The Republic of Rwanda
Energy, Water and
Sanitation Authority
(E W S A)

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR RURAL WATER SUPPLY (PHASE III)
IN
THE REPUBLIC OF RWANDA

March 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN TECHNO CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Japan Techno Co., Ltd.

The survey team held a series of discussions with the officials concerned of the Government of Rwanda, and conducted 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 Rwanda for their close cooperation extended to the survey team.

March, 2014

Masami Fuwa
Director General
Global Environment Department
Japan International Cooperation Agency

SUMMARY

Summary

1. General Description of Rwanda

The Republic of Rwanda (hereinafter referred to as “Rwanda”) is a landlocked country located in the central part of the African Continent. With a population of 10,537,222 persons (Population Census, 2012) within an area of 26,300km^2, Rwanda is the most densely populated country in Africa. . The target area of Eastern Province is located in the Eastern plains region having elevations from about 1,000m to 1,500m with many undulations in the southern part but becoming semi-plains going north. . The Akagera river basin spans from the central plateau to the Eastern plains gradually decreasing altitude and the flow of the Akagera River and its tributaries create the topography which forms the “land of thousand hills” with an average elevation of 1,600m.

There are two rainy seasons in March to May and October to December, and the mean annual precipitation is approximately 1,000mm. Since Rwanda is situated just below the equator, its climatic zone is classified as temperate, but due to high altitudes, the climate is relatively pleasant. . The monthly average temperatures at the capital, Kigali, and Kibungo, where the target sites are located in Eastern Province, are between 20℃ and 22℃ throughout the year without any large fluctuations.

With regard to economic situation in Rwanda, GNI per capita is 578 USD (UN, 2011) and economic growth rate is 8.6% in 2011 (UN, 2011). The breakdown of GDP by industry is 33% for the primary industries, 16% for the secondary industries and 45% for the tertiary industries (NISR, 2013). The economy of Rwanda highly depends on agriculture where 90% of total working population is engaged in agricultural activities. The main agricultural products are coffee and tea, and Rwandan government puts emphasis on increasing productivity and improving the quality of these products in order to make them highly commercialized and competitive in the international market place (2012, NISR, Third Integrated Household Living Conditions Survey (EICV3)) .

In 1980’s, Rwanda accepted the structural adjustment program for reconstructing its economy. However, the economic growth turned negative after the civil war, and the country’s economy suffered a devastating blow from Genocide in 1994. In 1999, GDP recovered to the level of that before the civil war due to the steady of the agricultural sector, assistance from donors and implementation of sound economic policy. In 2000, Rwandan government formulated VISION 2020, which sets forth the long-tern development goals by 2020. To actualize these goals,

Economic Development and Poverty Reduction Strategy (EDPRS) 2008-2012 was formulated in 2007, followed by EDPRS II (2013-2017), and the Rwandan government striving for reconstruction of the country's economy.

2. Background of the Project

In the development process, the government places importance on improvement in access to safe water, where VISION 2020, Rwanda's long-tern development plan, has aims to achieve 100% access by 2020. However, in order to reach this goal, additionally more than 425,000 persons need to access safe water by 2020 requiring accelerated reforms in the water sector. To this end, Energy, Water and Sanitation Authority (hereafter referred to as "EWSA"), the lead agency of water sector in Rwandan government, puts its efforts into implementing water projects. Nevertheless, the safe water access rate remains at 74.2% nationally as of 2012, and particularly in Eastern Province, the target area of this project, the rate remains at 66.6%, being one of the lowest in Rwanda.

With this background, Japan places the supply of safe water as Rwanda's important development issue and therefore, comprehensive assistance is being focused towards rural areas of Eastern Province where water supply coverage rate is low as compared to other provinces. In 2002, the "Umutara Province Rural Water Supply Project", and in 2003, the "Groundwater Project in Eastern and Central Areas" were requested to the Japanese government by the Rwandan government. Based on these requests, JICA executed a project formulation study, the "Kibungo Province Rural Development Program", to sort out and organize the request contents. As a result, the "Rural Water Supply Project (Phase 1 of 3)" and "Rural Water Supply Project, Phase 2" were implemented as grant aid projects. Then, in response to the request from the Rwandan government, in 2008, the "Study on Improvement of Rural Water Supply" was carried out to create the water supply master plan for Eastern Province including selection, preliminary designing and cost estimation of priority projects.

Consequently, from the 2 grant aid projects mentioned above, along with the 3 schemes which were taken out of scope, 8 schemes having high priority out of the master plan priority projects were targeted for the present project. The objectives of the preparatory survey of this project were to (1) review existing information, (2) confirm the necessity and feasibility of the assistance, (3) formulate a water supply plan, and (4) confirm the capacity of the executing agency and organization for operation and maintenance. Based on these findings, preliminary designing and cost estimation were conducted.

During the Survey, however, since 3 to 5 years have lapsed since the master plan was formulated, evolutions in local conditions and new constructions and rehabilitations of water supply schemes were observed, which resulted in 4 sites in 4 districts to be targeted for the project after the Second Field Survey. Then, through the screening, the target sites became 4 sites. Although those 4 sites in 4 districts had been determined in the Minutes of Meeting on the Draft Outline Design Survey, the request letter from EWSA, which consisted of the 3 sites listed in Table S-1, was submitted due to the reason of the tax exemption system for bilateral assistance to Rwanda, and therefore the target sites became the 3 sites.

3. Summary of Results of the Survey and Contents of the Project

Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the preparatory survey team to Rwanda for two field surveys from 31st March to 29th April 2013 (The first field survey) and from 1st June to 19th July 2013 (The second field survey). Following these field surveys, the survey team analyzed the data acquired at field and prepared the Draft Preparatory Survey Report. To explain the draft Outline Design in this report to Rwandan side, the survey team was dispatched from 3rd December to 12th December 2013.

As a result, the project content was agreed as summarized below.

(1) Construction of Water Supply Schemes

In this project, piped water schemes using springs and boreholes as water sources will be constructed at 3 sites. Due to geographical features, Rukira, one of the target sites, will have 2 schemes, and thus the number of water supply schemes to be constructed will be 4 in total. This project will ensure about 33,000 increased service population in the target year 2020.

The daily water supply plan and list of water supply facilities for each site are shown in the following tables.

Table S-1 Daily Water Supply Plan for this Project

No.	Target Site (Sector)	No. of Target Cells	Target Cell	Design Service Population (2020) (pers.)	Design Daily Average Supply Rate (m^3)
1	Rukira	2	Nyarubumu Kibatsi	8,087	162
2	Murama	3	Nyakanazi Muko Rusave	10,663	213
3	Remera	4	Nyagakombe Kigabiro Rurenge Butiruka	14,451	289
Total		9		33,201	664

Table S-2　List of Water Supply Facilities of this Project

Facility		Quantity					
		Unit	Rukira (East)	Rukira (West)	Murama	Remera	Total
Intake Facility	Intake Facility	unit	1	1	2	4	8
	Conveyance Pipeline	km	－	0.1	0.1	－	0.2
Transmission Facility	Receiving Tank	unit	1	1	1	1	4
	Control House	unit	1	1	3	4	9
	Balancing Tank	unit	－	－	2	2	4
	Transmission Pipeline	km	0.8	0.4	3.7	4.8	9.7
	Chlorination Room	unit	1	1	－(*1)	－(*1)	2
Distribution Facility	Distribution Tank	unit	1	1	1	1	4
	Distribution pipeline	km	4.7	10.2	28.7	15.7	59.3
	Monitoring Room	unit	－	－	1	1	2
	Break Pressure Tank	unit	1	－	5	3	9
Water Service Facility	Public Tap Stand	Nos	7	16	27	29	79

(2)　Software Component Plan

In order to establish a management structure for water facilities to be constructed by this project, a software component plan will be implemented.

In Rwanda, the owner of constructed water schemes is the District. Recently, privatization of water scheme management is being promoted, and daily operation and maintenance tasks are managed by private Water Service Providers (WSPs) such as enterprises and cooperatives, whereas the District has responsibility in supervising them. Taking in account of this tendency and to strengthen the WSPs on operation and maintenance of water schemes, the software component program of this project aims for the following main points.

1) To support target Districts to select appropriate water service providers
2) To support selected water service providers to operate and manage the constructed water schemes appropriately
3) To support selected water service providers to promote sanitation awareness to the population in target sites in order to increase the number of facility users

4. Implementation Schedule of the Project

The implementation period of this project, after the E/N and G/A, is 24 months. The standard working hours of Rwanda is 8 hours per day with non-working days as Sundays and 13 other days in the year designated as national holidays of Rwanda. Furthermore, the schedule will be planned in consideration of natural conditions such as rainy days[1] and social conditions such as Umuganda as well as consideration for proper construction supervision based on factors such as facilities scale and village layout. Also, to complete the entire construction works on water schemes within the planned schedule, works will progress in parallel under an appropriate team formation.

The implementation schedule based on the Japanese grant aid scheme is shown below.

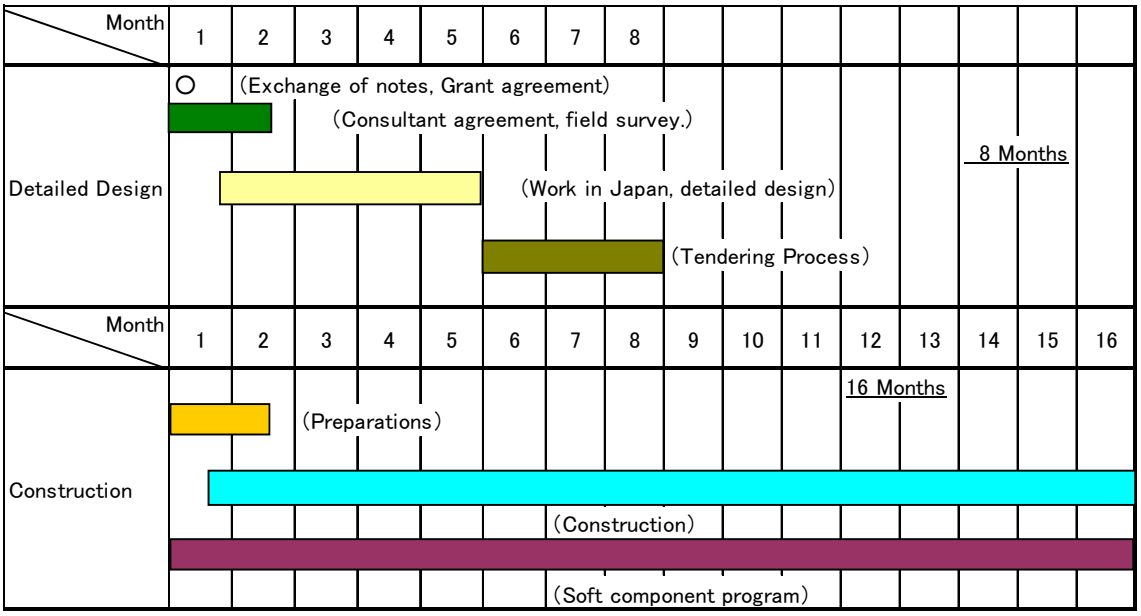


Figure S-1 Project Implementation Schedule

5. Project Evaluation

(1) Relevance

1) The target of this project is 3 sites in 3 districts of Eastern Province which has the lowest water supply coverage rate in Rwanda and the beneficiary population in the design year will be about 33,000 persons.

2) The objective of this project is the "increase in population who can access safe water"

[1] In Rwanda, the rainy seasons are March to May and October to December, but for this project, construction works will not be interrupted during the rainy season and working days during rains are considered into the nonworking coefficient.

which is one of the basic human needs.

3) The target residents of this project have needs to use safe water by reducing labor for water fetching.

4) The construction of water supply schemes through this project (expected to be completed in 2016) is necessary to achieve the objective of 100% coverage of VISION 2020 as the superior plan of Rwanda, for which the target year was moved forward through the Seven Year Government Plan.

5) Japan's Country Assistance Plan (April 2012) for Rwanda emphasizes comprehensive water supply services to strengthen the social development foundation through social service improvement (supply of safe water) focused on Eastern Province having low water supply coverage and strengthening of the operation and maintenance organization. This project will directly contribute to this objective.

6) As a result of environmental and social consideration, this project will not have any negative effects.

(2) Effectiveness

1) Quantitative Effects

Effects anticipated by the project are shown in the following table for each parameter.

Table S-3 Quantitative Effects

Parameter	Base Value (2012)	Goal (2020, 4 years after project completion)
Water Supply Rate (m^3/day)	954	1,618
Service Population (persons)	47,693	80,894

2) Qualitative Effects

The qualitative effects are shown below.

(a) Benefits

Water fetching efforts will be reduced and safe water can be procured near settlements. Also, time saved can be used for other productive work by women and learning at school by children.

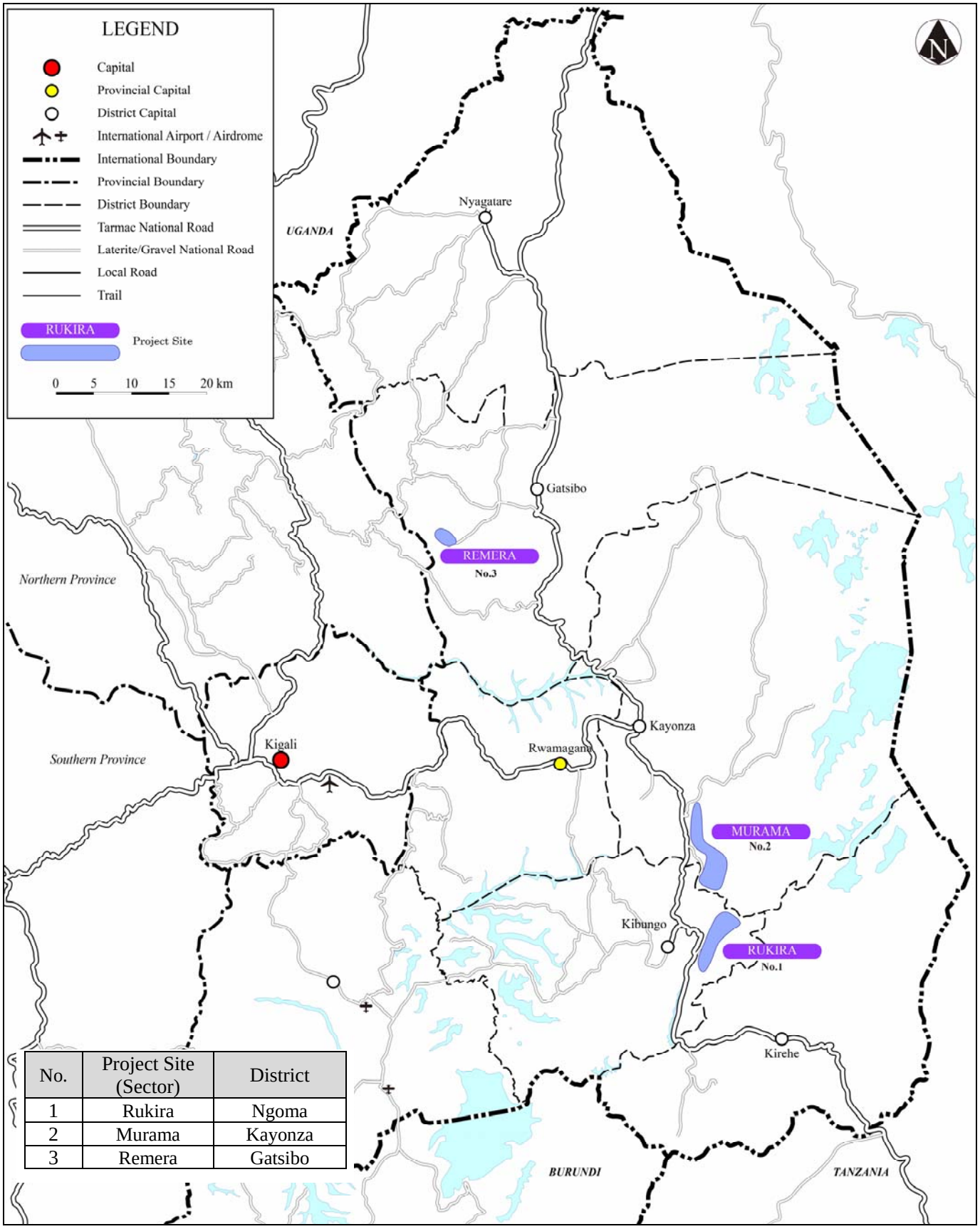
(b) Sanitation Awareness

Due to the support to be given to use of safe and stable water and sanitation promotion activities, improvements in awareness of users to enhance the sanitation conditions can be anticipated.

Contents

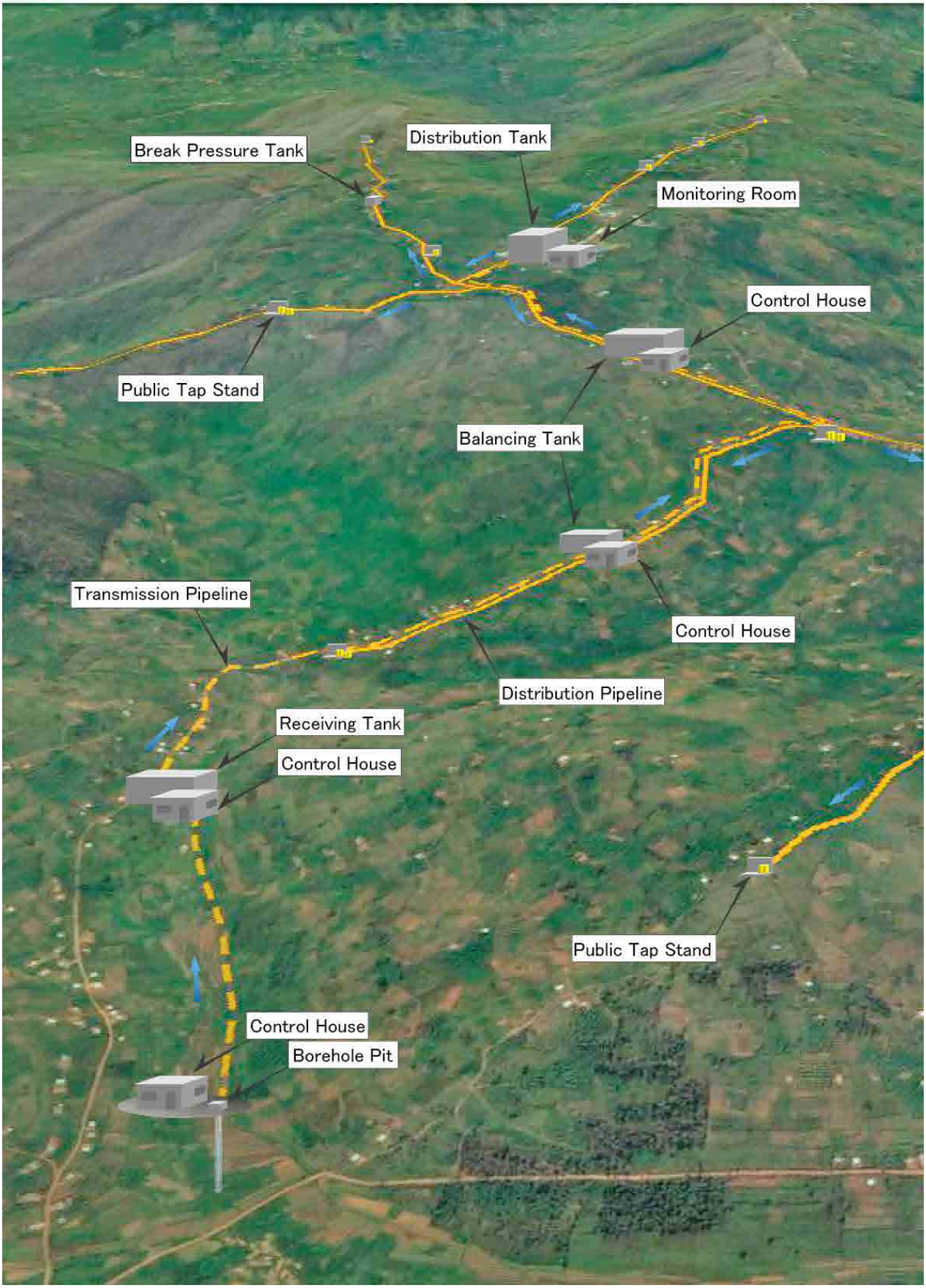
[Appendices]

Project Area Map



No.	Project Site (Sector)	District
1	Rukira	Ngoma
2	Murama	Kayonza
3	Remera	Gatsibo

Perspective



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Abbreviations

AfDB	African Development Bank
BADEA	Arab Bank for Economic Development in Africa
BHN	Basic Human Needs
DD	Detailed Design
DSU	District Support Unit
EDPRS	Economic Development and Poverty Reduction Strategy
EICV	Integrated Household Living Conditions Survey (Fr：Enquête Intégrale sur les Conditions de Vie des ménages)
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
EU	European Union
EWSA	Energy, Water and Sanitation Authority
G/A	Grant Agreement
GDP	Gross Domestic Product
GNI	Gross National Income
HDPE	High Density Polyethylene
IMF	International Monetary Fund
JICA	Japan International Cooperation Agency
LV-WATSAN	Lake Victoria Water and Sanitation Programme
MDGs	Millennium Development Goals
MINECOFIN	Ministry of Finance and Economic Planning
MININFRA	Ministry of Infrastructure
NGO	Non-Governmental Organizations
NISR	National Institute of Statistics Rwanda
OD	Outline Design
PNEAR	National Rural Drinking Water Supply and Sanitation Programme （Fr：Programme National d’Alimentation en Eau Potable et d’Assainissement en Milieu Rural）
PPP	Public Private Partnership
PRSP	Poverty Reduction Strategy Paper
PVC	Poly-Vinyl Chloride
RC	Reinforced Concrete
RDB	Rwanda Development Board
RECO	Rwanda Electricity Corporation
REMA	Rwanda Environment Management Authority
RWASCO	Rwanda Water and Sanitation Corporation
RWF	Rwandan Franc
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s Fund
WSP	Water Service Provider
WSP	Water and Sanitation Program

CHAPTER 1

BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Background of the Project

Since 1994, The Republic of Rwanda (hereinafter referred to as “Rwanda”) has strived to achieve national reconstruction and economic growth. . In this process, the government has placed importance on improvement in access to safe water, where VISION 2020, Rwanda’s long-tern development plan, has aims to achieve 100% access by 2020. However, in order to reach this goal, additionally more than 425,000 persons need to access safe water by 2020 requiring accelerated reforms in the water sector. To this end, Energy, Water and Sanitation Authority (hereafter referred to as “EWSA”), the lead agency of water sector in Rwandan government, puts efforts into implementing water projects. Nevertheless, the safe water access rate remains at 74.2% nationally as of 2012, and particularly in Eastern Province, the target area of this project, the rate remains at 66.6%, being one of the lowest in Rwanda.

With this background, Japan places the supply of safe water as Rwanda’s important development issue and therefore, comprehensive assistance is being focused towards rural areas of Eastern Province where water supply coverage rate is low as compared to other provinces. In 2002, the “Umutara Province Rural Water Supply Project”, and in 2003, the “Groundwater Project in Eastern and Central Areas” were requested to the Japanese government by the Rwandan government. Based on these requests, JICA executed a project formulation study, the “Kibungo Province Rural Development Program”, to sort out and organize the request contents. As a result, the “Rural Water Supply Project (Phase 1 of 3)” and “Rural Water Supply Project, Phase 2” were implemented as grant aid projects. Then, in response to the request from the Rwandan government, in 2008, the “Study on Improvement of Rural Water Supply” was carried out to create the water supply master plan for Eastern Province including selection, preliminary designing and cost estimation of priority projects.

Consequently, from the 2 grant aid projects mentioned above, along with the 3 schemes which were taken out of scope, 8 schemes having high priority out of the master plan priority projects were targeted for the present project. The objectives of the preparatory survey of this project were to (1) review existing information, (2) confirm the necessity and feasibility of the assistance, (3) formulate a water supply plan, and (4) confirm the capacity of the executing agency and organization for operation and maintenance. Based on these findings, preliminary designing and cost estimation were conducted.

During the Survey, however, since 3 to 5 years have lapsed since the master plan was formulated, evolutions in local conditions and new constructions and rehabilitations of water supply schemes were observed, which resulted in 5 sites in 6 districts to be targeted for the project after the Second Field Survey. Then, through the screening, the target sites became 4 sites. Although those 4 sites in 4 districts had been determined in the Minutes of Meeting on the Draft Outline Design Survey, the request letter from EWSA, which consisted of the 3 sites listed in Table S-1, was submitted due to the reason of the tax exemption system for bilateral assistance to Rwanda, and therefore the target sites became the 3 sites.

Table 1-1 Requested Project

Item	Description
Requested Cost	About 941 million Japanese Yen
Requested Site Number	3 sites (Rukira, Murama, Remera)
Target Area	3 Districts in Eastern Province (Ngoma, Kayonza, Gatsibo)
Requested Contents	Construction of piped water schemes and software component

1-2 Natural and Socio-Economic Conditions

1-2-1 Natural Conditions

1-2-1-1 Topography

Rwanda is a country landlocked in the central part of Africa between 1° and 3° N latitude and 29° and 31° E longitude. The country is bordered by the Democratic Republic of the Congo to the west, Uganda to the north, Tanzania to the east, and Burundi to the south. With a population of

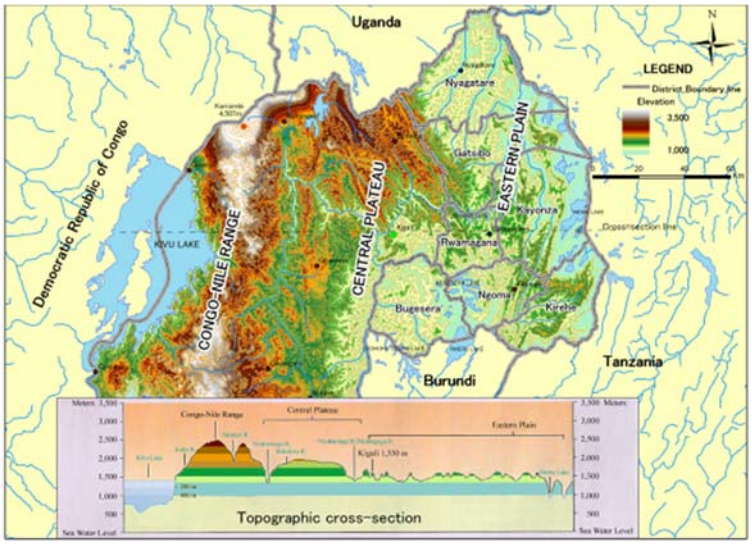


Figure 1-1 Topographical Cross Section of Rwanda

10,537,222 persons (Population Census, 2012) within an area of 26,300km^2, Rwanda is the most densely populated country in Africa. Along the western border with Congo lies the Western rift valley which forms part of the Great African Rift Valley. Also in this area, Kivu Lake (elevation 1,460m) formed by the volcanic activities of the rift valley and the Virunga volcanic mountain ranges with the country's highest peak Karisimbi (elevation 4,507m) can be found. Starting from these volcanic mountain ranges, the Congo-Nile water divide range stretches to the south, with Kivu Lake water basin to the west and the Akagera river basin to the east covering over 80% of the national land. The Akagera river basin spans from the central plateau to the Eastern plains gradually decreasing altitude and the flow of the Akagera River and its tributaries create the topography which forms the "land of thousand hills" with an average elevation of 1,600m. The topographical cross section of the target area is shown in Figure 1-1.

The target area of Eastern Province is located in the Eastern plains region having elevations from about 1,000m to 1,500m with many undulations in the southern part but becoming semi-plains going north. Lowlands and lakes of the Akagera river basin from the south-eastern border area and the Akagera national park can be found along the eastern border. The target area is comprised of relatively gentle valleys and steep sloped valleys, and the wide valley floor is used as paddy fields and farming lands.

1-2-1-2 Geology and Hydrogeology

In Rwanda, bedrocks are generally composed of metamorphic and granitic rocks of the Precambrian Period which are distributed all over the country. Metamorphic rocks are mostly schists produced by low to medium pressure metamorphic actions of sandy to muddy sediments. Also, granitic rocks are intrusive rocks originating from metamorphic actions. After the Cenozoic era, due to the vigorous activities of the Great African Rift Valley and volcanic actions of the Virunga volcanic mountain range including the Karisimbi Mountains, the whole country became thickly covered with volcanic ashes. Eventually, when the volcanic activities came to an end, the thickly covered volcanic sediments gradually cracked while mountain sides collapsed to form talus cone layers and gravel from upstream rivers were distributed as alluvium lowlands and wetlands along rivers and valley floors. The characteristic geological structure is formed by metamorphic rocks of the Precambrian Period stretching linearly north-south with many faults running in similar directions due to rift valley activities in the east-west direction.

The western part of Eastern Province from Nyagatare District through Rwamagana District to Bugesera District is widely distributed with intrusive granitic rocks, and along the border with

Northern Province, metamorphic rocks are distributed in a narrow belt shape. In the central and south-eastern parts of Eastern Province, schist-quartzite metamorphic rocks and mudstone-sandstone sedimentary rocks are distributed in the north-south direction. Lakes and marshes can be found along the eastern border with Tanzania, and in the surrounding areas, sediment alluviums of few km widths are distributed. Moreover, alluvial layers composed of clay, sand and gravel layers are distributed along rivers and valley floors throughout the province. Springs appear between these alluvial layers and bedrocks.

In Eastern Province, since spring sources appear mostly from points lower than the settlements, residents must go down to valley floors to fetch their water. As can be seen from the topographical cross section, this is a topographical characteristic of Eastern Province, and since spring intake points in other provinces are higher than the settlements, water can be supplied by gravity in those areas.

Since alluviums distributed in valleys of project target areas form weak foundations, penetration tests are needed to be carried out before facilities construction to assure required foundation strengths. Also, in the wide valley floor, since recharged groundwater is assumed to be plentiful, possibilities for using boreholes as water sources to supplement springs were considered. Therefore, field reconnaissance and electrical prospecting were carried out, geological structures of valleys were surveyed, and test drillings were conducted at sites having potential for borehole construction. Consequently, 3 test drillings were able to be used as productive wells.

1-2-1-3 Meteorology

Since Rwanda is situated just below the equator, its climatic zone is classified as temperate, but due to high altitudes, the climate is relatively pleasant. The monthly average temperatures at the capital, Kigali, and Kibungo, where the target sites are located in Eastern Province, are between 20℃ and 22℃ throughout the year without any large fluctuations.

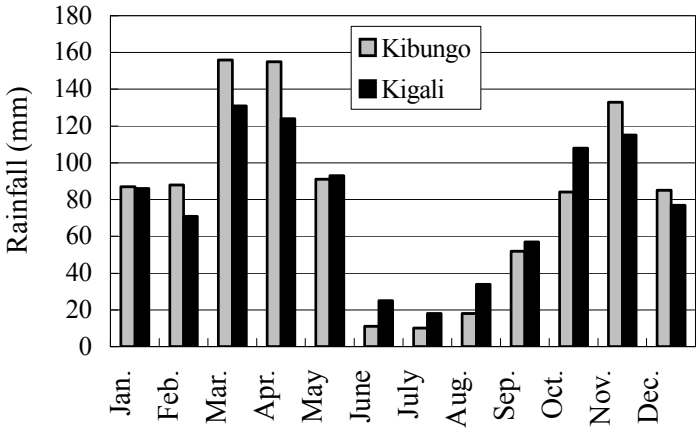


Figure 1-2 Average Annual Rainfall at Kibungo and Kigali (Average 1970-2009)

The annual maximum temperature at Kibungo is about 29℃ from March to April, and the minimum temperature is about 14℃ from October to November.

The annual rainfall at Kigali is about and at Kibungo, between 1,000mm and 1,267mm (refer to Figure 1-2). Seasons are the rainy seasons occurring twice a year, from February to April and again from October to November, and the dry season from June to August with almost no rainfall. This rainfall pattern is similar around the whole province.

During the rainy season, unpaved roads become muddy and slippery to hinder passage of construction vehicles. Therefore, in the construction plan and schedule, access conditions during the rainy season will be sufficiently considered.

Since Rwanda has a relatively high rate of rainfall, during the raining periods, rainwater harvesters are used to procure drinking water. According to inquiries, residents do not drink rainwater directly, but use rainwater for cooking and other domestic uses. On the other hand, during the dry season from June to August, since rainwater drastically decreases to cause water shortage, residents must walk for hours to fetch spring water located far away.

1-2-2 Socio-Economic Conditions

Results of the social condition survey carried out for this project are explained below.

1-2-2-1 Summary of Survey

A socio-economic survey was conducted for communities in 8 sectors[1] to identify basic information, socio-economic conditions, water supply situation and development needs. The survey was made through interviews using questionnaires. For the inquiry survey, since smooth communication with local residents is essential, a local consultant having experience in this type of survey was used with scheduling and survey methods being managed by the Japanese consultant.

1-2-2-2 Community Development Needs related to Water Supply Improvement

The existing water sources being used for domestic use by sample households of target

[1] Out of the survey for 8 sectors, the project target became 4 sectors. This section explains the socio-economic conditions for the 8 sectors.

sectors during the dry season are, ponds/streams/lakes being the most at 25.4% followed by public tap stands using boreholes (20.8% including sectors other than the 4 project targets), traditional shallow wells (18.3%), and point source protected springs (17.5%). On the other hand, during the rainy season, rainwater is the highest at 26.3% while public tap stands using boreholes (19.2%), ponds/streams/lakes (18.3%) and traditional shallow wells (12.1%) follow.

Concerning priorities for development needs of communities, out of improvements in living conditions such as village electrification, medical and health improvements, educational facilities, sanitation facilities /sewerage, agricultural and access roads, solid waste management, and poverty reduction (increase in job opportunities), the number of households giving "improvement in water supply" as their first priority was highest at 80% of all households. If those responding 'improvement in water supply" as their second priority is added to this number, the total will be over 90%, revealing the high development needs for promoting water supply schemes.

At the target communities, while needs for improvements in water supply is the highest, as to response to question on awareness on present water supply conditions, they are highly dissatisfied during the dry season. On the other hand, as a result of questions on water quality, many residents replied that water quality is unsatisfactory during the rainy season. The use of unprotected springs and ponds/streams/lakes by nearly all residents claiming dissatisfaction probably has relation to the cause.

Since awareness on water quality by target communities is rising, anticipation for safe water supply through the new water supply schemes will be high. In formulating the operation and maintenance plan including software component program, activities aiming to raise awareness on sanitation concepts related to "water and sanitation" will be included to improve consciousness of target communities. Also, raising the use rate of water supply schemes and establishment of water fee payments will be promoted.

1-2-2-3 Willingness to Participate in Operation and Maintenance

Table 1-2 shows the results of response from to question on awareness related to operation and maintenance of water supply schemes. In response to the question, "who should operate and maintain the constructed water supply schemes?" participants responding as user (including water user association and village committee) was over half at 63.8%. On the other hand, those anticipating the government was 23.7% which is not necessarily a low figure. Although high

awareness on operation and maintenance focused on local residents can be conceived, since a tendency to rely on government still remains, during execution of software component, considerations will be made to improve awareness of target persons.

Table 1-2 Response to Question on Operation and Maintenance

Question: Who should operate and maintain the constructed water supply schemes?	
Response	Response Rate
User	45.8%
State Government	12.9%
Local Administration	10.8%
Water User Association	9.2%
Village Committee	8.8%

1-2-2-4 Payment of Water Fees

Results of response to question on payment of water user fees are shown in Table 1-3. In response to the question, "will you pay water fees for using the constructed water supply scheme?", 90.0% responded as willing to pay, 7.5% not willing to pay and 2.5% could not answer.

Table 1-3 Response to Question on Water User Fee

Question: Will you pay water fees for using the constructed water supply scheme?	
Response	Response Rate
Will pay	90.0%
Will not pay	7.5%
Don't know	2.5%

As to setting the water tariff, since operation and maintenance differs between schemes and affordable amounts also differ between residents, refer to the operation and maintenance plan in the next chapter.

1-3 Environmental and Social Consideration

According to the Environmental and Social Consideration Guidelines of JICA, this project is evaluated as Category C. Also, according to the Guidelines for Environmental Impact Assessment established by the Rwanda Development Board (RDB), since this project involves construction of small scale rural water supply schemes, the study on environmental impact assessment (EIA) is not necessary.

1-3-1 Environmental Impact Assessment

1-3-1-1 Project to provide Environmental and Social Impacts

This project aims to construct water supply schemes for rural villages located in 4 districts of Eastern Province of Rwanda. Table 1-4 summarizes the description of the target sites.

Table 1-4 List of Target Sites

No.	District	Served Sector	Water Source	Scheme Type	Design Population (2020)	Design Supply Rate (2020)
1	Ngoma	Rukira	Spring	Pumped	8,087	162
2	Kayonza	Murama	Spring	Pumped	10,663	213
3	Gatisbo	Remera	Spring and Groundwater	Pumped	14,451	289

For the target sites, the main water source is spring, but since the yield for 1 site does not meet the design water supply rate, boreholes will also be combined. Concerning the use of springs, these are regulated to be managed by the state and water use for drinking is given the highest priority. However, since impacts on communities in the surrounding and downstream areas are feared, as a result of field reconnaissance and discussions with the Rwandan side, the following concepts will be applied.

- Concerning the use of springs for target sites of this project, taking into consideration on the amount being used by communities in downstream areas, 25% of the spring flow rate will be assured for residents in surrounding and downstream areas and the remaining 75% will be used for the project. Also, in response to a request made by the Rwandan side for consideration on continuous use of springs by those who are presently using those sources, in this project, the intake facilities will be designed so that overflow from the facilities can also be used. Concerning this use of spring water to supply the target sites, the situation was explained to the relevant districts and sectors, and consequently, they have given their consents.
- Concerning impacts on springs from use of agricultural chemicals in neighboring farms, since the use of agricultural chemicals in the target areas was not apparent, the impacts are determined to be very low. Also, since use of agricultural chemicals in these areas are restricted only when crops (such as maize) are affected with disease, only chemicals specified by the Ministry of Agriculture can be used through the consent of the Sector. Therefore, supposing agricultural chemicals are used near springs, although preliminary

confirmation can be made through the Sector office, the field study has confirmed that agricultural chemicals are not being used at the target sites.

1-3-1-2 Baseline Environmental and Social Conditions

(1) Conservation Areas in Target Districts

The study area has many swamps and lakes and some of them were previously designated as conservation areas, but according to Ramsar Sites Information Service, as of 2005, these are no longer designated. However, these conservation areas are not located in or near the target sites.

Additionally, the target districts have areas to be preserved as buffer zones around them which are stipulated by the Organic Law. Inside those buffer zones, any activity for individual profit is prohibited, but if development projects are expected with positive contributions to the public, construction works may be allowed in those areas. However, the target sites will not be affected by these regulations.

(2) Involuntary Resettlement and Land Expropriation

Land in Rwanda is mostly individual land and partly state owned public land. Since the target sites are situated in individual lands, if land expropriation is required in implementing public projects, "Law No. 18/2007 of 19/04/2007 relating to Expropriation in the Public Interest" must be followed. Also, this law stipulates that the government conducts land expropriation in case of public projects. For the present rural water supply project, locations planned for construction of intake facilities, control houses, storage tanks and public tap stands were confirmed as land owned by the target villages in the presence of the target district and sector as well as village leaders. Moreover, the use of these lands was agreed and confirmation was made during the field survey that resettlement will not be necessary.

(3) Areas Bordering Neighbor Countries

The western side of Rwanda borders the Democratic Republic of Congo (DRC) and presently, an organization called Forces Democratiques de Liberation du Rwanda (FDLR) is repeatedly carrying out armed activities. Due to the degrading situation of DRC's eastern area since April 2012, the gradually weakening FDLR began to expand its controlling area, and in November and December 2012, attacks were reported. However, since the Rwanda Defense Force (RDF) is

strictly defending the border between both countries, possibilities for continuous terrorist activities by FDLR in Rwanda is expected to decrease, but continued attention is still required. On the other hand, a number of incidents where hand grenades were thrown into crowds inside Rwanda in 2012 occurred, and although facts are uncertain, the Rwandan government considers these as acts of terrorism. However, Eastern Province, where the target sites of this project are located, is situated more than 100km away from the DRC border, but information on current situation in that area needs to be collected and sufficient safety precautions must be taken.

1-3-1-3 Environmental and Social Consideration Procedures and Organization in Rwanda

(1) EIA Procedures in Rwanda

In Rwanda, environment has been identified as one of the essential issues concerned for sustainable development. In this predicament, while emphasizing environmental protection in Rwanda, Article 67 of the Organic Law states that environmental impact assessment (EIA) is mandatory for implementing development projects in the infrastructure, agriculture, industrial and mining sectors. Also, in order to achieve the sustainable development from an environmental point of view, the Government of Rwanda has made efforts in strengethening the environment sector and established the Rwanda Environment Management Authority (REMA) under the Ministry of Natural Resources (MINIRENA)[2], in 2005. Moreover, the "General Guidelines and Procedure for Environmental Impact Assessment" (hereinafter called as "the Guidelines") was established in 2006. Thereafter, the Rwanda Development Board (RDB) was established in early 2009 and the section in charge of environmental impact assessment in development activities was transferred[3] from REMA to the RDB.

(2) EIA in Rwanda

In order to achieve the objectives of EIA in Rwanda, environmental risks and potential adverse impacts must be identified, and possible mitigation and monitoring measures for any negative aspect need to be clarified before implementation of projects. Therefore, the environmental impact assessment guideline proposes EIA prior to implementation of

[2] In December 2009, MINIRENA became Ministry of Environment and Lands (MINELA).

[3] Based on the Organic Law N° 53/2008 of 02/09/2008 Establishing Rwanda Development Board (RDB) and Determining its Responsibilities, Organization and Functioning, the Department of Environmental Impact Assessment, Compliance and Enforcement of REMA was transferred to RDB as the Unit of Environmental Compliance, Awareness and Cleaner Production.

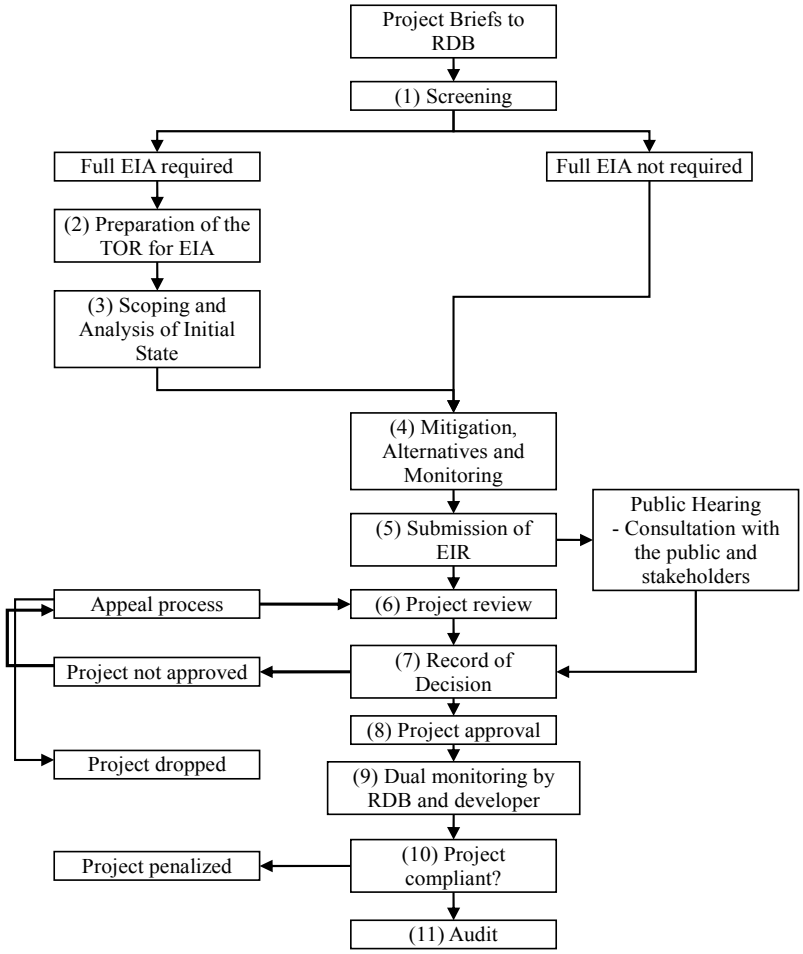
development projects through the cooperation of RDB and other ministries along with residents of the project area and private organizations in the community. Projects requiring EIA are listed in Table 1-5.

Table 1-5 List of Works, Activities and Projects that require EIA

Sector	Projects
Infrastructure	1. Construction and repair of international roads, national roads, district roads and repair of large bridges 2. Construction of industries, factories and activities carried out in those industries 3. Construction of hydro-dams and electrical lines 4. Construction of public dams for water conservation, rainwater harvesting for agricultural activities and artificial lakes 5. Construction of oil pipelines and its products, gases and storage tanks 6. Construction of terminals, airports, railways and car parks 7. Construction of hotels and large public buildings which house more than a hundred persons per day 8. **Water distribution activities** and sanitation 9. Construction of public landfills 10. Construction of slaughter houses 11. Construction of hospitals 12. Construction of stadiums and large markets 13. Initial installation of communication infrastructures
Agriculture and Animal Husbandry	1. Agricultural and breeding activities which use chemical fertilizers and pesticides in wetlands and large scale monoculture agricultural practices such as tea, coffee, flowers and pyrethrum, etc. 2. Works and activities that use bio-technology to modify seeds and animals
Works in parks and in its buffer zones	
Works for extraction of mines	

Source: Ministerial Order No. 004/2008 of 15/08/2008, Establishing the List of Works, Activities and Projects that have to undertake an Environmental Impact Assessment

Since this project is categorized under "8. Water distribution activities and sanitation" in the above table, EIA procedures described in Figure 1-4 need to be taken. This procedure usually takes about 18 to 50 days and all costs incurred in the process must be paid by the project developer (implementation organization). Also, although costs for submission of the EIA reports to RDB are not necessary, the developer must pay 0.1% of the total project cost to the National Environment Fund (Fond National de l'Environnement: FONERWA).



EIA steps, as stipulated in the Guidelines

(1) Screening: RDB examines the Project Brief prepared by a developer according to the screening criteria, and clarifies whether or not the project may need further environmental analysis
(2) Preparation of TOR for EIA: If a project is categorized as one which may have critical impacts to natural resources, the developer is required to identify mitigation measures against them and describe how to practice the TOR for impact assessment surveys.
(3) Scoping and analysis of initial state: On the basis of the TOR, the developer works on scoping and analysis of the pre-project situations with stakeholders' involvements and develop their TOR
(4) Mitigation, alternatives and monitoring: Throughout impact assessment surveys determined in the TOR, the developer proposes measures of mitigating possible impacts and monitoring methods.
(5) Submission of EIR: A developer submits to RDB the Environmental Impact Report (EIR), describing the results of the survey.
(6) Project review: RDB reviews the EIR and makes decisions on whether the project is approved or not. The EIR is distributed to relevant ministries and local authorities. If necessary, RDB conducts public hearings with stakeholders over the area affected by the project
(7) Record of Decision: After the decision on whether the project is approved or not is finalized by the Executive Committee (RDB and relevant ministries), a Record of Decision is prepared by RDB.
(8) Project approval: Following step (7), the official document on the decision is published.
(9) Dual monitoring: Regular monitoring proposed in the EIR is conducted by the developer and RDB. REMA is also involved if necessary.
(10) Project compliant: Referring to the monitoring results, RDB observes whether the agencies have implemented the project in manners determined by the approval.
(11) Audit The agencies continue self-auditing of the project.

Source: Modified from General Guidelines and Procedure for Environmental Impact Assessment, 2006

Figure 1-3 EIA Procedure in Rwanda

1-3-1-4 Scoping and Zero Option Comparison

In April 2004, JICA established the "Japan International Cooperation Agency Guidelines for Environmental and Social Considerations" (hereinafter referred to as "JICA guidelines") upon combining the previous guidelines of Japan Bank for International Cooperation and JICA. Since the establishment, all preliminary studies of grant aid projects conducted by JICA must follow the regulated procedure. Environmental and social consideration was carried out based on the results of environmental impact assessment made by JICA before commencement of this study, and the project was categorized according to the following 4 categories (these were previously categorized into 3 categories) , depending on their possible impacts expected on the environment and societies of project target sites and surroundings.

Category A: Project having possibility for significant and unfavorable impacts on the environment and society

Category B: Project which can cause unfavorable impacts on the environment and society less than that of Category A

Category C: Project having minimum or no unfavorable impacts on the environment and society

Category FI: JICA investments to a financial institution or other legal entity in which, after JICA's approval of the financing, the financial institution will practically select and examine a specific subproject, but before JICA's financing approval (or project examination), the subproject cannot be specified and presumed to have potential environmental impacts

Information necessary for evaluation was collected through interviews with relevant organizations and field surveys at the study area. Here, conceivable impacts to be caused by implementing this project will be identified and examined from environmental and social aspects based on the scoping matrix described in the JICA Guidelines, consisting of 30 items under three fields. Also, based on environmental and social impacts for zero option, comparison with the scoping results is made in the next table.

