	9839.7	1311	1957/1/15	3	109.0	90.0	10.0		63.1		II
MC-024	Machakos	C2333	ATHI RIVER	149/4			333123	9834158	333.1	9834.2	1134	1955/2/6	3	107.0	103.0	3.0		1.5	18.18	
MC-025	Machakos	C2357	ITHANGA	150/1			342364	9885761	342.4	9885.8	1143	1955/4/8	3	110.0	84.0	20.0		83.5	3.90	I
MC-026	Machakos	C2406	SIATHANI	149/4			327548	9850739	327.5	9850.7	1219	1955/7/12	3	93.0	90.0	19.0		60.6	4.56	
MC-027	Machakos	C2407	MBIUNI	149/4			331255	9848895	331.3	9848.9	1219	1955/7/6	3	104.0	88.0	20.0		37.4	0.84	
MC-028	Machakos	C2427	MBAIKINI	150/3			338680	9845218	338.7	9845.2	1262	1955/9/30	3	93.0	87.0	76.0			0.06	
MC-029	Machakos	C2474	ATHI RIVER	162/2			333126	9830476	333.1	9830.5	1237	1956/1/13	3	107.0	101.0	2.0		7.9	6.78	
MC-030	Machakos	C2731	KANGUNDO	162/4			333159	9788087	333.2	9788.1	1638	1957/12/6	3	75.0	66.0	2.0		65.8	3.66	
MC-031	Machakos	C2815		149/2			313120	9877150	313.1	9877.2			9			40.0			4.50	
MC-032	Machakos	C2943		149/2			313420	9878120	313.4	9878.1			9	106.7	21.0	14.0			10.50	
MC-033	Machakos	C3124		149/2			310560	9889110	310.6	9889.1			9	61.0	18.2	16.0			0.60	
MC-034	Machakos	C3151	BESTOWS (MKANGA)	183/3			409225	9690502	409.2	9690.5	610	1961/11/9	3	52.0	37.0	33.0		3.7	8.10	
MC-035	Machakos	C3453	MACHAKOS	150/3			336828	9836007	336.8	9836.0	1308	1967/7/30	3	89.0	82.0	17.0		69.1	8.16	
MC-036	Machakos	C3454	MACHAKOS	162/2			329419	9832309	329.4	9832.3	1234	1967/8/24	3	91.0	43.0	29.0		56.9	3.30	
MC-037	Machakos	C3679	KIMA	162/3			303492	9782530	303.5	9782.5	1701	1970/6/1	3	153.0	57.0	50.0		44.0	1.02	
MC-038	Machakos	C3776	KANGUNDO	149/4			316415	9858106	316.4	9858.1	1560	1971/4/17	3	168.0	163.0	5.0		145.9	5.46	
MC-039	Machakos	C3842	ATHI RIVER	149/4			320125	9850734	320.1	9850.7	440	1972/6/6	3	70.0				28.6	8.58	
MC-040	Machakos	C3957	KAANI	149/4			316431	9834146	316.4	9834.1	1370	1973/1/23	3	167.0	128.0	69.0		91.1	0.30	
MC-041	Machakos	C3967	MAKUTANO	149/4	37.47	-1.40	329415	9837837	329.4	9837.8	1230	27030	3	182.0	39.0	22.0		130.2	4.08	
MC-042	Machakos	C3997	ATHI RIVER	173/2			310935	9762269	310.9	9762.3	1240	1973/12/6	3	214.0	35.0	19.0		35.4	4.26	
MC-043	Machakos	C4000	KDO(MATHENI)	149/2			312703	9867315	312.7	9867.3	1448	1974/5/25	3	123.0	30.0	4.0		70.1	9.06	
MC-044	Machakos	C4039	MAKUTANO	149/4			327553	9843364	327.6	9843.4	1300	1974/8/1	3	92.0	74.0	10.0		10.5	8.16	
MC-045	Machakos	C4162	DITHINI	135/4			331229	9898648	331.2	9898.6	1133	1975/10/23	3	200.0	111.0	40.0		139.1	0.30	
MC-046	Machakos	C4295	MUNGEY FARM	162/1			371215	9811215	371.2	9811.2	1720	1977/3/22	3	206.0	105.0	47.0		66.3	2.10	
MC-047	Machakos	C4452	MWALA	149/4			325689	9852584	325.7	9852.6	1249	1978/2/10	3	150.0	103.0	18.0		90.0	3.00	II
MC-048	Machakos	C4483	KAWETHEI	149/4			312712	9852575	312.7	9852.6	1480	1978/5/6	3	130.0	66.0	10.0		22.0	9.84	
MC-049	Machakos	C4541	MANYATTA	149/4			321984	9850735	322.0	9850.7	1413	1978/7/21	3	81.0	45.0	62.0		59.0	7.08	II
MC-050	Machakos	C4978	MBITINI	174/1			335025	9778879	335.0	9778.9	1025	1981/8/8	3	68.0	18.0	2.0		22.0	2.40	
MC-051	Machakos	C5004	KINGATUNI	149/4			328900	9840950	328.9	9841.0		29921	3	100.0	48.0	3.0				
MC-052	Machakos	C5255	KATINE	149/4			312707	9859939	312.7	9859.9	1530	30305	3	120.0	22.0	15.0		87.0	3.00	
MC-053	Machakos	C5256	MATUNGULU	149/4			312712	9852575	312.7	9852.6		1983/1/15	3	10.0	1.0	1.0		1.0	11.22	
MC-054	Machakos	C5440	Kitangani Sec School		37.65	-1.04	349982	9885567	350.0	9885.6										
MC-055	Machakos	C6035		149/4			313480	9861440	313.5	9861.4			9	100.0	70.0	12.0				II
MC-056	Machakos	C6038	KYAMULENDU	149/4			312708	9858104	312.7	9858.1		1985/3/3	3	88.0	36.0	3.0		72.0	1.20	
MC-057	Machakos	C6301	KAVINGONI	163/3			353554	9784422	353.6	9784.4	1060	1985/10/17	3	120.0	90.0	46.0		12.0	5.28	
MC-058	Machakos	C6890	MUISUNI KANGUNDO H/S	149/4			319000	9854780	319.0	9854.8		31594	9	83.0	52.0	19.0			3.30	
MC-059	Machakos	C9473	KANGUNDO	149/4			320221	9856315	320.2	9856.3	1554	1991/3/30	9	72.0	43.0	13.0				
MC-060	Machakos	C10622	MAVOLINI	149/2			320698	9797280	320.7	9797.3		1994/1/13	1	51.0	42.0					
MC-061	Machakos	C10875	VYULYA	149/4			320150	9846000	320.2	9846.0		34516	2	61.0	47.0	0.0		17.2	8.40	
MC-062	Machakos	C11092	UTITHINI	149/4			326700	9836000	326.7	9836.0		1995/3/9	2	71.0	32.0	2.8			20.00	
MC-063	Machakos	C11274	VYULYA	149/4			321189	9840589	321.2	9840.6		1995/10/1	1	68.0	18.0	5.0				
MC-064	Machakos	C11434	MUISUNI	149/4			317408	9854409	317.4	9854.4		1996/6/28	3	100.0	12.0	8.7		64.2	14.40	
MC-065	Machakos	C11619		149/2			326440	9869820	326.4	9869.8			9	120.0	118.0	13.0			7.50	
MC-066	Machakos	C11696		150/3			357320	9839280	357.3	9839.3			9	120.0	35.0	31.0			13.00	
MC-067	Machakos	C11854	YATHUI				342271	9839712	342.3	9839.7				80.0						
MC-068	Machakos	C11856		149/4			315800	9852800	315.8	9852.8			9	80.0	6.0	24.0			3.00	II
MC-069	Machakos	C11923	IKATINI				336250	9881632	336.3	9881.6				80.0	20.0	22.0			2.00	
MC-070	Machakos	C11926					311621	9863927	311.6	9863.9	35886									
MC-071	Machakos	C11936	TALA	149/4			332088	9860499	332.1	9860.5	1540	35835	3	150.0	24.7	0.0		62.0	21.60	II
MC-072	Machakos	C11942	UVAINI	150/3			333820	9846440	333.8	9846.4			9	102.0	60.0	40.0			2.00	II
MC-073	Machakos	C11943	WAMUNYU	150/3			340200	9844100	340.2	9844.1			9	41.0	12.0	2.0			3.00	
MC-074	Machakos	C11976	MASII	149/4			326693	9838996	326.7	9839.0			9							
MC-075	Machakos	C12053	MUKALWA				311621	9863927	311.6	9863.9				110.0	72.0					II
MC-076	Machakos	C12060	KINYAATA	150/3	37.64	-1.34	348799	9851499	348.8	9851.5	1294	1998	9	75.0	30.0	2.0			4.00	
MC-077	Machakos	U1	MIUMBINI	149/4			309992	9849335	310.0	9849.3	1460	37437		82.0	50.0	32.0			3.00	
MC-078	Machakos	U3	MUUSINI	150/3			351414	9848993	351.4	9849.0	1280	37529		78.0	48.0	38.0			5.00	
MC-079	Machakos	-	Kithimani Mixed Sec. School		37.45	-1.19	327319	9868985	327.3	9869.0										
MC-080	Machakos	-	Mwala Mixed Sec. School		37.45	-1.36	327651	9850192	327.7	9850.2										
MC-081	Machakos	-	Kwa Maung Water Project		37.57	-1.40	340364	9844996	340.4	9845.0										
MC-082	Machakos	-	Ngangani B/H		37.65	-1.04	349429	9885457	349.4	9885.5										
MC-083	Machakos	-	Katangi High School		37.69	-1.41	353409	9844775	353.4	9844.8										
MC-084	Machakos	-	KATANGI SCH	150/3			353823	9844386	353.8	9844.4	1285									II
MC-085	Machakos	TW-1	JICA-BD		37.41	-1.23	322786	9864673	322.8	9864.7				103.0		17.5		39.0	1.80	
	Masinga	148	Kangonde Primary School (JICA 2nd IRS)		E37°40'36.6"	S01°04'43.5"								Dry	-	-			Dry	
	Masinga	151	Kamunyu Primary School (JICA 2nd IRS)		E37°44'33.5"	S00°50'36.4"								54	21-36, 42-48	11.75		26.5	4.50	
	Yatta	156	Nguumo-Kathithu (JICA 2nd IRS)		E37°25'32.9"	S1°10'22.6"								Dry	-	-			Dry	
	Yatta	158	Mavoloni-Kisiiiki (JICA 2nd IRS)		E37°26'52.0"	S1°04'46.8"								60	9-24, 45-51	4.7		31.01	4.70	
	Yatta	162	Kikeneani (JICA 2nd IRS)		E37°45'18.2"	S01°25'58.2"								140	44-71, 113-136	44.60		40.47	1.10	
	Yatta	163	Matinga (JICA 2nd IRS)		E37°42'04.1"	S01°26'42.2"								137	116-134	81.48		24.42	10.90	
	Yatta	165	Ndalani (JICA 2nd IRS)		E37°29'11.5"	S01°05'57.8"								Dry	-	-			Dry	
	Kathiani	167	Mukukuni (JICA 2nd IRS)		E37°16'30.8"	S01°20'11.8"								110	86-107	20.15		13.57	2.00	
	Mwala	172	Mbele (JICA 2nd IRS)		E37°31'33.4"	S01°23'28.4"								92	9-24, 33-50, 62-74, 80-86	4.4		46.35	18.00	
	Mwala	173	Kathama (JICA 2nd IRS)		E37°22'38.8"	S01°12'10.6"								Dry	-	-			Dry	
	Mwala	175	Mango Sec School (JICA 2nd IRS)		E37°25'27.7"	S01°23'38.7"								Dry	-	-			Dry	
	Mwala	177	Kwendana S/H/Group (JICA 2nd IRS)		E37°23'04.0"	S01°13'52.2"								38	26-35	4.95		11.55	5.00	
	Mwala	178	Kyawango (JICA 2nd IRS)		E37°29'07.9"	S1°19'04.6"								Dry	-	-			Dry	
	Kangundo	180	Kyamuanyani(Meka) (JICA 2nd IRS)		E37°20'27.7"	S01°24'32.0"								100	34-58, 64-82, 88-94	6.4		17.59	14.40	
	Yathui	183	Miu Sec School (JICA 2nd IRS)		E37°34'51.5"	S01°31'29.0"	Remark: Existent borehole, Test pumping and Water quality tests only							128	100 (Testing pump level)	38.10		50.46	7.20	
	Mwala	185	Kikulumi (JICA 2nd IRS)		E37°35'55.1"	S01°31'37.0"								Dry	-	-			Dry	
	Mwala	186	Nzeveni (JICA 2nd IRS)		E37°33'47.8"	S01°28'30.2"								120	[illegible]	7.3		73.48	2.00	
	Mwala	187	Kilembwa (JICA 2nd IRS)		E37°32'03.0"	S01°20'31.9"								100	[illegible]	1.0		67.47	0.40	
	Masinga	188	Muambani (JICA 2nd IRS)		E037°25'12.4"	S00°58'00.4"								Dry	-	-			Dry	
	Masinga	189	Ndithini Sec School (JICA 2nd IRS)		E37°20'03.5"	S00°56'39.1"								92	23-47, 71-77	11.1		25.71	3.60	
	Masinga	191	Manaja Sec School (JICA 2nd IRS)		E37°16'31,7"	S00°50'51.6"								Dry	-	-			Dry	
	Masinga	195	Thayu wa Ndela (JICA 2nd IRS)		E37°17'10.0"	S00°52'01.5"								Dry	-	-			Dry	
	Masinga	196	Milaani (JICA 2nd IRS)		E37°22'56.2"	S00°53'47.5"								Dry	-	-			Dry	
	Masinga	197	Militani (JICA 2nd IRS)		E37°24'35.8"	S0°52'47.7"								60	9-15, 21-36, 54-57	6.85		26.88	6.70	
	Machakos	200	Kyamutheke (JICA 2nd IRS)		E37°10'12.6"	S01°32'08.5"	Remark: Existent borehole, Test pumping and Water quality tests only							150	100 (Testing pump level)	44.68		46.02	0.60	

No.	District	BH No.	Location Name	Map sheet	Longitude E	Latitude N	X grid (m)	Y grid (m)	X grid (km)	Y grid (km)	Altitude (m)	Completion date	Litho-logy	Drilling depth (GL-m)	Depth of Aquifer (GL-m)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Pumping rate (m3/h)	Level Type
MK-001	Makueni	C6	KILIMA KIU	162/4	37.27	-1.83	307194	9797284	307.2	9797.3	1524	12745	3	62.0	35.0	30.0			0.40	
MK-002	Makueni	C16	KIMA	162/3			303484	9789905	303.5	9789.9	1524	12190	3	50.0						
MK-003	Makueni	C17	KIMA	162/3	37.23	-1.93	305346	9786225	305.3	9786.2	1737	12208	3	38.0	30.0	19.0			7.60	
MK-004	Makueni	C18	KIMA	162/4	37.27	-1.95	307206	9784380	307.2	9784.4	1585	12247	3	47.0	38.0	29.0			3.00	
MK-005	Makueni	C19	KIMA	162/4	37.27	-1.97	307208	9782533	307.2	9782.5	1493	12269	3	64.0	25.0	20.0			3.80	
MK-006	Makueni	C33	MASONGALENI	175/3	38.05	-2.48	394381	9725499	394.4	9725.5	878	13895	3	122.0		13.0			1.62	
MK-007	Makueni	C34	MASONGALENI	175/3	38.07	-2.48	396238	9725500	396.2	9725.5	878	13927	3	77.0		1.2			2.21	
MK-008	Makueni	C51	EMALI	173/2	37.42	-2.03	325751	9775188	325.8	9775.2	1234	14396	3	91.0	39.0	33.0			4.60	
MK-009	Makueni	C52	KILIMA KIU	162/3	37.20	-1.85	299773	9795430	299.8	9795.4	1768	14447	3	68.0	55.0	37.0			8.70	
MK-010	Makueni	C55	SULTAN HAMUD	162/4			318338	9778863	318.3	9778.9	1524	14488	3	122.0	37.0	32.0			0.20	
MK-011	Makueni	C60	KIMA	162/3	37.25	-1.93	305346	9786225	305.3	9786.2	1433	12290	3	44.0	25.0	20.0			9.10	
MK-012	Makueni	C82	SULTAN HAMUD	173/2	37.37	-2.02	318340	9777016	318.3	9777.0	1372	11322	3	24.0					0.00	
MK-013	Makueni	C120					307206	9784380	307.2	9784.4										
MK-014	Makueni	C305	ULU	162/3	37.18	-1.85	297915	9795428	297.9	9795.4	1646	16243	3	107.0	102.0	71.0			3.14	
MK-015	Makueni	C315	SULTAN HAMUD	173/2	37.37	-2.02	318340	9777016	318.3	9777.0	1524	16301	3	59.0	50.0	48.0			0.28	
MK-016	Makueni	C328	SIMBA	174/1	37.67	-2.05	351716	9773365	351.7	9773.4	1006	17290	3	76.0	48.0	42.0			5.00	
MK-017	Makueni	C359	SULTAN HAMUD	173/2	37.37	-2.02	318340	9777016	318.3	9777.0	1524	16524	3	60.0	50.0	46.0			9.10	
MK-018	Makueni	C398	MAKUENI	163/3	37.70	-1.88	355406	9791797	355.4	9791.8	1158	16834	3	145.0		1.0			0.00	
MK-019	Makueni	C414	MAKUENI	163/3	37.72	-1.90	357265	9789953	357.3	9790.0	1189	16947	3	135.0	84.0	47.0			4.80	II
MK-020	Makueni	C427	KIU	162/3	37.17	-1.90	296074	9789897	296.1	9789.9	1460	16981	3	85.0		7.0			9.10	
MK-021	Makueni	C437	KEITA RIVER	163/3	37.60	-1.78	344271	9804680	344.3	9804.7	1220	16895	3	123.0	115.0	15.0			7.20	
MK-022	Makueni	C445	ULU	162/3	37.23	-1.85	297915	9795428	297.9	9795.4	1585	17029	3	123.0	60.0	54.0			6.50	
MK-023	Makueni	C446	MAKUENI	163/3	37.60	-1.77	344271	9804680	344.3	9804.7	1128	17015	3	123.0	109.0	18.0			6.40	I
MK-024	Makueni	C454	MAKUENI	163/3	37.73	-1.78	359103	9802855	359.1	9802.9	1036	17059	2	84.0	84.0	16.0			4.87	
MK-025	Makueni	C461	MWANI SEC SCH	163/3	37.66	-1.75	351692	9804685	351.7	9804.7	1067	16984	2	54.3	53.0	8.0			16.36	II
MK-026	Makueni	C469	KIU	162/3	37.15	-1.88	294214	9791742	294.2	9791.7	1524	17076	2	63.0	33.0	24.0			12.72	
MK-027	Makueni	C474	MAKUENI	163/4	37.82	-1.78	368381	9802861	368.4	9802.9	914	17087	2	41.0	41.0	10.0			3.98	
MK-028	Makueni	C482	EMALI	163/3			357265	9789953	357.3	9790.0	1067	1946/6/1	2	135.0	84.0	47.0				
MK-029	Makueni	C488	MALIBANI	163/3	37.58	-1.78	342415	9802843	342.4	9802.8	1158	17107	2	123.0	91.0	13.0			3.06	II
MK-030	Makueni	C500	MAKUENI	163/4			362831	9784429	362.8	9784.4	1067	17168	2	67.0	12.0	9.0			5.83	
MK-031	Makueni	C518	MAKUENI	163/3			349851	9782573	349.9	9782.6	990	17240	2	132.0	99.0	16.5				
MK-032	Makueni	C545	SIMBA	174/1	37.63	-2.12	348007	9765988	348.0	9766.0	991	17312	2	83.0	76.0	17.0			5.53	
MK-033	Makueni	C603	KIMA	162/3	37.20	-1.92	299781	9788055	299.8	9788.1	1524	17432	2	171.0	61.0	21.0			10.50	
MK-034	Makueni	C610	ULU	162/3			296072	9791744	296.1	9791.7	1524	17486	2	109.0					0.00	
MK-035	Makueni	C612	ULU	162/3	37.15	-1.88	294214	9791742	294.2	9791.7	1524	17500	2	30.0	9.0	9.0			9.10	
MK-036	Makueni	C687	ULU	162/3			303481	9793587	303.5	9793.6	1524	17693		146.0					0.00	
MK-037	Makueni	C688	ULU	162/3	37.25	-1.87	305339	9793589	305.3	9793.6	1585	17734		153.0	98.0	73.0			0.60	
MK-038	Makueni	C1004	KIBWEZI	175/3	38.05	-2.45	394379	9729180	394.4	9729.2	838	18191		173.0	85.0	76.0			0.23	
MK-039	Makueni	C1005	KIBWEZI	175/3	38.05	-2.45	394379	9729180	394.4	9729.2	838	18158		68.0	16.0	46.0			1.35	
MK-040	Makueni	C1053	MACHAKOS	162/4	37.30	-1.97	310913	9782537	310.9	9782.5	1585	18095		52.0	43.0	34.0			0.38	
MK-041	Makueni	C1054	MACHAKOS	162/4			314622	9778859	314.6	9778.9	1524	22372		123.0	113.0	38.0			9.08	
MK-042	Makueni	C1131	KIMA	162/4	37.30	-1.93	310910	9786230	310.9	9786.2	1737	18430	3	80.0	52.0	41.0			6.80	
MK-043	Makueni	C1132	KIMA	162/4	37.28	-1.92	309050	9788064	309.1	9788.1	1280	18378	3	134.0	46.0	40.0			0.14	
MK-044	Makueni	C1181	MTITO ANDEI	183/1	38.12	-2.75	401818	9696023	401.8	9696.0	914	18543	3	139.0	31.0	27.0			1.60	
MK-045	Makueni	C1311	KIMA	162/3			305343	9789907	305.3	9789.9	1630	18685	3	137.0	89.0	36.0			6.80	
MK-046	Makueni	C1376	KIMA	162/3			305339	9793589	305.3	9793.6	1597	18717	3	122.0	67.0	59.0			2.70	
MK-047	Makueni	C1455	MTITO ANDEI	183/3			396263	9692338	396.3	9692.3	975	18808	3	108.0	102.0	47.0			2.04	
MK-048	Makueni	C1485	KIMA	162/4			307205	9786227	307.2	9786.2	1453	18816	3	159.0	85.2	42.0			0.19	
MK-049	Makueni	C1518	KITETA	162/2			333126	9830476	333.1	9830.5	1280	18870	3	152.0	81.0	54.0			1.18	
MK-050	Makueni	C1557	MBITINI	173/2			331311	9777029	331.3	9777.0	1234	18923	3	148.0	57.0	58.0			2.04	II
MK-051	Makueni	C1578	SULTAN HAMUD	163/3			351693	9802850	351.7	9802.9	1158	18933		79.0	42.0	21.0			7.00	II
MK-052	Makueni	C1579	KIU	162/3			294214	9791742	294.2	9791.7	1524	18863		122.0	36.0	10.0			18.20	
MK-053	Makueni	C1580	KAUMONI	163/1			340564	9808370	340.6	9808.4	1463	18890		84.0	45.0	27.0			3.70	
MK-054	Makueni	C1667	DARANJANI	162/4			312752	9802818	312.8	9802.8	762	18954		40.2					0.00	
MK-055	Makueni	C1668	DARANJANI	162/4			310894	9802816	310.9	9802.8	762	19015		73.0					0.00	
MK-056	Makueni	C1802	SULTAN HAMUD	162/3			297925	9786217	297.9	9786.2	1423	19080		17.0					0.00	
MK-057	Makueni	C1804	SULTAN HAMUD	162/4			312757	9797289	312.8	9797.3	1231	19119		178.0	60.0	49.0			0.90	
MK-058	Makueni	C1835	EMALI	163/3			346135	9797318	346.1	9797.3	1219	19259		91.0					0.00	
MK-059	Makueni	C1849	EMALI	163/3	37.71	-1.84	355402	9797325	355.4	9797.3	1120	19278		76.0					0.00	
MK-060	Makueni	C1856	NGOSINI	163/3	37.71	-1.80	360962	9801010	361.0	9801.0	1067	19294	3	68.0	61.0	18.0			0.73	
MK-061	Makueni	C1885	NZOENI	163/3			346135	9797318	346.1	9797.3	1173	19299	3	134.0	116.0	65.0			39.30	
MK-062	Makueni	C1886	MASAU	163/3			351703	9789948	351.7	9789.9	1186	19329	3	136.0	58.0	55.0			49.00	II
MK-063	Makueni	C1890	MAKUENI	163/3			355402	9797325	355.4	9797.3	1219	1952/11/1	3	61.0						
MK-064	Makueni	C1945	MAKUENI	163/3			355402	9797325	355.4	9797.3	1402	19448	3	122.0	88.0	6.0				
MK-065	Makueni	C2004	KIU	162/3			297919	9791746	297.9	9791.7	1524	19589	3	64.0	64.0	27.0			4.50	
MK-066	Makueni	C2123	SULTAN HAMUD	162/4			312773	9780704	312.8	9780.7	1265	19736	3	36.6	113.0	54.9			18.20	
MK-067	Makueni	C2130	SULTAN HAMUD	173/2			318340	9777016	318.3	9777.0	1372	19701	3	78.0	63.0	52.0				
MK-068	Makueni	C2150	KIMA	162/3			299775	9793584	299.8	9793.6	1707	19775		76.0	55.0	41.0			40.00	
MK-069	Makueni	C2182	SULTAN HAMUD	162/4			316480	9778861	316.5	9778.9	1493	19819	3	85.0	67.0	30.0			0.03	
MK-070	Makueni	C2203	SULTAN HAMUD	162/4			316480	9778861	316.5	9778.9	1524	19859	3	120.0	76.0	40.0		0.5	2.27	
MK-071	Makueni	C2232	SULTAN HAMUD	173/2			320187	9777018	320.2	9777.0	1234	19903	3	90.0	81.0	41.0		0.0	7.26	
MK-072	Makueni	C2267	TAWA	162/2			327563	9828626	327.6	9828.6	1470	20010	3	73.0	57.0	7.0		0.2	8.18	II
MK-073	Makueni	C2284	MIU	163/1			342394	9832318	342.4	9832.3	1158	20037	3	134.0	55.0	8.0			4.09	
MK-074	Makueni	C2365	SULTAN HAMUD	173/2			318340	9777016	318.3	9777.0	1372	20170	3	76.0	67.0	55.0				
MK-075	Makueni	C2370	SULTAN HAMUD	173/2			318340	9777016	318.3	9777.0	1227	20181	3	76.0	62.0	46.0		1.0	8.17	
MK-076	Makueni	C2426	MBIUNI	163/1			342400	9823108	342.4	9823.1	1280	20318	3	122.0	76.0	49.0		0.7	1.53	
MK-077	Makueni	C2451	KILALA	163/3			338708	9804675	338.7	9804.7	1219	20382	3	78.0	42.0	6.0		0.1	6.50	II
MK-078	Makueni	C2452	YOANI	162/3			303479	9795434	303.5	9795.4	1524	20390	3	107.0	85.0	70.0			1.80	
MK-079	Makueni	C2453	OKIA	162/4			333145	9804671	333.1	9804.7	1317	20411	3	61.0						
MK-080	Makueni	C2454	NZIU	163/3			336855	9799146	336.9	9799.1	1219	20412	3	110.0	105.0	6.1			2.70	II
MK-081	Makueni	C2476	CHYULU HILLS	183/1			388844	9697859	388.8	9697.9	1067	1955/10/17	3	145.0	127.0	121.0				
MK-082	Makueni	C2477	CHYULU HILLS	183/1			392544	9699697	392.5	9699.7	1006	20423	3	108.0	47.0	46.0				
MK-083	Makueni	C2498	SIMBA	174/1			351723	9765991	351.7	9766.0	1204	20553	3	118.0					0.00	
MK-084	Makueni	C2515	KASIKEU MARKET	162/4			320179	9784393	320.2	9784.4	1280	20625	3	55.0						
MK-085	Makueni	C2520	KILALA	162/4			333166	9780723	333.2	9780.7	1234	20627	3	122.0	117.0	69.0			6.50	
MK-086	Makueni	C2556	KASIKEU	162/4			320179	9784393	320.2	9784.4	1265	1956/7/27	3	21.0	15.0	3.0				
MK-087	Makueni	C2604	KASIKEU	162/4			320179	9784393	320.2	9784.4	1737	1956/10/1	3	96.0						
MK-088	Makueni	C2695	SULTA HAMUD	173/2			310937	9760423	310.9	9760.4	1311	21030	3	108.0	102.0	61.8		1.0	11.40	
MK-089	Makueni	C2747	MBOONI	162/3			305335	9797282	305.3	9797.3	1372	21207	3	182.0	71.1	59.0			1.03	II
MK-090	Makueni	C2777	MTITO ANDEI	183/1			401817	9697869	401.8	9697.9	930	21224	3	138.0	56.0	52.0			0.06	
MK-091	Makueni	C2778	MTITO ANDEI	183/3			396263	9692338	396.3	9692.3	975	21238	3	52.0	43.0	27.0		5.0	4.68	
MK-092	Makueni	C2779	MTITO ANDEI	183/3			396263	9692338	396.3	9692.3	975	21247	3	67.0	48.0	37.0			0.06	
MK-093	Makueni	C2824	YOANI	162/3			301632	9795432	301.6	9795.4	1524	21415	3	116.0	73.0	60.0				
MK-094	Makueni	C2829	YOANI	163/1			336837	9823104	336.8	9823.1	1920	21399	3	108.0	60.0	58.0			0.54	
MK-095	Makueni	C2849	ULU	162/3			303477	9797281	303.5	9797.3	1707	21539	3	122.0						
MK-096	Makueni	C2855	YOANI	149/4			331261	9839685	331.3	9839.7	1646	21556	3	92.0	78.0	59.0			3.60	
MK-097	Makueni	C2860	YOANI	162/3			305343	9789907	305.3	9789.9	1646	21583	3	71.0	71.0	43.0			10.00	
MK-098	Makueni	C2896	KIMA	162/4			307201	9789909	307.2	9789.9	1372	21639	3	65.0	55.0	43.0			18.20	
MK-099	Makueni	C2921	MTITO ANDEI	183/3			399963	9694176	400.0	9694.2	853	21792	3	158.0	128.0	67.0				
MK-100	Makueni	C2944	MTITO ANDEI	183/3			396265	9690492	396.3	9690.5	975	21843	3	76.0	69.0	39.0		3.0	13.10	
MK-101	Makueni	C2975		173/2			310933	9764116	310.9	9764.1	1509	21855	3	213.0	95.0	85.0			9.12	
MK-102	Makueni	C3092	MTITO ANDEI	183/3			403679	9675763	403.7	9675.8	914	22225	3	92.0	37.0	24.0			5.40	
MK-103	Makueni	C3116	MTITO ANDEI	183/3			407395	9670239	407.4	9670.2	914	22302	3	10.0	10.0				5.94	
MK-104	Makueni	C3121	MTITO ANDEI	183/1			407371	9703400	407.4	9703.4	701	22366	2	96.0	31.0	26.0			1.27	

No.	District	BH No.	Location Name	Map sheet	Longitude E	Latitude N	X grid (m)	Y grid (m)	X grid (km)	Y grid (km)	Altitude (m)	Completion date	Litho-logy	Drilling depth (GL-m)	Depth of Aquifer (GL-m)	Static Water Level (GL-m)	Pumping Water Level (GL-m)	Draw-down (m)	Pumping rate (m3/h)	Level Type
MK-105	Makueni	C3128	MARWA EST.KIMA	162/3			299779	9789901	299.8	9789.9	1524	22456	3	144.0	76.0	69.0			0.16	
MK-106	Makueni	C3132	MARWA EST.KIMA	162/3			303484	9789905	303.5	9789.9	1524		3	158.0	137.0	41.0			2.60	
MK-107	Makueni	C3135	NGULIA NO 2	183/3			407394	9672074	407.4	9672.1	914	22512	3	74.0	42.0	27.4			0.02	
MK-108	Makueni	C3145	NDAWE	183/3			411093	9673922	411.1	9673.9	1067	22558	3	141.0	29.0	5.0			1.68	
MK-109	Makueni	C3315	MACHAKOS	162/3			301634	9793585	301.6	9793.6	1524	23638	3	114.0	53.0	5.0			0.58	
MK-110	Makueni	C3322	MTITO ANDEI	183/1			403660	9701551	403.7	9701.6	762	23784	3	82.0	40.0	4.0			13.18	
MK-111	Makueni	C3323	KENANI HILL	183/4			420340	9692355	420.3	9692.4	610	23804	3	57.0					0.00	
MK-112	Makueni	C3336	TSAVO PARK	183/4			427761	9679460	427.8	9679.5	610	23897	3	85.0	43.0	35.0			1.38	
MK-113	Makueni	C3338	SULTAN HAMUD	173/2			310923	9773327	310.9	9773.3	1528	23743	3	137.0	49.0	37.8			5.90	
MK-114	Makueni	C3347	TSAVO PARK	183/1			390682	9721804	390.7	9721.8	884	23886	3	50.0	15.0	11.0			7.00	
MK-115	Makueni	C3356	NBI/MBS ROAD	183/4			420340	9692355	420.3	9692.4	1615	23947	3	107.0	107.0	44.0			2.88	
MK-116	Makueni	C3510	MAKUENI	162/3			296072	9791744	296.1	9791.7	1524	25073	3	84.0	78.0	14.0			13.00	
MK-117	Makueni	C3755	TAWA	162/2			327565	9826779	327.6	9826.8	1301	26042	3	107.0	92.0	36.0				
MK-118	Makueni	C3977	KATHONZWENI	163/3			359113	9788108	359.1	9788.1	1040	27048	3	152.0	94.0	41.0		42.0	4.27	
MK-119	Makueni	C4009	MAKUENI	163/3			349834	9804684	349.8	9804.7	1066	27120	3	134.0	36.0	29.0		5.0	0.75	II
MK-120	Makueni	C4016	MAKUENI	163/3			349834	9804684	349.8	9804.7	1066	27178	3	92.0	4.0	3.0		6.0	4.50	II
MK-121	Makueni	C4275	MATILIKU	163/3			336867	9784408	336.9	9784.4	1040	28084	3	80.0	50.0	42.0		29.0	4.50	II
MK-122	Makueni	C4878	KAKO MUKA W/S	163/3			337400	9797700	337.4	9797.7		29705	3	60.0	28.0	3.0		8.0	2.88	
MK-123	Makueni	C5054	MASONGALENI	175/3			403635	9738394	403.6	9738.4	700	30022	3	26.0	18.0	7.0		5.0	2.52	
MK-124	Makueni	C5055	MASONGALENI	175/3			399932	9738391	399.9	9738.4		30033	3	25.0	20.0	15.0			2.70	
MK-125	Makueni	C5067	KAKO-SAVANI VALLEY	149/			348480	9811820	348.5	9811.8		30011	3	80.0	47.0					
MK-126	Makueni	C5095	MAKUENI	163/1			352500	9807700	352.5	9807.7		30076	3	85.0					0.00	
MK-127	Makueni	C5110	KALAWA				356500	9813300	356.5	9813.3		30121	3	64.0	56.0	49.0			18.00	
MK-128	Makueni	C5262					336600	9785180	336.6	9785.2			3							
MK-129	Makueni	C5759	UNOA	163/3			346600	9803400	346.6	9803.4	1250	31048	3	126.0	110.0	17.0			1.68	
MK-130	Makueni	C6009		162/4			317320	9779300	317.3	9779.3				140.0					0.00	
MK-131	Makueni	C6010		162/4			317340	9779320	317.3	9779.3				120.0	108.0	34.0				
MK-132	Makueni	C6036	EMALI	173/2			331317	9771501	331.3	9771.5	1101	31099	3	124.0	96.0	55.0		8.0	1.50	
MK-133	Makueni	C4745	MATILIKU	163/3			336100	9785100	336.1	9785.1	1160	29231	3	31.0	20.0	5.0				
MK-134	Makueni	C4753	KAKO				349500	9811000	349.5	9811.0		29247	3	98.0	50.0					
MK-135	Makueni	C4772	KAKO	163/1			349500	9848000	349.5	9848.0		29357	3	80.0	66.0					
MK-136	Makueni	C7294					305780	9794320	305.8	9794.3	1500	1987/7/1	3	100.0	56.0	55.0				
MK-137	Makueni	C7963	KATHONZWENI	163/3	37.73	-1.92	358446	9788960	358.4	9789.0	1090	32319	3	130.0	46.0	34.9		9.0		
MK-138	Makueni	C8144	KATHONZWENI	163/3	37.74	-1.92	351820	9788800	351.8	9788.8	1015	33160	3	99.0	46.0	40.0		3.3		
MK-139	Makueni	C8519	KATHONWENI				358120	9788860	358.1	9788.9										
MK-140	Makueni	C8745	WOTE	163/3	37.66	-1.76	351136	9805100	351.1	9805.1	1100	32914	1	97.0	30.0	1.7	16.0	14.3	6.20	II
MK-141	Makueni	C9004	TSAVO LODGE		38.17	-2.68	406659	9703456	406.7	9703.5	700	33350	9	57.0	46.0	14.0		7.0	26.00	
MK-142	Makueni	C9750	NGAAMBA	162/3			291350	9790500	291.4	9790.5		33472	2	100.0	68.0	50.0			0.55	
MK-143	Makueni	C10036	MTITO ANDEI	183/1			404709	9706381	404.7	9706.4				70.0	46.0	26.0	34.0	8.0	1.80	I
MK-144	Makueni	C10334	MTITO ANDEI	183/1	38.17	-2.69	407300	9702400	407.3	9702.4	746	33924	8	75.0	38.0	16.9		12.0	6.30	
MK-145	Makueni	C10405	NTHONGONI	183/1			393400	9700200	393.4	9700.2		34057	1	100.0	40.0	8.0		3.0	7.76	
MK-146	Makueni	C10406	MAKUTANO	183/1	38.05	-2.66	395420	9712120	395.4	9712.1		34088	1	48.0		23.0				
MK-147	Makueni	C10667	KANDOLO	162/4	37.37	-1.95	317700	9784500	317.7	9784.5	1100	34465	3	61.0	42.5	35.5			18.80	
MK-148	Makueni	C11153	MASONGALINI		38.50	-3.30	444454	9634772	444.5	9634.8	4129	34902	1	87.5	70.0	18.3		1.5	1.20	
MK-149	Makueni	C11154	MASONGALENI		38.51	-3.68	334644	9593659	334.6	9593.7	4129	34891	2	81.0	72.0	11.2		1.5	6.00	
MK-150	Makueni	C11353	DARAJANI	183/1			400900	9714700	400.9	9714.7				125.0	48.0	36.0			1.26	II
MK-151	Makueni	C11615	KAMBU	183/1			395600	9712600	395.6	9712.6				100.0	40.0	51.8			11.00	
MK-152	Makueni	C11673	MTITO ANDEI	183/3			406400	9703200	406.4	9703.2										
MK-153	Makueni	C12054	HETANI	162/2			322300	9826200	322.3	9826.2		36008	2	75.0	50.0	15.0			4.00	II
MK-154	Makueni	C12055	MALIVANI	163/3			340990	9801780	341.0	9801.8		35916	2	100.0	70.0	8.0			7.00	II
MK-155	Makueni	C12056	KALAWA	163/3			355500	9818100	355.5	9818.1		36008		96.0					0.00	
MK-156	Makueni	C12057	NZUENI	163/3			346135	9797320	346.1	9797.3		36008	2	110.0	70.0	60.0			5.00	II
MK-157	Makueni	C12058	THAVU	163/3			362831	9784490	362.8	9784.5		36008	2	34.0	11.0	4.0			5.00	II
MK-158	Makueni	C12238	KAITI	162/2			319450	9809650	319.5	9809.7				114.0	40.0	30.0			0.80	I
MK-159	Makueni	C12239		162/2			324700	9808350	324.7	9808.4										
MK-160	Makueni	C12339		163/3			344271	9804680	344.3	9804.7										
MK-161	Makueni	C13126		163/3			347100	9800500	347.1	9800.5									1.20	
MK-162	Makueni	C13262	KALAWA Divisiob Hqs	163/1	37.70	-1.65	356300	9817540	356.3	9817.5	1160	37053		96.0	52.0	21.1	84.0		3.90	
MK-163	Makueni	C13263	Watema	162/2	37.26	-1.68	310086	9811880	310.1	9811.9	1800	37072		130.0	43.0	18.8	99.0		0.66	
MK-164	Makueni	C13265	Mwanyani Dispensary	74/1&174	37.50	-2.03	333480	9775280	333.5	9775.3	1190	37074		130.0	87.0	57.8	71.1		1.32	
MK-165	Makueni	C13509	MAKUTANO	183/3			407300	9702600	407.3	9702.6										
MK-166	Makueni	P28	KIU STATION	162/3	37.16	-1.89	295400	9790600	295.4	9790.6		10584	2	53.0	24.0	4.0			15.75	
MK-167	Makueni	P57	KILUNGU	162/4	37.28	-1.95	309150	9784200	309.2	9784.2		10778	1	45.4	35.0	9.1			4.68	
MK-168	Makueni	P98	ULU	162/	37.19	-1.83	299000	9798000	299.0	9798.0		11101	2	60.0	49.0	46.0			2.73	
MK-169	Makueni	P127	MACHAKOS/SIMBA	174/1	37.70	-2.08	355660	9769800	355.7	9769.8		11323	2	36.0					0.00	
MK-170	Makueni	P143	SIMBA	174/1			349250	9769750	349.3	9769.8		11571	2	60.0					0.00	
MK-171	Makueni	U4	KAMBU	183/1	38.03	-2.62	392510	9710184	392.5	9710.2	930	20^may		70.0	10.0	4.0				
MK-172	Makueni	U6	MAKAME AMBEO	174/1	37.64	-2.08	349122	9769847	349.1	9769.8	1040	37405		98.0	69.0	40.0			15.00	II
MK-173	Makueni	U8	MAIYANI	162/4	37.30	-1.92	311157	9787964	311.2	9788.0	1970	37419		72.0	34.0	8.0			8.00	
MK-174	Makueni	U9	TAWA CENTER	162/2	37.45	-1.10	326968	9878677	327.0	9878.7	1300	37424		80.0	32.0	12.0			5.00	
MK-175	Makueni	U10	KIVUTINI	163/3	37.57	-1.79	340328	9802705	340.3	9802.7	1200	37432		52.0	20.0	6.0			30.00	
MK-176	Makueni	-	Maiani B/H		37.30	-1.85	310957	9796133	311.0	9796.1										
MK-177	Makueni	-	Mwani B/H		37.37	-2.00	319027	9778887	319.0	9778.9										
MK-178	Makueni	-	Maatha Water Project		37.51	-2.03	333620	9775460	333.6	9775.5										
MK-179	Makueni	-	New Kilala Water Project		37.53	-1.77	336605	9804314	336.6	9804.3										
MK-180	Makueni	-	Yandia River near 113		37.54	-1.99	337047	9779772	337.0	9779.8										
MK-181	Makueni	-	Wamyatu		37.55	-2.00	338042	9779551	338.0	9779.6										
MK-182	Makueni	-		182/2			388500	9712280	388.5	9712.3										
MK-183	Makueni	-					305780	9794320	305.8	9794.3	1500	31959	3	100.0	56.0	55.0				
MK-184	Makueni	-	Komboyo B/H		38.00	-2.61	388675	9712116	388.7	9712.1										
MK-185	Makueni	-	Mbui Nzau B/H		38.07	-2.38	395972	9736879	396.0	9736.9										
MK-186	Makueni	-	Umani Spring		37.91	-2.45	378615	9728919	378.6	9728.9										
MK-187	Makueni	-	Msima Spring		38.02	-2.69	390776	9702388	390.8	9702.4										
MK-188	Makueni	-	Mtiti-a-Ndei B/H		38.17	-2.69	406695	9702388	406.7	9702.4										
MK-189	Makueni	TW-2	JICA-BD TW-2		37.60	-1.94	343570	9785631	343.6	9785.6				103.0		9.1		86.6	0.18	
	Makueni	96	Muambani (JICA 2nd IRS)		E37°38'45.0"	S01°48'26.6"								128	[illegible]	23.76		70.57	0.9	
	Makueni	98	Nguumo/Senda (JICA 2nd IRS)		E37°39'08.1"	S1°53'57.8"								Dry	-	-			Dry	
	Makueni	102	Kithunzi (JICA 2nd IRS)		E37°33'25.1"	S01°45'50.4"								155	[illegible]	5		132.32	2.7	
	Nzaui	110	Kanzili (JICA 2nd IRS)		E37°35'47.1"	S01°56'22.4"								Dry	-	-			Dry	
	Nzaui	111	Kilili Secondary School (JICA 2nd IRS)		E37°34'25.2"	S01°54'14.1"								Dry	-	-			Dry	
	Nzaui	112	Mulenyu (JICA 2nd IRS)		E37°37'27.2"	S01°56'51.1"								Dry	-	-			Dry	
	Mbooni east	121	Ititu (JICA 2nd IRS)		E37°43'35.3"	S01°44'22.5"								100	23-34, 48-58, 70-82, 89-98	9.15		3.93	15.0	
	Mbooni east	123	Ngunini (JICA 2nd IRS)		E37°40'17.6"	S01°37'34.0"	Remark: Existent borehole, Test pumping and Water quality tests only							87	67.0	51.3		13.9	1.7	
	Mukaa	127	Kwekolya (JICA 2nd IRS)		E37°10'10.9"	S01°54'15.0"								Dry	-	-			Dry	
	Mkaa	128	Enzae (JICA 2nd IRS)		E37°18'52.0"	S01°50'31.8"								Dry	-	-			Dry	
	Mkaa	133	Mangala (JICA 2nd IRS)		E37°19'58.7"	S01°54'59.6"								120	48-54, 60-78, 96-102, 108-114	16.28		25.57	9.0	
	Mkaa	134	Nguuni (JICA 2nd IRS)		E37°23'46.2"	S01°58'08.6"								Dry	-	-			Dry	
	Nzaui	137	Mbulutini (JICA 2nd IRS)		E37°35'19.3"	S02°06'08.7"								100	18-34, 38-54, 60-82, 84-102, 108-114	1.95		2.59	15.7	
	Kibwezi	142	Utu (JICA 2nd IRS)		E37°58'12.7"	S02°36'43.5"	Remark: Existent borehole, Test pumping and Water quality tests only							100→84	42-48	35.0→			1.7	
	Kibwezi	146	Kitengei (JICA 2nd IRS)		E38°08'14.2"	S02°32'56.7"								120	[illegible]	22.18		15.72	1.0	

No.	District	BH No.	PH	COLOR	TURB	PV	COND	TDS	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	THARD	TALK	Cl (mg/l)	F (mg/l)	SO4 (mg/l)	PO4 (mg/l)	FCO2 (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	NO2 (mg/l)	NO3 (mg/l)	SiO2 (mg/l)	Cu (mg/l)	Zn (mg/l)	Pb (mg/l)	As (mg/l)
MC-001	Machakos	C401	7.3	5	0			282	470	0.2		60.0	11.0	25.0	7.0	198.0	273.0	18.0	0.2	14.0		13.0	0.0	273.0	0.0	0.0	70.0				
MC-002	Machakos	C436	7.6	5	0			414	690	0.1		49.0	13.0	68.0	7.0	178.0	264.0	102.0	0.6	9.0		10.0	0.0	364.0	0.0	4.0	15.0				
MC-003	Machakos	C473																													
MC-004	Machakos	C492																													
MC-005	Machakos	C1133																													
MC-006	Machakos	C1430																													
MC-007	Machakos	C1493	7.3	0	0			380	608	0.0		32.0	33.0			216.0	254.0	31.0	1.4	0.3			0.0	254.0	0.1	0.0	70.0				
MC-008	Machakos	C1507	7.5					715	1144	0.2		86.0	33.0			351.0	426.0	62.0	2.3	80.0							74.0				
MC-009	Machakos	C1508																	1.4												
MC-010	Machakos	C1571						960	1536	0.1		118.0	46.0			484.0	465.0	217.0	2.9	45.0											
MC-011	Machakos	C1572																													
MC-012	Machakos	C1595	7.2	0	0			879	1406	0.0		94.0	36.0			383.0	437.0	165.0	2.4	48.0			0.0	437.0	0.0	0.0	36.0				
MC-013	Machakos	C1632																													
MC-014	Machakos	C1864																													
MC-015	Machakos	C1949																													
MC-016	Machakos	C1972																													
MC-017	Machakos	C1973																													
MC-018	Machakos	C1989																													
MC-019	Machakos	C2019																													
MC-020	Machakos	C2024																													
MC-021	Machakos	C2041																													
MC-022	Machakos	C2132																													
MC-023	Machakos	C2266																													
MC-024	Machakos	C2333																													
MC-025	Machakos	C2357																													
MC-026	Machakos	C2406	7.5	10	8	2.00		183	305	0.7	0.1	0.8	0.4	83.0		14.0	162.0	13.0		7.0											
MC-027	Machakos	C2407																													
MC-028	Machakos	C2427																													
MC-029	Machakos	C2474																													
MC-030	Machakos	C2731																													
MC-031	Machakos	C2815																													
MC-032	Machakos	C2943																													
MC-033	Machakos	C3124																													
MC-034	Machakos	C3151																													
MC-035	Machakos	C3453																													
MC-036	Machakos	C3454	7.6					1560	2496	0.0						1060.0	385.0	46.0		631.0											
MC-037	Machakos	C3679																													
MC-038	Machakos	C3776	7.2	35	14			220	260	0.0		28.0	10.0	26.0	4.0	110.0	173.0	7.0	0.4	3.0		30.0	0.0	173.0	2.3	2.7	60.0				
MC-039	Machakos	C3842																													
MC-040	Machakos	C3957	7.5	0	0			1660	2656	4.0	0.0	252.0	78.0	95.0	54.0	955.0	264.0	110.0	0.3	1033.0					0.2	8.9					
MC-041	Machakos	C3967	7.6	5			800	540	864		0.1	88.0	30.0	48.0	12.0	346.0		42.0	0.5	50.0		23.0		249.0	0.0		30.0				
MC-042	Machakos	C3997																													
MC-043	Machakos	C4000	6.9	0	0	0.20		290	315	0.4	0.1	26.0	7.0	32.0	3.0	94.0	163.0	16.0	1.5	8.0		9.0		163.0	0.0	0.0	100.0				
MC-044	Machakos	C4039	7.2	5		0.20		575	1000	0.0	0.2	77.0	40.0	36.0	8.0	360.0	432.0	107.0	0.0	37.0		5.0		432.0	0.0	11.1	60.0				
MC-045	Machakos	C4162																													
MC-046	Machakos	C4295	6.7	5	10	16.00		390	650	0.1						168.0	125.0	175.0	0.3												
MC-047	Machakos	C4452	8.0	5	5	6.00		888	1479	0.4	1.3					564.0	192.0	119.0	0.8	290.0											
MC-048	Machakos	C4483	7.2	5	15	28.00		990	1650	0.7	0.5					1000.0	214.0	200.0	0.4	624.0											
MC-049	Machakos	C4541	6.2	5	2				126	0.1		2.5	1.4	15.1				19.7	0.3						0.0	1.0					
MC-050	Machakos	C4978																													
MC-051	Machakos	C5004	8.0		4	7.90	980	588	941			94.0	30.0			358.0	280.0	82.0	1.1	37.0											
MC-052	Machakos	C5255	7.6		3	12.60	500	300	480	0.7	0.1	17.0	9.3					76.0	0.6	18.7				170.6							
MC-053	Machakos	C5256	6.0		21	6.32		90	150	1.1	0.1	0.9	1.4			32.0	26.0	18.0	0.2	0.6	0.1			31.7							
MC-054	Machakos	C5440	6.8					1086	1738	0.0	0.0								0.8												
MC-055	Machakos	C6035																													
MC-056	Machakos	C6038	8.2	30	25	0.30		498	830	4.5	0.3	47.0	82.0	150.0	8.9	364.0	205.0	115.0	1.1	216.0				250.0							
MC-057	Machakos	C6301																													
MC-058	Machakos	C6890																													
MC-059	Machakos	C9473	8.0	100	33	2.10		154	257	1.6	0.5	13.0	5.0	30.0	23.0	54.0	70.0	9.0	0.4	30.0	0.0	8.0			1.0						
MC-060	Machakos	C10622																													
MC-061	Machakos	C10875																													
MC-062	Machakos	C11092																													
MC-063	Machakos	C11274																													
MC-064	Machakos	C11434																													
MC-065	Machakos	C11619																													
MC-066	Machakos	C11696																													
MC-067	Machakos	C11854	7.3	5	1	0.40		360	520	0.2	0.0	65.6	21.6	110.6	12.3	254.0	274.0	86.0	2.0	60.0		5.0	0.0	274.0	0.1	0.0	40.0				
MC-068	Machakos	C11856																													
MC-069	Machakos	C11923																													
MC-070	Machakos	C11926	7.5	5	1	0.75		4800	7000	0.0	1.0	200.0	90.0	620.6	15.8	900.0	400.0	1150.0	3.0	1500.0		5.0	0.0	400.0	0.0	0.0	20.0				
MC-071	Machakos	C11936																													
MC-072	Machakos	C11942	7.2	5	1	2.30		800	1200	0.4	2.1	36.0	69.6	78.7	13.1	380.0	370.0	130.0	0.4	60.0		10.0	0.0	370.0	1.0	0.0	20.0				
MC-073	Machakos	C11943																													
MC-074	Machakos	C11976																													
MC-075	Machakos	C12053																													
MC-076	Machakos	C12060																													
MC-077	Machakos	U1																													
MC-078	Machakos	U3																													
MC-079	Machakos	-	7.8					425	680	0.0	0.0								1.5												
MC-080	Machakos	-	7.5					1675	2680	0.0	0.0								0.0												
MC-081	Machakos	-	7.3					1275	2040	0.0	0.0								1.5												
MC-082	Machakos	-	7.0					1294	2070		1.0								0.8												
MC-083	Machakos	-	6.9					878	1405	0.0	0.0								0.4												
MC-084	Machakos	-																													
MC-085	Machakos	TW-1		0	5			3464	4100	0.6	0.1	290.0	571.0	851.0	9.9	175.0	495.0	151.0	1.1	193.0	1.1				0.2	0.0	33.6				
	Masinga	148																													
	Masinga	151	7.47	5	2			1,345	2,170	0.12	0.02	220		400				275	2.80	354					<0.01	1.2		<0.01	1.1	<0.01	<0.01
	Yatta	156																													
	Yatta	158	7.5	15	25			1,817		0.45	0.06	440		383				600	1.40	209					<0.01	3.1		<0.01	1.2	<0.01	<0.01
	Yatta	162	7.73	15	6			756	1,220	0.28	0.02	540		30				37	1.2	31.4					0.01	1.5		<0.01	0.01	<0.01	<0.01
	Yatta	163	6.73	<5	3			402	648	0.1	<0.01	208		52.2				82	0.5	2.86					<0.01	0.36		<0.01	0.03	<0.01	
	Yatta	165																													
	Kathiani	167	8.21	5	2			569	917	0.12	<0.01	128		150				49	1.45	32.6					0.01	0.15		<0.01	0.02	<0.01	<0.01
	Mwala	172	7.2	10	2			683	942	0.3	0.07	450		188.3				250	1.50	100					0.013	-		0.013	0.018	Not detected	<0.01
	Mwala	173																													
	Mwala	175																													
	Mwala	177	7.14	5	1			1,227	1,979	0.12	<0.01	710		127				310	1.0	42					<0.01	0.36		<0.01	0.02	<0.01	<0.01
	Mwala	178																													
	Kangundo	180	6.9	12	1			1,580	2,257	0.08	Not detected	420		146				450	0.50	320					Not detected	-		Not detected	0.284	Not detected	<0.01
	Yathui	183	7.77	5	2			583	940	0.14	<0.01	144		126.5				56	2.9	9.43					<0.01	<0.1		<0.01	0.01	<0.01	<0.01
	Mwala	185																													
	Mwala	186	7	8	0			1,750	2,520	0.3	0.4	1,150		155.9				400	2.0	300					Not detected	-		Not detected	1.47	Not detected	<0.01
	Mwala	187	7.1	5	0			820	1,166	0.002	0.008	500		130.9				250	1.5	100					0.2	-		Not detected	2.29	Not detected	<0.01
	Masinga	188																													
	Masinga	189	6.87	10	4			371		<0.01	0.06	222		35				43	0.76	63					<0.01	0.32		<0.01	2.4	<0.01	<0.01
	Masinga	191																													
	Masinga	195																													
	Masinga	196																													
	Masinga	197	7.56	<5	1			1,082		<0.01	0.02	480		180				40	3.0	226					<0.01	0.43		<0.01	1.8	<0.01	<0.01
	Machakos	200	7.04	10	1			65	106	0.22	0.01	28		11.2				6	0.32	19.14					<0.01	<0.1		<0.01	0.02	<0.01	<0.01