Table 1-6 Scoping Matrix

Item			Rating			Brief Description
			Construction phase	Operation phase	Without project	
Social Environment	1	Involuntary Resettlement	D	D	D	1) Residential areas are not found around water sources to be used. 2) New tanks and pumping stations will be constructed in public empty spaces and pipelines will be newly installed along existing public roads.
	2	Local Economy such as Employment and Livelihood, etc.	D	D	D	1) At the construction phase, employment opportunities can be expected. 2) Construction of public tap stands around residential areas will save time for people's fetching water.
	3	Land Use and Utilization of Local Resources	D	D	D	New tanks and pumping stations will be constructed in public empty spaces and pipelines will be newly installed along existing public roads.
	4	Social Institutions such as Social Infrastructure and Local Decision - making Institutions	C	D	D	In order to achieve efficient and sustainable water supply services, the establishment of new water service providers will be recommended.
	5	Existing Social Infrastructures and Services	D	D	D	New facilities will be constructed in public spaces. Also, since sanitary water will be supplied, qualitative improvements in domestic water use can be expected.
	6	The Poor, Indigenous and Ethnic people	D	D	D	At present, water is free. Introducing the water fee payment system may cause difficulties for economically vulnerable people to procure their water.
	7	Misdistribution of Benefit and Damage	D	D	D	Since public tap stands are public facilities, a significant misdistribution of benefits cannot be conceived.
	8	Cultural heritage	D	D	D	No heritage exists in the target sites.
	9	Local Conflicts of Interest	D	D	D	Establishing new community water service providers for O&M can promote ownership and reduce local conflict of interests.
	10	Water Usage or Water Rights and Communal Rights	D	D	D	Due to management by a new water supply provider, water rights can be ensured and responsibilities of water users can be clarified.
	11	Sanitation	C	D	A	Improvement in public health through supply of clean water is one of the basic objectives of the project. Since water quality of water sources is confirmed, target residents will receive advantageous effects in health and hygiene.
	12	Hazards (risk) Infectious Diseases such as HIV/AIDS	C	D	A	1) At the construction phase, the influx of workers into the Project area may cause risks in health aspects. 2) After completion of the project, the improvement in public health as a result of improved accessed to clean water can prevent water-borne diseases such as cholera.
Natural Environment	13	Topography and Geographical Features	C	D	D	1) At the construction phase, land preparation works may affect the Project area. 2) Since pipelines will be laid following existing topographic conditions, impacts are not expected.
	14	Soil Erosion	D	D	D	Since rural water supply facilities are of small scale, serious soil outflow due to installation and use of facilities will not occur.
	15	Groundwater	D	D	D	The main water source is springs with groundwater as secondary source, but since rural water supply facilities are small scale, design water supply rates are low and will not have negative impact on groundwater.
	16	Hydrological Situation	D	D	D	Since rural water supply facilities are small scale and design supply rates are low, impacts on rivers from use of springs and groundwater are not expected.
	17	Coastal zone	D	D	D	No coastal zone exists.

Item			Rating			Brief Description
			Construction phase	Operation phase	Without project	
	18	Flora, Fauna and Biodiversity	C	D	D	1) During the construction phase, land preparation works may affect vegetation by cutting grasses and small trees. 2) No protected area exists in the project area.
	19	Meteorology	D	D	D	Since designed facilities are small scale, significant impact on meteorology is not expected.
	20	Landscape	C	D	D	Although storage tanks and pump houses will be newly constructed, they are not large to have impacts.
	21	Global Warming	D	D	D	Since designed facilities are small scale, emission rates of CO_2 gases to cause global warming are not significant to generate any impacts.
Pollution	22	Air Pollution	C	D	D	1) Construction machinery and vehicles used during the construction works may emit exhaust gases. 2) The amount of emission gases during operation of the water supply facilities is small and will not have significant impact to cause air pollution.
	23	Water Pollution	C	D	D	1) Since wastewater during the construction stage is managed to prevent water contamination, impacts are small. 2) Since supply of drinking water is the objective during the operation stage, amount of contaminated water is low to have no negative impact.
	24	Soil Contamination	C	D	D	1) Pollutants during the construction works may contaminate the soil. 2) Since chemicals to cause soil pollution are not necessary during the operation phase, significant impacts are not expected.
	25	Waste	C	D	D	1) Small amounts of wastes will be generated during the construction phase. 2) No wastes will be generated during the operation phase.
	26	Noise and Vibration	C	D	D	1) Construction machinery and vehicles may temporarily generate some noise and vibration during the construction works 2) During the operation stage, significant impacts are not expected.
	27	Ground Subsidence	D	D	D	Since design water supply rates are low, possibilities of ground subsidence from use of water sources cannot be conceived.
	28	Offensive Odor	D	D	D	Elements causing offensive odor are not used at both the construction and operation phases.
	29	Bottom Sediment	D	D	D	Since water sources for this project are springs and groundwater, factors to affect bottom sediments in lakes and rivers are not found.
	30	Accidents	C	D	D	1) Construction vehicles can cause accidents due to carelessness during the construction phase. 2) Since vehicles and large machinery are not used during the operation phase, accidents are not expected.
Overall rating			C	D	A	

Evaluation Categories:
A: Serious impact is expected.
B: Some impact is expected.
C: Extent of impact is unknown. Examination is needed. Impacts may become clear as study progress.
D: No impact or very small impact is expected. Further study is not necessary.

The water supply plan to be finally formulated in this project includes new construction of rural water supply schemes and expansion of existing water supply facilities, and therefore, implementation of this project was determined to fall under Category C.

1-3-1-5 Environmental Management Plan, Monitoring Plan and Mitigation Measures

As part of EIA, an environmental management plan needs to be prepared by the project implementation organization as the developer. According to the Guidelines, the objective of the plan is to streamline environmental issues into the business and operational plans of a development project. As for institutional systems for environmental management and monitoring in Rwanda, a dual level monitoring system works on the project implementation process. In the system, a developer is responsible for regular monitoring activities on the basis of the environmental management and monitoring plans and for compiling and analyzing data/information obtained in the activities into annual monitoring reports and RDB reviews those monitoring reports and make comments on them if necessary. Lead agencies related to the project (MININFRA and EWSA) and REMA may also attend at this procedure as well. If a developer does not comply with the plan, it could face penalties and project closure which are determined by the authorities above.

The scoping matrix and impacts to be considered in the design and implementation of the target sites were explained above. The mitigation measures against the impacts as well as environmental management and monitoring plans are shown in the next table. As explained previously, prior to the commencement of a water supply development project, the developer is required to submit the Project Brief to RDB, and RDB identifies the level of expected environmental and social impacts of the project and determines whether or not the project needs an EIA study. And rural water supply project such as this Project has never need an EIA study in the past.

Table 1-7 Provisional Environmental Management and Monitoring Plan

Impact		Mitigation	Monitoring methods	Responsibility	Implementation schedule
Construction phase					
Accidents		1)Control of vehicles' routes around the construction sites for construction works 2)Safety control around the construction sites 3)Control methods will be confirmed between the developer and contractor. Additionally, the methods must be notified to people around the Project area.	1), 2) and 3) Regular safety patrol in and around the construction sites	Contractor	To be determined under the construction contracts between the contractor and the developer, under the local authority's supervision if necessary
Pollution	Water	1)Installation of treatment systems for wastewater from construction sites	1)-1 Regular quality monitoring and observation of flows of wastewater and sewerage 1)-2 Regular maintenance of the systems	Contractor Developer Local authority	
	Air	1)Selection of emission-controlled vehicles	1)Regular air quality monitoring around the construction sites		
	Construction Waste	1)Discussions with local authorities on locations for waste disposal and set up appropriate disposal points	1)Regular clearance and maintenance of waste disposal points		
	Noise and Vibration	1)Selection of appropriate machinery 2)Control of working period and daily time schedule	1)Regular monitoring of noise and vibrations around the construction sites 2)Monitoring of daily working schedule and routes of vehicles		
	Odor	1)Appropriate management of wastewater and wastes from construction works and wastes of workers 2)Protection of waste disposal points agreed with local authorities	1)Regular monitoring around the construction sites 2)Regular maintenance and monitoring of waste disposal points		
Land preparation		1)Site inspection to minimize amount of soil excavated and the area where grasses and small trees are cut.	1)Control of vehicular transportation at the area to be prepared	Contractor Developer Local authority	
Waste management		1)Discussions with local authorities on appropriate methods and locations for waste disposal 2)Prepare waste disposal points nearby construction sites	1) and 2) Regular monitoring and maintenance of the waste disposal systems	Contractor Developer Local authority	
Operation phase					
Establishment of new water supply systems and water service providers		1)Identification of existing socio-economic situations around the planned beneficial areas 2)Identification of requirements and conditions for establishing new water service providers 3)Establishment of water tariff systems	1)Conducting social assessments prior to the Project 2)Regular supervision during the establishment process 3)Regular discussions among beneficiaries, developer, local authorities and new water service provider members, if they exist	Developer Local authority Water service provider (after establishment)	To be discussed and determined at when the new water service provider is established
Noise and vibration from the pumping station		1)The location may be proposed far from residential areas.	1)The location will be determined in the detailed design stage.		To be discussed at the detailed design stage when locations of facilities are explained
Waste management around public tap stands		1)Establishment of waste management systems 2)Maintenance and clearance of areas surrounding the tap stands	1)Create a monitoring and maintenance group and carry out regular monitoring of the system 2)Monitor clearance and maintenance of surroundings		To be discussed at the detailed design stage when locations of facilities are explained

1-3-1-6 Stakeholder Consultation

RDB is in charge of conducting public hearings during the EIA process. In the Guidelines, the purpose of public hearings is defined as "to furnish interested and affected parties and the public with an opportunity to comment on, or raise issues relevant to an application for environmental authorization". Therefore, development projects are required to hold public hearings even though some of them are not necessarily required to conduct the EIA studies. The Guidelines suggests that attendants to be included should be at least government ministries, local governments covering the project area, environmental committees, trade associations, public, local committees, NGOs and the developer.

Meetings on three major stages are to be held as public hearings. First, public hearings are to be held before commencement of the EIA study after the Project Brief is accepted in order to explain the project itself to the people and organizations which may be affected with the project, and receive any comments and objections from them. The second is during the EIA study, aiming at identifying issues and impacts raised by the people and organizations. Frequencies of the public hearings are dependent on the project, but RDB or relevant authorities may require the developer to hold a hearing when they identify the necessity. The third is after completion of the EIA study in which the results of the EIR submitted by the developer is informed to the public. Finally, after completion of whole public hearings, the Public Hearing Report will be submitted to RDB. The Report will be opened to the public through various media.

1-3-2 Land Expropriation and Resettlement

In Rwanda, procedures of exploiting private property for public interests are based on the "Law No. 18/1007 of 19/04/2007 relating to Expropriation in the Public Interest".

Projects for constructing water supply facilities as targeted in this study are not included individually as "Acts of public interests" described in Article 5. However this Article has a description saying "basic infrastructure and any other activities aimed at public interest which are not indicated on this list that are approved by an Order of the Minister in charge of expropriation, at own initiative or upon request by other concerned persons". Because water supply facilities may contribute to public livelihoods, projects of setting up water supply facilities may be categorized into that item. The Law stipulates requirements for each process of land expropriation as shown in Table 1-8.

Table 1-8 Requirements for Land Expropriation Process

Process	Organization in charge	Chapter
1. Preparation of an application for land expropriation Contents of the application: − Description of the project proposal − Indication that the project is aimed at public interest − Land use plan on which the project shall be carried out − Document indicating that the project does not degrade the environment − Proof confirming the availability of the value of just compensation − Explanatory note to verify that such a land or place suits the project − Minutes indicating that the concerned population was sensitized on the importance of the project	Executive Committee at the District Level	8, 11
2. Evaluation of the application	Land Commission at the District Level	9
3. Consultative meeting with population to be affected by the project and finalization of the project	District Land Commission at the District Level	12
4. Preparation of the list of project-affected population at the time of land expropriation	Land Commission at the District Level	16
5. Establishment of compensation systems against lands and economic activities to be affected by the project	Land Commission at the District Level	21, 22, 23, 24, 25
6. Implementation of land expropriation activities	District Council	10

Source: Prepared by JICA Study Team with reference to the Law No. 18/2007 of 19/04/2007 relating to Expropriation in the Public Interest

CHAPTER 2

CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Project Objective and Overall Goal

In 2000, Rwanda has fixed the development goals in "Vision 2020 (2000-2020)" for each sector including the water supply sector. The plan sets the goal of 100% access to safe drinking water by 2020. Then, the target year of this goal has been revised to 2017 by the "Seven Years Government Program (2010-2017)" and EDPRS 2 (2013-2018).

In 2010, the Rwandan government formulated *National Policy and Strategy for Water and Sanitation Services* (hereafter referred to as "Water and Sanitation Policy (2010)" in which fundamental concepts such as definition of "Safe Water" were set forth. In 2013, Strategy part of this Policy and Strategy (2010) was revised as *Water and Sanitation Sector Strategic Plan*, where strategic plans were elaborated aiming to achieve the goal mentioned above.

Meanwhile, coverage rate of safe drinking water supply has been evolved from 2005 to 2011 as indicated in the table below according to the survey reports by NISR.

Table 2-1 Water service Coverage per Province

Province/City	EICV2（2006）	EICV3（2012）
Kigali City	84.8%	82.7%
Southern Province	73.4%	74.8%
Western Province	67.8%	74.2%
Northern Province	76.7%	78.9%
Eastern Province	57.7%	66.6%
Rwanda	70.3%	74.2%

EICV：Integrated Household Living Conditions Survey（Enquête Intégrale sur les Conditions de Vie des ménages）
Data were collected during 2005 and 2011 for EICV2 and EICV3 respectively.

The national water supply coverage was 74.2% in 2011. Although the percentage has increased in some provinces during 6 years from 2005 to 2011, there was no significant progress as a whole, and this situation puts the Rwandan government under the pressure for accelerated improvement. Particularly the water supply coverage rate of Eastern Province, the target area of

this project, is one of the lowest among the 4 Provinces in Rwanda, estimated at 66.6%.[1]

Under such situation, the project aims "To improve the coverage rate of Eastern Province by supplying safe potable water to the population of the province". As a result, the overall goal of this project is expected "To improve the sanitary and living conditions of the people in the target area".

To achieve the project objective mentioned above, the construction of water supply schemes along with a software component plan will be implemented at the 3 Districts of Ngoma, Kayonza, and Gatsibo. After the completion of this project, the service population will increase by approximately 33,000 persons to become about 80,000 persons in the target year (2020)[2]. Also, the average coverage rate of the 3 Districts will increase from 66.6% (2013) to 88.2% (2020).

2-1-2 **Outline of the Project**

To achieve the project objective mentioned above, this project will implement the construction of water supply schemes accompanied by the software component plan at 4 sites in 4 Districts. With this implementation the water supply coverage rate of the target area is expected to increase.

(1) Construction of Water Supply Schemes

In this project, piped water schemes using springs and boreholes as water sources will be constructed at 3 sites. Due to geographical features, Rukira, one of the target sites, will have 2 schemes, and thus the number of water supply schemes to be constructed will be 4 in total. This project will ensure about 33,000 increased service population in the target year 2020.

The daily water supply plan and list of water supply facilities for each site are shown in the following tables.

[1] Source: The Third Integrated Household living Conditions Survey (EICV3) (2012)

[2] The target year for this project is fixed at 2020 upon the request from the Rwandan government, rather than 2017 which is the target year of the "Seven Years Government Program" (Refer to Appendix 1 "Minute of Discussion").

Table 2-2 Daily Water Supply Plan for this Project

No.	Target Site (Sector)	No. of Target Cells	Target Cell	Design Service Population (2020) (pers.)	Design Daily Average Supply Rate (m^3)
1	Rukira	2	Nyarubumu Kibatsi	8,087	162
2	Murama	3	Nyakanazi Muko Rusave	10,663	213
3	Remera	4	Nyagakombe Kigabiro Rurenge Butiruka	14,451	289
Total		9		33,201	664

Table 2-3 List of Water Supply Facilities of this Project

Facility		Quantity					
		Unit	Rukira (East)	Rukira (West)	Murama	Remera	Total
Intake Facility	Intake Facility	unit	1	1	2	4	8
	Conveyance Pipeline	km	－	0.1	0.1	－	0.2
Transmission Facility	Receiving Tank	unit	1	1	1	1	4
	Control House	unit	1	1	3	4	9
	Balancing Tank	unit	－	－	2	2	4
	Transmission Pipeline	km	0.8	0.4	3.7	4.8	9.7
	Chlorination Room	unit	1	1	－(*1)	－(*1)	2
Distribution Facility	Distribution Tank	unit	1	1	1	1	4
	Distribution pipeline	km	4.7	10.2	28.7	15.7	59.3
	Monitoring Room	unit	－	－	1	1	2
	Break Pressure Tank	unit	1	－	5	3	9
Water Service Facility	Public Tap Stand	Nos	7	16	27	29	79

*1 Chlorination unit is installed inside the control house.

(2) Software Component Plan

In order to establish a management structure for water facilities to be constructed by this project, a software component plan will be implemented. In Rwanda, the owner of constructed water schemes is the District. Recently, privatization of water scheme management is being promoted, and daily operation and maintenance tasks are managed by private Water Service Providers (WSPs) such as enterprises and cooperatives, whereas the District has responsibility

in supervising them (see 2-2-1-8 and 2-4 for more details). Taking in account of this tendency and to strengthen the WSPs on operation and maintenance of water schemes, the software component plan of this project aims for the following main points.

1) To support target Districts to select appropriate water service providers
2) To support selected water service providers to operate and manage the constructed water schemes appropriately
3) To support selected water service providers to promote sanitation awareness to the population in target sites in order to increase the number of facility users

2-2 Outline Design of the Japanese Assistance

2-2-1 **Design Policy**

2-2-1-1 Basic Concept

Based on the basic design of "The Project for Rural Water Supply (2006)" (hereafter, referred to as the "Phase 1 Project") and the master plan formulated in "The Study on Improvement of Rural Water Supply in the Eastern Province in the Republic of Rwanda (2008- 2010)" (hereafter, referred to as the "Master Plan"), the basic concept of this project was the construction of small scale water supply facilities using spring sources. However, as a result of field surveys, changes from the previous projects in natural conditions such as spring yield and changes in water supply situation of each target site were confirmed. Also, contents of the request from the Rwandan side were modified. Therefore, the basic design of previous projects and master plan concepts were reviewed. The evolution in change of contents of the project is explained in Sections (1) to (3) below.

(1) Concept on Spring Yield Fluctuation

For this project, water supply schemes will be constructed basically using springs as water source in accordance with the Master Plan, but the hydrological survey carried out in this survey revealed that spring yields are limited. This meant that water could not be supplied to the total population of requested sites.

Usually for water supply projects, water supply facilities are planned according to design water supply rates based on targeted populations. However, for this project, in view of the water

source situation, the service population is calculated based on the flow rate of the water sources and the supply facilities are designed accordingly. The details are shown in Section 2-2-1-3 Concept for Natural Conditions, (1) Water Source.

(2) Evolution of Changes in Survey Target Sites

At the beginning of the project, a total of 11 sites were survey targets before departure of the survey team to Rwanda (March 2013): 3 sites which became out of scope from the Phase 1 Project and "The Project for Rural Water Supply Phase 2 (2010)" (hereafter, referred to as the "Phase 2 Project") and 8 sites selected from the priority projects of the Master Plan. Before arrival of the survey team (in March 2013), JICA Rwanda office carried out a confirmation survey on the target sites at each district and due to changes in the target sites requested by the districts, the number of target sites became 13. However, during the discussions on the Minutes of Meeting (June 2013), at the request of EWSA, 8 sites out of the 13 sites were selected as the survey target sites. Furthermore, during the second survey in Rwanda, since overlaps with projects of the Rwandan government and other donors were confirmed, the number of survey target sites became 6. The evolution in changes of target sites is shown in the next table.

Table 2-4 Changes in Survey Target Sites

District	Site (Sector)	Scheme Code from Master Plan	Before Survey in Rwanda March 2013	JICA Rwanda Office Survey March 2013	Minutes Agreement April 2013	Second Survey in Rwanda June 2013
Kirehe	Gahara	KiPs01	○	×	—	—
	Mushikiri	KiPs19	○	○	—	—
	Kigina	KiPs12	○	○	—	—
	Mahama	KiPs13	○	○	○	×
	Musaza	KiPs17	—	○	○	○*1
Ngoma	Kibungo	NgPs03	○	×	—	—
	Rukira	NgPs13	○	○	○	○
	Gashanda	NgPs01	○	×	—	—
	Rurenge 1	NgPs14	—	○	—	—
	Rurenge 2	NgPs15	—	○	—	—
Kayonza	Murama	KaPs09	○	○	○	○
	Ruramira	KaPs16	—	○	○	○
Gatsibo	Remera	GaPs01	○	○	○	○
	Kageyo	GaPs05	○	×	—	—
	Murambi	GaPs08	—	○	○	×
Nyagatare	Katabagemu	NyPs06	○	○	○	○*2
	Ngoma	NyPs09	—	○	—	—

*1 Service area changed to a cell different from Master Plan

*2 For this scheme, the scope was changed (before departure to Rwanda); scope consisting of pipeline extension and public tap stands only was changed to a scope to include intake facility and supply pipeline

2-2-1-2 Selection of Target Sites

As a single fiscal year grant project, implementation is expected to start in 2014. Since the construction period limit is 24 months after the E/N, a project scale appropriate for implementation within this period needed to be considered and due to budget constraints of the Japanese government, a screening using selection criteria and priority ranking of the target sites had to be conducted. The selection process for the project sites is described below.

(1) Site Selection using Project Implementation Selection Criteria

Criteria for selection of project sites for implementation based on 9 items were agreed during the discussions on the Minutes of Meeting (refer to Appendix 4 Minutes of Discussions) at the beginning of the survey in Rwanda. In accordance with the criteria, each site was evaluated based on field survey results as shown in the table below.

Table 2-5 Evaluation of Each Site according to Selection Criteria

Criteria for Selection of Project Site			Musaza	Rukira	Murama	Ruramira	Remera	Katabagemu
1	Urgency (Coverage Rate)	Presently the site is not supplied with water	High	High	High	High*1	High	High
2	Population Scale	Population size can be covered by 1 water scheme	8,595	8,087	10,663	9,624	14,451	3,661
3	Water Source Reliability (Demand, water quality, daily demand in dry season)	Monthly spring yield fluctuation is low and spring yield has allowance against design population	Moderate	Relatively High	Relatively High	Moderate	High	None
4	Water Resources Development Possibility	Other than springs, possibility for borehole development as complementary water source	No	No	No	No	Yes (3 test wells)	No
5	O&M Capacity*2	Existence of management body and stable district O&M capacity	–	–	–	–	–	–
6	O&M Cost (Per capita O&M cost/Cost appropriateness)	Water tariff compared to income of user is appropriate	**High**	Low	Intermediate	**High**	Intermediate	Low
7	Water Supply Type (Gravity, pumped, booster necessary)	O&M is simple (gravity type has advantage)	Moderate	Simple	Moderate	**Somewhat Difficult**	Moderate	Easy (Gravity)
8	Accessibility (Cost of access road construction)	Road construction cost for access by construction vehicles and electrification cost are not high	Access: No Elect. Cost: High	Access: No Elect. Cost: Mid	Access: Need Elect. Cost: Mid	Access: No Elect. Cost: Mid	Access: No Elect. Cost: Mid	Access: No Elect. Cost: None
9	Willingness to Pay for Water Supply Services	Users are willing to pay	Yes	Yes	Yes	Yes	Yes	Yes

N.B. Does not meet criteria, Possess relative problems

*1 Public taps managed by EWSA exist in target cell

*2 Since active WSPs do not exist in target sites, presently evaluations cannot be made. Remera and Katabagemu had WSPs for previous existing schemes, but presently activities have stopped.

As shown above, Katabagemu has problems with water source reliability and water resources development possibility. The flow rates of the 4 water sources intended for Katabagemu cannot meet the water demand for the population of Katabagemu (approx.. 50,000 persons). On the other hand, since other usable springs are not available and the area does not have potential for

large scale groundwater development capable of meeting the water demand for this site, the possibilities for water resources development was judged to be low. Consequently, the sites meeting the selection criteria are, excluding Katabagemu, the 5 sites of Rukira, Remera, Murama, Musaza and Ruramira.

However, due to budget constraints for implementation of the Japanese grant aid, since all of the above 5 sites may not be implemented, 4 sites were decided to be selected out of the 5 sites. As shown in the above table, large differences are not seen for urgency and service population, but from the viewpoints of operation and maintenance cost and construction cost, those for Musaza and Ruramira are higher than other sites. The reasons are that for both sites, (1) due to large height differences between the water source and water service area, multiple control houses are needed, which results in increasing fuel costs, and (2) since a scattered number of springs are to be used as water sources, construction cost to connect these sources becomes high. Moreover, in Kayonza district where Ruramira is located, an AfDB water supply program "LV-WATSAN"[3] is planned which includes construction of a water treatment plant to supply water to all areas of Kayonza. Although the total plan of LV-WATSAN is not yet decided, Ruramira has possibilities to become targeted. As a consequence, out of the selected 5 sites, Ruramira was decided to be excluded for a project implementation site. Although those 4 sites in 4 districts had been determined in the Minutes of Meeting on the Draft Outline Design Survey, the request letter from EWSA, which consisted of the 3 sites listed in Table S-1, was submitted due to the reason of the tax exemption system for bilateral assistance to Rwanda, and therefore the target sites became the 3 sites.

(2) Selection of Project Implementation Sites

As a result of excluding Ruramira, outline design for the 4 sites of Musaza, Rukira, Murama and Remera were carried out. However for Musaza, if commercial power cannot be used as power source for the facility, the cost for operation and maintenance will be high and the cost may not be covered by the water fees willing to be paid by the beneficiary. Therefore, the plan is formulated under the condition that the Rwandan side electrifies the site. Also for Murama and Remera, if the sites cannot be electrified, then operation and maintenance has possibilities to become difficult, and so, promotion for electrification of these 2 sites is also desired. For more details on operation and maintenance costs, refer to 2-5-2.

[3] This is an AfDB funded program to supply water to Kayonza area through the construction of a water treatment plant using Muhazi Lake as water source.

2-2-1-3 Concept for Natural Conditions

(1) Water Source

As explained previously, to effectively distribute the limited spring yield, the design makes considerations on spring yield fluctuations. Table 2-6 shows the feasible water supply rates based on spring yield measurements made from July to October 2013 in this survey. For spring yield fluctuations from the hydrological survey of this survey, refer to Appendix 6 (2) Results of Hydrological Survey.

(2) Water Quality

For rural water supply in Rwanda, EWSA is managing water quality following WHO Guidelines for Drinking Water Quality. From results of field surveys, values of water quality parameters, other than biological parameters (such as coliform groups), pH, turbidity and color, sufficiently meet the guideline values. As the schemes to be constructed in this project will mainly use springs, chlorination is essential. Therefore, the spring water will be disinfected with chlorine, so that the biological parameters of water quality will meet the guideline value.

Concerning pH, low value of pH does not mean that the water is unsuitable for drinking, However, because it has possibility to have an adverse effect on the facilities, the existing facilities were observed during the survey to examine whether there was such indication. At existing facilities in the target areas, significant corrosion on Galvanized Steel Pipes was not observed. Also, deterioration of concrete tanks due to water quality was not observed. Therefore, since significant effects on facilities due to low pH values in the target area are not occurring, measures against low pH will not be taken in this project.

(3) Rainy Season

In the target area, the rainy seasons are March to May and October to December, implying that over half of the year is raining. Also, since roads are mostly unpaved, passage by vehicles during the rainy season is expected to be difficult. Therefore, the construction schedule will be prepared with sufficient consideration for effects on the construction during the rainy season.

Table 2-6 Feasible Water Supply Rate

Site No.		2		3		4			
Target Site (Sector)		Rukira		Murama		Remera			
District		Ngoma		Kayonza		Gatsibo			
Sector Population		25,447		19,981		26,183			
Sector Population Growth Rate (%) (From 2012 Census)		3.5%		3.5%		2.5%			
A	Sector Population (2020)	33,509		26,311		31,901			
Name of Water Source		Kabuye (East)	Akanyirarukima (West)	Gicaca	Gaseke	Nyabukobero	Borehole 1	Borehole 2	Borehole 3
B	Yield (m^3/hr)*	2.758	10.605	6.005	7.159	6.05	7	6	5
C＝B×24	24 hrs Yield (m^3)	66.192	254.52	144.12	171.816	145.2	84	72	60
D=C×0.75×0.9	Effective Yield (m^3) **	44.6796	171.801	97.281	115.976	98.01	75.6	64.8	54
E=D/20/1000	Feasible Service Population	2,234	8,590	4,864	5,799	4,901	3,780	3,240	2,700
F＝Σ En	Feasible Service Population (Site Total)	2,234	8,590	10,663		14,621			
G	Beneficiary Population***	2,234	5,853	10,663		14,451			
G/A×100	Population Ratio within the sector (%)	24%		41%		46%			

Total Beneficiary Population (***)	33,201

* Spring yields are calculated from minimum yields of measurements from April to July 2013 and borehole yields are determined from pumping tests (August)

** Effective yield = [Spring yield (m^3/hr) x 24 (hr) x 75% x 90%] (25% is discharged downstream, 10% is unaccounted-for water)
For boreholes, subtract 10% unaccounted-for water from pumping rate for 12 hours

*** Beneficiary population (G) = [Spring yield (m^3/hr) x 24 (hr) x 75% x 90%] / [0.02m^3/cap/day]
Rukira Sector has a large administrative district area and a variety of geography. Therefore, an administrative district in this sector was set up at “Cell level”. Target water service area in Rukira (East), namely Kibats Cell has a population of 7,170 people and the area in Rukira (West), namely Nyarubumu Cell has 5,853 in 2020. According to Rukira (West), the feasible service population for yield (site total) (8,590) exceeds the number of people in target service area (5,853), so that the number (5,853) was set to the beneficiary population.

(4) Height Difference in Topography

Rwanda has topography with plenty of undulations of valleys and hills. The height differences between water sources and water service areas are so large that if the difference is over 110m, pumps and storage tanks need to be installed at suitable locations in order to prevent pipelines and ancillaries as well as pumps from being damaged from excessively high pressures. Pumps and pipe materials available from local agents in Rwanda will be preferentially selected and procurement of spare parts will also be given consideration.

(5) Ground Foundation

Around some water sources (springs), the ground is found to be soft. As a result of the geotechnical survey, weak ground requiring confirmation was detected at 2 locations (Rukira and Murama) and therefore, additional surveys will be carried out during the detailed design stage.

2-2-1-4 Concept on Socio-Economic Situation

(1) Residents' Awareness on Use of Spring Sources

Although springs will be used as water sources for this project, some are already being used by residents in surrounding areas and downstream. According to Rwandan law, springs belong to districts, but presently, since the sense of ownership by surrounding residents is high, requests from EWSA to give consideration to these residents in the facilities design were received. In actuality, from the fact that water supply facilities of Gashure 1 and 2 springs at Katabagemu were destroyed for the similar reason, attention needs to be paid to the possibility for vandalism in this project as well.

In view of the above situation, in this project, the design will make consideration that springs will be used not only for the target sites, but the present users such as those around the water source and downstream residents can also continue to use the sources (Refer to Section 2-2-2-1 Water Supply Plan). In most cases, new public tap stands cannot be constructed for those who currently use the water source due to topographical condition of where they live. Collection of water fees from users of the source water should be finally decided by the district, who is in charge of scheme management and supervision.

(2) Grouped Resettlement (Imidugudu) Policy

Grouped settlement was originally not a custom of Rwanda, but after the civil war, as an emergency assistance to returnees, collective housing centers were constructed. This was part of the campaign to promote the grouped resettlement (imidugudu) policy of the government where settlements were relocated and concentrated on mountain ridges for reasons of effectiveness in improvement of social infrastructure. Due to this policy, although communities were resettled from low areas where drinking water was readily available to higher areas, this project will be planned in consideration of this housing environment peculiar to Rwanda.

(3) Current conditions of Infrastructures

With respect to electricity, almost none of the target site is electrified. Therefore, the power source of water supply schemes for this project will be primarily diesel generator, but since using generators will increase operation and maintenance costs, the Rwandan government is advised to electrify these sites.

In terms of road, conditions are not very good. In the phase 2 Project, the cost of maintenance road construction was borne by the Japanese side. However, in this project, unspecified temporary road for construction works is to be constructed at one site (Murama) only and self-support efforts of the Rwandan side will be promoted as much as possible.

(4) Umuganda

In Rwanda, community service activities called umuganda are held once every month in the morning of the last Saturday of the month. All residents are obligated to participate in these activities and during the umuganda period, traveling by vehicles is prohibited where police control is enforced everywhere. Since participation in umuganda is basically required for all residents, the implementation plan and construction schedule of this project will be prepared with due consideration for actual working days.

2-2-1-5 Concept on Existing Schemes

In the target sites, there are no functioning piped water schemes, and only broken and deteriorated non-functioning facilities exist. In this project, damaged and deteriorated existing

facilities will not be rehabilitated while new water schemes will be constructed. However, protected springs and intake facilities will be used maximally to assure sufficient intake yield.

In some non-target sites within the same sector, gravity schemes and hand pumps can be found, but water fees are not being collected for most of the schemes. As there could be a possible implication with this project schemes, a policy for water fee collection at these existing schemes needs to be well discussed with the districts.

2-2-1-6 Concept on Procurement of Materials, Equipment and Labor

(1) Concept on Procurement of Materials

Since the market for construction materials and equipment in Rwanda is not yet well developed, reliable contractors for procurement of public works are very few. Also, many problems in quality of materials are found and frequent stock shortages are observed to delay delivery of goods implying a lack of stable supply. In this situation, for this project, procurement in Rwanda will be limited to materials and equipment without any problems from the viewpoints of quality and distribution, and other materials and equipment will be procured from Japan or surrounding third countries. For equipment such as pumps and generators, those procurable from local agents in Rwanda will be given priority. Concerning third country procurement, suppliers of good quality materials and equipment in surrounding countries such as Kenya and Tanzania where markets are well developed will be expected. However, in the Phase 2 Project, when materials were imported from major trading firms in third countries, problems were found in quality, resulting in a schedule delay. Therefore, measures such as thorough inspection of goods before selection of suppliers and preloading inspection before transport should be taken in advance.

Aggregates, crushed stone and sand etc. are procurable in Rwanda. Aggregates for concrete will be purchased from appropriate quarries and shops in Kigali with consideration for quality, stable supply and costs (including transport cost). Other materials such as crushed stone and sand for pipe protection will be procured from confirmed quarries and shops in Eastern Province.

(2) Concept on Procurement of Labor

Laborers for simple works can be procured locally around the target sites. However,

according to results of the Phase 2 Project, for supervisory and managerial positions such as foremen, capacities of Rwandan workers are uncertain, and therefore procurement from Japan or third countries will be considered. Also, as explained in the next section, since capacities of specific skilled workers (such as mechanics, electricians and plumbers) of Rwandan subcontractors cannot be anticipated, these workers will be procured from third countries.

2-2-1-7 Concept on Use of Local Contractors (Construction Companies and Consultants)

Local contractors with engineering experience are available in Rwanda, but most of their experiences are construction works on roads and buildings around Kigali and contractors having interest in water supply works with similar work experience are rare. Also, concerning construction works other than simple works such as excavation, Rwandan contractors are not yet well experienced especially in terms of quality control, schedule management and safety control.

For construction works of the Phase 2 Project, local subcontractors were used, but due to lack of capacity of workers, problems such as reworks and schedule delays on main works were observed. Some local subcontractors did not follow instructions and directions of the Japanese prime contractor, which hindered the smooth performance of the works and created serious problems. In consideration of this situation, for this project, local subcontracting will be avoided in principle and the Japanese prime contractor will directly hire workers only for simple works. For skilled labor, well experienced local laborer will be procured only when their capacities are deemed sufficient for those types of works. For works in which capacity cannot be anticipated from local laborers, procurement will be made from third countries (mainly, Kenya and Tanzania).

2-2-1-8 Concept on Operation and Maintenance

Under Rwandan law, the district is designated as the owner of rural water supply schemes.[4] Operation and maintenance of water supply schemes is carried out by community organizations (water users associations) or private service provider (WSPs: cooperatives or enterprises), and management and supervision over those organizations is under the responsibility of districts.

In Rwanda, privatization is being promoted for rural water supply where the district selects

[4] National Policy & Strategy for Water Supply and Sanitation Services, 2010

private WSPs through tendering and contracts the successful tenderers. However, it has been revealed that due to capacity shortage of districts, their roles such as contracting with private WSPs and supervising them are not adequately fulfilled. Therefore, in some districts, rather than following the operation and maintenance system as stated in Rwanda's water policy, their management and supervision responsibilities are exceptionally requested to EWSA (refer to 2- 4 Project Operation and Maintenance Plan).

In this project, while respecting the proper system of operation and maintenance, in view of the capacities of districts, the exceptional case of a tripartite contract between the 3 parties of district, EWSA and WSP will also be considered as an option. Also, in order to establish an operation and maintenance system in which WSPs can continuously operate and maintain the water supply schemes, a software component plan will be conducted.

2-2-1-9 Concept on Application of Quality Grading of Facilities and Equipment

In accordance with various concepts described above, quality grading of facilities and equipment will be based on the following concept.

- Quality of materials and equipment: The level of Japan's grant aid will be maintained while materials and equipment will be procured within Rwanda as much as possible. Access to spare parts will be also well considered.
- Quality of facilities (level of construction quality): The level of Japan's grant aid will be maintained, while appropriateness and applicability of technology level in Rwanda will be taken into account. Also usability by beneficiaries and WSPs' capacity of operation and maintenance will be considered carefully.

2-2-1-10 Concept on Construction Method and Construction Schedule

(1) Concept on Construction Method

Design standards will basically follow Japanese standards and construction methods will be local methods in Rwanda. The construction methods for this project are as follows.

Table 2-7 Construction Methods for this Project

Work Type	Applied Method
Earthwork	Earthworks for civil works and plumbing will be trenching by manpower
Plumbing	1) Outdoor buried pipes will be high-density polyethylene pipes and exposed pipes will be galvanized steel pipes. 2) Installations will basically be stainless steel pipes.
Structure	1) Foundations, floors, pillars, beams and roofs of buildings will be of reinforced concrete structure with mortar and paint finishing. 2) Walls of buildings will be of piled concrete blocks with mortar finishing 3) Main structure of storage tanks will be reinforced concrete, and the inside the tank will be treated for waterproof. (For underground type tank, both inside and outside will be treated.)
Concrete	On-site machine mixing using batch mixer

(2) Concept on Construction Schedule

This project is a single fiscal year grant aid project, and so the construction period is 24 months after the E/N. In this project, water supply schemes will be constructed at 4 sites with about 69 km of pipeline which is a relatively large scale work for a single term project. Therefore, construction will be executed with careful consideration of team organization and team number for each work.

2-2-2 **Basic Plan**

2-2-2-1 Water Supply Plan

(1) Target Year

The target year for this project is 2020 as agreed in the Minutes of Discussions signed at the beginning of the survey. Therefore, for designing the facilities, the population for 2020 will be used as the design service population.

(2) Population Growth Rate and Service Population

In Rwanda, a population census was carried out in August 2012 and the latest populations and population growth rates were announced. Based on this, the 2020 design service populations of the Master Plan were reviewed. Table 2-8 shows the population growth rates of project target sites.

Table 2-8 Population Growth Rates of Target Sites

Target Site (Sector)	RUKIRA	MURAMA	REMERA
Population Growth Rate	3.5%	3.5%	2.5%

(3) Design Water Supply Rate

1) Feasible Spring Yield

In the Phase 2 Project, the plan was formulated using the spring yield in October as the minimum value during the survey period. In this project, in addition to results of spring yield measurements taken from April to October 2013, data from the Phase 2 Project (August 2011 to April 2013: Refer to Appendix 4 Minutes of Discussions) were also analyzed, but the month with minimum value changed by year and was not necessary October. Therefore, for this project, the minimum spring yield within the measurements made during the survey (April to October 2013) was taken as the feasible spring yield.

2) Design Intake Rate

As explained in Section 2-2-1-4, considerations for existing users around the target water source as well as downstream residents are needed. Therefore, 25% of the feasible spring yield will be discharged to residents in surrounding areas and downstream[5].

Design Intake Rate = Feasible Yield (m^3/hr) x 24 (hr) x 75%

However, during the drought periods that occur about twice a year, the 25% discharge will be adjusted according to the demand at that time. In addition, if the supply is insufficient, measures such as limiting service hours will be taken (For details, refer to Appendix 6(2) Results of Hydrogeological Survey).

3) Design Supply Rate

The design water supply rate is calculated under the assumption that 10% of the design intake rate is the unaccounted-for water[6] for the scheme. This is the amount of water for which cost of facility operation cannot be recovered, and includes spilled water at public tap stands, water for cleaning tanks and other facilities and leakages.

[5] At Musaza, since the spring source is being used downstream by a coffee cooperative, the design intake rate is calculated after deducting the amount being used by this cooperative and further considering the discharge rate to surrounding and downstream users.

[6] Concerning the unaccounted-for water rate, 10% is also assumed in Japan's Waterworks Guideline.

(4) Unit Water Supply Rate

The daily minimum water supply rate of 20.0 ℓ/cap/day stipulated in the "Water and Sanitation Policy (2010)" is taken as the unit water supply rate. This was agreed in the previously mentioned Minutes.

(5) Beneficiary Population

The design supply rate divided by the unit supply rate is the beneficiary population.

Beneficiary Population = [Spring Yield (m^3/hr) x 24 (hr) x 75% x 90%] / [0.02m^3/cap/day]

(6) Service Area

The service area was determined from the viewpoints of distance from the water source; priority order of cells; natural conditions such as height differences; and level of difficulty in facilities construction. (For details, refer to Site Layout Drawings)

(7) Water Supply Plan

From the above explanations, the water supply plans for each sector were formulated as shown in the following table.

Table 2-9 Water Supply Plan for Target Sites

Target Sector (Includes Target Site)	Sector Population (2012)	(a) Supply Rate*1 (m^3/day) (2012)	(b) Increased Supply Rate due to Project (m^3/day) (2016)	(c) Supply Rate at Project Completion (m^3) (2016)	(d) Service Population at Project Completion (Persons) (2016)	(e) Projected Population (Persons) (2020)
RUKIRA	25,447	339	162	501	25,035	33,509
MURAMA	19,981	266	213	479	23,970	26,311
REMERA	26,183	349	289	638	31,889	31,901
Total	71,611	954	664	1,618	80,894	91,721

*1 Estimate from existing facilities
(c) = (a) + (b), (d) = (c) ÷ 20ℓ/cap/day

Table 2-10 Water Coverage Improvement at Target Sectors

Target Sector (Includes Target Site)	Service coverage rate[7] (2020) (d)÷(e)	Ratio of Service Population to Sector Population (%) (2020)	Coverage Rate Improvement (2012 – 2020)	Service Population without Project (2020)	Service Population with Project (2020)
RUKIRA	75%	24%	9%	16,948	25,035
MURAMA	91%	41%	25%	13,307	23,970
REMERA	78%	45%	34%	17,438	31,889
Total for 3 Sectors	85%	35%	19%	47,693	80,894

As a result, average daily supply rate increases by 836m^3 and the service population increases by 33,201. Consequently the coverage rate for the 3 sectors will improve from 66.6% in 2012 to 88.2% in 2020. From Table 2-9, the coverage rate (2020)=(d) ÷(e)= 80,894 ÷ 91,721 = 88.2%

(8) Calculation of Water Coverage Rate

The water coverage rate of Rwanda includes not only the coverage rate for piped water schemes, but also coverage rates for protected springs and rainwater harvesters. Concerning existing water supply schemes in the target sites of this project, the piped water schemes are not functioning due to breakages and deterioration, and therefore the residents are relying on springs. The coverage rate calculation will assume that these springs are included in the coverage, the coverage rate (66.6% for Eastern Province) from EICV 3(2012) which is the latest data will be adopted as a base.

Coverage rates were also calculated in the Master Plan, but since more than 4 years has lapsed from formulation of the Master Plan and changes in numbers of protected springs, rainwater harvesters and other water supply schemes cannot be confirmed for that period, these coverage rates will not be used.

2-2-2-2 Water Supply Facilities Plan

The water supply facilities in this project consist of water source facilities (intake facilities and conveyance pipelines), transmission facilities (receiving tanks, control houses, balancing tanks, transmission pipelines, chlorination houses), distribution facilities (distribution tanks,

[7] This percentage includes protected springs and rainwater harvesting facilities. It is based on the method by the Rwandan government.

distribution pipelines, monitoring rooms, break pressure tanks), and water service facilities (public tap stands of 1 tap and 2 taps)

In the control houses, mechanical, electrical and instrumentation equipment (such as booster pumps, control panels, electrical generators, valves, and instrumentations) will be installed.

The outlines of water supply facilities for each site are shown in the following drawings:

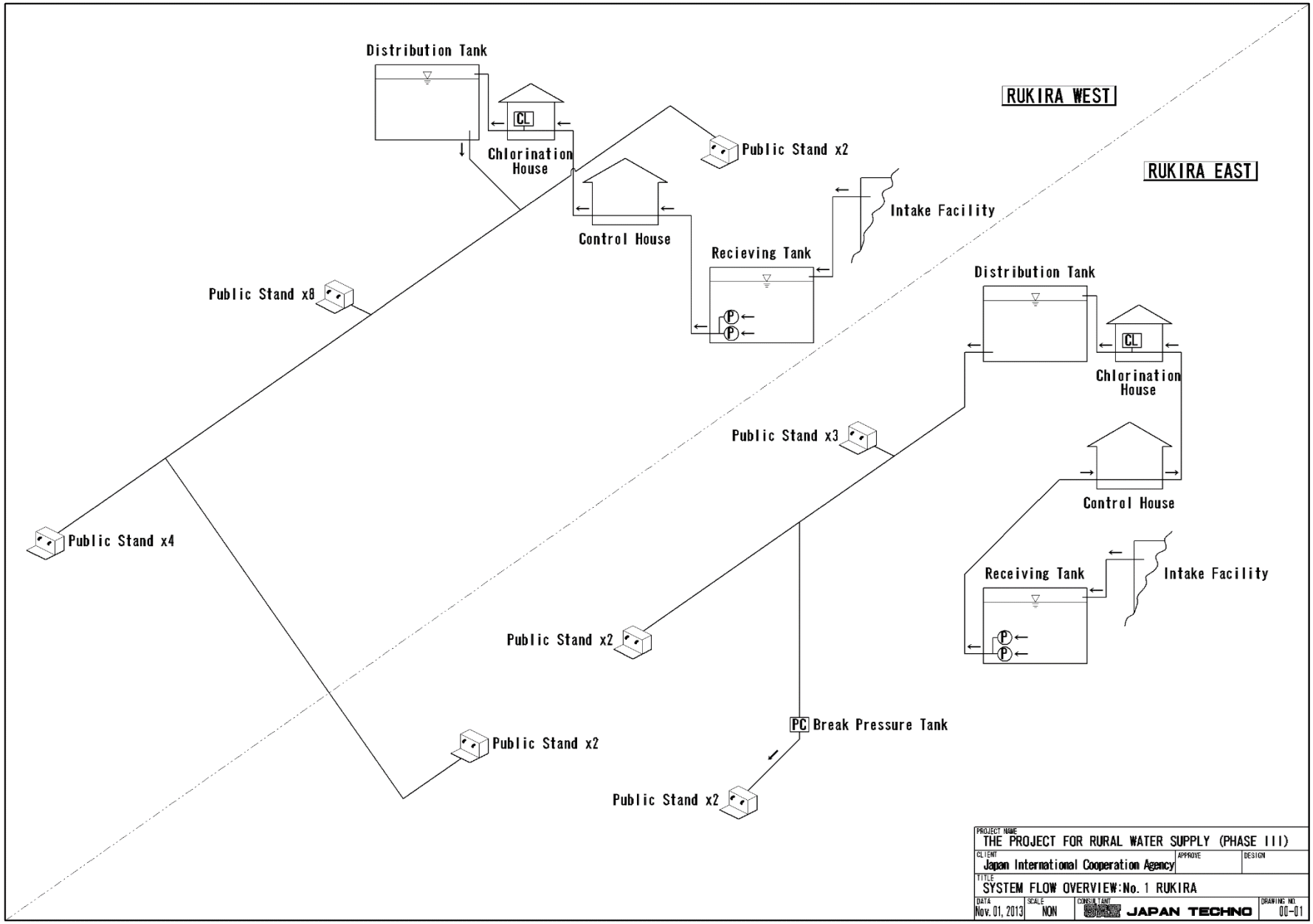


Figure 2-1 System Flow Overview: Site No.1 Rukira

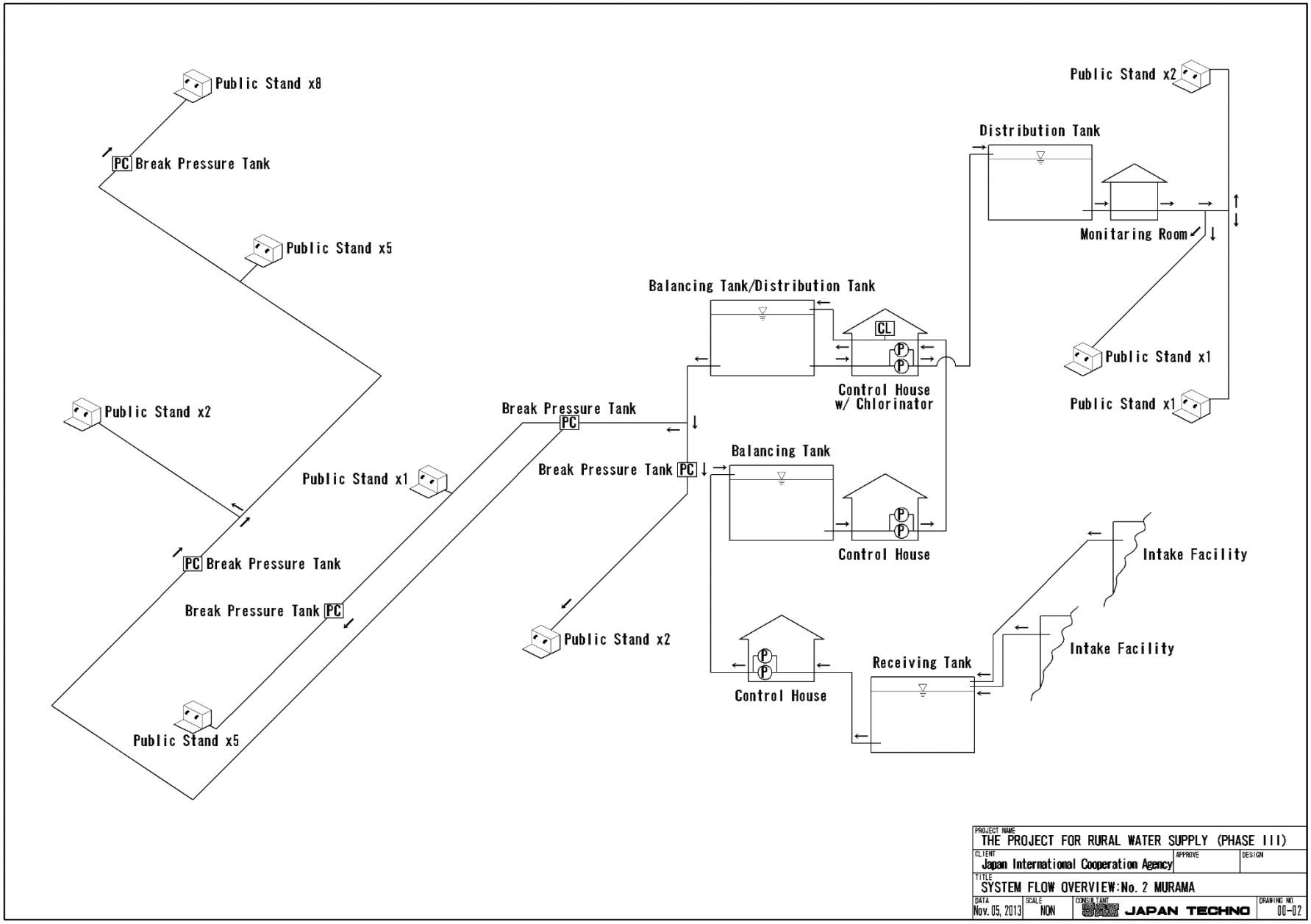


Figure 2-2 System Flow Overview: Site No.2 Murama

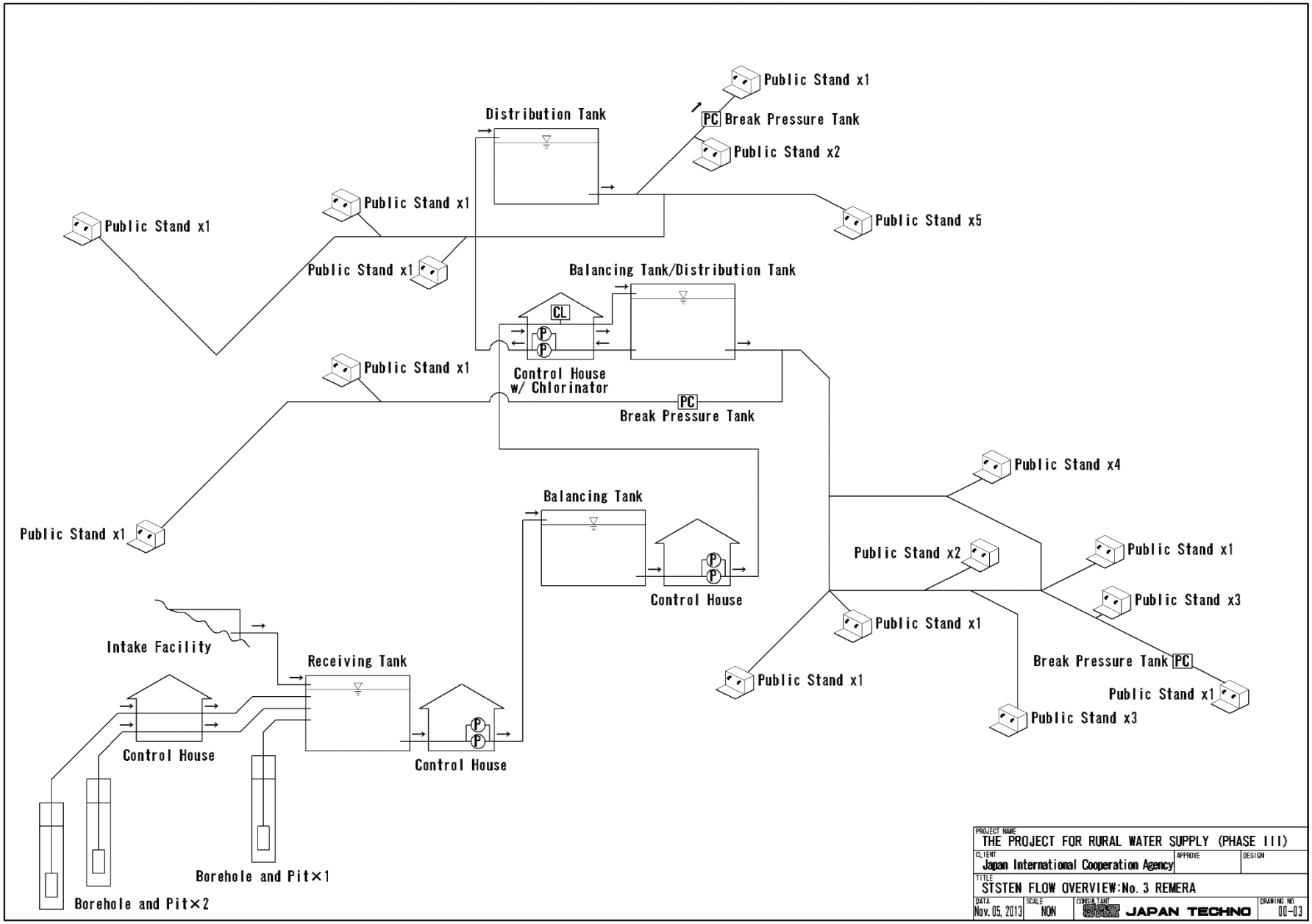


Figure 2-3 System Flow Overview: Site No.3 Remera

For the design of water supply facilities in this project, the following design policy will be adopted in consideration of environmental and social conditions of each target site.

(1) Common Design Policy

1) Compressive Strength of Concrete Structures (Specified design strength)

(a) For water tanks: 24N/mm^2

(b) For reinforced structures (excluding water tanks which require high water-tightness) : 21N/mm^2

(c) For unreinforced structures: 18N/mm^2

2) Pipeline Design

(a) Covering Depth

- Unpaved roads: Minimum 60cm (laid along the road)
  Minimum 80cm (laid across the road)
- Paths and areas other than roads: Minimum 60cm
- In case hard rocks are found in shallow layers or outcropped, pipelines will be laid over the ground.

(b) Design Water Pressure

(i) Conveyance, transmission (by gravity) and distribution pipelines

Water pressures of conveyance, transmission and distribution pipelines will be designed to be less than 0.7MPa through the use of break pressure tanks. For sections where the design water pressure of the pipeline become more than 0.7MPa, durable pipeline materials capable of resisting high pressures will be used.

Minimum dynamic water pressures of distribution pipelines will basically be designed to be over 0.1MPa (10m residual hydraulic head) at the branch points to public tap stands.

(ii) Transmission pipelines (pressurized by pumping)

Minimum dynamic water pressures of transmission pipelines pressurized by pumping will be set as over 0.05MPa (5m residual hydraulic head) at inlets of water tanks.

(c) Hydraulic Calculations

- Internal diameter > 50mm: Hazen Williams Formula
- Other than the above: Weston Formula

- Coefficient of flow velocity: 110

(d) Pipe Materials

In principle, pipe materials will be as follows:

- Pipes for installations inside facilities: stainless steel pipes
- Pipes for buried laying: high density polyethylene (HDPE) pipes
- Pipes for exposed laying: galvanized steel pipes (GSP)

(2) Facility Design

1) Intake Facility

(a) Utilization of Existing Intake Facility

If an intake facility already exists at the spring intake point, a new intake facility will be constructed utilizing the existing intake facility. A typical structure of the intake facility designed to collect as much spring water as possible is shown in Figure 2-5.

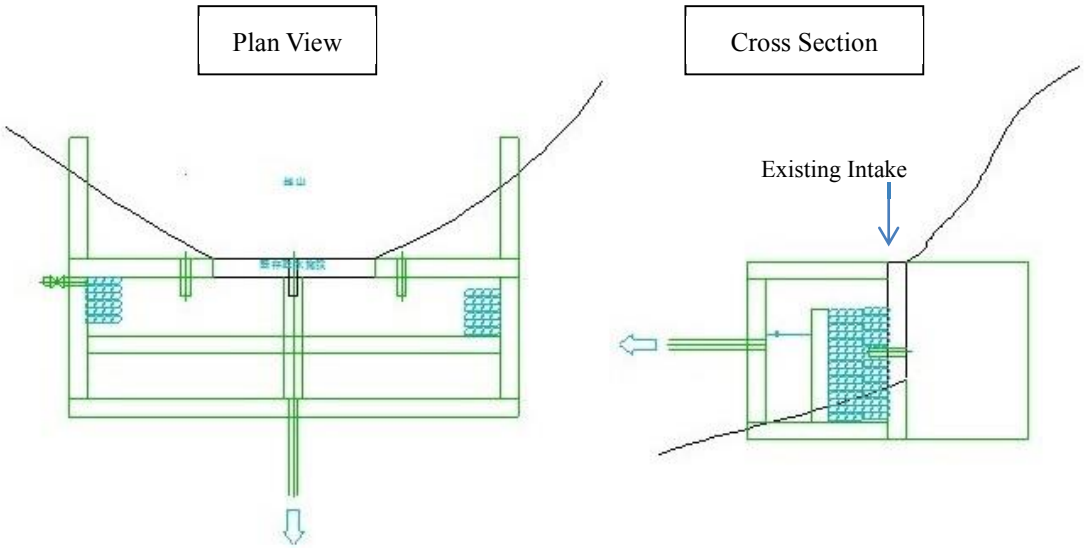


Figure 2-4 Typical Structure of Intake Facility (Making Use of Existing Intake Facility)

(b) When Intake Facility is not Existent

For the case where an intake facility does not exist at the spring intake point, the typical structure for the new intake facility is shown in Figure 2-6. If the spring intake point is formed with rock, the edge of the new intake facility will be constructed directly on the rock surface joined by steel bars. Otherwise, the new intake facility will be constructed after excavating the ground down to some extent. However, if the excavation has possibilities to affect the quantity, quality and/or passage of spring water due to its geological structure, excavation will be limited only to the ground surface.

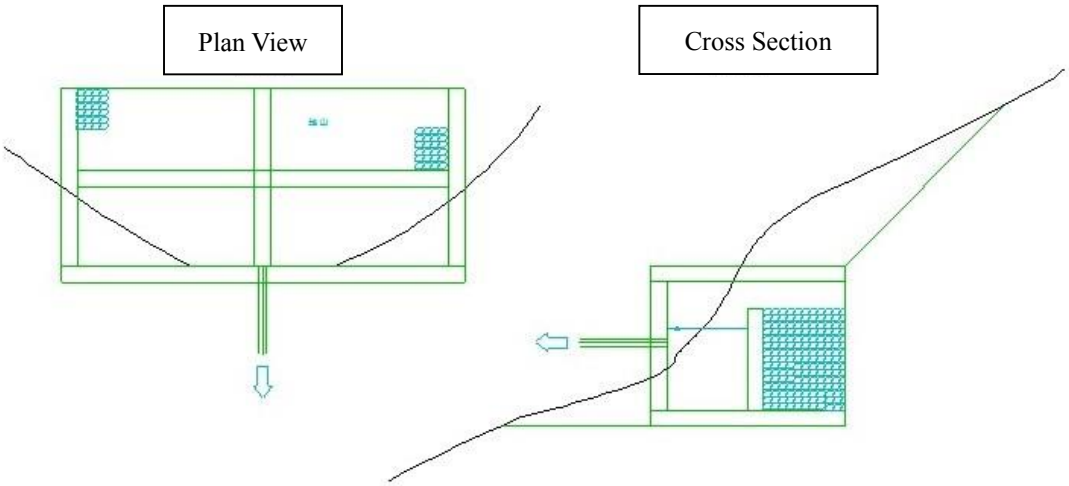


Figure 2-5 Typical Structure of Intake Facility (Without Existing Intake Facility)

(c) Common Design Policy for Intake Facility

- In principle, 1 tap of 1/2" (15A) will be installed on or near each intake facility so the population living near the spring can fetch the spring water.
- Crushed stones will be filled up to about 30cm below the top slab of intake facilities considering maintenance efficiency. The crushed stones should not include any sand or fillers.
- Intake facilities will be of reinforced concrete (RC) structures.
- Top slabs of each intake facility will have maintenance holes with steel covers.

(d) Boreholes (for Remera Scheme only)

In the preparatory survey, 3 test drillings were conducted and developed as successful productive boreholes. In this project, these 3 boreholes will be used as the water sources. The details of these boreholes are shown in Appendix-6(4).

2) Conveyance Pipeline

Specifications of conveyance pipelines will be decided according to design pressure. Wherever conveyance pipelines are to be connected, catch pits will be installed at the connecting points.

3) Receiving Tank

Receiving tanks will be designed as rectangular-type reinforced concrete tanks. As a standard, they will be designed as above-ground type tanks. However, in case high water levels (HWL) of receiving tanks must be higher than the dynamic water levels of the conveyance pipelines, they will be designed as underground type or semi-underground type.

For the design of receiving tanks, the long term bearing capacity of the ground and the influence of buoyancy due to high groundwater level must be considered. Receiving tanks will consist of two basins considering convenience in maintenance. Effective capacities of tanks will be designed as the amount of intake for 18 hours including a 2 hours reserve amount, under the assumption that the operation period of transmission pumps is 8 hours. In case of utilizing boreholes, the capacities will be the difference between the operation hours of borehole pumps and transmission pumps with additional 2 hours as reserve. Inside walls of receiving tanks will be of epoxy painting for waterproofing. In case of underground tanks, water proof mortar will be applied on outsides of tanks.

4) Control House

Control houses will consist of separate rooms for generator, control and operator along with installations for transmission. Considering water hammer pressure, air valves will be installed appropriately along transmission lines to prevent generation of water column separations due to negative pressures. Other appropriate equipment, such as air chambers, will be installed as necessary. Moreover, the dimensions and layouts of doors as well as delivery routes for replacement of generators and transmission pumps will be given consideration.

Concerning power sources, although electrification of each site is being requested to the Rwandan government to suppress operation and maintenance costs, even if electrifications are realized, in consideration of Rwanda's power supply situation, since power failures are frequent in Eastern Province, diesel generators will be installed in each facility as standby.

5) Transmission Pipeline (pressurized)

The planned hourly transmission rate will be calculated on the assumption that water is transmitted from the receiving tank to the distribution tank or balancing tank for 8 hours per day. The diameters of transmission pipes will be decided through hydraulic calculations. The residual pressure at the inlet of the water tank will be more than 0.05MPa (residual hydraulic head 5m) in principle. Regarding the selection of piping materials, the design pressure will be followed in (2) Facility Deisgn in page 2-25.

The operation hours of borehole pumps will be designed as 12 hours per day so that water can be supplied to as many residents as possible.

6) Balancing Tank (Booster Pump Station)

In case the difference in height between the high water level (HWL) of the distribution tank

and the low water level (LWL) of the receiving tank is more than 110m, balancing tanks and control houses will be designed along the transmission pipeline so that the maximum water pressure of the transmission pipeline can be designed below 1.6MPa. This is to avoid using pipes specialized for high pressures and pumps for high hydraulic heads since procurement of spare parts and operation and maintenance are difficult, and also operational risks involved with high pressures will increase. Selection of pumps and generators and measures against water hammering will be in accordance with explanations described in 5). The role of the balancing tank is to balance the outflow from the receiving tank and inflow into the distribution tank. If distributing water directly from the balancing tank to parts of the target area is more effective, the balancing tank will also function as a distribution tank. In this case, the effective capacity of the balancing tank will be calculated by adding the planned transmission amount for 2 hours as a distribution tank to the effective capacity. The calculation of the effective capacity of the distribution tank will follow 7) below. The interior of the balancing tank will be painted with epoxy materials.

7) Distribution Tank

Distribution tanks will be designed as rectangular-type reinforced concrete tanks. Each tank will be designed as an above-ground type and consist of 2 basins considering the convenience in maintenance. The effective capacity of the distribution tank will be calculated according to Table 2-11 based on the Japanese "Design criteria for small water supply facilities (revised version)". As standard unit water supply rates are quite different between Rwanda and Japan, the index will be adapted upon converting the design service population to design daily maximum water supply rate. The design daily maximum water supply rate used as the index will be calculated based on the Japanese "Guidelines for design of water supply facilities (2011)".

Table 2-11 Effective Capacity of Distribution Tank

Design Service Population (Japanese standard)	Design Daily Maximum Water Supply Rate (m^3/day) -Converted value	Effective Capacity of Distribution Tank (m^3)
1,000 < N < 2,000	$200m^3 < Q < 400m^3$	16 hours of Daily Maximum Supply Rate
500 < N < 1,000	$100m^3 < Q < 200m^3$	18 hours of Daily Maximum Supply Rate
300< N < 500	$60m^3 < Q < 100m^3$	20 hours of Daily Maximum Supply Rate
100 < N < 300	$20m^3 < Q < 60m^3$	22 hours of Daily Maximum Supply Rate
Less than 100	Less than $20m^3$	24 hours of Daily Maximum Supply Rate

Interior of the distribution tank will be painted with epoxy considering the raw water quality.

8) Chlorination Room

Chlorine agent will be dosed into transmission pipelines just before the inlets of distribution tanks. To prevent corrosion, uPVC pipes will be used in and around the chlorination room. These pipes will be given attention not to receive direct sunlight.

9) Distribution Pipeline

Diameters of distribution pipes will be decided through hydraulic calculations. The time factor used in hydraulic calculations is 4 for distribution mains, because public tap stands are used intensively for 6 hours in the morning and the evening. In case the number of taps along the pipeline is below 10, the design hourly water supply rate will be calculated by multiplying the number of taps on the pipeline with 20 liters per minute, which is the standard water supply rate per tap (1/2"= 15A). Regarding the selection of piping materials, the design diameterwill be followed in (2) Facility Deisgn in page 2-25.Concrete blocks for protection will be installed along the pipeline at points having more than 45 degrees horizontal or vertical bends.

10) Break Pressure Tank

The effective capacity of the break pressure tank of reinforced concrete will be designed as about 1 m^3. Water-proof mortar will be applied on the interiors of the tanks.

11) Valve Chamber

(a) For sluice valve

The valve chamber for sluice valves will be a cubic structure constructed with concrete blocks. The cover will be made with checkered steel plate reinforced with steel bars. The cover must fully cover the valve chamber and be provided with a durable lock.

The sluice valve will be standard gate-type valve.

(b) For air valve

The structure of the valve chamber for air valves will be the same as the structure for sluice valves. The air valve will be a small-sized, intake/exhaust type with lever (screw-in type).

(c) For washout valve

One set of washout valve will consist of 2 sluice valves. One sluice valve will be installed in the downstream of the main pipeline and the other one will be installed on the washout pipeline. Galvanized steel pipe will be used as the washout pipe. If washout to the side of the road is possible, water will be drained out directly. Otherwise, a drainage pit

will be installed at the end of the washout pipe.

12) Public Tap Stand

Each public tap stand will have 1 or 2 taps as standard and one tap will be designed to serve about 350 persons. Each public tap stand will be allocated at distances of 500 to 1,500 meters depending on the layout of households. Public tap stands will be designed as reinforced concrete structures without any protective housings. The cover of the public tap stand will be of checkered steel plate reinforced by steel bars and will have a durable lock. The water flow meter will be installed with a strainer.

13)Temporary Road for Construction

A construction road will be made at Murama (approx. 600m) and planned as an unspecified temporary work[8] to avoid placing a big burden on the Contractor. The planned location of the construction road will be described in the technical specifications and a suitable temporary work will be planned not to hinder safe construction work procedures. For the cost estimation, volume of excavation will be calculated by multiplying the area of a typical section by its length. Drain ditches will be planned without supporting.

(3) Water Supply Facilities

The required specifications and number of facilities for each site according to the above-mentioned design policy are shown in Table 2-12.

Table 2-12 Water Supply Facilities

Facilities	No. 1 Rukira		No. 2 Murama	No. 3 Remera
	East	West		
Intake / Conveyance Facilities				
Intake Facilities				
Intake Facilities	1	1	1	1
Borehole Pits				3
Conveyance Pipelines				
Buried		83.2m	149.7m	
Exposed		6.0m	6.0m	
Transmission Facilities				
Receiving Tanks				
60m^3 Above-ground type with Pit	1			
110m^3 Underground type with Pit		1		

[8] A suitable temporary work for which method is left to Contractor's judgment

Facilities	No. 2 Rukira		No. 3 Murama	No. 4 Remera
	East	West		
150m³ Above-ground type				1
180m³ Underground type			1	
Control Houses				
Type-A			2	2
Type-B				
Type-C	1	1		1
Type-D			1	1
Balancing Tanks				
30m³ Above-ground type				
30m³ Above-ground type (Deep type)				
150m³ Above-ground type			1	1
Transmission Pipelines				
Buried	527.9m	248.4m	3,126.2m	4,706.2m
Exposed	254.3m	146.3m		4.0m
Chlorination Rooms	1	1		
Distribution Facilities				
Distribution Tanks				
30m³ Above-ground type			1	
110m³ Above-ground type	1	1		1
Distribution pipelines				
Buried	4,725.9m	10,229.2m	28,690.6m	15,737.5m
Exposed	8.0m	16.0m	9.0m	
Monitoring Rooms			1	1
Break Pressure Tanks	1		5	3
Water service Facilities				
Public Tap Stands				
Type A (1 tap)	7	15	23	16
Type B (2taps)		1	4	13
Temporary Road				
Temporary Road			604.6m	

2-2-2-3 Detailed Design Survey

In considering the surveys to be executed during the detailed design stage, survey conditions and necessities for additional surveys are explained below.

(1) Topographical Survey

Necessary topographical measurements based on results of field reconnaissance are already completed. Therefore, additional topographical survey is not necessary.

(2) Geotechnical Survey

From results of the geotechnical survey, bearing capacities required for foundations of the receiving tanks are shown below.

Table 2-13 Results of Geotechnical Survey and Foundation Bearing Capacities

Site	Facility		Bearing Capacity			Additional Survey
	Facility	Slab Level (G.L.-m)	Survey Result * (MPa@G.L.-m)		Required Bearing Capacity (MPa)	Necessary/ Unnecessary
			BH-1	BH-2		
Rukira	Receiving Tank1	0.50	min.0.09@0.5		0.057	Unnecessary
	Receiving Tank2	2.50	0.024@3.0	0.024@3.0	0.054	2 Surveys Necessary
Murama	Receiving Tank	2.65	0.006@3.0	0.018@3.0	0.040	2 Surveys Necessary
Remera	Receiving Tank	0.50	0.042@1.0	0.116@1.0	0.056	Unnecessary

* From bearing capacities reported by subcontractors and those calculated from N-values, the smaller value was adopted

At the locations requiring additional survey as shown in the above table, locating the areas having the required bearing capacities is expected to be difficult. Therefore, foundation soil reinforcements will be planned for project implementation with reference to data obtained during this survey and detailed design survey.

With objectives to collect data necessary to design the foundation soil reinforcements, additional geotechnical surveys will be conducted around the candidate locations for receiving tanks (existing boring points). In this case, additional samples for laboratory soil tests will be taken from lower survey depths.

Table 2-14 Additional Geotechnical Survey for Detailed Design

Site	Facility	Survey Depth	Borings	Standard Penetration Test	Laboratory Soil Test
Rukira	Receiving Tank2	10m	2	2 sets	4 Samples (5.0m and 10m depths)
Murama	Receiving Tank	10m	2	2 sets	4 Samples (5.0m and 10m depths)

(3) Water Source Survey

As explained previously, since spring yields have monthly and yearly fluctuations, if the design yield greatly differs from the actual rate, design modifications might be required. Therefore, during the detailed design stage, surveys for spring yield and spring water quality as well as pumping tests and water quality surveys for test drillings will be carried out.

(4) Policy on Use of Booster Pumps

At the 3 project target sites, due to large height differences between the water sources and distribution tanks of 270 to 340m, the design will include installation of booster pumps. To prevent high pressures (caused by pumping directly up to 300m height difference without a booster), the policy will be, “if the height difference between the high water level of the distribution tank and low water level of the receiving tank is more than 110m, balancing tanks and booster pump stations will be designed and considerations will be made to restrain design of supply pipe pressures within 1.6Mpa”.

On the other hand, from viewpoints of minimization in operational control and salaries for pump operators as well as simplicity of electrical units, EWSA strongly requested maximum use of direct pumping to the distribution tank rather than using booster pumps following experiences in urban water supply for Kigali where large capacity pumps are used. Therefore, after returning to Japan, discussions with the Japanese side concluded that risks from using high pressures should be avoided.

2-2-3 **Outline Design Drawings**

(1) Facilities Layout Drawings

The facilities layout drawings for all 3 sites are shown in the following pages.

(2) Facilities Structural Drawings

Water flow diagrams for each site and structural drawings of main facilities are presented after the facilities layout drawings.

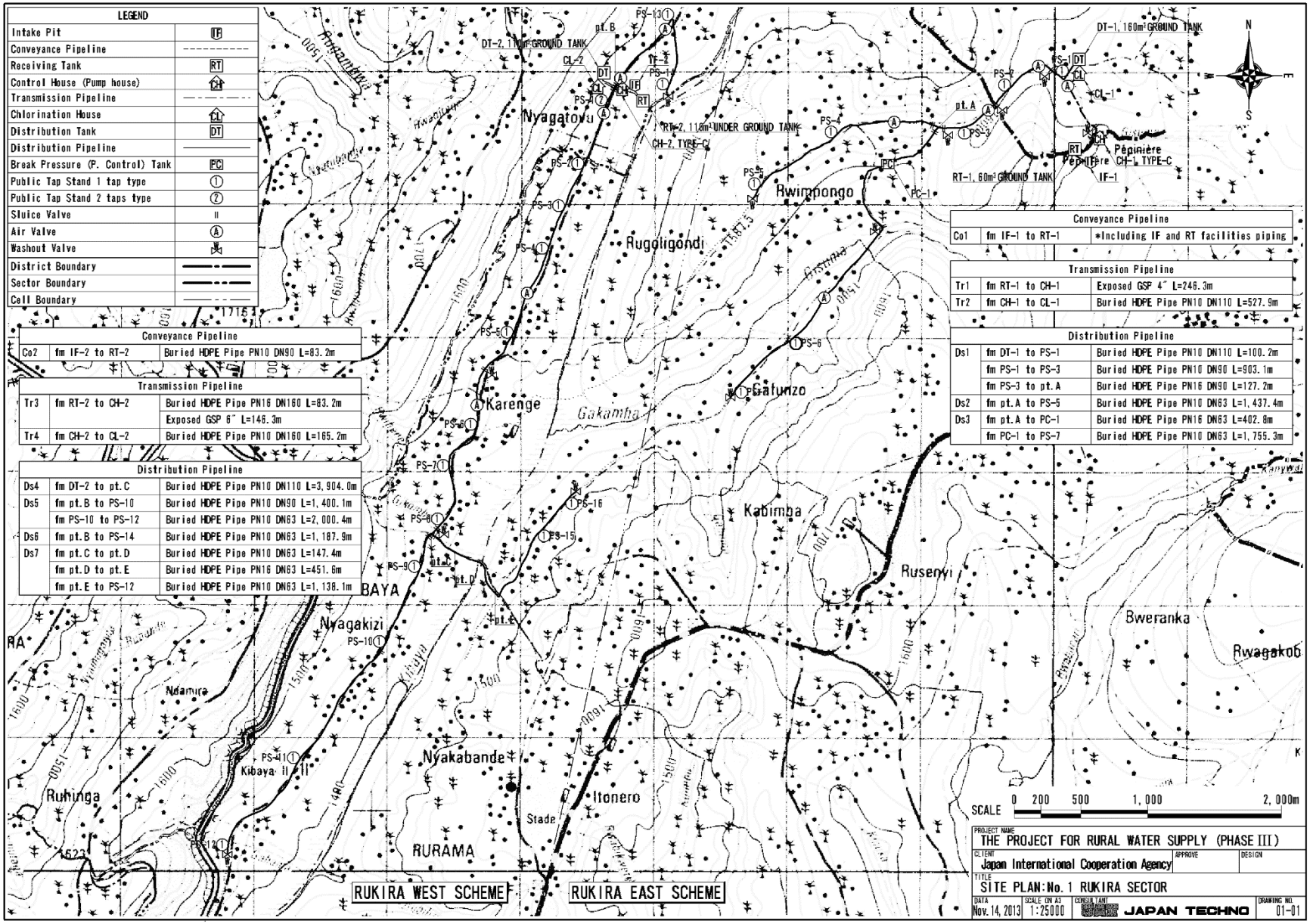


Figure 2-6 Site Plan No.1 Rukira

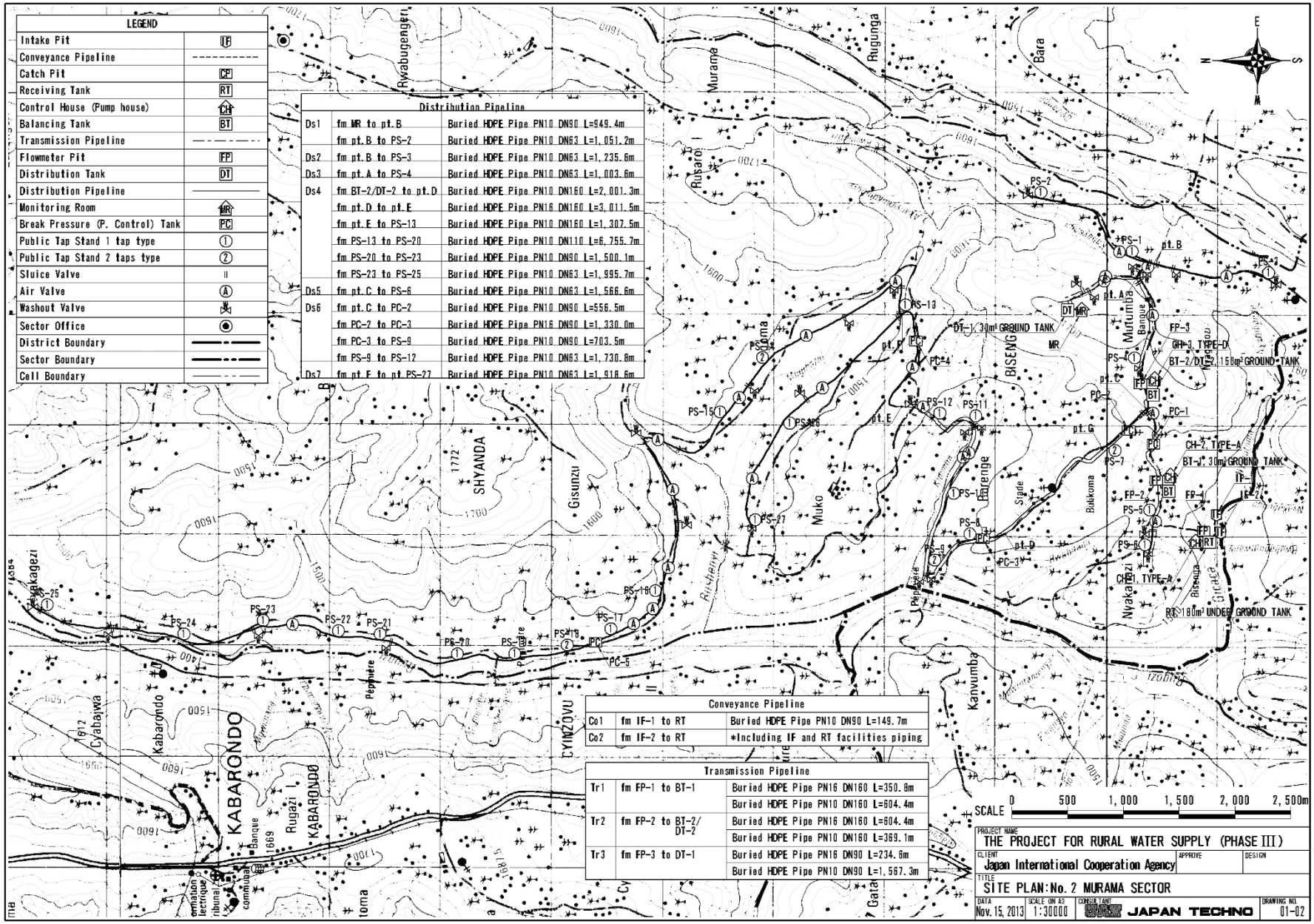
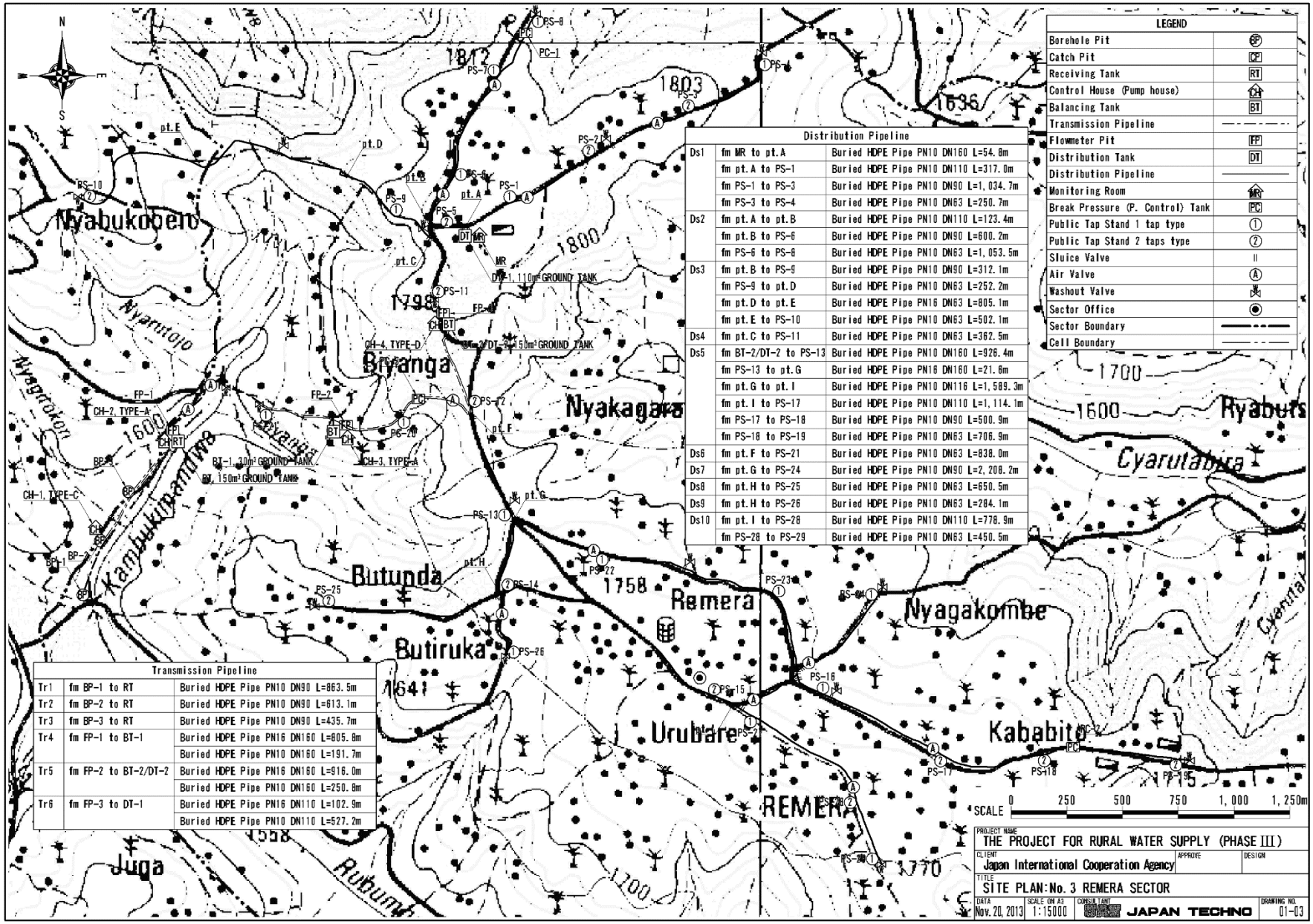


Figure 2-7 Site Plan No.2 Murama



Distribution Pipeline		
Ds1	fm MR to pt.A	Buried HDPE Pipe PN10 DN160 L=54.8m
	fm pt.A to PS-1	Buried HDPE Pipe PN10 DN110 L=317.0m
	fm PS-1 to PS-3	Buried HDPE Pipe PN10 DN90 L=1,034.7m
	fm PS-3 to PS-4	Buried HDPE Pipe PN63 L=250.7m
Ds2	fm pt.A to pt.B	Buried HDPE Pipe PN10 DN110 L=123.4m
	fm pt.B to PS-6	Buried HDPE Pipe PN10 DN90 L=600.2m
	fm PS-6 to PS-8	Buried HDPE Pipe PN10 DN63 L=1,053.5m
Ds3	fm pt.B to PS-9	Buried HDPE Pipe PN10 DN90 L=312.1m
	fm PS-9 to pt.D	Buried HDPE Pipe PN10 DN63 L=252.2m
	fm pt.D to pt.E	Buried HDPE Pipe PN16 DN63 L=805.1m
	fm pt.E to PS-10	Buried HDPE Pipe PN10 DN63 L=502.1m
Ds4	fm pt.C to PS-11	Buried HDPE Pipe PN10 DN63 L=362.5m
Ds5	fm BT-2/DT-2 to PS-13	Buried HDPE Pipe PN10 DN160 L=926.4m
	fm PS-13 to pt.G	Buried HDPE Pipe PN16 DN160 L=21.6m
	fm pt.G to pt.I	Buried HDPE Pipe PN10 DN116 L=1,589.3m
	fm pt.I to PS-17	Buried HDPE Pipe PN10 DN110 L=1,114.1m
	fm PS-17 to PS-18	Buried HDPE Pipe PN10 DN90 L=500.9m
	fm PS-18 to PS-19	Buried HDPE Pipe PN10 DN63 L=706.9m
Ds6	fm pt.F to PS-21	Buried HDPE Pipe PN10 DN63 L=838.0m
Ds7	fm pt.G to PS-24	Buried HDPE Pipe PN10 DN90 L=2,208.2m
Ds8	fm pt.H to PS-25	Buried HDPE Pipe PN10 DN63 L=650.5m
Ds9	fm pt.H to PS-26	Buried HDPE Pipe PN10 DN63 L=284.1m
Ds10	fm pt.I to PS-28	Buried HDPE Pipe PN10 DN110 L=778.9m
	fm PS-28 to PS-29	Buried HDPE Pipe PN10 DN63 L=450.5m

Transmission Pipeline		
Tr1	fm BP-1 to RT	Buried HDPE Pipe PN10 DN90 L=863.5m
Tr2	fm BP-2 to RT	Buried HDPE Pipe PN10 DN90 L=613.1m
Tr3	fm BP-3 to RT	Buried HDPE Pipe PN10 DN90 L=435.7m
Tr4	fm FP-1 to BT-1	Buried HDPE Pipe PN16 DN160 L=805.8m
		Buried HDPE Pipe PN10 DN160 L=191.7m
Tr5	fm FP-2 to BT-2/DT-2	Buried HDPE Pipe PN16 DN160 L=916.0m
		Buried HDPE Pipe PN10 DN160 L=250.8m
Tr6	fm FP-3 to DT-1	Buried HDPE Pipe PN16 DN110 L=102.9m
		Buried HDPE Pipe PN10 DN110 L=527.2m

LEGEND	
Borehole Pit	BP
Catch Pit	CP
Receiving Tank	RT
Control House (Pump house)	CH
Balancing Tank	BT
Transmission Pipeline	
Flowmeter Pit	FP
Distribution Tank	DT
Distribution Pipeline	
Monitoring Room	MR
Break Pressure (P. Control) Tank	PC
Public Tap Stand 1 tap type	①
Public Tap Stand 2 taps type	②
Sluice Valve	
Air Valve	Ⓐ
Washout Valve	
Sector Office	
Sector Boundary	
Cell Boundary	

PROJECT NAME: THE PROJECT FOR RURAL WATER SUPPLY (PHASE III)			
CLIENT: Japan International Cooperation Agency	APPROVE	DESIGN	
TITLE: SITE PLAN: No. 3 REMERA SECTOR			
DATA: Nov. 20, 2013	SCALE ON A3: 1:15000	CONSULTANT: JAPAN TECHNO	DRAWING NO.: 01-03