No.	District	BH No.	PH	COLOR	TURB	PV	COND	TDS	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	THARD	TALK	Cl (mg/l)	F (mg/l)	SO4 (mg/l)	PO4 (mg/l)	FCO2 (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	NO2 (mg/l)	NO3 (mg/l)	SiO2 (mg/l)	Cu (mg/l)	Zn (mg/l)	Pb (mg/l)	As (mg/l)
MK-001	Makueni	C6																													
MK-002	Makueni	C16																													
MK-003	Makueni	C17																													
MK-004	Makueni	C18																													
MK-005	Makueni	C19																													
MK-006	Makueni	C33																													
MK-007	Makueni	C34																													
MK-008	Makueni	C51																													
MK-009	Makueni	C52																													
MK-010	Makueni	C55																													
MK-011	Makueni	C60																													
MK-012	Makueni	C82	7.0					450	720	0.0		32.0				86.0	186.0	213.0	2.0	0.3			0.0	186.0		0.0	65.0				
MK-013	Makueni	C120																	3.7												
MK-014	Makueni	C305																													
MK-015	Makueni	C315																													
MK-016	Makueni	C328	6.9	30				1960	3136	5.6		240.0	86.0			950.0	192.0	232.0		865.0			0.0	192.0	0.0	0.0					
MK-017	Makueni	C359																													
MK-018	Makueni	C398																													
MK-019	Makueni	C414																													
MK-020	Makueni	C427																													
MK-021	Makueni	C437	7.3									81.2	48.5			355.0	270.0	102.0	0.0	261.0			0.0	270.0	0.0	0.0					
MK-022	Makueni	C445																													
MK-023	Makueni	C446																													
MK-024	Makueni	C454																													
MK-025	Makueni	C461	7.9	5		0.10	1400	1125	1800	0.2	1.3	19.2	139.0	122.0	17.0	608.0		87.0	0.6	560.0		12.0		314.0	0.0		50.0				
MK-026	Makueni	C469																													
MK-027	Makueni	C474																													
MK-028	Makueni	C482																													
MK-029	Makueni	C488	7.0	0	0		1641	985	1576	0.0		125.0	26.0			419.0	416.0	112.0	1.6	30.0			0.0	416.0	0.0	0.0	30.0				
MK-030	Makueni	C500	7.2							0.0						1820.0	571.0	860.0	2.9	1640.0											
MK-031	Makueni	C518						5956	9530	0.0		617.0	254.0			2587.0	369.0	1688.0		1550.0											
MK-032	Makueni	C545	7.1					2757	4411			343.0	114.0			1326.0	307.0	210.0		1276.0					0.0	0.0					
MK-033	Makueni	C603																													
MK-034	Makueni	C610																													
MK-035	Makueni	C612																													
MK-036	Makueni	C687																													
MK-037	Makueni	C688																													
MK-038	Makueni	C1004																													
MK-039	Makueni	C1005																													
MK-040	Makueni	C1053																													
MK-041	Makueni	C1054																													
MK-042	Makueni	C1131																													
MK-043	Makueni	C1132																													
MK-044	Makueni	C1181																													
MK-045	Makueni	C1311																													
MK-046	Makueni	C1376	6.0					231	370							25.0	29.0	5.0	0.8						0.0		20.0				
MK-047	Makueni	C1455																													
MK-048	Makueni	C1485	7.7	0	0			1775	2840	0.0		220.0	73.0			850.0		490.0	0.9	136.0					0.1	30.0	50.0				
MK-049	Makueni	C1518																													
MK-050	Makueni	C1557																													
MK-051	Makueni	C1578	6.9	0	0			890	1424	0.1		44.0		121.0		483.0	304.0	98.0	1.6												
MK-052	Makueni	C1579																													
MK-053	Makueni	C1580																													
MK-054	Makueni	C1667	6.9	0	0			545	872	0.1		67.0	31.0			295.0	375.0	49.0	0.7	32.0					0.0	0.0	44.0				
MK-055	Makueni	C1668																													
MK-056	Makueni	C1802																													
MK-057	Makueni	C1804																													
MK-058	Makueni	C1835																													
MK-059	Makueni	C1849																													
MK-060	Makueni	C1856																													
MK-061	Makueni	C1885																													
MK-062	Makueni	C1886																													
MK-063	Makueni	C1890																													
MK-064	Makueni	C1945																													
MK-065	Makueni	C2004																													
MK-066	Makueni	C2123																													
MK-067	Makueni	C2130																													
MK-068	Makueni	C2150																													
MK-069	Makueni	C2182																													
MK-070	Makueni	C2203																													
MK-071	Makueni	C2232																													
MK-072	Makueni	C2267																													
MK-073	Makueni	C2284																													
MK-074	Makueni	C2365																													
MK-075	Makueni	C2370																													
MK-076	Makueni	C2426																													
MK-077	Makueni	C2451																													
MK-078	Makueni	C2452																													
MK-079	Makueni	C2453																													
MK-080	Makueni	C2454																													
MK-081	Makueni	C2476																													
MK-082	Makueni	C2477																													
MK-083	Makueni	C2498																													
MK-084	Makueni	C2515																													
MK-085	Makueni	C2520																													
MK-086	Makueni	C2556																													
MK-087	Makueni	C2604																													
MK-088	Makueni	C2695	7.7	5	0		1000	470	752	0.3		16.0	40.0	74.0	20.0	198.0	270.0	50.0	0.1	110.0		10.0	0.0	270.0	0.0	0.0	40.0				
MK-089	Makueni	C2747																													
MK-090	Makueni	C2777																													
MK-091	Makueni	C2778																													
MK-092	Makueni	C2779																													
MK-093	Makueni	C2824																													
MK-094	Makueni	C2829																													
MK-095	Makueni	C2849																													
MK-096	Makueni	C2855	7.5	0				1250	2000	0.7						558.0	512.0	98.0	0.6	329.0											
MK-097	Makueni	C2860																													
MK-098	Makueni	C2896																													
MK-099	Makueni	C2921																													
MK-100	Makueni	C2944	8.2	5	3	0.16	1900	1140	1824	0.1	0.0	100.0	68.0			380.0	390.0	100.0	0.5	34.0	0.0										
MK-101	Makueni	C2975																													
MK-102	Makueni	C3092																													
MK-103	Makueni	C3116																													
MK-104	Makueni	C3121	7.8	5	1	8.50	1400	840	1344	0.3	0.1	69.0	30.0	110.0		372.0	314.0	189.0	2.2	93.0											

No.	District	BH No.	PH	COLOR	TURB	PV	COND	TDS	EC (µS/cm)	Fe (mg/l)	Mn (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	THARD	TALK	Cl (mg/l)	F (mg/l)	SO4 (mg/l)	PO4 (mg/l)	FCO2 (mg/l)	CO3 (mg/l)	HCO3 (mg/l)	NO2 (mg/l)	NO3 (mg/l)	SiO2 (mg/l)	Cu (mg/l)	Zn (mg/l)	Pb (mg/l)	As (mg/l)
MK-105	Makueni	C3128																													
MK-106	Makueni	C3132																													
MK-107	Makueni	C3135																													
MK-108	Makueni	C3145																													
MK-109	Makueni	C3315																													
MK-110	Makueni	C3322	7.5					926	1482			71.0	65.0	84.0	16.0	440.0	584.0	108.0	1.5												
MK-111	Makueni	C3323																													
MK-112	Makueni	C3336	7.6	0	0			4119	6590	0.0		293.0	388.0	592.0	34.0	2450.0		1720.0	1.5	151.0							60.0				
MK-113	Makueni	C3338																													
MK-114	Makueni	C3347																													
MK-115	Makueni	C3356																													
MK-116	Makueni	C3510																													
MK-117	Makueni	C3755																													
MK-118	Makueni	C3977	7.3	0	0			1700	2720	0.0	0.0	247.0	74.0	182.0	11.0	920.0	441.0	740.0	0.5	70.0					0.1	33.0					
MK-119	Makueni	C4009	8.0	5		0.10	1100	740	1184	0.1	0.6	132.0	24.0	527.0	69.0	428.0		184.0	0.6	9.0				293.0	0.0	2.5	50.0				
MK-120	Makueni	C4016	7.1	5		0.20	2800	2020	3232	0.2	3.3	358.0	66.0	280.0	16.0	1170.0		220.0		1040.0		8.0		390.0			60.0				
MK-121	Makueni	C4275	8.1	5	45	2.00	1420	752	1203	0.8	0.3			30.0	7.0	178.0	132.0	192.0													
MK-122	Makueni	C4878																													
MK-123	Makueni	C5054	8.2	5	25	56.00	1900	1140	1824	4.7	0.4	133.0	100.0	1020.0	15.0	690.0	112.0	1140.0	1.7	109.0	0.1										
MK-124	Makueni	C5055																													
MK-125	Makueni	C5067	8.2		96	6.00	450	270	432			21.0	24.0			140.0	152.0	16.0	0.4	16.8	0.0										
MK-126	Makueni	C5095																													
MK-127	Makueni	C5110	8.2		10		2000	1200	1920			83.0	87.0			514.0	126.0	366.0	0.5	108.0	0.1										
MK-128	Makueni	C5262																													
MK-129	Makueni	C5759																													
MK-130	Makueni	C6009																													
MK-131	Makueni	C6010																													
MK-132	Makueni	C6036	8.0	60	67		840	504	806	7.6	0.3	35.0	90.0	130.0	9.4	368.0	227.0	110.0	1.3	168.0				277.0							
MK-133	Makueni	C4745																													
MK-134	Makueni	C4753																													
MK-135	Makueni	C4772																													
MK-136	Makueni	C7294	7.7	5				1150	1600		0.4	112.0	29.0	189.0	13.3	600.0	490.0	64.0	0.9	275.0		12.0					55.0				
MK-137	Makueni	C7963																													
MK-138	Makueni	C8144																													
MK-139	Makueni	C8519																													
MK-140	Makueni	C8745	7.3	5	4	1.60	2000	1200	1920	0.1	2.0	279.0	168.0	160.0	15.0	1388.0	330.0	124.0	0.5	409.0	0.0	28.0			0.0						
MK-141	Makueni	C9004																													
MK-142	Makueni	C9750																													
MK-143	Makueni	C10036	6.9	5	1			630	900	0.0	0.5	60.0	55.2	53.0	5.4	380.0	330.0	111.0	0.7	30.0		9.0	0.0	330.0	0.1	0.0	120.0				
MK-144	Makueni	C10334	7.9	5	24	6.30	6500	3900	6500			624.0	261.0	714.0	37.0	2630.0	230.0	234.0	1.0	1068.0	0.1	30.0			0.2						
MK-145	Makueni	C10405																													
MK-146	Makueni	C10406																													
MK-147	Makueni	C10667																													
MK-148	Makueni	C11153																													
MK-149	Makueni	C11154																													
MK-150	Makueni	C11353																													
MK-151	Makueni	C11615																													
MK-152	Makueni	C11673																													
MK-153	Makueni	C12054																													
MK-154	Makueni	C12055																													
MK-155	Makueni	C12056																													
MK-156	Makueni	C12057																													
MK-157	Makueni	C12058																													
MK-158	Makueni	C12238																													
MK-159	Makueni	C12239																													
MK-160	Makueni	C12339																													
MK-161	Makueni	C13126																													
MK-162	Makueni	C13262	7.0	5	6	2.37	3250	2275	3640	0.7	0.0	424.0	191.0	118.0	22.0	1844.0	198.0	550.0	1.0	1057.0		480.0			0.0	9.0					
MK-163	Makueni	C13263	7.8	15	48	2.37	1602	1113	1781	3.1	0.2	200.0	57.0	65.0	20.0	733.0	273.0	170.0	0.7	200.0		178.0			0.0	14.0					
MK-164	Makueni	C13265	6.9	5	0	1.58	2400	1674	2678	0.2	0.0	304.0	155.0	98.0	17.0	1396.0	354.0	200.0	0.1	857.0		1098.0			0.0	6.2					
MK-165	Makueni	C13509																													
MK-166	Makueni	P28																													
MK-167	Makueni	P57																													
MK-168	Makueni	P98																													
MK-169	Makueni	P127																													
MK-170	Makueni	P143																													
MK-171	Makueni	U4																													
MK-172	Makueni	U6																													
MK-173	Makueni	U8																													
MK-174	Makueni	U9																													
MK-175	Makueni	U10																													
MK-176	Makueni	-	7.7					130	208	2.0	0.0								0.8												
MK-177	Makueni	-	7.6					538	861	0.0	0.0								0.4												
MK-178	Makueni	-	8.2					1656	2650	0.0	0.0								0.4												
MK-179	Makueni	-	7.8					505	808	0.0	0.0								1.5												
MK-180	Makueni	-	7.4					658	1053	0.1	0.5								0.4												
MK-181	Makueni	-	7.4					111	177		0.0								0.4												
MK-182	Makueni	-																													
MK-183	Makueni	-																													
MK-184	Makueni	-	7.2					1507	942	0.0	0.0								0.8												
MK-185	Makueni	-	7.7					4560	2850	0.0	0.0								2.5												
MK-186	Makueni	-	7.9					973	608	0.0									2.0												
MK-187	Makueni	-	7.8					1013	633	0.0									3.0												
MK-188	Makueni	-	7.7					4560	2850	0.0	0.0								2.0												
MK-189	Makueni	TW-2		0	8			3711	4190	0.3	0.1	322.0	1562.0	1163.0	23.4	144.0	379.0	82.0	1.4	1232.0	0.5				0.1	0.0					
	Makueni	96	7.5	Nil	Nil			2,040		Not detected	Not detected	1850		542				200	0.40	437.5					0.05	-		Not detected	1.36	0.018	<0.01
	Makueni	98																													
	Makueni	102	8	Nil	Nil			909		0.03	Not detected	600		103.1				75	0.50	700					Not detected	-		Not detected	0.42	0.024	<0.01
	Nzaui	110																													
	Nzaui	111																													
	Nzaui	112																													
	Mbooni east	121	6.9	5	1			1,168	1,700	0.3	0.08	850		265.3				222	1.50	350					0.04	-		0.93	1.84	0.114	<0.01
	Mbooni east	123	7.9	Nil	Nil			1,286		Not detected	Not detected	750		139.2				250	1.50	400					Not detected	-		Not detected	0.169	0.019	<0.01
	Mukaa	127																													
	Mkaa	128																													
	Mkaa	133	7.3	Nil	6			1,626		0.2	0.3	800		242.3				100	1.50	210					<0.003	0.3		1.03	1.45	<0.05	<0.05
	Mkaa	134																													
	Nzaui	137	7	15	2			6,490	9,220	1.2	0.9	3,000		234.4				320	3.30	350					0.02	-		0.14	1.24	-	<0.05
	Kibwezi	142	8.2	Nil	Nil			681		0.3	0.06	500		78.9				125	0.20	12					0.04	-		Not detected	0.04	0.008	<0.01
	Kibwezi	146	7.1	5	4			2,610		0.3	0.04	1280		158.7				960	0.40	200					0.08	0.55		0.94	1.32	<0.05	<0.05

8.2
Standards for Water Quality in Kenya

Chemical quality of Kenyan Standard in Practice Manual for Water Supply Services

1. Aesthetic Quality Requirements

Test Items	Unit	Kenyan Standard in the Manual		WHO Guideline
		Desirable	Permissible Level	Health based value
1. Total Dissolved Solids (TDS)	mg/l	1,500	-	Not proposed
2. Turbidity		5	25	Not proposed
3. Color		15	50	Not proposed
4. Taste		Shall not be offensive to consumers		-
5. Total Hardness	mg/l	500	-	-
6. Aluminum (Al)	mg/l	0.1	-	Not derived
7. Chloride (Cl)	mg/l	250	600	-
8. Copper (Cu)	mg/l	0.1	1.5	2.0
9. Iron (Fe)	mg/l	0.3	1.0	-
10. Manganese (Mn)	mg/l	0.1	0.5	0.4
11. Sodium (Na)	mg/l	200	-	-
12. Sulphate (SO_4)	mg/l	400	-	-
13. Zinc (Zn)	mg/l	5	15	-

2. Constituents of Health Significance

Test Items	Unit	Limit of Concentration
1. Arsenic (As)	mg/l	0.05
2. Cadmium (Cd)	mg/l	0.005
3. Chromium (Cr)	mg/l	0.05
4. Cyanide (Cn)	mg/l	0.01
5. Fluoride (F)	mg/l	3.0
6. Lead (Pb)	mg/l	0.05
7. Mercury (Hg)	mg/l	0.001
8. Nitrate (NO_3)	mg/l	10
9. Selenium (Se)	mg/l	0.01

8.3
Result of Power Source for Water Supply Facility

Larger Makueni District

No.	S. No.	Location					Coordination		No. of Beneficiary	Type of Facility* (Original)	Test Drilling			O&M			Type of Facility* (Final)	Remarks
		District	Division	Location	Sub-location	Community name	Latitude	Longitude			Drilling	Pumping	Result	O&M Cost (Ksh/yr)	Collected Fee (Ksh/yr)	Result		
1	96A	Makueni	Wote	Kikumini	Kambimawe	Muambani	S1˚48'33.5"	E37˚39'43.8"	2,415	G	●	●	Failed	355,791	925,549	OK	G	
2	98A	Makueni	Wote	Muvau	Kitonyoni	Kyuswani	S1˚54'44.4"	E37˚38'57.6"	1,509	G				355,312	578,324	OK	G	
3	100	Makueni	Wote	Kako	Kako	Kyaume	S1°43'05.6"	E37°39'51.6"	1,762	H				33,014	306,600	OK	H	
4	102	Makueni	Kaiti	Ukea	Kilala	Kithunzi	S1°45'50.4"	E37°33'25.1"	838	W	●	●	Successful	84,311	321,164	OK	W	
5	107	Mbooni east	Kisau	Waia	Usalala	Kyang'ondu Primary	S1°37'54.2"	E37°35'31.9"	1,522	H				33,014	61,320	OK	H	
6	108	Mbooni east	Kisau	Kisau	Usalala	Kisau Health Centre	S1°37'52.9"	E37°33'46.9"	1,269	H				33,014	61,320	OK	H	
7	110A	Nzaui	Matiliku	Kilili	Wee	Kanzili	S1˚55'36.9"	E37˚35'36.2"	740	G	●	Dry	Failed	33,014	283,605	OK	H	Changed to Handpump due to unsucessful well.
8	111A	Nzaui	Matiliku	Kilili	Kilili	Syaolwe	S1˚53'44.9"	E37˚35'16.2"	428	W	●	Dry	Failed	33,014	164,031	OK	H	Changed to Handpump due to unsucessful well.
9	112A	Nzaui	Matiliku	Kilili	Mulenyu	Loyal turban	S1˚57'12.7"	E37˚37'48.4"	381	G	●	Dry	Failed	33,014	146,018	OK	H	Changed to Handpump due to unsucessful well.
10	113	Nzaui	Matiliko	Kilili	Mulenyu	Mboani	S1°55'16.1"	E37°34'42.7"	727	H				33,014	278,623	OK	H	
11	114	Nzaui	Mbitini	Mulala	Ng'ethe	Kitandi	S1°58'19.8"	E37˚31'06.9"	3,018	G				33,014	204,272	OK	H	
12	118	Nzaui	Kalamba	Kithumba	Kithumba	Mathanguni	S1°55'01.0"	E37°30'14.4"	4,334	H				33,014	204,272	OK	H	
13	121	Mbooni east	Kalawa	Katengine	Ititu	Ititu	S1°44'22.5"	E37°43'35.3"	1,691	G	●	●	Successful	101,084	648,076	OK	S	
14	123	Mbooni east	Kalawa	Kawala	Mbukoni	Ngunini	S1°37'34.0"	E37°40'17.6"	328	H	-	●	Successful	101,084	125,706	OK	S	
15	124	Mbooni east	Kalawa	Athi	Miangeni	Kyamutuku	S1°37'32.9"	E37°44'56.2"	634	G				33,014	242,981	OK	H	
16	127A	Mukaa	Malili	Ngaamba	Itumbule	Kalembwani (Uvunye)	S1°55'54.8"	E37°11'18.1"	3,150	G				355,312	510,872	OK	G	
17	128A	Mukaa	Kilome	Mukaa	Mukaa	Enzae-Maiani	S1˚50'16.7"	E37˚19'13.2"	2,574	G	●	Dry	Failed	355,573	204,272	Change to handpump	H	Changed to Handpump due to unsucessful well and unable to collect O/M cost.
18	130	Mukaa	Kiou	Kwalee	Kwalee	Ndivo	S1°58'10.7"	E37°16'27.7"	2,517	W				28,214	408,928	OK	H	
19	131	Mukaa	Kiou	Kiou	Kiou	Lumu	S1°57'29.3"	E37°20'49.1"	1,578	G				33,014	204,272	OK	H	
20	133	Mukaa	Kasikeu	Kasikeu	Wathini	Mangala	S1°54'59.6"	E37°19'58.7"	1,850	G	●	●	Successful	97,793	709,013	OK	E	Changed to Submersible pump by electrical wire due to electricity installation plan.
21	134A	Mukaa	Kiou	Muani	Muani	Nguuni	S1°57'46.9"	E37°24'20.2"	2,614	G	●	Dry	Failed	413,173	204,272	Change to handpump	H	Changed to Handpump due to unable to cover O/M cost.
22	137A	Nzaui	Nguu	Kikulumi	Ndunguni	Mbulutini	S2°06'08.7"	E37°35'19.3"	1,691	H				356,139	648,076	OK	G	Changed to Submersible pump by generator due to the number of beneficiary and balance of O/M.
23	140	Nzaui	Nguu	Wolma	Wolma	Ilingoni	S2°09'22.9"	E37°37'10.3"	238	H				33,014	91,214	OK	H	
24	142	Kibwezi	Mtito Adei	Nthunguni	Nthingumi	Utu	S2°36'43.5"	E37°58'12.7"	330	H	-	●	Successful	101,084	126,473	OK	S	Changed to Submersible pump by Solar after consideration of installing solar power.
25	145	Kibwezi	Mtito Adei	Ngawate	Mukange	Yongoni	S2°27'45.4"	E38°08'29.2"	291	H				33,014	111,526	OK	H	
26	146A	Kibwezi	Mtito Andei	Kambu	Kitengei	Kietengei/Nguuswini	S2°32'50.1"	E38°09'01.6"	359	G	●	●	Failed	33,014	137,587	OK	H	Changed to Handpump due to unsucessful well.

* Facility Type; G: Submergible pump by Generator, W: Windmill pump, H: Handpump, S: Submergible pump by Solar, E: Sumbersible pump by electrical wire

Larger Machakos District

No.	S. No.	Location					Coordination		No. of Beneficiary	Type of Facility* (Original)	Test Drilling			O&M			Type of Facility* (Final)	Remarks
		District	Division	Location	Sub-location	Community name	Latitude	Longitude			Drilling	Pumping	Result	O&M Cost (Ksh/yr)	Collected Fee (Ksh/yr)	Result		
27	148A	Masinga	Masinga	Kangonde	Kangonde	Kangonde-Kyaani	S1°4'7.6"	E37°38'56.1"	1,181	W	●	Dry	Failed	33,014	646,598	OK	H	Changed to Handpump due to unsucessful well.
28	151	Masinga	Masinga	Kivaa	Kivaa	Kamunyu Primary School	S0°50'36.4"	E37°44'33.5"	1,515	G				355,312	829,463	OK	G	
29	152	Masinga	Masinga	Kivaa	Iiani	City Cotton Village	S0°50'32.9"	E37°45'36.8"	585	H				33,014	320,288	OK	H	
30	156A	Yatta	Yatta	Kithimani	Kithimani	Kithayoni (Kwakoko Pri. Sch)	S1°10'06.4"	E37°26'16.4"	2,925	G				355,791	1,167,818	OK	G	
31	158	Yatta	Yatta	Mavoloni	Kisiiki	Mavoloni-Kisiiiki	S1°4'46.8"	E37°26'52.0"	2,854	G	●	●	Successful	527,358	1,360,538	OK	G	
32	162	Yatta	Katangi	Kyua	Kyua	Kikeneani	S1°2'55.2"	E37°45'18.2"	3,031	G	●	●	Successful	101,084	240,900	OK	S	Changed to Submersible pump by Solar after consideration of installing solar power.
33	163	Yatta	Katangi	Kyua	Syo Kisinga	Matinga	S1°26'42.2"	E37°42'04.1"	1,480	G	●	●	Successful	434,837	810,300	OK	G	
34	164	Yatta	Katangi	Kyua	Kyua	Itithini Primary School	S1°28'08.5"	E37°43'59.1"	2,968	H				33,014	146,183	OK	H	
35	165A	Yatta	Yatta	Ndalani	Ndalani	Ndalani (Sec. School)	S1°5'56.1"	E37°29'10.9"	2,537	G	●	Dry	Failed	355,312	291,818	Change to handpump	H	Changed to Handpump due to unsucessful well and unable to collect O/M cost.
36	166	Kathiani	Kathiani	Mitaboni	Miumbuni	Miwani	S1°20'58.2"	E37°16'18.1"	2,608	H				33,014	584,183	OK	H	
37	167	Kathiani	Kathiani	Mitaboni	Kinyau	Mukukuni	S1°20'11.8"	E37°16'30.8"	3,383	G	●	●	Successful	385,678	584,183	OK	G	
38	172	Mwala	Mwala	Uvaini	Embui	Mumbuni	S1°23'28.4"	E37°31'33.4"	2,784	G	●	●	Successful	356,313	1,524,240	OK	G	
39	173A	Machakos	Mwala	Kathama	Katitu	Kalama	S1°12'10"	E37°21'50"	1,674	H				355,573	584,183	OK	G	Changed to Submersible pump by generator due to the number of beneficiary and balance of O/M.
40	175A	Mwala	Masii	Mango	Wetaa	Kwakamelo	S1°23'23"	E37°25'53"	2,009	H				355,312	291,818	Change to handpump	H	Changed to Handpump due to unable to cover O/M cost.
41	177	Mwala	Mwala	Mwala	Myanyani	Kwendana S/H/Group	S1°13'52.2"	E37°23'04.0"	1,586	G	●	●	Successful	384,112	868,335	OK	G	
42	178A	Machakos	Mwala	Kyawango	Kyawango	Misuuni	S1°20'44"	E37°30'19"	1,974	G				385,722	876,000	OK	G	
43	180	Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyandu(Meka)	S1°24'32.0"	E37°20'27.7"	2,315	G	●	●	Successful	919,199	1,267,463	OK	G	
44	183	Mwala	Yathui	Miu	Makuhimo	Miu Sec School	S1°31'29.0"	E37°34'51.5"	1,674	G	-	●	Successful	498,514	916,515	OK	G	
45	184	Mwala	Yathui	Yathui	Kyamatula	Kikaso	S1°30'35.7"	E37°35'04.6"	1,797	H				33,014	233,783	OK	H	
46	185A	Mwala	Yathui	Miu	Kikulumi	Kikulumi	S1°31'38.0"	E37°35'12.1"	3,771	W	●	Dry	Failed	33,014	642,218	OK	H	Changed to Handpump due to unsucessful well.
47	186	Mwala	Yathui	Miu	Kyawikyo	Nzeveni	S1°28'30.2"	E37°33'47.8"	1,445	H				356,878	584,183	OK	G	Changed to Submersible pump by generator due to the number of beneficiary and balance of O/M.
48	187A	Mwala	Yathui	Wamunyu	Kilembwa	Mikameni	S1°20'30"	E37°33'02"	1,621	G				385,722	642,218	OK	G	
49	188A	Masinga	Ndithine	Muthesya	Kikule	Muambani	S0°57'58.2"	E37°25'46.5"	1,142	G				384,939	625,245	OK	G	
50	189	Masinga	Ndithine	Ndithini	Ndithini	Ndithini Sec School	S0°56'39.1"	E37°20'03.5"	2,379	G	●	●	Successful	130,715	1,051,200	OK	E	Changed to Submersible pump by electrical wire due to electricity installation plan.
51	190	Masinga	Ndithine	Mananja	Mananja	Tana ranch	S0°51'24.3"	E37°21'47.5"	381	G				33,014	208,598	OK	H	Drilling and installation was done by NGO at an original site, therefore alternative site was selected to install handpump.
52	191A	Masinga	Ndithini	Mananja	Mananja	Kyaume	S0°51'06.2"	E37°17'17.7"	2,889	G				385,722	876,000	OK	G	Original site (No.191, Manaja Sec School) was unsucessful so the site was changed
53	195A	Machakos	Ndithini	Mananja	Mananja	Ndela	S0°51'47"	E37°17'51"	1,726	H				355,312	876,000	OK	G	Changed to Submersible pump by generator due to the number of beneficiary and balance of O/M.
54	196A	Masinga	Ndithini	Ndithini	Milaani	Milaani-Ngweye	S0°52'44.7"	S37°23'05.3"	1,163	W	●	Dry	Failed	33,014	636,743	OK	H	Changed to Handpump due to unsucessful well.
55	197	Masinga	Ndithini	Ndithini	Milaani	Militani	S0°52'47.7"	E37°24'35.8"	2,836	G	●	●	Successful	355,530	1,552,710	OK	G	
56	198	Machakos	Kalama	Kombo	Muumandu	Kavete	S1°40'45.2"	E37°16'42.3"	2,132	H				33,014	116,618	OK	H	
57	199	Machakos	Kalama	Kola	Iiyuni	Iyuni	S1°41'04.8"	E37°19'55.8"	2,114	H				33,014	146,183	OK	H	
58	200	Machakos	Central	Kalama	Nziuni	Kyamutheke	S1°32'08.5"	E37°10'12.6"	2,361	G	-	●	Successful	101,084	131,400	OK	S	Changed to Submersible pump by Solar after consideration of installing solar power.

* Facility Type; G: Submergible pump by Generator, W: Windmill pump, H: Handpump, S: Submergible pump by Solar, E: Sumbersible pump by electrical wire

8.4
Success Rate of Borehole

Success Rate of Boreholes

The success rate of boreholes is calculated in combination with results of test drilling of Phase-1 and 2 of the Study.

Boreholes are largely classified as three types, namely for hand pump, windmill pump and submergible pump. Boreholes for windmill pump is drilled only in Phase-1 and not drilled from now on including construction stage. In case of failed borehole for windmill pump in Phase-1, the alternative borehole for hand pump is substituted for. These issues were agreed in Minutes of discussions for inception of Phase-1 on 4th November 2009. Therefore, calculation of success rates of boreholes targets only boreholes of Level-1 for hand pump and Level-2 for submergible pump.

The following are the conditions of calculation of success rates of boreholes:

(i) Criteria of water yield are not less than $0.33m^3/h$ for Level-1 and not less than $1.0m^3/h$ for Level-2.

(ii) Criteria of water quality are as follows:

i) Arsenic, Fluoride, Total Dissolved Solid

Parameter	Proposed standard value (mg/L)
Arsenic (As)	0.05
Fluoride (F)	3
Total Dissolved Solid (TDS)	2000

ii) Lead, Nitrate, Nitrite, Copper

Parameter	Health based guideline value (mg/L)
Lead (Pb)	0.05
Nitrate (NO_3)	10
Nitrite (NO_2)	0.2
Copper (Cu)	2.0

iii) Total hardness, Chloride (Cl), Iron (Fe), Manganese (Mn), Sodium (Na), Sulphate (SO_4), Zinc (Zn)

Health based guide line value of Kenyan standards for Water quality. If no, that of WHO guidelines for drinking-water quality is fulfilled.

(iii) Success rates of boreholes for water yield and water quality are separately calculated and these rates are multiplied to finally result in the success rates of boreholes.

1. Result of Test drilling in Phase-1

In Test drilling in Phase-1, 5 boreholes for windmill pump, 13 for submergible pump and 18 in total were targeted. The result of Test drilling in Pahse-1 is described in Table-1.

Boreholes for windmill pump were targeted only in Phase-1. Most of borehole points for windmill pump were set up at the top of hill where the wind well blows and success rate of boreholes was extremely low. Therefore, success rate of boreholes for windmill pump were not targeted for the calculation.

Table-1 Result of Test drilling in Pahse-1

Larger district	No.	S/N	Village/Community Name	District	Division	Location	Sub-location	Coordinate		Facilty Type	Well depth (m)	Discharge (m3/h)	Static water level (m)	Dynamic water level (m)	Water quality test
MAKUENI	1	96	Muambani	Makueni	Wote	Wote	Kambi Mawe	S01°48'26.6"	E37°38'45.0"	S/P	128	0.9	23.76	94.33	N/A
	2	102	Kithunzi	Makueni	Kaiti	Ukea	Kilala	S01°45'50.4"	E37°33'25.1"	W/P	155	2.7	5	137.32	A
	3	110	Kanzili	Nzaui	Matiliku	Kilili	Kanzili	S01°56'22.4"	E37°35'47.1"	S/P	120	**Dry**	-	-	-
	4	111	Kilili Secondary School	Nzaui	Matiliko	Kilili	Kilili	S01°54'14.1"	E37°34'25.2"	W/P	139	**Dry**	-	-	-
	5	112	Mulenyu	Nzaui	Matiliko	Kilili	Mulenyu	S01°56'51.1"	E37°37'27.2"	S/P	123	**Dry**	-	-	-
	6	128	Enzae	Mkaa	Kilome	Mukaa	Maiani	S01°50'31.8"	E37°18'52.0"	S/P	117	**Dry**	-	-	-
	7	133	Mangala	Mkaa	Kasikeu	Kasikeu	Wathini	S01°54'59.6"	E37°19'58.7"	S/P	120	9.0	16.28	41.85	A
	8	134	Nguuni	Mkaa	Kasikeu	Kiou	Muani	S01°58'08.6"	E37°23'46.2"	S/P	160	**Dry**	-	-	-
	9	146	Kitengei	Kibwezi	Mtito Adei	Kambu	Kitengei	S02°32'56.7"	E38°08'14.2"	S/P	120	1.0	22.18	37.90	**N/A**
MACHAKOS	1	148	Kangonde Primary School	Masinga	Masinga	Kangonde	Kangonde	S01°04'43.5"	E037°40'36.6"	W/P	80	**Dry**	-	-	-
	2	162	Kikeneani	Yatta	Katangi	Kyua	Kyua	S01°25'58.2"	E37°45'18.2"	S/P	140	1.10	44.60	85.07	A
	3	163	Matinga	Yatta	Katangi	Kyua	Syo Kisinga	S01°26'42.2"	E37°42'04.1"	S/P	137	10.9	81.48	105.90	A
	4	165	Ndalani	Yatta	Yatta	Ndalani	Ndalani	S01°05'57.8"	E037°29'11.5"	S/P	60	**Dry**	-	-	-
	5	167	Mukukuni	Kathiani	Kathiani	Mitaboni	Kinyau	S01°20'11.8"	E37°16'30.8"	S/P	110	2.0	20.15	33.72	A
	6	177	Kwendana S/H/Group	Mwala	Mwala	Mwala	Myanyani	S01°13'52.2"	E37°23'04.0"	S/P	38	5.0	4.95	16.50	A
	7	185	Kikulumi	Mwala	Yathui	Miu	Kikulumi	S01°31'37.0"	E37°35'55.1"	W/P	110	**Dry**	-	-	-
	8	191	Manaja Sec School	Masinga	Ndithine	Mananja	Mananja	S00°50'51.6"	E37°16'31,7"	S/P	98	**Dry**	-	-	-
	9	196	Milaani	Masinga	Ndithine	Ndithini	Milaani	S00°53'47.5"	E37°22'56.2"	W/P	136	**Dry**	-	-	-

A: Applicable, "N/A": Not applicable
S/P: Submergtible pump
W/P: Windmill pump

Success rates of boreholes are described in Table-2 to 4.

(1) Success rate of boreholes for water yield

Table-2 Success rate of boreholes for water yield

Well Level	Larger Makueni	Larger Machakos
Level-1 (not less than 0.33m^3/h): (A)	42.9% (3/7) [81.7%]	66.7% (4/6) [95.4%]
Level-2 (not less than 1.0m^3/h): (B)	28.6% (2/7) [73.6%]	66.7% (4/6) [86.3%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(2) Success rate of boreholes for water quality

Calculation of success rate of boreholes for water quality targeted all boreholes with water yield of not less than 0.33m^3/h.

Table-3 Success rate of boreholes for water quality

Well Level	Larger Makueni	Larger Machakos
Level-1 and 2 (C)	50.0% (2/4) [89.9%]	100.0% (4/4) [100.0%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(3) Success rate of boreholes for water yield and water quality

Table-4 Success rate of boreholes for water yield and water quality

Well Level	Larger Makueni	Larger Machakos	Total
Level-1 (not less than 0.33m3/h): (A)x(C)	21.5% [73.4%]	66.7% [95.4%]	44.1% [84.4%]
Level-2 (not less than 1.0m3/h): (B)x(C)	14.3% [66.1%]	66.7% [86.3%]	40.5% [76.2%]

[ ]: data from Basic design stage

2. Result of Test drilling in Phase-2

In Test drilling in Phase-2, boreholes for submergible pump were only targeted. At the beginning of Phase-2, number of targeted boreholes was 19. However, one of them was drilled by Plan Kenya and successful. Since it was confirmed that that borehole would be equipped, the borehole was excluded from the Test drilling. Number of boreholes of Test drilling was finally 18. The result of Test drilling in Phase-2 is described in Table 5.

Table-5 Result of Test drilling in Pahse-2

Larger District	No.	S/N	District	Division	Location	Sub-location	Village/Community Name	Coordinates in WGS84		Well depth (m)	Discharge (m^3/h)	Static water level(m)	Dynamic water level (m)	Water quality
Larger Makueni	1	98	Makueni	Wote	Muvau	Muvau	Nguumo/Senda	S01°53'57.8"	E37°39'08.1"	Dry	Dry	-	-	-
	2	121	Mbooni east	Kalawa	Katengine	Ititu	Ititu	S01°44'22.5"	E37°43'35.3"	100	15.0	9.15	13.08	A
	3	127	Mukaa	Malili	Kiima-Kiu	Ngaamba	Kwekolya	S01°54'15.0"	E37°10'10.9"	Dry	Dry	-	-	-
	4	137	Nzaui	Nguu	Kikulumi	Ndunguni	Mbulutini	S02°06'08.7"	E37°35'19.3"	100	15.7	1.95	4.54	N/A
Larger Machakos	1	151	Masinga	Masinga	Kivaa	Kivaa	Kamunyu Primary School	S00°50'36.4"	E037°44'33.5"	54	4.5	11.75	38.21	A
	2	156	Yatta	Yatta	Kithimani	Kithimani	Nguumo-Kathithu	S1°10'22.6"	E37°25'32.9"	Dry	Dry	-	-	-
	3	158	Yatta	Yatta	Mavoloni	Kisiiki	Mavoloni-Kisiiiki	S1°04'46.8"	E37°26'52.0"	60	4.7	4.7	35.71	A
	4	172	Mwala	Mwala	Masii	Embui	Mbele	S01°23'28.4"	E37°31'33.4"	92	18.0	4.4	50.75	A
	5	173	Mwala	Mwala	Masii	Mbaani	Kathama	S01°12'10.6"	E37°22'38.8"	Dry	Dry	-	-	-
	6	175	Mwala	Mwala	Mango	Wetaa	Mango Sec School	S01°23'38.7"	E37°25'27.7"	Dry	Dry	-	-	-
	7	178	Mwala	Mwala	Kyawango	Kyawango	Kyawango	S1°19'04.6"	E37°29'07.9"	Dry	Dry	-	-	-
	8	180	Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyamuanyani(Meka)	S01°24'32.0"	E37°20'27.7"	100	14.4	6.4	23.99	A
	9	186	Mwala	Yathui	Miu	Kyawikyo	Nzeveni	S01°28'30.2"	E37°33'47.8"	120	2.0	7.3	80.78	A
	10	187	Mwala	Yathui	Wamunyu	Kilembwa	Kilembwa	S01°20'31.9"	E37°32'03.0"	100	0.4	1.0	68.47	A
	11	188	Masinga	Ndithine	Muthesya	Kikule	Muambani	S00°58'00.4"	E037°25'12.4"	Dry	Dry	-	-	-
	12	189	Masinga	Ndithine	Ndithini	Ndithini	Ndithini Sec School	S00°56'39.1"	E37°20'03.5"	92	3.6	11.1	36.81	A
	13	195	Masinga	Ndithine	Mananja	Mananja	Thayu wa Ndela	S00°52'01.5"	E37°17'10.0"	Dry	Dry	-	-	-
	14	197	Masinga	Ndithini	Ndithini	Milaani	Militani	S0°52'47.7"	E37°24'35.8"	60	6.7	6.85	33.73	A

"A": Applicable, "N/A": Not applicable

Success rates of boreholes are described in Table-6 to 8.

(1) Success rate of boreholes for water yield

Table-6 Success rate of boreholes for water yield

Well Level	Larger Makueni	Larger Machakos
Level-1 (not less than 0.33m^3/h): (A)	50.0% (2/4) [81.7%]	57.1% (8/14) [95.4%]
Level-2 (not less than 1.0m^3/h): (B)	50.0% (2/4) [73.6%]	50.0% (7/14) [86.3%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(2) Success rate of boreholes for water quality

Calculation of success rate of boreholes for water quality targeted all boreholes with water yield of not less than 0.33m^3/h.

Table-7 Success rate of boreholes for water quality

Well Level	Larger Makueni	Larger Machakos
Level-1 and 2 (C)	50.0% (1/2) [89.9%]	100.0% (8/8) [100.0%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(3) Success rate of boreholes for water yield and water quality

Table-8 Success rate of boreholes for water yield and water quality

Well Level	Larger Makueni	Larger Machakos	Total
Level-1 (not less than 0.33m^3/h): (A)x(C)	25.0% [73.4%]	57.1% [95.4%]	41.1% [84.4%]
Level-2 (not less than 1.0m^3/h): (B)x(C)	25.0% [66.1%]	50.0% [86.3%]	37.5% [76.2%]

[ ]: data from Basic design stage

3. Combination of results of Test drilling in Phase-1 and 2

The followings are success rates of boreholes in combination with results of Test drilling in Phase-1 and 2:

(1) Success rate of boreholes for water yield

Table-9 Success rate of boreholes for water yield

Well Level	Larger Makueni	Larger Machakos
Level-1 (not less than 0.33m^3/h): (A)	45.5% (5/11) [81.7%]	60.0% (12/20) [95.4%]
Level-2 (not less than 1.0m^3/h): (B)	36.4% (4/11) [73.6%]	55.0% (11/20) [86.3%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(2) Success rate of boreholes for water quality

Calculation of success rate of boreholes for water quality targeted all boreholes with water yield of not less than 0.33m^3/h.

Table-10 Success rate of boreholes for water quality

Well Level	Larger Makueni	Larger Machakos
Level-1 and 2 (C)	50.0% (3/6) [89.9%]	100.0% (12/12) [100.0%]

( ): a number of successful boreholes and Denominator a number of boreholes with water yield of not less than 0.33m^3/h., [ ]: data from basic design stage

(3) Success rate of boreholes for water yield and water quality

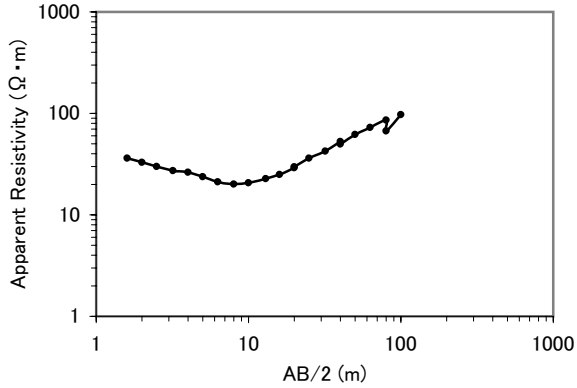
Table-11 Success rate of boreholes for water yield and water quality

Well Level	Larger Makueni	Larger Machakos	Total
Level-1 (not less than 0.33m^3/h): (A)x(C)	22.8% [73.4%]	60.0% [95.4%]	41.4% [84.4%]
Level-2 (not less than 1.0m^3/h): (B)x(C)	18.2% [66.1%]	55.0% [86.3%]	36.6% [76.2%]

[ ]: data from Basic design stage

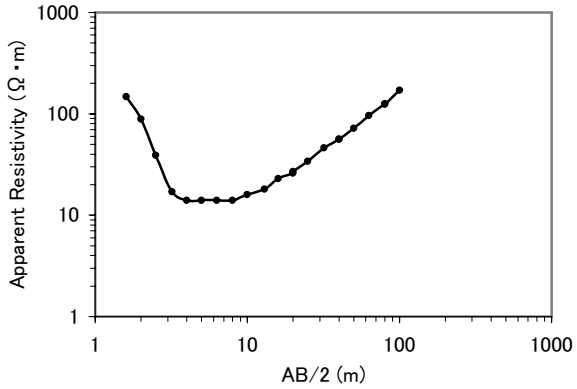
8.5
Result of Electric Sounding Survey for 40 Communities

96A



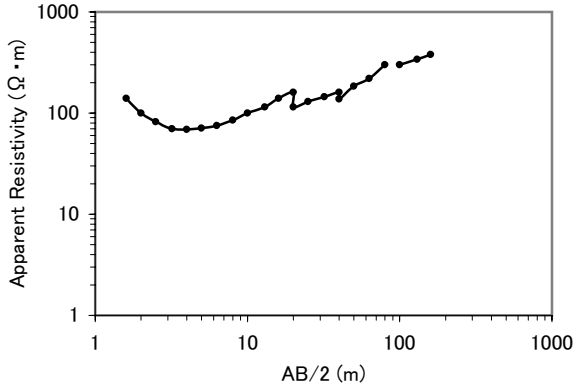
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	40.0	1.0
2	20.0	9.0
3	57.0	35.0
4	1000.0	
5		

98A



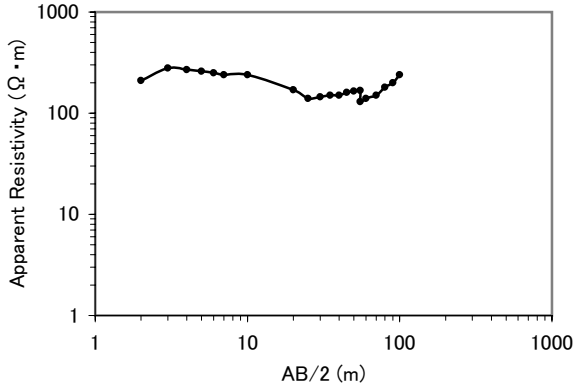
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	200.0	1.0
2	12.0	7.0
3	20.0	2.0
4	15.0	3.0
5	38.0	7.0
6	25.0	12.0
7	1500.0	

100



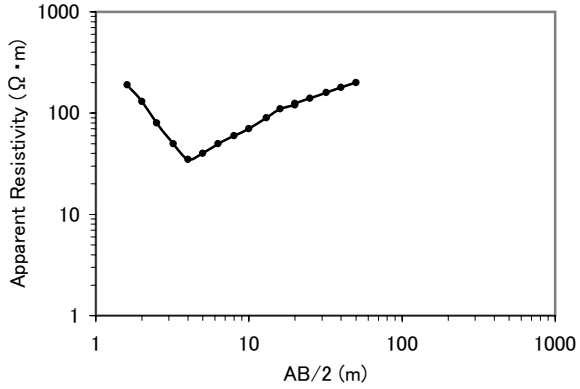
L#	Resistivity (Ω・m)	Thickness (m)
1	301.4	0.8
2	36.7	5.6
3	58.0	2.3
4	566.7	62.0
5	513.4	45.6
6	588.0	

107



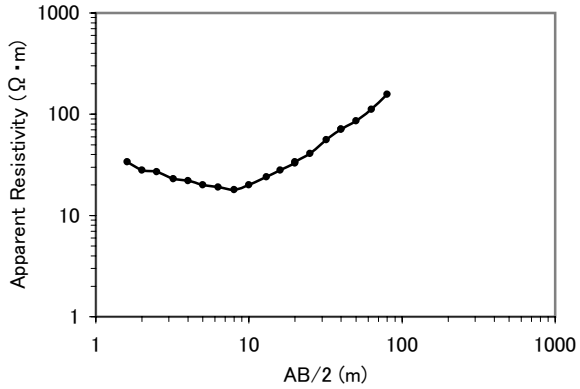
L#	Resistivity (Ω・m)	Thickness (m)
1	96.1	1.0
2	157.5	6.7
3	75.1	18.8
4	64.3	17.6
5	124761.7	

108



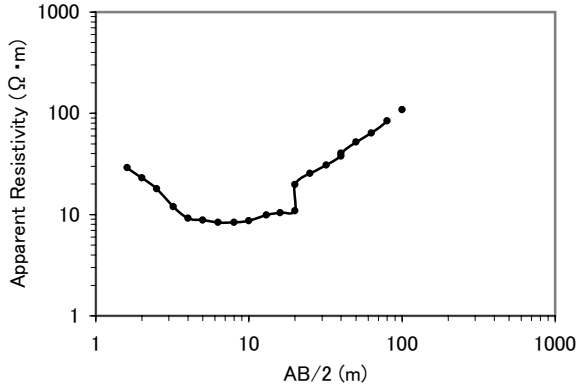
L#	Resistivity (Ω・m)	Thickness (m)
1	446.4	0.8
2	19.3	1.8
3	276.6	60.8
4	26794.4	50.2
5	496.2	

110A



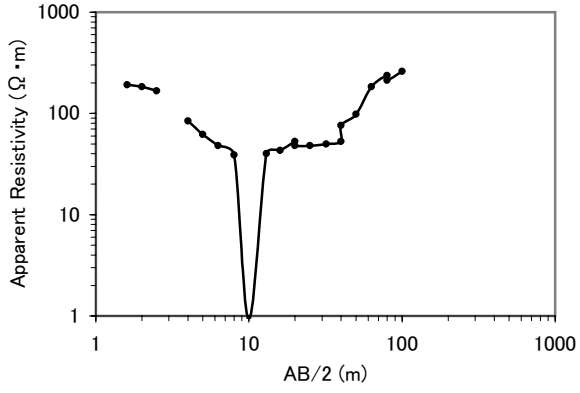
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	40.0	1.0
2	17.0	7.0
3	50.0	17.0
4	40.0	7.0
5	500.0	

111A



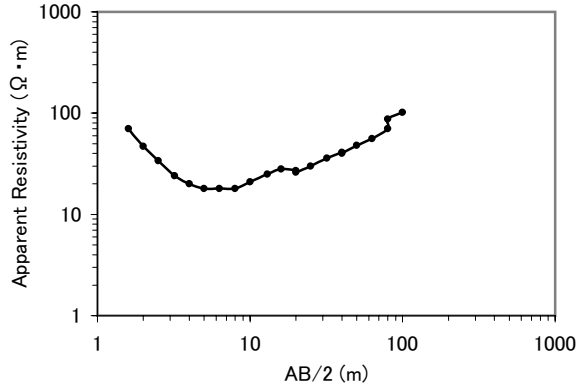
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	35.0	1.0
2	9.0	3.0
3	11.0	9.0
4	11.0	7.0
5	400.0	

112A



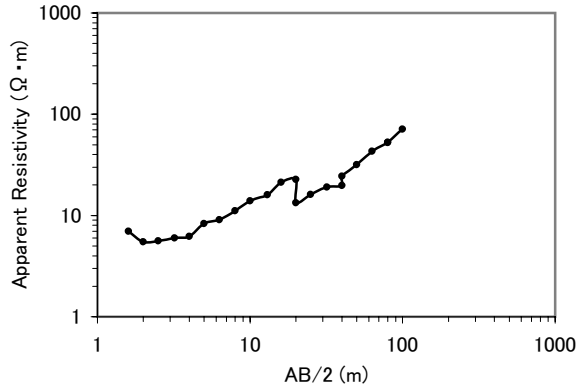
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	180.0	1.0
2	140.0	2.2
3	40.0	36.8
4	1500.0	
5		