Figure 2-8 Site Plan No.3 Remera

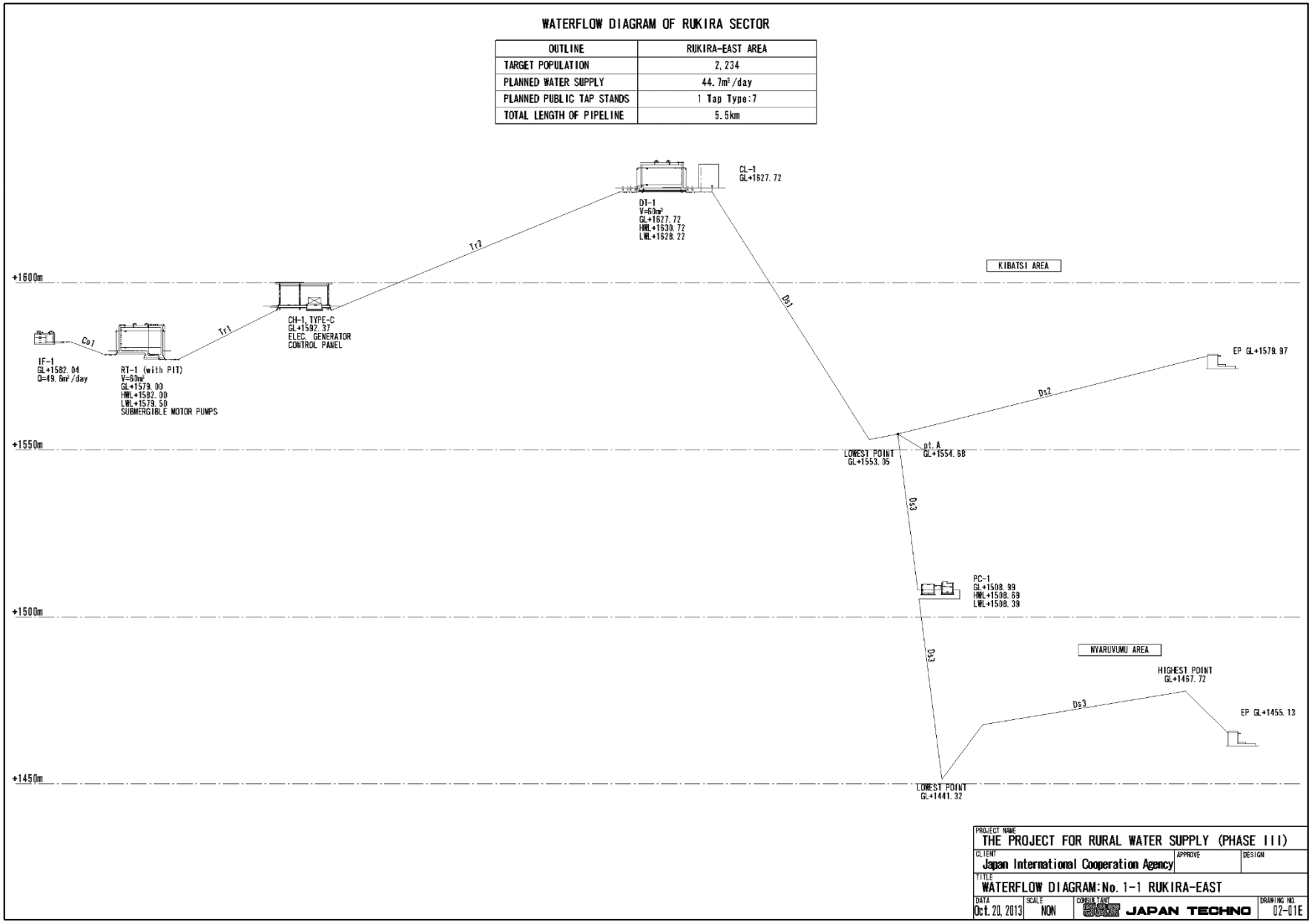


Figure 2-9 Water Flow Diagram No.1 Rukira East

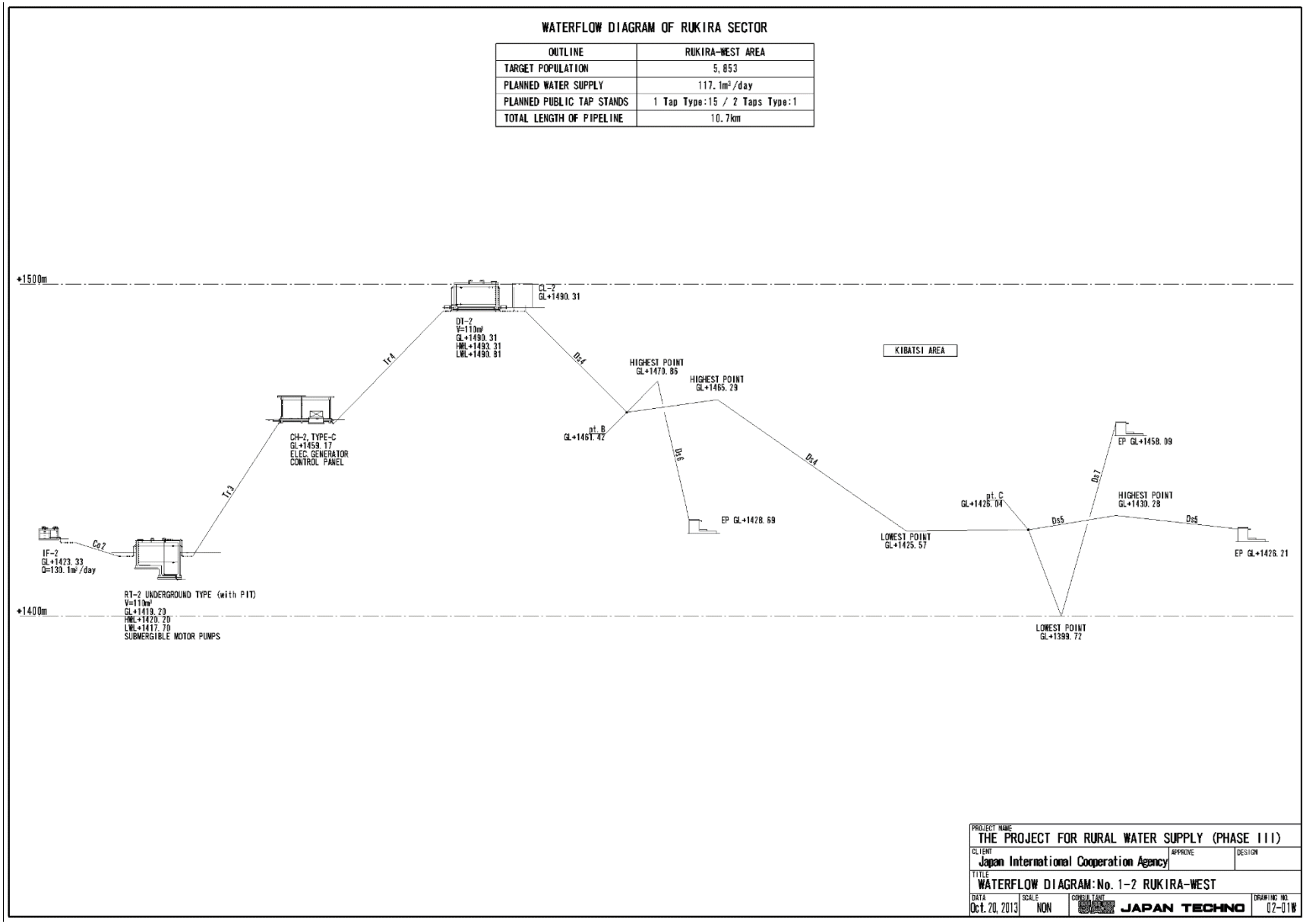


Figure 2-10 Water Flow Diagram No.1 Rukira West

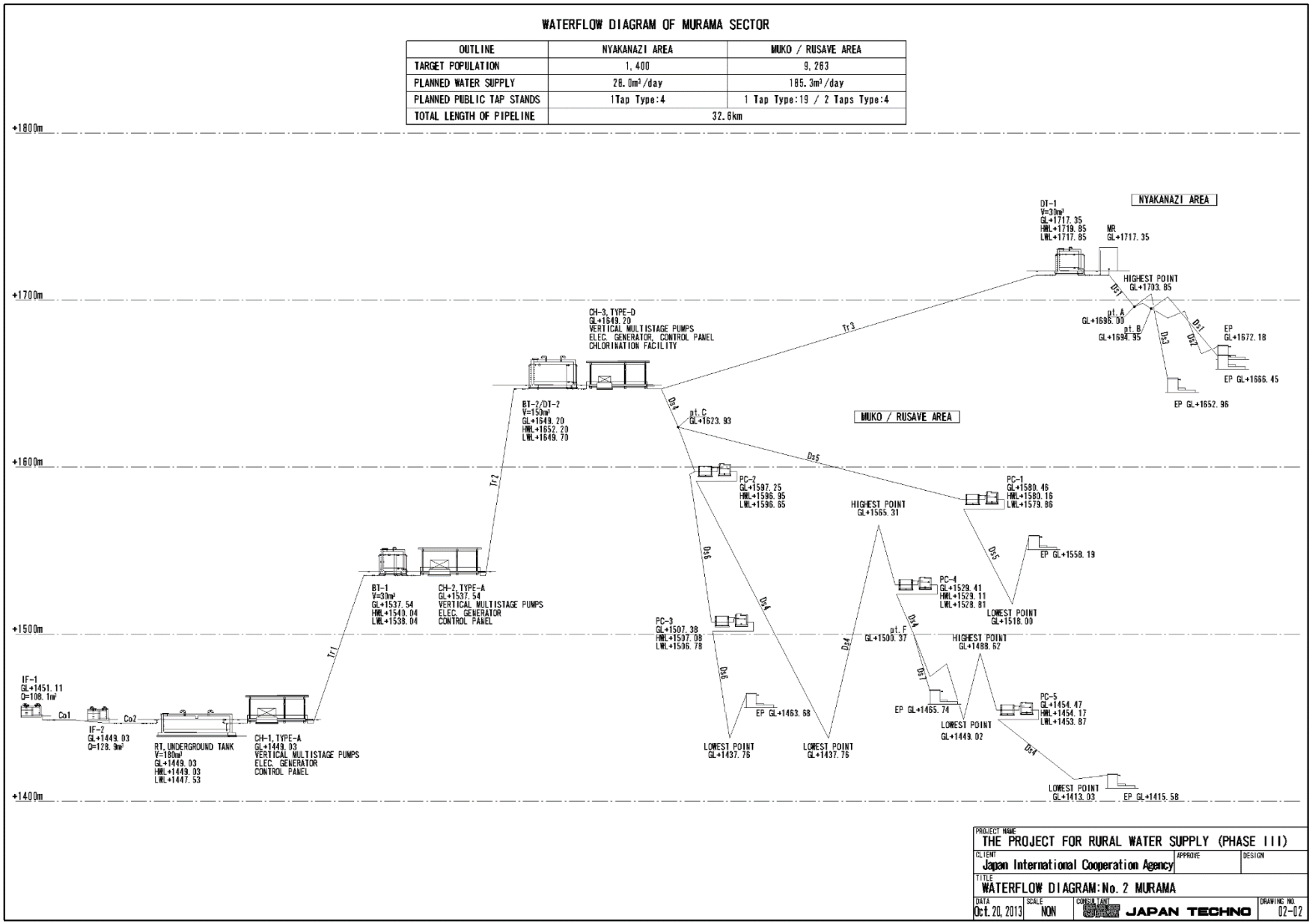


Figure 2-11 Water Flow Diagram No.2 Murama

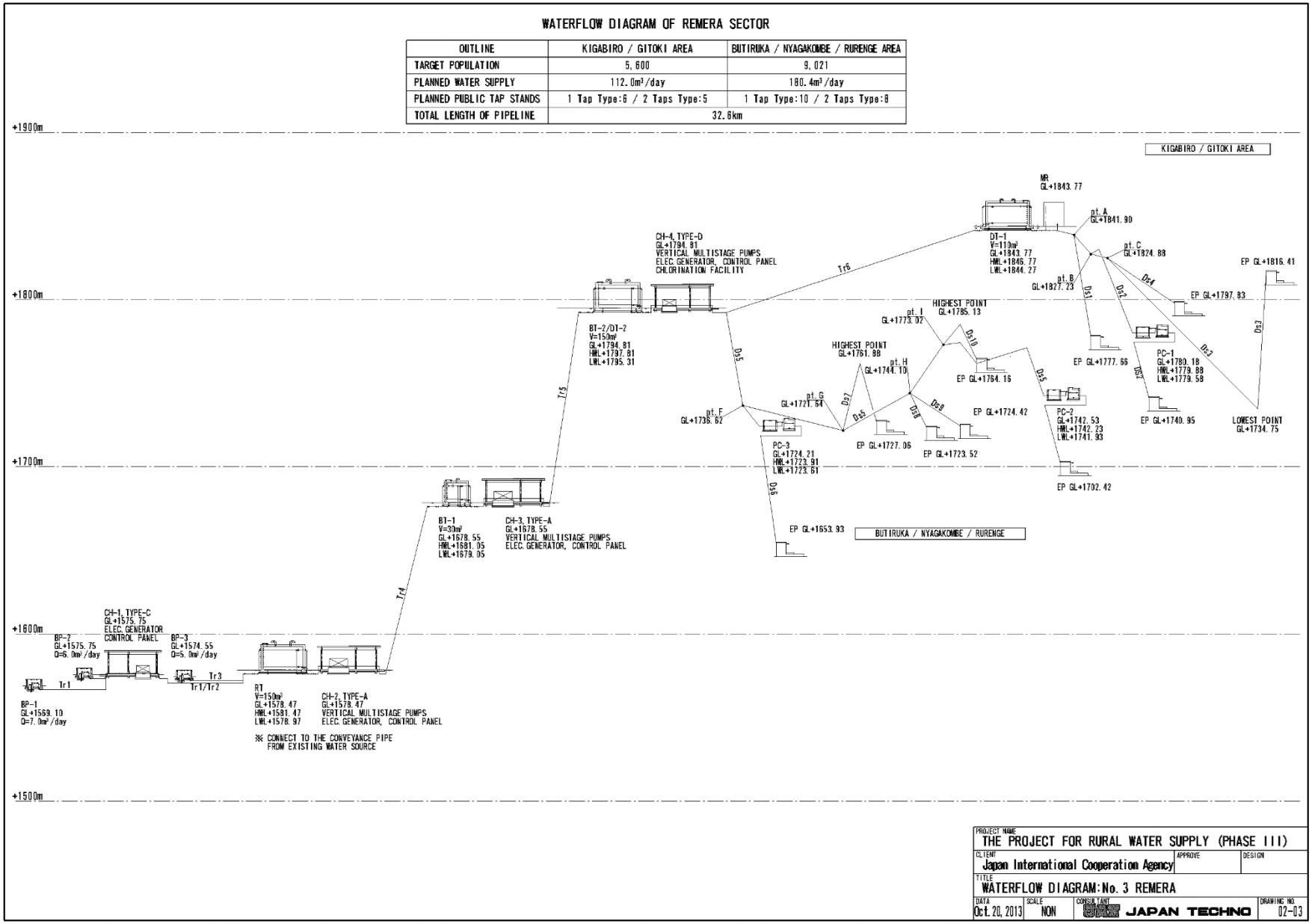


Figure 2-12 Water Flow Diagram No.3 Remera

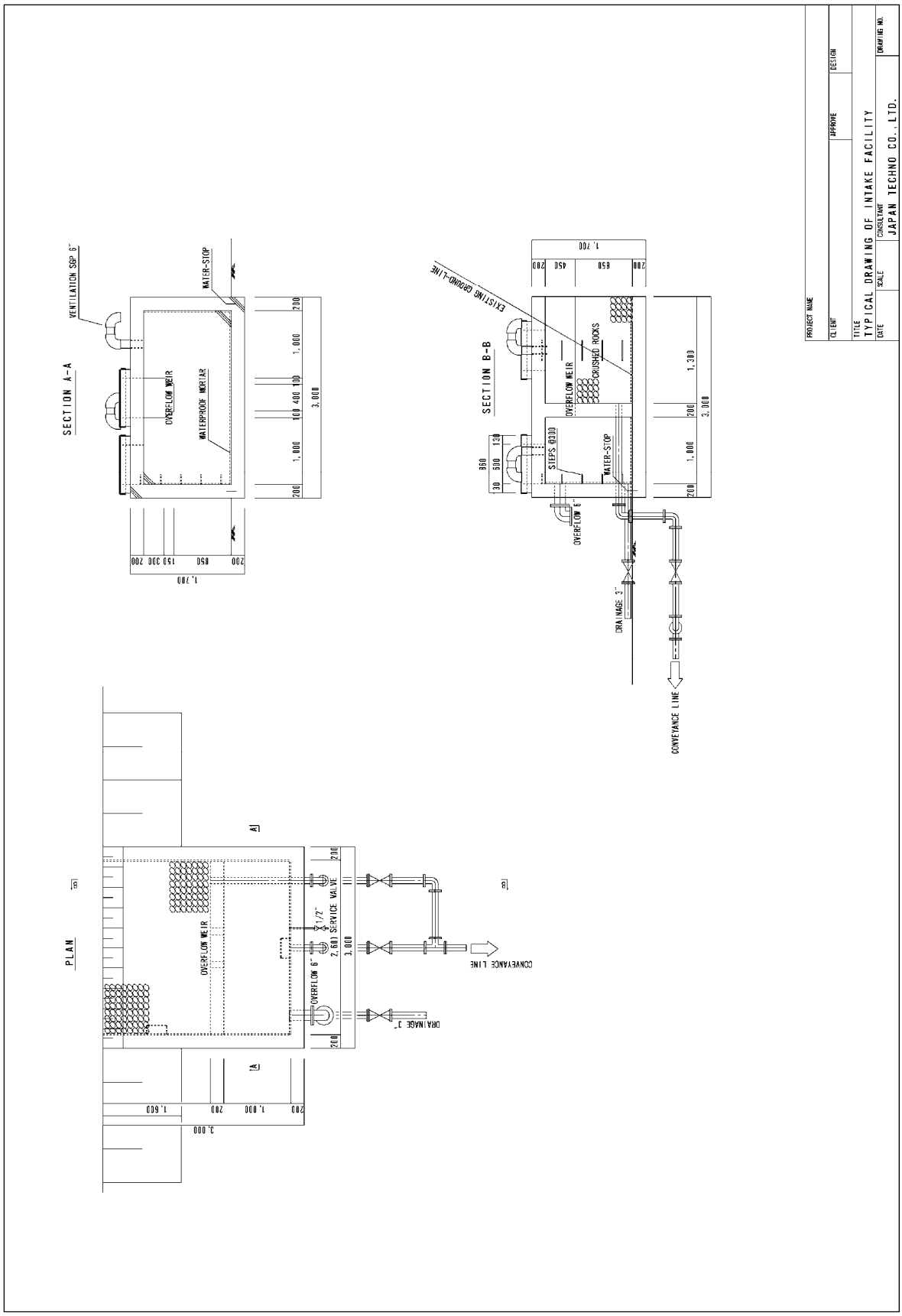


Figure 2 -13 Typical Drawing of Intake Facility

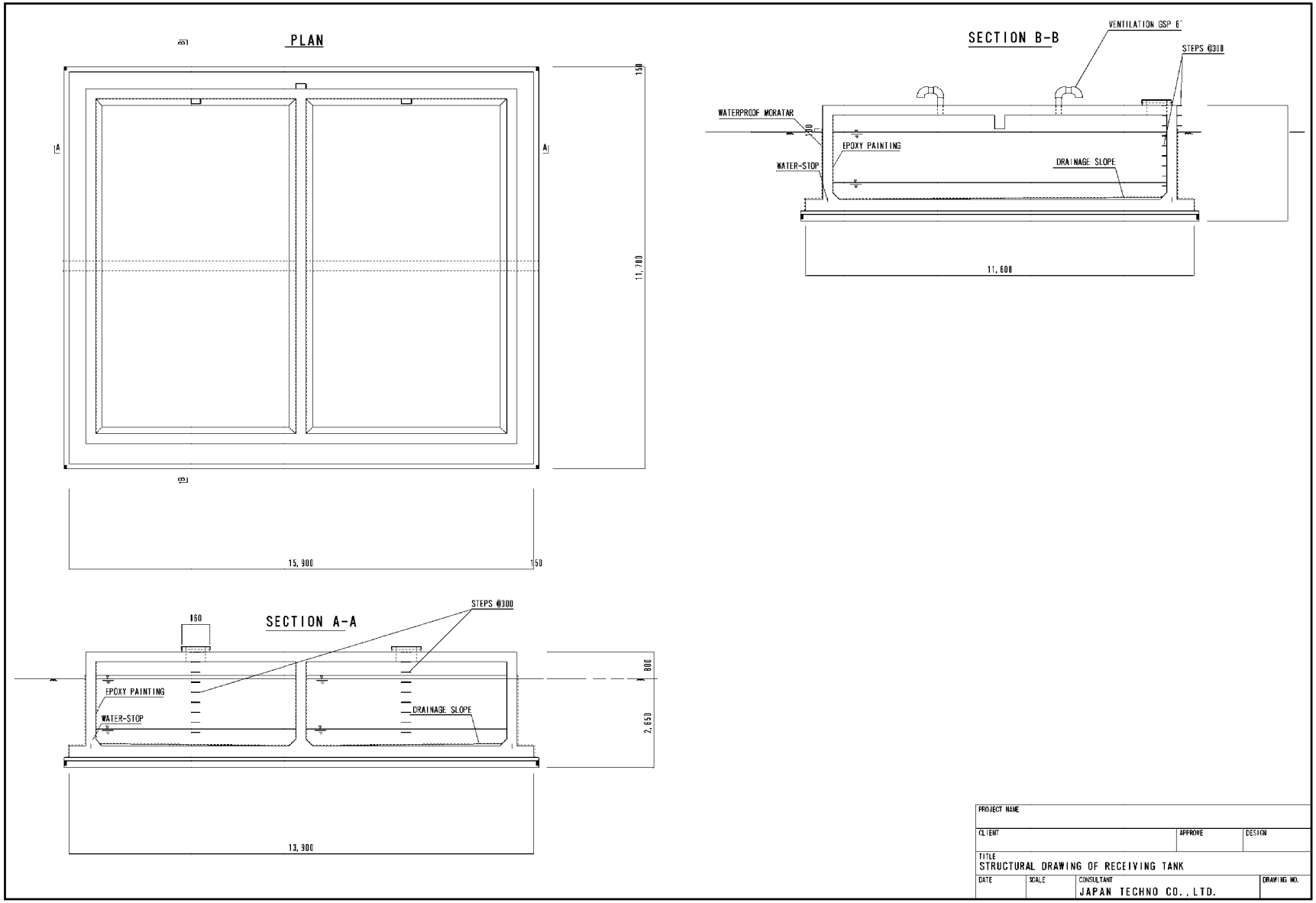


Figure 2 -14 Structural Drawing of Receiving Tank

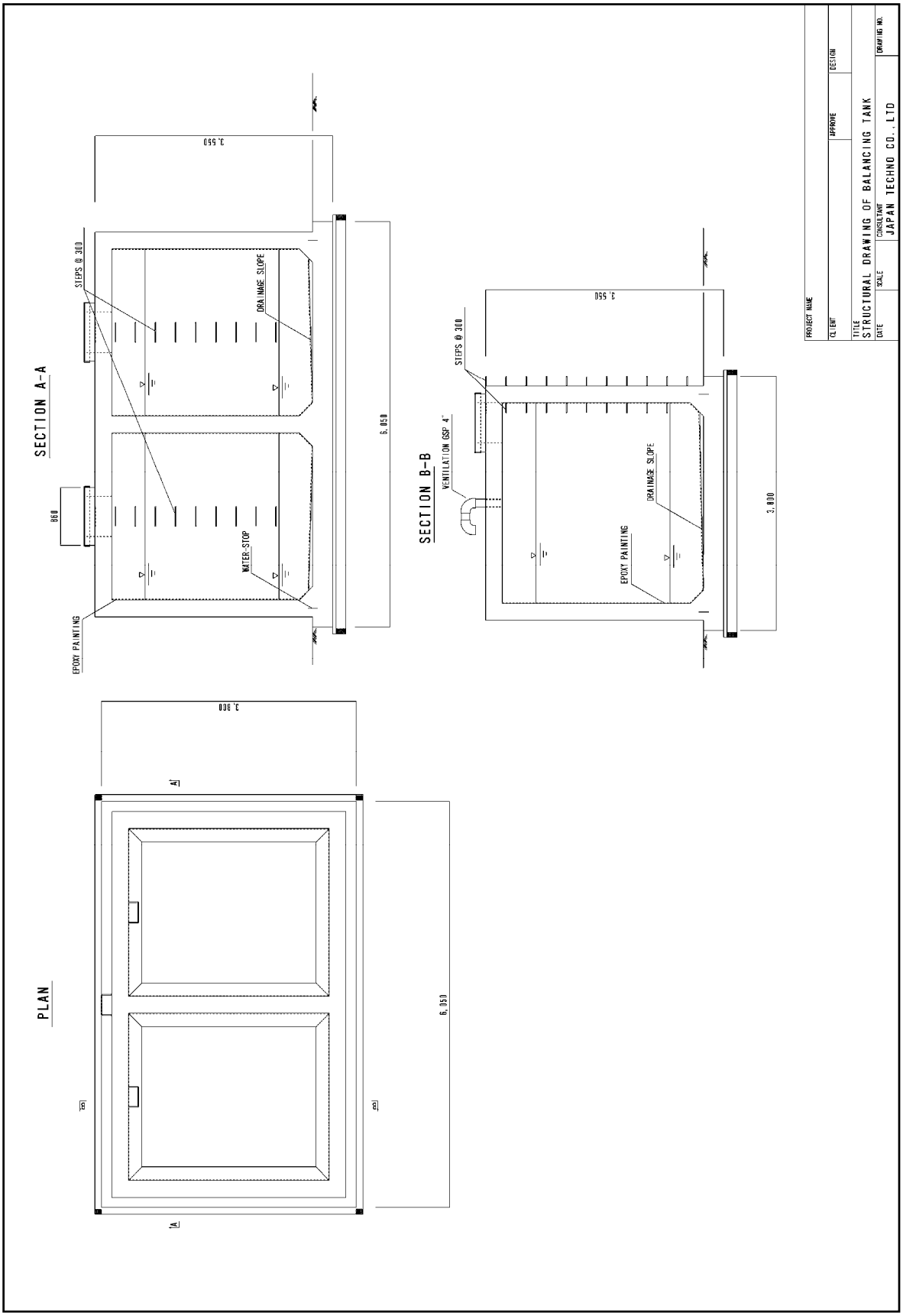


Figure 2-15 Structural Drawing of Balancing Tank

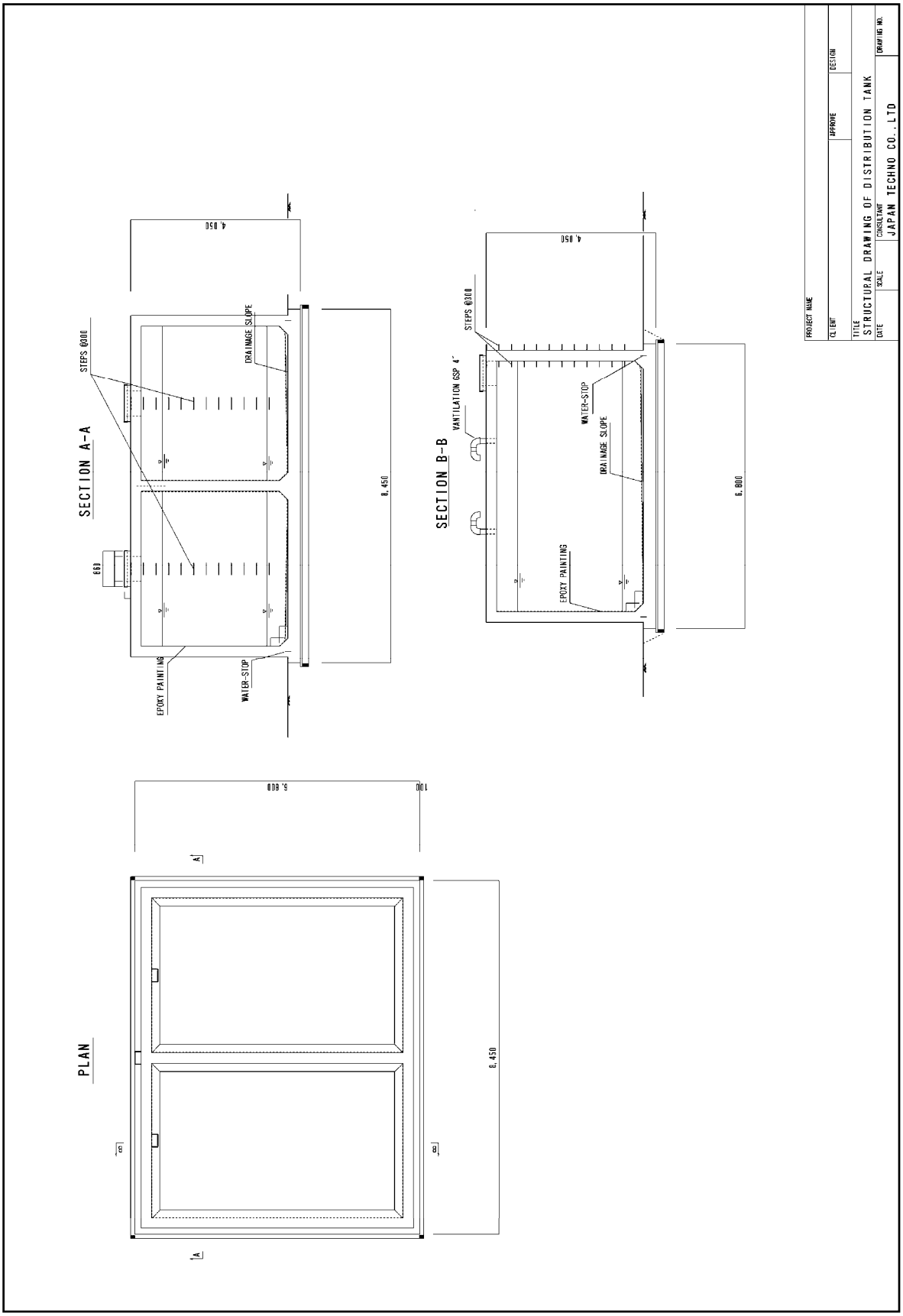


Figure 2-16 Structural Drawing of Distribution Tank

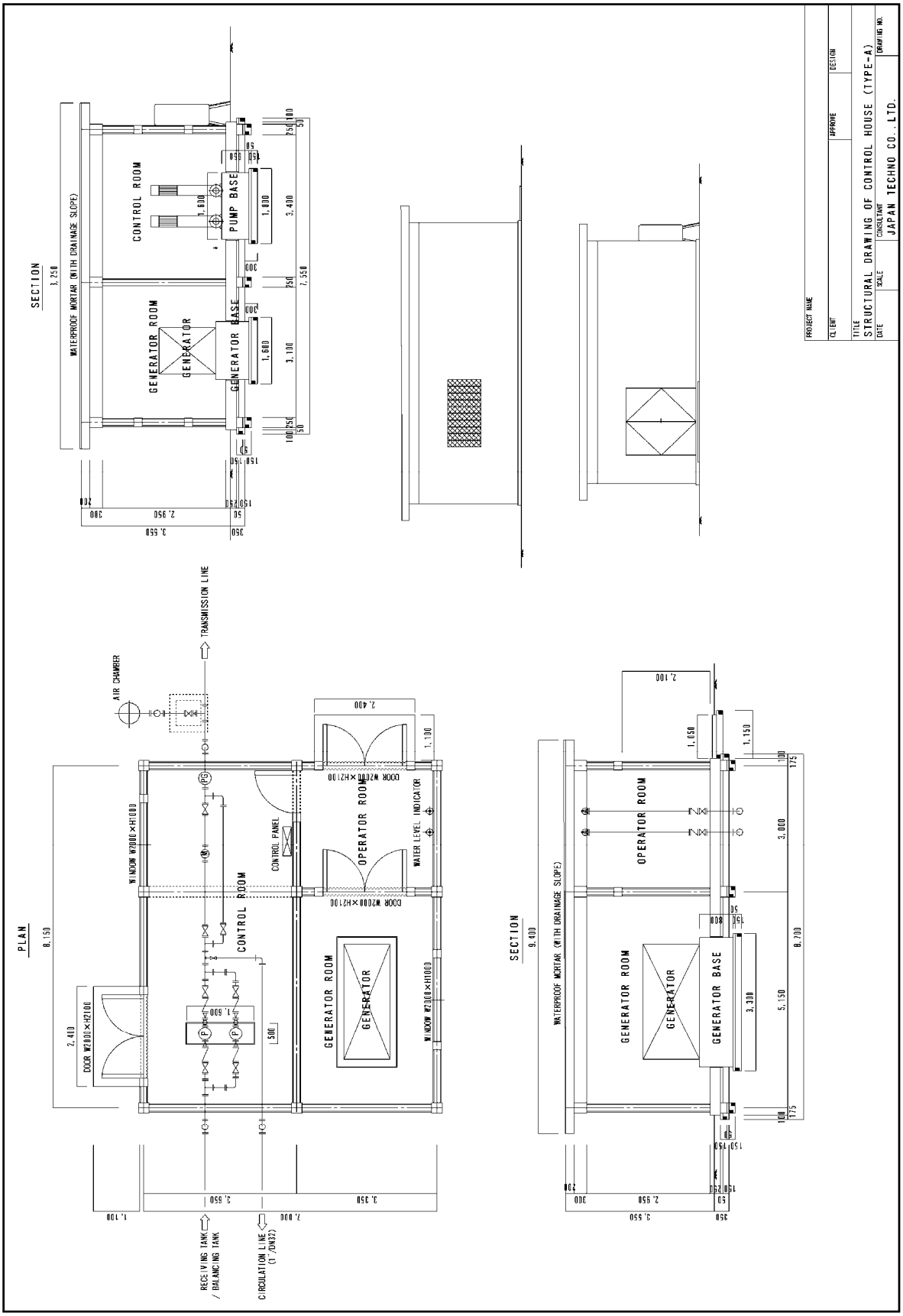


Figure 2-17 Structural Drawing of Control House

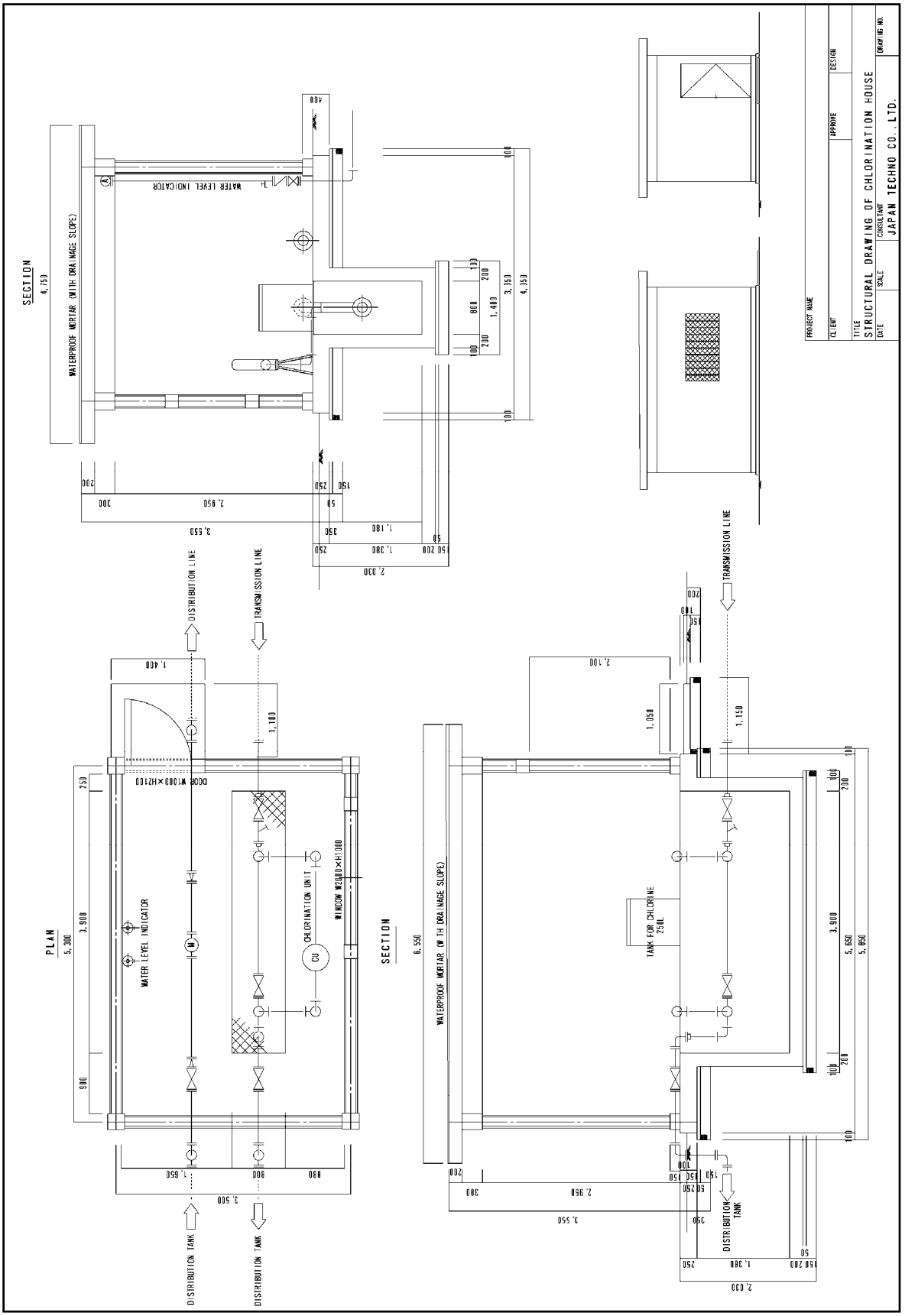


Figure 2-18 Structural Drawing of Chlorination Room

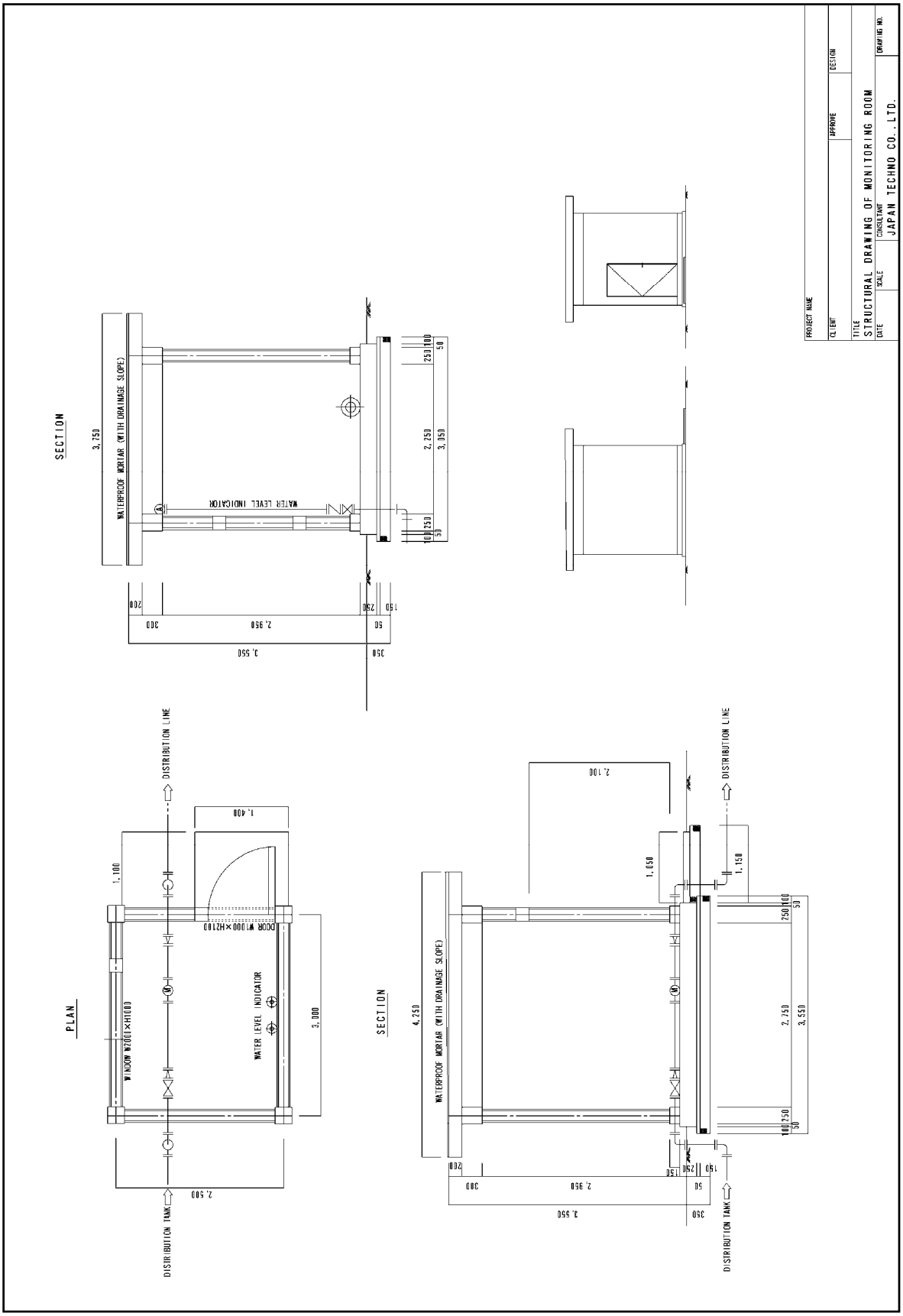
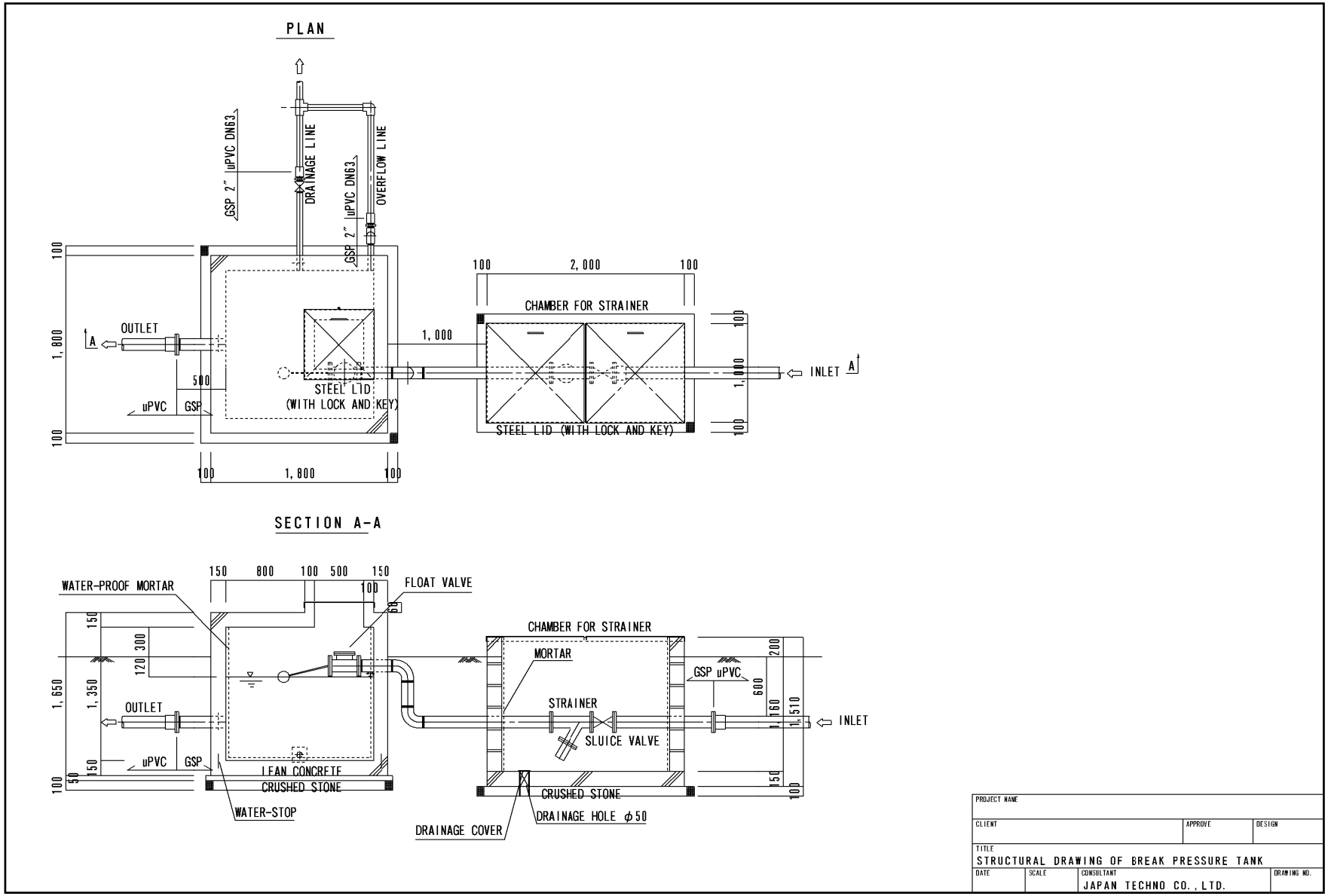


Figure 2-19 Structural Drawing of Monitoring Room



PROJECT NAME			
CLIENT		APPROVE	DESIGN
TITLE: STRUCTURAL DRAWING OF BREAK PRESSURE TANK			
DATE	SCALE	CONSULTANT: JAPAN TECHNO CO., LTD.	DRAWING NO.

Figure 2-20 Structural Drawing of Break Pressure Tank

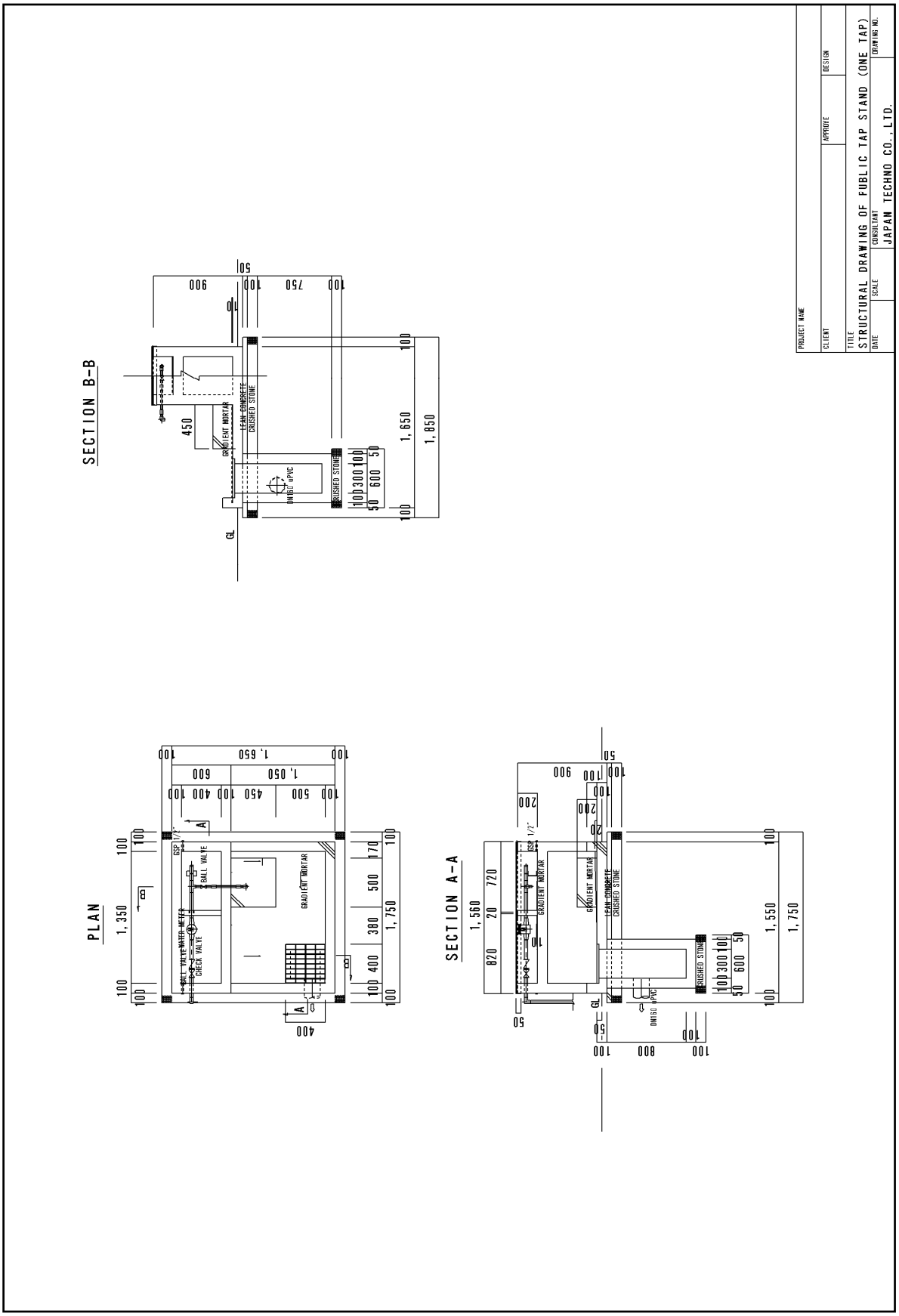


Figure 2-21 Structural Drawing of Public Tap Stand

2-2-4 **Implementation Plan**

2-2-4-1 Implementation Policy

This project is to be implemented as a General Grant Aid project of the Japanese government. Therefore, by sufficiently considering the Japanese grant aid system, appropriate organizational structure and suitable schedule for implementation need to be planned.

EWSA as the executing agency for this project is responsible for activities from detailed design to facilities construction as well as operation and maintenance of the water supply schemes.

After concluding the E/N between countries, the G/A will be concluded between the Rwandan government and JICA. Then, JICA will recommend to the Rwandan side a Japanese consultant to supervise the project. Thereafter, the recommended consultant will conclude an agreement with the executing agency to carry out the detailed design, prepare tender documents to select a Japanese prime contractor and support the tendering procedures. Based on the tendering results, the successful tenderer will conclude a contractor contract with the Rwandan government to construct the water supply schemes. The construction works will be carried out under the supervision of the contracted Japanese consultant.

Operation and maintenance of the facility after completion of the construction will be conducted by the selected WSPs under supervision of the districts. Support to the districts and WSPs will be given through the software component plan using local consultants or local NGOs. The organizational structure for the project implementation is shown in Figure 2-22.

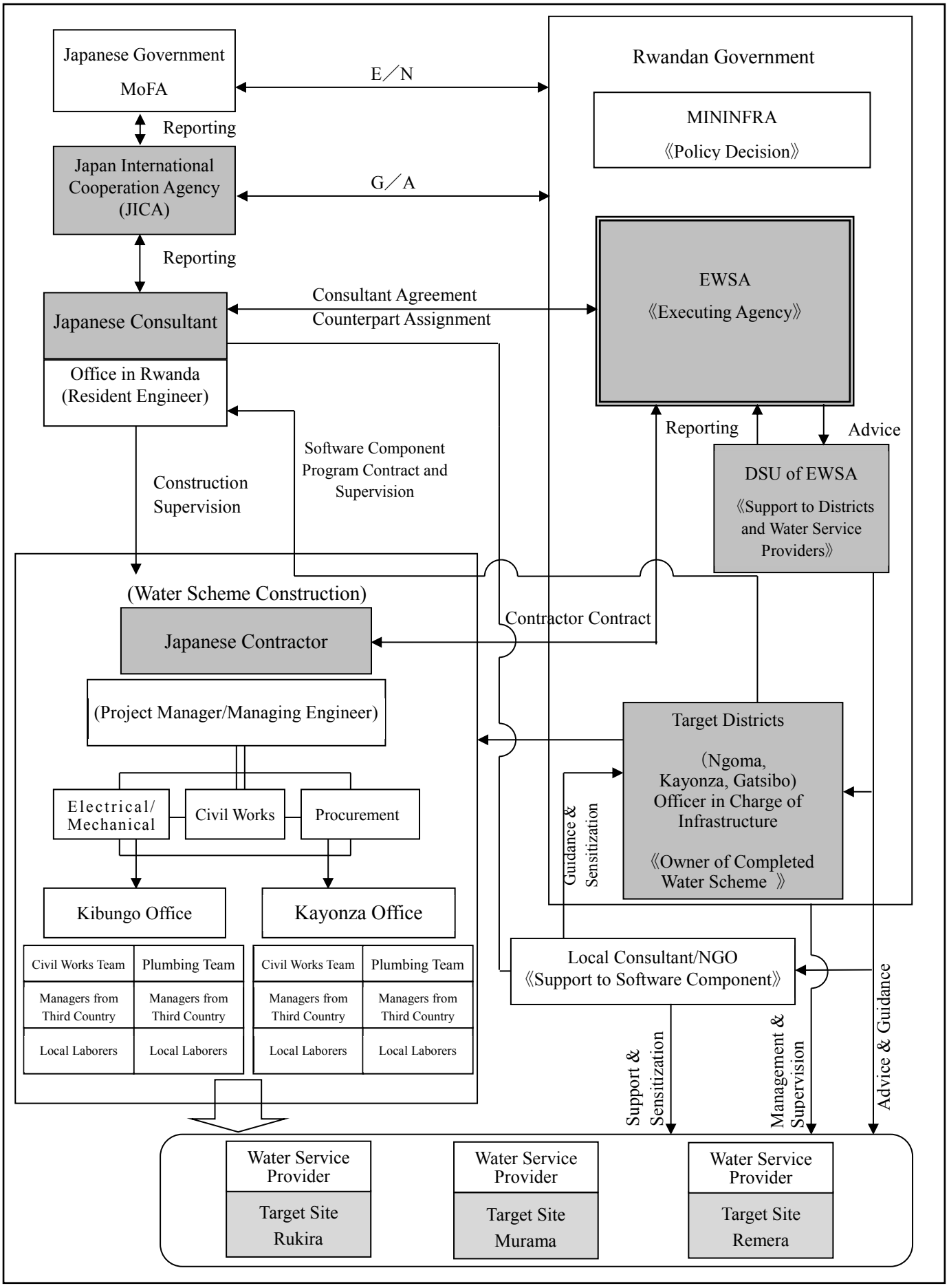


Figure 2-22　Organizational Structure of Project Implementation

2-2-4-2 Implementation Conditions

Considerations required for construction of water supply schemes and procurement of materials and equipment of this project are as follows.

(1) While maintaining a rigid standard for construction works at the target sites, a construction schedule which can be efficiently carried out without delays will be prepared.
(2) By confirming the accessibility conditions of each site during the rainy seasons and periods in which access is difficult after the rainy seasons, a feasible construction schedule will be prepared.
(3) Trenching in construction works for rural water supply projects in Rwanda is conducted mostly by manpower, and also for previous similar projects, most of the trenching was handled by manual labor. This is due to limitations in the type and number of construction machineries possessed by local contractors, and also, because laborers to handle manual trenching are readily available in the target areas. Therefore, trenching will be carried out basically by manpower, but for areas where hard rocks are outcropped, rocky ground will be excavated using hand breakers.
(4) At the target sites (sectors), construction information and schedule will be announced and labor from the villages will be used as much as possible.
(5) Rwandan standard scaffolding consisting of scaffold planks set on round pipes with ladders is temporary work which lack safety precautions. Therefore, safety and quality assured standard scaffolding and timbering of surrounding countries (Kenya and Tanzania) will be adopted and materials for this works will be imported from surrounding countries.
(6) Since many third country procurements are expected, quality control during ordering and transportation will be given attention.
(7) Due to relations with the neighboring country, Democratic Republic of Congo, hand grenade explosion incidents in the capital, Kigali, are reported. Therefore, through communications with the Embassy of Japan and JICA Rwanda Office, attention will be paid to safety management.
(8) In this project, construction works at the 3 target sites are planned to be carried out simultaneously. Moreover, the site No. 1 (Rukira) consists of 2 water supply systems divided into western and eastern regions. Therefore, 4 sites will be constructed substantially. Since the sites are scattered except eastern and western 2 sites divided into in No. 1 (Rukira), project management offices for the contractor will be arranged at 2 locations to advance the works without delay.
(9) As mentioned above, 4 sites will be constructed in parallel, and therefore, for safety

management of the construction works, attention will be given to frequency of inspections, allocation of guards and warnings to workers.

2-2-4-3 Scope of Works

The scope of this project with demarcation of responsibilities for implementation of the Rwandan side and the Japanese side are shown below.

Table 2-15 Demarcation of Responsibilities

	Demarcated Responsibilities	Japanese Responsibility	Rwandan Responsibility
1	Construction of access roads to target sites[9]	–	○
2	Securing and clearing of land for construction of water supply schemes and construction base offices	–	○
3	Assignment of counterparts for community awareness activities on facilities construction and operation and maintenance	–	○
4	Costs related to operation and maintenance of completed water supply schemes	–	○
5	Construction of water supply schemes at the 3 target sites	○	–
6	Execution of software component plan (capacity strengthening of districts on WSP management including WSP selection and operation and maintenance guidance, as well as management guidance to WSPs) at 3 target sites	○	○

2-2-4-4 Consultant Supervision

Since this project is to be implemented as a Japanese grant aid scheme, a Japanese consultant will be assigned to carry out activities from detailed design to construction supervision. The scope of works is shown below.

[9] The temporary road to the water source for construction works at Murama is under the responsibility of the Japanese side.

Table 2-16 Scope of Works of Japanese Consultant for this Project

Stage		Scope of Work
1.	Detailed Design	Conclusion of consultant agreement Detailed design survey Preparation of tender documents Support to tendering Evaluation of tendering results Assistance to contractor contracting
2.	Construction	Supervision of works and procurement Execution of software component plan Inspections, initial operation guidance Construction works reporting

(1) Detailed Design Stage

At the detailed design stage, conditions at the target sites will be confirmed and especially, to ensure that land problems of facilities allocation (water source, pipeline routing and water supply facilities layout) will not occur during the construction stage, through cooperation with the executing agency, districts and sectors, reconfirmation of the beneficiary communities is needed.

Just after conclusion of E/N and G/A, a consultant agreement will be concluded, and then, preparations for tendering will start. Upon conducting the detailed designing of the water sources and water supply facilities, the tender documents will be prepared. If necessary, modifications in design will be made and the construction cost will be re-estimated to prepare the OD/DD comparison documents.

Based on discussions with the relevant ministries, the tender opening date will be decided. The consultant will represent the executing agency for the tendering procedures and evaluate the tender results. Also, the consultant will assist the contracting process between the executing agency and the contractor.

(2) Construction Stage

At the construction stage, to ensure proper construction works without delays, a Japanese supervising engineer will be stationed. The resident supervisor will supervise the quality, schedule and safety of the construction works while making adjustments with the executing agency and other related organizations. For the software component activities, although local consultants or NGOs well-experience in social surveys will be subcontracted, a Japanese

consultant in charge of operation and maintenance plan will make spot supervisions at commencement, intermediate stage and after completion of the construction works.

2-2-4-5 Quality Control Plan

The methods for quality control of materials and equipment for each construction works are explained below.

(1) Control and Confirmation of Quality of Materials and Equipment

The flow of quality control of materials and equipment will be as follows.

1) The procurement manager of the prime contractor confirms qualities of materials and equipment and places the orders after receiving approval from the resident supervising consultant, in principle.
2) Before construction, the qualities of materials and equipment are confirmed by the prime contractor and resident consultant.
3) Upon arrival of the materials and equipment at the construction site, the site engineer of the prime contractor re-inspects them.

(2) Foundation Trenching Works

The foundation installation depths were decided based on the results of the geo-soil survey carried out in this survey. During the construction works, after trenching, reconfirmation on the geology whether it is the same as the survey results; confirmation on the presence of groundwater; in-situ testing; and ground bearing capacity reconfirmation will be conducted.

(3) Concrete Works

The quality control items for concrete works are the following.

1) Test Mixing

Test mixing will be carried out for (a) structures requiring high water tightness, (b) reinforced structures not requiring high water tightness and (c) unreinforced structures, each with respective appropriate mixtures. Workability can be assured through procedures such as adjustment of slump values. In this case, to prevent occurrence of rock pockets and other flaws in the finished concrete, concrete mixture to be placed needs to be determined through test

mixing.

2) Water for Concrete

Water to be mixed for concrete will be taken from springs at the construction sites. In this respect, to confirm the water quality, simple water quality measurements (pH, chloride and total solids) will be made.

3) Inspection of Bar Arrangement and Molding

Before placing concrete, the mold size and reinforcement bar requirements (such as diameter, length, layout and anchorage length) will be verified for conformity with the working drawings. Also, confirmations will be made on whether the moldings are without gaps and if supports can withstand lateral pressures. The points worth noting will be photographed and recorded.

4) Compressive Strength Test

To confirm if the placed concrete has the specified compressive strength, tests will be conducted at appropriate frequencies on structures at each site. Compressive strength tests will be carried out on samples cured for 7 days and 28 days. When samples are taken, the mixture ratios will be recorded and field tests such as slump tests will be made.

(4) Reinforcement Work

When quality control of reinforcement works is carried out, submissions of the following documents from the prime contractor will be managed.

1） Classification, type, country of origin and manufacturer of reinforcing bars
2） Mill sheets or tensile test certificates

Confirmations will be made on storage conditions at the sites (whether bars are not stored directly on the ground) and curing sheets. Before construction works, inspections will be made on bar arrangements and moldings.

(5) Plumbing

In terms of plumbing, at each stage of trenching, laying and backfilling, verification at appropriate frequencies will be made. After pipeline laying works are completed for each route, water pressure tests will be conducted and nonexistence of leakages will be confirmed. After

completion of all plumbing works, when test runs of facilities are made, water flow testing will be carried out along with pipeline cleaning using chlorine.

2-2-4-6 Procurement Plan

The suppliers of main construction materials are shown in the table below.

Table 2-17 Suppliers of Main Construction Materials

Material	Rwanda	Japan	3rd Country	Reason
Land (in-line) pump Submersible pump	○		○	Agents for some products are available in Rwanda, but no assurance for stable supply
Generator, control panel			○	To assure quality
HDPE pipe			○	To assure quality
Galvanized steel pipe			○	No distribution in Rwanda
Water meter, flow meter, valves	○	○	○	Instantaneous flow meter and safety valve are not available in Rwanda or third countries
Steel materials (steel sheet, shape steel)		○	○	No distribution in Rwanda
Reinforcement bar, shuttering			○	To assure quality
Concrete block	○			
Sand, aggregates	○			
Cement	○			
Fixtures and fittings	○			
Paint	○			
Waterproofing agent			○	To assure quality

2-2-4-7 Operational Guidance Plan

Concerning initial operation guidance, the Japanese prime contractor along with local subcontractors will conduct test runs. During the test runs, the operators assigned by the WSP at each site will be guided on operation until they are proficient. The main guidance items are as follows.

- Confirmation of water supply system (valve operation and flow of water)
- Regular operation method for generators and pumps
- Routine inspection method for generators
- Refilling of generator fuel and replacement of lubricants and air filters
- Measures for handling abnormal cases of generators and pumps
- Routine inspection method for public tap stands
- Flow meter readings and recordings (pumping and distribution rates) and calculation method for hourly pumping and distribution rates

- Operation and inspection method for pipelines and valves
- Recording method for daily operation log

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

In this Preparatory Survey, the national plan and policy concerning the rural water supply sector were reviewed and current status on operation and maintenance of water facilities was surveyed. Also, challenges of EWSA, the new executing agency established in December 2010, local governments (districts and sectors) and WSPs[10], the executing bodies for operation and maintenance of piped water supply schemes, were evaluated.

As the result of those surveys and evaluation, it is determined that support for the project through the software component plan is necessary from the points of view described below (refer to "2-4 Project Operation and Maintenance Plan" which explains the present conditions, issues and policy in operation and maintenance of water supply facilities).

The outline of this software component plan is as follows:

(1) Objective of the Plan

In order to achieve the project purpose of "Safe water is provided to the target population in Eastern Province in a sustainable manner from the piped water supply schemes to be constructed in the Project, and water supply coverage rate is increased" and secure sustainability in effectiveness of the project considering privatization of operation and maintenance being promoted by the Government of Rwanda, the software component plan was prepared. The objective of the plan is set as "the system for management of WSPs by districts as owners of water supply schemes is established and also, due to the support of the districts, the system for operation and maintenance of WSPs is strengthened".

(2) Expected Outputs of the Plan

Expected outputs of the plan will be as shown below:

[10] Due to promotion of privatization, this project will basically support the operation and maintenance system with WSPs, but depending on the site, since water users' associations before being registered as cooperatives will also be supported, all of these organisations will be considered as WSPs. Eventually, the districts will be anticipated to contract with the cooperatives transformed from the water users' associations.

【Output 1】 The system for support and management of water service providers by districts is strengthened.

【Output 2】 The institutional management system of water service providers for operation and maintenance of piped water supply schemes to be constructed and rehabilitated by the Project is strengthened.

【Output 3】 Awareness on water and sanitation is enhanced in the target communities and piped water supply schemes are utilized properly.

(3) Activities of the Plan (Plan of Inputs)

The plan for activities (inputs) of the plan necessary for achievement of "The Objective of the Plan" and "Expected Outputs of the Plan" was formulated. Those activities are related to the outputs and structured as follows:

【Activities for Output 1】

1. Confirmation on organization capacity of Districts and Sectors
2. Support to preparation for selection of water service providers (through tendering)
3. Support to execution of selection of water service providers (through tendering)
4. Supervision and monitoring of activities related to O&M of piped water supply schemes

【Activities for Output 2】

5. Training of water service providers to improve their capacities for O&M of piped water supply schemes
6. Follow up on the above activities for improving capacities in O&M of piped water supply schemes

【Activities for Output 3】

7. Training of water service providers to improve community awareness on hygiene and sanitation

2-2-4-9 Implementation Schedule

The flow of implementation procedures for this project as a grant aid scheme of the Japanese government is as follows.

a. Exchange of Notes (E/N)
b. Grant Agreement (G/A)
c. Consultant agreement

d. Detailed design survey in Rwanda
e. Tender document preparation
f. Tendering, contractor contracting
g. Procurement of materials and equipment
h. Construction of water supply schemes
i. Execution of software component plan
j. Hand-over of completed schemes

The implementation period of this project, after the E/N and G/A, is 24 months. The standard working hours of Rwanda is 8 hours per day with non-working days as Sundays and 13 other days in the year designated as national holidays of Rwanda. Furthermore, the schedule will be planned in consideration of natural conditions such as rainy days[11] and social conditions such as Umuganda as well as consideration for proper construction supervision based on factors such as facilities scale and village layout. Also, to complete the entire construction works on water schemes within the planned schedule, works will progress in parallel under an appropriate team formation.

The implementation schedule based on the Japanese grant aid scheme is shown below.

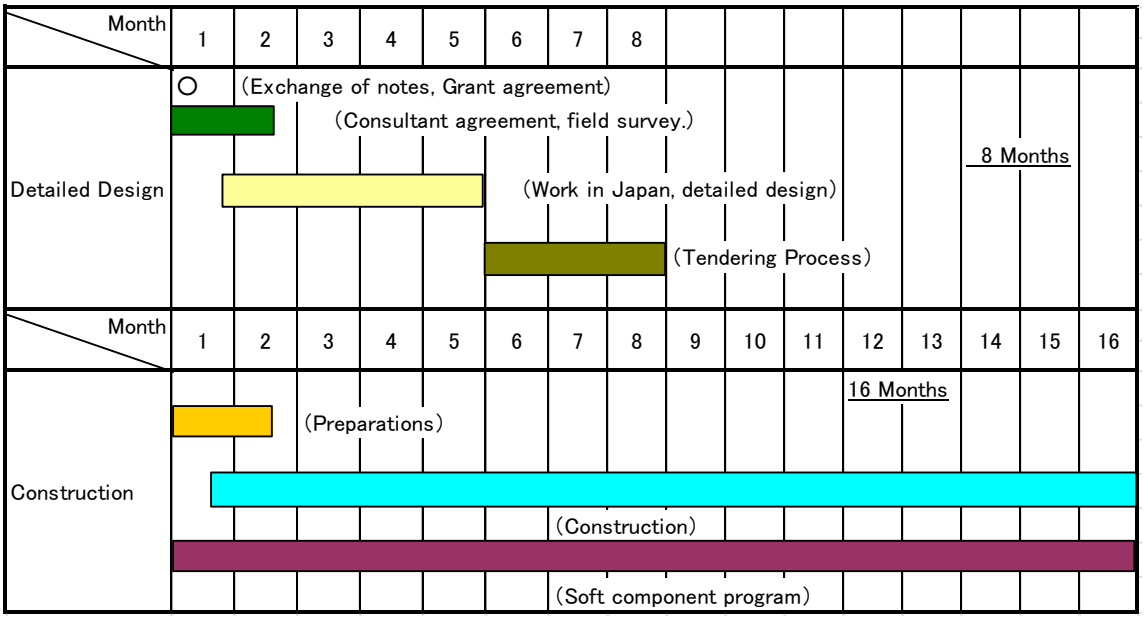


Figure 2-23 Project Implementation Schedule

[11] In Rwanda, the rainy seasons are March to May and October to December, but for this project, construction works will not be interrupted during the rainy season and working days during rains are considered into the nonworking coefficient.

2-3 Obligations of Recipient Country

If the Government of Japan decides to implement the Project under the scheme of grant aid, the Government of Rwanda must confirm undertaking the following responsibilities in order for the Project to proceed in a smooth manner.

2-3-1 Administrative Procedures

(1) To bear all expenses necessary for the Authorization to Pay (A/P) and payment commission to the Bank
(2) To ensure quick procedures for customs clearance and exemption of internal taxes for purchases of equipment and materials for this project
(3) To implement the inspection, confirmation and approval for the construction works

2-3-2 Obligations of Rwandan Side

(1) To secure lands necessary for construction of intake facilities, distribution tanks and temporary roads
(2) To explain the object of this project to the existing users of spring sources to be developed for this project and to receive their consents for use of those springs
(3) To secure safe drinking water for those existing users of spring sources during the construction works
(4) To provide the project team with data and information necessary for implementation of the project
(5) To provide storage spaces for equipment and materials as well as temporary work spaces during implementation of the project
(6) To maintain security in and around the project sites
(7) To electrify (3-phase) the 4 target sites before completion of the project
(8) To ensure selecting, contracting and managing water service providers for new schemes by the districts
(9) To ensure the participation of the counterpart (EWSA) in the project implementation, and the participation of persons in charge (at EWSA (including DSU), Districts and Sectors) in software component activities

In this project, the executing agency is EWSA which has already implemented the “Phase 2 Project” after the change in organization of MININFRA in 2010. With this experience, EWSA is

familiar with the grant aid scheme of JICA. According to EWSA's actual performance in "Phase 2 Project", it is deemed to be capable of undertaking the responsibilities mentioned above.

2-4 Project Operation Plan

2-4-1 Present State of Operation and Maintenance

2-4-1-1 Organization for Operation and Maintenance in the Water Supply Sector of Rwanda

EWSA, the executing organization for the water supply sector, is responsible for improvements in water supply coverage of Rwanda, and has responsibilities to formulate water supply plans and coordinate programs in both rural and urban areas. Although EWSA is an independent public organization, the decision maker for water policies is MININFRA. The owners of constructed water supply schemes are the Districts and their responsibilities are to manage and supervise the activities of WSPs, who are in charge of operation and maintenance of the water schemes. The water users pay water fees according to fixed tariffs. The actors in the water supply sector of Rwanda and their roles and responsibilities are shown in the figure below.

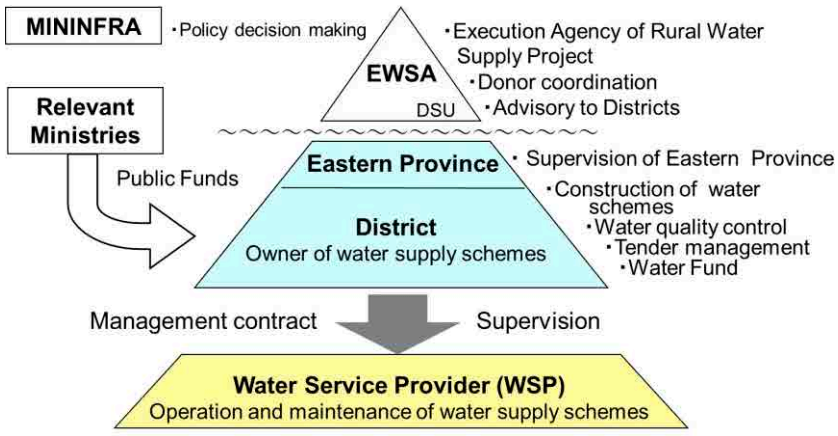


Figure 2-24 Stakeholders and Their Roles for Rural Water Supply Sector of Rwanda

2-4-1-2 Transition in Policy of Operation and Maintenance of Rural Water Supply Schemes

Since 1994 in Rwanda, water supply schemes were operated and maintained by water users' associations called "Regies" formed by residents of the service area. Thereafter in 2004, the Rwandan government implemented an evaluation survey on operation and maintenance of water

schemes and the results showed that water users' associations had problems with community participation, financial management and inadequate repairing/maintenance of facilities. According to this result, the Rwandan government decided as a sector strategy for 2004-2007 to promote application of Public-Private Partnership (PPP). In this regard, revision of the "Water and Sanitation Policy (2010)" is ongoing, and in this revised policy the government of Rwanda emphasizes the importance of collaboration with the private sector in order to ensure sustainability of financial inputs for operation and maintenance of water supply schemes. This project also supports the establishment of an effective operation and maintenance system at the target sites in consideration of privatization being promoted by the Rwandan government.

2-4-1-3 Present Situation of Organizations Related to Rural Water Supply

(1) Water Service Providers (WSP)

1) Water Users' Association

Water users' associations are community organizations which consist of members selected from beneficiaries including president, vice president, accountant, plumbers, pump technicians, meter readers and guards.

Since Rwanda has decided to promote privatization of operation and maintenance, water users' associations do not exist in the target sectors of this project, and only a few exist in Eastern Province.

2) Private Water Service Providers

From the lessons learnt from management by water users' associations, the application of management by private service provider was recommended in the "Water and Sanitation Program" which was implemented since 2004 by the World Bank to clarify the responsibilities of WSPs and to ensure an accepted level in technical standard. The rate of water schemes being managed by private WSPs is about 57%[12] as of 2012, showing that privatization is being promoted at a rapid pace due to the support of the Rwandan government and development partners,.

Private WSPs can be divided into cooperatives and enterprises. Cooperatives are organizations formed through joint capital investment of the members. Enterprises are

[12] Study on Operation and Maintenance of Rural Water Supply Systems in Rwanda (2012)

corporate organizations having corporate status. The characteristics of each organization are explained below.

(a) Cooperative

Since a cooperative is an organization with joint capital investment from members, each cooperative registers through the procedures of Districts based on the cooperative law. The council formed by the members is the highest decision-making body which decides on the selection of the president and employment of the staff. The officers can be members or hired from outside. An auditor and advisor are recruited as members of the cooperative. The profit from water sales can be shared among the cooperative members. In many cases, the cooperative is the transformation from a water users' association.

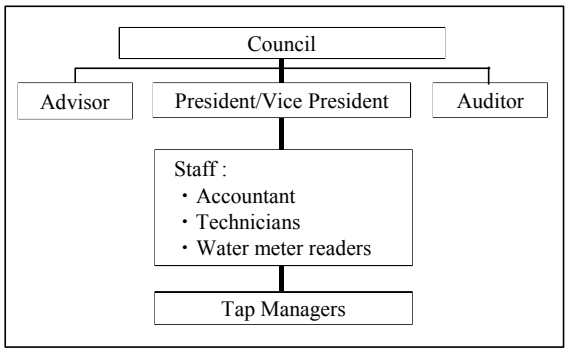


Figure 2-25 Organization of Cooperative

(b) Enterprise

Enterprise is a corporate organization with corporate status. The director has the right to make decisions and staffs are employed by the director. Apart from this staff formation, some enterprises also employ an auditor and advisor for confirmation and auditing of their work. In the target sites, enterprises do not exist as of July 2013.

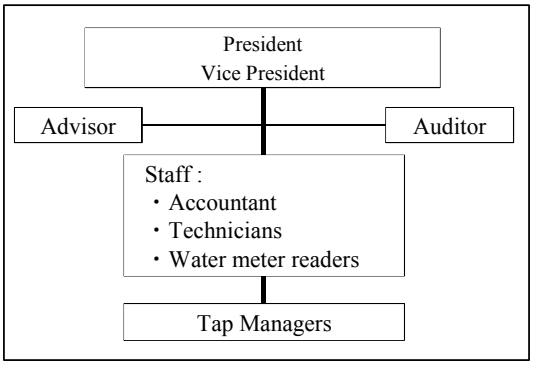


Figure 2-26 Organization of Enterprise

(2) Other Organizations

If management by WSPs is difficult or if an organization itself does not exist, then as exceptional cases, the District, Sector or EWSA takes the responsibility for management of the scheme.

1) District

Districts are the owners of water supply schemes and have responsibilities to supervise the water scheme management. Each District has a staff member in charge of infrastructure[13] who is responsible for all the infrastructures including water supply schemes. As mentioned above, since privatization of water scheme management is being promoted, the District is recommended to select the most appropriate WSP through tendering. The selected WSP has the obligation to submit monthly reports to the District which includes the financial report. The District confirms the management situation of each WSP through the monthly reports and gives them advices whenever necessary. Also, 15% of total sales of each WSP has to be paid to the District as royalty and the accumulated royalty forms Water Fund which will be used for medium and large scale repairs of water supply schemes in the District.

However, since the duties of the staff in charge of infrastructure are numerous and also their budget for water supply schemes is limited, most of them cannot fulfill their responsibilities in water schemes. Because of this situation, the management of water schemes becomes difficult to continue. As a result, more and more Districts are requesting the transfer of responsibilities in management to EWSA. For example, in Kirehe District and Ngoma District, the management contracts to be concluded between the District and WSP has actually been concluded among the 3 parties of District, EWSA and WSP. This means that EWSA took a part of the responsibilities which the District has to bear.

2) EWSA

EWSA is a governmental agency in charge of electricity and water services. It undertakes utility management of water supply systems in urban areas while it supports districts in management of water supply schemes in rural areas. In Eastern Province, EWSA has branch offices at the 3 towns of Rwamagana, Kibungo and Nyagatare to handle collection of water tariffs from water supply systems being directly managed by EWSA. Other branches at Gatsibo,

[13] Some districts have allocated staffs in charge of water as assistants (Districts of Ngoma and Kayonza) while some districts have staffs in charge of water resources and environment who sometimes complement the staffs in charge of infrastructure.

Kirehe and Kayonza towns are planned to be placed in the near future where all districts in the province will be able to have branch offices after establishment of these additional offices. Since the management responsibilities of the districts are unsatisfactory as explained above, the District Support Unit (DSU) of EWSA was established in February 2013 to advise and guide the districts. Although the DSU was organized recently and actual activities are to be started soon, the outcomes are being anticipated.

While EWSA's role is limited to advising and directing districts according to the water policy, there are an increasing number of cases where districts are requesting EWSA to carry out management tasks directly. For example, during the Preparatory Survey, some sites in Kayonza and Gatsibo Districts were found to be under "EWSA's direct management" in which EWSA serves both functions of WSP and district. Also, Kirehe and Ngoma Districts have submitted such request letters for "EWSA's direct management" of water schemes. Since the target sites of this project are located in these districts, attention to EWSA's involvement is needed upon planning operation and maintenance systems.

2-4-1-4 Issues in Operation and Maintenance

Through the assessment on current situation as well as socio-economic survey in Rwanda, the following issues have been revealed.

(1) Issues in Policy and Implementation Structure for Rural Water Supply in Rwanda

While roles of organizations involved in rural water supplies has been mentioned above, the contents and scope of each role and responsibility are not clear, and no documentation clearly defines the roles and responsibilities of different organizations. In terms of the District's role, expectation of its function is far from reality due to lack of financial and human resources. This is demonstrated in the above mentioned example of the tripartite contract between District, EWSA and WSP in which some part of the district's role is entrusted to EWSA.

In addition, since structural reforms of governmental bodies take place frequently in Rwanda, of which the water sector is no exception, another reform can possibly take place during the implementation of this project. Under these circumstances, the software component plan should be carried out with close attention to changes in policies pertinent to water and organizational structures for project implementation.

(2) Issues in Management Capacity and Implementation Structure of Districts

The District is required to supervise the organization in charge of operation and maintenance of water supply schemes. In practice, however, this role of the district is rarely achieved due to the lack of financial and human resources and insufficient management capacity among others. The following table shows issues encountered by districts.

Table 2-18 Issues of Districts concerning O&M of Water Supply Schemes

Issue		Description
1) Lack of Human Resources		Although districts have personnel in charge of infrastructure, they deal with substantial amount of work related to all types of infrastructures, and this situation results in the persons in charge not being able to allocate enough time for water supply activities.
2) Lack of Financial Resources		Budget for districts is allocated from the central government, which often does not meet the amount requested by districts.
3) Low Management Capacity	(a) Capacity to select WSPs	While districts are supposed to prepare tender documents, evaluate tenders and conclude contracts with WSPs, 3 out of 4 target districts (excluding Kayonza) have no experience in tendering for WSPs or the experience is insufficient.
	(b) Capacity to evaluate management of WSPs	Districts' roles includes reviewing and appraising monthly reports from WSPs and giving feedback to them, but such communications between them are not well documented and contributions to improvement of water supply services cannot be observed.
	(c) Utilization of Water Fund	Most existing WSPs in target 3 districts pay royalties to districts, but its utilization as water funds has not been common practice. Classification of water fund use as to type of repairs and demarcation of repair responsibilities need to be clarified in some districts.
	(d) Water tariff appraisal	Water tariffs proposed by WSPs for each scheme need to be approved by districts, but proper evaluation of water tariffs using financial simulation is currently not performed by districts.

(3) Management Capacity of Private Water Service Providers (WSPs)

Among the target districts, only Kayonza District has experience in selecting WSPs through tendering. Therefore, since the WSPs expected to be selected in the future could not be confirmed during the field survey, in addition to inquiries to private WSPs in other districts, information from reports of the previous Development Study and Technical Cooperation Project were used to identify the issues shown in the following table.

Table 2-19 Issues of WSPs concerning O&M of Water Supply Schemes

Issue		Description
1) Financial Capacity	Tariff setting	Water tariffs should be calculated by WSPs in consideration of expected costs incurred for operation and maintenance, minor repairs and salaries for personnel. However in actuality, for existing water schemes managed by WSPs, water tariffs are decided merely based on water users' willingness and ability to pay without any cost balance simulations. As a result, some WSPs cannot recover even recurrent costs to degenerate financial situations where services must be discontinued and the WSPs become bankrupt.
	Tariff recovery	Water tariffs are collected at each public tap stand by tap managers and then gathered by the accountant. In cases where the water scheme has a large number of public taps, tariffs cannot be collected timely by the accountant to lower the tariff recovery rate jeopardizing the WSP's management.
2) Technical Capacity	Periodic inspections	In cases where operators employed by WSPs do not receive adequate training, their required duties such as periodic inspections and timely replacements of spare parts are not being conducted to create operational problems.
3) Managerial Capacity	Report preparation	WSPs are obligated to inform districts on the state of its service and scheme management (such as facilities conditions and financial statement) in the form of monthly and annual reports. However, since report preparation capacities of some WSPs are poor, districts are facing difficulties to evaluate the status of water schemes and give feedback and advice to WSPs.

(4) Issues of EWSA

While EWSA is well experienced in managing urban water supplies, it has few experiences with rural water supply management, and demarcation of areas for management responsibilities between EWSA and district remain undefined. As mentioned above, though theoretically EWSA's role is limited to advising districts, in some cases EWSA is actually doing tripartite contracting and direct management where responsibilities of the two parties are not yet well distinguished.

2-4-2 **Basic Concept for Operation and Maintenance Plan**

During the Project, reinforcement of the operation and maintenance system will be implemented primarily in accordance with the present Water and Policy (2010). However, close attention needs to be kept for changes in the policy as ambiguities in responsibilities of EWSA and districts are observed. In regard to the problems and challenges of relevant organizations involved in rural water supply shown above, minimal support will be given aiming for sustainable management of the constructed schemes.

As for districts, selection of WSPs is one of the most important roles. Therefore, support will

focus on activities such as preparation of tender documents, tender evaluation and other processes to conclude the contract. WSPs selected by the districts will receive trainings on administration (e.g., report preparation), financial aspects (e.g., accounting and tariff collection) and technical aspects (e.g., Operation & Maintenance) for management of water schemes.

Since the type of water supply management is yet to be determined for each site, the software component plan will be planned in a manner where its activities can support any type of management. The possible arrangements for operation and maintenance for new schemes are shown below.

Table 2-20 Possible Arrangements for O&M for this Project

	Management/Supervision	Contract	Service Provider
a)	District	Yes	Private WSP（Cooperative or Enterprise）
b)	District	No	Sector
c)	EWSA	No	EWSA
d)	District with Technical Support from EWSA	Yes	Private WSP（Cooperative or Enterprise）
e)	EWSA	yes	Private ESP（Cooperative or Enterprise）

The following approaches are presented in response to the issues being challenged by districts and WSPs addressed in the previous section.

Table 2-21 Activities to Support Districts

Issue		Activities
1) Lack of Human Resources		No particular activities will be carried out in this project. Districts will be advised to make efforts to improve the situation following such examples as those of Ngoma and Kayonza Districts, where the districts have employed persons solely in charge of water supply to assist the officers in charge of infrastructure.
2) Lack of Financial Resources		No particular activities will be carried out in this project. The royalties from each WSP should be properly collected and effectively used as water fund as stated.
3) Low Managerial Capacity	Capacity to select WSPs	Support will be given for reinforcement of districts' capacities for preparation of tender documents, tender evaluation and other processes to conclude the contract.
	Capacity to evaluate management of WSPs	These are out of scope of the software component plan and need to be carried out continuously by the districts after completion of the project implementation. Districts will be advised on these matters by the consultant.
	Utilization of Water Fund	
	Water tariff appraisal	

Table 2-22 Activities to Support WSPs

Issue		Activities
1) Financial Capacity	Tariff setting	During the software component plan, advice on method of water tariff setting and estimation will be given. Trainings on tariff collection and management will also be given to accountants and tap managers by the consultant.
	Tariff recovery	
2) Technical Capacity	Periodic inspections	Upon completion of the construction, the contractor will give instructions on operation and maintenance of equipment using instruction manuals of pumps and generators. There will also be collaborations with the software component plan.
3) Managerial Capacity	Report preparation	Method of operation and maintenance recording and reporting will be instructed during the software component plan.

2-5 Project Cost Estimation

2-5-1 **Initial Cost Estimation**

2-5-1-1 Cost Borne by the Rwandan Government

Table 2-23 Cost Borne by the Rwandan Government （RWF1.00 = ¥0.1516）

Item		Amount	Remarks
Extension of commercial power line		For 3 sites	
Personnel costs during Detailed Design Survey and Construction supervision	EWSA staff	For 55 days	・Participation in kickoff meeting, monthly meetings, and site transfer ・Attendance at the final inspection and the inspection after warranty period
	District Staff*	For 55 days	
	Sector office Staff*	For 55 days	
Personnel costs during Software Component Plan	EWSA staff	For 4 days	Discussions on the project contents and explanation to the districts
	District staff in charge of infrastructure *	For 63 days	Discussion on the project contents, verification on organizational structure of the project implementation, monitoring activities1
	Sector office staff *	For 51 days	Discussions on the project contents and explanation to the districts
Advising Commission for Authorization to Pay (A/P)		20,000 JPY (131,926RWF)	Opening of A/P： JPY 6,000 (39,578 RWF) /time×2 times A/P amendment： JPY 4,000 (26,385 RWF) /time×2 times
Payment commission to the Bank		995,000JPY (6,563,325RWF)	0.1% of the E/N amount E/N amount ＝995 million JPY
Total		1,015,000JPY (6,645,2519RWF)	*This amount does not include electrification cost for the sites but Musaza. Actual total would include the costs for the other sites.

Total 6,645,2519 RWF (1,10million JPY)

* The numbers of days indicated for district staff and sector office staff are the total for several personnel

2-5-1-2 Conditions for Estimation

(1)	Base month of estimation	:	July 2014
(2)	Exchange rate	:	1 USD = 103.16JPY 1 RWF= 0.1516 JPY
(3)	Period of Construction	:	Approximately 24 months from the E/N, including detailed design survey, tendering procedures and construction. See Implementation Schedule (Figure 2-23) for details.
(4)	Others	:	This Project cost estimation is to be completed in accordance with the guidelines for Grant Aid Assistance of the Japanese government.

2-5-2 **Operation and Maintenance Cost**

2-5-2-1 Conditions of Cost Estimation

Operation and maintenance costs for water schemes to be constructed by this project, and minimum requirements of water tariffs per 20-liter plastic tank (jerry can) are estimated per site under two different conditions: in case diesel generators are used as power sour and in case commercial power is available from a grid line.

The following expense items were included in the estimated annual cost. For detailed conditions for each item, see Table 2-25 – Table 2-28.

Table 2-24 Items included for O&M Cost Estimation

Category	Items	Conditions
Operation Cost	▪ Fuels, electricity ▪ Transportation of fuels ▪ Chlorine additives	Fuel consumption rate considers engine oil and consumables such as filters
Management Cost	Remuneration to personnel ▪ President ▪ Vice President ▪ Accountant ▪ Technicians ▪ Responsible for hygiene ▪ Operator ▪ Tap manager	Based on the accounting record from a WSP at existing facility in the target area. For tap manager, remuneration is estimated to be 10% of the total sales from water fees
	Other expenses (Transport. Communication, allowance etc.)	Cost per person based on the actual expense at existing facility
Maintenance Cost	Minor pipe repair (transmission and distribution pipes)	Unit repair cost /meter based on actual expense in past years
	Cleaning tanks	Unit cost /time based on actual record
	Replacement of Ball valves at public tap stand	Replacement/valve: estimated to be every 3 years
	Water meter and other valves	Unit cost/ item based on the actual expense record
Royalty	Royalty to the District as water fund	15%of the total sales
Non-Accounted-For Water	Uncollected water fees, leakage et.	15% of the total sales

※ Accounting record from a WSP at existing facility in target area was obtained for calculation purpose

Note that the calculation does not account for recovery of relatively large scale repair costs or savings for pump and generator renewals after their life. While the Water and Sanitation Policy (2010) recommends that various costs including costs for repairs and equipment replacement be recovered from the water tariff, it is not realistic to suggest such water tariff considering the incomes of households. At present, therefore it is more feasible that districts, EWSA and central government give complementary support for such expenses.

2-5-2-2 Operation and Maintenance Cost

The results of cost estimation are shown in Table 2-25, 2-26 (in case of always using diesel generators) and Table 2-27, 2-28 (in case commercial power is available but with consideration of 10% of blackout).

Table 2-25 Operation and Maintenance Cost (in case of using diesel generator)

Site No.	Site Name	Supply population*1	Operation hours*2 hr/day (a)	Generator*3 Output (kVA)	Generator*3 Quantity (台)	Reference model	Fuel Consp. Rate*4 lit/hr (b)	Fuel amount consumed lit/day (c) = (a) x (b)	Total fuel amount consumed per scheme lit/day (d)	Fuel Price (Jul 2013)*5 RWF/リットル (e)	Fuel Cost RWF/day (f)= (d) x (e)	Fuel Transport Cost*6 RWF/day (g) = (d) ÷400× 30,000
1-1	Rukira (East)	2,234	8.0	15.0	1.0	DCA-20ESK	3.2	25.6	25.6	1,085	27,776	1,920
1-2	Rukira (West)	5,853	8.0	25.0	1.0	DCA-35SPK	5.6	44.8	44.8	1,085	48,608	3,360
2	Murama	10,663	8.0	60.0	1.0	DCA-75SPI	11.7	93.6	244.0	1,085	264,740	18,300
			8.0	75.0	1.0	DCA-100ESI	15.6	124.8				
			8.0	15.0	1.0	DCA-20ESK	3.2	25.6				
3	Remera	14,621	12.0	15.0	1.0	DCA-20ESK	3.2	38.4	429.6	1,085	466,116	32,220
			12.0	75.0	1.0	DCA-100ESI	15.6	187.2				
			8.0	100.0	1.0	DCA-125SPK3	19.9	159.2				
			8.0	25.0	1.0	DCA-35SPK	5.6	44.8				

Site No.	Site Name	Item	(1) Fuel	(2) Fuel Transportation	(3) Chlorine additives*7	(4) Pipe repair (Transmission) *8		(5) Pipe repair (Distribution) *9	(6) Cleaning tanks*10	(7) Replacement of valves*11	(8) Salary for staff*12	(9) Management expenses*13	Total OM cost /year
		Annual Unit Cost (1000 RWF)	- Year (h) = (f)×365÷ 1000	- Year (i) = (g)× 365÷1000	- Year	0.0028 Year/m		0.00069 Year/m	5.4 Year/Tank	- Year	997.5 Year/Person	58.5 Year/Person	1000RWF/year
1-1	Rukira (East)	Q'ty	-	-	-	782		4,734	2	-	6	6	
		(1000 RWF)	10,138	701	132	2		3	11	155	5,985	351	17,478
1-2	Rukira (West)	Q'ty	-	-	-	484		10,245	2	-	6	6	
		(1000 RWF)	17,742	1,226	344	1		7	11	157	5,985	351	25,824
2	Murama	Q'ty	-	-	-	3,282		28,700	3	-	6	6	
		(1000 RWF)	96,630	6,680	627	9		20	16	426	5,985	351	110,743
3	Remera	Q'ty	-	-	-	4,710		15,738	3	-	6	6	
		(1000 RWF)	170,132	11,760	860	13		11	16	419	5,985	351	189,547

Table 2-26 O&M Cost per capita (in case of using diesel generator)

Site No.	Site Name	Item	Total OM cost /year	Total OM cost /day	Allowance for tap managers (10% of OM cost)	Water fund (15% of OM cost)	NRW(15% of OM cost) *14	Total cost /day	Charge per person (Water tariff for 20L Plastic tank)
		Annual Unit Cost (1000 RWF)	1000RWF/year	RWF/day	RWF/day	RWF/day	RWF/day	RWF/day	RWF/person
1-1	Rukira (East)	Q'ty							
		(1000 RWF)	17,478	47,885	4,788	7,183	7,183	67,038	**30**
1-2	Rukira (West)	Q'ty							
		(1000 RWF)	25,824	70,752	7,075	10,613	10,613	99,053	**17**
2	Murama	Q'ty							
		(1000 RWF)	110,743	303,407	30,341	45,511	45,511	424,769	**40**
3	Remera	Q'ty							
		(1000 RWF)	189,547	519,306	51,931	77,896	77,896	727,028	**50**

N.B. and Conditions for Calculation

*1 See Table 2-3 (Chapter 2). Except Rukira West, discharge of water source (measured from April to July 2013) governs the number people that can be served by the project facilities. Water at 3 boreholes in Remera will be pumped for 12 hours at maximum per day.

*2 Based on the design criteria

*3 Outputs of generators were estimated from the outputs of pumps and their starting method.

*4 0.17 liter/kWh (guinding document by Japan Construction Machinery and Construction Association). The figure includes oils and consumables for daily operation and maintenance.

*5 Quotation obtained in July 2013. Inflation rate of 1.085 is applied.

*6 The Maximum of 400 litres at a time is assumed to be possible for transportation for 30,000RWF/time according to the existing WSP record.

*7 Exchange rate 1 RWF = ¥0.1579 Reference Price from other projects (JPY) : 208 JPY/kg

Chlorinator	Design Quantity (L/h)	Quantity per day (L/day)	Chlorine residual (mg/L)	Required chlorine (gr/day)	Calcium hypochlorite ($CaClO_2$)	JPY/day	JPY/year	RWF/year	RWF/year (Total per site)
	a	b = a x 8hrs	c	d = b x c / 1000	e = d / 0.6	f = ex208	g = f x 365	g/0.1579 JPY	
Musaza-1	15,000	120,000	3	360	600	125	45,552	288,486	505,428
Musaza-2	11,280	90,240	3	271	451	94	34,255	216,942	-
Rukira (E)	6,840	54,720	3	164	274	57	20,772	131,550	131,550
Rukira (W)	17,880	143,040	3	429	715	149	54,298	343,876	343,876
Murama	32,580	260,640	3	782	1,303	271	98,939	626,592	626,592
Remera	44,700	357,600	3	1,073	1,788	372	135,745	859,689	859,689

*8 Cost per meter is estimated from expense reord (obtained July 2013) for 2 years at existing WSP. 5.6RWF/m/2years = 2.8RWF/m/year

*9 Cost per meter is estimated from expense reord (obtained July 2013) for 6 months at existing WSP. 0.34RWF/m /6 months = 0.69/m/year

*10 Cost per meter is estimated from expense reord (obtained July 2013) for 1 year at existing WSP. 5,400RWF/Tank /year

*11

Site	Item	Replacement of ball valve	Replacement of meters	Replacement of float valve	Replacement of other valves	Total
	Annual Unit Cost	1.67	4.11	22.74	1.20	(1000 RWF)
	(1000 RWF)	Year/piece	Year/piece	Year/piece	Year/piece	
Musaza	Q'ty	25	21	15	30	
	(1000 RWF)	42	86	341	36	505
Rukira (E)	Q'ty	7	7	4	20	
	(1000 RWF)	12	29	91	24	155
Rukira (W)	Q'ty	17	16	2	15	
	(1000 RWF)	28	66	45	18	157
Murama	Q'ty	31	27	10	30	
	(1000 RWF)	52	111	227	36	426
Remera	Q'ty	42	29	8	40	
	(1000 RWF)	70	119	182	48	419

・As for ball valves, the unit price of 5,000RWF was obtained in July 2013. They are ssumed to be replaced every three years. 5,000RWF÷3years = 1,667RWF/year

・For other items, unit cost per item was estimated from expense record (obtained July 2103) for 5 years at existing WSP.

*12 From expense record at existing WSP (obtained July 2013). Actual salaries and the number of personnel would depend on characteristics of facilities and WSP, but at this estimation, the standard number of WSP personnel (President, vice president, accountant, person in charge of hygiene, pipe technician and operator) and average unit salary of 997,500RWF/year/person are used.

*13 Management cost includes transportation, allawances, communication fees etc., and based on expense record of existing WSP. 39,000RWF/month for 8 employees at existing WSP. 39,000RWF÷8×12months = 58,500RWF/year/person

*14 15% of OM cost is asssumsed as Non-Revenue-Water such as leakages and uncollected water tariff.

Table 2-27 Operation and Maintenance Cost (with commercial power)

Site No.	Site Name	Supply population*1	Operation hours*2	Output of pump*3	Electric consumption /day	Locatio of installation	Total Elec. Consumption /site	Tariff *15	Electricity cost
			hr/day	kW	kWh/day		kWh/day	RWF/kWh	RWF/day
			(a)	(b)	(c) = (a)×(b)		(d)	(e)	(f) = (d)×(e)
1-1	Rukira (East)	2,234	8.0	2.2	17.6	CH1	17.6	134	2,358
1-2	Rukira (West)	5,853	8.0	7.5	60.0	CH2	60.0	134	8,040
2	Murama	10,663	8.0	18.5	148.0	CH1	341.6	134.0	45,774
			8.0	22.0	176.0	CH2			
			8.0	2.2	17.6	CH3			
3	Remera	14,621	12.0	2.2	26.4	BH1	542.0	134.0	72,628
			12.0	2.2	26.4	BH2			
			12.0	1.1	13.2	BH3, CH2			
			8.0	22.0	176.0	CH2			
			8.0	30.0	240.0	CH3			
			8.0	7.5	60.0	CH4			

Site No.	Site Name	Item	(1) Eelec.ty charge	(3) Chlorine additives*7	(4) Pipe repair (Transmission) *8	(5) Pipe repair (Distribution) *9		(6) Cleaning tanks*10	(7) Replacement of valves*11	(8) Salary for staff*12	(9) Management expenses*13	Total OM cost /year	Total OM cost /day
		Annual Unit Cost (1000 RWF)	- year	- year	0.0028 year/m	0.00069 year/m		5.4 Year/Tank	- Year	997.5 Year/Person	58.5 Year/Person	1000RWF/year	RWF/day
1-1	Rukira (East)	Q'ty	-	-	782	4,734		2	-	6	6		
		(1000 RWF)	861	132	2	3		11	155	5,985	351	7,500	20,547
1-2	Rukira (West)	Q'ty	-	-	484	10,245		2	-	6	6		
		(1000 RWF)	2,935	344	1	7		11	157	5,985	351	9,791	26,824
3	Murama	Q'ty	-	-	3,282	28,700		3	-	6	6		
		(1000 RWF)	16,708	627	9	20		16	426	5,985	351	24,141	66,141
4	Remera	Q'ty	-	-	4,710	15,738		3	-	6	6		
		(1000 RWF)	26,509	860	13	11		16	419	5,985	351	34,164	93,600

Table 2-28 O&M Cost per capita (with commercial power)

Site No.	Site Name	Item	Total OM cost /day	Allowance for tap managers (10% of OM cost)	Water fund (15% of OM cost)	NRW(15% of OM cost) *14	Total cost /day	Charge per person (Water tariff for 20L Plastic tank)
		Annual Unit Cost (1000 RWF)	RWF/day	RWF/day	RWF/day	RWF/day	RWF/day	RWF/人
1-1	Rukira (East)	Q'ty (1000 RWF)	20,547	2,055	3,082	3,082	28,766	**15**
1-2	Rukira (West)	Q'ty (1000 RWF)	26,824	2,682	4,024	4,024	37,553	**7**
2	Murama	Q'ty (1000 RWF)	66,141	6,614	9,921	9,921	92,597	**12**
3	Remera	Q'ty (1000 RWF)	93,600	9,360	14,040	14,040	131,038	**13**

N.B. and Conditions for Calculation:
*1-3, 7-14 are the same comments as those for the case of diesel generator.
*15 EWSA electricity tariff (as of July 2013)

2-5-2-3 Evaluation of Water Tariff Affordability

Based on the ratio of operation and maintenance (O&M) cost to be borne per capita (estimated water tariff) to average income of household, affordability for water by the served population was evaluated. Water tariff per 20-liter jerry can and affordable water tariff based on average household income are shown in Table 2-29 in the net page.

Average income per capita is based on the result of social condition survey and the field interviews as a reference. In the survey questions on income, however, only cash income was asked and the amount from self-consumed agricultural product not counted. Implication of self-consumption was examined as follows.

According to the statistical data of Rwanda, the average expenditure of the person engaged in agriculture amounts to 63 RWF/day of which 98% is the cash expenditure and 53% is the expenditure on foods (the cost of self-consumed agricultural products is not included). Considering this situation, the poverty line with 250 RWF/cap/day and the cash income data obtained in the survey, the equivalent cost of self-consumed food is estimated at half of the amount spent on food. According to the result of interviews with sector office, assuming that most food consumption is from subsistent agriculture, the cost for food per day corresponds to 3,500 RWF per family (700 RWF per capita) at the market price.

Given the above circumstances, the amount of self-consumption is estimated at 350 RWF/capita/day. Therefore, the cash income added by 350 RWF/capita/day was compared with O&M cost per capita to evaluate its affordability.

Table 2-29 Ratio of O&M Cost to be Borne per Capita and Income per Capita

SiteNo.	Site (Scheme)	Water tariff (RWF/20L) (OM cost to be borne / capita)		Cash income (A) (RWF/cap/day) *HH income divided by no. of members	(A)+ self-consumption =(B) (RWF/cap/day)	Affordable price (5% of (B))
		Diesel generator	Commercial power (10% use of generator in blackout)			
1-1	RukiraEast	30	15	255.20	605.20	31
1-2	RukiraWest	17	7			
2	Murama	40	12	179.51	529.51	27
3	Remera	50	13	134.17	484.17	22

As shown above, the estimated O&M costs vary greatly among sites and between two different conditions for power source. 5% of the average income is recommended as critical point in evaluating water tariff affordability by World Bank, and this percentage is adopted in this evaluation as well. When 5 % of the average income is compared with the O&M cost per capita (cost per unit water supply rate of 20 liter/capita/day), it is found that tariff setting for sites except Rukira is too high if generators are used as power source.

On the contrary, if all the sites are electrified, meaning that commercial power lines are available for use and generators will be used only in case of blackout (10% of blackout frequency is assumed at the calculation[14]), it is suggested that water tariffs for all 5 schemes will become affordable.

In view of these conditions, it is anticipated that at all the sites but Rukira, sustainable use of facility would be difficult unless commercial power line is extended for the schemes. As the results of calculations shown from Table 2-25 to Table2-28 is a reference value based on the factors such as fuel consumption of equipment selected for Outline Design and Cost Estimation of the project, selection of the equipment should be re-examined at the stage of Detailed Design and at the stage of actual Procurement with careful consideration of operation and maintenance cost.

[14] Because of unstable power supplies in target areas of Rwanda, generators will be installed even when commercial power line becomes available at the sites.

CHAPTER 3

PROJECT EVALUATION

Chapter 3 Project Evaluation

3-1 Preconditions

(1) Project Implementation Organization

At the time of project commencement, the implementation organization of EWSA and target districts does not change.

(2) Advising Commission for Authorization to Pay (A/P) and Bank Commission

The Rwandan government must bear the costs of advising commission for Authorization to Pay (A/P) and payment commission to the bank arranged under the grant aid system.

(3) Prompt Custom Clearance

The construction period under the grant aid system is limited where 2 years after the E/N is planned for this project. This period is from the detailed design stage to completion of construction, and therefore, custom clearance of all imported construction equipment and materials needs to be carried out promptly.

(4) Tax Exemption

In the previous Japanese grant aid project, there was a delay in tax exemption process due to the lack of consent from the Rwandan government on some types of taxes to be exempted. This problem was finally solved at the beginning of 2014.

However, in the meantime, there was a change in the governmental policy on tax exemption for international aid projects where the taxes that were exempted before would instead be borne by the executing agency of the project (i.e., EWSA). There are similar cases in other countries, and usually because the taxes need to be secured as part of the agency's budget, justification on cost-effectiveness of the project becomes strict. Especially as implementation of this project will be the first project for EWSA to go through this budget requirement, it sees the issue very carefully. In this project, good understanding and smooth procedures on tax exemption by the Rwandan side is essential to complete the construction works with the limited timeframe.

3-2 Necessary Inputs by Recipient Country

(1) Commercial Power Line Extension Works to Reduce Operation and Maintenance Costs

Costs necessary for works related to extension of commercial power including wiring from the existing power transmission grids to the target sites and installation of necessary electric poles, transformers and breakers as well as installation of breakers, integrating wattmeter and power switching control panel in the control houses, should be borne by the recipient country to decrease operation and maintenance costs.

(2) Support Activities for Operation and Maintenance Strengthening

Before commencement of activities, participation in the project of not only the persons from target sites to be in charge of operation and maintenance, but also EWSA, districts and water service providers must be available.

(3) Monitoring and Supervision for Sustainable Use of Facilities

Districts and EWSA must continuously carry out monitoring and supervision, as planned, after completion of water supply schemes. Also, districts, EWSA and MININFRA must secure necessary budget for these activities.

3-3 Important Assumptions

(1) Rwanda continues the operation and maintenance system of constructed water supply schemes (organization of water supply sector of Rwandan government does not change)

Continuation of the supervision system by the supervising organization (district or EWSA) and operation and maintenance system by water service providers is an indispensable condition for sustainable scheme management.

(2) Spring yields and borehole pumping rates do not decrease (groundwater potential does not decline unexpectedly)

Discharge rates of target springs and potential pumping rates of the 3 boreholes in Remera, which are targeted as the water sources for this project, are assumed to cover the water supply rates in the design year. However, groundwater potential should not degrade to create deficits in spring yields and groundwater pumping rates, and water level should not lower to cause difficulties in pumping.

3-4 Project Evaluation

3-4-1 Relevance

(1) The target of this project is 4 sites in 4 districts of Eastern Province which has the lowest water supply coverage rate in Rwanda and the beneficiary population in the design year will be about 33,000 persons.
(2) The objective of this project is the "increase in population who can access safe water" which is one of the basic human needs.
(3) The target residents of this project have needs to use safe water by reducing labor for water fetching.
(4) The construction of water supply schemes through this project (expected to be completed in 2016) is necessary to achieve the objective of 100% coverage of VISION 2020 as the superior plan of Rwanda, for which the target year was moved forward through the Seven Year Government Plan.
(5) Japan's Country Assistance Plan (April 2012) for Rwanda emphasizes comprehensive water supply services to strengthen the social development foundation through social service improvement (supply of safe water) focused on Eastern Province having low water supply coverage and strengthening of the operation and maintenance organization. This project will directly contribute to this objective.
(6) As a result of environmental and social consideration, this project will not have any negative effects.

Due to the above factors, this project has sufficient relevance.

3-4-2 Effectiveness

(1) Quantitative Effects

Effects anticipated by the project are shown in the Table 3-1 for each parameter.

The following values are calculated based on Table 2-9 (Refer to Page 2-17.)

Table 3-1 Quantitative Effects

Parameter	Base Value (2012)	Goal (2020, 4 years after project completion)
Water Supply Rate (m^3/day)	954	1,618
Service Population (persons)	47,693	80,894

(2) Qualitative Effects

The qualitative effects are shown below.