113



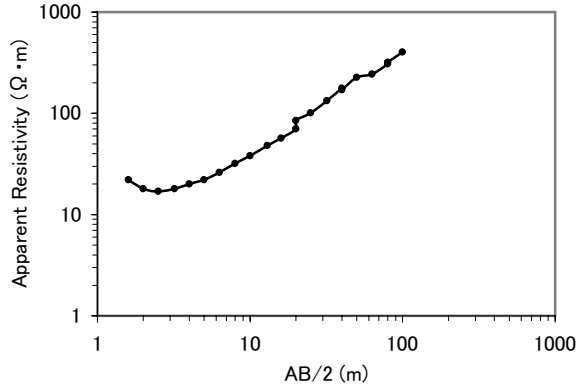
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	90.0	1.0
2	16.0	7.0
3	30.0	8.0
4	24.0	4.0
5	50.0	20.0
6	42.0	10.0
7	700.0	

114



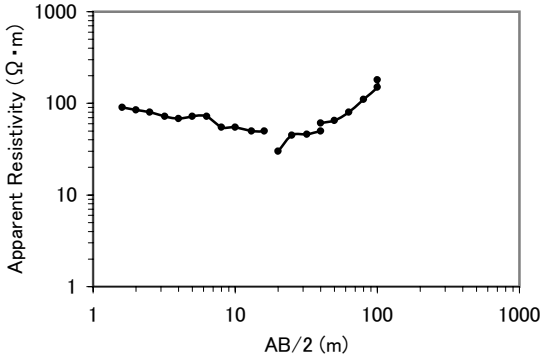
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	8.0	1.0
2	5.8	3.0
3	25.0	12.0
4	18.0	24.0
5	500.0	

118A



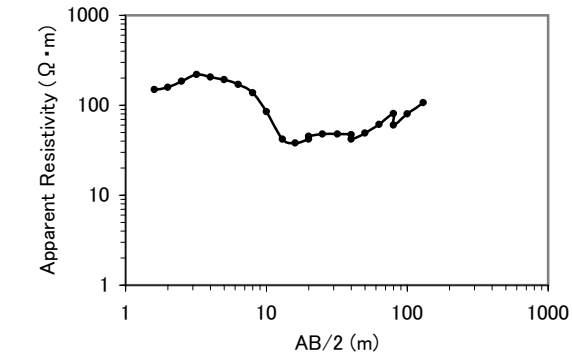
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	30.0	1.0
2	25.0	5.0
3	230.0	44.0
4	240.0	13.0
5	2200.0	

124



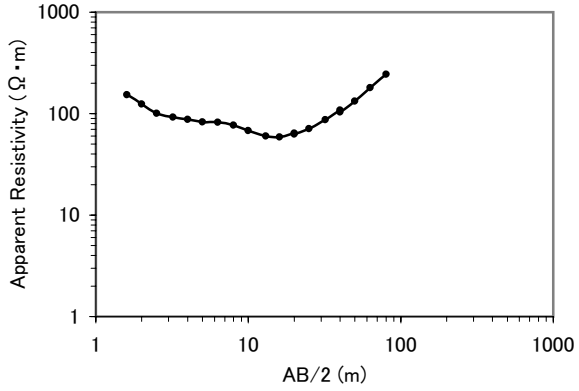
L#	Resistivity (Ω・m)	Thickness (m)
1	141.1	3.1
2	61.3	2.8
3	53.3	30.0
4	84.8	13.8
5	16711.9	

127A



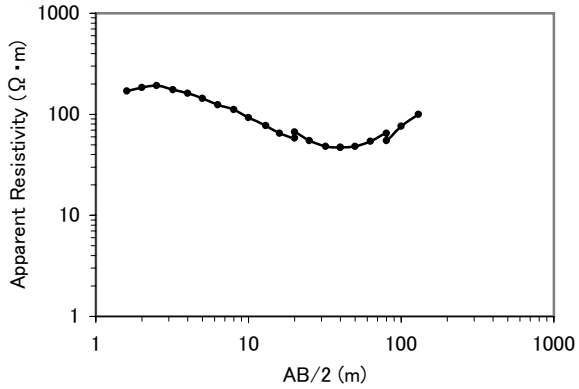
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	120.0	1.0
2	250.0	2.2
3	40.0	46.8
4	1000.0	

128A



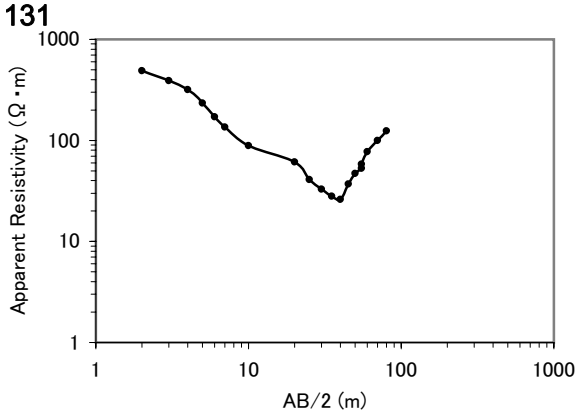
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	170.0	1.0
2	74.0	3.0
3	85.0	4.5
4	66.0	12.5
5	700.0	

130



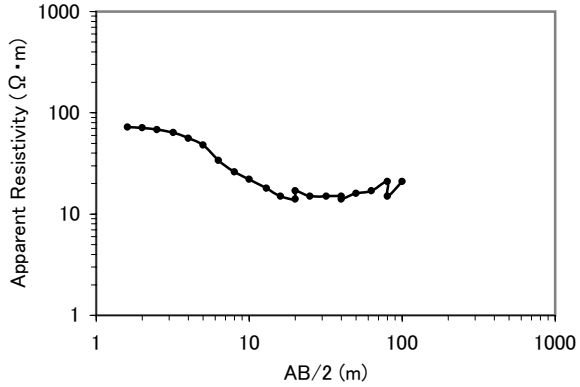
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	150.0	1.0
2	180.0	2.2
3	42.0	46.8
4	1000.0	

131



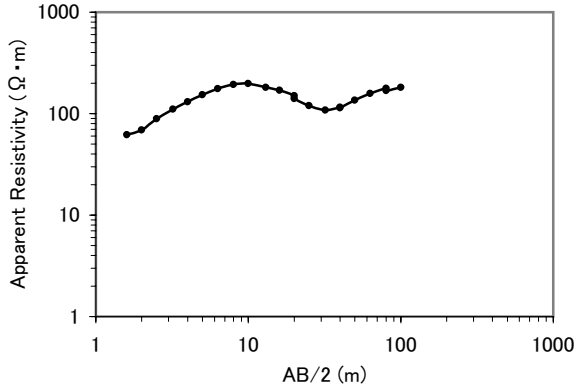
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	600.0	1.0
2	150.0	5.3
3	34.0	18.7
4	60.0	7.0
5	47.0	8.0
6		

134A



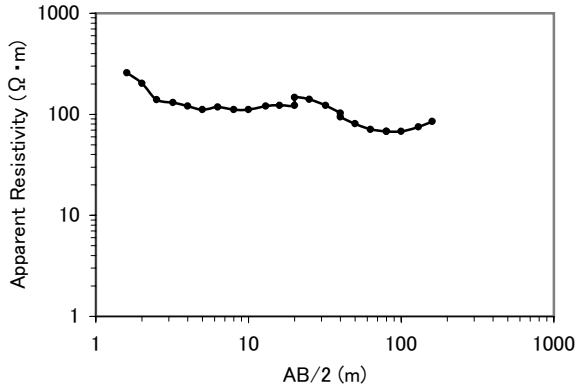
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	80.0	1.0
2	60.0	3.0
3	15.0	46.0
4	700.0	

137A



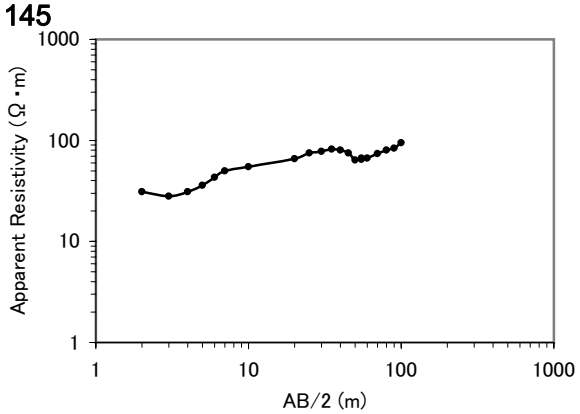
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	50.0	1.0
2	200.0	7.0
3	110.0	32.0
4	1000.0	

140



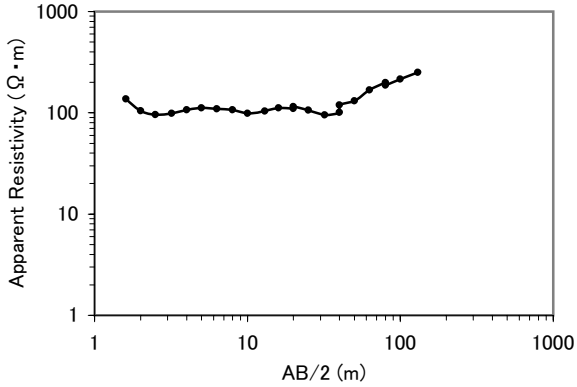
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	300.0	1.0
2	130.0	9.0
3	150.0	10.0
4	65.0	90.0
5	400.0	

145



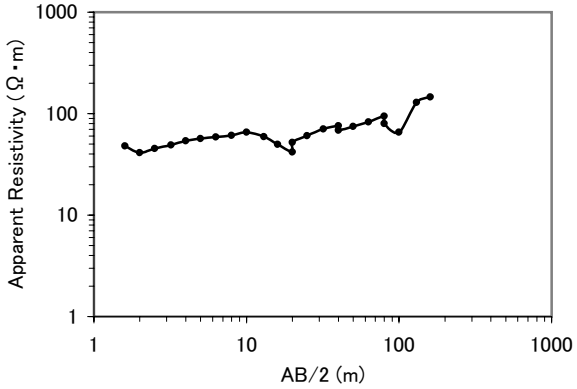
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	40.0	1.0
2	25.0	1.5
3	90.0	17.5
4	60.0	35.0
5	600.0	

146A



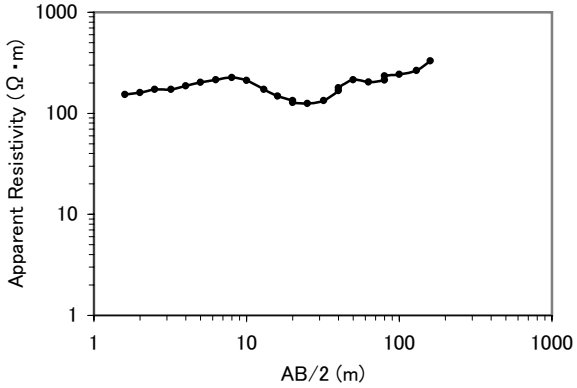
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	160.0	1.0
2	90.0	3.0
3	150.0	12.0
4	90.0	29.0
5	1000.0	

148A



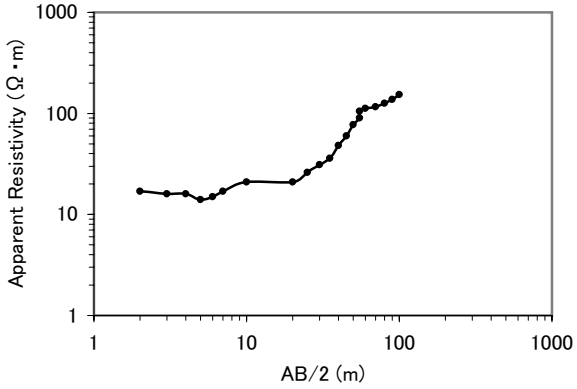
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	55.0	1.0
2	40.0	1.0
3	70.0	7.0
4	45.0	9.0
5	85.0	52.0
6	65.0	30.0
7	450.0	

152



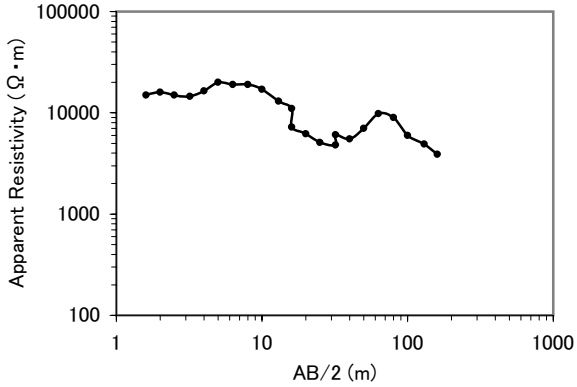
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	110.0	1.0
2	80.0	5.0
3	400.0	32.0
4	270.0	100.0
5	infinity	

156



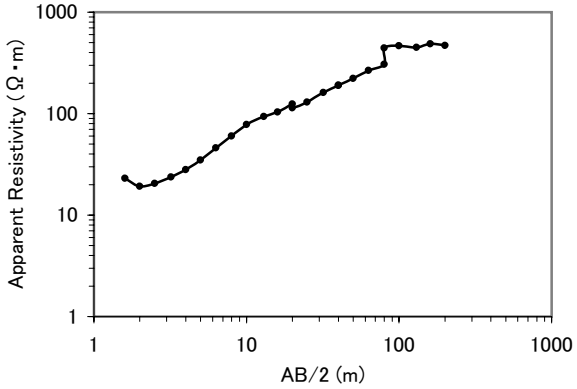
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	15.0	1.0
2	18.0	4.0
3	24.0	5.0
4	120.0	30.0
5	100.0	40.0
6	1000.0	

164



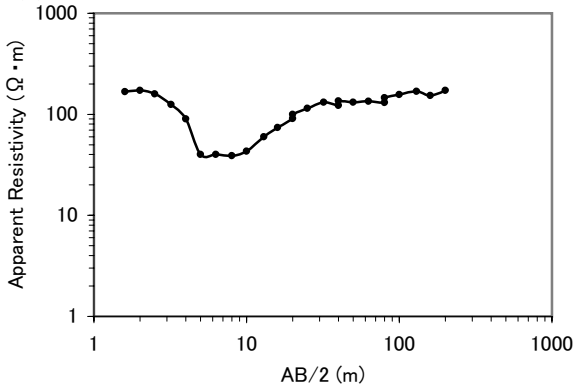
L#	Resistivity (Ω・m)	Thickness (m)
1	14586.0	0.8
2	5752.0	0.9
3	108633.3	0.9
4	1981.1	6.6
5	25536.6	20.5
6	402.2	

165A



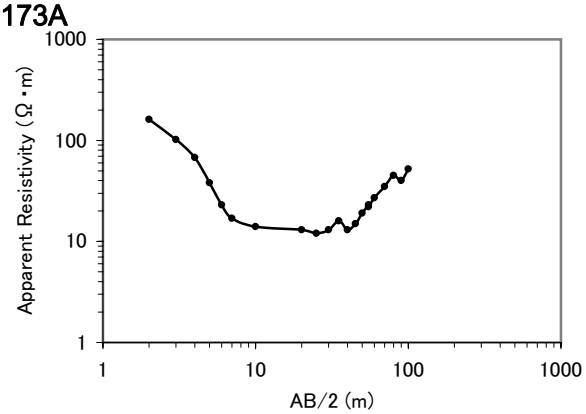
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	28.0	1.0
2	19.0	1.3
3	130.0	17.7
4	330.0	70.0
5	295.0	45.0
6	500.0	

166'



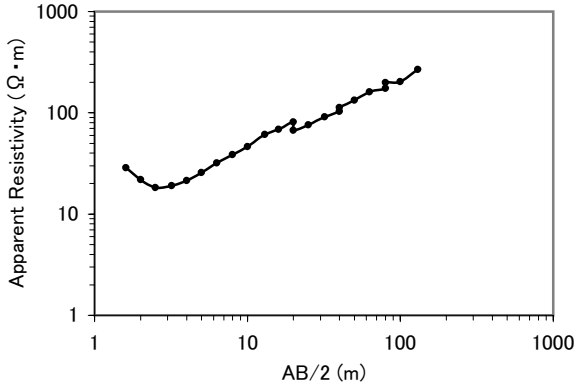
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	230.0	1.0
2	38.0	6.0
3	125.0	26.0
4	120.0	17.0
5	170.0	80.0
6	150.0	30.0
7	600.0	

173A



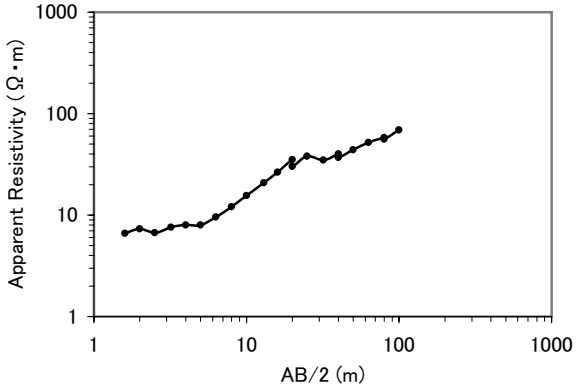
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	280.0	1.0
2	10.0	19.0
3	40.0	12.0
4	22.0	8.0
5	500.0	

175A



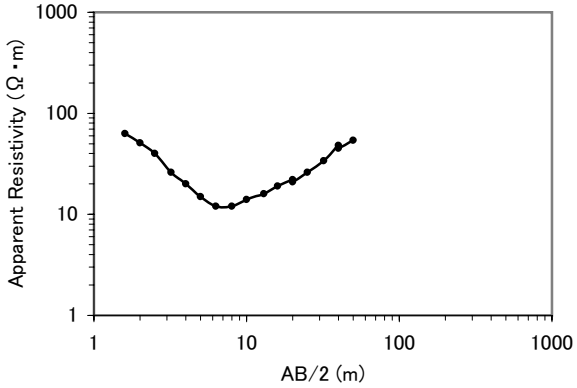
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	38.0	1.0
2	19.0	3.0
3	70.0	9.0
4	60.0	3.0
5	250.0	47.0
6	170.0	37.0
7	2000.0	

178A



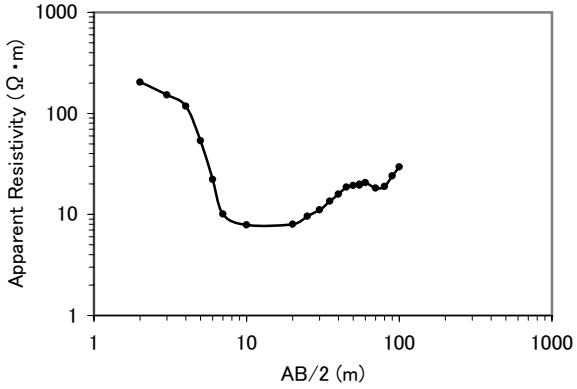
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	5.5	1.0
2	7.0	4.0
3	45.0	20.0
4	32.0	7.0
5	60.0	31.0
6	51.0	17.0
7	500.0	

184



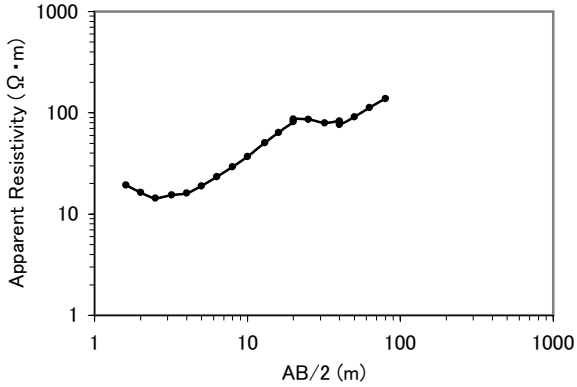
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	22.0	1.0
2	33.0	4.0
3	23.0	16.0
4	1000.0	

185A



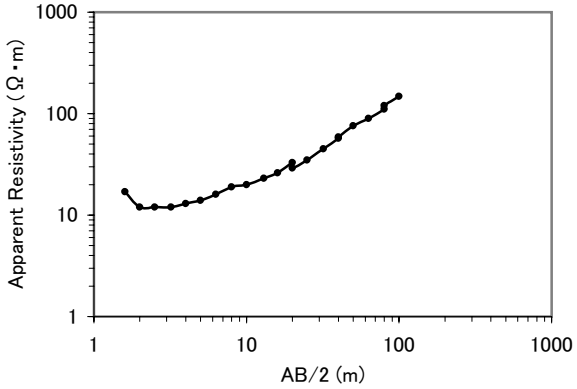
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	250.0	1.0
2	8.0	9.0
3	25.0	15.0
4	18.0	15.0
5	40.0	10.0
6	25.0	30.0
7	500.0	

187A



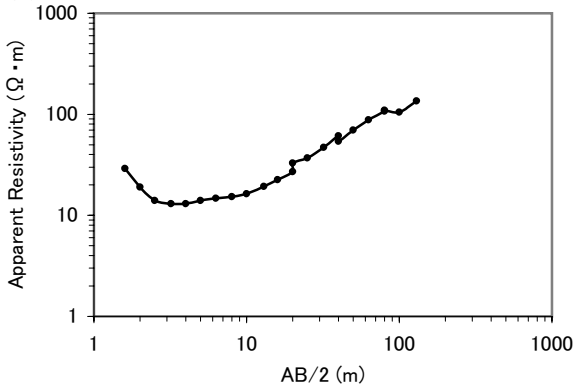
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	25.0	1.0
2	14.0	3.0
3	95.0	16.0
4	70.0	20.0
5	500.0	

188A



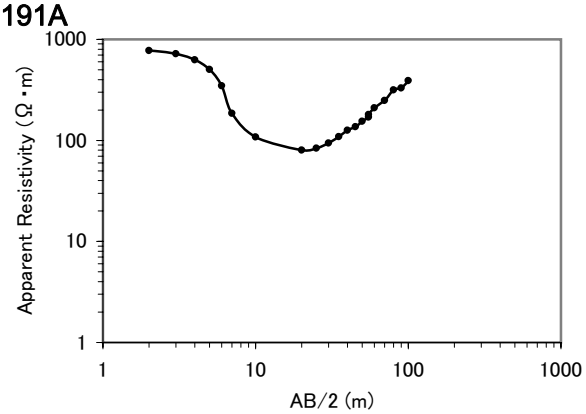
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	20.0	1.0
2	12.0	3.0
3	25.0	4.0
4	18.0	2.0
5	45.0	10.0
6	34.0	12.0
7	500.0	

190A



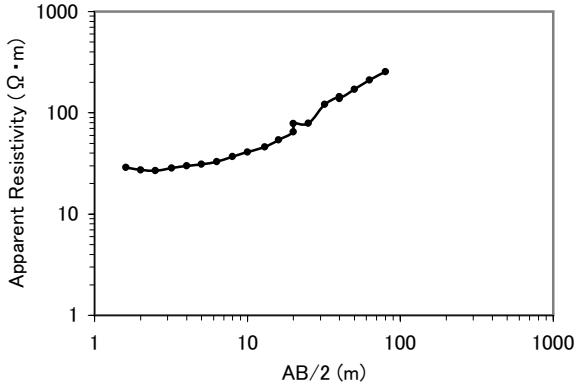
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	40.0	1.0
2	13.0	7.0
3	38.0	12.0
4	30.0	5.0
5	120.0	55.0
6	100.0	20.0
7	500.0	

191A



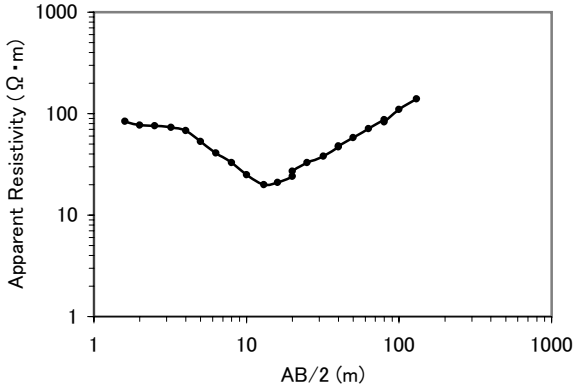
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	800.0	1.0
2	700.0	3.0
3	75.0	13.0
4	1500.0	

195A



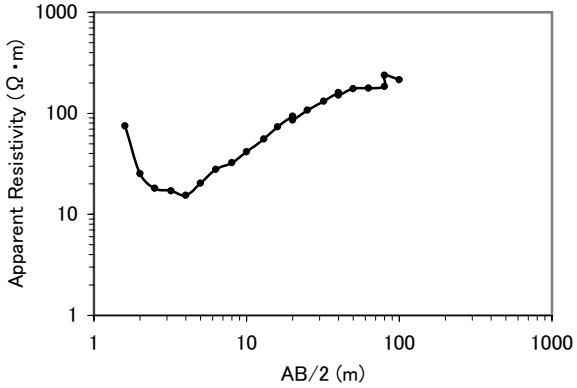
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	40.0	1.0
2	25.0	4.0
3	50.0	5.0
4	40.0	19.0
5	1500.0	

196A



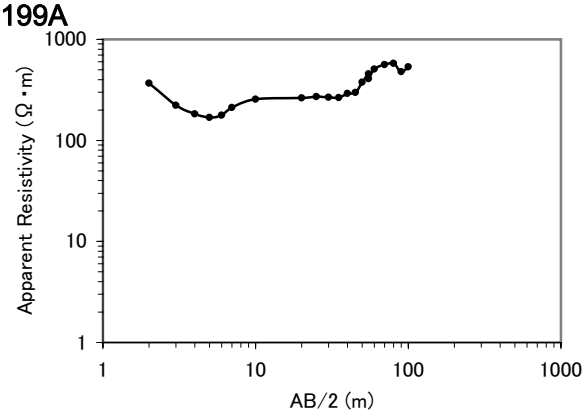
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	90.0	1.0
2	75.0	3.0
3	20.0	12.0
4	1000.0	

198



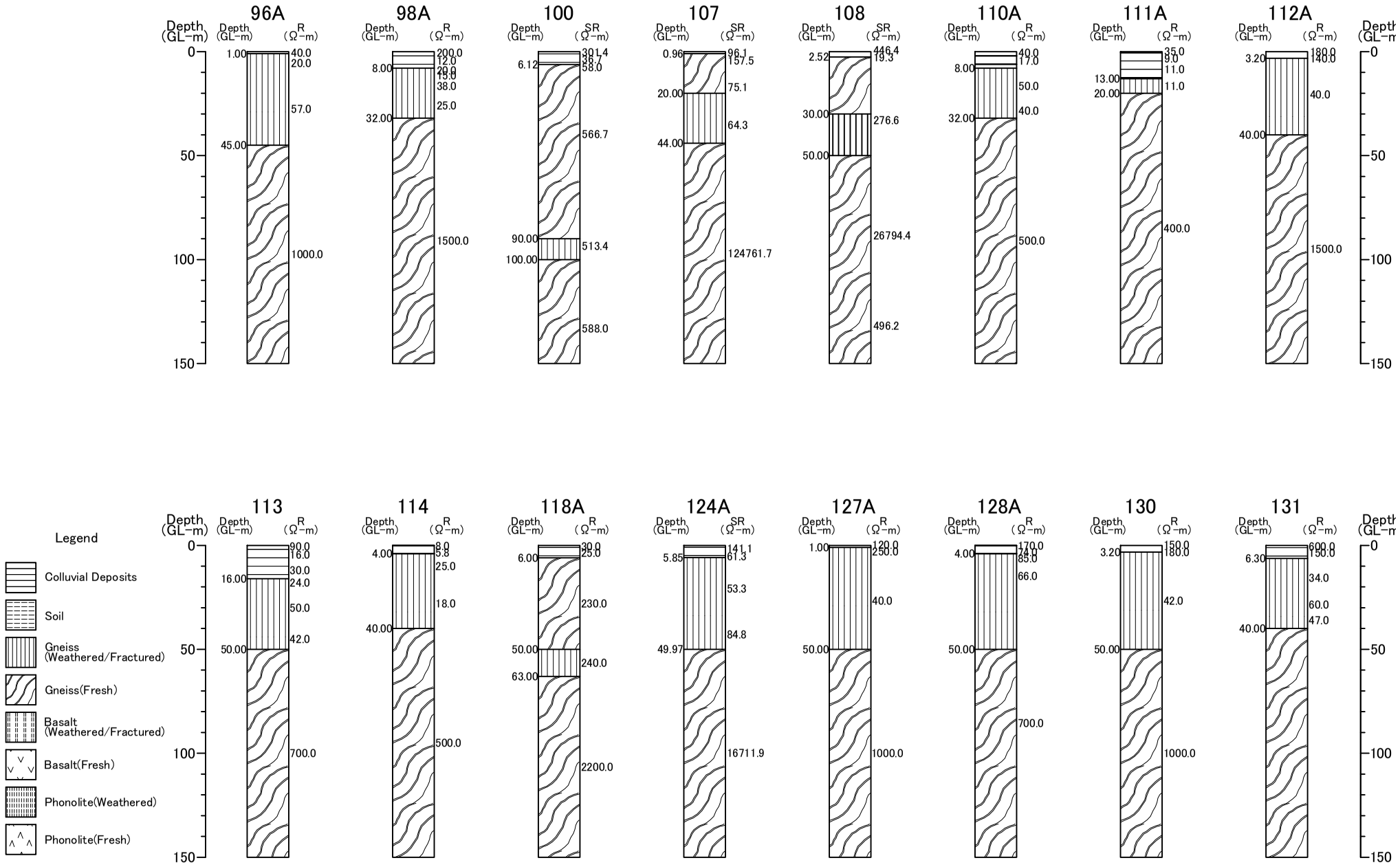
L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	60.0	1.0
2	15.0	3.0
3	180.0	46.0
4	180.0	13.0
5	1000.0	

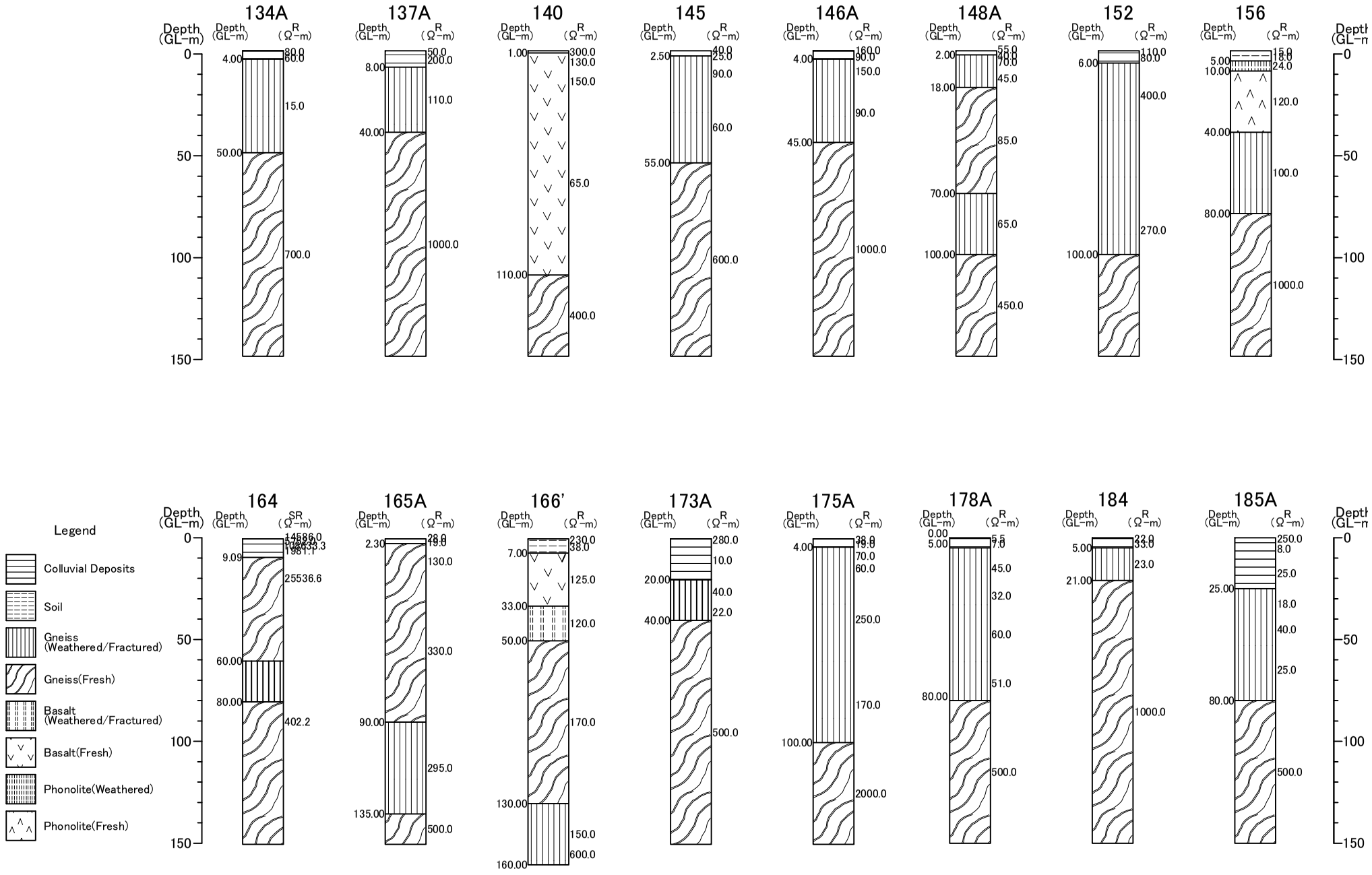
199A

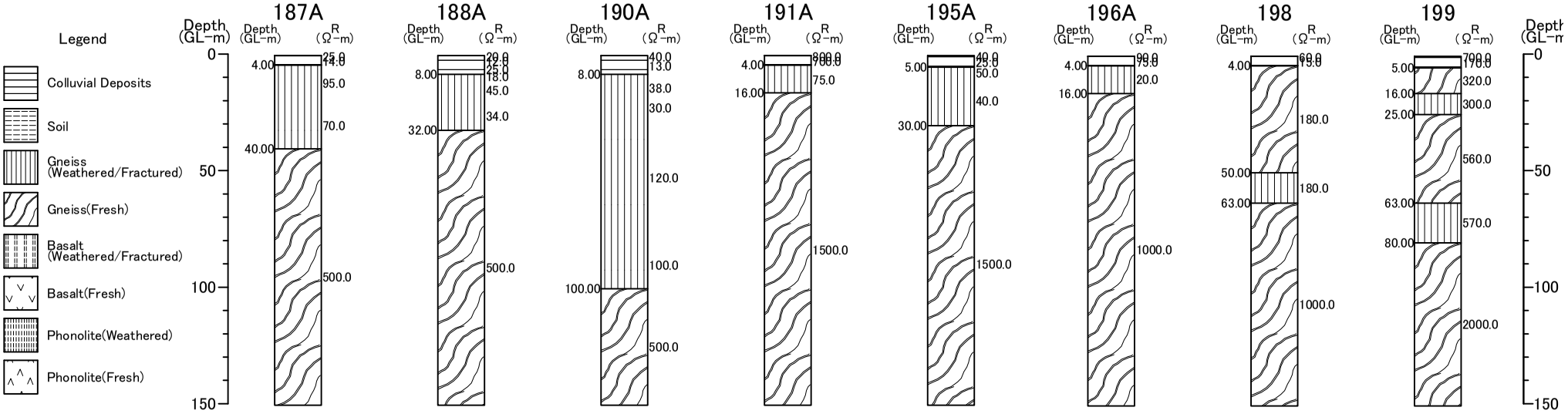


L#	Apparent Resistivity (Ω・m)	Thickness (m)
1	700.0	1.0
2	170.0	4.0
3	320.0	11.0
4	300.0	9.0
5	560.0	38.0
6	570.0	17.0
7	2000.0	

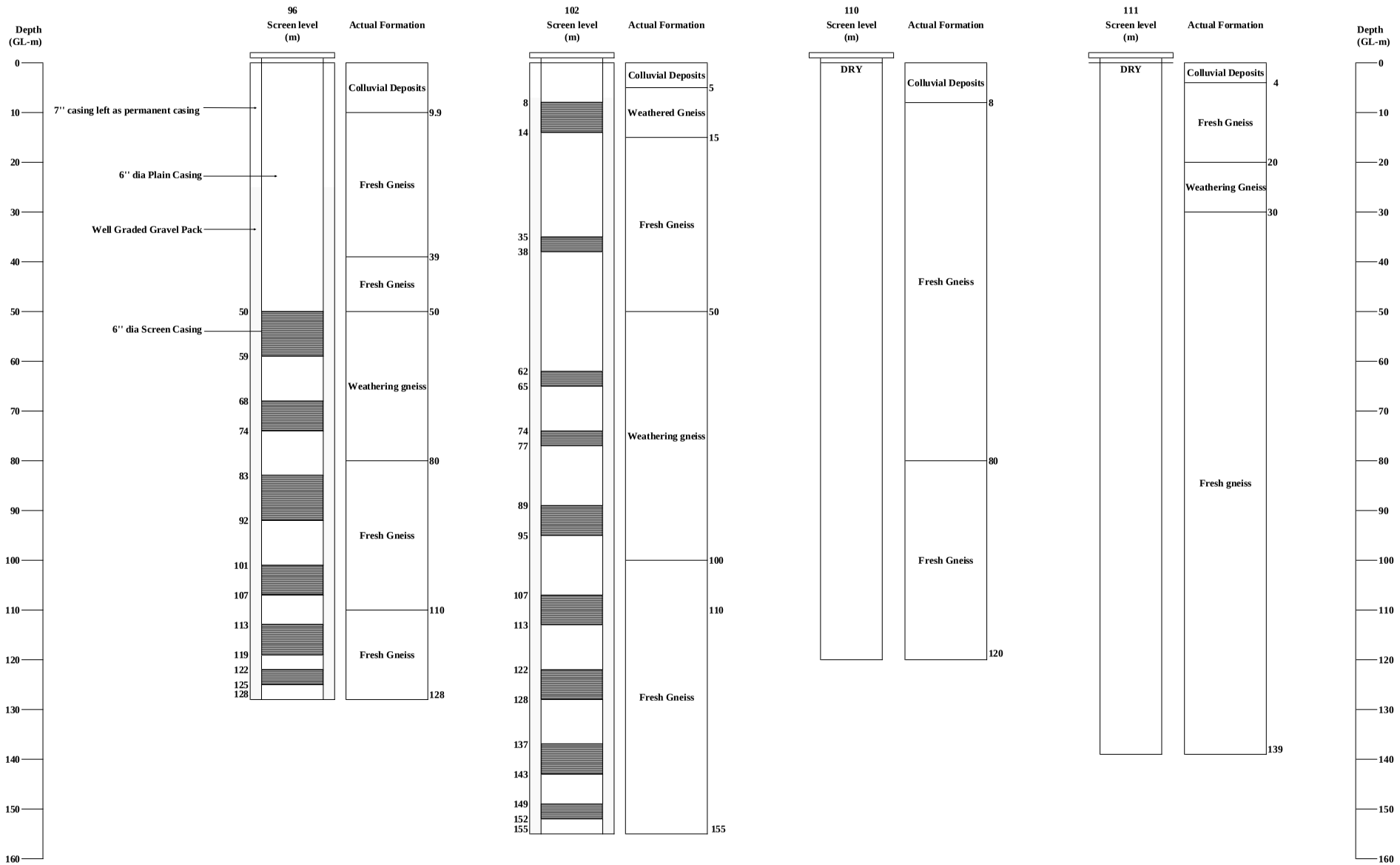
8.6
Borehole Columnar Sections in 40 Communities


96A
98A
100
107
108
110A
111A
112A
113
114
118A
124A
127A
128A
130
131
Depth (GL-m)
R (Ω-m)
SR (Ω-m)
0
50
100
150
1.00
40.0
20.0
57.0
45.00
1000.0
8.00
200.0
12.0
20.0
19.0
38.0
25.0
32.00
1500.0
6.12
301.4
38.7
58.0
566.7
90.00
513.4
100.00
588.0
0.96
96.1
157.5
75.1
20.00
64.3
44.00
124761.7
2.52
446.4
19.3
276.6
30.00
50.00
26794.4
496.2
8.00
40.0
17.0
50.0
40.0
32.00
500.0
35.0
9.0
11.0
13.00
11.0
20.00
400.0
3.20
180.0
140.0
40.0
40.00
1500.0
90.0
16.0
30.0
24.0
16.00
50.0
42.0
50.00
700.0
4.00
8.0
5.8
25.0
18.0
40.00
500.0
30.0
25.0
6.00
230.0
50.00
240.0
63.00
2200.0
141.1
61.3
5.85
53.3
84.8
49.97
16711.9
120.0
250.0
1.00
40.0
50.00
1000.0
170.0
74.0
85.0
66.0
700.0
150.0
180.0
42.0
1000.0
600.0
150.0
6.30
34.0
60.0
47.0
Legend
Colluvial Deposits
Soil
Gneiss (Weathered/Fractured)
Gneiss(Fresh)
Basalt (Weathered/Fractured)
Basalt(Fresh)
Phonolite(Weathered)
Phonolite(Fresh)

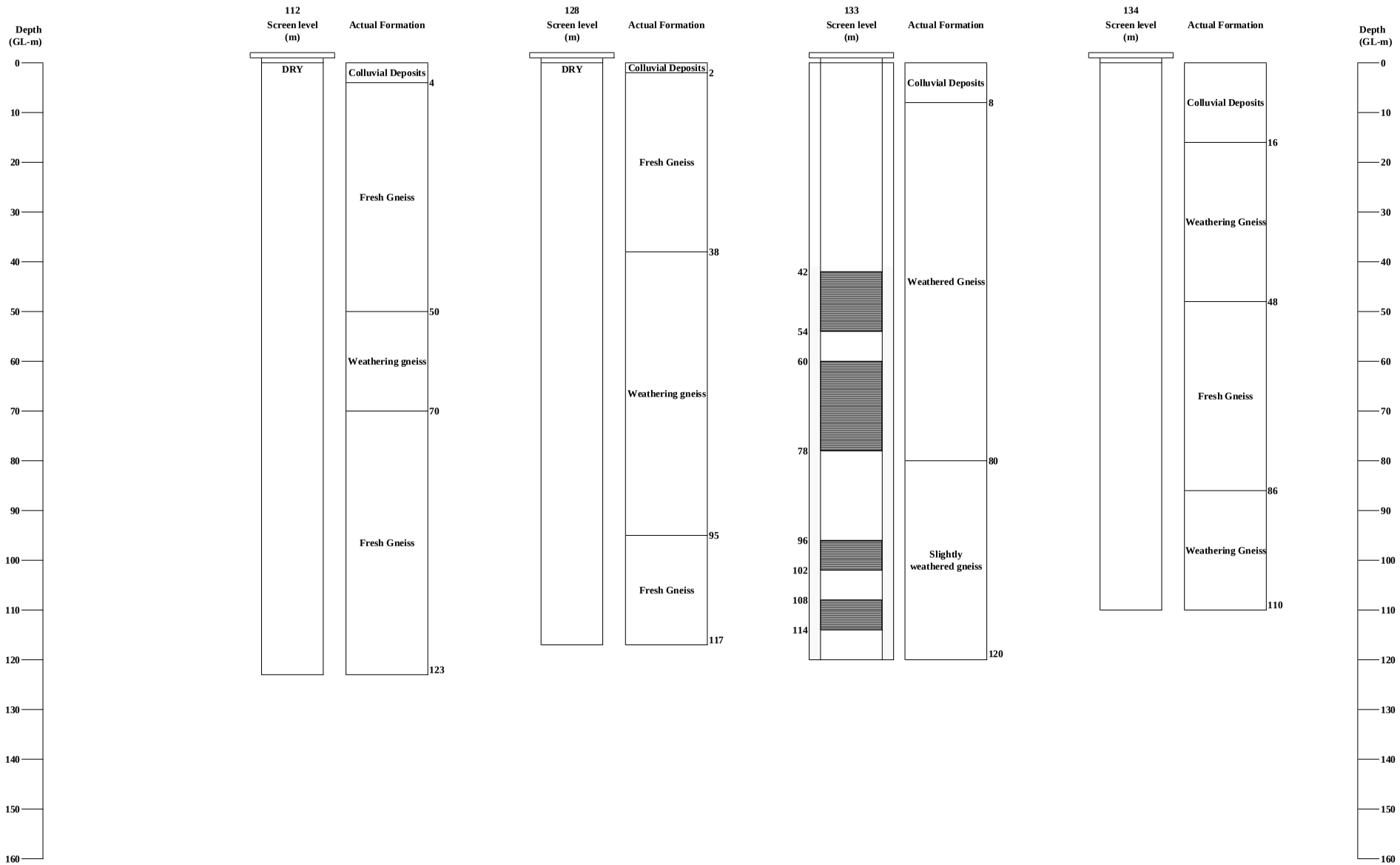

134A
137A
140
145
146A
148A
152
156
164
165A
166'
173A
175A
178A
184
185A
Depth (GL-m)
R (Ω-m)
SR (Ω-m)
0
50
100
150
4.00
50.00
80.0
60.0
15.0
700.0
8.00
40.00
50.0
200.0
110.0
1000.0
1.00
110.00
300.0
130.0
150.0
65.0
400.0
2.50
55.00
40.0
25.0
90.0
60.0
600.0
4.00
45.00
160.0
90.0
150.0
90.0
1000.0
2.00
18.00
70.00
100.00
55.0
40.0
70.0
45.0
85.0
65.0
450.0
6.00
100.00
110.0
80.0
400.0
270.0
5.00
10.00
40.00
80.00
15.0
13.0
24.0
120.0
100.0
1000.0
9.09
60.00
80.00
14586.0
25536.6
402.2
2.30
90.00
135.00
28.0
19.0
130.0
330.0
295.0
500.0
7.00
33.00
50.00
130.00
160.00
230.0
38.0
125.0
120.0
170.0
150.0
600.0
20.00
40.00
280.0
10.0
40.0
22.0
500.0
4.00
100.00
38.0
19.0
70.0
60.0
250.0
170.0
2000.0
0.00
5.00
80.00
5.5
7.0
45.0
32.0
60.0
51.0
500.0
5.00
21.00
22.0
33.0
23.0
1000.0
25.00
80.00
250.0
8.0
25.0
18.0
40.0
25.0
500.0
Legend
Colluvial Deposits
Soil
Gneiss (Weathered/Fractured)
Gneiss(Fresh)
Basalt (Weathered/Fractured)
Basalt(Fresh)
Phonolite(Weathered)
Phonolite(Fresh)


Legend
Colluvial Deposits
Soil
Gneiss (Weathered/Fractured)
Gneiss(Fresh)
Basalt (Weathered/Fractured)
Basalt(Fresh)
Phonolite(Weathered)
Phonolite(Fresh)
Depth (GL-m)
0
50
100
150
187A
Depth (GL-m)
R (Ω-m)
4.00
40.00
25.0
14.0
95.0
70.0
500.0
188A
8.00
32.00
20.0
12.0
25.0
18.0
45.0
34.0
500.0
190A
8.00
100.00
40.0
13.0
38.0
30.0
120.0
100.0
500.0
191A
4.00
16.00
800.0
700.0
75.0
1500.0
195A
5.00
30.00
40.0
25.0
50.0
40.0
1500.0
196A
4.00
16.00
90.0
75.0
20.0
1000.0
198
4.00
50.00
63.00
60.0
15.0
180.0
180.0
1000.0
199
5.00
16.00
25.00
63.00
80.00
700.0
170.0
320.0
300.0
560.0
570.0
2000.0

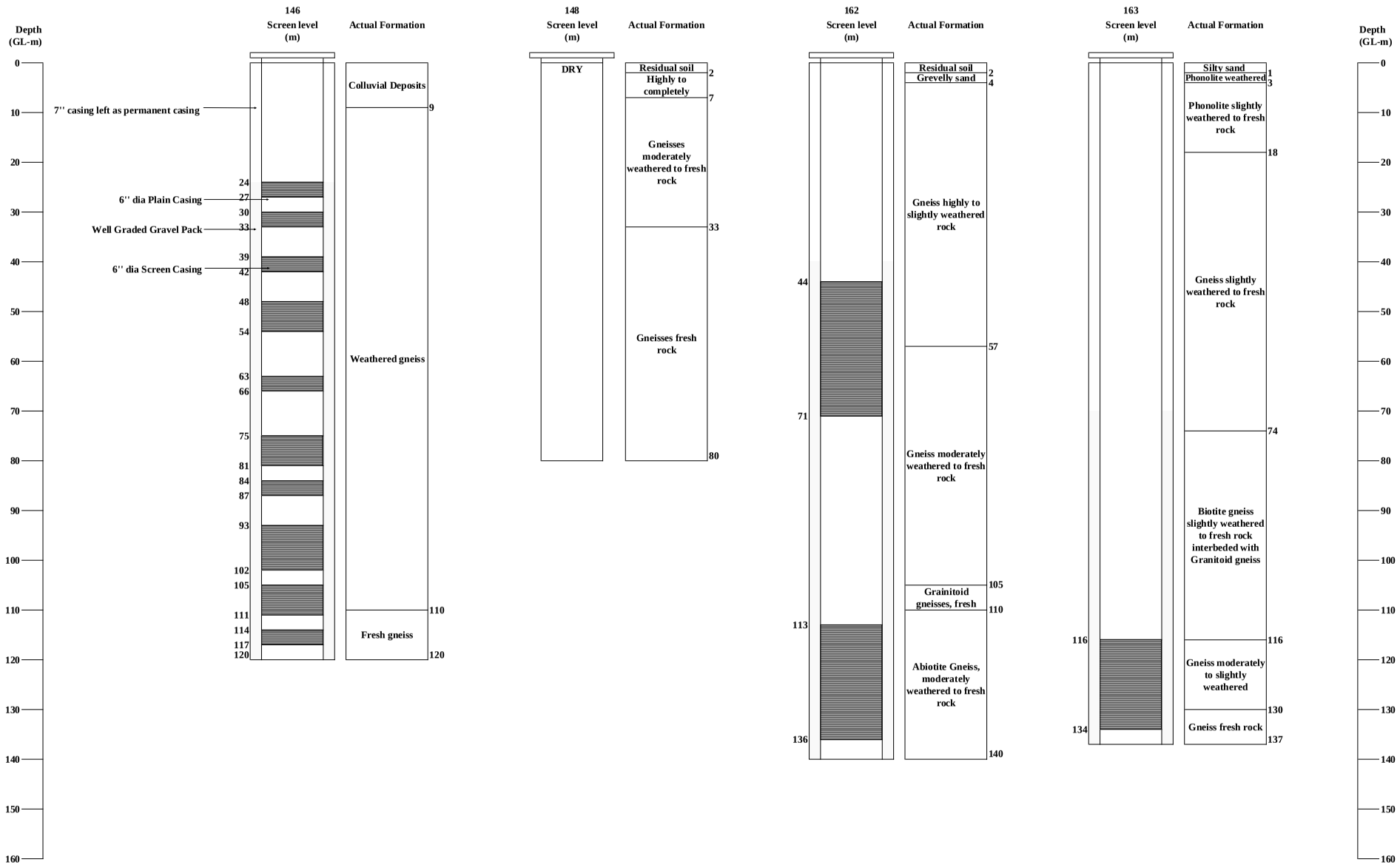
8.7
Result of Test Drilling at 36 Communities

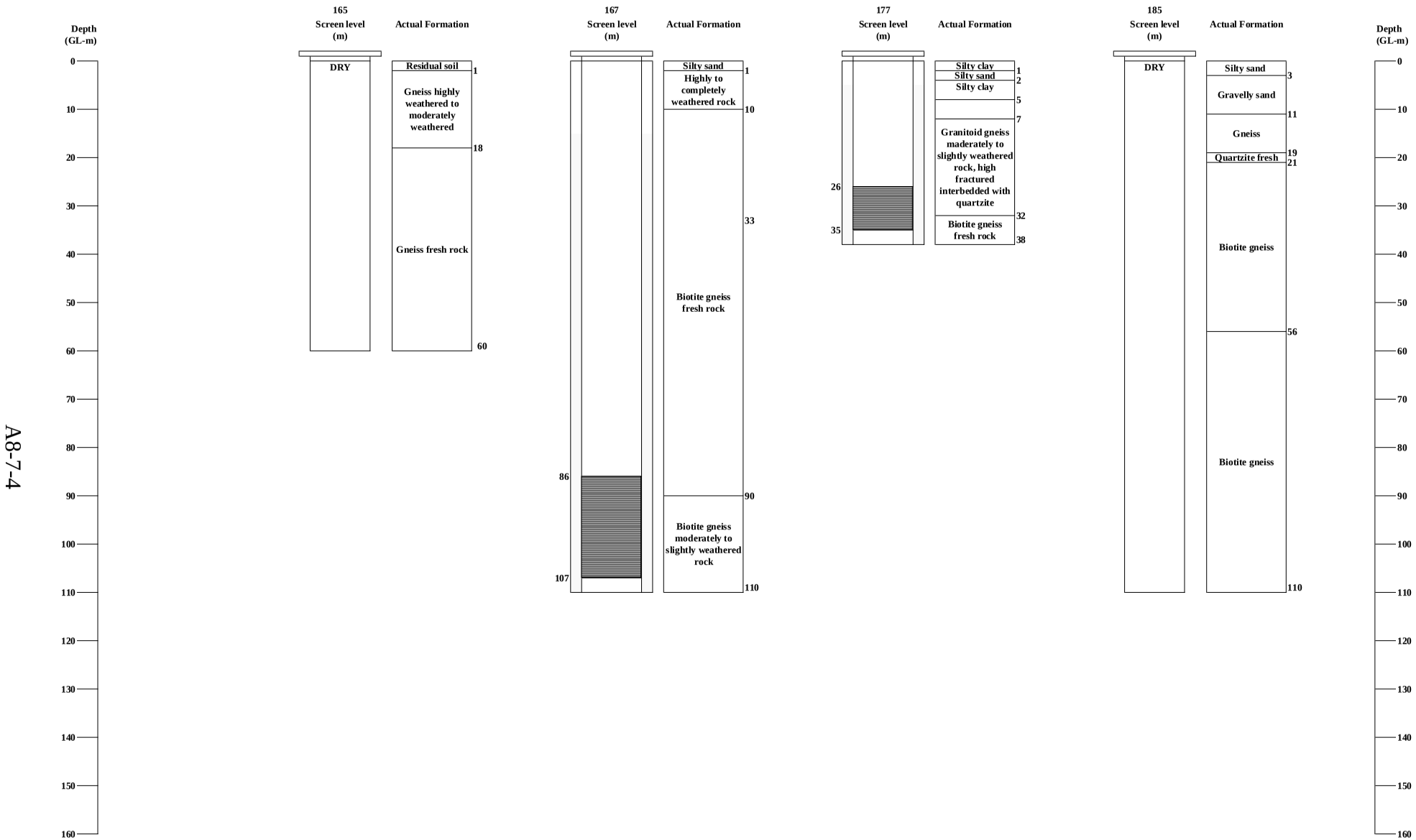

Depth (GL-m)
96
Screen level (m)
Actual Formation
7'' casing left as permanent casing
6'' dia Plain Casing
Well Graded Gravel Pack
6'' dia Screen Casing
Colluvial Deposits
Fresh Gneiss
Fresh Gneiss
Weathering gneiss
Fresh Gneiss
Fresh Gneiss
9.9
39
50
80
110
128
50
59
68
74
83
92
101
107
113
119
122
125
128
102
Screen level (m)
Actual Formation
Colluvial Deposits
Weathered Gneiss
Fresh Gneiss
Weathering gneiss
Fresh Gneiss
5
15
50
100
110
155
8
14
35
38
62
65
74
77
89
95
107
113
122
128
137
143
149
152
155
110
Screen level (m)
Actual Formation
DRY
Colluvial Deposits
Fresh Gneiss
Fresh Gneiss
8
80
120
111
Screen level (m)
Actual Formation
DRY
Colluvial Deposits
Fresh Gneiss
Weathering Gneiss
Fresh gneiss
4
20
30
139
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