1） Benefits

Water fetching efforts will be reduced and safe water can be procured near settlements. Also, time saved can be used for other productive work by women and learning at school by children.

2） Sanitation Awareness

Due to the support to be given to use of safe and stable water and sanitation promotion activities, improvements in awareness of users to enhance the sanitation conditions can be anticipated.

APPENDICES

Appendix-1　Member List of the Study Team

Appendix-1 Member List of the Study Team

First Field Survey

Name	Position	Organization
Toshio MURAKAMI	Leader	JICA Visiting Senior Advisor
Tadashi KAGEYAMA	Project Management	Water Resources Management Division II, Global Environment Department, JICA HQ
Ryotaro MIYAUCHI	Chief Consultant / Water Supply Planning	Japan Techno Co., Ltd.
Shoji FUJII	Hydrogeology 1 / Environmental and Social Consideration	Japan Techno Co., Ltd.

Second Field Survey

Name	Position	Organization
Ryotaro MIYAUCHI	Chief Consultant / Water Supply Planning	Japan Techno Co., Ltd.
Makoto YAMAMOTO	Water Supply Facilities Design	Japan Techno Co., Ltd.
Koji MIYAUCHI	Topographic Survey / Ground Condition Investigation	Japan Techno Co., Ltd.
Chifumi YAMASHITA	Hydrogeology 2 / Geophysical Survey & Test Drilling	UNITEKU Co., Ltd
Takafumi OHASHI	Socio-Economic Survey / Operation and Maintenance Planning	Japan Techno Co., Ltd.
Kazuko HORIUCHI	Implementation & Procurement Planning / Cost Estimation	Japan Techno Co., Ltd.

Explanation of Draft Outline Design

Name	Position	Organization
Toshio MURAKAMI	Leader	JICA Visiting Senior Advisor
Yuichi KUMAGAI	Project Management	Water Resources Management Division II, Global Environment Department, JICA HQ
Ryotaro MIYAUCHI	Chief Consultant / Water Supply Planning	Japan Techno Co., Ltd.
Kazuko HORIUCHI	Implementation & Procurement Planning / Cost Estimation	Japan Techno Co., Ltd.

Appendix-2　Study Schedule

Appendix-2 Study Schedule

First Field Survey

Date			JICA		Consultant Team	
			Team Leader Mr. Toshio MURAKAMI	Planning Management Mr. Tadashi KAGEYAMA	Chief Consultant /Water Supply Plan Ryotaro MIYAUCHI	Hydrogeology1 / Environment Survey Shoji FUJII
1	31-Mar	Sun			Departure from Tokyo	Departure from Osaka
2	1-Apr	Mon	Departure from Tokyo		13:50 Arrival at Kigali 16:00 Meeting at JICA Office	
3	2-Apr	Tue	9:00 Arrival at Kigali 15:00 Meeting at JICA Office		AM: Courtesy call and explanatin of IC/R to EWSA 15:00 Meeting at JICA Office	
4	3-Apr	Wed	9:00 Courtesy call to MININFRA 10:30 Courtesy call to MINECOFIN 14:00 Courtesy call and discussion on the study scope with EWSA			
5	4-Apr	Thu	9:00 Examination of Minutes of Discussion on the study scope with EWSA 14:00 Ditto			
6	5-Apr	Fri	9:00 Courtesy call to Eastern Province (located in Rwamagana) 11:30 Site visit (Murambi, Ruramira)			
7	6-Apr	Sat	Site visit (Rurenge2, Musaza, Phase 2 sites)			
8	7-Apr	Sun	Data analysis			
9	8-Apr	Mon	10:00 Signing on Minutes of Discussion on the study scope with EWSA			
10	9-Apr	Tue	9:00 Report to JICA Office 11:00 Report to Japanese Embassy			
			16:45 Departure from Kigali	20:20 Departure from Kigali	PM: Meeting with EWSA	
11	10-Apr	Wed	Arrival at Dushanbe for another mission	Transit	Preparation for survey, information collection	Preparation for survey, Tender evaluation
12	11-Apr	Thu		Arrival at Tokyo	Preparation for survey, information collection	Tender evaluation, information collection
13	12-Apr	Fri			Preparation for survey, information collection	Negociation and signing of contract with local consultant
14	13-Apr	Sat			Field survey	Field survey
15	14-Apr	Sun			Data compliation	Data compliation, Report on tender evaluation
16	15-Apr	Mon			Field survey	Field survey
17	16-Apr	Tue			Field survey	Field survey
18	17-Apr	Wed			Field survey	Field survey
19	18-Apr	Thu			Field survey	Field survey
20	19-Apr	Fri			Field survey	Field survey
21	20-Apr	Sat			Field survey	02:25 Departure from Kigali for another mission
22	21-Apr	Sun			Data compliation	
23	22-Apr	Mon			Field survey	
24	23-Apr	Tue			Field survey	
25	24-Apr	Wed			Field survey	
26	25-Apr	Thu			Field survey	
27	26-Apr	Fri			Report to JICA, EWSA	
28	27-Apr	Sat			Data compliation	
29	28-Apr	Sun			14:50 Departure from Kigali	
30	29-Apr	Mon			17:50 Arrival at Tokyo	

Second Field Survey

	Date		Survey Team Members					
			A. Chief Consultant / Water Supply Planning	C. Water Supply Facilities Design	D. Topographic Survey / Geotechnical Survey	E. Hydrogeological Survey2 / Geophysical Survey and Test Drilling	F. Socio-Economic Survey / Operation & Maintenance Planning	Implementation & Procurement Planning / Cost Estimation
1	6/1	Sat	22:00 Departure from Tokyo	22:00 Departure from Tokyo	22:00 Departure from Tokyo	22:00 Departure from Tokyo		22:00 Departure from Tokyo
2	6/2	Sun	13:50 Arrival at Kigali	13:50 Arrival at Kigali	13:50 Arrival at Kigali	13:50 Arrival at Kigali		13:50 Arrival at Kigali
3	6/3	Mon	Courtesy call and meeting at JICA Rwanda	Courtesy call and meeting at JICA Rwanda	Courtesy call and meeting at JICA Rwanda	Courtesy call and meeting at JICA Rwanda		Courtesy call and meeting at JICA Rwanda
4	6/4	Tue	KG→NY, Site survey (No.5), travel to KB	KG→NY, Site survey (No.5), travel to KB	KG→NY, Site survey (No.5), travel to KB	KG→NY, Site survey (No.5), travel to KB		KG→NY, Site survey (No.5), travel to KB
5	6/5	Wed	Site survey (No.2 & MKM) travel to RM	Site survey (No.2 & MKM) travel to RM	Site survey (No.2 & MKM) travel to RM	Site survey (No.2 & MKM) travel to RM		Site survey (No.2 & MKM) travel to RM
6	6/6	Thu	Site survey (No.3 & No.4)	Site survey (No.3 & No.4)	Site survey (No.3 & No.4)	Site survey (No.3 & No.4)		Site survey (No.3 & No.4)
7	6/7	Fri	Site survey (No.1), travel to KG	Site survey (No.1), travail to KG	Site survey (No.1), travel to KG	Site survey (No.1), travel to KG		Site survey (No.1), travel to KG
8	6/8	Sat	Desk work, Tender process for Surveys	Desk work, Tender process for Surveys	Desk work, Tender process for Surveys	Desk work, Tender process for Surveys	22:00 Departure from Tokyo	Desk work, Tender process for Surveys
9	6/9	Sun	Team meeting, desk work	Team meeting, desk work	Team meeting, desk work	Team meeting, desk work	13:50 Arrival at Kigali	Team meeting, desk work
10	6/10	Mon	Meeting on selection of local consultants	Market survey	Meeting on selection of local consultants	Meeting on selection of local consultants	Courtesy call to JICA Rwanda, team meeting	Market survey
11	6/11	Tue	KG→NY Site survey No.6	KG→NY Site survey No.6	KG→NY Site survey No.6	KG→RM, Site survey No.6	Preparation for tendering (Socio-eonomic survey)	KG→NY Site survey No.6
12	6/12	Wed	Site survey No.6	Site survey No.6	Site survey No.6	Site transfer for geophysical survey	Preparation for tendering (Socio-eonomic survey)	Site survey No.6
13	6/13	Thu	Site survey No.6	Site survey No.6	Site survey No.6	Site transfer for geophysical survey	KG→KB, site survey	Site survey No.6
14	6/14	Fri	Site survey No.3&4	Site survey No.3&4	Site survey No.3&4	Selection of drilling points	Site survey, KB→KG	Site survey No.3&4
15	6/15	Sat	Meeting on selection of local consultants	Interview with the Japanese contractor of Phase2 project and visit to Phase 2 site	Interview with the Japanese contractor of Phase2 project and visit to Phase 2 site	Test drilling supervision	Selection of local consultant	Interview with the Japanese contractor of Phase2 project and visit to Phase 2 site
16	6/16	Sun	Desk work, Team meeting RM→KG	Desk work, Team meeting	Desk work, Team meeting	Test drilling supervision	Desk work, Team meeting	Desk work, Team meeting RM→KG
17	6/17	Mon	Site survey (No.6)	Site survey No.1&2	Site survey No.1&2	Test drilling supervision	KG→KB, Selection of local consultant	Market survey, request for quotations
18	6/18	Tue	Site survey (No.5)	Site survey (No.5) travel to NY	Site survey (No.5) travel to NY, meeting with the local surveyor	Test drilling supervision	Contract for socio-economic survey with local consultant	Market survey, request for quotations
19	6/19	Wed	Site survey (No.4) NY→KB	Site survey (No.6)	Site survey (No.6), instruction to the local surveyor	Test drilling supervision	Pre-test for the survey	Market survey, request for quotations
20	6/20	Thu	Site survey (No.2) travel to KG	Site survey (No.6) travel to KG	Instruction to the local surveyor (No.6), travel to KG	Test drilling supervision, travel to KG	Pre-test for the survey, travel to KG	Market survey, request for quotations
21	6/21	Fri	Meeting with EWSA	Discussion with EWSA	Discussion with EWSA	Discussion with EWSA	Discussion with EWSA	Discussion with EWSA
22	6/22	Sat	Desk work, team meeting	Desk work, team meeting	Desk work, team meeting	Desk work, team meeting	Desk work, team meeting	Desk work, team meeting
23	6/23	Sun	Survey in Southern Province	Survey in Southern Province	Survey in Southern Province	Survey in Southern Province	Survey in Southern Province	Kigali ⇒Nairobi
24	6/24	Mon	KG→KB, Site survey	KG→KB, Site survey	KG→RM, Instruction to local surveyor	KG→RM Site survey (No.5 spring source)	KG→KB Site survey (No.2)	Market survey in Nairobi
25	6/25	Tue	Site survey (No.3)	Site survey (No.2)	Site No.2 Instruction to local surveyor	Site survey (No.6 spring source)	Site survey (No.2)	Market survey in Nairobi
26	6/26	Wed	Travel to KG, Reporting work	Site survey (No.3)	Site No.3 Instruction to local surveyor	Travel to KG, Reporting work	Site survey (No.3)	Market survey in Nairobi
27	6/27	Thu	Discussion with EWSA	Site survey (No.4)	Site No.4 Instruction to local surveyor	Discussion with EWSA	Site survey (No.3)	Market survey in Nairobi
28	6/28	Fri	Report to JICA	Site survey (No.4)	Site No.4 Instruction to local surveyor	Report to JICA	Site survey (No.4)	Market survey in Nairobi
29	6/29	Sat	Umuganda day 9:55 Departure from Kigali	Umuganda day Desk work	Umuganda day Desk work	Umuganda day 9:55 Departure from Kigali	Umuganda day Desk work	Market survey in Nairobi
30	6/30	Sun	17:50 Arrival in Tokyo	Desk work, team meeting	Desk work, team meeting	17:50 Arrival in Tokyo	Desk work, team meeting	Desk work, team meeting
31	7/1	Mon	**30 days**	Site survey (No.5) Travel to NY	Site survey (No.5) survey supervision	**30 days**	KB→NY Site survey (No.5)	Market survey in Nairobi
32	7/2	Tue		Site survey (No.6)	Site survey (No.6)		Site survey (No.5)	Market survey in Nairobi
33	7/3	Wed		Site survey (No.6)	Site survey (No.6)		Site survey (No.6)	Nairobi⇒Kigali
34	7/4	Thu		Site survey (No.1&2)	NY→KG, reporting work		Site survey (No.6)	Mark
35	7/5	Fri		Site survey (No.3&4)	Report to JICA		Site survey (No.7)	Market survey, request for quotations
36	7/6	Sat		Site survey (No.4)	Meeting with local surveyor		Site survey (No.7)	Market survey, request for quotations
37	7/7	Sun		Desk work	Desk work		Desk work	Desk work
38	7/8	Mon		Site survey (No.5)	14:50 Departure from Kigali		Site survey (No.8)	Market survey, request for quotations
39	7/9	Tue		Site survey (No.6) Travel to KG	17:50 Arrival in Tokyo		Site survey (No.8)) NY→KG	Market survey, request for quotations
40	7/10	Wed		Report to EWSA and JICA	**39 days**		Interview with EWSA	Market survey, request for quotations
41	7/11	Thu		9:55 Departure from Kigali			Interview with EWSA	Reporting work
42	7/12	Fri		17:50 Arrival in Tokyo			Report to JICA	Report to JICA
43	7/13	Sat		**42 days**			KG→KB Site survey	Desk work
44	7/14	Sun	【ABBREVIATIONS】				14:50 Departure from Kigali	14:50 Departure from Kigali
45	7/15	Mon	KG: Kigali	RM: Rwamagana			17:50 Arrival in Tokyo	17:50 Arrival in Tokyo
46	7/16	Tue	KB: Kibungo	NY: Nyagatare			**38 days**	**45 days**

Explanation of Draft Outline Design

Date		Day	Time	JICA (Leader, Project Management)	Consultant (Chief Consultant, Implementation & Procurement Plannng/Cost Estimation)
Dec	3	Tue	22:30	Depart from Narita (QR 807)	
	4	Wed	14:30	Arrival at Kigali (QR 1387)	
			16:00	Meeting at JICA Office	
	5	Thu	8:00	Courtesy Call, M/D Consultation (EWSA DDG)	
	6	Fri	9:00	Courtesy call to MINAFETT (Asia and Oceania Unit)	Site visit with C/Ps (Musaza)
			10:00	Courtesy call to MINECOFIN (External Finance Unit)	
			PM	Site visit with C/Ps (Rukira, Murama)	
	7	Sat		Meeting with JOCV, Visit MKM site	
	8	Sun		Data analysis	
	9	Mon	8:00	Meeting with EWSA and 4 districts (Explanation of the outline design report, Discussion on M/D)	
			13:30	Site visit with C/Ps (Remera)	
	10	Tue	8:00	M/D document confirmation (EWSA DDG) Signing on M/D	
			14:00	Courtesy call to MININFRA (Permanent Secretary)	
	11	Wed	9:00	Report to JICA Office	
			11:00	Report to Japanese Embassy	
			15:30	Depart from Kigali (QR 1388)	
	12	Thu	16:55	Arrival at Narita(QR 806)	

Appendix-3　List of Parties Concerned in the Recipient Country

Appendix-3 List of Parties Concerned in the Recipient Country

1. Embassy of Japan in the Republic of Rwanda

Mr. Kazuya OGAWA	Ambassador of Japan
Ms. Shoko Nakatomi	Coordinator of Economic Cooperation
Ms. Fumiko YAMAMOTO	Researcher

2. JICA Rwanda office

Mr. Hiroyuki KOBAYASHI	Chief Representative
Mr. Takahiro MORIYA	Senior Representative
Mr. Fumiaki ISHIZUKA	Program Manager
Mr. Norbert HABINCUTI	Program Coordinator (Water and Sanitation)

3. Energy, Water and Sanitation Authority (EWSA)

Mr. James C.SANO	Deputy Director General for Water and Sanitation
Mr. Jean Bosco KANYESHEJA	Director of Water and Sanitation Development Division
Mr. Stanley NKUBITO	Water Projects Implementation Manager
Mr. Maurice IRAGUHA	Head of Engineering
Mr. Emmanuel NIWENSHUTI	Head of O&M Section in District Support Unit
Mr. Innocent KIMPAYE NKUSI	Program Engineer
Mr. Albert YARAMBA	Principal Engineer in charge of Water and Sanitation, PNEAR
Mr. Benoit NYIRIGIRA	Water and Sanitation Engineer, PNEAR

Eastern Province

Ms. Odette UWAMARIYA	Governor
Mr. Jean Marie Vianney MAKOMBE	Executive Secretary
Mr. Alexis R RUGAJU	Director of District Development Programs
Mr. Richards R KAGABO	Advisor to Governor
Mr. Boniface NTIRENGANYA	Director of Planning and Budget

Ministry of Infrastructures (MININFRA)

Ms. Emma Francoise ISUMBINGABO	Minister of State in Charge of Energy and Water
Ms. Christine M. UMUBYEYI	Water and Sanitation Engineer Local Counterpart
Ms. Peace KALIISA	Donors and External Links Coordinator
Mr. Emmanuel HATEGEKIMANA	Principal Engineer for Energy and Water

Ministry of Finance and Economic Planning (MINECOFIN)

Mr. Minega Michel SEBERA	International Legal Agreements Expert

Rwanda Development Board (RDB)

Mr. Sebastien DUSABEYEZU	UNFCCC's NFP and Senior Environmental Analyst Investment Implementation Division

Gatsibo District

Mr. William RUKUNDO	Executive Secretary
Mr. Jean Pierre SEBAHIRE	In charge of Infrastructure
Mr. Jonas MWISENEZA	In charge of Environment and Water
Mr. Venant MURENZI	In charge of Social Affairs
Mr. Issa MWUMVANEZA	Technician, NGARAMA Sector (former President of CODEANGA cooperative)

Kayonza District

Mr. Ronald CYIWANUKA	Executive Secretary
Mr. Damascene TWAGIRAYEZU	In charge of Infrastructure (1)
Mr. Espoir MURAGWA	In charge of Infrastructure (2)
Mr. Emmanuel MBONYUMUKIZA	In charge of Infrastructure (3)
Mr. Jean Paul MUDENGE	In charge of Environment
Ms. Francine MUTESI	In charge of Water Supply Management
Mrs. Hyancethe NYIRANEZA	Agronomist, RURAMIRA Sector
Mr. Theogene HABINEZA	Executive Secretary, RUYONZA Cell
Mr. Diogene SEMINEGA	Executive Secretary, BUGAMBIRA Cell

Ngoma District

Mr. Gerard MUZUNGU	Executive Secretary
Mr. Fidel KAYIGIRE	In charge of Infrastructure
Mr. Mbuecky MUTABARUKA	In charge of Environment
Mr. Edgard RUDASIGWA	In charge of Water Supply Management
Ms. Clementine NYIRATOMBORA	Agronomist, RUKIRA Sector

Kirehe District

Mr. Eric ZIKAMA	Executive Secretary
Mr. Danny MBERAKURORA	In charge of Infrastructure
Mr. Fred BITITI	In charge of Environment (Acting)
Mr. Jean Damascene NSENGIYUMVA	Agronomist, MAHAMA Sector
Mr. Felicien MANIRAGABA	President of COOPEREMA (cooperative), MAHAMA Sector

Nyagatare District

Ms. Mary KANTEGWA	Executive Secretary
Mr. John MURINZI	In charge of Infrastructure
Mr. Samuel MURENZI	In charge of Environment
Mr. Francois BYINSHI	Director of Planning

Appendix-4　Minutes of Discussions（M/D）

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR RURAL WATER SUPPLY (Phase III)
IN
THE REPUBLIC OF RWANDA

In response to the request from the Government of Rwanda (hereinafter referred to as "Rwanda"), the Government of Japan (hereinafter referred to as "Japan") decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Rural Water Supply (Phase III) (hereinafter referred to as "the Project") and entrusted the Study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Rwanda the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Mr. Toshio MURAKAMI, Visiting Senior Advisor of JICA, and is scheduled to stay in the country from 1 April 2013 to 28 April 2013.

The Team held the series of discussions with the officials concerned of the Rwanda and conducted a field survey in the Project area.

In the course of discussions and field survey, both parties have confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Outline Design Study Report.

Kigali, 9 April 2013

Mr. Toshio MURAKAMI
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. James C.SANO
Deputy Director General for Water and Sanitation
Energy, Water and Sanitation Authority
The Republic of Rwanda

ATTACHMENT

1. Objective of the Project

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

2. Study Sites

The Rwandan side and the Team (hereinafter referred to as ''both sides'') confirmed the target sites of the Study were 8 piped water schemes shown in Annex-2. The Rwandan side proposed to remove Mushikiri and Kigina pumped systems because of unstable source and replace them with Byimana-Rubona system. In addition, the Rwandan side proposed linking the Project for Ruramira with LVWATSAN Project. The Rwandan side promised to submit the necessary planning documents to the Team. The Project Sites to be implemented would be selected and confirmed through the Study.

3. Responsible and Implementing Agencies

The responsible agency is Ministry of Infrastructure (MININFRA). The Implementing Agency is Energy, Water and Sanitation Authority (EWSA).

4. Objective of the Preparatory Survey Phase

The Team explained that the objective of the Survey is collecting information for confirmation of the feasibility required for implementation of the Project. If some of the components are found feasible as a result of the Survey, JICA will continue the Survey for the outline design of the Project. Thus, the enforcement of the project is not guaranteed by Japanese side during the Survey process. The Rwandan side understood that.

5. Japan's Grant Aid Scheme

5-1. The Rwandan side understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex-3.

5-2. The Rwandan side promised to take the necessary measures, as described in Annex-3, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

5-3. The Rwandan side promised to arrange necessary personnel and counterpart budget for the water supply facilities development plan in the selected schemes.

5-4. JICA will report to the Rwandan side if there are any other undertakings based on the result of this survey.

6. Schedule of the Survey

6-1. Consultant members will proceed to further studies in Rwanda until 28th April 2013.

6-2. JICA will send the second Preparatory Survey Team of the Project based on the result of this Survey around the end of May 2013.

6-3. JICA will prepare the draft report in English and dispatch another mission in order to explain its contents around the beginning of November 2013.

6-4. In case that the contents of the report is accepted in principle by the Rwandan side, JICA will complete the final report and send it to the Rwandan side around January 2014.

7. Other relevant issues

7-1. Inception Report

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

7-2. Arrangements of the Rwandan side

As response to the request by the Team, the Rwandan side agreed to provide necessary number

of counterpart personnel from EWSA for the Study and also provide all the data and information relevant to the Project for the smooth implementation of the Study.

The Rwandan side committed to provide an office space at the EWSA Office for the Team.

7-3. Prioritization of the Water Schemes

Both sides agreed that the target water schemes were to be prioritized applying following criteria;

- Urgency (access rate to the potable water)
- Population
- Stability of water source (discharge rate per day in driest season / total amount of day-demand, water quality)
- Potential of water resource development
- Capacity of Operation and Maintenance
- Operation and Maintenance Cost (per-head O&M cost / affordability of beneficiary)
- Scheme Types (Gravity / Motorized by Generator / Booster pump / Existing treatment plant)
- Accessibility (cost of access road construction, availability of electricity etc.)
- Willingness to pay for water supply services

7-4. Test drillings

If necessary, the Team will carry out test drillings to get producing wells to complement the quantity of spring water. Rwandan side agreed that Rwandan side should be responsible to avail the land for drilling, ensure temporary access roads to the drilling sites and protect the test boreholes until the commencement of the Project.

7-5. No duplication with Other Projects

The Rwandan side promised to inform Japanese side immediately in case that any duplication with other donors, NGOs and the Government of Rwanda at 8 target schemes is found out. If any duplication is identified, the schemes will be removed from the Project.

7-6. Target water consumption rate per capita

Both sides agreed that the target water consumption rate per capita in village would be 20 liters per capita per day.

7-7. Target Year

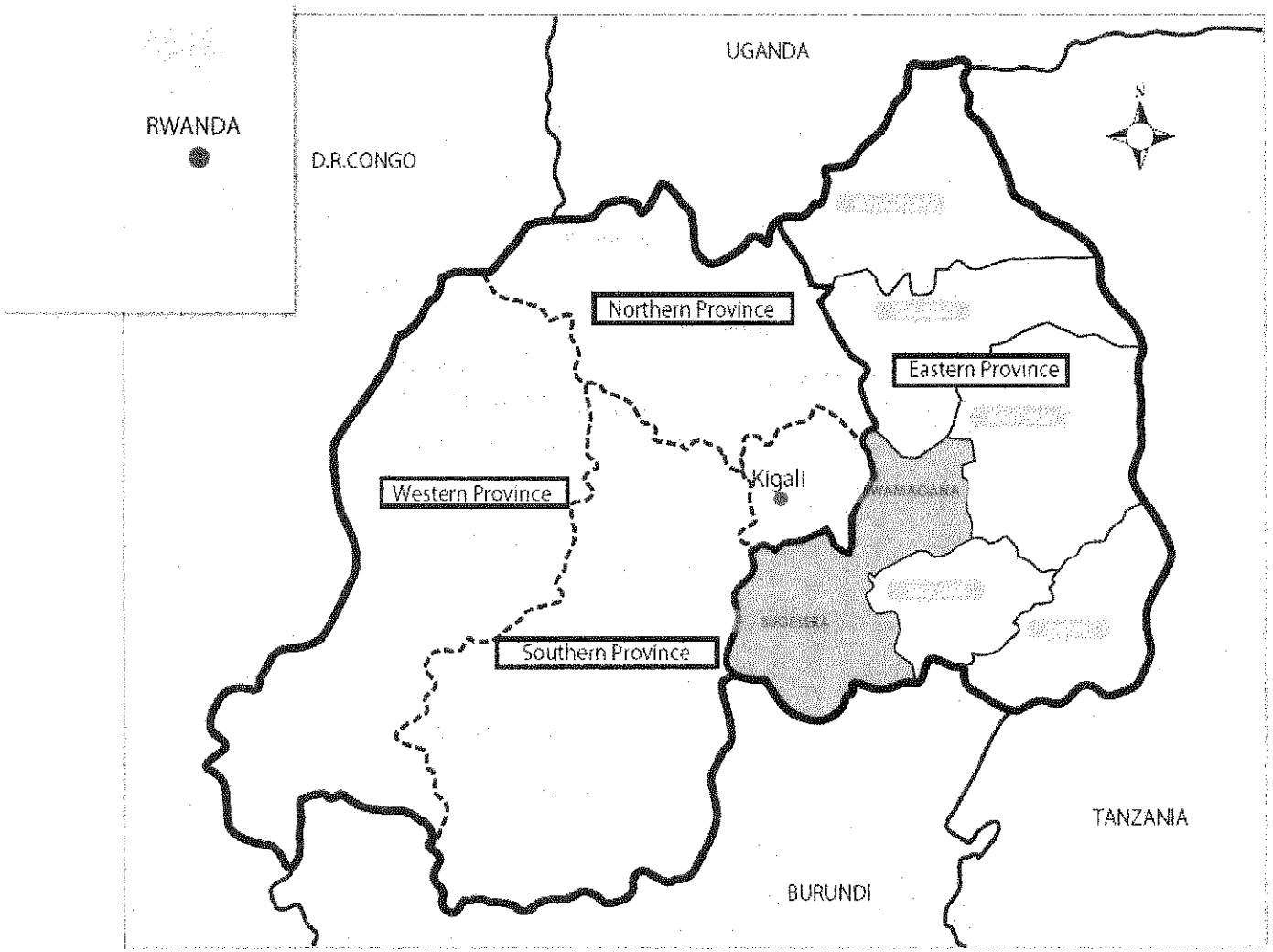
The Japanese side explained that the target year of the Project would be 2020. The Rwandan side expressed their intention to prefer larger scale facilities considering the future increase of the water demand in a longer term. The Japanese side explained that it would try to make the design that can be easily extended in the future.

7-8. EWSA's new approach

The Rwandan side explained their new approach to focus on large-scale water sources rather than small spring water sources. In response to the new approach, the both parties confirmed that the Japanese side would try to make the design that allows the facilities to be connected to nearby existing water source facilities to realize larger water supply network in the future. The Rwandan side promised to provide Japanese side with the concrete information on those existing water source facilities.

Annex-1 Project Area Map
Annex-2 Target Sites of the Study
Annex-3 Japan's Grant Aid Scheme
Annex-4 Discussion Participant List

TARGET AREA MAP



PREPARATORY SURVEY ON THE RURAL WATER SUPPLY PROJECT (PHASE III) IN THE REPUBLIC OF RWANDA

Target Sites of the Study

	District	Sector	Type	New/Rehab/Ext
1	Kayonza	Murama	Pumped	New
2	Kirehe	Mahama	Gravity	Rehabilitation
3	Gatsibo	Remera	Pumped	Rehabilitation+New Extension
4	Gatsibo	Murambi	Pumped	Rehabilitation
5	Nyagatare	Katabagemu	Gravity	New Extension
6	Ngoma	Rukira	Pumped	New
7	Kayonza	Ruramira	Gravity	Rehabilitation+New Extension
8	Kirehe	Musaza	Pumped	Rehabilitation+New Extension

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 a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

The Grant Aid is non-reimbursable fund provided to a recipient country to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for its economic and social development 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

The Japanese Grant Aid is supplied through following procedures:

- Preparatory Survey
  - The Survey conducted by JICA
- Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- Authority for Determining 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 preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies 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 between both parties concerning the basic concept of the Project.
- Preparation of an outline 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 Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve 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 of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness 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 Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge 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

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's

implementation after the E/N and G/A.

(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".

(4) Necessity of "Verification"

The Government of the 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 fulfill 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 the recipient country is required to maintain and use properly and effectively the facilities constructed and the equipment purchased under the Grant Aid, to assign staff necessary for this operation and maintenance and 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 under 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.

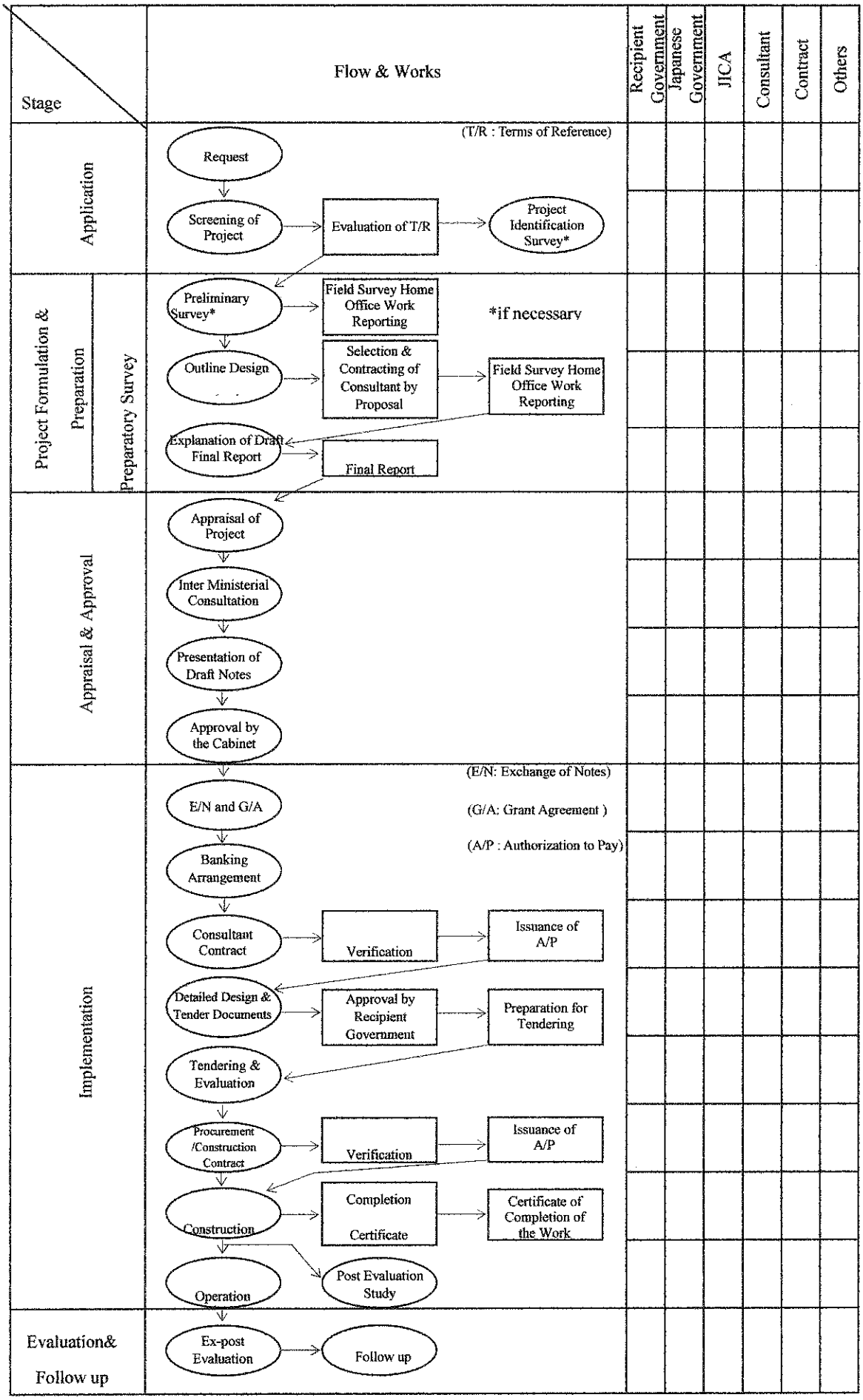
(9) Authorization to Pay (A/P)

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

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

FLOW CHART OF JAPAN'S GRANT AID PROCEDURES



Major Undertakings to be taken by Each Government (Construction)

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure [a lot] /[lots] of land necessary for the implementation of the Project and to clear the [site]/[sites];		●
2	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the Products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted		●
4	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 the recipient country and stay therein for the performance of their work		●
5	To ensure that [the Facilities and the products]/[the Facilities]/ [the products] be maintained and used properly and effectively for the implementation of the Project		●
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
7	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
8	To give due environmental and social consideration in the implementation of the Project.		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

Annex-4

Discussion Participant List

Energy, Water and Sanitation Authority (EWSA)		
1	Mr. James C.SANO	Deputy Director General for Water and Sanitation
2	Mr. Jean Bosco KANYESHEJA	Director of Water and Sanitation Development Division
3	Mr. Stanley NKUBITO	Water Projects Implementation Manager
4	Mr. Maurice IRAGUHA	Head of Engineering
5	Mr. Emmanuel NIWENSHUTI	Head of O&M Section in District Support Unit
6	Mr. Clement M.GAFISHI	Program Coordinator
JICA Preparatory Study Team		
1	Mr.Toshio MURAKAMI	Visiting Senior Advisor, JICA HQs
2	Mr.Tadashi KAGEYAMA	Assistant Director, Water Resources Management Division II, Global Environment Department, JICA HQs
3	Mr.Ryutaro MIYAUCHI	Executive Officer, Deputy General Manager of Technical Group, Japan Techno Co.,ltd
4	Mr.Shoji FUJII	Director Deputy General Manager of Technical Group, Japan Techno Co.ltd
JICA Rwanda Office		
1	Mr.Fumiaki ISHIZUKA	Program Manager for Water and Sanitation
2	Mr. Norbert HABINCUTI	Program Coordinator for Water and Sanitation

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR RURAL WATER SUPPLY (PHASE III)
IN
THE REPUBLIC OF RWANDA

In March 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Preparatory Survey Team on the Project for Rural Water Supply (Phase III) (herein after referred to as "Project") to the Republic of Rwanda (herein after referred to as "Rwanda") and through discussion, field survey, and technical examination of the result of the survey in Japan, JICA prepared a Draft Outline of the Survey.

In order to explain to and consult with Energy, Water and Sanitation Authority (hereinafter referred to as "EWSA"), the implementing agency of water supply development projects of the Government of Rwanda, regarding the components of the Draft Outline Design, JICA sent to Rwanda the Draft Outline Design Explanation Team (hereinafter referred to as "the Team"), which is headed by Mr. Toshio MURAKAMI, Visiting Senior Advisor of JICA, from January 3rd to 12th 2013.

As a result of discussion, both parties confirmed the main items described on the attached sheets.

Kigali, 10th December, 2013

Mr. Toshio MURAKAMI
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. James C. SANO
Deputy Director General for Water and Sanitation
Energy, Water and Sanitation Authority
The Republic of Rwanda

ATTACHMENT

1. Component of the Draft Report

The Rwandan side agreed and accepted in principle the components of the draft report explained by the Team.

2. Project Sites

(1) Musaza, Kirehe District (2) Rukira, Ngoma District (3) Murama, Kayonza District (4) Remera, Gatsibo District

3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed items and send it to the Rwandan side by the 25th of March, 2014.

4. Regarding Climate Change Issues

Both sides agreed that the Project is expected to contribute to the adaptation to climate change.

5. Customs and Tax Exemption

The Rwandan side agreed to facilitate and support the necessary procedures regarding customs and tax exemption during implementation of the Project.

6. Other Relevant Issues

The following issues were discussed and confirmed by both sides.

(1) Project Cost Estimate and Budgetary Arrangement

The Team explained to the Rwandan side the estimated project cost as attached in Annex-2. Both sides confirmed that this estimated cost was provisional and would be examined further by the Government of Japan for its final approval.

EWSA confirmed to request the necessary counterpart budget for the Project from Ministry of Finance and Economic Planning (MINECOFIN). EWSA will also ask an advice from MINECOFIN on the cost-effectiveness of the Project to secure the necessary counterpart budget.

Furthermore, both sides confirmed that this estimated project cost is strictly confidential, and should never be duplicated or released to other parties.

(2) Components of the Project

Both sides agreed that the Project would be composed of components in Annex-3.

Both sides also confirmed that the water supply systems are designed in a way which easily allows the future extensions, once the water discharge is increased.

EWSA requested to re-examine the number of the booster pumps in the Project sites to minimize the future operational cost, and considering the change of the management system which involves EWSA more directly, Japanese side agreed to examine this issue further during the Detailed Design study period.

(3) Overlapping with Other Project

The Rwandan side agreed that it will take measures to assure that this project would not overlap with any other projects executed by other donor agencies, NGOs and other Rwandan institutions.

(4) Undertakings by the Rwandan Side

The Rwandan side agreed to take the necessary measures in the above "2. Japan's Grant Aid Scheme", and furthermore, the following important measures.

1) To ensure appropriate operation and maintenance of the water supply facilities constructed under Japan's Grant Aid.
2) To fix management system for the operation and maintenance of constructed facilities by June 2014[1].
3) To complete the electrification works at all project sites before completion of the Project.
4) To ensure the selection of Water Service Provider (WSP) and conclusion of the contract between WSP and district or/and EWSA in each site 6 months before the end of construction of the Project.
5) To ensure the project participation of counterparts from EWSA and during the implementation of Soft Component, the participation of persons in charge from EWSA, particularly the District Support Unit as well as Districts and Sectors.
6) To explain to current water source users as well as new users through the district on the development of the source and construction of the facilities to receive their consent, and that any complaints will be handled by the Rwandan side.
7) To agree that a staff of EWSA and staff in charge of infrastructure/water supply management in each district would supervise and support the soft component program with the Japanese consultant and the local consultant or the local NGO.

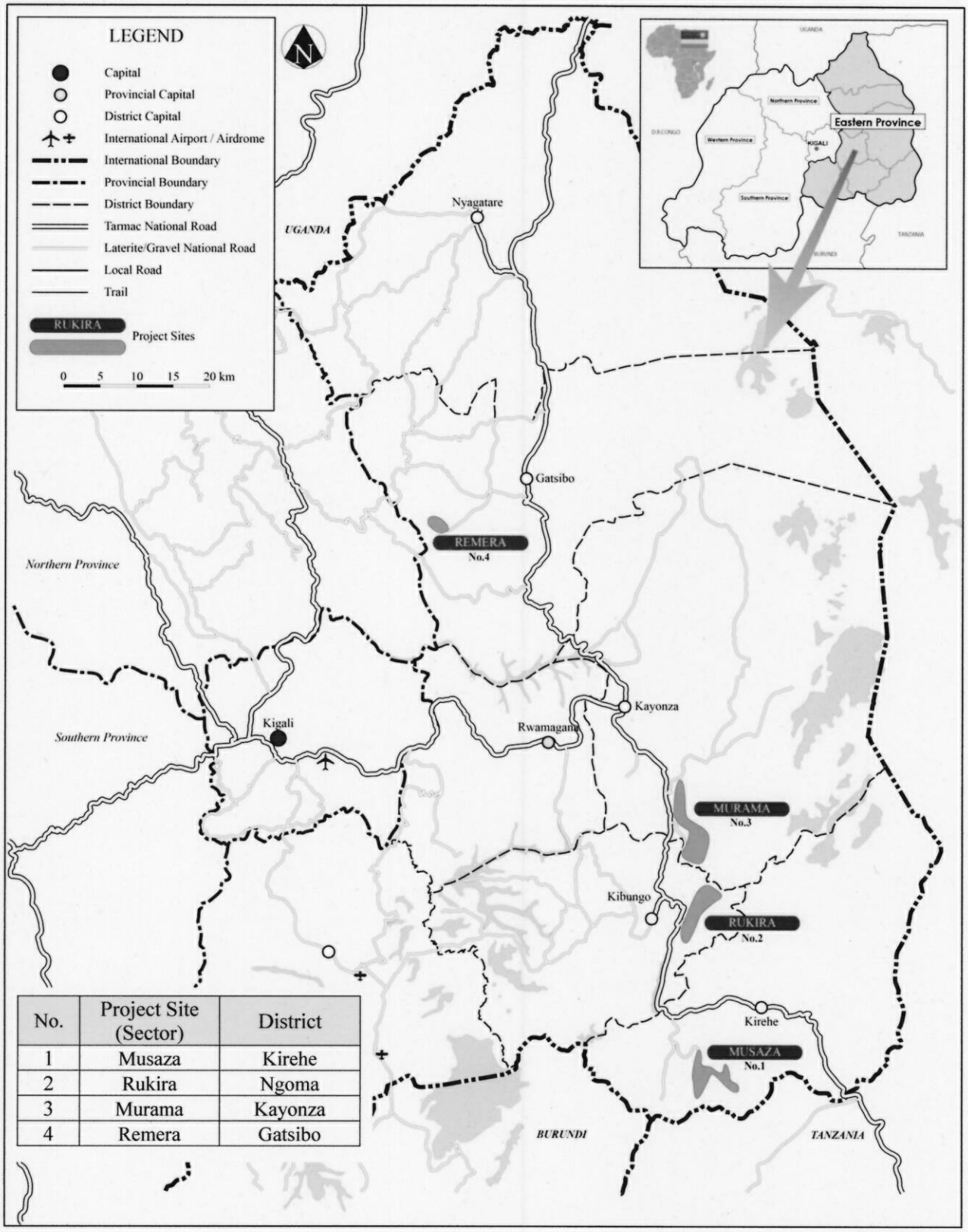
7. Japan's Grant Aid

EWSA understood the scheme of Japan's Grant Aid and would implement the necessary measures of the Rwandan side as described in Minutes of Discussions signed and dated on 9, April 2013.

Annex-1 Project Area Map
Annex-2 Project Cost Estimate (Confidential)
Annex-3 Project Components
Annex-4 Implementation Schedule

[1] EWSA will be under the organizational reform and will have a transition period until June 2014

Project Area Map



No.	Project Site (Sector)	District
1	Musaza	Kirehe
2	Rukira	Ngoma
3	Murama	Kayonza
4	Remera	Gatsibo

Project Components

(1) Construction

List of Water Supply Facilities

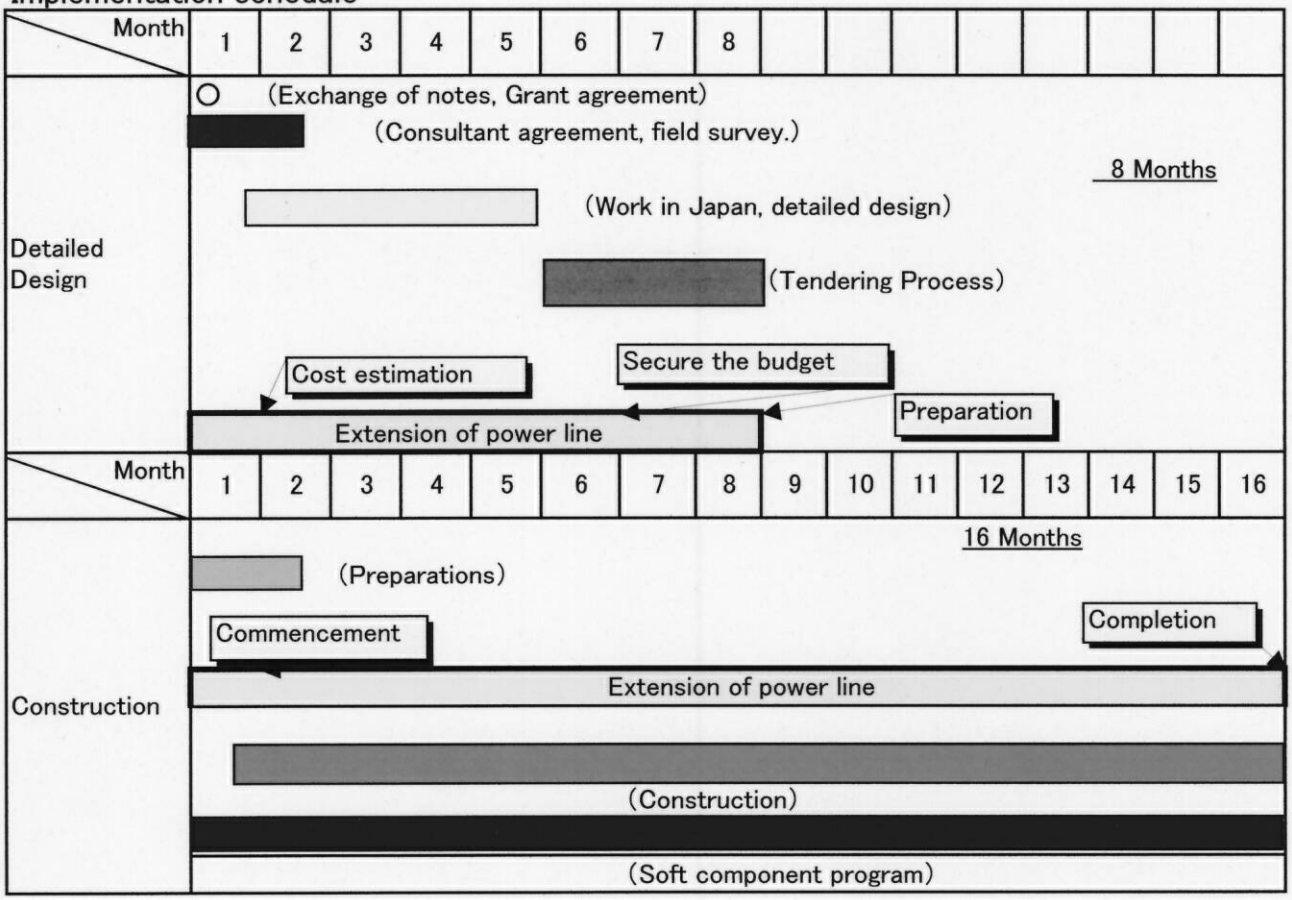
Facilities		Unit	Quantity				
			Musaza	Rukira (East)	Rukira (West)	Murama	Remera
Intake Facilities	Intake Facilities	Set	2	1	1	1	3
	Conveyance Pipelines	m	1,114.4	—	89.2	155.7	—
Transmission Facilities	Receiving Tanks	Set	1	1	1	1	1
	Control Houses	Bldg.	2	1	1	3	4
	Balancing Tanks	Set	2	—	—	2	2
	Transmission Pipelines	m	9,514.1	782.2	394.7	3,126.2	4,710.2
	Chlorination Room	Bldg.	2	1	1	—	—
Distribution Facilities	Distribution Tanks	Set	2	1	1	1	1
	Distribution pipelines	m	18,766.0	4,733.9	10,245.2	28.699.6	15,737.5
	Monitoring Room	Bldg.	—	—	—	1	1
	Break Pressure Tank	Set	6	1	—	5	3
Water service Facilities	Public Tap Stands	Nos	21	7	16	27	29

(2) Soft Component (Technical Assistance)

In Rwanda, the owner of the constrcted water facilities is Dstrict and its responsibility is to supervise the management of those facilities. Recently, privatization of water facility management is promoted in Rwanda. Taking account of this tendency, Soft component of this project aims mainly the points below.

① To support target Districs to select the appropriate Water Service Provider
② To support selected Water Service Provider to operate and manage the constructed facilities appropriately
③ To support selected Water Service Provider to promote the hygiene conscience of the population in target sites in order to increase the facility users

Implementation schedule



Appendix-5　Software Component

(Technical Assistance) Plan

APPENDIX -5 SOFTWARE COMPONENT (Technical Assistance) PLAN

1 Background of Software Component Plan

In order to achieve the Project Purpose of "Safe water is provided to the target population in Eastern Province in a sustainable manner from the piped water supply facilities to be constructed in the Project", this Grant Aid Cooperation Project improves water supply facilities in Eastern Province through construction and rehabilitation of those facilities.

In this Preparatory Survey, the national plan and policy concerning rural water supply sector ware reviewed, and the current status and challenges of the operation and maintenance system managed by EWSA (Energy, Water and Sanitation Authority) which has set in December, 2010, the local government (District offices and Sector offices) and private organizations (Water Service Providers) were evaluated. As a result of the survey, it was concluded that support of the organization related to operation and maintenance is indispensable for sustainability of water supply, in terms of the following points:

Now, privatization of operation and maintenance of water supply facilities was introduced in Rwanda, but it has not been finalized. In the target areas, Water Service Providers, EWSA or Sector office operate and maintain the facilities. For the introduction of privatization, however, the software component activities as supports for each of "improvement of capacity on operation and maintenance in the District office" and "establishment of operation system in Water Service Provider" are adapted in any above situation. Therefore, software component plan shall be implemented in this Grant Aid Cooperation Project.