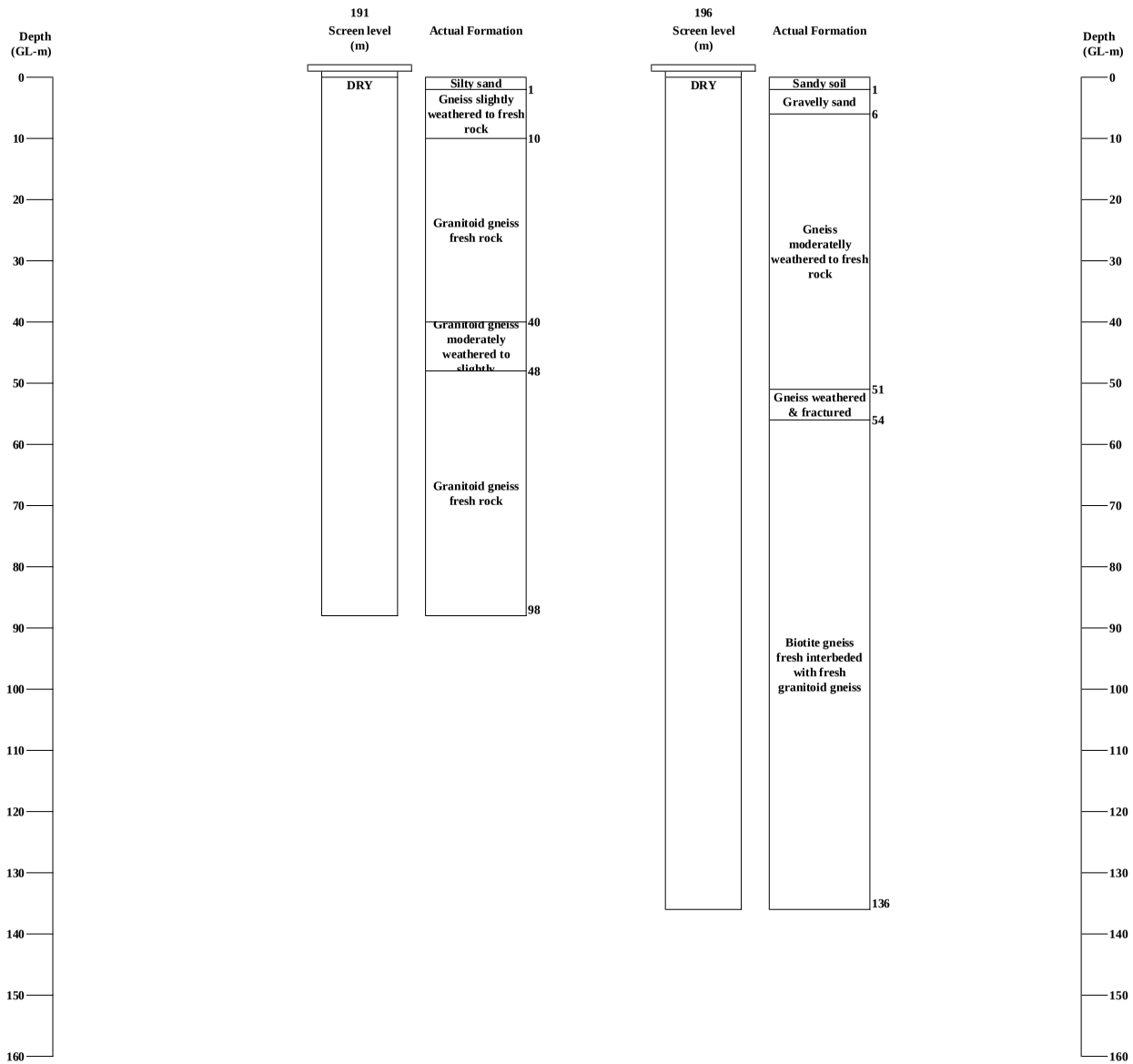
A8-7-1

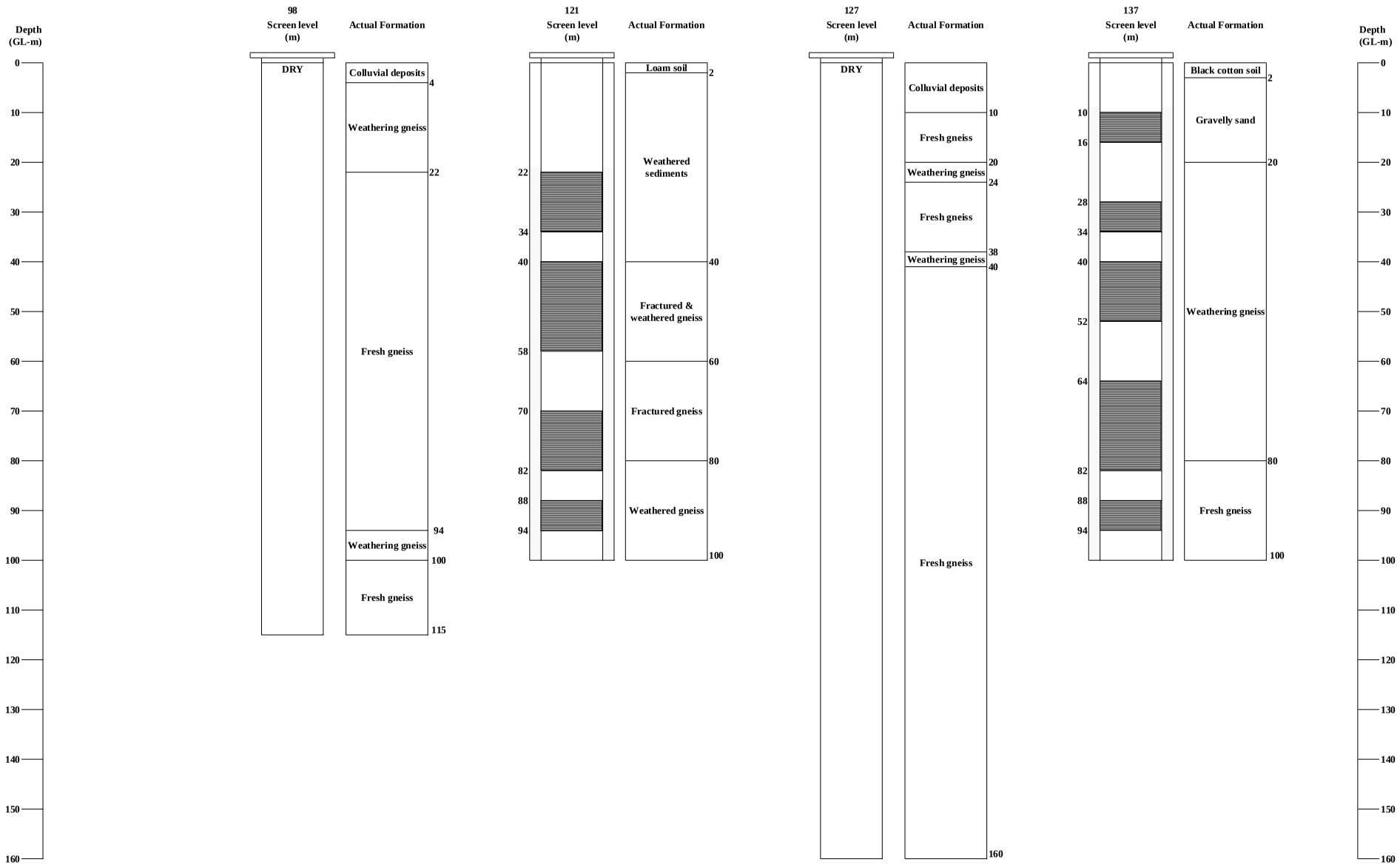

Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
112
Screen level (m)
Actual Formation
DRY
Colluvial Deposits
4
Fresh Gneiss
50
Weathering gneiss
70
Fresh Gneiss
123
128
Screen level (m)
Actual Formation
DRY
Colluvial Deposits
2
Fresh Gneiss
38
Weathering gneiss
95
Fresh Gneiss
117
133
Screen level (m)
Actual Formation
42
54
60
78
96
102
108
114
Colluvial Deposits
8
Weathered Gneiss
80
Slightly weathered gneiss
120
134
Screen level (m)
Actual Formation
Colluvial Deposits
16
Weathering Gneiss
48
Fresh Gneiss
86
Weathering Gneiss
110
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

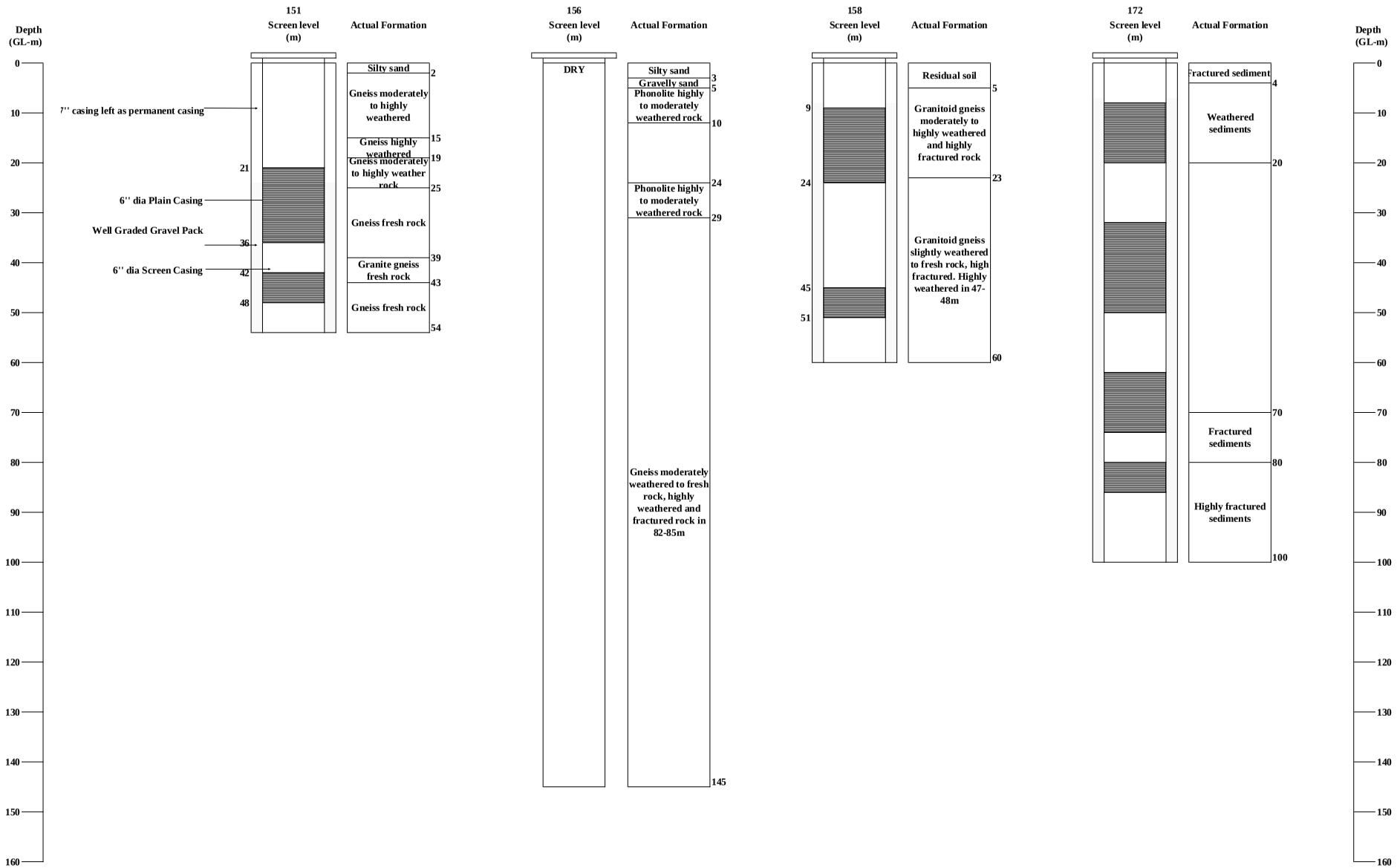
A8-7-2

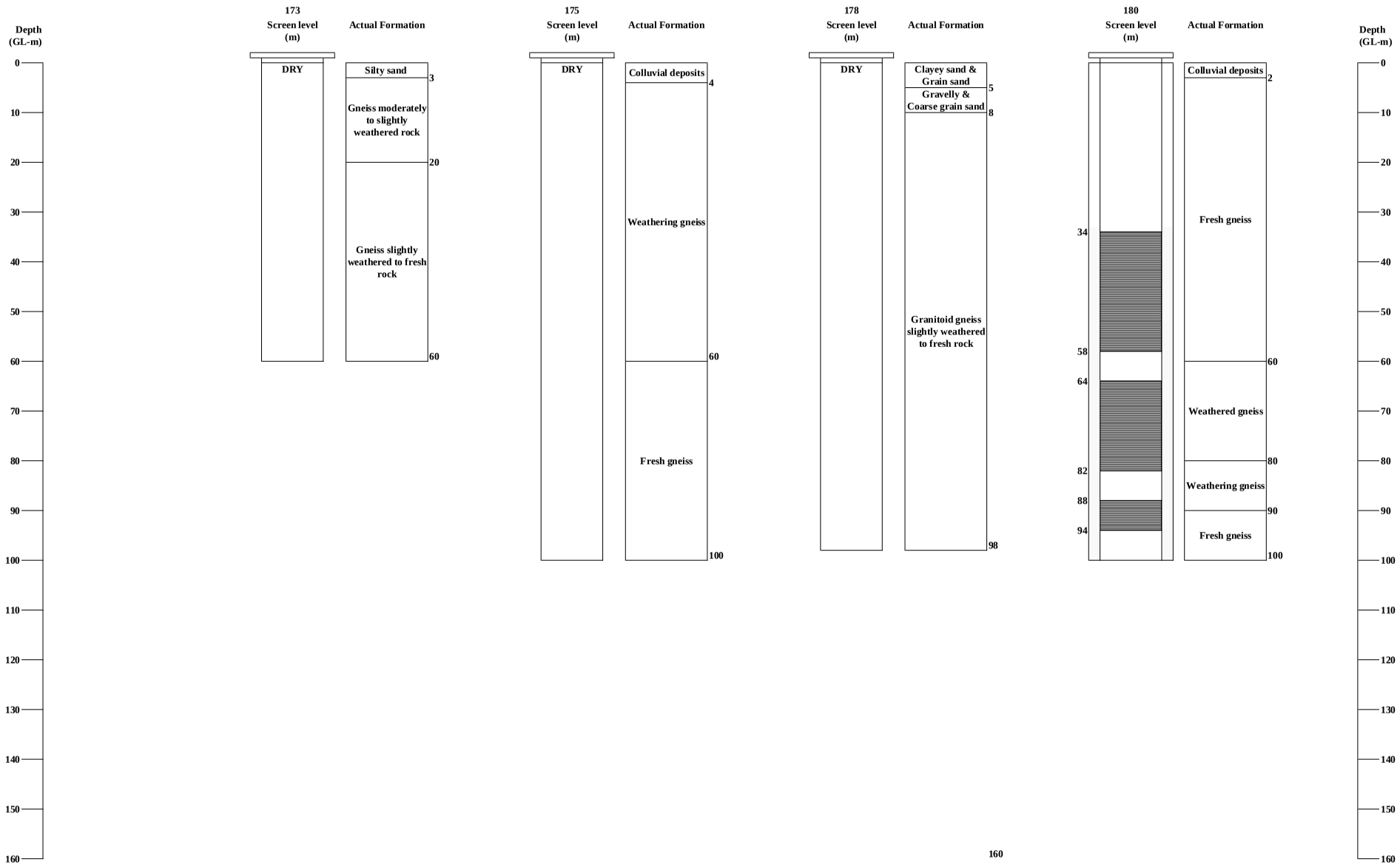

Depth (GL-m)
146
Screen level (m)
Actual Formation
148
Screen level (m)
Actual Formation
162
Screen level (m)
Actual Formation
163
Screen level (m)
Actual Formation
Depth (GL-m)
7'' casing left as permanent casing
6'' dia Plain Casing
Well Graded Gravel Pack
6'' dia Screen Casing
24
27
30
33
39
42
48
54
63
66
75
81
84
87
93
102
105
111
114
117
120
Colluvial Deposits
9
Weathered gneiss
110
Fresh gneiss
120
DRY
Residual soil
2
Highly to completely
7
Gneisses moderately weathered to fresh rock
33
Gneisses fresh rock
80
44
71
113
136
Residual soil
2
Grevelly sand
4
Gneiss highly to slightly weathered rock
57
Gneiss moderately weathered to fresh rock
105
Grainitoid gneisses, fresh
110
Abiotite Gneiss, moderately weathered to fresh rock
140
116
134
Silty sand
1
Phonolite weathered
3
Phonolite slightly weathered to fresh rock
18
Gneiss slightly weathered to fresh rock
74
Biotite gneiss slightly weathered to fresh rock interbeded with Granitoid gneiss
116
Gneiss moderately to slightly weathered
130
Gneiss fresh rock
137
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

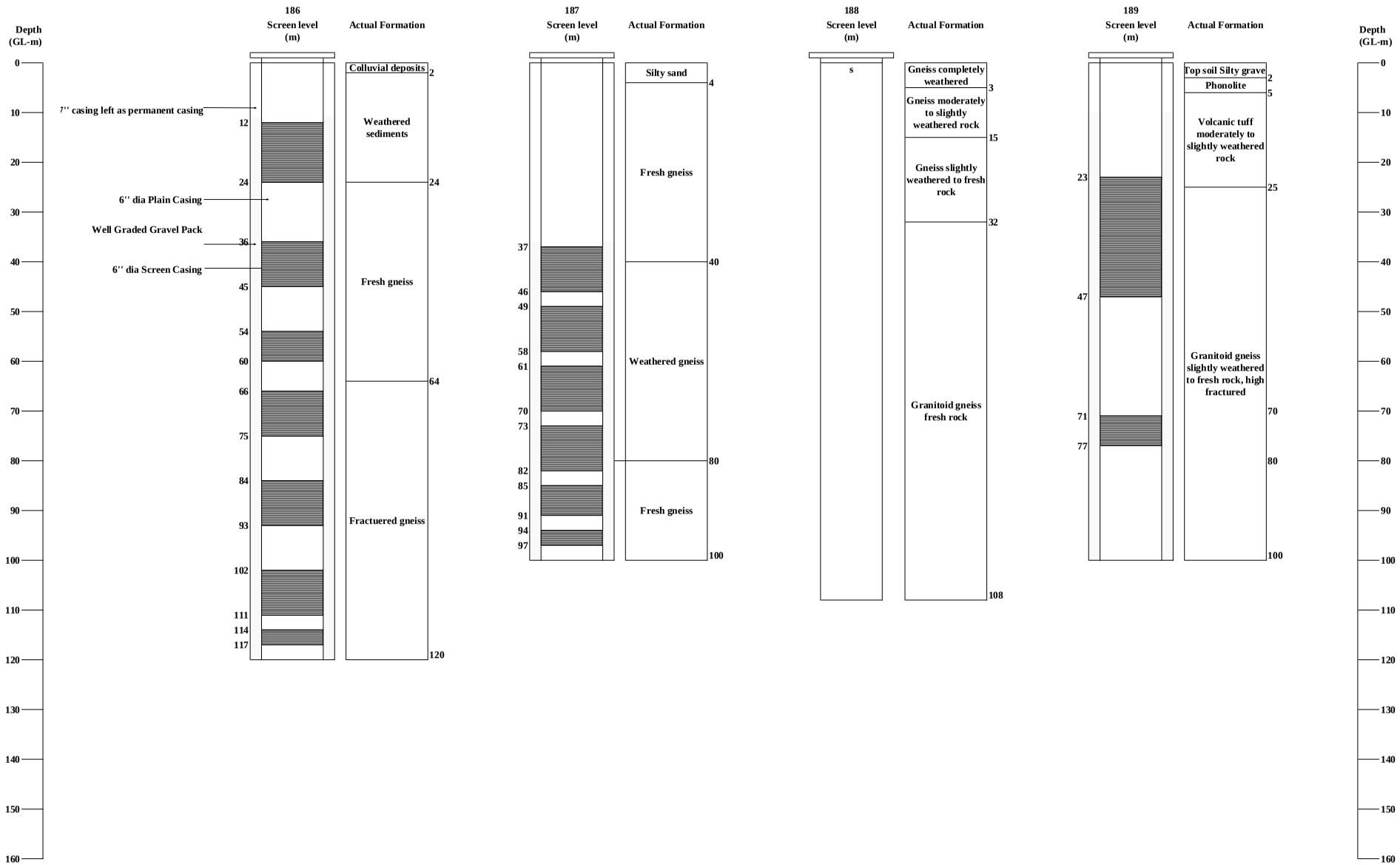

Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
165
Screen level (m)
DRY
Actual Formation
Residual soil
1
Gneiss highly weathered to moderately weathered
18
Gneiss fresh rock
60
167
Screen level (m)
86
107
Actual Formation
Silty sand
1
Highly to completely weathered rock
10
Biotite gneiss fresh rock
33
90
Biotite gneiss moderately to slightly weathered rock
110
177
Screen level (m)
26
35
Actual Formation
Silty clay
1
Silty sand
2
Silty clay
5
7
Granitoid gneiss maderately to slightly weathered rock, high fractured interbedded with quartzite
32
Biotite gneiss fresh rock
38
185
Screen level (m)
DRY
Actual Formation
Silty sand
3
Gravelly sand
11
Gneiss
19
Quartzite fresh
21
Biotite gneiss
56
Biotite gneiss
110
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


Depth
(GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
191
Screen level
(m)
DRY
Actual Formation
Silty sand
1
Gneiss slightly weathered to fresh rock
10
Granitoid gneiss fresh rock
40
Granitoid gneiss moderately weathered to slightly
48
Granitoid gneiss fresh rock
98
196
Screen level
(m)
DRY
Actual Formation
Sandy soil
1
Gravelly sand
6
Gneiss moderatelly weathered to fresh rock
51
Gneiss weathered & fractured
54
Biotite gneiss fresh interbeded with fresh granitoid gneiss
136
Depth
(GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

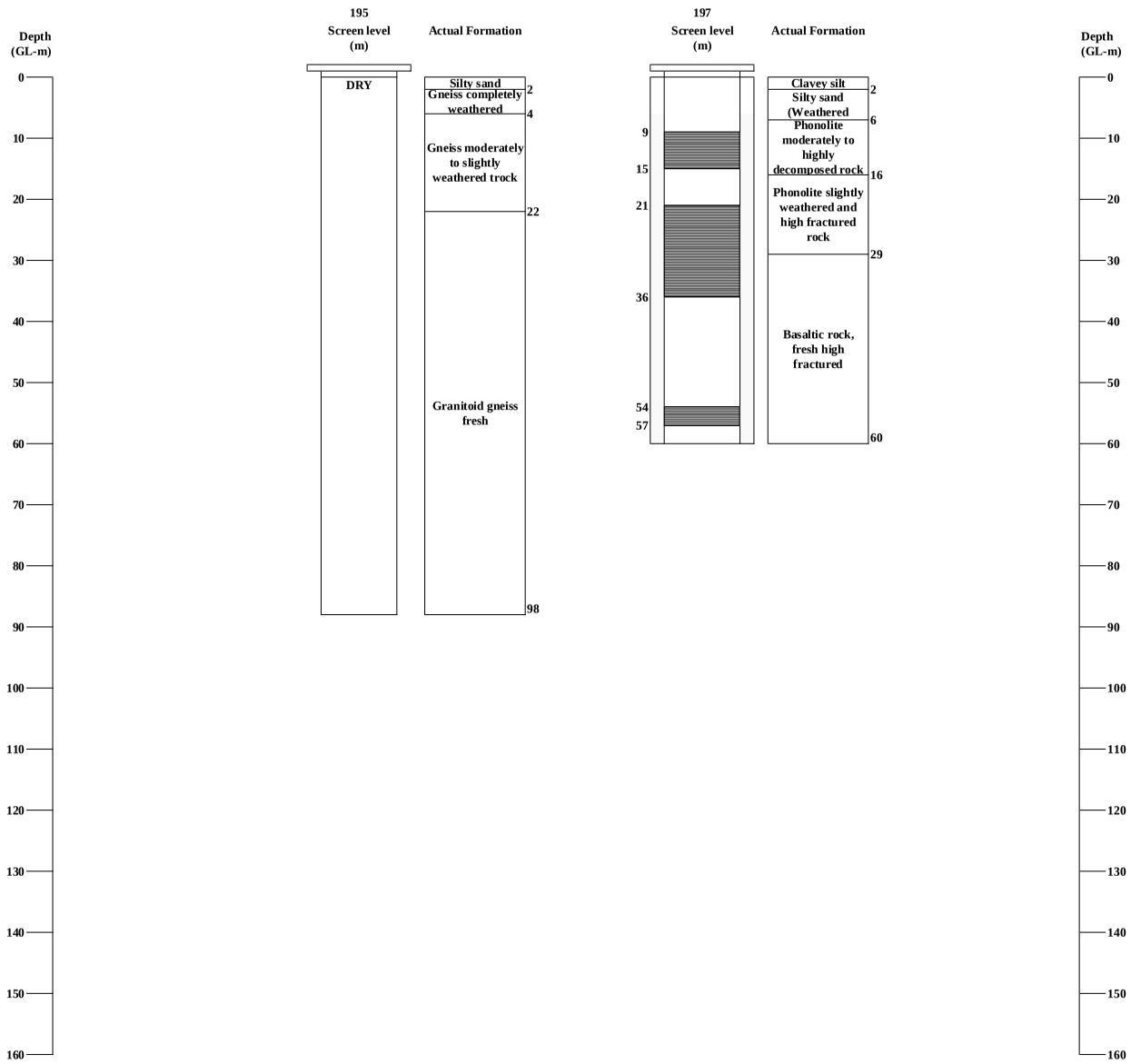

Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
98
Screen level (m)
DRY
Actual Formation
Colluvial deposits
4
Weathering gneiss
22
Fresh gneiss
94
Weathering gneiss
100
Fresh gneiss
115
121
Screen level (m)
22
34
40
58
70
82
88
94
Actual Formation
Loam soil
2
Weathered sediments
40
Fractured & weathered gneiss
60
Fractured gneiss
80
Weathered gneiss
100
127
Screen level (m)
DRY
Actual Formation
Colluvial deposits
10
Fresh gneiss
20
Weathering gneiss
24
Fresh gneiss
38
Weathering gneiss
40
Fresh gneiss
160
137
Screen level (m)
10
16
28
34
40
52
64
82
88
94
Actual Formation
Black cotton soil
2
Gravelly sand
20
Weathering gneiss
80
Fresh gneiss
100
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


Depth (GL-m)
151
Screen level (m)
Actual Formation
7'' casing left as permanent casing
21
6'' dia Plain Casing
Well Graded Gravel Pack
36
6'' dia Screen Casing
42
48
Silty sand
2
Gneiss moderately to highly weathered
Gneiss highly weathered
15
Gneiss moderately to highly weather rock
19
25
Gneiss fresh rock
Granite gneiss fresh rock
39
43
Gneiss fresh rock
54
156
Screen level (m)
Actual Formation
DRY
Silty sand
3
Gravelly sand
5
Phonolite highly to moderately weathered rock
10
24
Phonolite highly to moderately weathered rock
29
Gneiss moderately weathered to fresh rock, highly weathered and fractured rock in 82-85m
145
158
Screen level (m)
Actual Formation
9
24
45
51
Residual soil
5
Granitoid gneiss moderately to highly weathered and highly fractured rock
23
Granitoid gneiss slightly weathered to fresh rock, high fractured. Highly weathered in 47-48m
60
172
Screen level (m)
Actual Formation
Fractured sediment
4
Weathered sediments
20
70
Fractured sediments
80
Highly fractured sediments
100
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
173
Screen level (m)
Actual Formation
DRY
Silty sand
3
Gneiss moderately to slightly weathered rock
20
Gneiss slightly weathered to fresh rock
60
175
Screen level (m)
Actual Formation
DRY
Colluvial deposits
4
Weathering gneiss
60
Fresh gneiss
100
178
Screen level (m)
Actual Formation
DRY
Clayey sand & Grain sand
5
Gravelly & Coarse grain sand
8
Granitoid gneiss slightly weathered to fresh rock
98
180
Screen level (m)
Actual Formation
34
58
64
82
88
94
Colluvial deposits
2
Fresh gneiss
60
Weathered gneiss
80
Weathering gneiss
90
Fresh gneiss
100
Depth (GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


Depth (GL-m)
186
Screen level (m)
Actual Formation
187
Screen level (m)
Actual Formation
188
Screen level (m)
Actual Formation
189
Screen level (m)
Actual Formation
Depth (GL-m)
7'' casing left as permanent casing
6'' dia Plain Casing
Well Graded Gravel Pack
6'' dia Screen Casing
Colluvial deposits
Weathered sediments
Fresh gneiss
Fractuered gneiss
Silty sand
Fresh gneiss
Weathered gneiss
Fresh gneiss
s
Gneiss completely weathered
Gneiss moderately to slightly weathered rock
Gneiss slightly weathered to fresh rock
Granitoid gneiss fresh rock
Top soil Silty grave
Phonolite
Volcanic tuff moderately to slightly weathered rock
Granitoid gneiss slightly weathered to fresh rock, high fractured

A8-79


Depth
(GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
195
Screen level
(m)
DRY
Actual Formation
Silty sand
Gneiss completely weathered
Gneiss moderately to slightly weathered trock
Granitoid gneiss fresh
2
4
22
98
197
Screen level
(m)
9
15
21
36
54
57
Actual Formation
Clavey silt
Silty sand (Weathered
Phonolite moderately to highly decomposed rock
Phonolite slightly weathered and high fractured rock
Basaltic rock, fresh high fractured
2
6
16
29
60
Depth
(GL-m)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160

A8-7-10

8.8
Result of Wind Velocity Survey

(Source: The First Implementation Review Study on The Project for Rural Water Supply in The Republic of Kenya)

Possible Term to Start Pump up and Possible Time to Work about Windmill Pump

District	Site No.	Possible Term to Start Pump up	Possible Time to Work（Hour）			
			2-3 m/sec	3-4 m/sec	over 4 m/sec	Total
Mwingi	6	9:00-2:00 (18 hrs)	5.1	2.8	0.9	8.8
	28	8:00-5:00 (22 hrs)	6.3	4.2	2.1	12.6
	42	0:00-23:00 (24 hrs)	1.3	5.7	6.8	19.7
	Ave.	(21 hrs)	4.2	4.2	3.3	13.7
Kitui	54	8:00-1:00 (18 hrs)	5.9	5.0	2.7	13.5
	59	0:00-23:00 (24 hrs)	7.8	6.0	3.1	16.9
	85	0:00-23:00 (24 hrs)	6.3	6.5	5.8	18.5
	Ave.	(22 hrs)	6.7	5.8	3.9	16.3
Makueni	99	9:00-4:00 (20 hrs)	5.8	3.4	1.2	10.3
	109	7:00-23:00 (17 hrs)	5.3	3.4	1.4	10.1
	121	10:00-2:00 (16 hrs)	4.9	2.2	0.6	7.7
	Ave.	(18 hrs)	5.3	3.0	1.1	9.4
Machakos	167	0:00-23:00 (24 hrs)	7.4	5.9	3.0	16.3
	172	9:00-0:00 (16 hrs)	4.7	2.8	1.2	8.7
	199	11:00-1:00 (15 hrs)	3.6	1.1	0.2	4.8
	Ave.	(18 hrs)	5.2	3.3	1.5	9.9

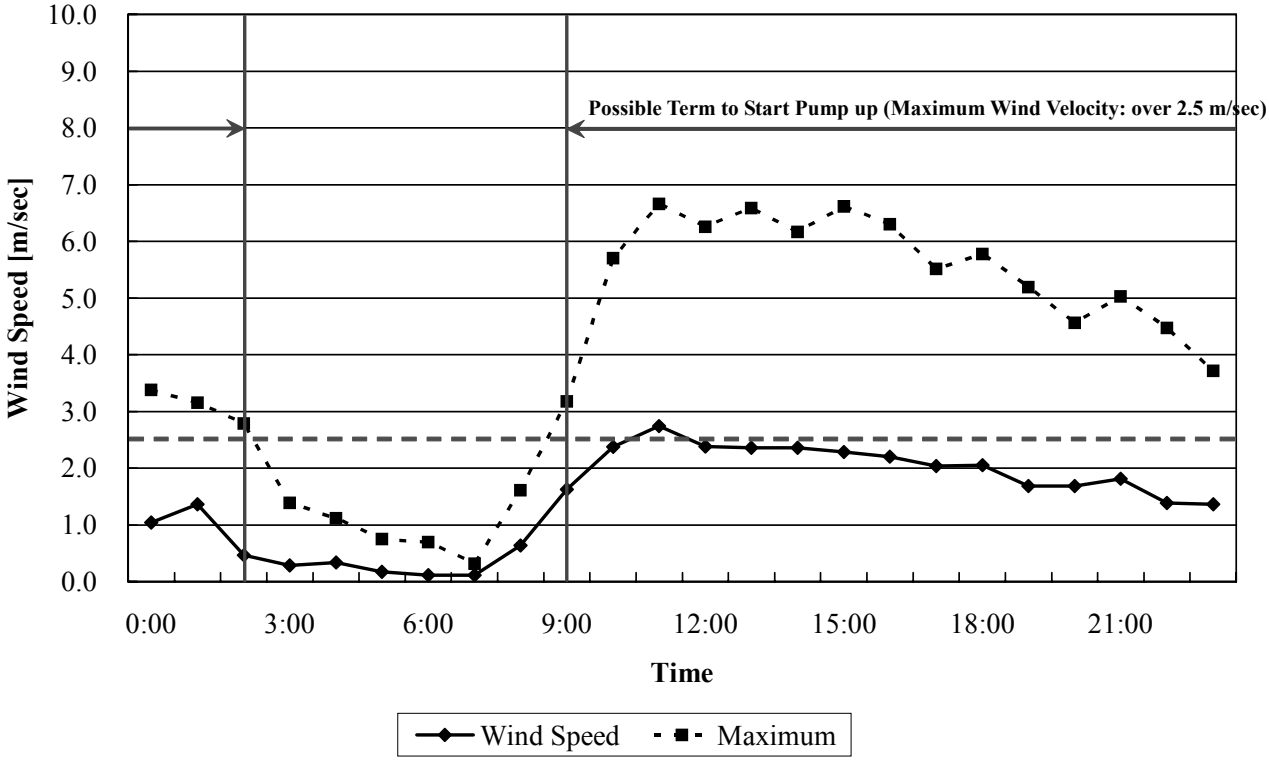


Fig-1 Hourly Wind Velocity Graph in No. 6 (Mosa) (2004.6.4~6.12 average)

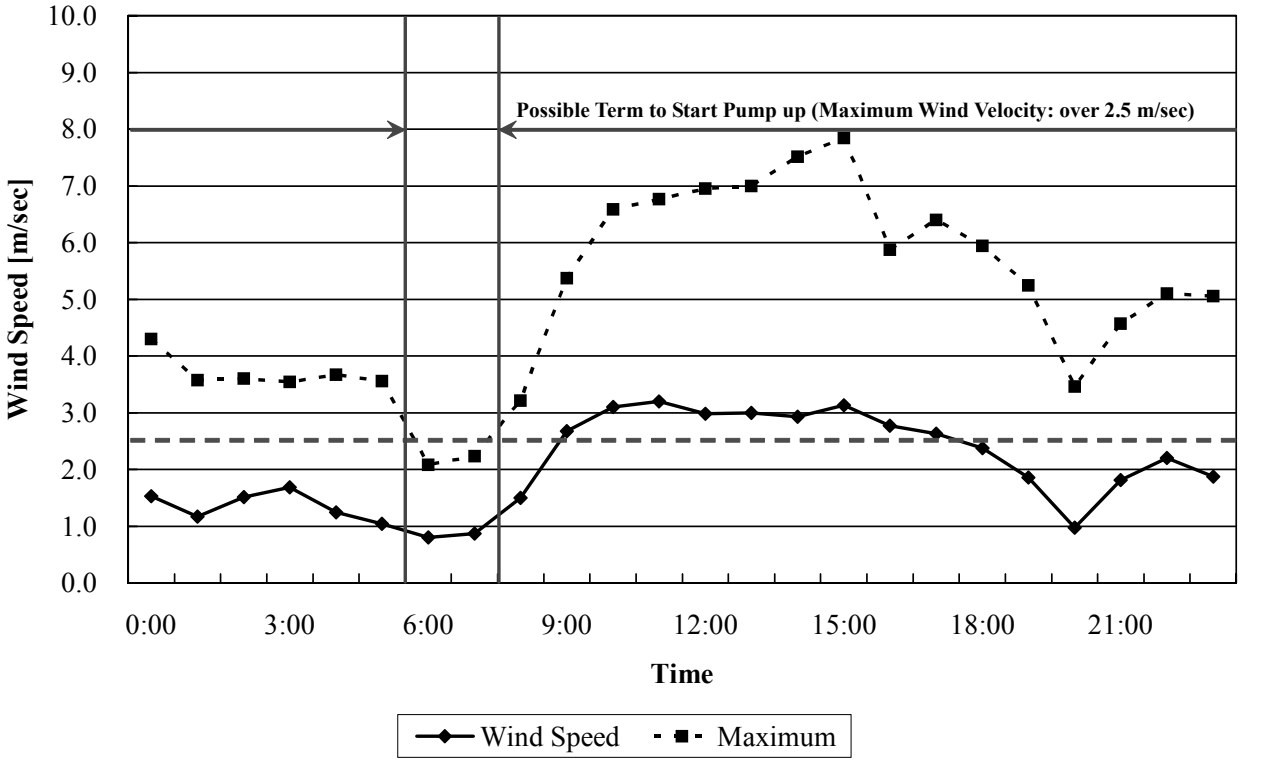


Fig-2 Hourly Wind Velocity Graph in No. 28 (Itiko) (2004.6.12~6.19 average)

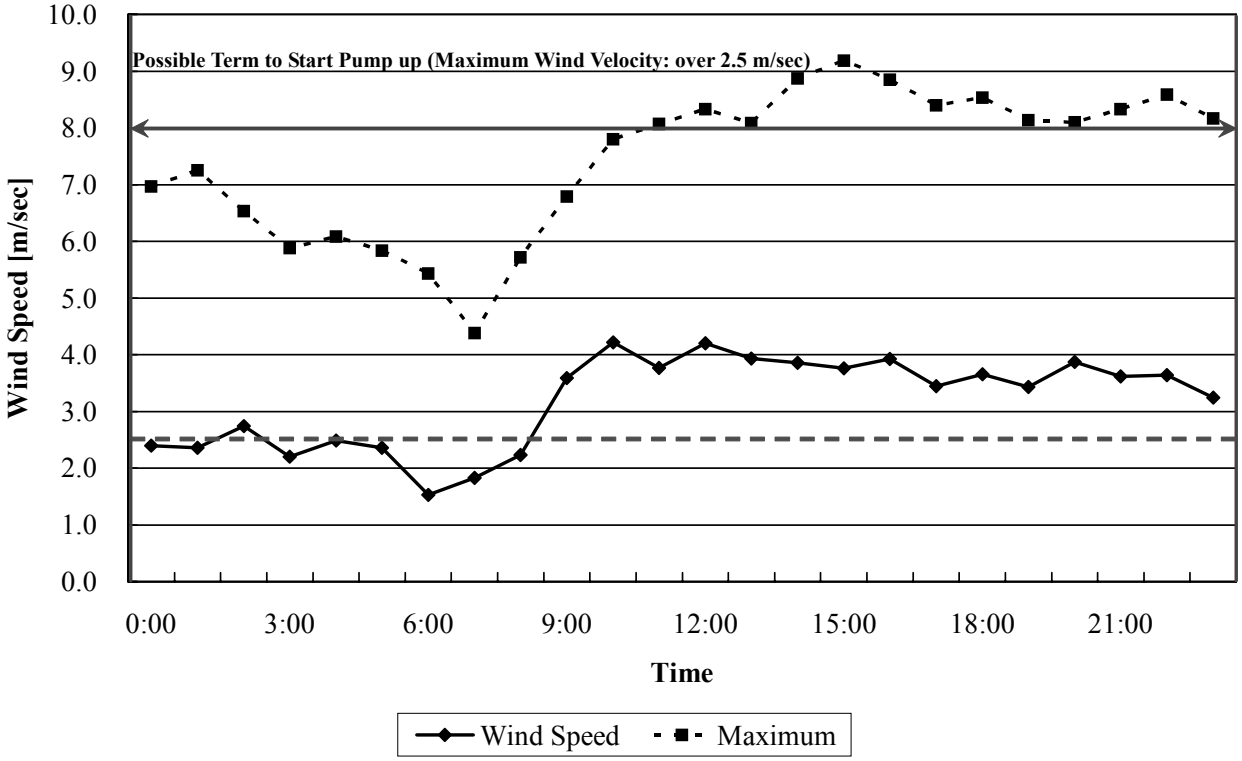


Fig-3 Hourly Wind Velocity Graph in No. 42 (Kakumuti) (2004.6.19~6.26 平均)

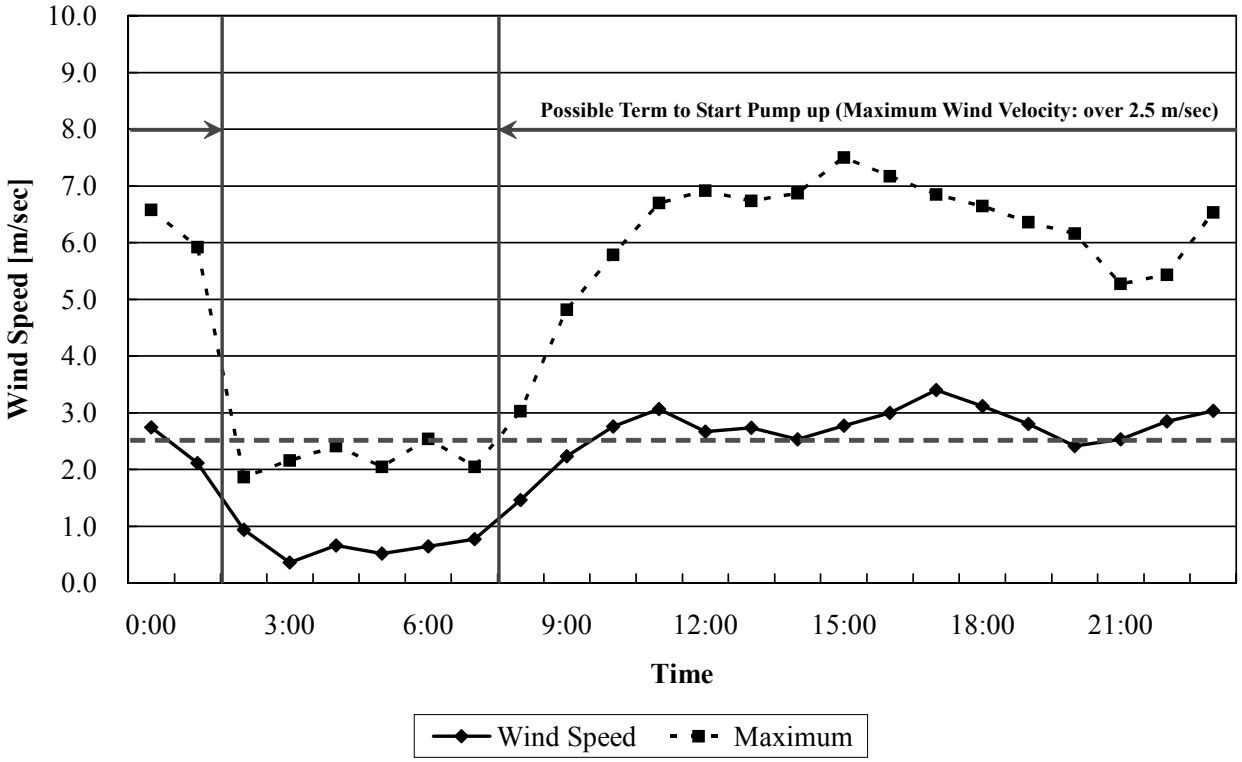


Fig-4 Hourly Wind Velocity Graph in No. 54 (Yenzuva) (2004.6.3~6.10 average)

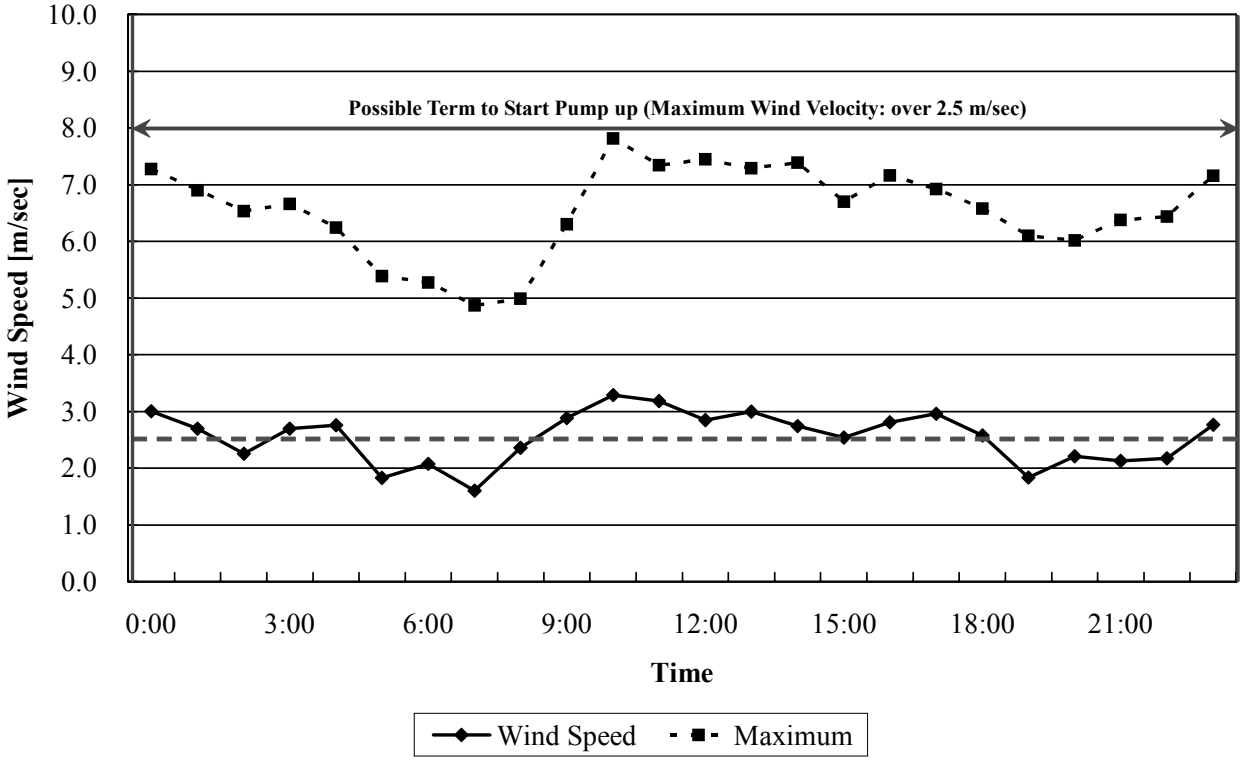


Fig-5 Hourly Wind Velocity Graph in No. 59 (Itumbi) (2004.6.17~6.24 average)

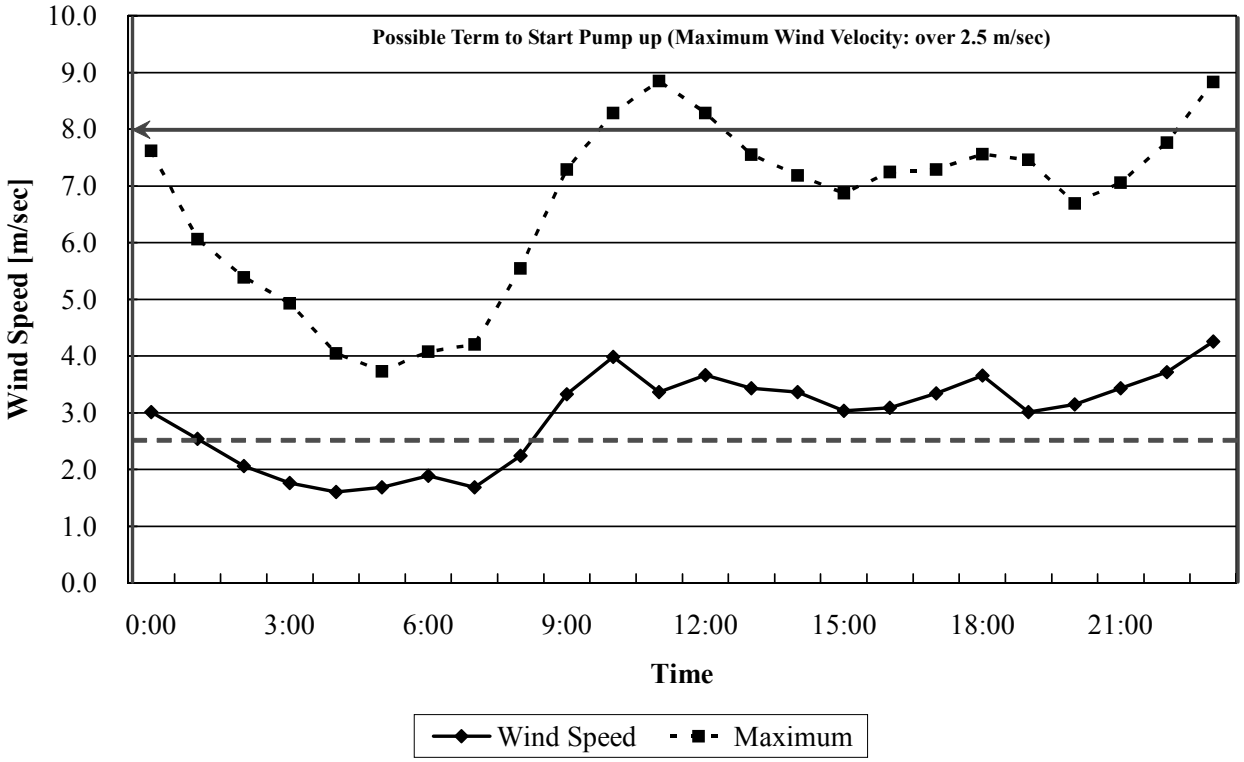


Fig-6 Hourly Wind Velocity Graph in No. 85 (Ndathani) (2004.6.10~6.17 average)

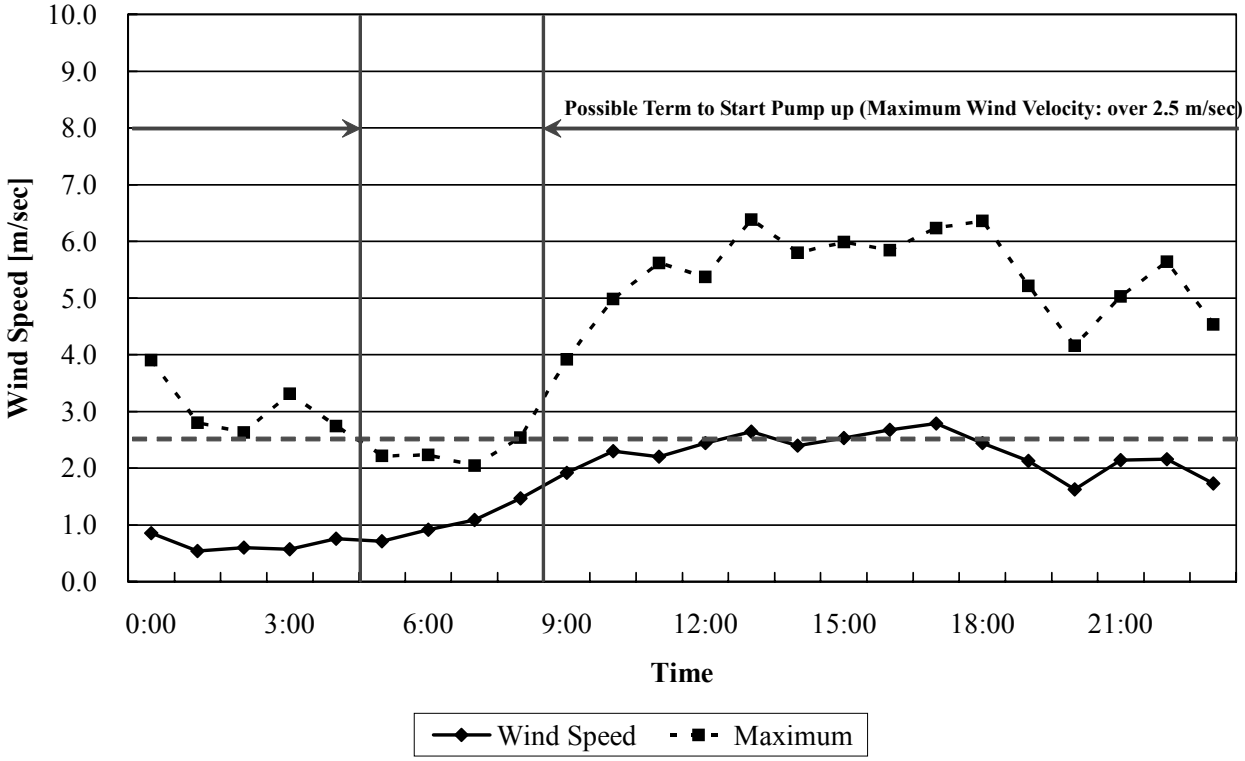


Fig-7 Hourly Wind Velocity Graph in No. 99 (Utui wa wote) (2004.6.2~6.9 average)

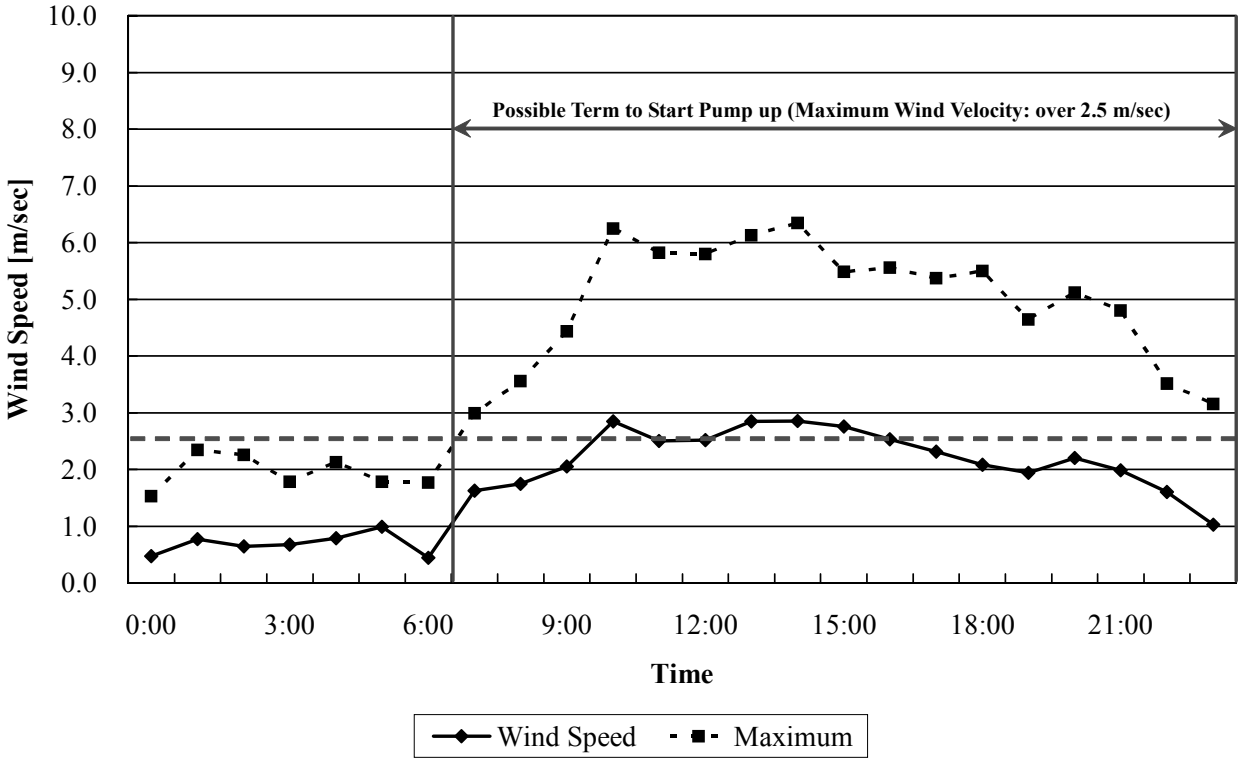


Fig-8 Hourly Wind Velocity Graph in No. 109 (Sakai) (2004.6.9~6.16 average)

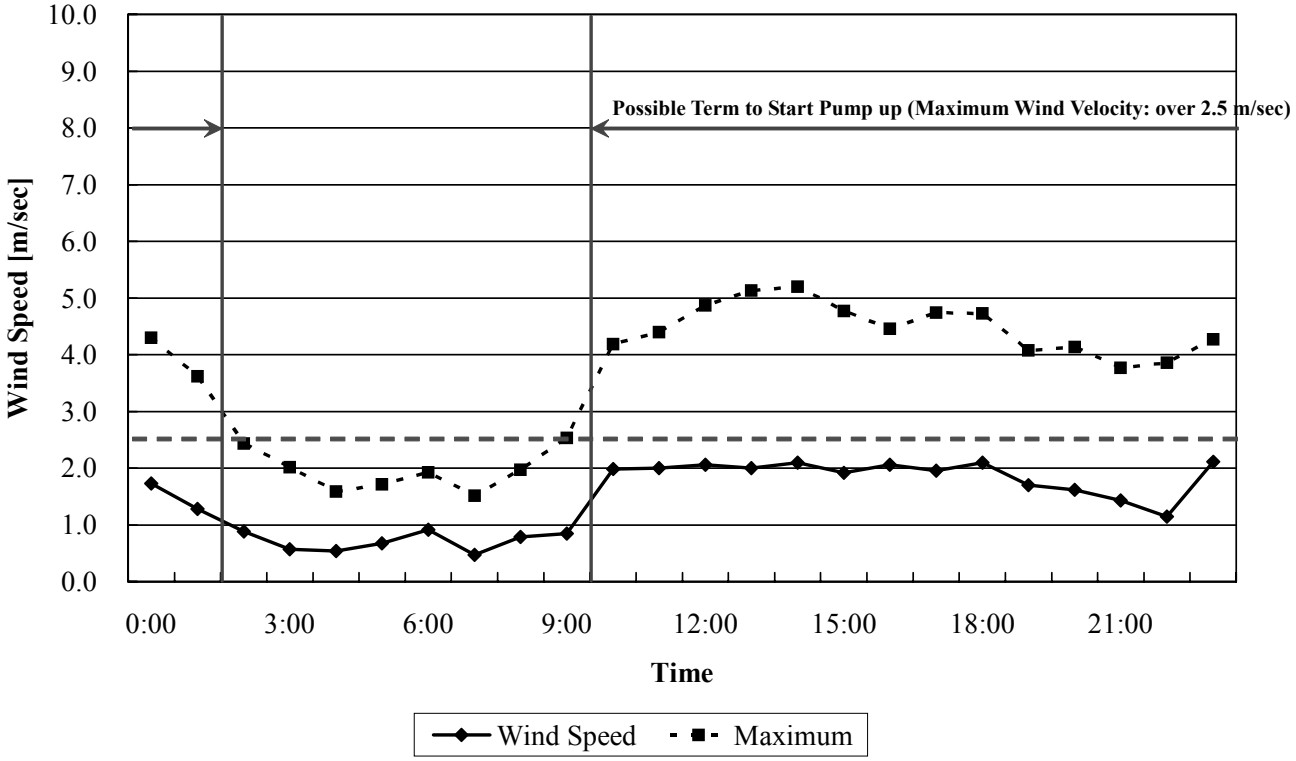


Fig-9 Hourly Wind Velocity Graph in No. 121 (Ititu Sec Sch) (2004.6.16~6.23 average)

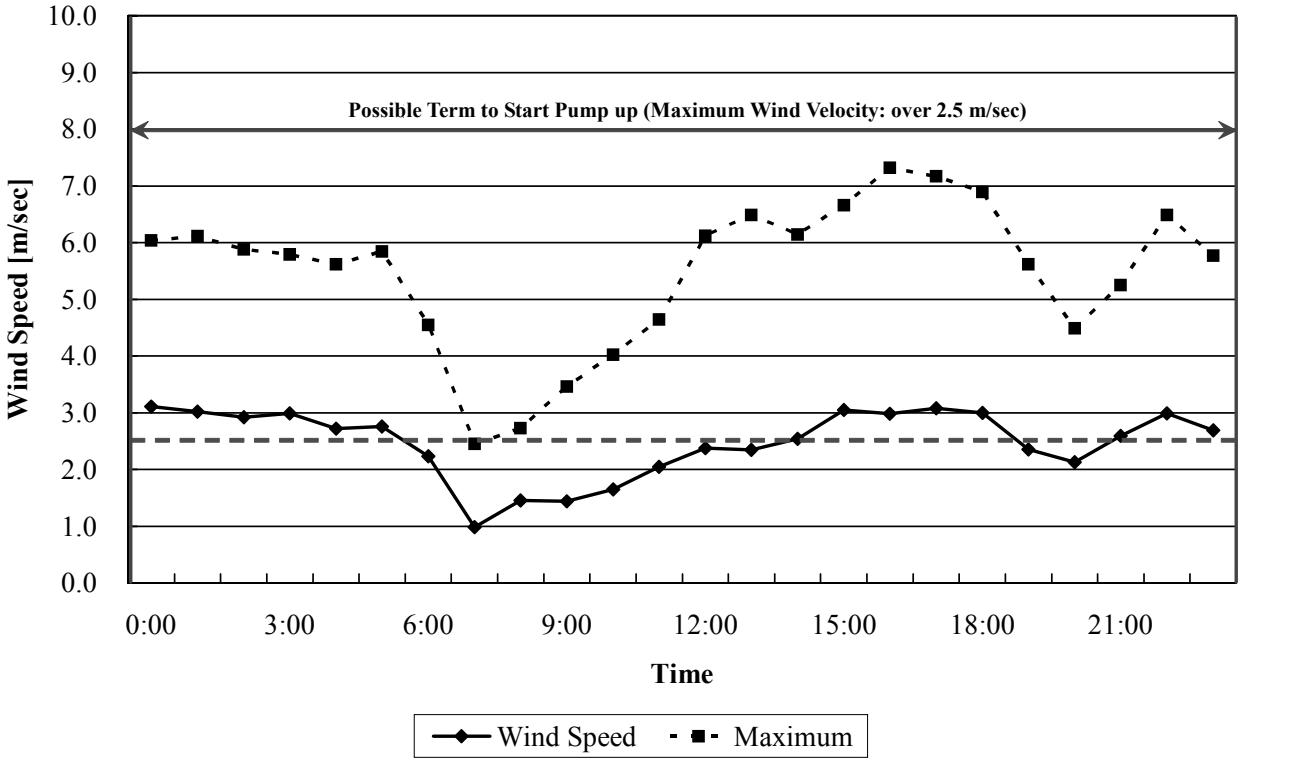


Fig-10 Hourly Wind Velocity Graph in No. 167 (Mukukuni) (2004.5.28~6.7 average)

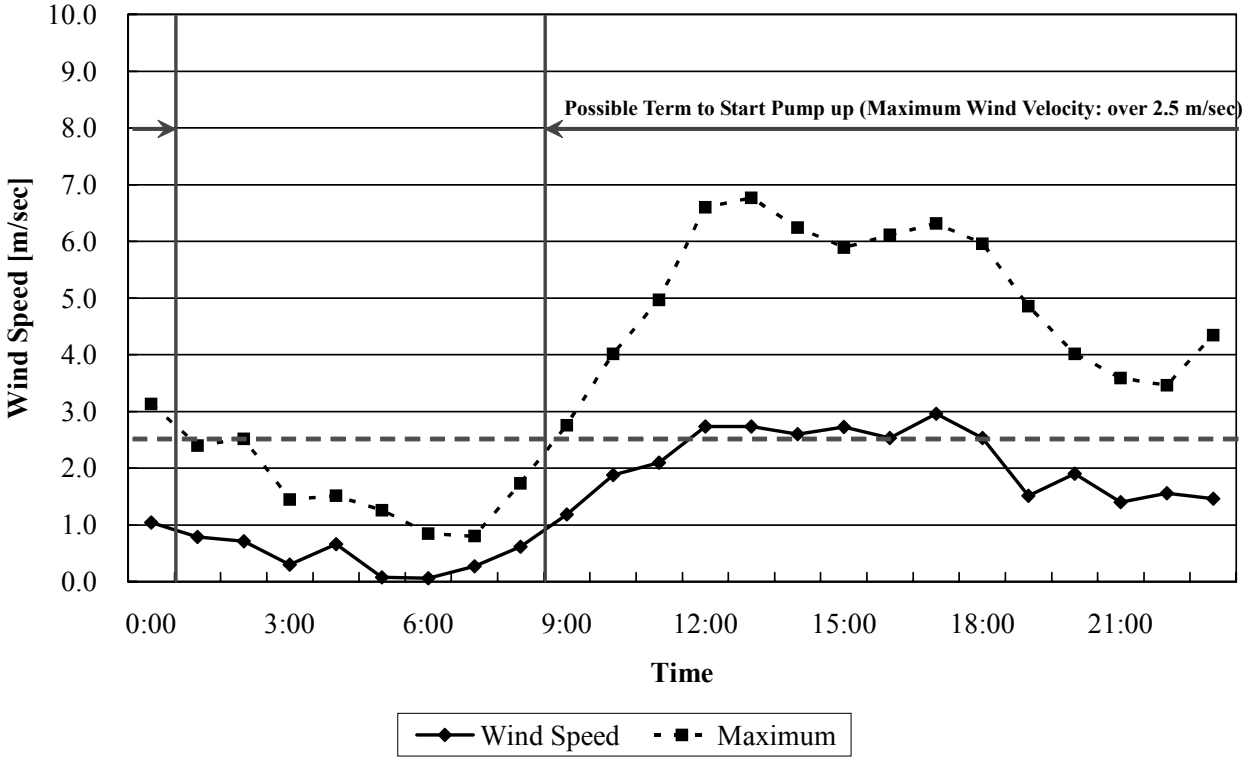


Fig-11 Hourly Wind Velocity Graph in No. 172 (Mbele wp) (2004.6.7~6.14 average)

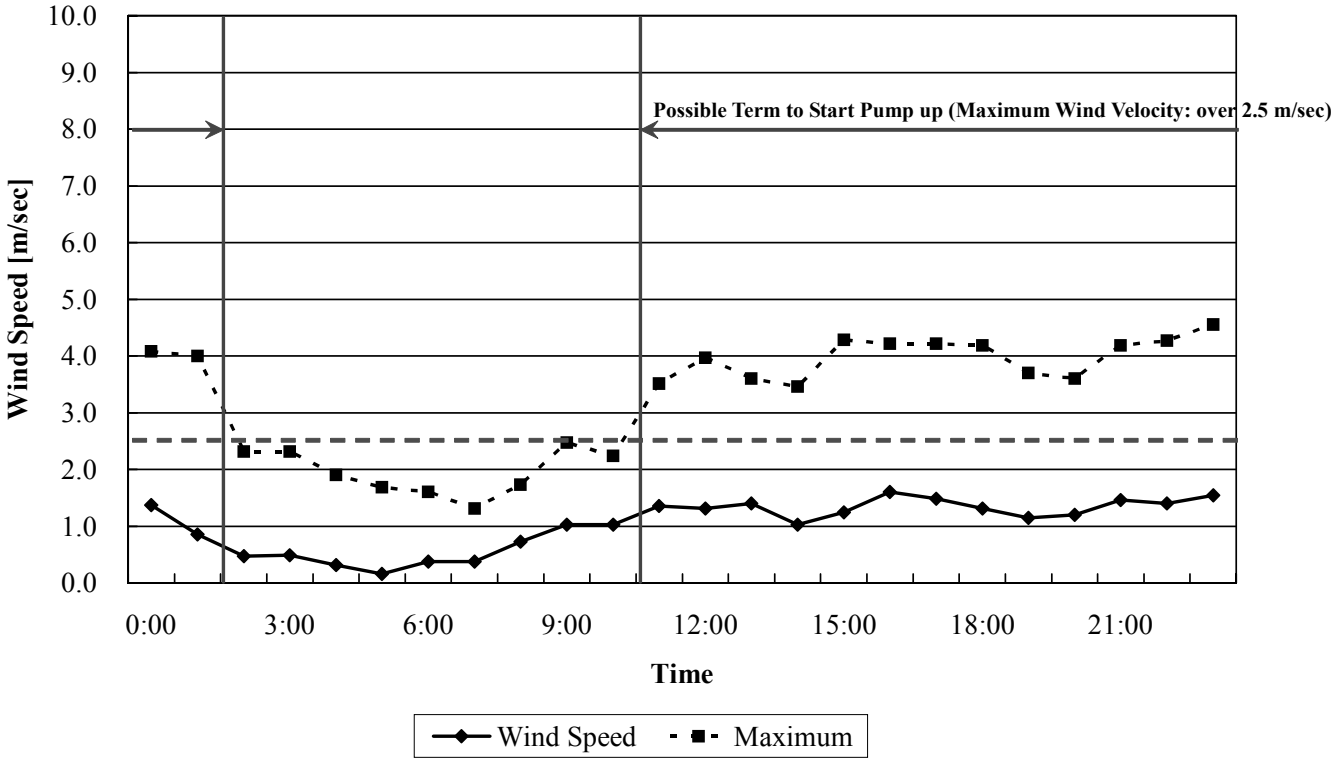


Fig-12 Hourly Wind Velocity Graph in No. 199 (Iyuni) (2004.6.14~6.21 average)

Date	Time	Kitui Mosa (No. 6) Hourly Mean		Kitui Mosa (No. 6) Hourly Maximum	
4. Jun	9:00		m/s		m/s
4. Jun	10:00		m/s		m/s
4. Jun	11:00		m/s		m/s
4. Jun	12:00		m/s		m/s
4. Jun	13:00	2.5	m/s	4.4	m/s
4. Jun	14:00	2.0	m/s	6.3	m/s
4. Jun	15:00	2.7	m/s	7.1	m/s
4. Jun	16:00	1.7	m/s	5.8	m/s
4. Jun	17:00	2.3	m/s	5.8	m/s
4. Jun	18:00	2.0	m/s	5.2	m/s
4. Jun	19:00	1.9	m/s	4.3	m/s
4. Jun	20:00	2.0	m/s	5.7	m/s
4. Jun	21:00	1.6	m/s	6.1	m/s
4. Jun	22:00	1.5	m/s	6.9	m/s
4. Jun	23:00	1.2	m/s	3.0	m/s
5. Jun	0:00	2.0	m/s	5.0	m/s
5. Jun	1:00	0.9	m/s	3.3	m/s
5. Jun	2:00	0.0	m/s	2.1	m/s
5. Jun	3:00	0.0	m/s	0.4	m/s
5. Jun	4:00	0.4	m/s	1.1	m/s
5. Jun	5:00	0.0	m/s	0.7	m/s
5. Jun	6:00	0.0	m/s	1.1	m/s
5. Jun	7:00	0.0	m/s	0.0	m/s
5. Jun	8:00	0.8	m/s	1.7	m/s
5. Jun	9:00	1.5	m/s	3.4	m/s
5. Jun	10:00	2.9	m/s	6.2	m/s
5. Jun	11:00	2.9	m/s	7.1	m/s
5. Jun	12:00	2.3	m/s	6.4	m/s
5. Jun	13:00	2.1	m/s	7.2	m/s
5. Jun	14:00	2.7	m/s	6.2	m/s
5. Jun	15:00	2.3	m/s	6.9	m/s
5. Jun	16:00	2.2	m/s	5.7	m/s
5. Jun	17:00	2.1	m/s	5.7	m/s
5. Jun	18:00	2.0	m/s	6.1	m/s
5. Jun	19:00	1.5	m/s	5.4	m/s
5. Jun	20:00	1.9	m/s	4.6	m/s
5. Jun	21:00	2.1	m/s	5.4	m/s
5. Jun	22:00	1.9	m/s	6.2	m/s
5. Jun	23:00	0.9	m/s	4.7	m/s
6. Jun	0:00	0.6	m/s	2.5	m/s
6. Jun	1:00	1.0	m/s	2.6	m/s
6. Jun	2:00	0.0	m/s	2.8	m/s
6. Jun	3:00	0.0	m/s	0.0	m/s
6. Jun	4:00	0.0	m/s	0.0	m/s
6. Jun	5:00	0.0	m/s	0.3	m/s
6. Jun	6:00	0.0	m/s	0.5	m/s
6. Jun	7:00	0.0	m/s	0.0	m/s
6. Jun	8:00	0.0	m/s	0.4	m/s
6. Jun	9:00	0.9	m/s	1.9	m/s
6. Jun	10:00	1.9	m/s	5.0	m/s
6. Jun	11:00	1.9	m/s	4.3	m/s
6. Jun	12:00	3.0	m/s	6.7	m/s
6. Jun	13:00	3.0	m/s	5.5	m/s
6. Jun	14:00	2.6	m/s	7.4	m/s
6. Jun	15:00	3.4	m/s	8.1	m/s
6. Jun	16:00	2.3	m/s	8.3	m/s
6. Jun	17:00	2.4	m/s	6.4	m/s
6. Jun	18:00	1.7	m/s	6.3	m/s
6. Jun	19:00	1.0	m/s	4.5	m/s
6. Jun	20:00	2.4	m/s	5.3	m/s
6. Jun	21:00	1.7	m/s	5.7	m/s
6. Jun	22:00	1.6	m/s	5.3	m/s
6. Jun	23:00	1.3	m/s	3.1	m/s

Date	Time	Kitui Itiko (No. 28) Hourly Mean		Kitui Itiko (No. 28) Hourly Maximum	
12. Jun	9:00		m/s		m/s
12. Jun	10:00		m/s		m/s
12. Jun	11:00		m/s		m/s
12. Jun	12:00		m/s		m/s
12. Jun	13:00	2.8	m/s	3.1	m/s
12. Jun	14:00	3.2	m/s	8.3	m/s
12. Jun	15:00	4.7	m/s	7.0	m/s
12. Jun	16:00	1.9	m/s	2.0	m/s
12. Jun	17:00	1.6	m/s	6.4	m/s
12. Jun	18:00	2.1	m/s	4.9	m/s
12. Jun	19:00	1.4	m/s	5.0	m/s
12. Jun	20:00	0.0	m/s	1.4	m/s
12. Jun	21:00	3.2	m/s	7.0	m/s
12. Jun	22:00	1.3	m/s	4.7	m/s
12. Jun	23:00	1.7	m/s	3.8	m/s
13. Jun	0:00	0.4	m/s	2.9	m/s
13. Jun	1:00	1.0	m/s	1.7	m/s
13. Jun	2:00	0.0	m/s	1.9	m/s
13. Jun	3:00	0.0	m/s	0.8	m/s
13. Jun	4:00	1.2	m/s	2.4	m/s
13. Jun	5:00	0.7	m/s	2.1	m/s
13. Jun	6:00	1.1	m/s	2.1	m/s
13. Jun	7:00	2.0	m/s	3.9	m/s
13. Jun	8:00	3.4	m/s	5.8	m/s
13. Jun	9:00	3.8	m/s	7.4	m/s
13. Jun	10:00	3.4	m/s	7.6	m/s
13. Jun	11:00	3.1	m/s	7.2	m/s
13. Jun	12:00	2.5	m/s	7.1	m/s
13. Jun	13:00	2.6	m/s	7.6	m/s
13. Jun	14:00	2.4	m/s	6.6	m/s
13. Jun	15:00	2.5	m/s	10.7	m/s
13. Jun	16:00	3.5	m/s	6.7	m/s
13. Jun	17:00	2.3	m/s	6.4	m/s
13. Jun	18:00	2.1	m/s	5.6	m/s
13. Jun	19:00	1.4	m/s	5.4	m/s
13. Jun	20:00	1.2	m/s	2.2	m/s
13. Jun	21:00	1.9	m/s	3.9	m/s
13. Jun	22:00	1.7	m/s	5.3	m/s
13. Jun	23:00	2.5	m/s	5.4	m/s
14. Jun	0:00	1.5	m/s	5.4	m/s
14. Jun	1:00	0.8	m/s	2.7	m/s
14. Jun	2:00	1.6	m/s	4.7	m/s
14. Jun	3:00	1.3	m/s	2.4	m/s
14. Jun	4:00	0.8	m/s	3.5	m/s
14. Jun	5:00	0.3	m/s	2.3	m/s
14. Jun	6:00	1.5	m/s	3.2	m/s
14. Jun	7:00	0.0	m/s	3.0	m/s
14. Jun	8:00	1.2	m/s	3.4	m/s
14. Jun	9:00	3.2	m/s	6.4	m/s
14. Jun	10:00	3.2	m/s	8.8	m/s
14. Jun	11:00	3.6	m/s	6.8	m/s
14. Jun	12:00	2.5	m/s	7.1	m/s
14. Jun	13:00	2.5	m/s	6.7	m/s
14. Jun	14:00	2.3	m/s	8.1	m/s
14. Jun	15:00	2.0	m/s	7.8	m/s
14. Jun	16:00	2.2	m/s	6.6	m/s
14. Jun	17:00	2.3	m/s	5.6	m/s
14. Jun	18:00	2.7	m/s	5.7	m/s
14. Jun	19:00	2.9	m/s	5.8	m/s
14. Jun	20:00	1.0	m/s	4.0	m/s
14. Jun	21:00	0.6	m/s	3.2	m/s
14. Jun	22:00	1.9	m/s	4.9	m/s
14. Jun	23:00	1.7	m/s	4.7	m/s

Date	Time	Kitui Kakumuti (No. 42) Hourly Mean		Kitui Kakumuti (No. 42) Hourly Maximum	
19. Jun	9:00		m/s		m/s
19. Jun	10:00		m/s		m/s
19. Jun	11:00		m/s		m/s
19. Jun	12:00		m/s		m/s
19. Jun	13:00		m/s		m/s
19. Jun	14:00	3.4	m/s	5.3	m/s
19. Jun	15:00	2.7	m/s	4.9	m/s
19. Jun	16:00	2.7	m/s	6.1	m/s
19. Jun	17:00	3.2	m/s	5.1	m/s
19. Jun	18:00	2.6	m/s	5.0	m/s
19. Jun	19:00	2.2	m/s	4.4	m/s
19. Jun	20:00	3.5	m/s	6.8	m/s
19. Jun	21:00	3.5	m/s	6.9	m/s
19. Jun	22:00	4.2	m/s	7.9	m/s
19. Jun	23:00	1.7	m/s	8.8	m/s
20. Jun	0:00	2.8	m/s	5.1	m/s
20. Jun	1:00	2.5	m/s	5.2	m/s
20. Jun	2:00	2.1	m/s	4.7	m/s
20. Jun	3:00	1.1	m/s	2.5	m/s
20. Jun	4:00	2.0	m/s	3.7	m/s
20. Jun	5:00	2.4	m/s	4.5	m/s
20. Jun	6:00	1.7	m/s	3.2	m/s
20. Jun	7:00	2.0	m/s	3.3	m/s
20. Jun	8:00	2.4	m/s	5.1	m/s
20. Jun	9:00	3.0	m/s	5.7	m/s
20. Jun	10:00	3.2	m/s	6.8	m/s
20. Jun	11:00	2.8	m/s	7.1	m/s
20. Jun	12:00	3.0	m/s	5.7	m/s
20. Jun	13:00	2.8	m/s	6.0	m/s
20. Jun	14:00	3.5	m/s	6.9	m/s
20. Jun	15:00	3.6	m/s	6.5	m/s
20. Jun	16:00	3.7	m/s	6.7	m/s
20. Jun	17:00	0.4	m/s	6.3	m/s
20. Jun	18:00	2.4	m/s	4.7	m/s
20. Jun	19:00	1.3	m/s	3.4	m/s
20. Jun	20:00	1.5	m/s	2.5	m/s
20. Jun	21:00	2.3	m/s	3.2	m/s
20. Jun	22:00	4.1	m/s	7.3	m/s
20. Jun	23:00	4.6	m/s	7.8	m/s
21. Jun	0:00	3.9	m/s	8.1	m/s
21. Jun	1:00	3.4	m/s	8.8	m/s
21. Jun	2:00	0.3	m/s	6.0	m/s
21. Jun	3:00	0.3	m/s	2.3	m/s
21. Jun	4:00	0.8	m/s	2.8	m/s
21. Jun	5:00	1.3	m/s	2.5	m/s
21. Jun	6:00	1.3	m/s	4.6	m/s
21. Jun	7:00	1.7	m/s	2.8	m/s
21. Jun	8:00	1.7	m/s	3.8	m/s
21. Jun	9:00	3.3	m/s	5.8	m/s
21. Jun	10:00	4.1	m/s	9.2	m/s
21. Jun	11:00	3.8	m/s	8.6	m/s
21. Jun	12:00	3.5	m/s	8.5	m/s
21. Jun	13:00	3.8	m/s	7.7	m/s
21. Jun	14:00	3.5	m/s	7.7	m/s
21. Jun	15:00	3.5	m/s	9.1	m/s
21. Jun	16:00	3.7	m/s	7.5	m/s
21. Jun	17:00	4.6	m/s	7.9	m/s
21. Jun	18:00	4.4	m/s	9.6	m/s
21. Jun	19:00	2.9	m/s	7.1	m/s
21. Jun	20:00	3.2	m/s	4.6	m/s
21. Jun	21:00	1.7	m/s	5.4	m/s
21. Jun	22:00	2.5	m/s	4.4	m/s
21. Jun	23:00	1.9	m/s	3.4	m/s

Date	Time	Kitui Mosa (No. 6) Hourly Mean	Kitui Mosa (No. 6) Hourly Maximum
7. Jun	0:00	0.0 m/s	2.6 m/s
7. Jun	1:00	1.5 m/s	3.2 m/s
7. Jun	2:00	0.4 m/s	2.4 m/s
7. Jun	3:00	0.0 m/s	1.5 m/s
7. Jun	4:00	1.1 m/s	2.2 m/s
7. Jun	5:00	0.0 m/s	2.1 m/s
7. Jun	6:00	0.0 m/s	0.0 m/s
7. Jun	7:00	0.0 m/s	0.5 m/s
7. Jun	8:00	0.0 m/s	0.0 m/s
7. Jun	9:00	1.5 m/s	2.9 m/s
7. Jun	10:00	2.1 m/s	5.3 m/s
7. Jun	11:00	2.4 m/s	5.4 m/s
7. Jun	12:00	2.0 m/s	5.9 m/s
7. Jun	13:00	1.0 m/s	5.7 m/s
7. Jun	14:00	1.8 m/s	3.6 m/s
7. Jun	15:00	1.7 m/s	5.3 m/s
7. Jun	16:00	2.0 m/s	5.4 m/s
7. Jun	17:00	1.9 m/s	3.5 m/s
7. Jun	18:00	2.0 m/s	4.5 m/s
7. Jun	19:00	1.2 m/s	3.8 m/s
7. Jun	20:00	1.6 m/s	3.2 m/s
7. Jun	21:00	1.7 m/s	3.4 m/s
7. Jun	22:00	1.4 m/s	2.7 m/s
7. Jun	23:00	1.6 m/s	3.8 m/s
8. Jun	0:00	0.9 m/s	4.9 m/s
8. Jun	1:00	1.5 m/s	3.7 m/s
8. Jun	2:00	1.4 m/s	3.3 m/s
8. Jun	3:00	0.6 m/s	3.8 m/s
8. Jun	4:00	0.2 m/s	1.2 m/s
8. Jun	5:00	0.0 m/s	0.0 m/s
8. Jun	6:00	0.0 m/s	0.5 m/s
8. Jun	7:00	0.0 m/s	0.0 m/s
8. Jun	8:00	0.5 m/s	1.6 m/s
8. Jun	9:00	1.4 m/s	2.7 m/s
8. Jun	10:00	1.7 m/s	3.7 m/s
8. Jun	11:00	2.9 m/s	6.5 m/s
8. Jun	12:00	2.0 m/s	5.5 m/s
8. Jun	13:00	2.3 m/s	6.6 m/s
8. Jun	14:00	2.4 m/s	6.6 m/s
8. Jun	15:00	2.1 m/s	6.9 m/s
8. Jun	16:00	2.4 m/s	6.7 m/s
8. Jun	17:00	2.2 m/s	5.4 m/s
8. Jun	18:00	1.9 m/s	5.9 m/s
8. Jun	19:00	2.4 m/s	6.9 m/s
8. Jun	20:00	2.1 m/s	5.7 m/s
8. Jun	21:00	1.8 m/s	5.2 m/s
8. Jun	22:00	0.7 m/s	2.7 m/s
8. Jun	23:00	1.3 m/s	2.3 m/s
9. Jun	0:00	0.5 m/s	1.7 m/s
9. Jun	1:00	1.3 m/s	2.4 m/s
9. Jun	2:00	0.5 m/s	2.2 m/s
9. Jun	3:00	0.0 m/s	0.4 m/s
9. Jun	4:00	0.0 m/s	0.4 m/s
9. Jun	5:00	0.0 m/s	0.3 m/s
9. Jun	6:00	0.0 m/s	0.0 m/s
9. Jun	7:00	0.0 m/s	0.4 m/s
9. Jun	8:00	0.8 m/s	1.9 m/s
9. Jun	9:00	1.2 m/s	3.0 m/s
9. Jun	10:00	2.0 m/s	4.8 m/s
9. Jun	11:00	2.9 m/s	6.1 m/s
9. Jun	12:00	2.0 m/s	4.9 m/s
9. Jun	13:00	2.5 m/s	9.4 m/s
9. Jun	14:00	2.3 m/s	5.9 m/s
9. Jun	15:00	2.1 m/s	7.0 m/s
9. Jun	16:00	2.7 m/s	5.8 m/s
9. Jun	17:00	1.9 m/s	7.4 m/s
9. Jun	18:00	2.4 m/s	6.3 m/s
9. Jun	19:00	2.0 m/s	6.0 m/s
9. Jun	20:00	2.5 m/s	6.4 m/s
9. Jun	21:00	1.3 m/s	5.1 m/s
9. Jun	22:00	1.5 m/s	4.7 m/s
9. Jun	23:00	1.0 m/s	5.4 m/s

Date	Time	Kitui Itiko (No. 28) Hourly Mean	Kitui Itiko (No. 28) Hourly Maximum
15. Jun	0:00	0.6 m/s	3.3 m/s
15. Jun	1:00	0.8 m/s	3.4 m/s
15. Jun	2:00	1.1 m/s	1.9 m/s
15. Jun	3:00	1.6 m/s	2.7 m/s
15. Jun	4:00	0.9 m/s	3.2 m/s
15. Jun	5:00	0.5 m/s	3.7 m/s
15. Jun	6:00	0.0 m/s	0.0 m/s
15. Jun	7:00	0.0 m/s	0.0 m/s
15. Jun	8:00	0.5 m/s	1.3 m/s
15. Jun	9:00	1.7 m/s	3.8 m/s
15. Jun	10:00	3.4 m/s	6.6 m/s
15. Jun	11:00	2.4 m/s	6.4 m/s
15. Jun	12:00	2.5 m/s	5.9 m/s
15. Jun	13:00	2.5 m/s	6.3 m/s
15. Jun	14:00	3.1 m/s	7.0 m/s
15. Jun	15:00	2.7 m/s	7.4 m/s
15. Jun	16:00	3.3 m/s	7.3 m/s
15. Jun	17:00	2.9 m/s	6.8 m/s
15. Jun	18:00	2.7 m/s	6.6 m/s
15. Jun	19:00	2.0 m/s	6.4 m/s
15. Jun	20:00	1.5 m/s	4.5 m/s
15. Jun	21:00	2.5 m/s	4.4 m/s
15. Jun	22:00	2.5 m/s	5.3 m/s
15. Jun	23:00	2.2 m/s	5.8 m/s
16. Jun	0:00	2.0 m/s	5.5 m/s
16. Jun	1:00	2.1 m/s	4.3 m/s
16. Jun	2:00	2.0 m/s	4.0 m/s
16. Jun	3:00	1.6 m/s	3.5 m/s
16. Jun	4:00	1.7 m/s	3.2 m/s
16. Jun	5:00	1.3 m/s	3.2 m/s
16. Jun	6:00	0.0 m/s	2.5 m/s
16. Jun	7:00	1.7 m/s	2.9 m/s
16. Jun	8:00	2.1 m/s	4.7 m/s
16. Jun	9:00	2.8 m/s	6.3 m/s
16. Jun	10:00	3.5 m/s	6.8 m/s
16. Jun	11:00	3.4 m/s	7.4 m/s
16. Jun	12:00	2.9 m/s	7.1 m/s
16. Jun	13:00	3.4 m/s	7.2 m/s
16. Jun	14:00	3.0 m/s	7.0 m/s
16. Jun	15:00	2.7 m/s	5.4 m/s
16. Jun	16:00	2.5 m/s	5.0 m/s
16. Jun	17:00	2.6 m/s	5.3 m/s
16. Jun	18:00	2.0 m/s	4.7 m/s
16. Jun	19:00	0.6 m/s	3.4 m/s
16. Jun	20:00	0.5 m/s	2.3 m/s
16. Jun	21:00	1.6 m/s	7.4 m/s
16. Jun	22:00	3.1 m/s	5.8 m/s
16. Jun	23:00	2.2 m/s	5.0 m/s
17. Jun	0:00	2.5 m/s	5.5 m/s
17. Jun	1:00	1.0 m/s	5.6 m/s
17. Jun	2:00	1.9 m/s	4.2 m/s
17. Jun	3:00	1.6 m/s	4.0 m/s
17. Jun	4:00	0.5 m/s	4.4 m/s
17. Jun	5:00	2.4 m/s	5.8 m/s
17. Jun	6:00	1.4 m/s	3.3 m/s
17. Jun	7:00	0.9 m/s	2.9 m/s
17. Jun	8:00	0.9 m/s	1.9 m/s
17. Jun	9:00	1.5 m/s	2.8 m/s
17. Jun	10:00	2.0 m/s	3.7 m/s
17. Jun	11:00	2.4 m/s	4.6 m/s
17. Jun	12:00	3.5 m/s	6.2 m/s
17. Jun	13:00	3.8 m/s	8.8 m/s
17. Jun	14:00	3.5 m/s	7.9 m/s
17. Jun	15:00	3.4 m/s	7.3 m/s
17. Jun	16:00	3.1 m/s	6.5 m/s
17. Jun	17:00	3.7 m/s	7.9 m/s
17. Jun	18:00	2.5 m/s	7.8 m/s
17. Jun	19:00	2.4 m/s	5.6 m/s
17. Jun	20:00	1.5 m/s	6.4 m/s
17. Jun	21:00	1.3 m/s	2.7 m/s
17. Jun	22:00	2.0 m/s	3.5 m/s
17. Jun	23:00	1.0 m/s	3.7 m/s

Date	Time	Kitui Kakumuti (No. 42) Hourly Mean	Kitui Kakumuti (No. 42) Hourly Maximum
22. Jun	0:00	0.0 m/s	2.1 m/s
22. Jun	1:00	0.0 m/s	4.2 m/s
22. Jun	2:00	0.0 m/s	2.3 m/s
22. Jun	3:00	0.0 m/s	1.7 m/s
22. Jun	4:00	0.0 m/s	1.4 m/s
22. Jun	5:00	0.0 m/s	0.4 m/s
22. Jun	6:00	0.0 m/s	1.5 m/s
22. Jun	7:00	0.0 m/s	0.3 m/s
22. Jun	8:00	1.9 m/s	4.4 m/s
22. Jun	9:00	2.7 m/s	5.2 m/s
22. Jun	10:00	3.7 m/s	6.3 m/s
22. Jun	11:00	3.2 m/s	6.2 m/s
22. Jun	12:00	3.5 m/s	7.0 m/s
22. Jun	13:00	3.7 m/s	7.9 m/s
22. Jun	14:00	3.6 m/s	6.7 m/s
22. Jun	15:00	3.2 m/s	7.4 m/s
22. Jun	16:00	4.6 m/s	7.7 m/s
22. Jun	17:00	4.3 m/s	7.8 m/s
22. Jun	18:00	5.4 m/s	10.1 m/s
22. Jun	19:00	4.2 m/s	8.9 m/s
22. Jun	20:00	4.1 m/s	8.1 m/s
22. Jun	21:00	4.6 m/s	8.1 m/s
22. Jun	22:00	4.9 m/s	8.9 m/s
22. Jun	23:00	3.2 m/s	8.3 m/s
23. Jun	0:00	4.7 m/s	8.3 m/s
23. Jun	1:00	3.4 m/s	7.0 m/s
23. Jun	2:00	4.0 m/s	7.0 m/s
23. Jun	3:00	3.9 m/s	6.8 m/s
23. Jun	4:00	3.4 m/s	6.7 m/s
23. Jun	5:00	2.8 m/s	7.2 m/s
23. Jun	6:00	1.3 m/s	4.4 m/s
23. Jun	7:00	0.0 m/s	2.8 m/s
23. Jun	8:00	0.0 m/s	0.3 m/s
23. Jun	9:00	2.5 m/s	5.4 m/s
23. Jun	10:00	3.8 m/s	7.1 m/s
23. Jun	11:00	4.2 m/s	7.9 m/s
23. Jun	12:00	4.6 m/s	10.1 m/s
23. Jun	13:00	3.8 m/s	8.2 m/s
23. Jun	14:00	3.8 m/s	7.8 m/s
23. Jun	15:00	4.0 m/s	9.1 m/s
23. Jun	16:00	3.5 m/s	7.3 m/s
23. Jun	17:00	4.0 m/s	8.1 m/s
23. Jun	18:00	2.9 m/s	6.1 m/s
23. Jun	19:00	3.9 m/s	8.7 m/s
23. Jun	20:00	4.6 m/s	8.1 m/s
23. Jun	21:00	4.7 m/s	10.3 m/s
23. Jun	22:00	2.2 m/s	7.5 m/s
23. Jun	23:00	2.5 m/s	4.9 m/s
24. Jun	0:00	0.0 m/s	3.1 m/s
24. Jun	1:00	0.0 m/s	3.7 m/s
24. Jun	2:00	2.4 m/s	3.9 m/s
24. Jun	3:00	3.0 m/s	5.4 m/s
24. Jun	4:00	3.6 m/s	5.8 m/s
24. Jun	5:00	3.4 m/s	5.7 m/s
24. Jun	6:00	0.0 m/s	5.1 m/s
24. Jun	7:00	2.2 m/s	5.4 m/s
24. Jun	8:00	3.0 m/s	5.9 m/s
24. Jun	9:00	4.9 m/s	8.3 m/s
24. Jun	10:00	5.3 m/s	8.5 m/s
24. Jun	11:00	4.3 m/s	8.1 m/s
24. Jun	12:00	4.6 m/s	8.5 m/s
24. Jun	13:00	4.4 m/s	9.1 m/s
24. Jun	14:00	5.0 m/s	9.3 m/s
24. Jun	15:00	4.0 m/s	9.0 m/s
24. Jun	16:00	5.1 m/s	9.6 m/s
24. Jun	17:00	3.6 m/s	7.8 m/s
24. Jun	18:00	3.3 m/s	7.8 m/s
24. Jun	19:00	4.9 m/s	7.8 m/s
24. Jun	20:00	4.4 m/s	8.8 m/s
24. Jun	21:00	3.6 m/s	7.6 m/s
24. Jun	22:00	3.7 m/s	7.7 m/s
24. Jun	23:00	3.4 m/s	7.2 m/s

Date	Time	Kitui Mosa (No. 6) Hourly Mean	Kitui Mosa (No. 6) Hourly Maximum
10. Jun	0:00	1.0 m/s	2.7 m/s
10. Jun	1:00	2.0 m/s	3.9 m/s
10. Jun	2:00	1.4 m/s	3.6 m/s
10. Jun	3:00	1.3 m/s	2.5 m/s
10. Jun	4:00	0.0 m/s	2.2 m/s
10. Jun	5:00	0.0 m/s	0.0 m/s
10. Jun	6:00	0.0 m/s	0.0 m/s
10. Jun	7:00	0.0 m/s	0.0 m/s
10. Jun	8:00	1.1 m/s	2.7 m/s
10. Jun	9:00	2.5 m/s	5.2 m/s
10. Jun	10:00	2.9 m/s	7.4 m/s
10. Jun	11:00	2.7 m/s	9.5 m/s
10. Jun	12:00	2.8 m/s	6.9 m/s
10. Jun	13:00	3.1 m/s	7.1 m/s
10. Jun	14:00	2.8 m/s	7.2 m/s
10. Jun	15:00	2.0 m/s	6.6 m/s
10. Jun	16:00	2.3 m/s	6.1 m/s
10. Jun	17:00	1.2 m/s	5.2 m/s
10. Jun	18:00	2.3 m/s	6.5 m/s
10. Jun	19:00	2.4 m/s	5.5 m/s
10. Jun	20:00	1.0 m/s	3.5 m/s
10. Jun	21:00	1.4 m/s	4.1 m/s
10. Jun	22:00	2.0 m/s	4.1 m/s
10. Jun	23:00	2.1 m/s	4.9 m/s
11. Jun	0:00	2.0 m/s	4.5 m/s
11. Jun	1:00	2.3 m/s	3.3 m/s
11. Jun	2:00	0.0 m/s	4.5 m/s
11. Jun	3:00	0.0 m/s	1.1 m/s
11. Jun	4:00	1.0 m/s	1.1 m/s
11. Jun	5:00	0.9 m/s	1.2 m/s
11. Jun	6:00	0.9 m/s	1.3 m/s
11. Jun	7:00	0.9 m/s	1.6 m/s
11. Jun	8:00	1.0 m/s	2.3 m/s
11. Jun	9:00	2.2 m/s	2.4 m/s
11. Jun	10:00	3.1 m/s	7.5 m/s
11. Jun	11:00	3.5 m/s	7.7 m/s
11. Jun	12:00	2.6 m/s	7.5 m/s
11. Jun	13:00	2.4 m/s	6.8 m/s
11. Jun	14:00	2.3 m/s	6.1 m/s
11. Jun	15:00	2.0 m/s	5.0 m/s
11. Jun	16:00	2.0 m/s	6.6 m/s
11. Jun	17:00	2.3 m/s	4.7 m/s
11. Jun	18:00	2.1 m/s	5.4 m/s
11. Jun	19:00	1.1 m/s	5.1 m/s
11. Jun	20:00	0.0 m/s	2.1 m/s
11. Jun	21:00	2.9 m/s	5.2 m/s
11. Jun	22:00	0.5 m/s	3.2 m/s
11. Jun	23:00	1.5 m/s	2.5 m/s
12. Jun	0:00	1.3 m/s	3.1 m/s
12. Jun	1:00	0.4 m/s	2.8 m/s
12. Jun	2:00	0.0 m/s	1.4 m/s
12. Jun	3:00	0.4 m/s	1.4 m/s
12. Jun	4:00	0.0 m/s	0.7 m/s
12. Jun	5:00	0.5 m/s	1.4 m/s
12. Jun	6:00	0.0 m/s	2.2 m/s
12. Jun	7:00	0.0 m/s	0.0 m/s
12. Jun	8:00	0.9 m/s	2.3 m/s
12. Jun	9:00	1.8 m/s	3.9 m/s
12. Jun	10:00	m/s	m/s
12. Jun	11:00	m/s	m/s
12. Jun	12:00	m/s	m/s
12. Jun	13:00	m/s	m/s
12. Jun	14:00	m/s	m/s
12. Jun	15:00	m/s	m/s
12. Jun	16:00	m/s	m/s
12. Jun	17:00	m/s	m/s
12. Jun	18:00	m/s	m/s
12. Jun	19:00	m/s	m/s
12. Jun	20:00	m/s	m/s
12. Jun	21:00	m/s	m/s
12. Jun	22:00	m/s	m/s
12. Jun	23:00	m/s	m/s

Date	Time	Kitui Itiko (No. 28) Hourly Mean	Kitui Itiko (No. 28) Hourly Maximum
18. Jun	0:00	1.6 m/s	3.1 m/s
18. Jun	1:00	0.5 m/s	2.2 m/s
18. Jun	2:00	1.3 m/s	2.8 m/s
18. Jun	3:00	2.9 m/s	5.1 m/s
18. Jun	4:00	1.7 m/s	5.8 m/s
18. Jun	5:00	2.1 m/s	3.8 m/s
18. Jun	6:00	1.6 m/s	3.5 m/s
18. Jun	7:00	1.5 m/s	2.9 m/s
18. Jun	8:00	2.1 m/s	4.3 m/s
18. Jun	9:00	2.9 m/s	5.5 m/s
18. Jun	10:00	3.1 m/s	6.0 m/s
18. Jun	11:00	4.3 m/s	8.2 m/s
18. Jun	12:00	4.0 m/s	8.3 m/s
18. Jun	13:00	3.4 m/s	9.3 m/s
18. Jun	14:00	3.0 m/s	7.7 m/s
18. Jun	15:00	3.9 m/s	9.3 m/s
18. Jun	16:00	2.9 m/s	7.0 m/s
18. Jun	17:00	3.0 m/s	6.4 m/s
18. Jun	18:00	2.5 m/s	6.3 m/s
18. Jun	19:00	2.3 m/s	5.1 m/s
18. Jun	20:00	1.1 m/s	3.4 m/s
18. Jun	21:00	1.6 m/s	3.4 m/s
18. Jun	22:00	2.9 m/s	6.2 m/s
18. Jun	23:00	1.8 m/s	7.0 m/s
19. Jun	0:00	2.1 m/s	4.4 m/s
19. Jun	1:00	2.0 m/s	5.1 m/s
19. Jun	2:00	2.7 m/s	5.7 m/s
19. Jun	3:00	2.8 m/s	6.3 m/s
19. Jun	4:00	1.9 m/s	3.2 m/s
19. Jun	5:00	0.0 m/s	4.0 m/s
19. Jun	6:00	0.0 m/s	0.0 m/s
19. Jun	7:00	0.0 m/s	0.0 m/s
19. Jun	8:00	0.3 m/s	1.1 m/s
19. Jun	9:00	2.8 m/s	5.4 m/s
19. Jun	10:00	m/s	m/s
19. Jun	11:00	m/s	m/s
19. Jun	12:00	m/s	m/s
19. Jun	13:00	m/s	m/s
19. Jun	14:00	m/s	m/s
19. Jun	15:00	m/s	m/s
19. Jun	16:00	m/s	m/s
19. Jun	17:00	m/s	m/s
19. Jun	18:00	m/s	m/s
19. Jun	19:00	m/s	m/s
19. Jun	20:00	m/s	m/s
19. Jun	21:00	m/s	m/s
19. Jun	22:00	m/s	m/s
19. Jun	23:00	m/s	m/s

Date	Time	Kitui Kakumuti (No. 42) Hourly Mean	Kitui Kakumuti (No. 42) Hourly Maximum
25. Jun	0:00	1.9 m/s	5.7 m/s
25. Jun	1:00	2.4 m/s	6.1 m/s
25. Jun	2:00	3.8 m/s	6.4 m/s
25. Jun	3:00	3.2 m/s	7.3 m/s
25. Jun	4:00	4.1 m/s	8.3 m/s
25. Jun	5:00	3.1 m/s	7.4 m/s
25. Jun	6:00	3.6 m/s	7.4 m/s
25. Jun	7:00	3.4 m/s	5.8 m/s
25. Jun	8:00	3.2 m/s	6.3 m/s
25. Jun	9:00	4.9 m/s	8.5 m/s
25. Jun	10:00	5.5 m/s	9.4 m/s
25. Jun	11:00	4.3 m/s	10.5 m/s
25. Jun	12:00	6.0 m/s	10.2 m/s
25. Jun	13:00	5.1 m/s	9.6 m/s
25. Jun	14:00	4.2 m/s	9.5 m/s
25. Jun	15:00	5.3 m/s	9.1 m/s
25. Jun	16:00	4.2 m/s	8.2 m/s
25. Jun	17:00	4.0 m/s	7.4 m/s
25. Jun	18:00	4.6 m/s	7.9 m/s
25. Jun	19:00	4.6 m/s	8.5 m/s
25. Jun	20:00	5.8 m/s	9.7 m/s
25. Jun	21:00	4.9 m/s	8.5 m/s
25. Jun	22:00	3.9 m/s	7.8 m/s
25. Jun	23:00	5.4 m/s	8.6 m/s
26. Jun	0:00	3.5 m/s	9.4 m/s
26. Jun	1:00	4.8 m/s	8.5 m/s
26. Jun	2:00	6.6 m/s	8.9 m/s
26. Jun	3:00	3.9 m/s	9.3 m/s
26. Jun	4:00	3.5 m/s	7.8 m/s
26. Jun	5:00	3.5 m/s	7.3 m/s
26. Jun	6:00	2.8 m/s	6.4 m/s
26. Jun	7:00	3.5 m/s	5.9 m/s
26. Jun	8:00	3.4 m/s	8.5 m/s
26. Jun	9:00	3.8 m/s	8.6 m/s
26. Jun	10:00	3.9 m/s	7.3 m/s
26. Jun	11:00	m/s	m/s
26. Jun	12:00	m/s	m/s
26. Jun	13:00	m/s	m/s
26. Jun	14:00	m/s	m/s
26. Jun	15:00	m/s	m/s
26. Jun	16:00	m/s	m/s
26. Jun	17:00	m/s	m/s
26. Jun	18:00	m/s	m/s
26. Jun	19:00	m/s	m/s
26. Jun	20:00	m/s	m/s
26. Jun	21:00	m/s	m/s
26. Jun	22:00	m/s	m/s
26. Jun	23:00	m/s	m/s