1) Necessity for encouragement of privatization of operation and maintenance by the Government

In Rwanda, WUA has taken responsibility for operation and maintenance of water supply facilities since 1994. Then, the operation and maintenance system was assessed by the Rwandan Government in 2004. And the assessment concluded that the operation and maintenance system is not proper1y managed due to

inappropriate management and skills which were caused by several reasons, that is: 1) less ownership of users of water supply facilities, 2) members of water users association are volunteers , 3) less participation of users in operation and maintenance, 4) less capacity of water users association to address technical issues and financial aspects.

In order to overcome these challenges, the Rwandan Government has decided to make use of private sectors in line with the policy of Public Private Partnership (PPP) as a part of the sector strategy from 2004 to 2007, based on the results of discussion about the operation and maintenance systems. In accordance with this change, the 2nd version of the Water and Sanitation Policy set in the year 2004 is now under revision. In the policy, necessity of cooperation with the private sector to secure the sustainability of the procurement of fund was stated

In such a background, the current situations on "introduction of operation and maintenance", which was determined as the national policy, in the target sites shall be indicated as below:

Table : Current Situations on Operation and Maintenance in the Target Sites

District	Water Service Provider	Current Situations and Movement on Privatization
Kayonza	Private Company and EWSA	Cooperatives operate 18 water supply facilities and EWSA does 3 facilities in the total 21 facilities in the District.
Ngoma	Private Company and EWSA	Cooperatives operate 10 water supply facilities, Private Operator does 1 facility and EWSA does 1 facility in the total 12 facilities in the District. The facility operated by EWSA has long distance of pipes.
Kirehe	Private Company	Cooperatives operate all 8 water supply facilities.
Gatsibo	EWSA and Sector office	Privatization has not been set yet. But, now the District office applies for operation by cooperative for water supply facility, which operated by the Sector office now, to District Council. After authorizing the application, notice of Tendering shall be conducted.
Nyagatare	EWSA	Only EWSA operate schemes in the District.

Thus, the privatization of operation and maintenance has not been completed in

each district of this Project. So, it is necessary for encouragement of privatization of operation and maintenance by the Government.

2) Necessity for establishment of system of operation and maintenance for Water Service Provider

According to the privatization of operation and maintenance, Water Service Providers can manage water tariff, which are collected by themselves, in their own way under the contract conditions. And they can allocate the collected tariff for improvement of services on edification etc. to the residents in addition to operation and maintenance of water supply facilities. Moreover, it shall ensure reliability for water supply services that Water Service Providers have responsibilities for necessary repairs.

Currently, however, it is considered the following improvements are necessary:

- District office is required to supervise the organization in charge of operation and maintenance of water supply facilities. In practice, however, this role of the District office is rarely achieved due to lack of financial and human resources and insufficient management capacity among others.

- Water Service Provider is not able to implement a large scale of rehabilitation or utilize collected tariff properly.

- Conditions of hygiene and sanitation have to be improved more due to dependence of Tap Manager for promoting utilization of safe water.

In such circumstances, the system of operation and maintenance for Water Service Provider has not been established completely, although the privatization has been introduced.

3) Necessity of establishment of the management system in the District office (Local Government Authority)

District Office (local government authority) has the ownership of water supply facilities and contract with a private organization for operation and maintenance

through a tendering procedure. The improvement of reliance upon the water supply condition has been expected by introducing privatization, although it is a concern that stable water supply will not be secured. One of the reasons that the adequate services will not be provided is no description of the responsibility of replacement and expansion of the facilities in the contract.

In addition, it causes difficulties with operation and maintenance of water supply facilities that some tenders participate the tender with less understanding of the facilities. So that, for operation and maintenance of water supply facilities, the candidates of tenderers need understand the water supply situations in the target areas, have similar experiences and be able to implement operation and maintenance according to those situations in the sites.

Therefore, the District office has to prepare for the tender document to evaluate properly what extent the tenderer perceives the current condition of the water supply in the target sites and how the tenderer is going to approach the challenges. In addition, enhancement of the capacity of the district on preparation of the tender documents and the assessment of the capacity of tenderers is a key factor to select the eligible private organization

Thus, the Local Government Authority mainly has responsibilities to manage operation and maintenance of water supply facilities for the achievement of successful project. And, according to the regulations in Rwanda, the District, which owns ownership of water supply facilities, has a duty to manage and supervise the facilities. Although, two District offices of Kirehe district and Ngoma district, to which the target sites for "Implementation Review Study on the Project for Rural Water Supply in the republic of Rwanda (2010)" belong, apply for the delegation of their roles of management of water supply facilities to EWSA due to lack of their capacities. As the result of consultation between EWSA and the District offices, "a tripartite contract" among EWSA, the District offices and Water Service Providers were adopted for those water supply facilities.

Those two Districts are also the target district of this Project. Therefore, it has a high potential for the same issue. And, currently there is no privatized facilities in Gatshibo district and Nygatare district, so that it is not certain that those two District offices play a role for management of the facilities. Therefore, it has to be

confirmed that not only above two District offices (Kirehe and Ngoma), but also all four District offices have a capacity of establishment of management system of their own water supply facilities preliminarily

Since the type of water supply management is yet to be determined for each site, the software component plan will be planned in a manner where its activities can support any type of management. The presently assumed arrangements for operation and maintenance are shown below.

Table : Possible Arrangements for O&M for this Project

	Management/Supervision	Contract	Service Provider
a)	District	Yes	Private Operator (Cooperative or Enterprise)
b)	District	No	Sector
c)	EWSA	No	EWSA
d)	District with Technical Support from EWSA	Yes	Private Operator (Cooperative or Enterprise)
e)	EWSA	Yes	Private Operator (Cooperative or Enterprise)

According to the above mentioned current situations, the present system of operation and management of water supply facilities and the target system in the future shall be described as follows:

Table : Present System of Operation and Management of Water Supply Facilities and the Target System in the future

District	Operation and Management System	
	Present	Target
Kayonza	Water Service Provider contracted with District Office or EWSA	Water Service Provider contracted with District
Ngoma	Water Service Provider contracted with District Office or EWSA	Water Service Provider contracted with District or a tripartite contract (*)
Kirehe	Water Service Provider contracted with District Office or Water Service Provider	Water Service Provider contracted with District or a tripartite contract(*)
Gatsibo	EWSA or Sector Office	Water Service Provider contracted with District

(*) "A tripartite contract" is set among EWSA, District and Water Service Provider.

2 Objectives on Software Component Plan

In order to achieve the project purpose of "Safe water is provided to the target population in Eastern Province in a sustainable manner from the piped water supply facilities to be constructed in the Project, and water supply coverage rate is increased" and secure sustainability in effectiveness of the project considering privatization of operation and maintenance being promoted by the Government of Rwanda, the soft component plan was prepared. The objective of the plan is set as "the system for management of Water Service Providers by District offices as owners of water supply facilities is established and also, due to the support of the District offices, the system for operation and maintenance of water service providers is strengthened". The target districts shall be 3 districts, namely Kayonza, Ngoma and Gatsibo from the above 4 districts.

3 Expected Outputs of the Plan

Expected outputs of the plan shall be described as below:

【Output 1】 Selection of Water Service Providers (Implementation and Supervision of Tendering) is implemented by the District offices smoothly.

【Output 2】 The institutional administration system of Water Service Providers for operation and maintenance of the piped water supply facilities to be constructed and rehabilitated by the Project is strengthened.

【Output 3】 Awareness on water and sanitation is enhanced in the target community and piped water supply facilities are utilized properly.

4 Means to confirm the achievement of the expected outputs

Means to confirm the achievement of the expected outputs indicated in "3 Expected Outputs of the Plan" and indicators are pointed out as follows:

【Expected Output (1)】: Selection of Water Service Providers (Implementation and Supervision of Tendering) is implemented by the District offices smoothly.

【Indicator 1-1】 Water Service Providers, which engage operation and maintenance of water supply facilities, are selected.

【Mean 1-1】 After contract between the District office and Water Service Provider, the documents (records, minutes) on Tendering (Tender Announcement, Tender Documents etc.) are prepared.

【Indicator 1-2】 Monitoring for Water Service Providers by the District office is implemented.

【Mean 1-2】 Monitoring report by the District and Sector offices are confirmed.

【Expected Output (2)】: The institutional administration system of Water Service Providers for operation and maintenance of the piped water supply facilities to be constructed and rehabilitated by the Project is strengthened.

【Indicator 2-1】 Bylaws / regulations and records for operation and maintenance and financial documents of Water Service Providers are prepared.

【Mean 2-1】 Bylaws / regulations and records for operation and maintenance and financial documents are confirmed at the end of software component.

【Indicator 2-2】 Operators in Water Service Provider, which have necessary capacity for operation and maintenance of water supply facility, are allocated.

【Mean 2-2】 Activities' conditions by operators in Water Service Provider are confirmed at the end of software component.

【Expected Output (3)】: The institutional administration system of Water Service Providers for operation and maintenance of the piped water supply facilities to be constructed and rehabilitated by the Project is strengthened.

【Indicator 3-1】 Water Service Providers understand the means of teaching hygiene and sanitation.

【Mean 3-1】 Training records for Water Service Provider (Tap managers), which educate hygiene and sanitation to the target community, are confirmed.

【Indicator 3-2】 Training on hygiene and sanitation for the target community is started by the Water Service Provider.

【Mean 3-2】 Activities' conditions on education of hygiene and sanitation are confirmed.

5 Activities of the Plan (Plan of Inputs)

Expected outputs of the Plan shall be described as below:

Plan for Activities (Inputs) of the Plan, necessary for achievement of "The Objective of the Plan" and "Expected Outputs of the Plan" was formulated. Those activities are related to the Outputs and structured as follows:

【Activities for Output 1】

1. Confirm Organization System and its Capacity of District Offices and Sector Offices *(Stage 1: Activity 1-2)*
2. Prepare for Selection of Water Service Providers (Tendering) *(Stage2: Activity 2-1)*
3. Support Implementation of Selection of Water Service Providers (Tendering) *(Stage 2: Activity 2-2)*
4. Supervision and Monitoring of the Activities related to O&M of Piped Water Supply Facilities *(Stage 4: Activity 4-1)*

【Activities for Output 2】

5. Train Water Service Providers to improve the capacity for O&M of the piped water supply facilities *(Stage 3: Activity 3-1)*
6. Follow up the above activities on improving the capacity for O&M of the piped water supply facilities *(Stage 3: Activity 3-2)*

【Activities for Output 3】

7. Train Water Service Providers to improve Community's awareness of Hygiene and Sanitation *(Stage 3: Activity 3-3)*

Those activities are divided by 4 stages. The contents of these activities, purpose, target, means of implementation, duration of activity, human resources for implantation, outputs and obligation of Japanese side / Rwandan side are described in the next table.

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
Stage 1 : Preparation for Contract with the Private Organization on O&M of Piped Water Supply Facilities						
1-1 Select NGO/Consultant and Consult with MLGH	☐NGO/Consultant which implement the Programme, is selected. ☐Activities' policy of this Programme is explained to EWSA and confirmed. ☐Those explanation is transferred to 5 District Offices by EWSA.	EWSA 3 District Offices	Meeting	14 days : Selection of Local NGO/Consultant 7days : Preparation for Meeting 3 days : Meeting 4 days	Japanese Consultant NGO/Consultant 【Japanese Side】	Minute of Meeting
1-2 Confirm Organization System and its Capacity of District Offices and Sector Offices	☐Activities' policy of this Programme is explained to District Offices and Sector Offices. ☐Organization System and its Capacity of District Offices and Sector Offices are verified. ☐Future activities and Schedule are confirmed.	3 District Offices 3 Sector Offices	Meeting	3 days / District	Japanese Consultant NGO/Consultant 【Japanese Side】	Minute of Meeting
Stage 2 : Selection of the Private Organization (Tendering)						
2-1 Prepare for Selection of the Private Organization (Tendering)	Support for District Offices to prepare for the following activities in order to conduct selection of the Private Organization (Tendering) is given. ☐Regulation of the Selection of the Private Organization is prepared. ☐Contract to be agreed with District Office and Private Organization is formulated. (Confirmation of responsibility on O&M of Piped Water Supply Facilities between them is included.) ☐Documents on Tendering (Tender Announcement, Tender Documents etc.) is prepared.	3 District Offices 3 Sector Offices	Meeting Supervising	1 month / District	Japanese Consultant Local NGO/Consultant 【Japanese Side】	☐Minute of Meeting ☐Regulation of Selection of the Private Organization ☐Draft of Contract ☐Draft of Announcement of Tender ☐Tender Documents
2-2 Support Implementation of Selection of the Private Organization (Tendering)	After the above preparation, Support for District Offices to implement the following activities in order to conduct selection of the Private Organization (Tendering) is given. ☐Tender Announcement ☐Tender Opening ☐Negotiation for Contract ☐Agreement of Contract ☐Notification to the Communities	3 District Offices 3 Sector Offices	Meeting Supervising	1 month / District	Japanese Consultant Local NGO/Consultant 【Japanese Side】	☐Minute of Meeting ☐Contract ☐Announcement of Tender
Stage 3 : Enhancement of Capacity of the Local Government and the Private Organization or WUA on the Privatization						

Activity	Output	Target	Means of Implementation	Period	Implementer【Responsibility】	Output of Submission
3-1 Train the Private Organization or WUA to improve the capacity for O&M of the piped water supply facilities	The following trainings are implemented for the purpose of improving the capacity of O&M for the Private Organization / WUA ☐Institutional Administration : the Entire Organization ☐Operation and Maintenance of Piped Water Supply Facilities : Tap Managers ☐Financing and Accounting : the Entire Organization and Tap Managers ☐Reporting : the Entire Organization ☐Monitoring : the Entire Organization	3 Private Organizations / WUAs	Workshop	10 days / Organization / Site	Japanese Consultant NGO/Consultant 【Japanese Side】	☐Training Report
3-2 Follow up the above activities on improving the capacity for O&M of the piped water supply facilities	Conditions and Progress of O&M of piped water supply facilities by the Private Organization / WUA are identified with District Office and the necessary follow up training is implemented to catch up the capacity of O&M.	3 Private Organizations / WUAs	Inspection / Workshop	5 days / Organization / Site : Inspection 2days : Workshop 3 days	Japanese Consultant NGO/Consultant 【Japanese Side】 District Office Staff 【Rwandan Side】	☐Training Report
3-3 Train the Private Organization / WUA to improve Community's awareness of Hygiene and Sanitation	Training for Tap Managers, who facilitate Community to improve awareness of Hygiene and Sanitation, and the Private Organization / WUA, which supervise the Tap Managers' outputs, are implemented.	3 Private Organizations / WUAs	Workshop	3 days / Organization / Site	Japanese Consultant NGO/Consultant 【Japanese Side】 District Office Staff 【Rwandan Side】	☐Training Report
Stage 4 : Supervising and Monitoring						
4-1 Supervision and Monitoring of the Activities related to O&M of Piped Water Supply Facilities	Supervision and Monitoring of the Activities performed by the Private Organization / WUA are executed.	3 District Offices 3 Sector Offices 3 Private Organizations / WUAs	Monitoring Visit / Assessment of the Result of Monitoring	4 days / Organization / Site : Monitoring Visit 2days : Workshop 2 days	Japanese Consultant NGO/Consultant 【Japanese Side】 District Office Staff 【Rwandan Side】	☐Monitoring Report

6 Assignment of Personnel

For the purpose of conducting software component activities, the following experts, which consist of Japanese Consultant and Local NGO / Consultant, are assigned:

(1) Japanese Consultant (in charge of Operation and Maintenance) (1 person)

A Japanese consultant is responsible for 1) formulation and supervision of the Software Component Plan, 2) reporting to the implementing agency and Japanese Side concerned, and coordinating parties concerned in the plan, and 3) coordination in implementation of the Plan with construction schedule. Also technical advice and capacity building will be given to local staff from the implementing agency and NGO / Local consultant.

(2) Counterparts in Rwandan side

EWSA : 1 person

Person in charge of Infrastructure Development and Maintenance :

3 persons (1 person/district×3 districts)

(2.1) EWSA (1 person)

A counterpart personnel assigned by EWSA is responsible for the supervision of implementation of the plan together with Japanese consultant, and coordination with and request to the parties of the Rwandan side.

(2.2) Person in charge of Infrastructure Development and Maintenance :

(3 persons (1 person/district×3 districts))

Person in charge of Infrastructure Development and Maintenance in the District office, which is responsible for operation and maintenance of water supply facilities, utilize own outputs acquired through activities concerning preparation for privatization and implement the activities for establishment of operation and maintenance system of Water User Association.

(3) Local NGO / Consultant

Since the implementation agency has less experiences and skills for the implementation of Software Component Plan, local NGO and/or local consultant experienced and capable is employed to carry out the activities. Staff from local NGO / Consultant is deployed as followed, considering the scale and schedule of activities involved in the plan. Each staff member shall be experienced in implementation of the similar work and fluent in the local language.

① Program Director (1 person)

Under the supervision of Japanese consultant, one program coordinator takes the leading roles in supervision of the whole activities in the program, as well as reporting to the Japanese consultant and EWSA. The program coordinator shall be experienced as a team leader in the similar works.

② Program Coordinator (2 persons)

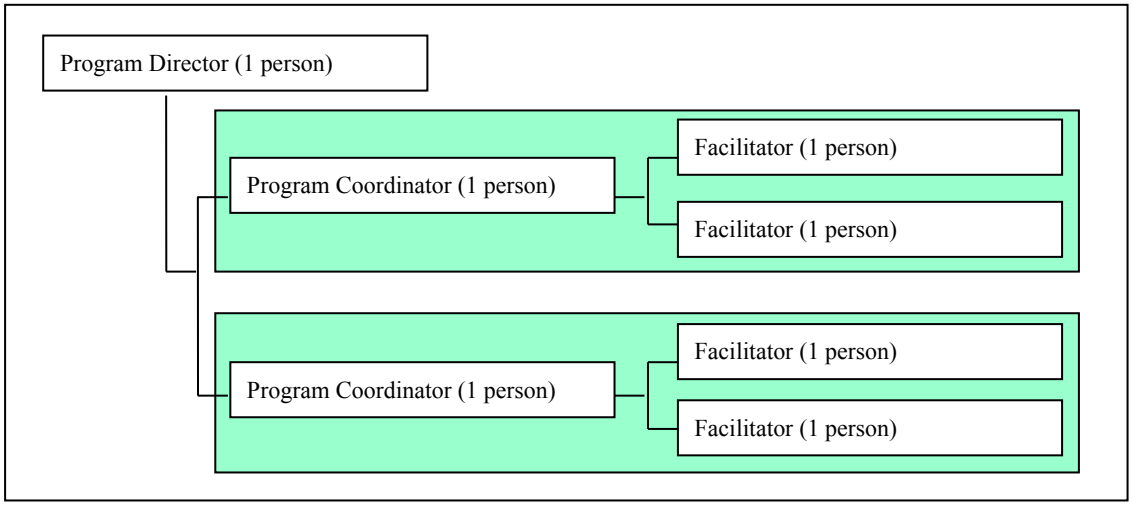
Under the supervision of program director, one program coordinator per the region takes the roles in implementation of field activities and manages the schedule, methodology and output of the Program, as well as reporting to the program director. The program coordinator shall be experienced as a program coordinator in the similar works.

③ Community Facilitator (4 persons)

Supervised by program coordinator, facilitators are deployed to conduct field activities to support the program coordinators. The community facilitators shall be experienced in establishment of community-based management, participatory planning, participatory monitoring and evaluation, capacity building, and health and sanitation education in the water and sanitation sector.

Local NGO and/or local consultant establish a team with 1 program director (supervisor), 1 program coordinator and 2 community facilitators. Total 2 teams are established and acting.

[Composition of Local NGO / Consultant Team]



7 Implementation Schedule

The implementation schedule is described in the next table.

8 Output of Submission

Outputs of submission are indicated in the above table for each activity. Main outputs of submission are bylaw / regulation, training and workshop reports and minutes of meeting.

9 Undertakings by Rwandan Authority

In the implementation of the Software Component Plan, the following activities shall be undertaken by Rwandan side:

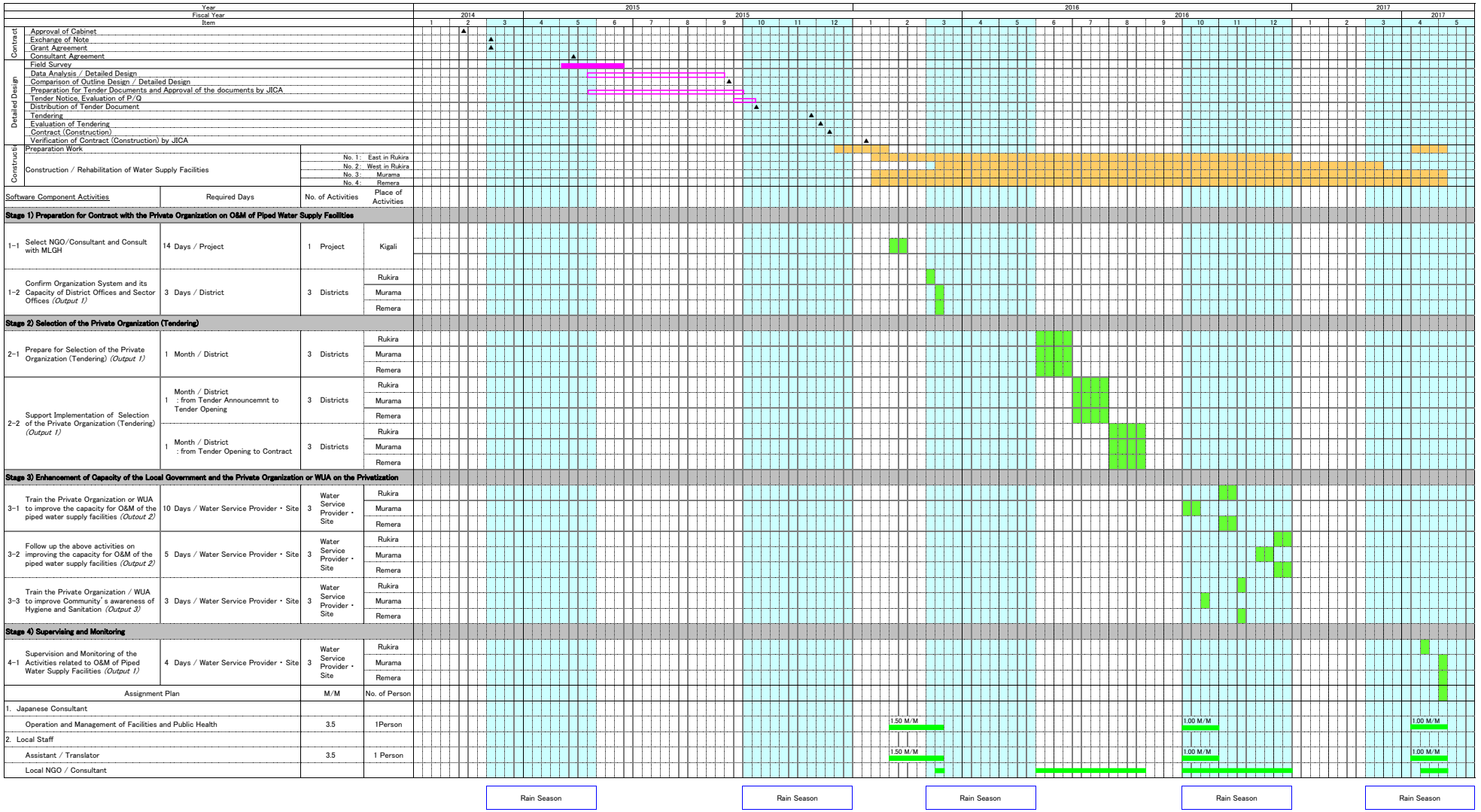
- Districts and EWSA must continuously carry out monitoring and supervision, as planned, after completion of water supply facilities. Also, districts, EWSA and MININFRA must secure necessary budget for these activities.

- The private organization or WUA is required to improve the condition of operation and maintenance, adapting the change of socio-economic conditions to the current system, in adapting the skills and lessons learnt obtained from the software component plan.

- EWSA and MININFRA shall encourage the privatization of operation and maintenance more in order to stimulate the activities for operation and maintenance of water supply facilities

Preparatory Survey on the Project for Rural Water Supply (Phase III)

Implementation Schedule of Software Component Plan



Appendix-6 Other Relevant Data

(1) References
(2) Results of Hydrogeological Survey
(3) Results of Water Quality Analysis
(4) Results of Test Drillings (including Results of Geophysical Survey)
(5) Results of Geotechnical Survey
(6) Results of Socio-Economic Survey

Appendix-6 (1) References

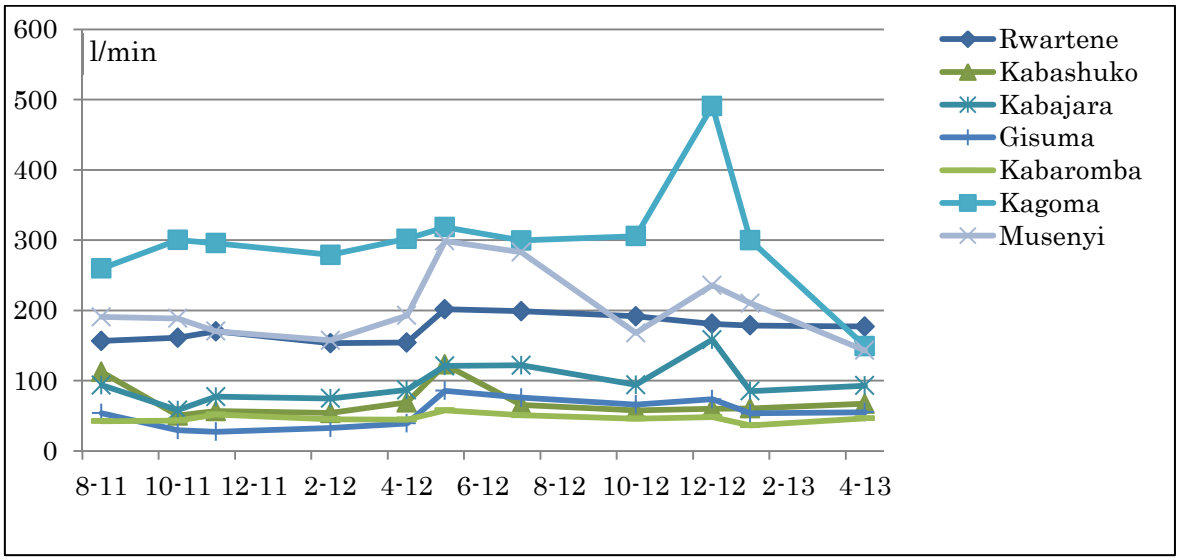
No.	Title	Type	Original/ Copy	Organisation / Publisher	Year
1	VISION 2020	PDF	Copy	Government of Rwanda	2000
2	VISION 2020 revised target	PDF	Copy	Government of Rwanda	2012
3	Economic Development and Poverty Reduction Strategy（2008-2012) (EDPRS）	PDF	Copy	Government of Rwanda	2007
4	Economic Development and Poverty Reduction Strategy (2013-2018)（EDPRSII）	PDF	Copy	Government of Rwanda	2011
5	National Policy and Strategy for Water Supply and Sanitation Services	PDF	Copy	MININFRA	Feb. 2010
6	Water and Sanitation Sector Srategic Plan 2013/14-2017/18	PDF	Copy	MININFRA	June 2013
7	General Guidelines and Procedure for Environmental Impact Assessment	PDF	Copy	Government of Rwanda, REMA	Nov. 2006
8	EWSA Organigram	PDF	Copy	EWSA	2012
9	EWSA DSU TOR	PDF	Copy	EWSA	2012
10	Law No 39/2001 of 13/09/2001 establishing an agency for the regulation of certain public utilities	PDF	Copy	Government of Rwanda	Sep. 2001
11	Law No 62/2008 of 10/09/2008 putting in place the use, conservation, protection and management of water resources regulations	PDF	Copy	Government of Rwanda	Sep. 2008
12	Law N°08/2006 of 24/02/2006 determining the organization and functioning of the district	PDF	Copy	Government of Rwanda	Feb. 2006
13	Law No 43/2010 of 07/12/2010 establishing Rwanda Energy, Water and Sanitation Authority (EWSA) and determining its responsibilities, organization and functioning	PDF	Copy	Government of Rwanda	Dec. 2010
14	Prime Minister's Order No 41/03 of 20/05/2011 determining the structure and summary of job positions for Rwanda Energy, Water and Sanitation Authority (EWSA)	PDF	Copy	Government of Rwanda	May 2011
15	Law No 16/2006 of 03/04/2006 determining the organization, functioning and mission of Rwanda Environment Management Authority	PDF	Copy	Government of Rwanda	June 2006
16	Organic Law No 08/2005 of 14/07/2005 detemining the use and management of land in Rwanda	PDF	Copy	Government of Rwanda	Sep. 2005
17	Organic Law No 04/2005 of 08/04/2005 detemining the modalities of protection, conservation and promotion of environment in Rwanda	PDF	Copy	Government of Rwanda	May 2005
18	Organic Law No 53/2008 of 02/09/2008 establishing Rwanda Development Board (RDB) and determining its responsibilities, organisation and functioning	PDF	Copy	Government of Rwanda	May 2005
19	Organic Law No 01/2009/OL of 17/04/2009 modifying and complementing Organic Law No 53/2008 of 02/09/2008 establishing Rwanda Development Board (RDB) and determining its responsibilities, organisation and functioning	PDF	Copy	Government of Rwanda	Nov. 2009
20	Law No 16/2012 of 22/05/2012 determining the organization, functioning and mission of the National Fund for Environment (FONERWA)	PDF	Copy	Government of Rwanda	June 2011
21	Ministerial Orders on environment: Ministerial Order No 003/2008 of 13/08/2008 relating to the requirements and procedure for environmental impact assement, Ministerial Order No 004/2008 of 15/08/2008 establishing the list of works, activities and projects that have to undertake an environmental impact assessment, Ministerial Order No 005/2008 of 15/08/2008 establishing modalities of inspecting companies or activities that pollute the environment, Ministerial Order No 006/2008 of 15/08/2008 regulating the importation and exportation of ozone layer deplering substance products and equipment containing such substances, Ministerial Order No 007/2008 of 15/08/2008 establishing the list of protected animal and plant species	PDF	Copy	Government of Rwanda	Nov. 2008
22	Law No 13/2009 of 327/5/2009 regulating labour in Rwanda	PDF	Copy	Government of Rwanda	May 2009
23	2012 Population and Housing Census	PDF	Copy	NISR	Nov 2012
24	The Evolution of Poverty in Rwanda from 2000 to 2011, Results from the Household Surveys (EICV)	PDF	Copy	NISR funded by DFID, EU and UN Rwanda	2012
25	Integrated Household Living Consitions Survey / Enquête Intégrale sur les Conditions de Vie des ménages1 (EICV1)	PDF	Copy	NISR	2002
26	Integrated Household Living Consitions Survey / Enquête Intégrale sur les Conditions de Vie des ménages (EICV2)	PDF	Copy	NISR	2006
27	Integrated Household Living Consitions Survey / Enquête Intégrale sur les Conditions de Vie des ménages (EICV3)	PDF	Copy	NISR	2012
28	World Economic Outlook 2013, Republic of Rwanda	Web	Copy	IMF	2013
29	Kirehe, Ngoma, Kayonza, Gatsibo Districts Rainfall data	Excel data	Copy	Rwanda Meteorology Angency	-

No.	Title	Type	Original/ Copy	Organisation / Publisher	Year
30	Revised Budget 2012-13	PDF	Copy	MINECOFIN	2013
31	Administrative map, Musaza sector	Map	Copy	NISR	2013
32	Administrative map, Rukira sector	Map	Copy	NISR	2013
33	Administrative map, Murama sector	Map	Copy	NISR	2013
34	Administrative map, Remera sector	Map	Copy	NISR	2013
35	Administrative map, Ruramira sector	Map	Copy	NISR	2013
36	Administrative map, Katabagemu sector	Map	Copy	NISR	2013
37	Administrative map, Ngarama sector	Map	Copy	NISR	2013
38	Administrative map, Nyagihanga sector	Map	Copy	NISR	2013
39	EDPRS Sector self assessment report: water supply and sanitation sector	PDF	Copy	MININFRA	Dec. 2011
40	JICA Study on Operation and Maintenance of Rural Water Supply Systems	PDF	Copy	MININFRA funded by JICA	May 2012
41	Rwanda State of Environment and Outlook, Summary for Decision Makers	PDF	Copy	REMA	2009
42	Rwanda Environmental Threats and Opportunities Assessment (ETOA) 2008 Update	PDF	Copy	USAID	July 2008
43	CONSTRUCTION DE L'ADDUCTION D'EAU PAR POMPAGE DE KIREHE DANS LE DISTRIT DE KIREHE, PROVINCE DE L'EST, RAPPORT FINAL	Print	Copy	LWF	March 2008
44	Mission to analyze and document the delegated management of rural water systems	PDF	Copy	Hydroconseil, Wrold Bank	June 2009
45	Tariff recommendtion for the Rural Water Sector in Rwanda	PDF	Copy	Hydroconseil, Wrold Bank	Aug. 2009

MININFRA: Ministry of Infrastructure, LWF: Lutheran World Federation, REMA: Rwanda Environment Management Authority,
RURA: Rwanda Utilities Regulatory Authority, NISR: National Instiute of Statistics
Rwanda

Results of Hydrogeological Survey

Figures 1(1) and 1(2) show records of spring discharges of Phase 2 Project. This indicates that for most springs, the months of minimum yield do not necessarily correspond to the driest season of October, and also variations in yields between years can be observed. Under these conditions, the water supply plan was formulated by multiplying the minimum discharge measured between April and July 2013 by the coefficient of 67.5%. (Refer to "Table 2-6 Feasible Intake Yield" in the main report)

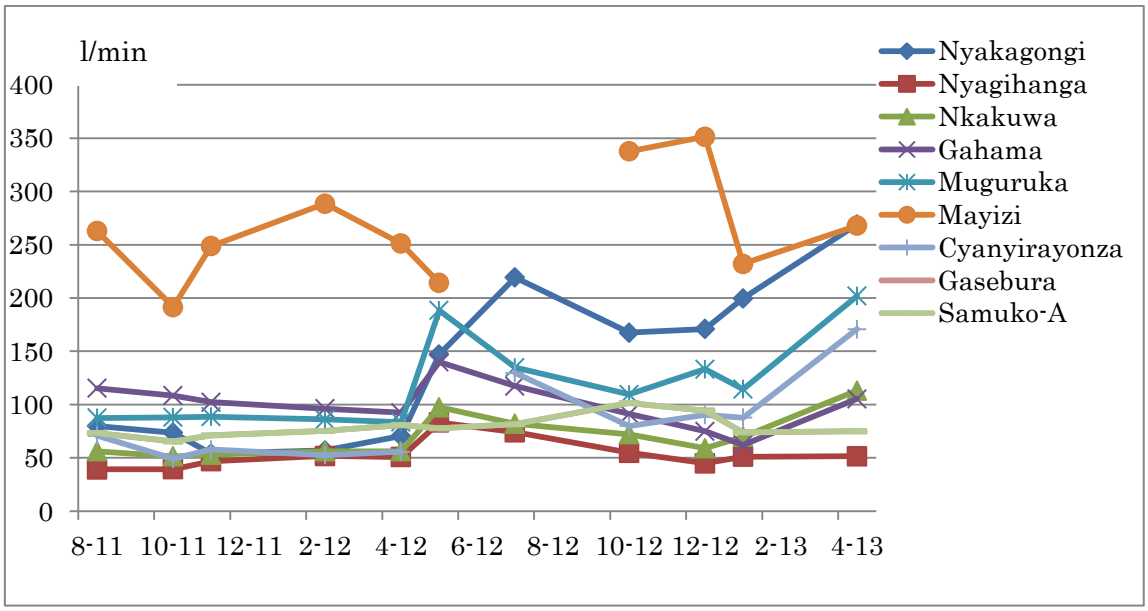


Source: Measurements by contractor for Phase 2 Project

Figure 1(1) Spring Discharges of the Project for Rural Water Supply, Phase 2 (Kirehe and Ngoma Districts) (Area 1)

Table 1-(1) Minimum Spring Discharge Months (August 2011 to April 2013) (Area 1)

Rwartene	Kabashuko	Kabajara	Gisuma	Kabaromba	Kagoma	Musenyi
Feb., 2012	Oct., 2011	Oct., 2011	Nov., 2011	Jan., 2013	Apr., 2013	Apr., 2013



Source: Measurements by contractor for Phase 2 Project

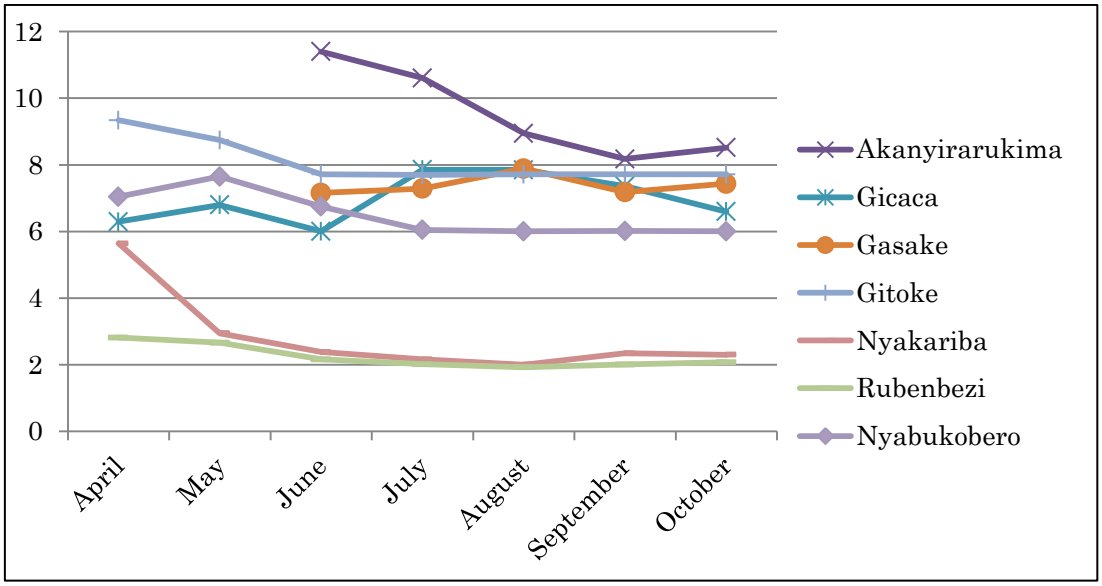
Figure 1(2) Spring Discharges of the Project for Rural Water Supply, Phase 2 (Kirehe and Ngoma Districts) (Area 2)

Table 1(2) Minimum Spring Discharge Months (August 2011 to April 2013) (Area 2)

Nyakagongi	Nyagihanga	Nkakuwa	Gahama	Muguruka	Mayizi	Cyanyirayonza
Nov., 2011	Aug., 2011	Oct., 2011	Jan., 2013	Apr., 2012	Oct., 2011	Oct., 2011
Gasebura	Samuko-A					
Aug., 2011	Oct., 2011					

N.B.: Some data are missing for Mayizi.

Spring discharge measurements taken at the study sites are shown in the following graph.



District	Ngoma	Kayonza		Gastsibo
Site	Rukira	Murama	Ruramira	Remera
Spring	Akanyirarukima	Gicaca Gasake	Gitoke Nyakariba Rubenbezi	Nyabukobero

Figure 3 Discharge Measurements of Protected Springs at Target Sites (April to October 2013)

Tables 3 and 4 show the months of minimum discharge at target springs from measurements taken up to October 2013 and the ratios of minimum measured discharge to design intake yield. Since the design intake yields are based on minimum values measured from April to July 2013, if measurements between August and October reveal values less than the design intake yields, the ratios become less than 100% (as is the case for Ruramira in the table below).

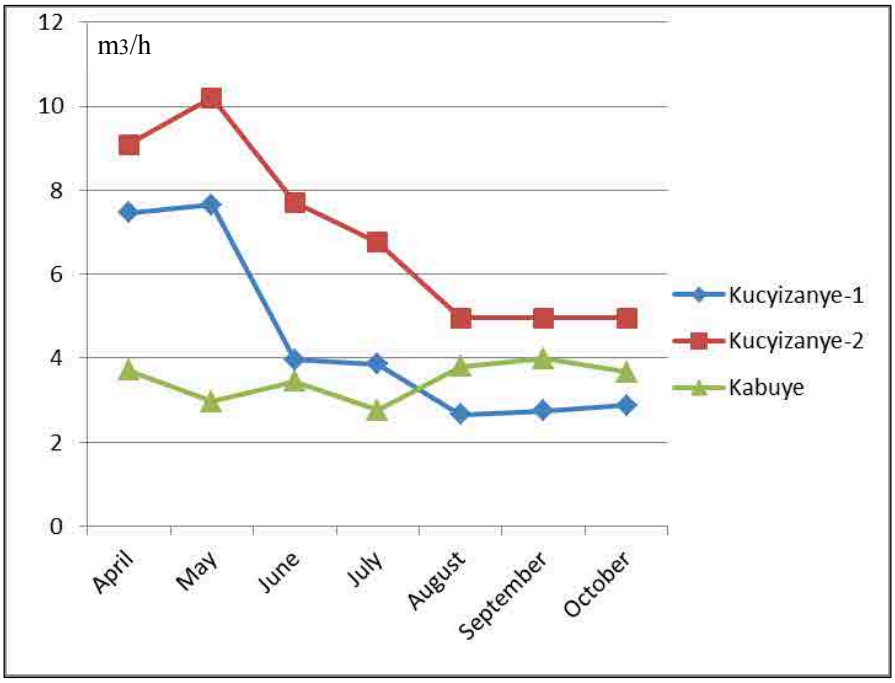
Table 3 Ratios of Minimum Discharges to Design Yields of Target Protected Springs

Site	Spring (Protected)	Minimum Discharge Month	Ratio of Minimum Discharge to Design Yield
Rukira	Akanyirarukima	September	100%
Murama	Gicaca	June	100%
	Gasake	June	100%
Ruramira	Gitoke	July	100%
	Nyakariba	August	93%
	Rubenbezi	August	95%
Remera	Nyabukobero	August	99%

N.B.: 1) Based on measurements from April to October 2013

2) For Akanyirarukima, the ratio is set as 100% though its discharge exceeds the demand

3) Ruramira was taken out of scope from this project



District	Kirehe	Ngoma
Site	Musaza	Rukira
Spring	Kucyizanye-1 Kucyizanye-2	Kabuye

Figure 4 Discharge Measurements of Unprotected Springs at Target Sites (April to October 2013)

Table 4 Ratios of Minimum Discharges to Design Yields of Target Unprotected Springs

Site	Spring (Unprotected)	Minimum Discharge Month	Ratio of Minimum Discharge to Design Yield (September)	Ratio of Total Yield for Musaza
Musaza	Kucyizanye-1	August	71%	72%
	Kucyizanye-2	August	73%	
Rukira	Kabuye	July	100%	—

N.B.: Based on measurements from April to October 2013

The 3 springs shown in Figure 4 and Table 4 are unprotected. When intake facilities are constructed, discharges are expected to improve, but from results of discharge measurements of the springs at Musaza, the minimum value is expected to be 72% of the design intake.
When

Table 5 summarize the results of discharge measurements during the survey.
From results of observations, only the discharge of Musaza would fall below the design yield. In such case, in principle, drinking water supply should be considered as priority, and 25% of release to the downstream should be limited. Although the design also considers 10% of water loss, this is an estimated design factor so when the demand exceeds the design water supply rate, the water service provider needs to plan appropriate measures such as promotion of water saving and restriction in service hours to avoid unfairness in water supply.

Table 5 Discharge Measurements of Target Springs (2013)

Site	Water Source	April	May	June	July	August	Sept.	Oct.	Minimum	Month
Musaza	Kucyizanye-1	7.454	7.650	3.957	3.857	2.660	2.750	2.876	2.660	August
	Kucyizanye-2	9.080	10.199	7.714	6.754	4.951	4.959	4.953	4.951	August
Rukira	Kabuye	3.717	2.967	3.445	2.758	3.804	3.992	3.671	2.758	July
	Akanyirarukima	—	—	11.400	10.605	8.947	8.175	8.517	8.175	Sept.
Murama	Gicaca	6.292	6.799	6.005	7.854	7.850	7.363	6.596	6.005	June
	Gasake	—	—	7.159	7.290	7.888	7.182	7.438	7.159	June
Ruramira	Gitoke	9.337	8.742	7.714	7.702	7.714	7.720	7.714	7.702	July
	Nyakariba	5.642	2.944	2.385	2.160	2.002	2.347	2.301	2.002	August
	Rubenbezi	2.816	2.660	2.160	2.020	1.928	2.010	2.076	1.928	August
Remera	Nyabukobero	7.044	7.650	6.750	6.050	6.005	6.015	6.005	6.005	August

The following table presents some suggestions to manage water shortages when spring discharge falls below the design yield and demand exceeds the design yield. Although this situation can differ between sites and water source characteristics, spring water would not necessarily become deficit every year, but as long as water sources such as springs are used, risks are inevitable. Countermeasures would differ depending on conditions such as distance between water source and service area, and height difference, but managers of WSPs should be familiar with the recommendations.

Table 6 Proposed Countermeasures for Handling Water Shortages

No.	Site	Countermeasure
1	Musaza	Urge the population to conserve as much water as possible and adjust the rate of downstream effluent. Limit service hours in a fair manner. Particular cooperation with the coffee cooperative is encouraged to share the same water source. N.B.: Since water will be partly used by the coffee cooperative, both WSP and coffee cooperative needs to strive to conserve as much water as possible in case of water shortages.
2	Rukira	Of the 2 springs, Akanyirarukima spring discharges 134% more than the design intake yield, and therefore, Rukira has more allowance compared to other sites. However, the WSP should encourage water-saving as necessary and urge the population to limit water use to drinking and cooking while relying on sources such as rivers for other uses.
3	Murama	The 2 springs of this site have stable yields, but when necessary, the WSP should promote water conservation and urge the population to resort to such sources as rivers for uses other than drinking and cooking.
4	Remera	Water sources for this site include 1 spring and 3 boreholes. Therefore, in case spring discharge diminishes, pumping hours (planned as 12 hours at maximum) of boreholes can be adjusted to meet the demand.