Date	Time	Mwingi Yenzuva (No. 54) Hourly Mean		Mwingi Yenzuva (No. 54) Hourly Maximum	
3. Jun	9:00		m/s		m/s
3. Jun	10:00		m/s		m/s
3. Jun	11:00		m/s		m/s
3. Jun	12:00		m/s		m/s
3. Jun	13:00		m/s		m/s
3. Jun	14:00	1.7	m/s	5.7	m/s
3. Jun	15:00	2.7	m/s	6.1	m/s
3. Jun	16:00	2.7	m/s	6.6	m/s
3. Jun	17:00	2.7	m/s	5.8	m/s
3. Jun	18:00	3.1	m/s	6.4	m/s
3. Jun	19:00	1.6	m/s	6.1	m/s
3. Jun	20:00	2.3	m/s	4.1	m/s
3. Jun	21:00	1.5	m/s	3.5	m/s
3. Jun	22:00	2.4	m/s	4.4	m/s
3. Jun	23:00	3.9	m/s	7.9	m/s
4. Jun	0:00	3.4	m/s	6.5	m/s
4. Jun	1:00	1.6	m/s	6.3	m/s
4. Jun	2:00	0.6	m/s	2.2	m/s
4. Jun	3:00	0.0	m/s	1.5	m/s
4. Jun	4:00	0.0	m/s	0.9	m/s
4. Jun	5:00	0.0	m/s	0.4	m/s
4. Jun	6:00	0.0	m/s	0.9	m/s
4. Jun	7:00	0.0	m/s	0.5	m/s
4. Jun	8:00	1.5	m/s	3.4	m/s
4. Jun	9:00	2.1	m/s	5.1	m/s
4. Jun	10:00	2.4	m/s	5.8	m/s
4. Jun	11:00	3.5	m/s	10.5	m/s
4. Jun	12:00	2.9	m/s	7.0	m/s
4. Jun	13:00	2.8	m/s	6.9	m/s
4. Jun	14:00	2.6	m/s	7.4	m/s
4. Jun	15:00	3.0	m/s	7.0	m/s
4. Jun	16:00	4.3	m/s	7.7	m/s
4. Jun	17:00	2.7	m/s	6.3	m/s
4. Jun	18:00	2.8	m/s	5.8	m/s
4. Jun	19:00	3.4	m/s	6.0	m/s
4. Jun	20:00	1.3	m/s	5.1	m/s
4. Jun	21:00	2.9	m/s	4.9	m/s
4. Jun	22:00	3.8	m/s	7.3	m/s
4. Jun	23:00		m/s		m/s
5. Jun	0:00		m/s		m/s
5. Jun	1:00	1.0	m/s	9.0	m/s
5. Jun	2:00	0.5	m/s	1.9	m/s
5. Jun	3:00		m/s		m/s
5. Jun	4:00	1.0	m/s	2.7	m/s
5. Jun	5:00	0.0	m/s	1.2	m/s
5. Jun	6:00	0.0	m/s	1.3	m/s
5. Jun	7:00	1.2	m/s	1.9	m/s
5. Jun	8:00	1.0	m/s	2.1	m/s
5. Jun	9:00	2.2	m/s	4.9	m/s
5. Jun	10:00	3.4	m/s	5.8	m/s
5. Jun	11:00	3.1	m/s	6.1	m/s
5. Jun	12:00	2.5	m/s	7.9	m/s
5. Jun	13:00	2.3	m/s	6.1	m/s
5. Jun	14:00	2.0	m/s	6.1	m/s
5. Jun	15:00	2.6	m/s	10.3	m/s
5. Jun	16:00	1.9	m/s	6.0	m/s
5. Jun	17:00	2.8	m/s	5.8	m/s
5. Jun	18:00	2.9	m/s	6.3	m/s
5. Jun	19:00	1.9	m/s	5.6	m/s
5. Jun	20:00	2.3	m/s	6.9	m/s
5. Jun	21:00	2.3	m/s	5.5	m/s
5. Jun	22:00	2.7	m/s	4.8	m/s
5. Jun	23:00	3.5	m/s	6.9	m/s

Date	Time	Mwingi Itumbi (No. 59) Hourly Mean		Mwingi Itumbi (No. 59) Hourly Maximum	
17. Jun	9:00		m/s		m/s
17. Jun	10:00		m/s		m/s
17. Jun	11:00		m/s		m/s
17. Jun	12:00		m/s		m/s
17. Jun	13:00		m/s		m/s
17. Jun	14:00		m/s		m/s
17. Jun	15:00		m/s		m/s
17. Jun	16:00	3.2	m/s	7.9	m/s
17. Jun	17:00	3.8	m/s	8.3	m/s
17. Jun	18:00	3.3	m/s	7.9	m/s
17. Jun	19:00	2.0	m/s	6.3	m/s
17. Jun	20:00	3.0	m/s	8.3	m/s
17. Jun	21:00	2.0	m/s	6.8	m/s
17. Jun	22:00	1.8	m/s	6.2	m/s
17. Jun	23:00	2.8	m/s	6.1	m/s
18. Jun	0:00	3.5	m/s	8.2	m/s
18. Jun	1:00	3.2	m/s	7.7	m/s
18. Jun	2:00	3.8	m/s	9.0	m/s
18. Jun	3:00	3.5	m/s	7.1	m/s
18. Jun	4:00	4.0	m/s	7.5	m/s
18. Jun	5:00	1.0	m/s	6.2	m/s
18. Jun	6:00	1.1	m/s	3.2	m/s
18. Jun	7:00	1.0	m/s	3.2	m/s
18. Jun	8:00	1.1	m/s	3.4	m/s
18. Jun	9:00	1.2	m/s	3.3	m/s
18. Jun	10:00	1.6	m/s	4.1	m/s
18. Jun	11:00	2.5	m/s	6.2	m/s
18. Jun	12:00	3.2	m/s	7.2	m/s
18. Jun	13:00	4.0	m/s	8.2	m/s
18. Jun	14:00	3.1	m/s	8.1	m/s
18. Jun	15:00	2.1	m/s	7.4	m/s
18. Jun	16:00	2.7	m/s	7.5	m/s
18. Jun	17:00	2.5	m/s	7.2	m/s
18. Jun	18:00	2.7	m/s	6.0	m/s
18. Jun	19:00	1.2	m/s	5.7	m/s
18. Jun	20:00	1.6	m/s	3.7	m/s
18. Jun	21:00	2.3	m/s	6.1	m/s
18. Jun	22:00	2.2	m/s	5.9	m/s
18. Jun	23:00	2.9	m/s	7.0	m/s
19. Jun	0:00	2.5	m/s	9.1	m/s
19. Jun	1:00	1.5	m/s	5.2	m/s
19. Jun	2:00	1.7	m/s	5.1	m/s
19. Jun	3:00	3.2	m/s	6.7	m/s
19. Jun	4:00	1.7	m/s	7.3	m/s
19. Jun	5:00	0.5	m/s	3.5	m/s
19. Jun	6:00	0.8	m/s	1.5	m/s
19. Jun	7:00	1.3	m/s	2.7	m/s
19. Jun	8:00	2.4	m/s	5.1	m/s
19. Jun	9:00	3.8	m/s	7.8	m/s
19. Jun	10:00	3.7	m/s	9.0	m/s
19. Jun	11:00	3.5	m/s	7.9	m/s
19. Jun	12:00	2.8	m/s	8.4	m/s
19. Jun	13:00	2.6	m/s	7.8	m/s
19. Jun	14:00	2.5	m/s	6.3	m/s
19. Jun	15:00	2.6	m/s	5.7	m/s
19. Jun	16:00	1.8	m/s	5.0	m/s
19. Jun	17:00	1.6	m/s	4.9	m/s
19. Jun	18:00	1.5	m/s	4.6	m/s
19. Jun	19:00	1.4	m/s	3.7	m/s
19. Jun	20:00	1.2	m/s	6.0	m/s
19. Jun	21:00	1.7	m/s	4.8	m/s
19. Jun	22:00	2.1	m/s	6.0	m/s
19. Jun	23:00	3.0	m/s	8.3	m/s

Date	Time	Mwingi Ndathani (No. 85) Hourly Mean		Mwingi Ndathani (No. 85) Hourly Maximum	
10. Jun	9:00		m/s		m/s
10. Jun	10:00		m/s		m/s
10. Jun	11:00		m/s		m/s
10. Jun	12:00		m/s		m/s
10. Jun	13:00		m/s		m/s
10. Jun	14:00		m/s		m/s
10. Jun	15:00		m/s		m/s
10. Jun	16:00	3.4	m/s	8.4	m/s
10. Jun	17:00	3.7	m/s	8.3	m/s
10. Jun	18:00	3.8	m/s	8.3	m/s
10. Jun	19:00	4.6	m/s	9.0	m/s
10. Jun	20:00	5.1	m/s	10.9	m/s
10. Jun	21:00	3.7	m/s	9.8	m/s
10. Jun	22:00	2.3	m/s	6.8	m/s
10. Jun	23:00	1.7	m/s	6.1	m/s
11. Jun	0:00	0.9	m/s	2.5	m/s
11. Jun	1:00	1.2	m/s	2.3	m/s
11. Jun	2:00	1.8	m/s	3.9	m/s
11. Jun	3:00	2.1	m/s	6.0	m/s
11. Jun	4:00	1.0	m/s	4.1	m/s
11. Jun	5:00	1.1	m/s	3.0	m/s
11. Jun	6:00	0.5	m/s	2.5	m/s
11. Jun	7:00	1.9	m/s	4.1	m/s
11. Jun	8:00	1.6	m/s	4.9	m/s
11. Jun	9:00	2.6	m/s	6.6	m/s
11. Jun	10:00	3.1	m/s	7.5	m/s
11. Jun	11:00	4.1	m/s	8.8	m/s
11. Jun	12:00	3.4	m/s	8.5	m/s
11. Jun	13:00	3.3	m/s	7.4	m/s
11. Jun	14:00	4.4	m/s	8.1	m/s
11. Jun	15:00	3.3	m/s	7.8	m/s
11. Jun	16:00	3.3	m/s	7.5	m/s
11. Jun	17:00	3.6	m/s	7.3	m/s
11. Jun	18:00	4.4	m/s	8.3	m/s
11. Jun	19:00	2.8	m/s	6.6	m/s
11. Jun	20:00	2.7	m/s	5.8	m/s
11. Jun	21:00	2.6	m/s	5.0	m/s
11. Jun	22:00	2.7	m/s	7.4	m/s
11. Jun	23:00	4.3	m/s	8.9	m/s
12. Jun	0:00	4.4	m/s	8.7	m/s
12. Jun	1:00	3.9	m/s	7.0	m/s
12. Jun	2:00	2.0	m/s	6.8	m/s
12. Jun	3:00	1.1	m/s	3.4	m/s
12. Jun	4:00	2.1	m/s	4.4	m/s
12. Jun	5:00	1.2	m/s	3.4	m/s
12. Jun	6:00	2.4	m/s	4.6	m/s
12. Jun	7:00	1.4	m/s	4.3	m/s
12. Jun	8:00	2.4	m/s	5.1	m/s
12. Jun	9:00	3.2	m/s	7.9	m/s
12. Jun	10:00	4.5	m/s	10.3	m/s
12. Jun	11:00	2.6	m/s	10.3	m/s
12. Jun	12:00	4.6	m/s	8.1	m/s
12. Jun	13:00	3.6	m/s	8.6	m/s
12. Jun	14:00	3.1	m/s	6.6	m/s
12. Jun	15:00	2.9	m/s	6.9	m/s
12. Jun	16:00	3.2	m/s	7.1	m/s
12. Jun	17:00	3.1	m/s	7.1	m/s
12. Jun	18:00	3.1	m/s	6.3	m/s
12. Jun	19:00	2.6	m/s	7.1	m/s
12. Jun	20:00	2.9	m/s	5.3	m/s
12. Jun	21:00	3.1	m/s	6.2	m/s
12. Jun	22:00	4.4	m/s	7.9	m/s
12. Jun	23:00	5.1	m/s	10.2	m/s

Date	Time	Mwingi Yenzuva (No. 54) Hourly Mean	Mwingi Yenzuva (No. 54) Hourly Maximum
6. Jun	0:00	4.0 m/s	8.9 m/s
6. Jun	1:00	2.4 m/s	5.1 m/s
6. Jun	2:00	0.9 m/s	4.1 m/s
6. Jun	3:00	0.0 m/s	3.1 m/s
6. Jun	4:00	0.0 m/s	1.2 m/s
6. Jun	5:00	0.0 m/s	0.0 m/s
6. Jun	6:00	0.6 m/s	1.3 m/s
6. Jun	7:00	0.4 m/s	1.5 m/s
6. Jun	8:00	1.0 m/s	2.7 m/s
6. Jun	9:00	2.7 m/s	6.5 m/s
6. Jun	10:00	3.4 m/s	6.3 m/s
6. Jun	11:00	3.2 m/s	6.0 m/s
6. Jun	12:00	2.9 m/s	6.7 m/s
6. Jun	13:00	3.4 m/s	7.9 m/s
6. Jun	14:00	2.6 m/s	7.6 m/s
6. Jun	15:00	2.4 m/s	8.1 m/s
6. Jun	16:00	3.1 m/s	9.2 m/s
6. Jun	17:00	4.7 m/s	8.8 m/s
6. Jun	18:00	4.5 m/s	8.5 m/s
6. Jun	19:00	3.6 m/s	7.9 m/s
6. Jun	20:00	2.0 m/s	7.3 m/s
6. Jun	21:00	3.2 m/s	7.3 m/s
6. Jun	22:00	m/s	m/s
6. Jun	23:00	3.5 m/s	8.3 m/s
7. Jun	0:00	m/s	m/s
7. Jun	1:00	4.2 m/s	8.6 m/s
7. Jun	2:00	m/s	m/s
7. Jun	3:00	m/s	m/s
7. Jun	4:00	1.7 m/s	5.1 m/s
7. Jun	5:00	1.4 m/s	6.2 m/s
7. Jun	6:00	1.3 m/s	7.9 m/s
7. Jun	7:00	1.3 m/s	3.1 m/s
7. Jun	8:00	1.9 m/s	3.4 m/s
7. Jun	9:00	1.6 m/s	3.4 m/s
7. Jun	10:00	1.9 m/s	4.1 m/s
7. Jun	11:00	2.3 m/s	4.3 m/s
7. Jun	12:00	2.0 m/s	5.6 m/s
7. Jun	13:00	2.1 m/s	6.5 m/s
7. Jun	14:00	2.8 m/s	6.6 m/s
7. Jun	15:00	2.8 m/s	6.2 m/s
7. Jun	16:00	3.0 m/s	7.1 m/s
7. Jun	17:00	3.1 m/s	6.5 m/s
7. Jun	18:00	2.2 m/s	5.0 m/s
7. Jun	19:00	2.4 m/s	5.1 m/s
7. Jun	20:00	2.1 m/s	5.1 m/s
7. Jun	21:00	1.7 m/s	3.4 m/s
7. Jun	22:00	1.1 m/s	3.1 m/s
7. Jun	23:00	2.8 m/s	4.4 m/s
8. Jun	0:00	1.8 m/s	3.5 m/s
8. Jun	1:00	1.9 m/s	4.5 m/s
8. Jun	2:00	1.7 m/s	4.1 m/s
8. Jun	3:00	1.4 m/s	3.7 m/s
8. Jun	4:00	1.6 m/s	5.4 m/s
8. Jun	5:00	1.6 m/s	3.7 m/s
8. Jun	6:00	1.2 m/s	2.7 m/s
8. Jun	7:00	0.9 m/s	2.3 m/s
8. Jun	8:00	1.0 m/s	2.2 m/s
8. Jun	9:00	1.6 m/s	3.1 m/s
8. Jun	10:00	2.3 m/s	5.6 m/s
8. Jun	11:00	3.1 m/s	6.5 m/s
8. Jun	12:00	2.7 m/s	7.0 m/s
8. Jun	13:00	3.5 m/s	6.0 m/s
8. Jun	14:00	2.7 m/s	6.1 m/s
8. Jun	15:00	3.6 m/s	8.0 m/s
8. Jun	16:00	2.8 m/s	6.2 m/s
8. Jun	17:00	4.0 m/s	7.4 m/s
8. Jun	18:00	3.2 m/s	7.0 m/s
8. Jun	19:00	2.9 m/s	6.8 m/s
8. Jun	20:00	3.7 m/s	8.1 m/s
8. Jun	21:00	2.8 m/s	6.9 m/s
8. Jun	22:00	3.6 m/s	6.2 m/s
8. Jun	23:00	2.4 m/s	6.1 m/s

Date	Time	Mwingi Itumbi (No. 59) Hourly Mean	Mwingi Itumbi (No. 59) Hourly Maximum
20. Jun	0:00	5.3 m/s	7.0 m/s
20. Jun	1:00	2.9 m/s	7.0 m/s
20. Jun	2:00	1.7 m/s	7.3 m/s
20. Jun	3:00	1.5 m/s	7.8 m/s
20. Jun	4:00	2.5 m/s	5.3 m/s
20. Jun	5:00	1.9 m/s	4.6 m/s
20. Jun	6:00	1.3 m/s	3.4 m/s
20. Jun	7:00	0.5 m/s	3.8 m/s
20. Jun	8:00	2.0 m/s	3.7 m/s
20. Jun	9:00	2.0 m/s	4.3 m/s
20. Jun	10:00	3.1 m/s	6.9 m/s
20. Jun	11:00	2.1 m/s	6.3 m/s
20. Jun	12:00	2.3 m/s	6.0 m/s
20. Jun	13:00	3.1 m/s	6.6 m/s
20. Jun	14:00	2.3 m/s	6.7 m/s
20. Jun	15:00	1.6 m/s	4.3 m/s
20. Jun	16:00	2.7 m/s	6.7 m/s
20. Jun	17:00	3.1 m/s	6.4 m/s
20. Jun	18:00	2.1 m/s	5.8 m/s
20. Jun	19:00	2.1 m/s	4.9 m/s
20. Jun	20:00	1.4 m/s	3.2 m/s
20. Jun	21:00	2.0 m/s	4.4 m/s
20. Jun	22:00	2.5 m/s	6.8 m/s
20. Jun	23:00	3.4 m/s	7.8 m/s
21. Jun	0:00	4.0 m/s	9.2 m/s
21. Jun	1:00	3.3 m/s	8.4 m/s
21. Jun	2:00	0.8 m/s	6.1 m/s
21. Jun	3:00	2.3 m/s	6.7 m/s
21. Jun	4:00	3.3 m/s	5.8 m/s
21. Jun	5:00	2.3 m/s	7.5 m/s
21. Jun	6:00	4.6 m/s	10.9 m/s
21. Jun	7:00	4.2 m/s	9.0 m/s
21. Jun	8:00	4.8 m/s	10.1 m/s
21. Jun	9:00	4.1 m/s	9.5 m/s
21. Jun	10:00	3.4 m/s	10.4 m/s
21. Jun	11:00	2.6 m/s	7.1 m/s
21. Jun	12:00	3.4 m/s	7.7 m/s
21. Jun	13:00	2.9 m/s	6.8 m/s
21. Jun	14:00	2.3 m/s	8.5 m/s
21. Jun	15:00	2.6 m/s	7.9 m/s
21. Jun	16:00	3.0 m/s	7.5 m/s
21. Jun	17:00	2.6 m/s	6.0 m/s
21. Jun	18:00	2.3 m/s	7.5 m/s
21. Jun	19:00	2.0 m/s	7.4 m/s
21. Jun	20:00	1.0 m/s	3.5 m/s
21. Jun	21:00	0.7 m/s	2.9 m/s
21. Jun	22:00	1.5 m/s	4.6 m/s
21. Jun	23:00	1.9 m/s	5.2 m/s
22. Jun	0:00	2.1 m/s	6.4 m/s
22. Jun	1:00	2.5 m/s	5.8 m/s
22. Jun	2:00	3.4 m/s	6.4 m/s
22. Jun	3:00	2.7 m/s	6.0 m/s
22. Jun	4:00	2.5 m/s	5.3 m/s
22. Jun	5:00	2.3 m/s	5.4 m/s
22. Jun	6:00	2.7 m/s	5.7 m/s
22. Jun	7:00	2.9 m/s	6.2 m/s
22. Jun	8:00	3.8 m/s	6.3 m/s
22. Jun	9:00	3.4 m/s	7.4 m/s
22. Jun	10:00	3.1 m/s	7.8 m/s
22. Jun	11:00	2.8 m/s	6.4 m/s
22. Jun	12:00	2.5 m/s	5.5 m/s
22. Jun	13:00	2.5 m/s	6.1 m/s
22. Jun	14:00	2.9 m/s	6.3 m/s
22. Jun	15:00	2.5 m/s	5.8 m/s
22. Jun	16:00	2.3 m/s	6.5 m/s
22. Jun	17:00	4.4 m/s	7.8 m/s
22. Jun	18:00	2.8 m/s	8.5 m/s
22. Jun	19:00	0.3 m/s	7.5 m/s
22. Jun	20:00	3.4 m/s	8.1 m/s
22. Jun	21:00	3.8 m/s	7.9 m/s
22. Jun	22:00	3.5 m/s	9.5 m/s
22. Jun	23:00	3.5 m/s	8.6 m/s

Date	Time	Mwingi Ndathani (No. 85) Hourly Mean	Mwingi Ndathani (No. 85) Hourly Maximum
13. Jun	0:00	2.1 m/s	8.2 m/s
13. Jun	1:00	1.5 m/s	5.8 m/s
13. Jun	2:00	1.2 m/s	3.1 m/s
13. Jun	3:00	0.7 m/s	3.7 m/s
13. Jun	4:00	0.7 m/s	1.3 m/s
13. Jun	5:00	0.6 m/s	1.3 m/s
13. Jun	6:00	1.4 m/s	2.3 m/s
13. Jun	7:00	0.6 m/s	3.0 m/s
13. Jun	8:00	2.5 m/s	5.4 m/s
13. Jun	9:00	3.8 m/s	8.5 m/s
13. Jun	10:00	4.1 m/s	8.3 m/s
13. Jun	11:00	3.4 m/s	8.4 m/s
13. Jun	12:00	3.7 m/s	9.5 m/s
13. Jun	13:00	4.1 m/s	7.9 m/s
13. Jun	14:00	3.2 m/s	8.9 m/s
13. Jun	15:00	4.0 m/s	7.4 m/s
13. Jun	16:00	3.7 m/s	7.5 m/s
13. Jun	17:00	3.1 m/s	7.5 m/s
13. Jun	18:00	2.9 m/s	7.4 m/s
13. Jun	19:00	2.9 m/s	6.0 m/s
13. Jun	20:00	2.8 m/s	5.4 m/s
13. Jun	21:00	5.2 m/s	8.9 m/s
13. Jun	22:00	4.5 m/s	9.0 m/s
13. Jun	23:00	6.5 m/s	11.1 m/s
14. Jun	0:00	4.1 m/s	11.4 m/s
14. Jun	1:00	1.7 m/s	7.4 m/s
14. Jun	2:00	1.5 m/s	3.5 m/s
14. Jun	3:00	1.6 m/s	4.3 m/s
14. Jun	4:00	1.2 m/s	2.7 m/s
14. Jun	5:00	0.8 m/s	2.3 m/s
14. Jun	6:00	1.1 m/s	2.0 m/s
14. Jun	7:00	1.1 m/s	2.3 m/s
14. Jun	8:00	1.7 m/s	4.8 m/s
14. Jun	9:00	3.4 m/s	8.0 m/s
14. Jun	10:00	5.7 m/s	10.5 m/s
14. Jun	11:00	3.8 m/s	10.7 m/s
14. Jun	12:00	4.4 m/s	8.6 m/s
14. Jun	13:00	3.6 m/s	7.7 m/s
14. Jun	14:00	3.4 m/s	6.5 m/s
14. Jun	15:00	2.3 m/s	6.5 m/s
14. Jun	16:00	2.0 m/s	7.4 m/s
14. Jun	17:00	2.7 m/s	6.1 m/s
14. Jun	18:00	3.2 m/s	6.0 m/s
14. Jun	19:00	1.8 m/s	6.5 m/s
14. Jun	20:00	2.9 m/s	6.9 m/s
14. Jun	21:00	3.7 m/s	8.7 m/s
14. Jun	22:00	4.6 m/s	8.1 m/s
14. Jun	23:00	4.7 m/s	9.2 m/s
15. Jun	0:00	4.5 m/s	8.1 m/s
15. Jun	1:00	2.4 m/s	4.3 m/s
15. Jun	2:00	0.7 m/s	4.7 m/s
15. Jun	3:00	0.4 m/s	2.6 m/s
15. Jun	4:00	0.6 m/s	2.3 m/s
15. Jun	5:00	0.7 m/s	2.1 m/s
15. Jun	6:00	1.6 m/s	3.5 m/s
15. Jun	7:00	0.7 m/s	2.9 m/s
15. Jun	8:00	2.1 m/s	5.1 m/s
15. Jun	9:00	3.8 m/s	8.0 m/s
15. Jun	10:00	3.5 m/s	7.7 m/s
15. Jun	11:00	3.4 m/s	8.1 m/s
15. Jun	12:00	3.5 m/s	8.2 m/s
15. Jun	13:00	2.3 m/s	7.0 m/s
15. Jun	14:00	2.7 m/s	6.8 m/s
15. Jun	15:00	3.2 m/s	6.9 m/s
15. Jun	16:00	3.6 m/s	7.4 m/s
15. Jun	17:00	3.8 m/s	7.6 m/s
15. Jun	18:00	3.7 m/s	8.1 m/s
15. Jun	19:00	3.5 m/s	8.1 m/s
15. Jun	20:00	3.7 m/s	7.0 m/s
15. Jun	21:00	3.4 m/s	6.4 m/s
15. Jun	22:00	4.6 m/s	8.8 m/s
15. Jun	23:00	4.4 m/s	9.0 m/s

Date	Time	Mwingi Yenzuva (No. 54) Hourly Mean	Mwingi Yenzuva (No. 54) Hourly Maximum
9. Jun	0:00	1.9 m/s	6.9 m/s
9. Jun	1:00	1.8 m/s	3.7 m/s
9. Jun	2:00	0.6 m/s	0.6 m/s
9. Jun	3:00	0.0 m/s	0.9 m/s
9. Jun	4:00	0.3 m/s	0.7 m/s
9. Jun	5:00	0.0 m/s	0.4 m/s
9. Jun	6:00	0.4 m/s	0.6 m/s
9. Jun	7:00	0.3 m/s	1.2 m/s
9. Jun	8:00	1.5 m/s	2.9 m/s
9. Jun	9:00	2.2 m/s	4.4 m/s
9. Jun	10:00	2.1 m/s	5.1 m/s
9. Jun	11:00	3.2 m/s	6.8 m/s
9. Jun	12:00	3.0 m/s	7.3 m/s
9. Jun	13:00	2.3 m/s	7.0 m/s
9. Jun	14:00	3.3 m/s	8.6 m/s
9. Jun	15:00	2.3 m/s	6.8 m/s
9. Jun	16:00	3.2 m/s	7.4 m/s
9. Jun	17:00	3.8 m/s	7.3 m/s
9. Jun	18:00	3.1 m/s	7.5 m/s
9. Jun	19:00	3.8 m/s	7.0 m/s
9. Jun	20:00	3.2 m/s	6.5 m/s
9. Jun	21:00	3.3 m/s	5.4 m/s
9. Jun	22:00	3.5 m/s	6.8 m/s
9. Jun	23:00	2.1 m/s	5.6 m/s
10. Jun	0:00	2.6 m/s	7.1 m/s
10. Jun	1:00	1.9 m/s	4.2 m/s
10. Jun	2:00	1.3 m/s	2.4 m/s
10. Jun	3:00	0.4 m/s	1.6 m/s
10. Jun	4:00	0.0 m/s	0.9 m/s
10. Jun	5:00	0.6 m/s	2.4 m/s
10. Jun	6:00	1.0 m/s	3.1 m/s
10. Jun	7:00	1.3 m/s	3.8 m/s
10. Jun	8:00	2.3 m/s	4.5 m/s
10. Jun	9:00	3.2 m/s	6.3 m/s
10. Jun	10:00	3.8 m/s	7.8 m/s
10. Jun	11:00	m/s	m/s
10. Jun	12:00	m/s	m/s
10. Jun	13:00	m/s	m/s
10. Jun	14:00	m/s	m/s
10. Jun	15:00	m/s	m/s
10. Jun	16:00	m/s	m/s
10. Jun	17:00	m/s	m/s
10. Jun	18:00	m/s	m/s
10. Jun	19:00	m/s	m/s
10. Jun	20:00	m/s	m/s
10. Jun	21:00	m/s	m/s
10. Jun	22:00	m/s	m/s
10. Jun	23:00	m/s	m/s

Date	Time	Mwingi Itumbi (No. 59) Hourly Mean	Mwingi Itumbi (No. 59) Hourly Maximum
23. Jun	0:00	2.8 m/s	8.5 m/s
23. Jun	1:00	3.8 m/s	9.8 m/s
23. Jun	2:00	2.9 m/s	7.2 m/s
23. Jun	3:00	3.2 m/s	7.3 m/s
23. Jun	4:00	3.0 m/s	7.5 m/s
23. Jun	5:00	3.2 m/s	7.0 m/s
23. Jun	6:00	2.3 m/s	8.1 m/s
23. Jun	7:00	0.0 m/s	5.4 m/s
23. Jun	8:00	0.7 m/s	3.1 m/s
23. Jun	9:00	3.1 m/s	5.5 m/s
23. Jun	10:00	4.0 m/s	7.5 m/s
23. Jun	11:00	5.2 m/s	9.2 m/s
23. Jun	12:00	3.3 m/s	9.6 m/s
23. Jun	13:00	2.6 m/s	7.8 m/s
23. Jun	14:00	3.1 m/s	7.3 m/s
23. Jun	15:00	2.7 m/s	7.7 m/s
23. Jun	16:00	3.4 m/s	6.8 m/s
23. Jun	17:00	2.3 m/s	6.7 m/s
23. Jun	18:00	3.2 m/s	6.5 m/s
23. Jun	19:00	2.9 m/s	6.7 m/s
23. Jun	20:00	3.8 m/s	8.2 m/s
23. Jun	21:00	2.4 m/s	10.8 m/s
23. Jun	22:00	1.5 m/s	6.1 m/s
23. Jun	23:00	0.9 m/s	6.1 m/s
24. Jun	0:00	0.8 m/s	2.5 m/s
24. Jun	1:00	1.7 m/s	4.4 m/s
24. Jun	2:00	1.5 m/s	4.6 m/s
24. Jun	3:00	2.5 m/s	5.0 m/s
24. Jun	4:00	2.3 m/s	5.0 m/s
24. Jun	5:00	1.6 m/s	3.5 m/s
24. Jun	6:00	1.7 m/s	4.1 m/s
24. Jun	7:00	1.3 m/s	3.8 m/s
24. Jun	8:00	1.7 m/s	3.2 m/s
24. Jun	9:00	2.6 m/s	6.3 m/s
24. Jun	10:00	4.1 m/s	9.0 m/s
24. Jun	11:00	3.6 m/s	8.3 m/s
24. Jun	12:00	2.4 m/s	7.7 m/s
24. Jun	13:00	3.3 m/s	7.7 m/s
24. Jun	14:00	3.0 m/s	8.5 m/s
24. Jun	15:00	3.7 m/s	8.1 m/s
24. Jun	16:00	3.4 m/s	9.4 m/s
24. Jun	17:00	3.4 m/s	8.1 m/s
24. Jun	18:00	2.7 m/s	5.8 m/s
24. Jun	19:00	2.8 m/s	6.6 m/s
24. Jun	20:00	2.3 m/s	7.1 m/s
24. Jun	21:00	2.1 m/s	7.3 m/s
24. Jun	22:00	2.3 m/s	6.4 m/s
24. Jun	23:00	3.7 m/s	8.1 m/s

Date	Time	Mwingi Ndathani (No. 85) Hourly Mean	Mwingi Ndathani (No. 85) Hourly Maximum
16. Jun	0:00	2.9 m/s	7.0 m/s
16. Jun	1:00	4.0 m/s	8.6 m/s
16. Jun	2:00	4.0 m/s	8.2 m/s
16. Jun	3:00	2.8 m/s	6.6 m/s
16. Jun	4:00	2.9 m/s	6.3 m/s
16. Jun	5:00	2.9 m/s	5.8 m/s
16. Jun	6:00	2.8 m/s	5.4 m/s
16. Jun	7:00	2.5 m/s	5.4 m/s
16. Jun	8:00	2.7 m/s	6.3 m/s
16. Jun	9:00	2.5 m/s	5.0 m/s
16. Jun	10:00	2.9 m/s	6.5 m/s
16. Jun	11:00	2.9 m/s	6.8 m/s
16. Jun	12:00	2.4 m/s	6.8 m/s
16. Jun	13:00	3.7 m/s	6.7 m/s
16. Jun	14:00	3.4 m/s	6.2 m/s
16. Jun	15:00	2.5 m/s	5.7 m/s
16. Jun	16:00	2.4 m/s	5.4 m/s
16. Jun	17:00	3.4 m/s	7.1 m/s
16. Jun	18:00	4.5 m/s	8.5 m/s
16. Jun	19:00	2.9 m/s	8.9 m/s
16. Jun	20:00	1.9 m/s	5.5 m/s
16. Jun	21:00	2.3 m/s	4.4 m/s
16. Jun	22:00	2.9 m/s	6.3 m/s
16. Jun	23:00	3.1 m/s	7.3 m/s
17. Jun	0:00	2.2 m/s	7.4 m/s
17. Jun	1:00	3.1 m/s	7.0 m/s
17. Jun	2:00	3.2 m/s	7.5 m/s
17. Jun	3:00	3.6 m/s	7.9 m/s
17. Jun	4:00	2.7 m/s	7.2 m/s
17. Jun	5:00	4.5 m/s	8.2 m/s
17. Jun	6:00	3.4 m/s	8.2 m/s
17. Jun	7:00	3.6 m/s	7.4 m/s
17. Jun	8:00	2.7 m/s	7.2 m/s
17. Jun	9:00	4.0 m/s	7.0 m/s
17. Jun	10:00	4.1 m/s	7.2 m/s
17. Jun	11:00	m/s	m/s
17. Jun	12:00	m/s	m/s
17. Jun	13:00	m/s	m/s
17. Jun	14:00	m/s	m/s
17. Jun	15:00	m/s	m/s
17. Jun	16:00	m/s	m/s
17. Jun	17:00	m/s	m/s
17. Jun	18:00	m/s	m/s
17. Jun	19:00	m/s	m/s
17. Jun	20:00	m/s	m/s
17. Jun	21:00	m/s	m/s
17. Jun	22:00	m/s	m/s
17. Jun	23:00	m/s	m/s

Date	Time	Makueni Utui wa wote (No. 99) Hourly Mean		Makueni Utui wa wote (No. 99) Hourly Maximum	
2. Jun	9:00		m/s		m/s
2. Jun	10:00		m/s		m/s
2. Jun	11:00		m/s		m/s
2. Jun	12:00	2.1	m/s	2.2	m/s
2. Jun	13:00	2.2	m/s	6.9	m/s
2. Jun	14:00	2.1	m/s	4.1	m/s
2. Jun	15:00	1.4	m/s	4.3	m/s
2. Jun	16:00	1.7	m/s	3.9	m/s
2. Jun	17:00	2.5	m/s	4.3	m/s
2. Jun	18:00	2.2	m/s	5.2	m/s
2. Jun	19:00	0.9	m/s	4.7	m/s
2. Jun	20:00	2.9	m/s	5.4	m/s
2. Jun	21:00	3.6	m/s	7.9	m/s
2. Jun	22:00	2.0	m/s	9.7	m/s
2. Jun	23:00	2.8	m/s	5.2	m/s
3. Jun	0:00	2.0	m/s	6.0	m/s
3. Jun	1:00	1.3	m/s	3.3	m/s
3. Jun	2:00	1.2	m/s	3.5	m/s
3. Jun	3:00	2.4	m/s	7.1	m/s
3. Jun	4:00	0.7	m/s	3.4	m/s
3. Jun	5:00	1.2	m/s	4.1	m/s
3. Jun	6:00	0.7	m/s	0.9	m/s
3. Jun	7:00	0.5	m/s	1.5	m/s
3. Jun	8:00	1.1	m/s	2.0	m/s
3. Jun	9:00	2.3	m/s	5.3	m/s
3. Jun	10:00	2.3	m/s	5.8	m/s
3. Jun	11:00	1.7	m/s	4.9	m/s
3. Jun	12:00	2.4	m/s	6.7	m/s
3. Jun	13:00	2.6	m/s	6.1	m/s
3. Jun	14:00	2.2	m/s	6.0	m/s
3. Jun	15:00	2.7	m/s	6.6	m/s
3. Jun	16:00	1.8	m/s	5.5	m/s
3. Jun	17:00	2.5	m/s	4.7	m/s
3. Jun	18:00	1.6	m/s	5.6	m/s
3. Jun	19:00	1.6	m/s	4.8	m/s
3. Jun	20:00	0.4	m/s	2.9	m/s
3. Jun	21:00	1.8	m/s	3.2	m/s
3. Jun	22:00	1.7	m/s	4.4	m/s
3. Jun	23:00	0.4	m/s	2.8	m/s
4. Jun	0:00	0.3	m/s	1.9	m/s
4. Jun	1:00	0.7	m/s	2.1	m/s
4. Jun	2:00	0.6	m/s	1.1	m/s
4. Jun	3:00	0.4	m/s	2.7	m/s
4. Jun	4:00	0.6	m/s	2.3	m/s
4. Jun	5:00	0.3	m/s	1.6	m/s
4. Jun	6:00	1.3	m/s	2.4	m/s
4. Jun	7:00	1.4	m/s	2.1	m/s
4. Jun	8:00	1.5	m/s	2.5	m/s
4. Jun	9:00	2.7	m/s	5.6	m/s
4. Jun	10:00	2.4	m/s	5.4	m/s
4. Jun	11:00	2.5	m/s	6.4	m/s
4. Jun	12:00	2.5	m/s	5.7	m/s
4. Jun	13:00	2.1	m/s	6.2	m/s
4. Jun	14:00	2.2	m/s	6.4	m/s
4. Jun	15:00	2.6	m/s	6.0	m/s
4. Jun	16:00	2.6	m/s	5.7	m/s
4. Jun	17:00	3.7	m/s	6.3	m/s
4. Jun	18:00	2.5	m/s	5.7	m/s
4. Jun	19:00	2.8	m/s	5.8	m/s
4. Jun	20:00	2.0	m/s	4.7	m/s
4. Jun	21:00	3.0	m/s	6.4	m/s
4. Jun	22:00	2.9	m/s	5.8	m/s
4. Jun	23:00	1.1	m/s	6.1	m/s

Date	Time	Makueni Sakai (No. 109) Hourly Mean		Makueni Sakai (No. 109) Hourly Maximum	
9. Jun	9:00		m/s		m/s
9. Jun	10:00		m/s		m/s
9. Jun	11:00		m/s		m/s
9. Jun	12:00	2.7	m/s	4.1	m/s
9. Jun	13:00	2.7	m/s	6.0	m/s
9. Jun	14:00	3.7	m/s	7.1	m/s
9. Jun	15:00	2.7	m/s	3.5	m/s
9. Jun	16:00	3.4	m/s	8.1	m/s
9. Jun	17:00	3.4	m/s	6.8	m/s
9. Jun	18:00	2.3	m/s	5.8	m/s
9. Jun	19:00	2.9	m/s	6.8	m/s
9. Jun	20:00	2.1	m/s	4.9	m/s
9. Jun	21:00	1.7	m/s	2.3	m/s
9. Jun	22:00	1.8	m/s	1.8	m/s
9. Jun	23:00	1.2	m/s	1.3	m/s
10. Jun	0:00	0.7	m/s	1.0	m/s
10. Jun	1:00	0.6	m/s	3.2	m/s
10. Jun	2:00	0.8	m/s	4.6	m/s
10. Jun	3:00	1.2	m/s	2.9	m/s
10. Jun	4:00	2.1	m/s	3.6	m/s
10. Jun	5:00	0.7	m/s	1.5	m/s
10. Jun	6:00	0.0	m/s	0.9	m/s
10. Jun	7:00	0.3	m/s	0.7	m/s
10. Jun	8:00	0.0	m/s	1.0	m/s
10. Jun	9:00	1.1	m/s	2.9	m/s
10. Jun	10:00	3.0	m/s	6.8	m/s
10. Jun	11:00	2.8	m/s	3.7	m/s
10. Jun	12:00	2.1	m/s	6.9	m/s
10. Jun	13:00	3.8	m/s	7.2	m/s
10. Jun	14:00	3.1	m/s	6.5	m/s
10. Jun	15:00	3.8	m/s	6.8	m/s
10. Jun	16:00	3.8	m/s	4.3	m/s
10. Jun	17:00	2.9	m/s	8.2	m/s
10. Jun	18:00	3.0	m/s	6.9	m/s
10. Jun	19:00	1.4	m/s	4.5	m/s
10. Jun	20:00	2.4	m/s	6.2	m/s
10. Jun	21:00	2.0	m/s	4.2	m/s
10. Jun	22:00	2.2	m/s	5.3	m/s
10. Jun	23:00	2.2	m/s	4.1	m/s
11. Jun	0:00	0.7	m/s	1.0	m/s
11. Jun	1:00	2.2	m/s	4.7	m/s
11. Jun	2:00	2.9	m/s	4.9	m/s
11. Jun	3:00	2.0	m/s	4.0	m/s
11. Jun	4:00	0.5	m/s	3.4	m/s
11. Jun	5:00	0.4	m/s	1.3	m/s
11. Jun	6:00	1.2	m/s	3.0	m/s
11. Jun	7:00	2.6	m/s	4.9	m/s
11. Jun	8:00	2.6	m/s	2.6	m/s
11. Jun	9:00	2.8	m/s	6.0	m/s
11. Jun	10:00	3.2	m/s	6.3	m/s
11. Jun	11:00	2.4	m/s	7.4	m/s
11. Jun	12:00	2.5	m/s	5.7	m/s
11. Jun	13:00	2.1	m/s	5.3	m/s
11. Jun	14:00	2.4	m/s	5.5	m/s
11. Jun	15:00	2.6	m/s	4.3	m/s
11. Jun	16:00	1.2	m/s	4.6	m/s
11. Jun	17:00	2.7	m/s	4.8	m/s
11. Jun	18:00	1.1	m/s	5.6	m/s
11. Jun	19:00	1.3	m/s	3.2	m/s
11. Jun	20:00	0.9	m/s	2.8	m/s
11. Jun	21:00	3.0	m/s	6.8	m/s
11. Jun	22:00	2.8	m/s	3.7	m/s
11. Jun	23:00	1.1	m/s	7.0	m/s

Date	Time	Makueni Ititu Secondary School (No. 121) Hourly Mean		Makueni Ititu Secondary School (No. 121) Hourly Maximum	
16. Jun	9:00		m/s		m/s
16. Jun	10:00		m/s		m/s
16. Jun	11:00		m/s		m/s
16. Jun	12:00		m/s		m/s
16. Jun	13:00	2.0	m/s	3.7	m/s
16. Jun	14:00	2.3	m/s	5.4	m/s
16. Jun	15:00	2.1	m/s	4.3	m/s
16. Jun	16:00	2.0	m/s	3.8	m/s
16. Jun	17:00	1.2	m/s	3.7	m/s
16. Jun	18:00	2.0	m/s	4.2	m/s
16. Jun	19:00	1.4	m/s	3.5	m/s
16. Jun	20:00	2.1	m/s	4.0	m/s
16. Jun	21:00	1.3	m/s	4.6	m/s
16. Jun	22:00	0.6	m/s	2.9	m/s
16. Jun	23:00	2.9	m/s	3.7	m/s
17. Jun	0:00	1.9	m/s	3.7	m/s
17. Jun	1:00	1.8	m/s	3.1	m/s
17. Jun	2:00	1.3	m/s	3.1	m/s
17. Jun	3:00	1.1	m/s	2.8	m/s
17. Jun	4:00	0.6	m/s	2.8	m/s
17. Jun	5:00	1.7	m/s	1.9	m/s
17. Jun	6:00	1.1	m/s	2.8	m/s
17. Jun	7:00	0.2	m/s	1.5	m/s
17. Jun	8:00	0.6	m/s	2.4	m/s
17. Jun	9:00	0.4	m/s	1.7	m/s
17. Jun	10:00	0.9	m/s	2.3	m/s
17. Jun	11:00	1.2	m/s	2.0	m/s
17. Jun	12:00	1.7	m/s	4.6	m/s
17. Jun	13:00	1.8	m/s	4.3	m/s
17. Jun	14:00	2.4	m/s	5.3	m/s
17. Jun	15:00	1.7	m/s	5.1	m/s
17. Jun	16:00	2.5	m/s	4.3	m/s
17. Jun	17:00	2.0	m/s	6.1	m/s
17. Jun	18:00	2.4	m/s	4.4	m/s
17. Jun	19:00	1.7	m/s	3.5	m/s
17. Jun	20:00		m/s		m/s
17. Jun	21:00	1.3	m/s	2.6	m/s
17. Jun	22:00	0.3	m/s	2.7	m/s
17. Jun	23:00	2.1	m/s	3.5	m/s
18. Jun	0:00	1.2	m/s	5.1	m/s
18. Jun	1:00	0.9	m/s	3.8	m/s
18. Jun	2:00		m/s		m/s
18. Jun	3:00	0.5	m/s	3.8	m/s
18. Jun	4:00	0.3	m/s	1.6	m/s
18. Jun	5:00	0.3	m/s	1.6	m/s
18. Jun	6:00	0.6	m/s	1.2	m/s
18. Jun	7:00	0.3	m/s	0.7	m/s
18. Jun	8:00	0.3	m/s	1.1	m/s
18. Jun	9:00	0.3	m/s	2.0	m/s
18. Jun	10:00	1.6	m/s	3.8	m/s
18. Jun	11:00	1.9	m/s	4.6	m/s
18. Jun	12:00	2.5	m/s	5.4	m/s
18. Jun	13:00	1.8	m/s	6.4	m/s
18. Jun	14:00	2.1	m/s	4.7	m/s
18. Jun	15:00	2.1	m/s	5.1	m/s
18. Jun	16:00	2.3	m/s	6.2	m/s
18. Jun	17:00	2.0	m/s	4.1	m/s
18. Jun	18:00	2.2	m/s	4.2	m/s
18. Jun	19:00	1.7	m/s	4.0	m/s
18. Jun	20:00	1.3	m/s	5.7	m/s
18. Jun	21:00	2.3	m/s	4.1	m/s
18. Jun	22:00	1.7	m/s	5.7	m/s
18. Jun	23:00	2.1	m/s	5.5	m/s

Date	Time	Makueni Utui wa wote (No. 99) Hourly Mean	Makueni Utui wa wote (No. 99) Hourly Maximum
5. Jun	0:00	0.9 m/s	1.9 m/s
5. Jun	1:00	0.4 m/s	2.5 m/s
5. Jun	2:00	0.3 m/s	1.9 m/s
5. Jun	3:00	0.5 m/s	1.7 m/s
5. Jun	4:00	1.0 m/s	2.5 m/s
5. Jun	5:00	0.5 m/s	1.1 m/s
5. Jun	6:00	1.2 m/s	2.6 m/s
5. Jun	7:00	1.7 m/s	2.9 m/s
5. Jun	8:00	2.0 m/s	2.9 m/s
5. Jun	9:00	1.9 m/s	3.1 m/s
5. Jun	10:00	2.4 m/s	5.4 m/s
5. Jun	11:00	2.4 m/s	6.0 m/s
5. Jun	12:00	2.7 m/s	5.5 m/s
5. Jun	13:00	3.8 m/s	6.2 m/s
5. Jun	14:00	2.0 m/s	5.8 m/s
5. Jun	15:00	2.5 m/s	4.9 m/s
5. Jun	16:00	3.0 m/s	5.2 m/s
5. Jun	17:00	2.3 m/s	6.5 m/s
5. Jun	18:00	2.5 m/s	8.1 m/s
5. Jun	19:00	2.9 m/s	5.1 m/s
5. Jun	20:00	1.9 m/s	4.7 m/s
5. Jun	21:00	1.5 m/s	5.5 m/s
5. Jun	22:00	2.1 m/s	4.4 m/s
5. Jun	23:00	0.0 m/s	2.1 m/s
6. Jun	0:00	1.1 m/s	3.2 m/s
6. Jun	1:00	0.3 m/s	1.9 m/s
6. Jun	2:00	1.3 m/s	4.1 m/s
6. Jun	3:00	0.0 m/s	5.9 m/s
6. Jun	4:00	1.3 m/s	5.9 m/s
6. Jun	5:00	0.4 m/s	2.3 m/s
6. Jun	6:00	0.8 m/s	4.6 m/s
6. Jun	7:00	1.8 m/s	2.8 m/s
6. Jun	8:00	2.3 m/s	3.8 m/s
6. Jun	9:00	2.1 m/s	4.3 m/s
6. Jun	10:00	2.8 m/s	5.6 m/s
6. Jun	11:00	2.9 m/s	5.8 m/s
6. Jun	12:00	2.6 m/s	6.4 m/s
6. Jun	13:00	2.9 m/s	6.6 m/s
6. Jun	14:00	2.4 m/s	6.9 m/s
6. Jun	15:00	2.9 m/s	6.9 m/s
6. Jun	16:00	3.4 m/s	8.3 m/s
6. Jun	17:00	3.7 m/s	7.7 m/s
6. Jun	18:00	3.5 m/s	7.3 m/s
6. Jun	19:00	1.7 m/s	5.8 m/s
6. Jun	20:00	0.7 m/s	2.0 m/s
6. Jun	21:00	2.8 m/s	5.1 m/s
6. Jun	22:00	1.9 m/s	6.8 m/s
6. Jun	23:00	2.8 m/s	5.6 m/s
7. Jun	0:00	0.4 m/s	5.5 m/s
7. Jun	1:00	0.2 m/s	4.1 m/s
7. Jun	2:00	0.1 m/s	1.9 m/s
7. Jun	3:00	0.0 m/s	2.1 m/s
7. Jun	4:00	0.9 m/s	1.0 m/s
7. Jun	5:00	0.6 m/s	3.1 m/s
7. Jun	6:00	0.7 m/s	1.1 m/s
7. Jun	7:00	0.9 m/s	2.0 m/s
7. Jun	8:00	2.0 m/s	2.9 m/s
7. Jun	9:00	1.6 m/s	3.3 m/s
7. Jun	10:00	2.3 m/s	4.5 m/s
7. Jun	11:00	1.7 m/s	5.4 m/s
7. Jun	12:00	2.5 m/s	5.0 m/s
7. Jun	13:00	2.4 m/s	5.8 m/s
7. Jun	14:00	2.7 m/s	5.5 m/s
7. Jun	15:00	2.7 m/s	6.4 m/s
7. Jun	16:00	2.9 m/s	5.7 m/s
7. Jun	17:00	2.3 m/s	8.0 m/s
7. Jun	18:00	2.9 m/s	5.0 m/s
7. Jun	19:00	2.3 m/s	5.1 m/s
7. Jun	20:00	1.6 m/s	3.1 m/s
7. Jun	21:00	0.9 m/s	3.0 m/s
7. Jun	22:00	2.2 m/s	3.4 m/s
7. Jun	23:00	2.9 m/s	4.8 m/s

Date	Time	Makueni Sakai (No. 109) Hourly Mean	Makueni Sakai (No. 109) Hourly Maximum
12. Jun	0:00	0.7 m/s	1.0 m/s
12. Jun	1:00	0.7 m/s	1.7 m/s
12. Jun	2:00	0.0 m/s	1.9 m/s
12. Jun	3:00	0.7 m/s	1.3 m/s
12. Jun	4:00	0.7 m/s	1.9 m/s
12. Jun	5:00	1.9 m/s	3.0 m/s
12. Jun	6:00	0.3 m/s	2.4 m/s
12. Jun	7:00	1.5 m/s	2.5 m/s
12. Jun	8:00	1.3 m/s	3.3 m/s
12. Jun	9:00	1.1 m/s	3.1 m/s
12. Jun	10:00	2.5 m/s	5.8 m/s
12. Jun	11:00	2.6 m/s	5.7 m/s
12. Jun	12:00	2.7 m/s	5.9 m/s
12. Jun	13:00	2.8 m/s	6.6 m/s
12. Jun	14:00	2.7 m/s	6.0 m/s
12. Jun	15:00	3.4 m/s	6.1 m/s
12. Jun	16:00	2.4 m/s	5.4 m/s
12. Jun	17:00	1.9 m/s	5.6 m/s
12. Jun	18:00	1.0 m/s	2.5 m/s
12. Jun	19:00	1.3 m/s	1.5 m/s
12. Jun	20:00	2.3 m/s	4.6 m/s
12. Jun	21:00	1.6 m/s	5.4 m/s
12. Jun	22:00	0.9 m/s	2.9 m/s
12. Jun	23:00	0.6 m/s	1.9 m/s
13. Jun	0:00	0.0 m/s	1.4 m/s
13. Jun	1:00	0.5 m/s	1.5 m/s
13. Jun	2:00	0.8 m/s	1.2 m/s
13. Jun	3:00	0.0 m/s	1.4 m/s
13. Jun	4:00	0.0 m/s	1.3 m/s
13. Jun	5:00	1.5 m/s	1.9 m/s
13. Jun	6:00	0.0 m/s	1.9 m/s
13. Jun	7:00	1.6 m/s	3.4 m/s
13. Jun	8:00	2.9 m/s	5.2 m/s
13. Jun	9:00	2.7 m/s	5.8 m/s
13. Jun	10:00	2.9 m/s	7.8 m/s
13. Jun	11:00	2.9 m/s	6.5 m/s
13. Jun	12:00	3.2 m/s	7.1 m/s
13. Jun	13:00	2.9 m/s	6.4 m/s
13. Jun	14:00	2.8 m/s	7.8 m/s
13. Jun	15:00	2.8 m/s	7.5 m/s
13. Jun	16:00	1.9 m/s	5.1 m/s
13. Jun	17:00	2.5 m/s	4.6 m/s
13. Jun	18:00	1.7 m/s	4.7 m/s
13. Jun	19:00	2.1 m/s	5.7 m/s
13. Jun	20:00	2.9 m/s	5.8 m/s
13. Jun	21:00	1.1 m/s	4.1 m/s
13. Jun	22:00	0.0 m/s	3.3 m/s
13. Jun	23:00	0.6 m/s	1.5 m/s
14. Jun	0:00	0.4 m/s	2.1 m/s
14. Jun	1:00	0.4 m/s	2.3 m/s
14. Jun	2:00	0.0 m/s	1.2 m/s
14. Jun	3:00	0.8 m/s	1.2 m/s
14. Jun	4:00	0.4 m/s	1.1 m/s
14. Jun	5:00	0.3 m/s	1.1 m/s
14. Jun	6:00	1.1 m/s	1.9 m/s
14. Jun	7:00	2.4 m/s	4.3 m/s
14. Jun	8:00	1.9 m/s	4.5 m/s
14. Jun	9:00	2.5 m/s	4.4 m/s
14. Jun	10:00	2.3 m/s	4.7 m/s
14. Jun	11:00	1.9 m/s	5.8 m/s
14. Jun	12:00	1.7 m/s	5.3 m/s
14. Jun	13:00	2.4 m/s	4.8 m/s
14. Jun	14:00	2.2 m/s	5.5 m/s
14. Jun	15:00	1.7 m/s	4.3 m/s
14. Jun	16:00	1.6 m/s	4.6 m/s
14. Jun	17:00	1.6 m/s	3.5 m/s
14. Jun	18:00	3.4 m/s	7.1 m/s
14. Jun	19:00	3.0 m/s	6.7 m/s
14. Jun	20:00	2.3 m/s	6.0 m/s
14. Jun	21:00	1.2 m/s	5.0 m/s
14. Jun	22:00	1.0 m/s	2.6 m/s
14. Jun	23:00	0.6 m/s	1.9 m/s

Date	Time	Makueni Ititu Secondary School (No. 121) Hourly Mean	Makueni Ititu Secondary School (No. 121) Hourly Maximum
19. Jun	0:00	1.5 m/s	4.4 m/s
19. Jun	1:00	1.3 m/s	3.5 m/s
19. Jun	2:00	1.0 m/s	3.4 m/s
19. Jun	3:00	0.7 m/s	2.0 m/s
19. Jun	4:00	0.6 m/s	1.7 m/s
19. Jun	5:00	0.6 m/s	1.5 m/s
19. Jun	6:00	0.7 m/s	1.6 m/s
19. Jun	7:00	0.3 m/s	1.5 m/s
19. Jun	8:00	1.1 m/s	2.0 m/s
19. Jun	9:00	1.0 m/s	2.1 m/s
19. Jun	10:00	3.2 m/s	5.7 m/s
19. Jun	11:00	2.3 m/s	5.1 m/s
19. Jun	12:00	1.7 m/s	6.6 m/s
19. Jun	13:00	2.4 m/s	5.4 m/s
19. Jun	14:00	2.0 m/s	4.7 m/s
19. Jun	15:00	1.3 m/s	3.1 m/s
19. Jun	16:00	1.2 m/s	2.4 m/s
19. Jun	17:00	2.0 m/s	3.5 m/s
19. Jun	18:00	1.9 m/s	4.2 m/s
19. Jun	19:00	1.5 m/s	3.5 m/s
19. Jun	20:00	1.5 m/s	3.1 m/s
19. Jun	21:00	1.7 m/s	4.1 m/s
19. Jun	22:00	2.6 m/s	5.1 m/s
19. Jun	23:00	2.1 m/s	4.7 m/s
20. Jun	0:00	2.2 m/s	4.4 m/s
20. Jun	1:00	1.5 m/s	4.4 m/s
20. Jun	2:00	1.1 m/s	2.5 m/s
20. Jun	3:00	0.9 m/s	1.7 m/s
20. Jun	4:00	1.0 m/s	1.8 m/s
20. Jun	5:00	1.4 m/s	2.4 m/s
20. Jun	6:00	1.1 m/s	2.3 m/s
20. Jun	7:00	0.9 m/s	1.9 m/s
20. Jun	8:00	1.1 m/s	2.2 m/s
20. Jun	9:00	1.1 m/s	2.8 m/s
20. Jun	10:00	1.9 m/s	4.3 m/s
20. Jun	11:00	1.5 m/s	3.7 m/s
20. Jun	12:00	2.0 m/s	3.4 m/s
20. Jun	13:00	1.5 m/s	2.9 m/s
20. Jun	14:00	1.2 m/s	2.7 m/s
20. Jun	15:00	1.5 m/s	3.0 m/s
20. Jun	16:00	1.1 m/s	3.1 m/s
20. Jun	17:00	0.6 m/s	2.6 m/s
20. Jun	18:00	1.3 m/s	3.6 m/s
20. Jun	19:00	1.3 m/s	2.0 m/s
20. Jun	20:00	0.5 m/s	2.8 m/s
20. Jun	21:00	0.0 m/s	0.9 m/s
20. Jun	22:00	0.0 m/s	0.0 m/s
20. Jun	23:00	2.4 m/s	5.8 m/s
21. Jun	0:00	2.1 m/s	5.7 m/s
21. Jun	1:00	1.5 m/s	4.6 m/s
21. Jun	2:00	0.4 m/s	2.4 m/s
21. Jun	3:00	0.0 m/s	1.2 m/s
21. Jun	4:00	0.0 m/s	1.0 m/s
21. Jun	5:00	0.0 m/s	1.7 m/s
21. Jun	6:00	1.0 m/s	1.9 m/s
21. Jun	7:00	0.6 m/s	1.8 m/s
21. Jun	8:00	1.2 m/s	2.4 m/s
21. Jun	9:00	1.1 m/s	3.1 m/s
21. Jun	10:00	2.5 m/s	5.9 m/s
21. Jun	11:00	3.1 m/s	6.0 m/s
21. Jun	12:00	2.5 m/s	5.8 m/s
21. Jun	13:00	2.4 m/s	7.8 m/s
21. Jun	14:00	2.5 m/s	7.5 m/s
21. Jun	15:00	2.5 m/s	6.8 m/s
21. Jun	16:00	2.8 m/s	6.2 m/s
21. Jun	17:00	3.1 m/s	7.5 m/s
21. Jun	18:00	2.4 m/s	5.8 m/s
21. Jun	19:00	1.7 m/s	5.1 m/s
21. Jun	20:00	1.5 m/s	3.5 m/s
21. Jun	21:00	0.7 m/s	2.6 m/s
21. Jun	22:00	0.9 m/s	1.9 m/s
21. Jun	23:00	1.0 m/s	1.6 m/s

Date	Time	Makueni Utui wa wote (No. 99) Hourly Mean	Makueni Utui wa wote (No. 99) Hourly Maximum
8. Jun	0:00	0.8 m/s	2.9 m/s
8. Jun	1:00	0.6 m/s	2.4 m/s
8. Jun	2:00	0.6 m/s	3.0 m/s
8. Jun	3:00	0.4 m/s	1.8 m/s
8. Jun	4:00	0.8 m/s	2.9 m/s
8. Jun	5:00	1.1 m/s	2.1 m/s
8. Jun	6:00	1.2 m/s	2.2 m/s
8. Jun	7:00	0.5 m/s	2.1 m/s
8. Jun	8:00	0.7 m/s	1.3 m/s
8. Jun	9:00	0.9 m/s	1.9 m/s
8. Jun	10:00	1.6 m/s	3.2 m/s
8. Jun	11:00	2.0 m/s	5.2 m/s
8. Jun	12:00	2.3 m/s	6.1 m/s
8. Jun	13:00	2.5 m/s	6.9 m/s
8. Jun	14:00	3.2 m/s	5.9 m/s
8. Jun	15:00	2.9 m/s	6.8 m/s
8. Jun	16:00	3.3 m/s	6.6 m/s
8. Jun	17:00	2.5 m/s	6.1 m/s
8. Jun	18:00	1.9 m/s	7.6 m/s
8. Jun	19:00	2.7 m/s	5.2 m/s
8. Jun	20:00	1.9 m/s	6.3 m/s
8. Jun	21:00	1.4 m/s	4.1 m/s
8. Jun	22:00	2.3 m/s	5.0 m/s
8. Jun	23:00	2.1 m/s	5.1 m/s
9. Jun	0:00	0.5 m/s	5.9 m/s
9. Jun	1:00	0.3 m/s	3.3 m/s
9. Jun	2:00	0.1 m/s	2.9 m/s
9. Jun	3:00	0.3 m/s	1.9 m/s
9. Jun	4:00	0.0 m/s	1.2 m/s
9. Jun	5:00	0.9 m/s	1.2 m/s
9. Jun	6:00	0.5 m/s	1.8 m/s
9. Jun	7:00	0.8 m/s	0.9 m/s
9. Jun	8:00	0.7 m/s	2.4 m/s
9. Jun	9:00	m/s	m/s
9. Jun	10:00	m/s	m/s
9. Jun	11:00	m/s	m/s
9. Jun	12:00	m/s	m/s
9. Jun	13:00	m/s	m/s
9. Jun	14:00	m/s	m/s
9. Jun	15:00	m/s	m/s
9. Jun	16:00	m/s	m/s
9. Jun	17:00	m/s	m/s
9. Jun	18:00	m/s	m/s
9. Jun	19:00	m/s	m/s
9. Jun	20:00	m/s	m/s
9. Jun	21:00	m/s	m/s
9. Jun	22:00	m/s	m/s
9. Jun	23:00	m/s	m/s

Date	Time	Makueni Sakai (No. 109) Hourly Mean	Makueni Sakai (No. 109) Hourly Maximum
15. Jun	0:00	0.4 m/s	2.1 m/s
15. Jun	1:00	0.5 m/s	1.5 m/s
15. Jun	2:00	0.0 m/s	0.3 m/s
15. Jun	3:00	0.0 m/s	0.7 m/s
15. Jun	4:00	0.3 m/s	1.3 m/s
15. Jun	5:00	0.8 m/s	1.4 m/s
15. Jun	6:00	0.0 m/s	1.2 m/s
15. Jun	7:00	1.4 m/s	2.5 m/s
15. Jun	8:00	2.4 m/s	4.6 m/s
15. Jun	9:00	2.1 m/s	4.4 m/s
15. Jun	10:00	3.2 m/s	6.1 m/s
15. Jun	11:00	2.4 m/s	5.8 m/s
15. Jun	12:00	2.7 m/s	5.6 m/s
15. Jun	13:00	3.2 m/s	6.6 m/s
15. Jun	14:00	3.1 m/s	6.0 m/s
15. Jun	15:00	2.3 m/s	5.9 m/s
15. Jun	16:00	3.4 m/s	6.8 m/s
15. Jun	17:00	1.2 m/s	4.1 m/s
15. Jun	18:00	2.1 m/s	5.9 m/s
15. Jun	19:00	1.6 m/s	4.1 m/s
15. Jun	20:00	2.5 m/s	5.5 m/s
15. Jun	21:00	3.3 m/s	5.8 m/s
15. Jun	22:00	2.5 m/s	5.0 m/s
15. Jun	23:00	0.9 m/s	4.4 m/s
16. Jun	0:00	0.4 m/s	2.1 m/s
16. Jun	1:00	0.5 m/s	1.5 m/s
16. Jun	2:00	0.0 m/s	1.7 m/s
16. Jun	3:00	0.0 m/s	1.0 m/s
16. Jun	4:00	1.5 m/s	2.3 m/s
16. Jun	5:00	1.3 m/s	2.3 m/s
16. Jun	6:00	0.5 m/s	1.1 m/s
16. Jun	7:00	1.6 m/s	2.6 m/s
16. Jun	8:00	1.1 m/s	3.7 m/s
16. Jun	9:00	m/s	m/s
16. Jun	10:00	m/s	m/s
16. Jun	11:00	m/s	m/s
16. Jun	12:00	m/s	m/s
16. Jun	13:00	m/s	m/s
16. Jun	14:00	m/s	m/s
16. Jun	15:00	m/s	m/s
16. Jun	16:00	m/s	m/s
16. Jun	17:00	m/s	m/s
16. Jun	18:00	m/s	m/s
16. Jun	19:00	m/s	m/s
16. Jun	20:00	m/s	m/s
16. Jun	21:00	m/s	m/s
16. Jun	22:00	m/s	m/s
16. Jun	23:00	m/s	m/s

Date	Time	Makueni Ititu Secondary School (No. 121) Hourly Mean	Makueni Ititu Secondary School (No. 121) Hourly Maximum
22. Jun	0:00	1.3 m/s	2.2 m/s
22. Jun	1:00	m/s	m/s
22. Jun	2:00	0.9 m/s	2.0 m/s
22. Jun	3:00	0.8 m/s	1.6 m/s
22. Jun	4:00	1.3 m/s	1.8 m/s
22. Jun	5:00	0.7 m/s	1.9 m/s
22. Jun	6:00	0.9 m/s	2.3 m/s
22. Jun	7:00	0.0 m/s	1.7 m/s
22. Jun	8:00	0.3 m/s	1.5 m/s
22. Jun	9:00	1.1 m/s	2.5 m/s
22. Jun	10:00	2.0 m/s	3.8 m/s
22. Jun	11:00	1.9 m/s	4.7 m/s
22. Jun	12:00	1.1 m/s	2.5 m/s
22. Jun	13:00	2.1 m/s	5.4 m/s
22. Jun	14:00	2.2 m/s	6.1 m/s
22. Jun	15:00	2.2 m/s	6.0 m/s
22. Jun	16:00	2.5 m/s	5.2 m/s
22. Jun	17:00	2.8 m/s	5.7 m/s
22. Jun	18:00	2.5 m/s	6.7 m/s
22. Jun	19:00	2.6 m/s	6.9 m/s
22. Jun	20:00	2.8 m/s	5.7 m/s
22. Jun	21:00	2.7 m/s	7.5 m/s
22. Jun	22:00	1.9 m/s	8.7 m/s
22. Jun	23:00	2.2 m/s	5.1 m/s
23. Jun	0:00	1.9 m/s	4.6 m/s
23. Jun	1:00	0.7 m/s	2.3 m/s
23. Jun	2:00	0.6 m/s	1.2 m/s
23. Jun	3:00	0.0 m/s	1.0 m/s
23. Jun	4:00	0.0 m/s	0.4 m/s
23. Jun	5:00	0.0 m/s	1.0 m/s
23. Jun	6:00	1.0 m/s	1.4 m/s
23. Jun	7:00	1.0 m/s	1.5 m/s
23. Jun	8:00	0.9 m/s	2.2 m/s
23. Jun	9:00	0.9 m/s	3.5 m/s
23. Jun	10:00	1.8 m/s	3.5 m/s
23. Jun	11:00	2.1 m/s	4.7 m/s
23. Jun	12:00	2.9 m/s	5.8 m/s
23. Jun	13:00	m/s	m/s
23. Jun	14:00	m/s	m/s
23. Jun	15:00	m/s	m/s
23. Jun	16:00	m/s	m/s
23. Jun	17:00	m/s	m/s
23. Jun	18:00	m/s	m/s
23. Jun	19:00	m/s	m/s
23. Jun	20:00	m/s	m/s
23. Jun	21:00	m/s	m/s
23. Jun	22:00	m/s	m/s
23. Jun	23:00	m/s	m/s

Date	Time	Machakos Mukukuni (No. 167) Hourly Mean		Machakos Mukukuni (No. 167) Hourly Maximum	
28. May	9:00		m/s		m/s
28. May	10:00		m/s		m/s
28. May	11:00		m/s		m/s
28. May	12:00		m/s		m/s
28. May	13:00		m/s		m/s
28. May	14:00	2.3	m/s	3.7	m/s
28. May	15:00	3.6	m/s	4.2	m/s
28. May	16:00	4.5	m/s	7.7	m/s
28. May	17:00	4.0	m/s	7.7	m/s
28. May	18:00	3.4	m/s	7.4	m/s
28. May	19:00	2.6	m/s	5.6	m/s
28. May	20:00	2.4	m/s	6.3	m/s
28. May	21:00	3.1	m/s	6.8	m/s
28. May	22:00	3.4	m/s	8.6	m/s
28. May	23:00	3.4	m/s	7.1	m/s
29. May	0:00	2.4	m/s	4.8	m/s
29. May	1:00	3.4	m/s	6.1	m/s
29. May	2:00	3.1	m/s	6.8	m/s
29. May	3:00	4.2	m/s	7.0	m/s
29. May	4:00	3.6	m/s	6.4	m/s
29. May	5:00	2.8	m/s	6.6	m/s
29. May	6:00	2.4	m/s	3.8	m/s
29. May	7:00	1.1	m/s	3.2	m/s
29. May	8:00	0.9	m/s	2.5	m/s
29. May	9:00	1.2	m/s	4.5	m/s
29. May	10:00	0.6	m/s	2.2	m/s
29. May	11:00	1.3	m/s	3.7	m/s
29. May	12:00	0.7	m/s	4.1	m/s
29. May	13:00	1.9	m/s	4.7	m/s
29. May	14:00	1.2	m/s	4.1	m/s
29. May	15:00	3.1	m/s	4.7	m/s
29. May	16:00	3.0	m/s	4.7	m/s
29. May	17:00	2.5	m/s	6.8	m/s
29. May	18:00	2.4	m/s	5.3	m/s
29. May	19:00	1.6	m/s	5.6	m/s
29. May	20:00	2.1	m/s	3.8	m/s
29. May	21:00	3.2	m/s	7.5	m/s
29. May	22:00	3.6	m/s	7.1	m/s
29. May	23:00	1.7	m/s	3.0	m/s
30. May	0:00	2.6	m/s	5.4	m/s
30. May	1:00	1.8	m/s	3.1	m/s
30. May	2:00	2.8	m/s	4.4	m/s
30. May	3:00	3.0	m/s	4.8	m/s
30. May	4:00	2.8	m/s	5.2	m/s
30. May	5:00	2.6	m/s	4.6	m/s
30. May	6:00	3.1	m/s	5.1	m/s
30. May	7:00	0.2	m/s	1.1	m/s
30. May	8:00	0.5	m/s	1.3	m/s
30. May	9:00	0.8	m/s	2.0	m/s
30. May	10:00	0.9	m/s	2.5	m/s
30. May	11:00	1.4	m/s	2.5	m/s
30. May	12:00	2.9	m/s	4.9	m/s
30. May	13:00	2.0	m/s	5.4	m/s
30. May	14:00	3.1	m/s	5.3	m/s
30. May	15:00	3.1	m/s	6.8	m/s
30. May	16:00	2.4	m/s	5.7	m/s
30. May	17:00	3.2	m/s	6.7	m/s
30. May	18:00	3.2	m/s	6.1	m/s
30. May	19:00	2.3	m/s	4.9	m/s
30. May	20:00	2.0	m/s	4.5	m/s
30. May	21:00	2.0	m/s	5.7	m/s
30. May	22:00	3.2	m/s	8.5	m/s
30. May	23:00	3.5	m/s	9.1	m/s

Date	Time	Machakos Mbele wp (No. 172) Hourly Mean		Machakos Mbele wp (No. 172) Hourly Maximum	
7. Jun	9:00		m/s		m/s
7. Jun	10:00		m/s		m/s
7. Jun	11:00		m/s		m/s
7. Jun	12:00		m/s		m/s
7. Jun	13:00		m/s		m/s
7. Jun	14:00	1.8	m/s	4.3	m/s
7. Jun	15:00	2.5	m/s	4.2	m/s
7. Jun	16:00	2.4	m/s	5.4	m/s
7. Jun	17:00	2.5	m/s	5.3	m/s
7. Jun	18:00	2.2	m/s	4.1	m/s
7. Jun	19:00	1.5	m/s	4.0	m/s
7. Jun	20:00	1.3	m/s	3.7	m/s
7. Jun	21:00	1.3	m/s	3.4	m/s
7. Jun	22:00	1.2	m/s	2.9	m/s
7. Jun	23:00	1.2	m/s	2.6	m/s
8. Jun	0:00	1.5	m/s	3.3	m/s
8. Jun	1:00	1.8	m/s	4.0	m/s
8. Jun	2:00	2.0	m/s	4.6	m/s
8. Jun	3:00	1.1	m/s	3.5	m/s
8. Jun	4:00	1.1	m/s	2.3	m/s
8. Jun	5:00	0.0	m/s	2.1	m/s
8. Jun	6:00	0.0	m/s	1.1	m/s
8. Jun	7:00	0.0	m/s	0.0	m/s
8. Jun	8:00	0.4	m/s	1.4	m/s
8. Jun	9:00	1.1	m/s	2.1	m/s
8. Jun	10:00	2.3	m/s	4.4	m/s
8. Jun	11:00	1.8	m/s	5.9	m/s
8. Jun	12:00	3.5	m/s	6.6	m/s
8. Jun	13:00	2.9	m/s	6.4	m/s
8. Jun	14:00	2.4	m/s	5.9	m/s
8. Jun	15:00	1.8	m/s	5.7	m/s
8. Jun	16:00	2.3	m/s	5.9	m/s
8. Jun	17:00	3.2	m/s	7.9	m/s
8. Jun	18:00	1.5	m/s	6.1	m/s
8. Jun	19:00	0.1	m/s	0.9	m/s
8. Jun	20:00	0.1	m/s	0.7	m/s
8. Jun	21:00	0.0	m/s	0.9	m/s
8. Jun	22:00	0.1	m/s	0.6	m/s
8. Jun	23:00	0.3	m/s	0.9	m/s
9. Jun	0:00	0.4	m/s	0.7	m/s
9. Jun	1:00	0.0	m/s	0.7	m/s
9. Jun	2:00	0.1	m/s	0.9	m/s
9. Jun	3:00	0.0	m/s	0.5	m/s
9. Jun	4:00	0.4	m/s	1.0	m/s
9. Jun	5:00	0.2	m/s	2.1	m/s
9. Jun	6:00	0.0	m/s	1.0	m/s
9. Jun	7:00	0.0	m/s	0.7	m/s
9. Jun	8:00	0.0	m/s	0.9	m/s
9. Jun	9:00	1.1	m/s	2.1	m/s
9. Jun	10:00	2.2	m/s	3.9	m/s
9. Jun	11:00	2.1	m/s	5.2	m/s
9. Jun	12:00	2.5	m/s	6.3	m/s
9. Jun	13:00	2.3	m/s	5.9	m/s
9. Jun	14:00	2.3	m/s	6.4	m/s
9. Jun	15:00	3.0	m/s	6.0	m/s
9. Jun	16:00	2.8	m/s	6.6	m/s
9. Jun	17:00	2.9	m/s	6.3	m/s
9. Jun	18:00	2.3	m/s	6.6	m/s
9. Jun	19:00	2.1	m/s	6.0	m/s
9. Jun	20:00	2.8	m/s	5.4	m/s
9. Jun	21:00	1.6	m/s	4.4	m/s
9. Jun	22:00	1.7	m/s	3.2	m/s
9. Jun	23:00	1.6	m/s	4.2	m/s

Date	Time	Machakos Iyuni (No. 199) Hourly Mean		Machakos Iyuni (No. 199) Hourly Maximum	
14. Jun	9:00		m/s		m/s
14. Jun	10:00		m/s		m/s
14. Jun	11:00		m/s		m/s
14. Jun	12:00		m/s		m/s
14. Jun	13:00		m/s		m/s
14. Jun	14:00	0.0	m/s	1.7	m/s
14. Jun	15:00	1.3	m/s	4.2	m/s
14. Jun	16:00	1.1	m/s	4.3	m/s
14. Jun	17:00	1.1	m/s	4.0	m/s
14. Jun	18:00	0.7	m/s	3.3	m/s
14. Jun	19:00	0.4	m/s	3.0	m/s
14. Jun	20:00	1.0	m/s	2.0	m/s
14. Jun	21:00	2.0	m/s	5.2	m/s
14. Jun	22:00	2.1	m/s	5.8	m/s
14. Jun	23:00	1.9	m/s	5.6	m/s
15. Jun	0:00	1.5	m/s	3.9	m/s
15. Jun	1:00	0.7	m/s	3.4	m/s
15. Jun	2:00	0.3	m/s	1.9	m/s
15. Jun	3:00	0.0	m/s	2.3	m/s
15. Jun	4:00	0.0	m/s	0.3	m/s
15. Jun	5:00	0.0	m/s	2.3	m/s
15. Jun	6:00	0.8	m/s	1.5	m/s
15. Jun	7:00	0.0	m/s	0.3	m/s
15. Jun	8:00	0.0	m/s	0.3	m/s
15. Jun	9:00	1.0	m/s	2.7	m/s
15. Jun	10:00	0.9	m/s	1.6	m/s
15. Jun	11:00	0.8	m/s	3.2	m/s
15. Jun	12:00	1.4	m/s	4.3	m/s
15. Jun	13:00	1.7	m/s	4.6	m/s
15. Jun	14:00	0.7	m/s	1.6	m/s
15. Jun	15:00	0.6	m/s	5.0	m/s
15. Jun	16:00	1.8	m/s	4.6	m/s
15. Jun	17:00	1.2	m/s	4.7	m/s
15. Jun	18:00	1.9	m/s	7.0	m/s
15. Jun	19:00	1.6	m/s	4.9	m/s
15. Jun	20:00	1.4	m/s	4.9	m/s
15. Jun	21:00	1.9	m/s	5.0	m/s
15. Jun	22:00	1.2	m/s	4.6	m/s
15. Jun	23:00	1.4	m/s	4.1	m/s
16. Jun	0:00	1.0	m/s	3.5	m/s
16. Jun	1:00	0.3	m/s	3.8	m/s
16. Jun	2:00	0.5	m/s	1.6	m/s
16. Jun	3:00	0.0	m/s	1.2	m/s
16. Jun	4:00	0.4	m/s	1.8	m/s
16. Jun	5:00	0.0	m/s	1.7	m/s
16. Jun	6:00	0.3	m/s	1.1	m/s
16. Jun	7:00	0.0	m/s	1.2	m/s
16. Jun	8:00	0.7	m/s	1.4	m/s
16. Jun	9:00	1.4	m/s	2.3	m/s
16. Jun	10:00	0.7	m/s	1.1	m/s
16. Jun	11:00	1.2	m/s	3.1	m/s
16. Jun	12:00	1.1	m/s	2.8	m/s
16. Jun	13:00	1.3	m/s	3.3	m/s
16. Jun	14:00	1.4	m/s	3.7	m/s
16. Jun	15:00	1.4	m/s	4.8	m/s
16. Jun	16:00	1.7	m/s	4.5	m/s
16. Jun	17:00	1.6	m/s	4.4	m/s
16. Jun	18:00	1.5	m/s	4.2	m/s
16. Jun	19:00	1.3	m/s	3.9	m/s
16. Jun	20:00	1.9	m/s	4.9	m/s
16. Jun	21:00	1.2	m/s	4.5	m/s
16. Jun	22:00	1.2	m/s	4.3	m/s
16. Jun	23:00	0.9	m/s	4.4	m/s

Date	Time	Machakos Mukukuni (No. 167) Hourly Mean	Machakos Mukukuni (No. 167) Hourly Maximum
31. May	0:00	4.1 m/s	8.9 m/s
31. May	1:00	3.7 m/s	9.0 m/s
31. May	2:00	3.4 m/s	8.2 m/s
31. May	3:00	3.0 m/s	7.1 m/s
31. May	4:00	2.8 m/s	6.9 m/s
31. May	5:00	4.2 m/s	9.2 m/s
31. May	6:00	3.8 m/s	7.9 m/s
31. May	7:00	1.6 m/s	3.7 m/s
31. May	8:00	1.7 m/s	2.7 m/s
31. May	9:00	0.6 m/s	2.7 m/s
31. May	10:00	2.8 m/s	5.1 m/s
31. May	11:00	2.9 m/s	6.1 m/s
31. May	12:00	1.9 m/s	5.2 m/s
31. May	13:00	2.8 m/s	6.1 m/s
31. May	14:00	2.1 m/s	6.1 m/s
31. May	15:00	3.2 m/s	6.8 m/s
31. May	16:00	2.7 m/s	7.9 m/s
31. May	17:00	3.4 m/s	7.5 m/s
31. May	18:00	2.6 m/s	6.9 m/s
31. May	19:00	2.9 m/s	5.9 m/s
31. May	20:00	3.3 m/s	5.7 m/s
31. May	21:00	3.6 m/s	5.5 m/s
31. May	22:00	1.3 m/s	2.7 m/s
31. May	23:00	1.9 m/s	3.9 m/s
1. Jun	0:00	2.3 m/s	4.3 m/s
1. Jun	1:00	2.5 m/s	5.3 m/s
1. Jun	2:00	2.4 m/s	5.8 m/s
1. Jun	3:00	3.2 m/s	7.4 m/s
1. Jun	4:00	2.3 m/s	6.9 m/s
1. Jun	5:00	2.5 m/s	6.5 m/s
1. Jun	6:00	2.8 m/s	6.9 m/s
1. Jun	7:00	3.1 m/s	7.8 m/s
1. Jun	8:00	3.5 m/s	7.4 m/s
1. Jun	9:00	2.3 m/s	4.3 m/s
1. Jun	10:00	2.5 m/s	5.3 m/s
1. Jun	11:00	2.4 m/s	5.8 m/s
1. Jun	12:00	3.2 m/s	7.4 m/s
1. Jun	13:00	2.3 m/s	6.9 m/s
1. Jun	14:00	2.5 m/s	6.5 m/s
1. Jun	15:00	2.8 m/s	6.9 m/s
1. Jun	16:00	3.1 m/s	7.8 m/s
1. Jun	17:00	3.5 m/s	7.3 m/s
1. Jun	18:00	3.5 m/s	7.2 m/s
1. Jun	19:00	2.0 m/s	5.1 m/s
1. Jun	20:00	0.5 m/s	0.7 m/s
1. Jun	21:00	0.2 m/s	2.5 m/s
1. Jun	22:00	3.1 m/s	5.6 m/s
1. Jun	23:00	2.6 m/s	4.4 m/s
2. Jun	0:00	3.8 m/s	6.1 m/s
2. Jun	1:00	3.5 m/s	5.4 m/s
2. Jun	2:00	2.3 m/s	5.3 m/s
2. Jun	3:00	2.8 m/s	4.8 m/s
2. Jun	4:00	3.0 m/s	5.1 m/s
2. Jun	5:00	2.1 m/s	4.3 m/s
2. Jun	6:00	1.1 m/s	2.3 m/s
2. Jun	7:00	1.3 m/s	2.7 m/s
2. Jun	8:00	1.9 m/s	3.9 m/s
2. Jun	9:00	2.3 m/s	4.3 m/s
2. Jun	10:00	2.5 m/s	5.3 m/s
2. Jun	11:00	2.4 m/s	5.8 m/s
2. Jun	12:00	3.2 m/s	7.4 m/s
2. Jun	13:00	2.3 m/s	6.9 m/s
2. Jun	14:00	2.5 m/s	6.5 m/s
2. Jun	15:00	2.8 m/s	6.9 m/s
2. Jun	16:00	2.1 m/s	7.8 m/s
2. Jun	17:00	3.5 m/s	7.4 m/s
2. Jun	18:00	3.5 m/s	7.2 m/s
2. Jun	19:00	1.6 m/s	5.3 m/s
2. Jun	20:00	1.5 m/s	3.5 m/s
2. Jun	21:00	2.0 m/s	2.4 m/s
2. Jun	22:00	2.1 m/s	4.0 m/s
2. Jun	23:00	1.9 m/s	3.8 m/s

Date	Time	Machakos Mbele wp (No. 172) Hourly Mean	Machakos Mbele wp (No. 172) Hourly Maximum
10. Jun	0:00	0.8 m/s	4.2 m/s
10. Jun	1:00	0.2 m/s	1.2 m/s
10. Jun	2:00	0.0 m/s	0.6 m/s
10. Jun	3:00	0.0 m/s	1.9 m/s
10. Jun	4:00	0.0 m/s	0.1 m/s
10. Jun	5:00	0.0 m/s	1.3 m/s
10. Jun	6:00	0.0 m/s	0.0 m/s
10. Jun	7:00	0.4 m/s	0.7 m/s
10. Jun	8:00	0.5 m/s	1.4 m/s
10. Jun	9:00	1.2 m/s	3.2 m/s
10. Jun	10:00	1.4 m/s	3.0 m/s
10. Jun	11:00	2.0 m/s	4.6 m/s
10. Jun	12:00	2.6 m/s	5.6 m/s
10. Jun	13:00	3.6 m/s	8.1 m/s
10. Jun	14:00	3.2 m/s	7.6 m/s
10. Jun	15:00	3.7 m/s	7.1 m/s
10. Jun	16:00	3.0 m/s	6.9 m/s
10. Jun	17:00	3.5 m/s	7.2 m/s
10. Jun	18:00	3.4 m/s	7.7 m/s
10. Jun	19:00	2.0 m/s	6.9 m/s
10. Jun	20:00	3.5 m/s	6.5 m/s
10. Jun	21:00	2.4 m/s	5.3 m/s
10. Jun	22:00	1.7 m/s	3.8 m/s
10. Jun	23:00	1.2 m/s	6.4 m/s
11. Jun	0:00	0.4 m/s	2.3 m/s
11. Jun	1:00	0.4 m/s	1.8 m/s
11. Jun	2:00	0.1 m/s	0.7 m/s
11. Jun	3:00	0.3 m/s	1.0 m/s
11. Jun	4:00	0.5 m/s	1.2 m/s
11. Jun	5:00	0.0 m/s	1.9 m/s
11. Jun	6:00	0.4 m/s	1.0 m/s
11. Jun	7:00	1.1 m/s	1.8 m/s
11. Jun	8:00	1.6 m/s	3.0 m/s
11. Jun	9:00	1.4 m/s	4.1 m/s
11. Jun	10:00	2.7 m/s	6.2 m/s
11. Jun	11:00	2.7 m/s	6.2 m/s
11. Jun	12:00	2.9 m/s	6.9 m/s
11. Jun	13:00	2.5 m/s	7.5 m/s
11. Jun	14:00	2.7 m/s	6.3 m/s
11. Jun	15:00	3.0 m/s	6.8 m/s
11. Jun	16:00	2.5 m/s	5.7 m/s
11. Jun	17:00	2.8 m/s	5.3 m/s
11. Jun	18:00	2.9 m/s	5.3 m/s
11. Jun	19:00	2.1 m/s	6.2 m/s
11. Jun	20:00	1.7 m/s	3.6 m/s
11. Jun	21:00	1.1 m/s	2.4 m/s
11. Jun	22:00	1.0 m/s	2.1 m/s
11. Jun	23:00	1.3 m/s	5.3 m/s
12. Jun	0:00	1.1 m/s	3.1 m/s
12. Jun	1:00	0.9 m/s	2.3 m/s
12. Jun	2:00	0.9 m/s	2.5 m/s
12. Jun	3:00	0.4 m/s	1.2 m/s
12. Jun	4:00	0.5 m/s	2.5 m/s
12. Jun	5:00	0.0 m/s	0.0 m/s
12. Jun	6:00	0.0 m/s	1.0 m/s
12. Jun	7:00	0.0 m/s	0.4 m/s
12. Jun	8:00	0.4 m/s	1.3 m/s
12. Jun	9:00	1.1 m/s	2.5 m/s
12. Jun	10:00	1.1 m/s	2.8 m/s
12. Jun	11:00	1.9 m/s	3.7 m/s
12. Jun	12:00	3.0 m/s	8.1 m/s
12. Jun	13:00	2.4 m/s	6.0 m/s
12. Jun	14:00	2.7 m/s	6.9 m/s
12. Jun	15:00	1.9 m/s	6.0 m/s
12. Jun	16:00	1.7 m/s	6.0 m/s
12. Jun	17:00	3.2 m/s	7.1 m/s
12. Jun	18:00	2.5 m/s	5.6 m/s
12. Jun	19:00	1.2 m/s	4.3 m/s
12. Jun	20:00	2.1 m/s	4.0 m/s
12. Jun	21:00	1.7 m/s	4.7 m/s
12. Jun	22:00	2.4 m/s	5.2 m/s
12. Jun	23:00	2.7 m/s	5.9 m/s

Date	Time	Machakos Iyuni (No. 199) Hourly Mean	Machakos Iyuni (No. 199) Hourly Maximum
17. Jun	0:00	1.0 m/s	3.5 m/s
17. Jun	1:00	0.6 m/s	2.8 m/s
17. Jun	2:00	0.4 m/s	2.7 m/s
17. Jun	3:00	0.0 m/s	2.3 m/s
17. Jun	4:00	0.7 m/s	2.0 m/s
17. Jun	5:00	0.8 m/s	2.7 m/s
17. Jun	6:00	0.3 m/s	1.6 m/s
17. Jun	7:00	0.9 m/s	2.2 m/s
17. Jun	8:00	0.4 m/s	1.7 m/s
17. Jun	9:00	0.3 m/s	1.7 m/s
17. Jun	10:00	1.5 m/s	2.5 m/s
17. Jun	11:00	1.2 m/s	3.3 m/s
17. Jun	12:00	1.3 m/s	3.7 m/s
17. Jun	13:00	1.1 m/s	2.8 m/s
17. Jun	14:00	1.6 m/s	4.2 m/s
17. Jun	15:00	1.7 m/s	5.1 m/s
17. Jun	16:00	2.0 m/s	4.7 m/s
17. Jun	17:00	2.0 m/s	4.3 m/s
17. Jun	18:00	1.6 m/s	4.2 m/s
17. Jun	19:00	1.5 m/s	4.1 m/s
17. Jun	20:00	1.3 m/s	4.1 m/s
17. Jun	21:00	1.5 m/s	3.7 m/s
17. Jun	22:00	1.6 m/s	3.5 m/s
17. Jun	23:00	1.3 m/s	3.1 m/s
18. Jun	0:00	1.6 m/s	3.1 m/s
18. Jun	1:00	1.3 m/s	2.5 m/s
18. Jun	2:00	0.4 m/s	2.7 m/s
18. Jun	3:00	1.7 m/s	3.4 m/s
18. Jun	4:00	0.0 m/s	2.9 m/s
18. Jun	5:00	0.0 m/s	0.3 m/s
18. Jun	6:00	0.0 m/s	1.3 m/s
18. Jun	7:00	0.0 m/s	1.2 m/s
18. Jun	8:00	1.2 m/s	2.0 m/s
18. Jun	9:00	1.0 m/s	2.1 m/s
18. Jun	10:00	0.8 m/s	2.1 m/s
18. Jun	11:00	1.7 m/s	4.6 m/s
18. Jun	12:00	2.2 m/s	5.5 m/s
18. Jun	13:00	1.9 m/s	4.0 m/s
18. Jun	14:00	1.4 m/s	4.9 m/s
18. Jun	15:00	1.6 m/s	4.3 m/s
18. Jun	16:00	2.5 m/s	5.1 m/s
18. Jun	17:00	2.3 m/s	5.3 m/s
18. Jun	18:00	1.6 m/s	4.6 m/s
18. Jun	19:00	1.0 m/s	3.5 m/s
18. Jun	20:00	1.1 m/s	2.6 m/s
18. Jun	21:00	1.6 m/s	5.2 m/s
18. Jun	22:00	1.7 m/s	4.6 m/s
18. Jun	23:00	1.9 m/s	6.8 m/s
19. Jun	0:00	1.6 m/s	5.1 m/s
19. Jun	1:00	1.2 m/s	5.7 m/s
19. Jun	2:00	0.7 m/s	2.7 m/s
19. Jun	3:00	0.6 m/s	2.8 m/s
19. Jun	4:00	0.4 m/s	2.7 m/s
19. Jun	5:00	0.0 m/s	1.7 m/s
19. Jun	6:00	0.0 m/s	1.5 m/s
19. Jun	7:00	0.7 m/s	1.5 m/s
19. Jun	8:00	0.6 m/s	1.3 m/s
19. Jun	9:00	1.6 m/s	2.8 m/s
19. Jun	10:00	1.3 m/s	3.3 m/s
19. Jun	11:00	1.3 m/s	3.2 m/s
19. Jun	12:00	1.3 m/s	3.2 m/s
19. Jun	13:00	1.2 m/s	4.2 m/s
19. Jun	14:00	0.6 m/s	2.7 m/s
19. Jun	15:00	0.9 m/s	3.2 m/s
19. Jun	16:00	1.2 m/s	3.4 m/s
19. Jun	17:00	1.1 m/s	3.1 m/s
19. Jun	18:00	0.9 m/s	3.2 m/s
19. Jun	19:00	1.2 m/s	3.9 m/s
19. Jun	20:00	0.8 m/s	3.6 m/s
19. Jun	21:00	0.9 m/s	2.9 m/s
19. Jun	22:00	1.0 m/s	3.5 m/s
19. Jun	23:00	1.8 m/s	3.8 m/s

Date	Time	Machakos Mukukuni (No. 167) Hourly Mean	Machakos Mukukuni (No. 167) Hourly Maximum
3. Jun	0:00	3.0 m/s	4.8 m/s
3. Jun	1:00	2.2 m/s	4.5 m/s
3. Jun	2:00	3.4 m/s	3.9 m/s
3. Jun	3:00	2.2 m/s	3.7 m/s
3. Jun	4:00	2.0 m/s	3.3 m/s
3. Jun	5:00	2.8 m/s	4.4 m/s
3. Jun	6:00	1.7 m/s	3.1 m/s
3. Jun	7:00	0.6 m/s	1.7 m/s
3. Jun	8:00	0.9 m/s	1.8 m/s
3. Jun	9:00	1.7 m/s	3.4 m/s
3. Jun	10:00	0.9 m/s	3.6 m/s
3. Jun	11:00	2.2 m/s	5.2 m/s
3. Jun	12:00	2.3 m/s	7.2 m/s
3. Jun	13:00	1.6 m/s	7.1 m/s
3. Jun	14:00	2.1 m/s	5.5 m/s
3. Jun	15:00	2.4 m/s	6.6 m/s
3. Jun	16:00	2.1 m/s	7.1 m/s
3. Jun	17:00	2.3 m/s	6.3 m/s
3. Jun	18:00	2.9 m/s	6.9 m/s
3. Jun	19:00	2.5 m/s	5.5 m/s
3. Jun	20:00	2.0 m/s	5.6 m/s
3. Jun	21:00	2.6 m/s	4.3 m/s
3. Jun	22:00	2.1 m/s	5.1 m/s
3. Jun	23:00	2.5 m/s	5.6 m/s
4. Jun	0:00	3.1 m/s	6.1 m/s
4. Jun	1:00	3.0 m/s	5.8 m/s
4. Jun	2:00	2.4 m/s	4.4 m/s
4. Jun	3:00	2.6 m/s	5.0 m/s
4. Jun	4:00	2.2 m/s	4.6 m/s
4. Jun	5:00	2.1 m/s	4.4 m/s
4. Jun	6:00	1.8 m/s	2.9 m/s
4. Jun	7:00	0.4 m/s	1.6 m/s
4. Jun	8:00	2.6 m/s	3.6 m/s
4. Jun	9:00	2.0 m/s	4.8 m/s
4. Jun	10:00	0.9 m/s	4.3 m/s
4. Jun	11:00	2.9 m/s	6.1 m/s
4. Jun	12:00	2.7 m/s	7.1 m/s
4. Jun	13:00	2.8 m/s	7.7 m/s
4. Jun	14:00	3.6 m/s	7.5 m/s
4. Jun	15:00	3.6 m/s	7.8 m/s
4. Jun	16:00	3.5 m/s	7.4 m/s
4. Jun	17:00	2.6 m/s	7.1 m/s
4. Jun	18:00	3.1 m/s	7.3 m/s
4. Jun	19:00	2.3 m/s	5.8 m/s
4. Jun	20:00	3.0 m/s	5.3 m/s
4. Jun	21:00	3.5 m/s	6.8 m/s
4. Jun	22:00	4.7 m/s	10.4 m/s
4. Jun	23:00	4.1 m/s	9.8 m/s
5. Jun	0:00	3.8 m/s	7.6 m/s
5. Jun	1:00	4.4 m/s	10.6 m/s
5. Jun	2:00	4.0 m/s	9.2 m/s
5. Jun	3:00	3.8 m/s	7.5 m/s
5. Jun	4:00	3.0 m/s	6.4 m/s
5. Jun	5:00	3.6 m/s	7.4 m/s
5. Jun	6:00	2.4 m/s	5.8 m/s
5. Jun	7:00	0.0 m/s	0.5 m/s
5. Jun	8:00	0.3 m/s	1.2 m/s
5. Jun	9:00	0.4 m/s	2.4 m/s
5. Jun	10:00	1.6 m/s	3.8 m/s
5. Jun	11:00	1.2 m/s	2.8 m/s
5. Jun	12:00	3.2 m/s	5.7 m/s
5. Jun	13:00	2.6 m/s	6.1 m/s
5. Jun	14:00	3.2 m/s	7.8 m/s
5. Jun	15:00	2.7 m/s	7.8 m/s
5. Jun	16:00	2.7 m/s	7.6 m/s
5. Jun	17:00	2.4 m/s	6.3 m/s
5. Jun	18:00	2.3 m/s	6.5 m/s
5. Jun	19:00	1.4 m/s	4.0 m/s
5. Jun	20:00	0.5 m/s	1.7 m/s
5. Jun	21:00	2.5 m/s	3.9 m/s
5. Jun	22:00	2.6 m/s	4.1 m/s
5. Jun	23:00	2.2 m/s	3.8 m/s

Date	Time	Machakos Mbele wp (No. 172) Hourly Mean	Machakos Mbele wp (No. 172) Hourly Maximum
13. Jun	0:00	1.9 m/s	4.8 m/s
13. Jun	1:00	1.3 m/s	3.8 m/s
13. Jun	2:00	1.3 m/s	2.3 m/s
13. Jun	3:00	0.3 m/s	1.5 m/s
13. Jun	4:00	0.0 m/s	0.3 m/s
13. Jun	5:00	0.0 m/s	0.5 m/s
13. Jun	6:00	0.0 m/s	1.4 m/s
13. Jun	7:00	0.4 m/s	1.3 m/s
13. Jun	8:00	0.9 m/s	2.1 m/s
13. Jun	9:00	1.5 m/s	3.2 m/s
13. Jun	10:00	1.6 m/s	3.8 m/s
13. Jun	11:00	2.1 m/s	4.2 m/s
13. Jun	12:00	1.9 m/s	6.1 m/s
13. Jun	13:00	2.7 m/s	6.7 m/s
13. Jun	14:00	3.1 m/s	6.3 m/s
13. Jun	15:00	3.2 m/s	5.4 m/s
13. Jun	16:00	3.0 m/s	6.3 m/s
13. Jun	17:00	2.6 m/s	5.1 m/s
13. Jun	18:00	2.9 m/s	6.3 m/s
13. Jun	19:00	1.6 m/s	5.7 m/s
13. Jun	20:00	1.8 m/s	4.2 m/s
13. Jun	21:00	1.7 m/s	4.0 m/s
13. Jun	22:00	2.8 m/s	6.4 m/s
13. Jun	23:00	1.9 m/s	5.1 m/s
14. Jun	0:00	1.2 m/s	3.5 m/s
14. Jun	1:00	0.9 m/s	3.0 m/s
14. Jun	2:00	0.6 m/s	6.0 m/s
14. Jun	3:00	0.0 m/s	0.5 m/s
14. Jun	4:00	2.1 m/s	3.2 m/s
14. Jun	5:00	0.3 m/s	0.9 m/s
14. Jun	6:00	0.0 m/s	0.4 m/s
14. Jun	7:00	0.0 m/s	0.7 m/s
14. Jun	8:00	0.5 m/s	2.0 m/s
14. Jun	9:00	0.9 m/s	2.1 m/s
14. Jun	10:00	m/s	m/s
14. Jun	11:00	m/s	m/s
14. Jun	12:00	m/s	m/s
14. Jun	13:00	m/s	m/s
14. Jun	14:00	m/s	m/s
14. Jun	15:00	m/s	m/s
14. Jun	16:00	m/s	m/s
14. Jun	17:00	m/s	m/s
14. Jun	18:00	m/s	m/s
14. Jun	19:00	m/s	m/s
14. Jun	20:00	m/s	m/s
14. Jun	21:00	m/s	m/s
14. Jun	22:00	m/s	m/s
14. Jun	23:00	m/s	m/s

Date	Time	Machakos Iyuni (No. 199) Hourly Mean	Machakos Iyuni (No. 199) Hourly Maximum
20. Jun	0:00	1.2 m/s	4.1 m/s
20. Jun	1:00	1.1 m/s	4.1 m/s
20. Jun	2:00	0.3 m/s	2.7 m/s
20. Jun	3:00	0.6 m/s	1.9 m/s
20. Jun	4:00	0.0 m/s	1.7 m/s
20. Jun	5:00	0.3 m/s	1.4 m/s
20. Jun	6:00	0.0 m/s	2.3 m/s
20. Jun	7:00	0.7 m/s	1.6 m/s
20. Jun	8:00	0.8 m/s	1.9 m/s
20. Jun	9:00	0.6 m/s	2.3 m/s
20. Jun	10:00	0.9 m/s	2.2 m/s
20. Jun	11:00	0.9 m/s	2.8 m/s
20. Jun	12:00	0.9 m/s	2.7 m/s
20. Jun	13:00	1.2 m/s	2.7 m/s
20. Jun	14:00	1.5 m/s	5.4 m/s
20. Jun	15:00	1.2 m/s	3.4 m/s
20. Jun	16:00	0.9 m/s	2.9 m/s
20. Jun	17:00	1.1 m/s	3.7 m/s
20. Jun	18:00	1.0 m/s	2.8 m/s
20. Jun	19:00	1.0 m/s	2.6 m/s
20. Jun	20:00	0.9 m/s	3.1 m/s
20. Jun	21:00	1.1 m/s	2.8 m/s
20. Jun	22:00	1.0 m/s	3.6 m/s
20. Jun	23:00	1.6 m/s	4.1 m/s
21. Jun	0:00	1.7 m/s	5.4 m/s
21. Jun	1:00	0.8 m/s	5.7 m/s
21. Jun	2:00	0.7 m/s	1.9 m/s
21. Jun	3:00	0.5 m/s	2.3 m/s
21. Jun	4:00	0.7 m/s	1.9 m/s
21. Jun	5:00	0.0 m/s	1.7 m/s
21. Jun	6:00	1.2 m/s	1.9 m/s
21. Jun	7:00	0.3 m/s	1.2 m/s
21. Jun	8:00	1.4 m/s	3.5 m/s
21. Jun	9:00	1.3 m/s	3.4 m/s
21. Jun	10:00	1.1 m/s	2.9 m/s
21. Jun	11:00	2.4 m/s	4.4 m/s
21. Jun	12:00	1.0 m/s	5.6 m/s
21. Jun	13:00	m/s	m/s
21. Jun	14:00	m/s	m/s
21. Jun	15:00	m/s	m/s
21. Jun	16:00	m/s	m/s
21. Jun	17:00	m/s	m/s
21. Jun	18:00	m/s	m/s
21. Jun	19:00	m/s	m/s
21. Jun	20:00	m/s	m/s
21. Jun	21:00	m/s	m/s
21. Jun	22:00	m/s	m/s
21. Jun	23:00	m/s	m/s

Date	Time	Machakos Mukukuni (No. 167) Hourly Mean	Machakos Mukukuni (No. 167) Hourly Maximum
6. Jun	0:00	2.0 m/s	3.5 m/s
6. Jun	1:00	1.9 m/s	3.1 m/s
6. Jun	2:00	2.4 m/s	3.9 m/s
6. Jun	3:00	2.0 m/s	3.4 m/s
6. Jun	4:00	1.9 m/s	3.0 m/s
6. Jun	5:00	2.1 m/s	4.2 m/s
6. Jun	6:00	1.1 m/s	3.4 m/s
6. Jun	7:00	1.1 m/s	0.7 m/s
6. Jun	8:00	1.5 m/s	0.5 m/s
6. Jun	9:00	2.1 m/s	4.3 m/s
6. Jun	10:00	2.1 m/s	4.1 m/s
6. Jun	11:00	1.7 m/s	3.8 m/s
6. Jun	12:00	1.3 m/s	6.1 m/s
6. Jun	13:00	2.8 m/s	7.5 m/s
6. Jun	14:00	2.8 m/s	8.4 m/s
6. Jun	15:00	3.2 m/s	8.1 m/s
6. Jun	16:00	3.7 m/s	9.5 m/s
6. Jun	17:00	3.4 m/s	8.6 m/s
6. Jun	18:00	3.1 m/s	8.1 m/s
6. Jun	19:00	4.3 m/s	8.5 m/s
6. Jun	20:00	4.0 m/s	7.8 m/s
6. Jun	21:00	3.2 m/s	7.1 m/s
6. Jun	22:00	3.8 m/s	8.8 m/s
6. Jun	23:00	3.1 m/s	7.2 m/s
7. Jun	0:00	4.0 m/s	8.9 m/s
7. Jun	1:00	3.8 m/s	8.2 m/s
7. Jun	2:00	3.0 m/s	6.9 m/s
7. Jun	3:00	3.1 m/s	7.2 m/s
7. Jun	4:00	3.6 m/s	8.4 m/s
7. Jun	5:00	2.8 m/s	6.8 m/s
7. Jun	6:00	2.1 m/s	4.3 m/s
7. Jun	7:00	0.4 m/s	1.5 m/s
7. Jun	8:00	0.7 m/s	2.4 m/s
7. Jun	9:00	1.0 m/s	1.9 m/s
7. Jun	10:00	m/s	m/s
7. Jun	11:00	m/s	m/s
7. Jun	12:00	m/s	m/s
7. Jun	13:00	m/s	m/s
7. Jun	14:00	m/s	m/s
7. Jun	15:00	m/s	m/s
7. Jun	16:00	m/s	m/s
7. Jun	17:00	m/s	m/s
7. Jun	18:00	m/s	m/s
7. Jun	19:00	m/s	m/s
7. Jun	20:00	m/s	m/s
7. Jun	21:00	m/s	m/s
7. Jun	22:00	m/s	m/s
7. Jun	23:00	m/s	m/s

Date	Time	Machakos Mbele wp (No. 172) Hourly Mean	Machakos Mbele wp (No. 172) Hourly Maximum

Date	Time	Machakos Iyuni (No. 199) Hourly Mean	Machakos Iyuni (No. 199) Hourly Maximum

Date: 2004/6/26 Time: 12:00 ~ 13:00

Mwingi					
Ndathani (No. 85)					
1 min	3.2	m/s	31 min	1.1	m/s
2 min	4.4	m/s	32 min	2.0	m/s
3 min	3.6	m/s	33 min	2.5	m/s
4 min	3.5	m/s	34 min	2.2	m/s
5 min	4.4	m/s	35 min	2.2	m/s
6 min	4.5	m/s	36 min	2.0	m/s
7 min	3.6	m/s	37 min	1.7	m/s
8 min	5.2	m/s	38 min	4.9	m/s
9 min	6.4	m/s	39 min	2.3	m/s
10 min	3.7	m/s	40 min	1.5	m/s
11 min	5.7	m/s	41 min	3.4	m/s
12 min	3.1	m/s	42 min	3.2	m/s
13 min	2.0	m/s	43 min	4.1	m/s
14 min	3.5	m/s	44 min	5.2	m/s
15 min	2.4	m/s	45 min	3.4	m/s
16 min	2.1	m/s	46 min	3.1	m/s
17 min	2.8	m/s	47 min	3.2	m/s
18 min	1.8	m/s	48 min	0.7	m/s
19 min	2.4	m/s	49 min	3.6	m/s
20 min	1.6	m/s	50 min	3.8	m/s
21 min	2.5	m/s	51 min	2.3	m/s
22 min	1.0	m/s	52 min	2.8	m/s
23 min	2.6	m/s	53 min	3.2	m/s
24 min	5.8	m/s	54 min	1.5	m/s
25 min	2.6	m/s	55 min	0.9	m/s
26 min	4.4	m/s	56 min	1.6	m/s
27 min	1.0	m/s	57 min	4.0	m/s
28 min	1.6	m/s	58 min	2.9	m/s
29 min	3.5	m/s	59 min	2.0	m/s
30 min	2.4	m/s	60 min	2.7	m/s

Date: 2004/6/26 Time: 10:00 ~ 11:00

Kitui					
Kakumuti (No. 42)					
1 min	3.8	m/s	31 min	3.8	m/s
2 min	2.8	m/s	32 min	6.1	m/s
3 min	2.9	m/s	33 min	4.2	m/s
4 min	4.1	m/s	34 min	4.7	m/s
5 min	3.5	m/s	35 min	5.2	m/s
6 min	4.7	m/s	36 min	4.5	m/s
7 min	6.0	m/s	37 min	3.5	m/s
8 min	4.1	m/s	38 min	4.3	m/s
9 min	4.0	m/s	39 min	3.6	m/s
10 min	5.1	m/s	40 min	2.6	m/s
11 min	3.4	m/s	41 min	4.1	m/s
12 min	3.7	m/s	42 min	3.9	m/s
13 min	3.4	m/s	43 min	3.8	m/s
14 min	5.9	m/s	44 min	2.9	m/s
15 min	3.8	m/s	45 min	3.2	m/s
16 min	3.1	m/s	46 min	2.6	m/s
17 min	3.5	m/s	47 min	2.5	m/s
18 min	3.2	m/s	48 min	4.6	m/s
19 min	2.6	m/s	49 min	5.1	m/s
20 min	3.1	m/s	50 min	6.0	m/s
21 min	4.4	m/s	51 min	4.5	m/s
22 min	4.7	m/s	52 min	5.2	m/s
23 min	4.3	m/s	53 min	6.4	m/s
24 min	4.3	m/s	54 min	3.5	m/s
25 min	4.5	m/s	55 min	5.3	m/s
26 min	4.7	m/s	56 min	7.3	m/s
27 min	4.3	m/s	57 min	6.1	m/s
28 min	4.3	m/s	58 min	5.4	m/s
29 min	4.6	m/s	59 min	5.1	m/s
30 min	4.2	m/s	60 min	5.5	m/s

8.9
Water fee as a result of Social survey

Water fee as a result of Social Survey

1. Willingness to pay

Almost 100% of sample households in larger Machakos district and 96% in larger Makueni expressed their willingness to pay for use of newly-constructed water supply system. Furthermore, almost all respondents revealed their willingness to establish water users association (WUA) and participate in WUA.

Table-1 shows the amount of willingness to pay for water of 20L in jerrycan by classified water fee ranges. The range of 1-2Ksh/20L in both larger districts is the most popular. Second popular range is 2-3Ksh/20L in larger Machakos district and less than 1Ksh/20L in larger Makueni. There are no respondents who are willing to pay more than 4Ksh/20L. Average amount of willingness to pay are 2.2Ksh/20L in larger Machakos district and 1.7Ksh/20L in larger Makueni as described in the following **Table-2**.

Table-1 Response to willingness to pay

(unit: households)

Water fee per jerry can	Larger Machakos	Larger Makueni	Total
Less than 1Ksh/20L	5	21	26
1-2Ksh/20L	64	57	121
2-3Ksh/20L	25	3	28
3-4Ksh/20L	2	0	2
More than 4Ksh/20L	0	0	0

Table-2 Average amount of willingness to pay

(unit: Ksh/20L)

Larger District	Implementation Review Study (2009)	Basic Design Study (2004)
Machakos	2.2	2.4
Makueni	1.7	

2. Ability to Pay

Ability to pay can be determined by assessing the monthly income per capita. **Table-3** shows the monthly expenditure and income per capita in larger Machakos and larger Makueni

districts.

Table-3 Monthly expenditure and income per capita

(Unit: Ksh/person/month)

Larger District	Basic Design Study (2004)		Implementation Review Study (2009)	
	Expenditure	Income	Expenditure	Income
Machakos	790	995	812	1,023
Makueni	524	809	393	607

The expenditure and income in larger Makueni district in 2009 are smaller than those of basic design study in 2004, because total rainfall in 2009 was 370mm which were 55% of rainfall in 2004 and it was the most serious drought season since year of 2007. Then, the drought resulted in reduction of agricultural income. Although larger Makueni district is adjacent to larger Machakos, larger Makueni is more sensitive to drought and the expenditure and income are easily affected.

In the basic design study, it is said that water fee is around 4% of income per household. Taking advantage of this view, amount of ability to pay for water is calculated as the following **Table-4**.

Table-4 Amount of ability to pay for water

Larger Distict	4% of income (Ksh/month)	Unit water consumption rate (L/capita/month)	Amount of ability to pay (Ksh/20L)	
			Implementation Review Study (2009)	Basic Design Study (2004)
Machakos	40.9	450	1.8	1.8
Makueni	24.3		1.1	1.4

3. Water Fee

The amount of ability to pay for water in 2009 (1.8Ksh/20L in larger Machakos and 1.1 Ksh/20L in larger Makueni) is almost the same as basic design study in 2004 (1.8Ksh/20L in larger Machakos and 1.4 Ksh/20L in larger Makueni) as described in **Table-4**. However, the amount of willingness to pay for water in 2009 (2.2Ksh/20L in larger Machakos and 1.7Ksh/20L in larger Makueni) was smaller than that of in 2004 (2.4Ksh/20L) as described in **Table-2**. It is considered that the reason is that the respondent showed the realistic willingness

to pay for receiving the safe and stable water supply services. Further, the monthly income per capita in normal season is estimated more than the amount in **Table-3** in consideration of serious drought impact in 2009.

Based on the above consideration, it is desirable that the average between amounts of willingness and ability to pay is adopted as water fees. Desirable water fees are presented in the following **Table-5**.

Table-5 Water fee

(unit: Ksh/20L)

Larger District	Willingness to pay	Ability to pay	Desirable water fee
Machakos	2.2	1.8	2.0
Makueni	1.7	1.1	1.4

8.10
Hydro-geological Data of Target Communities

Hydro-geological data of the Target Communities

Power type; G: Submergible pump by Generator, W: Windmill pump, H: Handpump, S: Submergible pump by Solar, E: Sumbersible pump by electrical wire

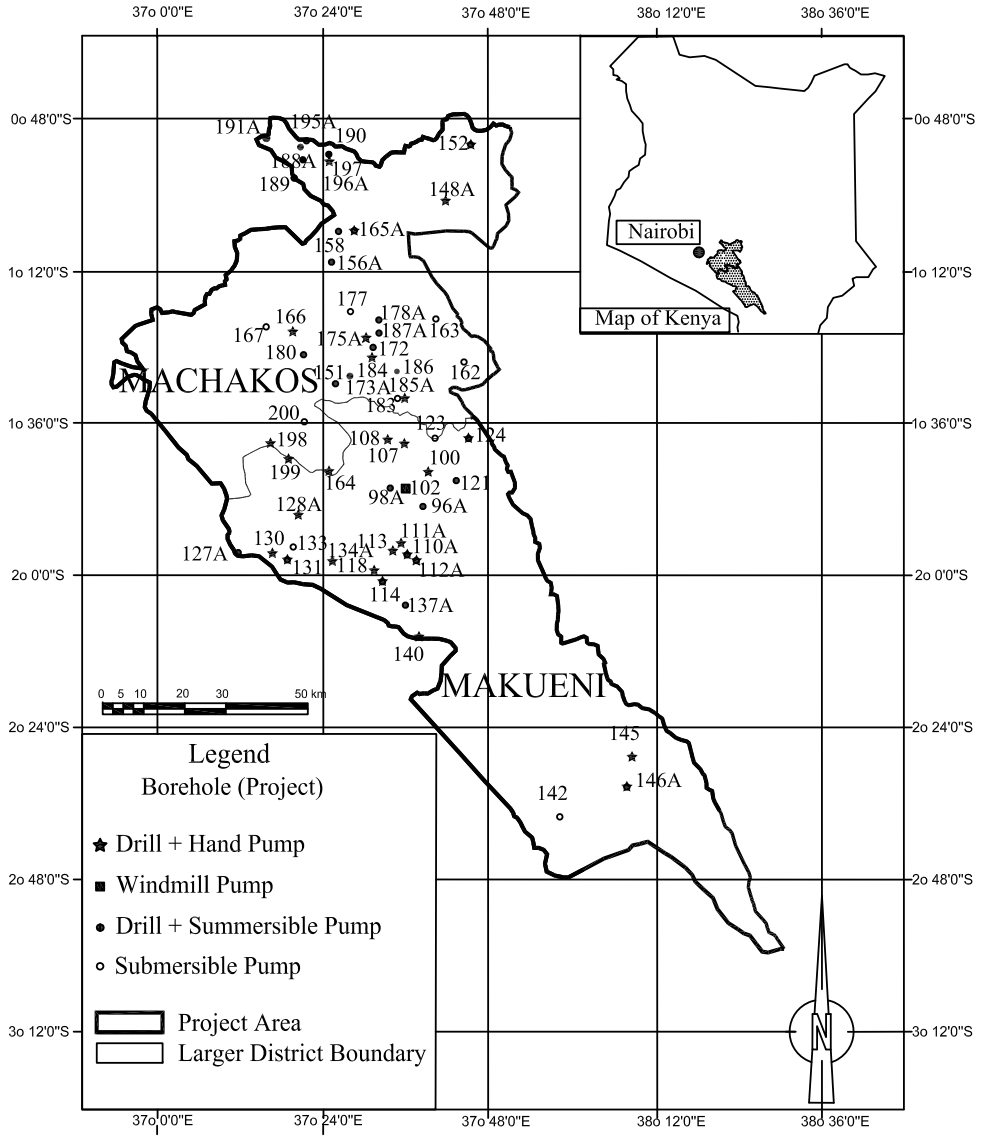
Larger District	S. No.	District	Division	Location	Sub-location	Community name	Coordination		Estimated Well data					Stautus	Power Type
							Latitude	Longitude	Well depth (m)	SWL (GL -m)	Draw Down: Δ(m)	Aquifer (GL -m)	Quantity (m3/h)		
Makueni	96A	Makueni	Wote	Kikumini	Kambimawe	Muambani	S1°48'33.5"	E37°39'43.8"	100.00	20.00	1.50	80.00	5.00		G
	98A	Makueni	Wote	Muvau	Kitonyoni	Kyuswani	S1°54'44.4"	E37°38'57.6"	100.00	20.00	9.30	80.00	3.00		G
	100	Makueni	Wote	Kako	Kako	Kyaume	S1°43'05.6"	E37°39'51.6"	110.00	20.00	5.70	100.00	1.50		H
	102	Makueni	Kaiti	Ukea	Kilala	Kithunzi	S1°45'50.4"	E37°33'25.1"	155.00	5.00	132.32	8-14, 35-38, 62-65, 74-77, 89-95, 107-113, 122-128, 137-143, 149-152	2.70	Secured	W
	107	Mbooni east	Kisau	Waia	Usalala	Kyang'ondu Primary	S1°37'54.2"	E37°35'31.9"	100.00	20.00	1.50	80.00	0.30		H
	108	Mbooni east	Kisau	Kisau	Usalala	Kisau Health Centre	S1°37'52.9"	E37°33'46.9"	100.00	20.00	1.50	80.00	0.30		H
	110A	Nzaui	Matiliku	Kilili	Wee	Kanzili	S1°55'36.9"	E37°35'36.2"	100.00	40.00	8.60	80.00	4.00		H
	111A	Nzaui	Matiliku	Kilili	Kilili	Syaolwe	S1°53'44.9"	E37°35'16.2"	100.00	40.00	8.60	80.00	4.00		H
	112A	Nzaui	Matiliku	Kilili	Mulenyu	Loyal turban	S1°57'12.7"	E37°37'48.4"	100.00	40.00	6.70	80.00	2.00		H
	113	Nzaui	Matiliko	Kilili	Mulenyu	Mboani	S1°55'16.1"	E37°34'42.7"	100.00	40.00	8.60	80.00	4.00		H
	114	Nzaui	Mbitini	Mulala	Ng'ethe	Kitandi	S1°58'19.8"	E37°31'06.9"	100.00	40.00	4.50	80.00	1.00		H
	118	Nzaui	Kalamba	Kithumba	Kithumba	Mathanguni	S1°55'01.0"	E37°30'14.4"	100.00	40.00	4.50	80.00	1.00		H
	121	Mbooni east	Kalawa	Katengine	Ititu	Ititu	S1°44'22.5"	E37°43'35.3"	100.00	9.15	3.93	22-34, 40-58, 70-82, 88-94	15.00	Secured	S
	123	Mbooni east	Kalawa	Kawala	Mbukoni	Ngunini	S1°37'34.0"	E37°40'17.6"	87.00	51.30	13.90	67.00	1.70	Secured	S
	124	Mbooni east	Kalawa	Athi	Miangeni	Kyamutuku	S1°37'32.9"	E37°44'56.2"	100.00	20.00	5.70	80.00	1.50		H
	127A	Mukaa	Malili	Ngaamba	Itumbule	Kalembwani (Uvunye)	S1°55'54.8"	E37°11'18.1"	100.00	40.00	8.30	80.00	2.50		G
	128A	Mukaa	Kilome	Mukaa	Mukaa	Enzae-Maiani	S1°50'16.7"	E37°19'13.2"	100.00	40.00	4.50	80.00	1.00		H
	130	Mukaa	Kiou	Kwalee	Kwalee	Ndivo	S1°58'10.7"	E37°16'27.7"	100.00	40.00	6.70	80.00	2.00		H
	131	Mukaa	Kiou	Kiou	Lumu	Lumu	S1°57'29.3"	E37°20'49.1"	100.00	40.00	4.50	80.00	1.00		H
	133	Mukaa	Kasikeu	Kasikeu	Wathini	Mangala	S1°54'59.6"	E37°19'58.7"	120.00	16.28	31.72	42-54, 60-78, 96-102, 108-114	9.00	Secured	E
	134A	Mukaa	Kiou	Muani	Muani	Nguuni	S1°57'46.9"	E37°24'20.2"	100.00	40.00	4.50	80.00	1.00		H
	137A	Nzaui	Nguu	Kikulumi	Ndunguni	Mbulutini	S2°06'08.7"	E37°35'19.3"	100.00	40.00	6.10	80.00	5.00		G
	140	Nzaui	Nguu	Wolma	Wolma	Ilingoni	S2°09'22.9"	E37°37'10.3"	130.00	35.00	9.30	110.00	3.00		H
	142	Kibwezi	Mtito Adei	Nthunguni	Nthingumi	Utu	S2°36'43.5"	E37°58'12.7"	84.00	31.36	20.84	48.00	1.70	Secured	S
	145	Kibwezi	Mtito Adei	Ngawate	Mukange	Yongoni	S2°27'45.4"	E38°08'29.2"	100.00	30.00	8.30	80.00	2.50		H
	146A	Kibwezi	Mtito Andei	Kambu	Kitengei	Kietengei/Nguuswini	S2°32'50.1"	E38°09'01.6"	100.00	25.00	8.30	80.00	2.50		H

Hydro-geological data of the Target Communities

Power type; G: Submergible pump by Generator, W: Windmill pump, H: Handpump, S: Submergible pump by Solar, E: Sumbersible pump by electrical wire

Larger District	S. No.	District	Division	Location	Sub-location	Community name	Coordination		Estimated Well data					Stautus	Power Type
							Latitude	Longitude	Well depth (m)	SWL (GL -m)	Draw Down: Δ(m)	Aquifer (GL -m)	Quantity (m3/h)		
Machakos	148A	Masinga	Masinga	Kangonde	Kangonde	Kangonde-Kyaani	S1°4'7.6"	E37°38'56.1"	150.00	25.00	6.10	130.00	5.00		H
	151	Masinga	Masinga	Kivaa	Kivaa	Kamunyu Primary School	S0°50'36.4"	E37°44'33.5"	54.00	11.75	26.46	21-36, 42-48	4.50	Secured	G
	152	Masinga	Masinga	Kivaa	Iiani	City Cotton Village	S0°50'32.9"	E37°45'36.8"	130.00	25.00	8.30	110.00	2.50		H
	156A	Yatta	Yatta	Kithimani	Kithimani	Kithayoni (Kwakoko Pri. Sch)	S1°10'06.4"	E37°26'16.4"	130.00	24.00	8.60	110.00	4.00		G
	158	Yatta	Yatta	Mavoloni	Kisiiki	Mavoloni-Kisiiiki	S1°4'46.8"	E37°26'52.0"	60.00	4.70	31.01	9-24, 45-51	4.66	Secured	G
	162	Yatta	Katangi	Kyua	Kyua	Kikeneani	S1°25'58.2"	E37°45'18.2"	140.00	44.60	40.47	44-71, 113-136	1.10	Secured	S
	163	Yatta	Katangi	Kyua	Syo Kisinga	Matinga	S1°26'42.2"	E37°42'04.1"	137.00	81.48	24.42	116-134	10.90	Secured	G
	164	Yatta	Katangi	Kyua	Kyua	Itithini Primary School	S1°28'08.5"	E37°43'59.1"	100.00	20.00	2.40	80	0.50		H
	165A	Yatta	Yatta	Ndalani	Ndalani	Ndalani (Sec. School)	S1°5'56.1"	E37°29'10.9"	145.00	20.00	4.50	125	1.00		H
	166	Kathiani	Kathiani	Mitaboni	Miumbuni	Miwani	S1°20'58.2"	E37°16'18.1"	185.00	12.00	6.70	165	2.00		H
	167	Kathiani	Kathiani	Mitaboni	Kinyau	Mukukuni	S1°20'11.8"	E37°16'30.8"	110.00	20.15	13.57	86-107	2.00	Secured	G
	172	Mwala	Mwala	Uvaini	Embui	Mumbuni	S1°23'28.4"	E37°31'33.4"	92.00	4.40	46.35	8-20, 32-50, 62-74, 80-86	18.00	Secured	G
	173A	Machakos	Mwala	Kathama	Katitu	Kalama	S1°12'10"	E37°21'50"	100.00	35.00	6.70	80	2.00		G
	175A	Mwala	Masii	Mango	Wetaa	Kwakamelo	S1°23'23"	E37°25'53"	130.00	30.00	4.50	110	1.00		H
	177	Mwala	Mwala	Mwala	Myanyani	Kwendana S/H/Group	S1°13'52.2"	E37°23'04.0"	38.00	4.95	11.55	26-35	5.00	Secured	G
	178A	Machakos	Mwala	Kyawango	Kyawango	Misuuni	S1°20'44"	E37°30'19"	100.00	35.00	9.30	80.00	3.00		G
	180	Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyandu(Meka)	S1°24'32.0"	E37°20'27.7"	100.00	6.40	17.59	34-58, 64-82, 88-94	14.40	Secured	G
	183	Mwala	Yathui	Miu	Makuhimo	Miu Sec School	S1°31'29.0"	E37°34'51.5"	127.80	38.10	50.46	100.00	7.20	Secured	G
	184	Mwala	Yathui	Yathui	Kyamatula	Kikaso	S1°30'35.7"	E37°35'04.6"	100.00	35.00	4.50	80.00	0.80		H
	185A	Mwala	Yathui	Miu	Kikulumi	Kikulumi	S1°31'38.0"	E37°35'12.1"	100.00	35.00	8.30	80.00	2.20		H
	186	Mwala	Yathui	Miu	Kyawikyo	Nzeveni	S1°28'30.2"	E37°33'47.8"	120.00	7.30	73.48	12-24, 36-45, 54-60, 66-75, 84-93, 102-111, 114-117	2.00	Secured	G
	187A	Mwala	Yathui	Wamunyu	Kilembwa	Mikameni	S1°20'30"	E37°33'02"	100.00	35.00	8.30	80.00	2.20		G
	188A	Masinga	Ndithine	Muthesya	Kikule	Muambani	S0°57'58.2"	E37°25'46.5"	100.00	20.00	8.30	80.00	2.20		G
	189	Masinga	Ndithine	Ndithini	Ndithini	Ndithini Sec School	S0°56'39.1"	E37°20'03.5"	92.00	11.10	25.71	23-47, 71-77	3.60	Secured	E
	190	Masinga	Ndithine	Mananja	Mananja	Tana ranch	S0°51'24.3"	E37°21'47.5"	130.00	20.00	8.30	110.00	2.20		H
	191A	Masinga	Ndithini	Mananja	Mananja	Kyaume	S0°51'06.2"	E37°17'17.7"	100.00	20.00	9.30	80.00	3.00		G
	195A	Machakos	Ndithini	Mananja	Mananja	Ndela	S0°51'47"	E37°17'51"	100.00	20.00	9.30	80.00	3.00		G
	196A	Masinga	Ndithini	Ndithini	Milaani	Milaani-Ngweye	S0°52'44.7"	S37°23'05.3"	120.00	20.00	9.30	100.00	3.00		H
	197	Masinga	Ndithini	Ndithini	Milaani	Militani	S0°52'47.7"	E37°24'35.8"	60.00	6.85	26.88	9-15, 21-36, 54-57	6.70	Secured	G
	198	Machakos	Kalama	Kombo	Muumandu	Kavete	S1°40'45.2"	E37°16'42.3"	130.00	20.00	2.00	110.00	0.40		H
	199	Machakos	Kalama	Kola	Iiyuni	Iyuni	S1°41'04.8"	E37°19'55.8"	110.00	20.00	2.40	90.00	0.50		H
	200	Machakos	Central	Kalama	Nziuni	Kyamutheke	S1°32'08.5"	E37°10'12.6"	150.00	44.68	46.02	100.00	0.60	Secured	S

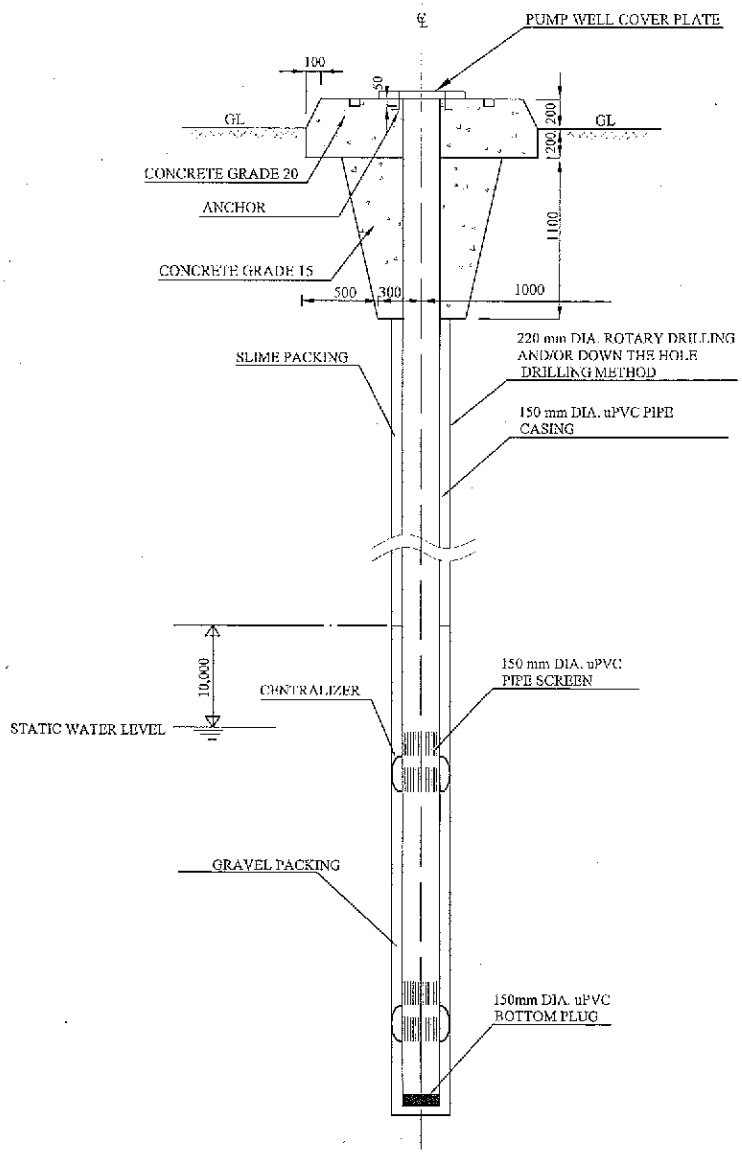
8.11
Outline Design Drawings



Major Information on Target Site

No.	Administrative Information						Provisional Coordinate (WGS 84)	
	Larger District	Particular District	Division	Location	Sub-location	Village (Community)	S	E
96A	(Unknown)	Mbooni	Wote	Kalumuni	Kimbumwe	Muambani	1°48'33.5"	37°39'43.8"
98A				Muvau	Muvau	Nguumo	1°53'58"	37°39'09"
100				Kako	Kako	Kyaume	1°43'05.6"	37°39'51.6"
102			Kathonzweni	Ukia	Kikila	Kithunzi	1°45'50.4"	37°33'25.1"
107		Mbooni East	Kisau	Wasi	Usalala	Kyang'oudi Primary	1°37'54.2"	37°35'31.9"
108				Kisau	Usalala	Kisau Health Centre	1°37'52.9"	37°33'46.9"
110A		Nzaui	Matuliku	Kiili	Wee	Kanzili	1°55'36.9"	37°35'36.2"
111A					Kiili	Syaoiwe	1°53'44.9"	37°35'16.2"
112A					Mulenyu	Loyal turbata	1°57'12.7"	37°37'48.4"
113						Mboani	1°55'16.1"	37°34'42.7"
114			Mutuu	Mukila	Ng'ethe	Kitandi	1°58'19.8"	37°31'06.9"
116			Kalamba	Kithumba	Kithumba	Mathangusu	1°58'04.7"	37°31'06.5"
121		Mbooni East	Kalawa	Katengane	Itutu	Itutu	1°44'22.5"	37°43'35.3"
123				Kawala	Mbukoni	Ngununi	1°37'34.0"	37°40'17.6"
124				Athi	Mangeni	Kyamutuku	1°37'32.9"	37°44'56.2"
127A		Makueni	Makili	Kiima-Kiu	Ngaamba	Kwekolya	1°54'10.9"	37°10'02.6"
128A			Kilome	Mukaa	Mukaa	Enzae-Muunu	1°50'16.7"	37°19'13.2"
130			Kiou	Kwale	Kwale	Kiou	1°57'25"	37°15'35"
131				Kiou	Sultan Hamed	Kiou Village	1°59'37.4"	37°19'45.1"
133			Kasikeu	Kasikeu	Wathini	Mangala	1°54'59.6"	37°19'58.7"
134A			Kiu	Muani	Muani	Nguuni	1°57'46.9"	37°24'20.2"
137A		Nzaui	Nguu	Ngui	Ilungu	Muangeni	2°0'437.7"	37°36'09.1"
140				Wdwa	Wdwa	Mbukani	2°0'921.4"	37°38'15.3"
142		Kibwezi	Mtito Andei	Nthungumi	Nthungumi	Utu	2°36'43.5"	37°58'12.7"
145				Ngnata	Mukange	Katulie S.Help Group	2°28'26.6"	38°09'24.3"
146A				Kambu	Kitengei	Kitengei	2°32'50.1"	38°09'01.6"
148A	(Unknown)	Makueni	Kibwezi	Kangonde	Kangonde	Kangonde-Ilyuuni	1°9'407.6"	37°38'56.1"
151				Kivaa	Kivaa	Kanuyu Pry. School	0°50'36.4"	37°44'33.5"
152						City Council	0°50'32.9"	37°45'36.8"
156A		Kilungu	Yatta	Kithimani	Kithimani	Nguumo	0°10'22.6"	37°25'32.9"
158				Mavoloni	Kisiki	Mavoloni-Kyumbi	1°9'446.8"	37°26'52.0"
162			Katangi	Kyua	Kyua	Kikeneani	1°25'58.2"	37°49'18.2"
163					Nyokisini a	Matinga	1°26'42.2"	37°42'04.1"
164					Kyua	Ituluni Pri. School	1°28'08.5"	37°43'59.1"
165A			Yatta	Ndalani	Ndalani	Ndalani (Sec. School)	1°9'56.1"	37°29'10.9"
166		Kathiani	Kathiani	Mitaboni	Mumbuni	Mawau	1°20'58.2"	37°16'18.1"
167		Kangundo	Kakuyuni	Kawethei	Kathaana	Mukukuni	1°20'11.8"	37°16'30.8"
172		Mwala	Masii	Masii	Ikibui	Mbele	1°23'29.6"	37°31'33.2"
173A			Mwala	Masii	Mbaani	Kathama	1°1'210.6"	37°22'38.8"
175A			Masii	Mango	Vetaa	Mango Sec. School	1°23'38.9"	37°25'26.5"
177			Mwala	Mwala	Myanyaru	Kwendana Shg	1°13'52.2"	37°23'04.0"
178A				Kyavango	Kyavango	Kyavango	1°18'58.7"	37°29'10.1"
180		Kangundo	Kakuyuni	Kakuyuni	Kyevaluki	Kyamuanyani (Alala)	1°24'23.9"	37°20'40.9"
183		Mwala	Mwala	Miu	Makuhimo	Miu Sec. School	1°31'29.0"	37°34'51.5"
184			Yathui	Yathui	Wamunyu	Munyuni	1°30'25.9"	37°35'12.4"
185A				Miu	Ikikuumi	Kikuhuni	1°31'38.0"	37°35'12.1"
186				Yathui	Kyamatu	Lenu Girls Sec. School	1°27'23.7"	37°34'36.5"
187A				Wamunyu	Kilembwa	Kalembwa	1°20'31.9"	37°32'03.0"
188A		Mwingi	Ndithini	Mutheya	Ikikule	Muambani	0°57'58.2"	37°29'46.5"
189				Ndithini	Ndithini	Ndithini Sec. School	0°56'39.1"	37°20'03.5"
190			Ndithini	Mutheya	Mutheya	Munyiiki	0°58'33.7"	37°22'49.6"
191A			Nthini	Mananja	Mananja	Mananja-Ndala	0°51'02.6"	37°17'17.3"
195A						Chayu wa Ndala	0°51'30.5"	37°16'38.2"
196A				Ndithini	Milaani	Milaani-Ngeveta	0°52'44.7"	37°23'05.3"
197						Militaru	0°52'47.7"	37°24'35.8"
198		Machakos	Kalama	Kombo	Nzumandu	Kavete	1°40'45.2"	37°16'42.3"
199			Kalama	Kola	Ilyuni	Ilyuni	1°41'04.8"	37°19'55.8"
200			Central	Kathekakai	Kitanga	Kyemutheke	1°32'08.5"	37°10'12.6"

OWNER: THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	PROJECT NAME: THE PROJECT FOR RURAL WATER SUPPLY	CONSULTING ENGINEERS: NIPPON KOEI CO.,LTD.	TITLE: GENERAL LOCATION MAP	
			SCALE: NONE	DATE: OCT 2010
				DRAWING NO.: GE-001



STANDARD FIGURE OF BOREHOLE STRUCTURE

Boreholes to be drilled and installed

Serial No.	Well depth (m)	Water Supply Facilities
96A	90	Submersible Pump by Generator
98A	100	Submersible Pump by Generator
100	110	Hand Pump
107	55	Hand Pump
108	55	Hand Pump
110A	100	Hand Pump
111A	100	Hand Pump
112A	100	Hand Pump
113	110	Hand Pump
114	100	Hand Pump
118	90	Hand Pump
124	55	Hand Pump
127A	80	Submersible Pump by Generator
128A	100	Hand Pump
130	100	Hand Pump
131	70	Hand Pump
134A	100	Hand Pump
137A	110	Submersible Pump by Generator
140	55	Hand Pump
145	110	Hand Pump
146A	120	Hand Pump
148A	150	Hand Pump
152	110	Hand Pump
156A	160	Submersible Pump by Generator
164	90	Hand Pump
165A	145	Hand Pump
166	185	Hand Pump
173A	55	Submersible pump by Generator
175A	90	Hand Pump
178A	100	Submersible Pump by Generator
184	130	Hand Pump
185A	100	Hand Pump
187A	130	Submersible Pump by Generator
188A	110	Submersible Pump by Generator
190	70	Hand Pump
191A	100	Submersible Pump by Generator
195A	90	Submersible Pump by Generator
196A	120	Hand Pump
198	80	Hand Pump
199	110	Hand Pump

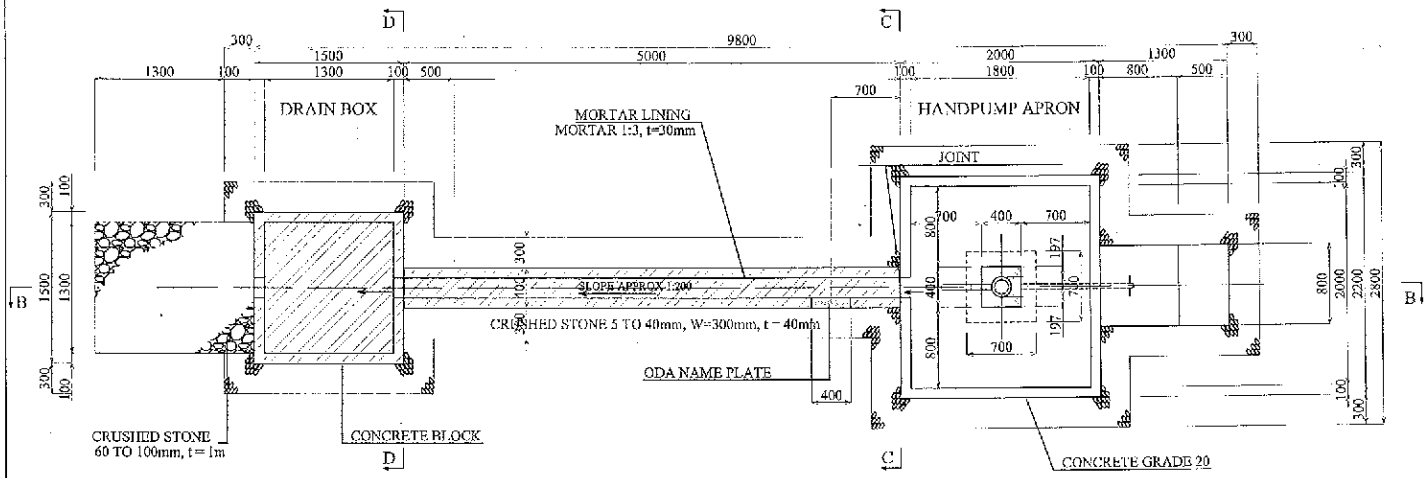
Note: Well depth in the above table is estimated depth.

Drilled Boreholes to be installed

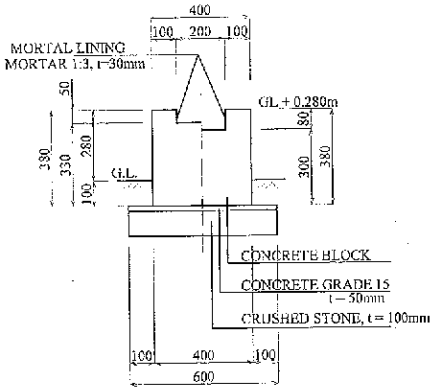
Serial No.	Borehole Depth (GL-m)	Statistic Water Level (GL-m)	Dinamic Water Level (GL-m)	Discharge/Yield (m3/hr)	Water Supply Facilities
102	155	5.0	137.3	2.70	Windmill pump
123	87	51.3	65.2	1.70	Submersible Pump by Solar
133	120	16.3	48.0	9.00	Submersible Pump by Electrical Line
142	84	31.4	52.2	1.70	Submersible Pump by Solar
162	141	44.6	85.1	1.10	Submersible Pump by Solar
163	137	81.5	105.9	10.90	Submersible Pump by Generator
167	110	20.2	33.7	2.00	Submersible Pump by Generator
177	38	5.0	16.5	5.00	Submersible Pump by Generator
183	128	38.1	88.6	7.20	Submersible Pump by Generator
200	150	44.7	90.7	0.60	Submersible Pump by Solar
121	100	9.2	13.1	15.0	Submersible Pump by solar
151	54	11.8	38.2	4.5	Submersible Pump by Generator
158	80	4.7	35.7	4.7	Submersible Pump by Generator
172	92	4.4	50.8	18.0	Submersible Pump by Generator
180	100	6.4	24.0	14.4	Submersible Pump by Generator
186	120	7.3	80.8	2.0	Submersible Pump by Generator
189	92	11.1	36.8	3.6	Submersible Pump by Electrical Line
197	60	6.9	33.7	6.7	Submersible Pump by Generator

Note: Above data are reference only

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: GENERAL DETAILS OF BOREHOLE STRUCTURE		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE NONE	DATE OCT 2010	DRAWING NO. BW-001

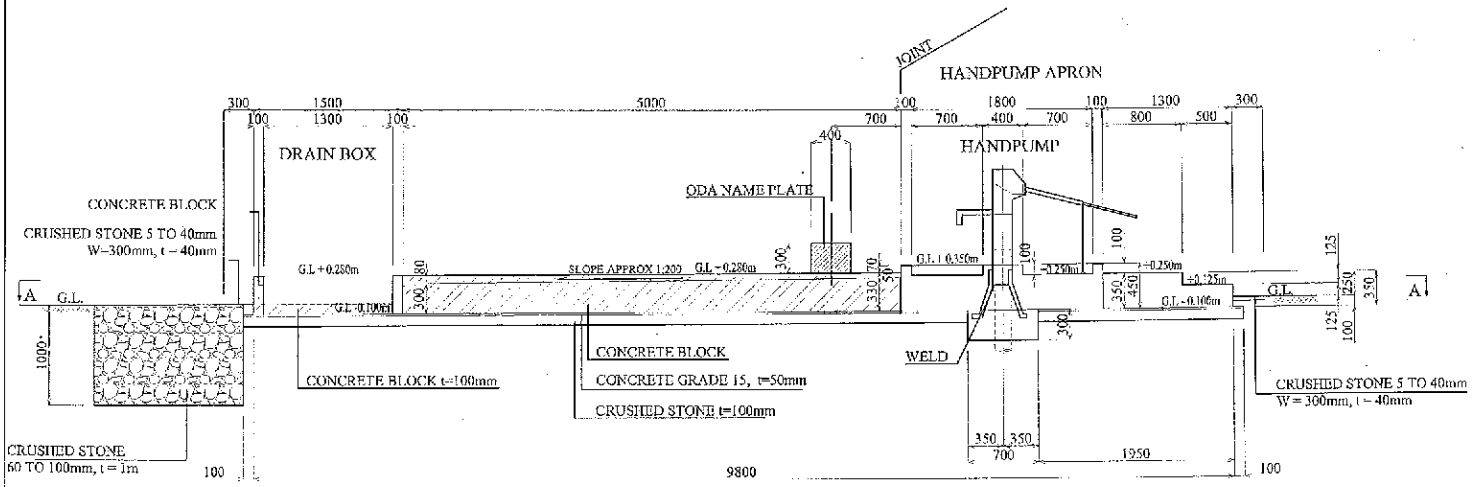


A-A
SCALE 1:50

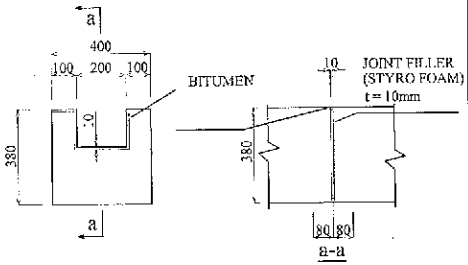


C-C
SCALE 1:20

D-D
SCALE 1:20

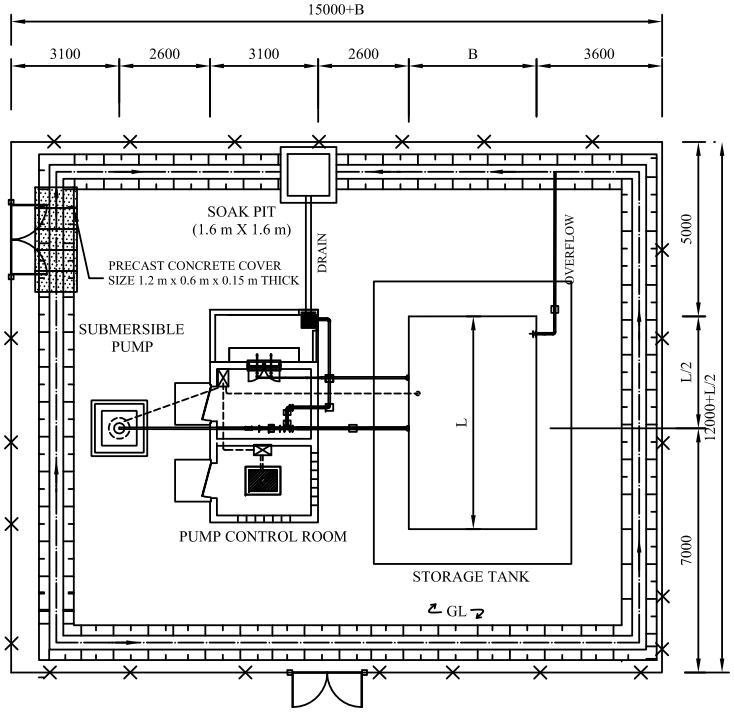


B-B
SCALE 1:50



JOINT DETAIL
SCALE 1:20

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: CONSTRUCTION OF BOREHOLE WATER SUPPLY FACILITIES HAND PUMP		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE 1:50 1:20	DATE JAN 2010	DRAWING NO. BW-002



SERIAL No.	L (mm)	B (mm)	TYPE
121	6100	3660	S0
123	2000	2000	
142	2000	2000	
162	2000	2000	
200	2000	2000	

NOTES:

1. FOR DETAILS OF PRECAST CONCRETE COVER, GATE, FENCE AND DRAIN uPVC DITCH, SEE DRAWING No. SP-069 & 070.
2. CONSTRUCTION WORKS FOR ; (1.) FENCES AND (2.) DRAIN OUTLETS ARE DONE BY RURAL COMMUNITY PARTICIPATION BASED ON THE UNDERTAKINGS OF THE GOVERNMENT OF KENYA.
3. THE NUMBER OF WATER TAP SHALL BE REQUIRED 4 FOR THE SERIAL NO. 121 AND 2 FOR THE OTHERS.

LEGEND:

: PRECAST CONCRETE COVER

: GATE

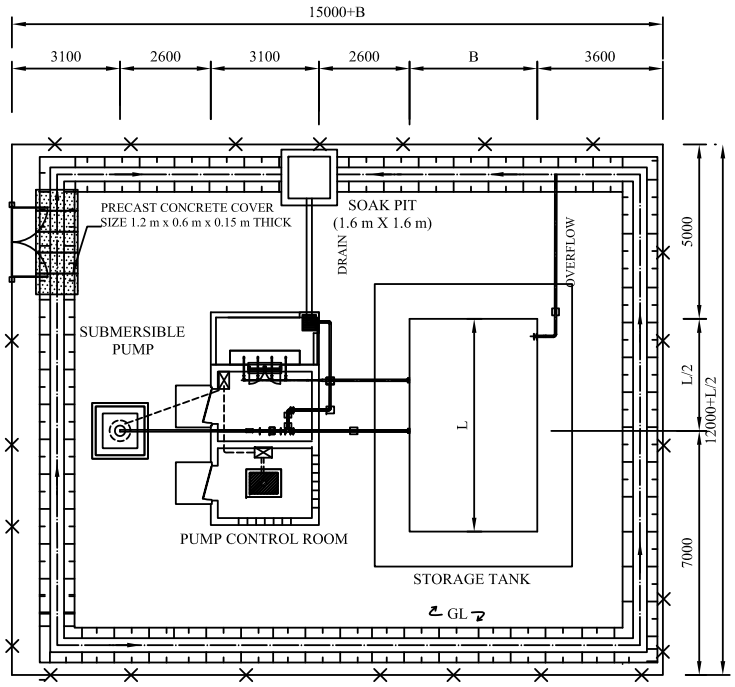
: CHAIN-LINK FENCE

: CUT SLOPE (GRADIENT 1:0.5)

: WATER SUPPLY PIPE

----- : CABLE

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: CONSTRUCTION OF WATER SUPPLY FACILITIES BY SUBMERSIBLE PUMP LAYOUT PLAN OF TYPE S0 AND S1		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE 1:150	DATE OCT 2010	DRAWING NO. SP-001A



SERIAL No.	L (mm)	B (mm)	TYPE
96A	6100	3660	S1
98A	4880	2440	
127A	4880	2440	
133	6100	3660	
137A	6100	3660	
151	4880	2440	
156A	6100	3660	
163	4880	2440	
172	6100	3600	
173A	4880	2440	
186	4880	2440	
195A	4880	2440	
197	6100	3660	

LEGEND:

: PRECAST CONCRETE COVER

: GATE

: CHAIN-LINK FENCE

: CUT SLOPE (GRADIENT 1:0.5)

: WATER SUPPLY PIPE

----- : CABLE

NOTES:

1. FOR DETAILS OF PRECAST CONCRETE COVER, GATE, FENCE AND DRAIN uPVC DITCH, SEE DRAWING No. SP-069 & 070.

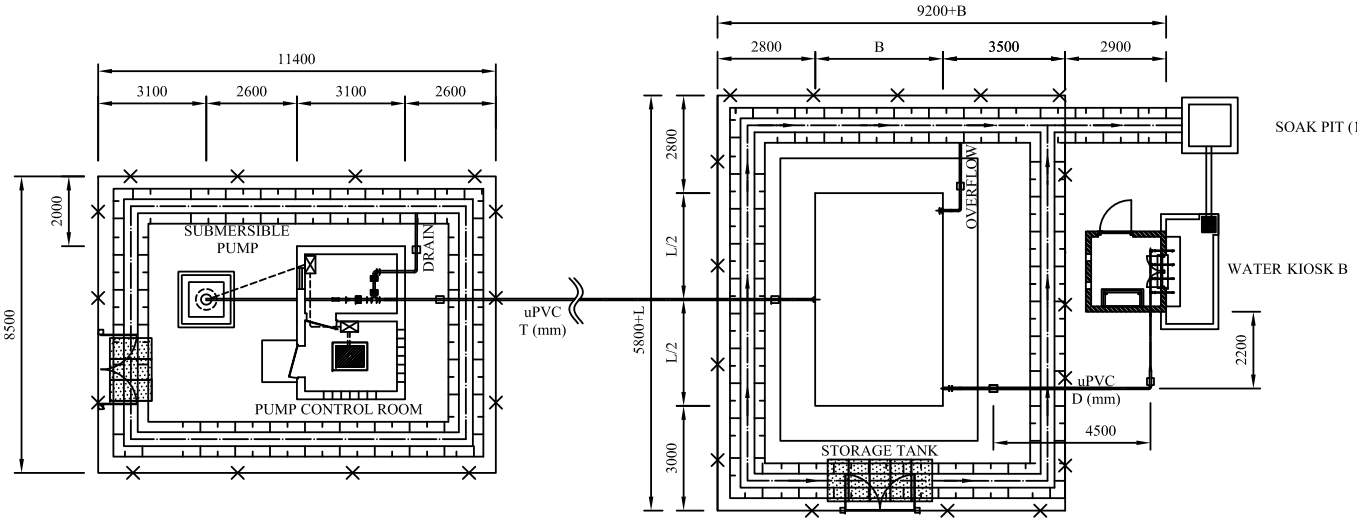
2. CONSTRUCTION WORKS FOR ; (1.) FENCES AND (2.) DRAIN OUTLETS ARE DONE BY RURAL COMMUNITY PARTICIPATION BASED ON THE UNDERTAKINGS OF THE GOVERNMENT OF KENYA.

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: CONSTRUCTION OF WATER SUPPLY FACILITIES BY SUBMERSIBLE PUMP LAYOUT PLAN OF TYPE S0 AND S1		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE 1:150	DATE OCT 2010	DRAWING NO. SP-001B

NOTES:

1. FOR DETAILS OF PRECAST CONCRETE COVER, GATE, FENCE AND DRAIN uPVC DITCH, SEE DRAWING No. SP-069 & 070.
2. CONSTRUCTION WORKS FOR 1) FENCES AND 2) DRAIN OUTLETS ARE DONE BY RURAL COMMUNITY PARTICIPATION BASED ON THE UNDERTAKINGS OF THE GOVERNMENT OF KENYA.

SERIAL No.	L (mm)	B (mm)	uPVC T (mm)	uPVC D (mm)
167	4880	2440	50	50
178A	4880	2440	50	50
187A	4880	2440	50	50
188A	4880	2440	50	50
191A	4880	2440	50	50



LEGEND:

- : PRECAST CONCRETE COVER
- : GATE
- : CHAIN-LINK FENCE
- : CUT SLOPE (GRADIENT 1:0.5)
- : WATER SUPPLY PIPE
- : CABLE

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: CONSTRUCTION OF WATER SUPPLY FACILITIES BY SUBMERSIBLE PUMP LAYOUT PLAN OF TYPE S2		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE 1:150	DATE OCT. 2010	DRAWING NO. SP-002

NOTES:

1. FOR DETAILS OF PRECAST CONCRETE COVER, GATE, FENCE AND DRAIN uPVC DITCH, SEE DRAWING No. SP-069 & 070.

2. CONSTRUCTION WORKS FOR 1) FENCES, AND 2) DRAIN OUTLETS ARE DONE BY RURAL COMMUNITY PARTICIPATION BASED ON THE UNDERTAKINGS OF THE GOVERNMENT OF KENYA.

LEGEND:

: PRECAST CONCRETE COVER

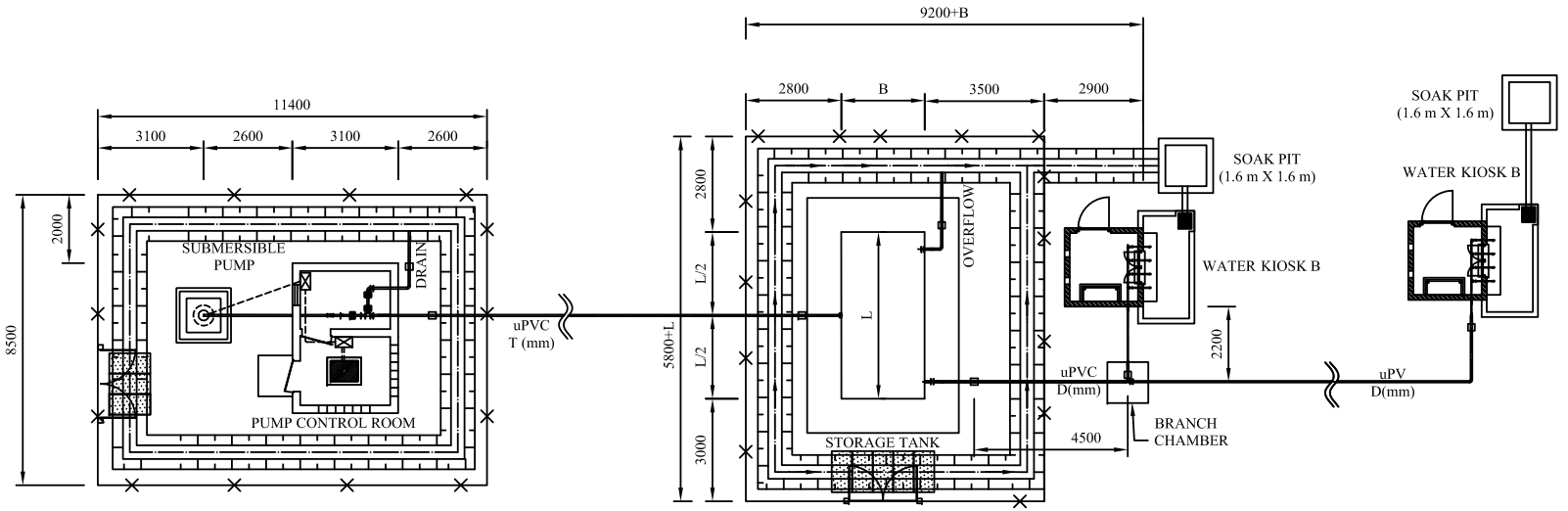
: GATE

: CHAIN-LINK FENCE

: CUT SLOPE (GRADIENT 1:0.5)

: WATER SUPPLY PIPE

: CABLE



SERIAL No.	L (mm)	B (mm)	uPVC T(mm)	uPVC D (mm)
189	6100	3600	50	50

OWNER:	PROJECT NAME:	CONSULTING ENGINEERS:	TITLE: CONSTRUCTION OF WATER SUPPLY FACILITIES BY SUBMERSIBLE PUMP LAYOUT PLAN OF TYPE S3		
THE MINISTRY OF WATER AND IRRIGATION THE REPUBLIC OF KENYA	THE PROJECT FOR RURAL WATER SUPPLY	NIPPON KOEI CO.,LTD.	SCALE 1:150	DATE OCT. 2010	DRAWING NO. SP-003