Result of Onsite Water Quality Test with Kit

Spring	pH	EC ms/m	Fe mg/ℓ	NH4 mg/ℓ	NO3 mg/ ℓ	NO2 mg/ ℓ	F mg/ ℓ	Temperature℃	Coliform	M Alkaline mg/ ℓ	P Acidity mg/ ℓ
Kucyizanye	6.05	20.2	0.2>	0.2>	2	0.02>	0.4	21	+	40	10
Kabuye	5.75	8.66	0.2>	0.2>	1	0.02>	0-0.4	23	+	5	20
Gaseke	5.5	20.2	0.2>	0.2>	1	0.02>	0-0.4	20	−	30	15
Gicaca	5.81	14.57	0.2>	0.2>	5	0.02>	0.4	21	−	20	10
Akanyirarukima	5.5	14.81	0.2>	0.2>	5	0.02>	0.4	15	−	10	20
Gitoke	5.5	12.9	0.2>	0.2>	2	0.02>	0.8	20	−	10	10
Nyakariba	5.7	16.7	0.2>	0.2>	1	0.02>	0.4	21	+	10	10
Rubenbezi	5.5	14.2	0.2>	0.2>	2	0.02>	0.8	22	+	20	10
Byimana	5.9	11	0.2>	0.2>	1	0.02>	0-0.4	23	+	5	20
Nyabukobero	5.8	12	0.2>	0.2>	1	0.02>	0-0.4	23	+	5	20
Rwobe-1	5.4	5.1	0.2>	0.2>	1	0.02>	0.8	24	+	15	10
Rwobe-2	5.5	2.8	0.2>	0.2>	2	0.02>	0.8	24	+	20	10
Gashure-1	5	20.2	0.2>	0.2>	10	0.02>	0.8	24	−	10	10
Gashure-2	5	10.9	0.2>	0.2>	5	0.02>	0.4	24	+	10	10

Result of Lab Analysis in Rwanda

Parameters			1	2	3	4	5	6	7	8	9	10	11	12
			Temperature	pH	Turbidity	Conductivity	Total Dissolved Solids	Colour	Taste & Odour	Alkalinity	Acidity	Total Hardness	Calcium	Magnesium
Unit			℃		NTU	µS/cm	mg/l	PtCo		mg/l $CaCO_3$	Phenolphthalein acidity $CaCO_3$	mg/l $CaCO_3$	mg/l Ca^{2+}	mg/l Mg^{2+}
District	**Sector**	**Spring**												
Kirehe	Musaza	Kucyizanye	21.7	5.82	14.77	471	244	24	Harmless	90	22	180	34.4	22.89
Kayonza	Murama	Gicaca	24.6	7.78	2.33	282	145	35	Harmless	48	18	100	16	14.62
Gatsibo	Katabagemu	Gashure-2	27.4	5.34	8.62	190	97	57	Harmless	20	12	60	16	4.87
Gatsibo	Katabagemu	Rwobe-1	27.4	5.53	14.08	60	30	77	Harmless	16	30	20	4.8	1.95
Gatsibo	Katabagemu	Gashure-1	27.4	5.85	4.31	320	159	32	Harmless	20	40	100	16	14.62
Gatsibo	Remera	Nyabukobero	26.8	4.73	1.98	324	168	29	Harmless	22	16	100	20	12.18
Kayonza	Ruramira	Rudendezi	23.8	4.81	12.98	256	131	31	Harmless	26	12	80	16	9.74
Ngoma	Rukira	Kabuye	22.8	4.59	1.96	35	18	24	Harmless	16	16	50	16	2.44
Gatsibo	Murambi	Byimana-Rubona	23.7	6.47	1.19	591	301	28	Harmless	52	12	170	38.4	12.8
Kayonza	Ruramira	Nyakariba	26.8	5.96	11.99	321	165	49	Harmless	56	18	120	28	12.8
Gatsibo	Katabagemu	Rwobe-2	28.7	4.54	23	48	24	63	Harmless	26	16	40	6.4	5.85
Kayonza	Ruramira	Gitoke	25.2	5.01	8.96	264	135	43	Harmless	24	14	80	20	7.31
Kayonza	Murama	Gaseke	20.4	5.45	1.36	258	129	15	Harmless	32	10	80	12	12.1
Ngoma	Rukira	Akanyirarukima	21.6	5.48	1.67	143	71	19	Harmless	24	12	50	8.8	6.6

Parameters			13	14	15	16	17	18	19	20	21	22	23	24	25
			Ammonia Nitrogen	Nitrites Nitrogen	Nitrates Nitrogen	Floride	Chloride	Sulfides	Iron	Manganese	Sodium	Potassium	Total Coliforms	Faecal Coliforms	E. Coli
Unit			mg/l	mg/l	mg/l	mg/l	mg/l	µS/l	mg/l	mg/l	mg/l	mg/l	Cfu/100ml	Cfu/100ml	Cfu/100ml
District	**Sector**	**Spring**													
Kirehe	Musaza	Kucyizanye	0.05	0.012	2	0.19	88.5	11	0.24	0.063	5.60	2.99	9x10^1	2x10^1	<1x10^0
Kayonza	Murama	Gicaca	0.03	0.012	1.9	0.16	62.5	8	0.44	0.035	4.75	2.79	9x10^1	6x10^1	<1x10^0
Gatsibo	Katabagemu	Gashure-2	0.12	0.008	4.2	0.13	39.1	7	0.13	0.182	2.16	7.46	5x10^2	2x10^1	<1x10^0
Gatsibo	Katabagemu	Rwobe-1	0.08	0.008	2	0.02	12	9	0.27	0.002	0.43	3.20	5x10^2	3x10^1	<1x10^0
Gatsibo	Katabagemu	Gashure-1	0.01	0.003	2.3	0.12	33.8	12	0.08	0.106	2.23	80.55	5x10^2	4x10^1	<1x10^0
Gatsibo	Remera	Nyabukobero	0.02	0.003	2.8	0.09	65.1	6	0.04	0.025	5.41	2.50	9x10^2	1x10^1	<1x10^0
Kayonza	Ruramira	Rudendezi	0.08	0.008	3.2	0.08	57.3	11	0.13	0.052	5.03	11.57	5x10^2	7x10^1	<1x10^0
Ngoma	Rukira	Kabuye	0.04	0.005	1.5	0.13	7.8	1	0.45	0.051	0.48	1.38	9x10^2	<1x10^0	<1x10^0
Gatsibo	Murambi	Byimana-Rubona	0.05	0.0.04	2.6	0.13	140.6	4	0.05	0.116	9.79	2.49	5x10^2	5x10^1	9x10^0
Kayonza	Ruramira	Nyakariba	0.08	0.007	1.6	0.12	70.3	8	0.15	0.261	5.44	13.94	1x10^2	9x10^1	4x10^1
Gatsibo	Katabagemu	Rwobe-2	0.09	0.013	2.4	0.05	15.6	8	0.6	0.046	0.55	4.27	2x10^2	4x10^0.	<1x10^0
Kayonza	Ruramira	Gitoke	0.07	0.033	3.2	0.15	44.5	5	0.07	0.034	4.13	4.58	6x10^2	<1x10^0	<1x10^0
Kayonza	Murama	Gaseke	0.02	0.004	1.1	0.82	28.6	3	0.04	0.000	2.434	4.127	3x10^1	<1x10^0	<1x10^0
Ngoma	Rukira	Akanyirarukima	0.15	0.004	1.9	0.79	28.6	4	0.05	0.000	1.888	2.956	3x10^1	<1x10^0	<1x10^0

Result of Analysis in Japan

A water quality analysis was conducted in Japan on the following parameters. The result shows there was no abnormality.

Parameters			1	2	3	4	5	6	7	8
			Humic acid	Mineral acid acidity	Total acidity	Sulfate	Total silicic acid	Dissolved silica	pH	R-pH
Unit			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		
District	**Sector**	**Spring**								
Kirehe	Musaza	Kucyizanye	ND	ND	47	37	11	10	6.5	7.7
Gatsibo	Katabagemu	Rwobe-1	1	ND	10	6.2	10	9.7	6.2	6.9
Gatsibo	Remera	Nyabukobero	ND	ND	58	8.9	26	16	5.7	6.9
Kayonza	Ruramira	Rudendezi	ND	ND	67	4.6	10	8.3	5.5	6.9
Ngoma	Rukira	Kabuye	ND	ND	38	1.4	16	9.8	5.0	6.7
Gatsibo	Katabagemu	Rwobe-2	ND	ND	42	6.3	8.4	6	5.1	6.5
Kayonza	Ruramira	Gitoke	ND	ND	30	9.8	9.4	8.2	6.1	7.1

Results of Test Drilling

(1) Outline of Test Drilling

Based on the results of geological prospecting, 3 points for test drilling were selected.

The test drilling points are shown in Figure 1.

Outline of the test drilling wells is described in Table 1.

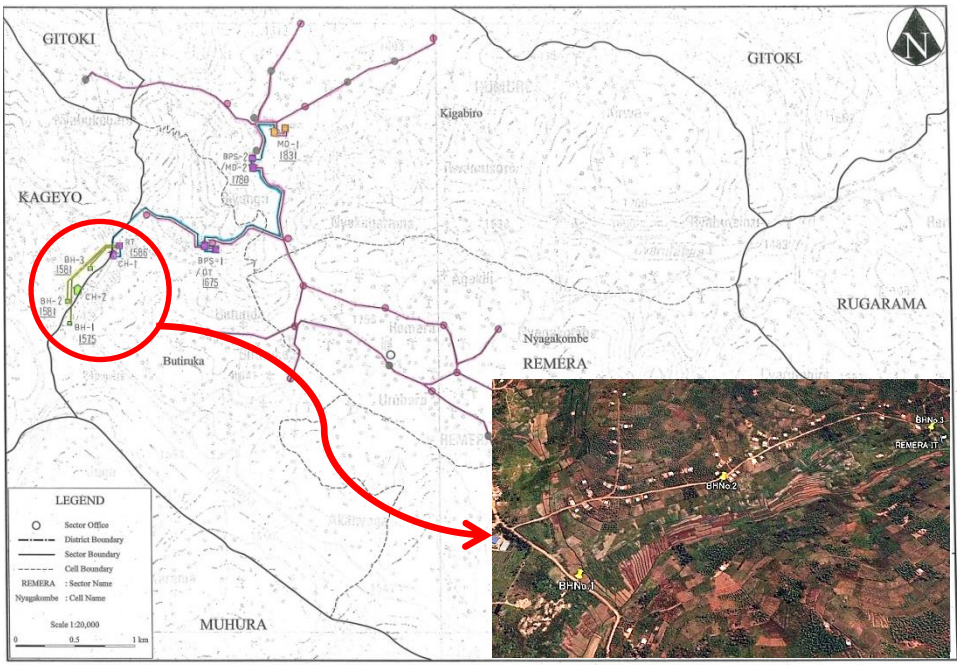


Figure 1 Test Drilling Points

Table 1 Details of Test Drilling Wells

Well Number	Drilling Depth (m)	Casing Diameter (mm)	Casing Depth (m)	Screen Locations and Length (m—m) (Total m)
BH 1	80	140/125	80	47.6-58.8, 71.2-74.0 (14.0)
BH 2	80	140/125	75	43.89-54.81, 69.2-72 (13.72)
BH 3	80	140/125	80	63.27-71.67, 74.47-77.2 (11.13)
Total	240		235	

(2) Pumping Test

Step drawdown tests to identify the well characteristics as well as continuous pumping tests and recovery tests to obtain hydraulic constants of aquifers were conducted. (refer to Annexe1 for graphs from the result pump test)

1) Step Drawdown Test

In this test, pumping is carried out for different yields to determine the well characteristics where

water is pumped for one yield value until the water level stabilizes and then the yield is increased (or decreased) to the next value, and this process is continued.

The test was conducted for yields divided into 5 steps with pumping for 2 hours at each step. Water flow can be divided into laminar and turbulent flows. If the flow velocity under laminar flow is increased by a step-wise increase in drawdown, the flow gradually becomes turbulent. Then, if drawdown is decreased under turbulent flow, the flow returns to laminar flow.

From results of Reynolds Experiment, if the relationship between drawdown and velocity is plotted on logarithmic coordinates with Q (yield) along the X-axis and s (drawdown) along the Y-axis, the relation becomes a straight line. The slope of this straight line is 45° for laminar flow and tilts over 45° for turbulent flow.

Analyses of step drawdown tests will be used for identifying the flow characteristics of groundwater. The yields (Q) and drawdowns (s) will be plotted on a logarithmic graph to determine the inflection point between laminar and turbulent flows and the yield at this point will be assumed as the critical yield. However, due to structural features of the well, detecting the inflection point might be difficult.

2) Results of Step Drawdown Test

The results of step drawdown tests for each test drilling are as shown in the following table.

Table 2 Results of Step Drawdown Tests

Well No.	Yield		Drawdown	Specific Capacity	Comment
	m^3/h	m^3/d	m	$m^3/h/m$	
BH 1	5	120	13.76	0.36	
	6	144	16.76	0.35	
	7	168	19.65	0.35	
	8	192	26.05	0.30	
	9	216	32.92	0.27	After 12 hrs. continuous pumping
BH 2	5	120	21.70	0.23	
	6	144	31.70	0.18	
	6.1	146.4	42.68	0.14	After 12 hrs. continuous pumping
	7	168	40.00	0.17	
	8	192	46.30	0.17	
BH 3	2.6	62.4	12.53	0.20	
	3.13	75.12	16.38	0.19	
	4.0	96.0	21.55	0.18	
	5.14	123.36	28.13	0.18	

	5.14	123.36	37.59	0.13	After 12 hrs. continuous pumping

Specific capacity is the average yield for a specified drawdown expressed as yield/drawdown and used as the value to indicate the capacity of the well.

From well performance characteristics, BH1 is the best borehole while BH2 and BH3 are similar in terms of specific capacities.

3) Critical Yield and Appropriate Yield

As explained above, the critical yield can be determined from the inflection point when yields and drawdowns for each step are plotted on logarithmic coordinates. However, due to problems with structural losses of the well, the inflection point may not be detected where the critical yield cannot be specified. From results of the tests in this survey, the inflection points for BH2 and BH3 are difficult to identify.

In consideration of the above conditions, the project will be formulated using the following yields.

Borehole No.	Yield for Outline Design (m^3/hr)
BH 1	7
BH 2	6
BH 3	5

Nevertheless for BH1, when the pumping rate exceeds 7 m^3/hr, the drawdown becomes drastically large, and thus, 7 m^3/hr can be considered as the critical point. For BH2 and BH3, the drawdown after 12 hours of continuous pumping is larger than the drawdown in the step drawdown test implying unstable water level. (From the continuous pumping test table)

In the outline design, the entire scale of the facilities will be determined and costs will be estimated. In this respect, similar to spring yields, if the groundwater yields are evaluated at minimum rates, the facilities scale will also be minimal and requirements of the needed population may not be met. On the other hand, even if the daily pumping rate is within the allowable limit and the hourly pumping rate is increased, this can have a harmful effect on the aquifer, but when the water flow into the well is in equilibrium with the pumping rate, this is the optimum rate.

The yields determined in the above table are considered to be rates near the critical yield according to results of pumping tests. Therefore, during the detailed design stage, pumping tests will be re-conducted to confirm the necessary yields.

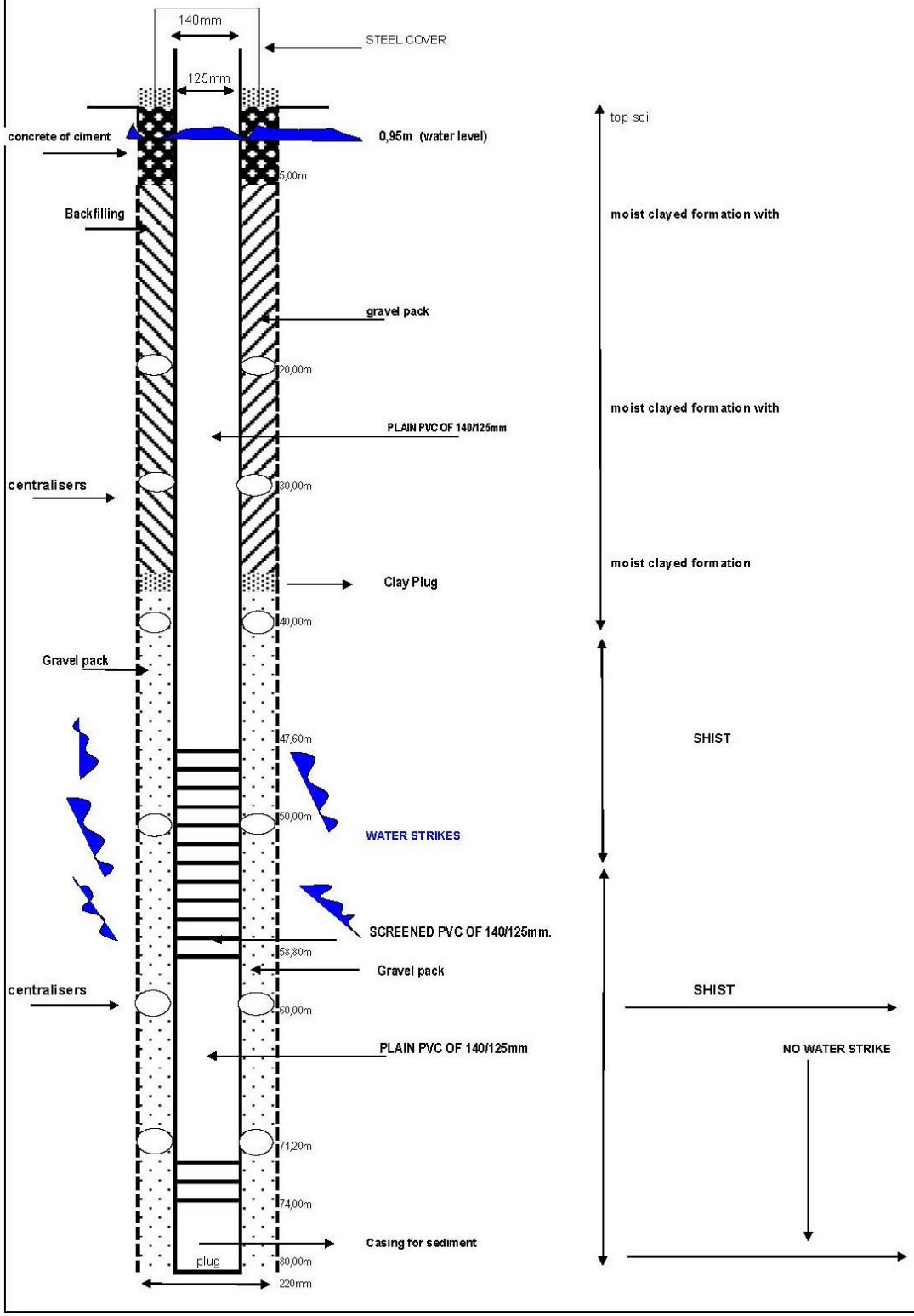
(3) Well Structure Drawing

The well structure drawings of the 3 test drillings are shown in the following pages.

Project : TEST DRILLING FOR PREPARATORY SURVEY ON THE PROJECT FOR RURAL WATER SUPPLY (PHASE III) IN THE REPUBLIC OF RWANDA

Foraky Africa Drilling Company s.a.r.l
BP 3356 Kigali - Rwanda

DESIGN OF BOREHOLE BH1



Project : TEST DRILLING FOR PREPARATORY SURVEY ON THE PROJECT FOR RURAL WATER SUPPLY (PHASE III) IN THE REPUBLIC OF RWANDA

Foraky Africa Drilling Company s.a.r.l

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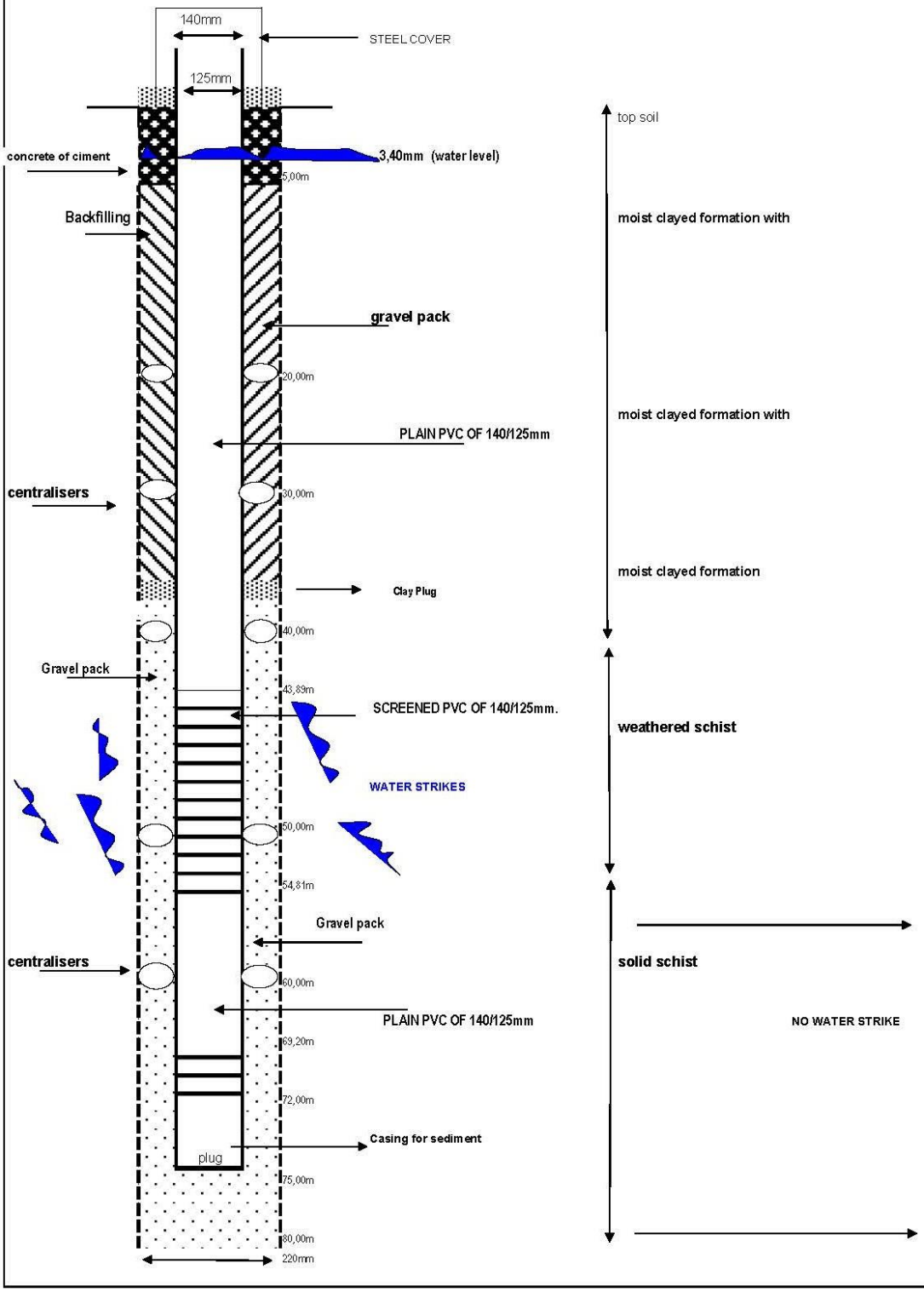
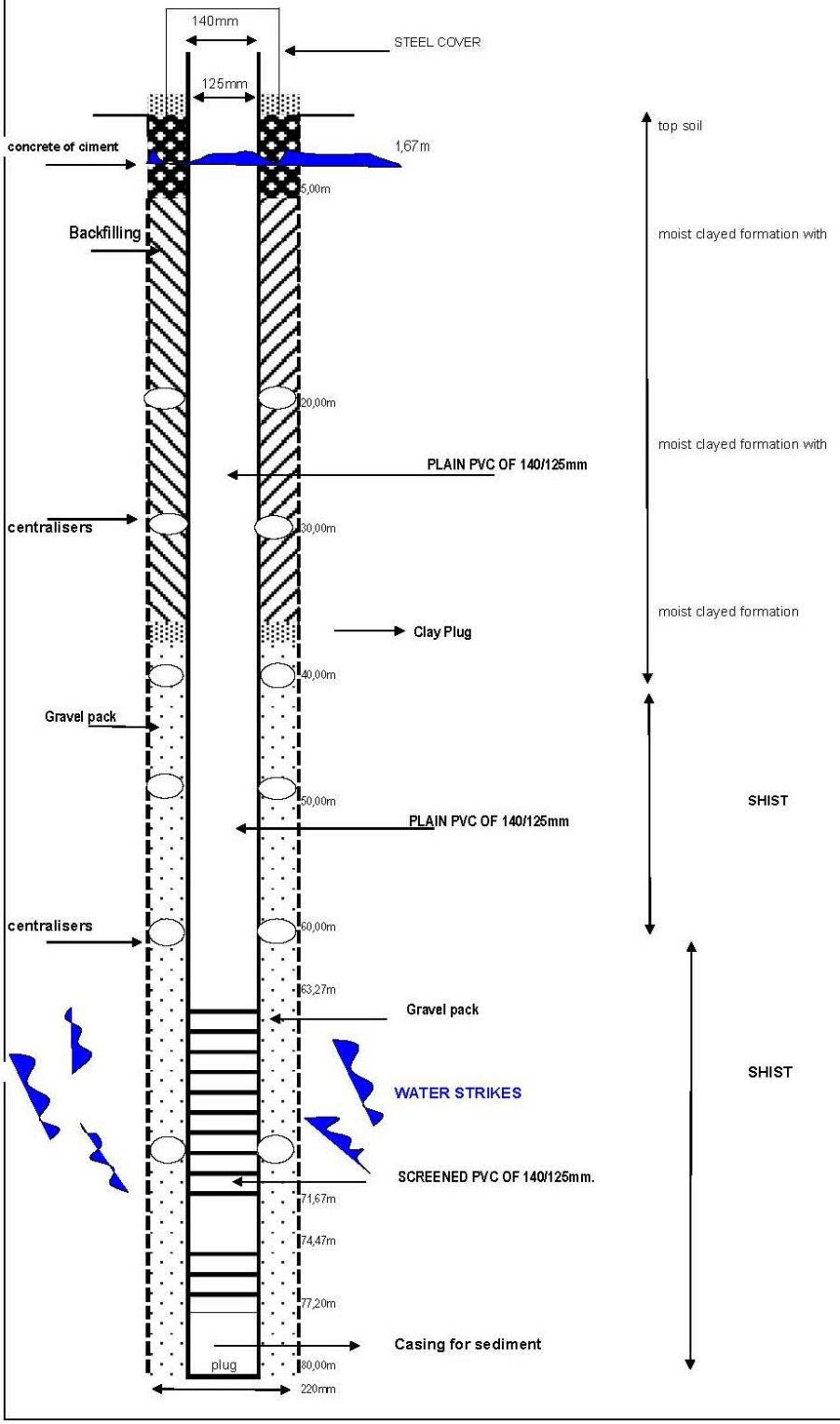
DESIGN OF BOREHOLE BH2



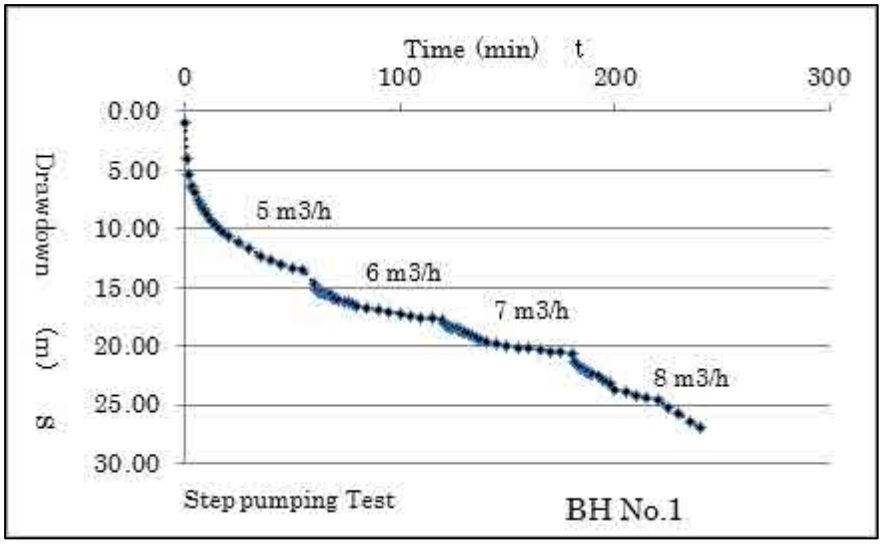
Project : TEST DRILLING FOR PREPARATORY SURVEY ON THE PROJECT FOR RURAL WATER SUPPLY (PHASE III) IN THE REPUBLIC OF RWANDA

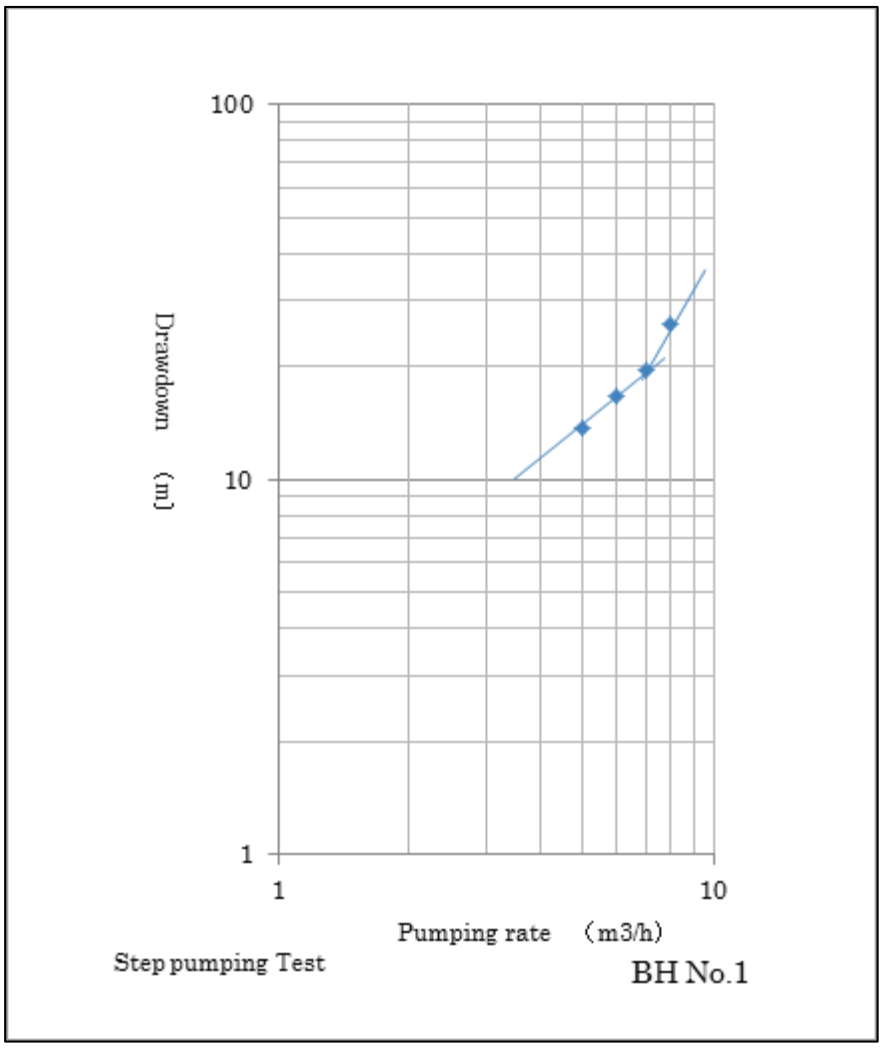
Foraky Africa **Drilling Company s.a.r.l**
BP 3356 Kigali - Rwanda

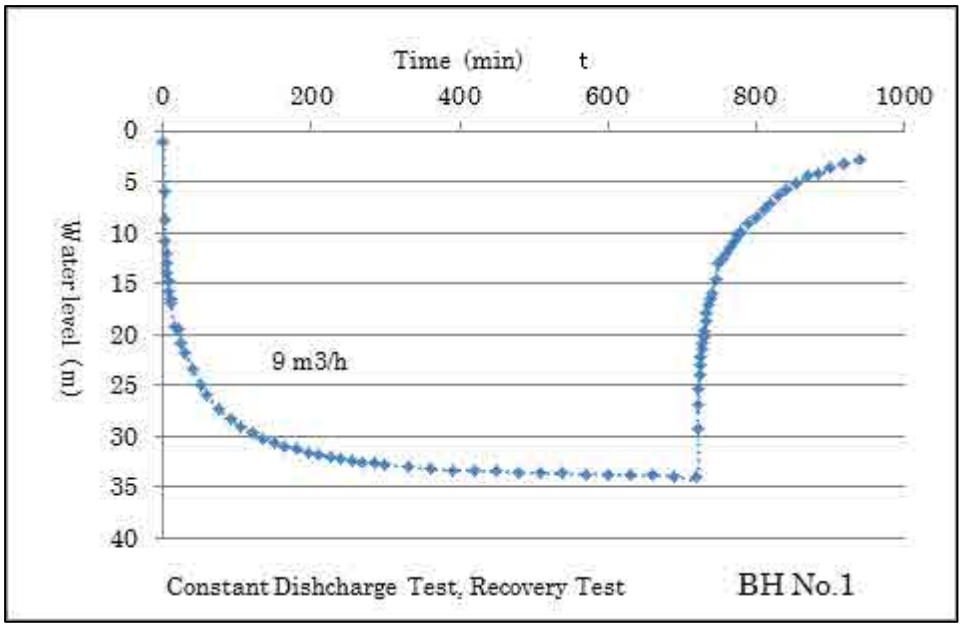
DESIGN OF BOREHOLE BH3

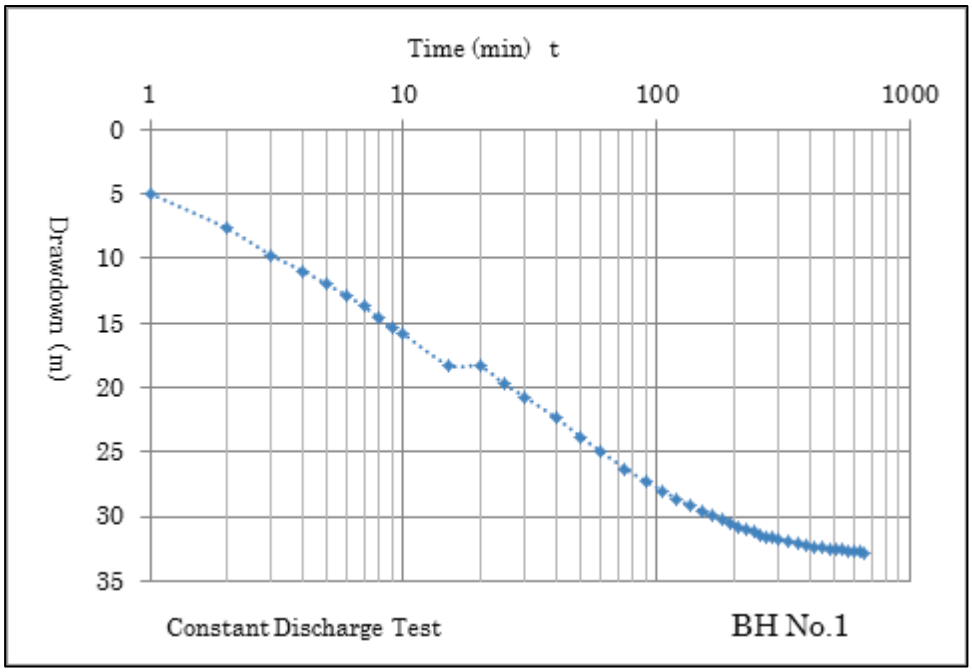


Annex1: Result of Pump Test






Time (min) t
0
200
400
600
800
1000
0
5
10
15
20
25
30
35
40
Water level (m)
9 m3/h
Constant Dishcharge Test, Recovery Test
BH No.1


Time (min) t
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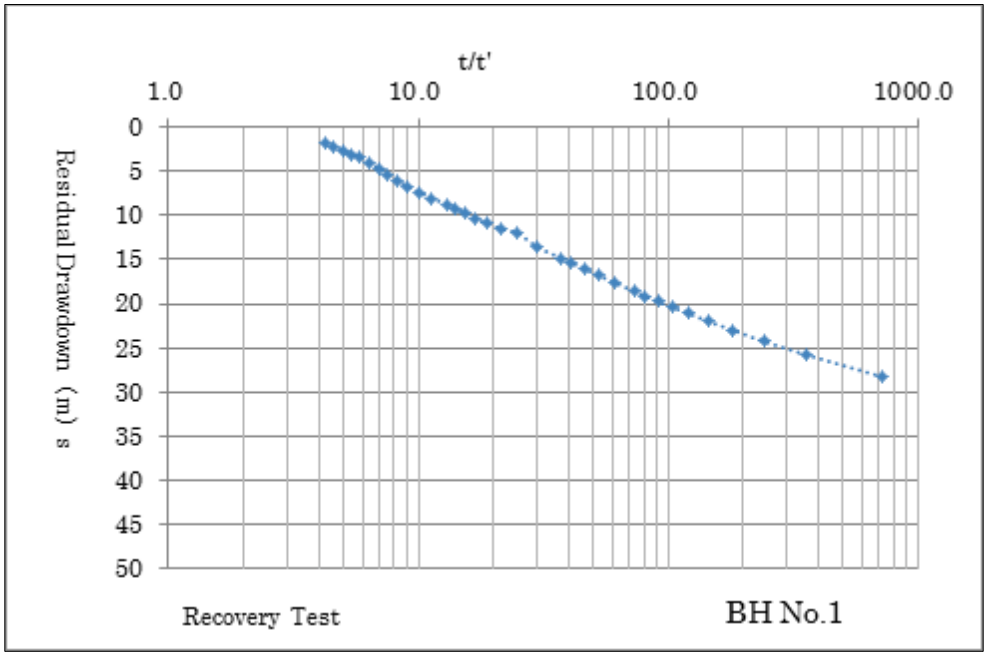
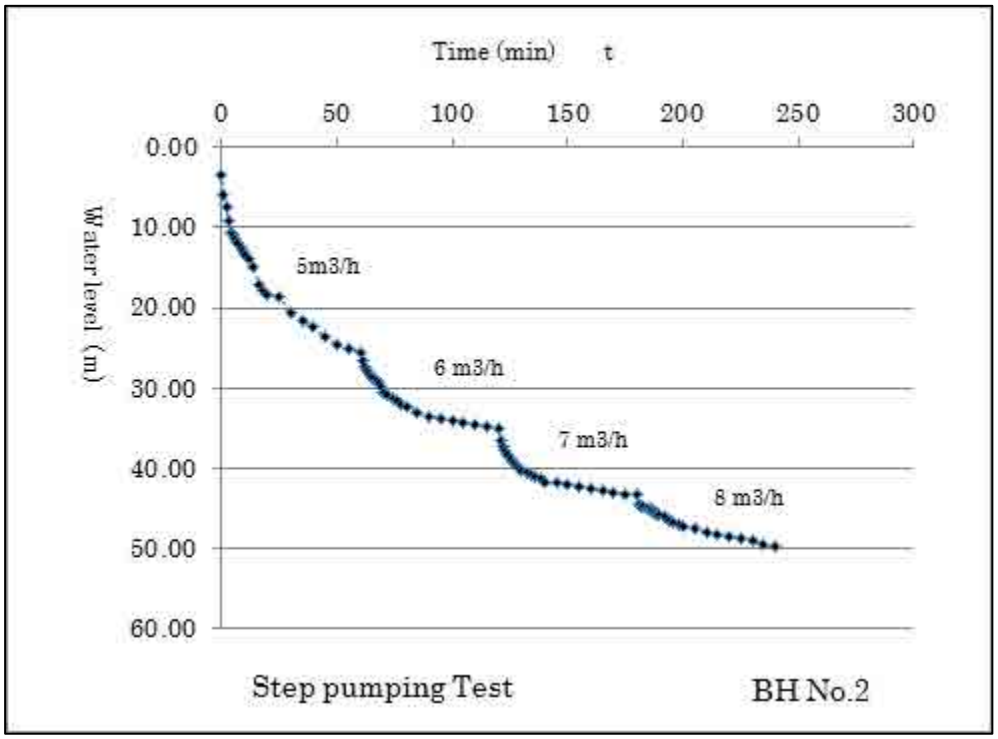
100
1000
0
5
10
15
20
25
30
35
Drawdown (m)
Constant Discharge Test
BH No.1


t/t'
1.0
10.0
100.0
1000.0
0
5
10
15
20
25
30
35
40
45
50
Residual Drawdown (m) s
Recovery Test
BH No.1


Time (min) t
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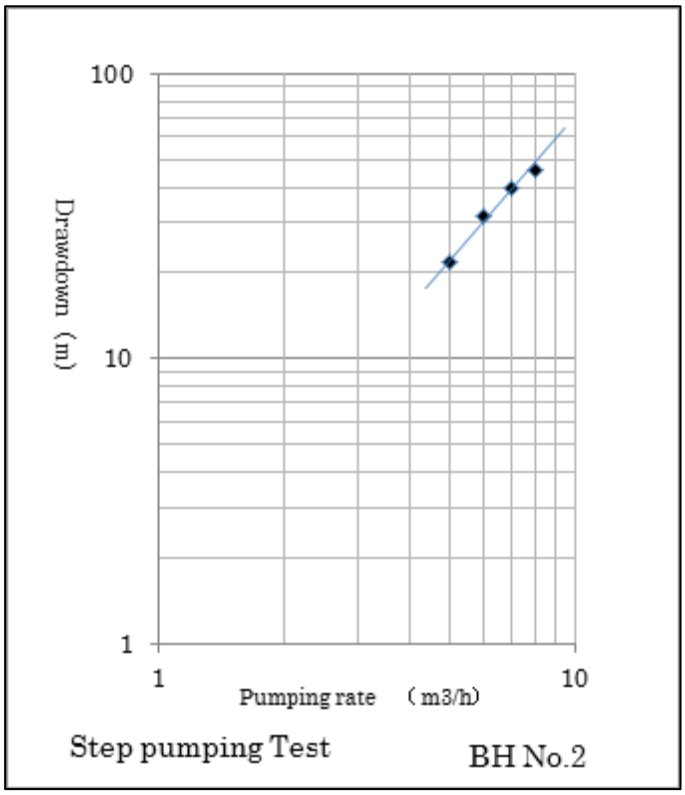
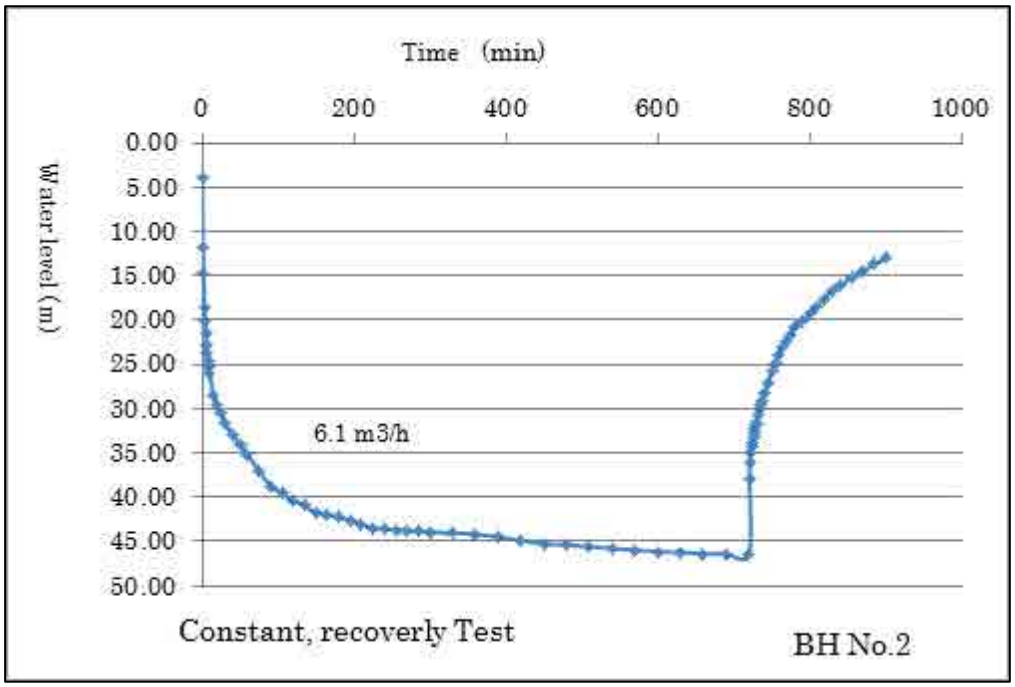
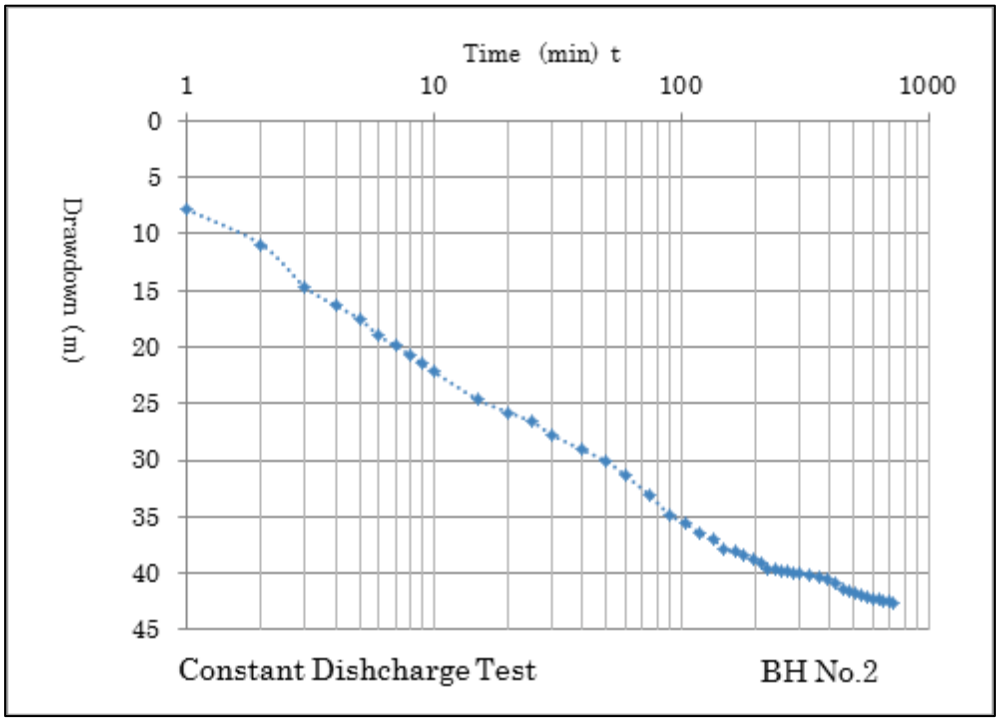
100
150
200
250
300
0.00
10.00
20.00
30.00
40.00
50.00
60.00
Water level (m)
5m3/h
6 m3/h
7 m3/h
8 m3/h
Step pumping Test
BH No.2


100
10
1
Drawdown (m)
1
10
Pumping rate (m3/h)
Step pumping Test
BH No.2


Time (min)
0
200
400
600
800
1000
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
Water level (m)
6.1 m3/h
Constant, recoverly Test
BH No.2


Time (min) t
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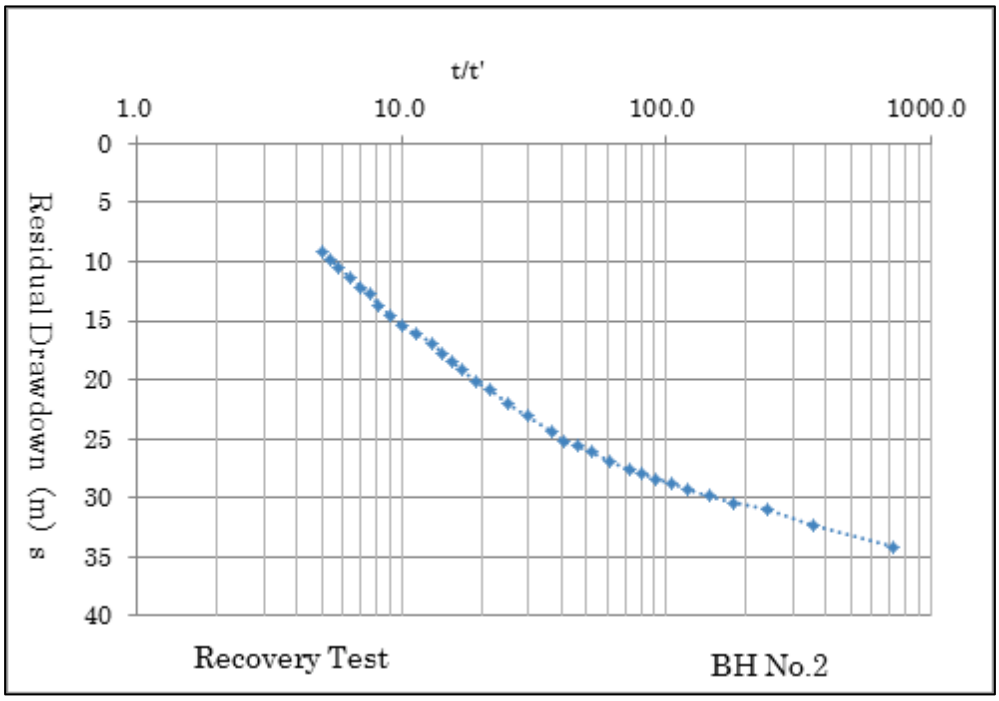
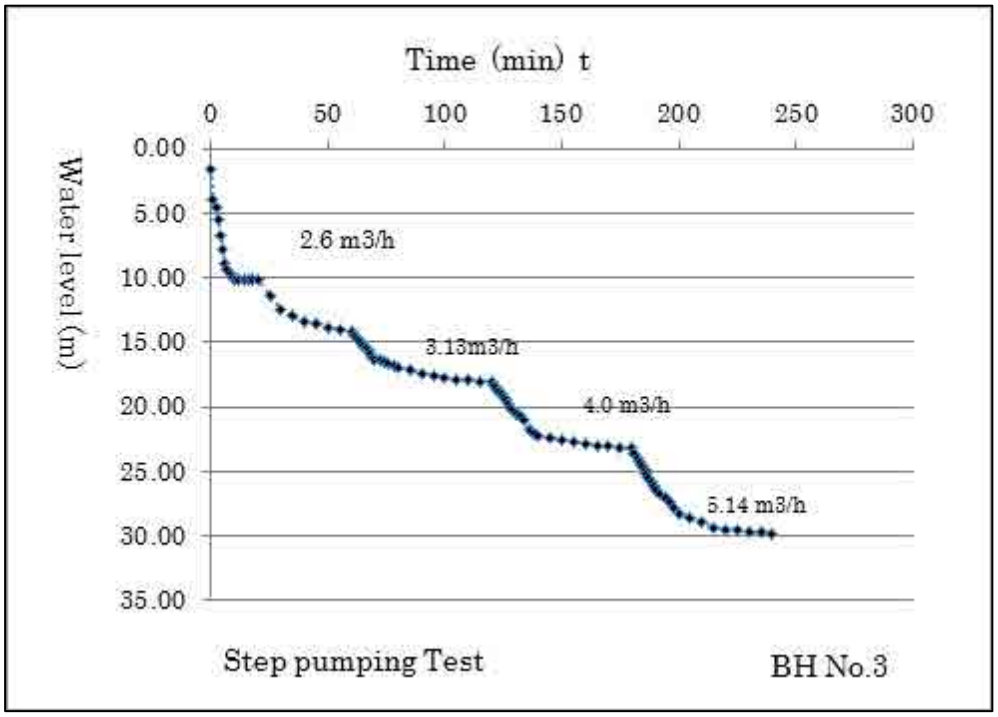
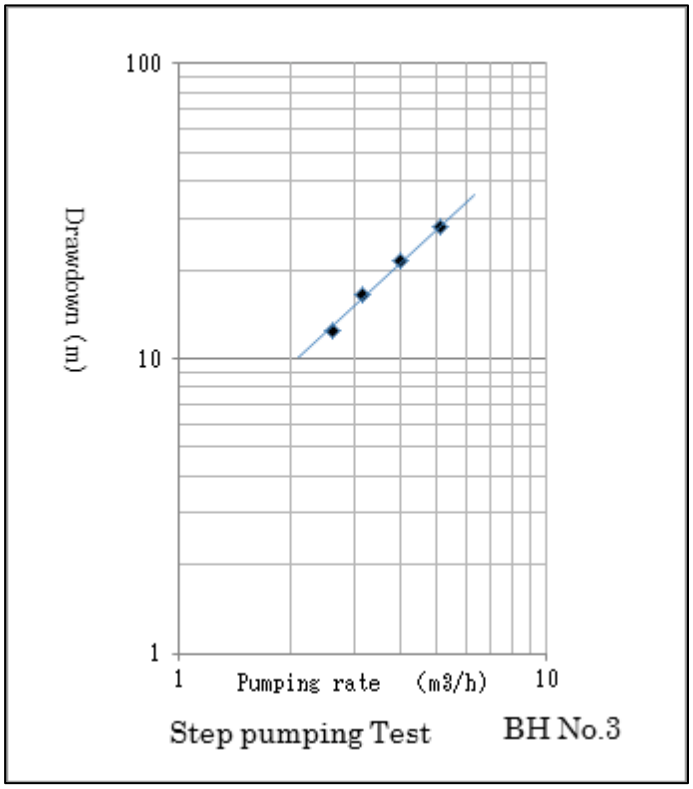
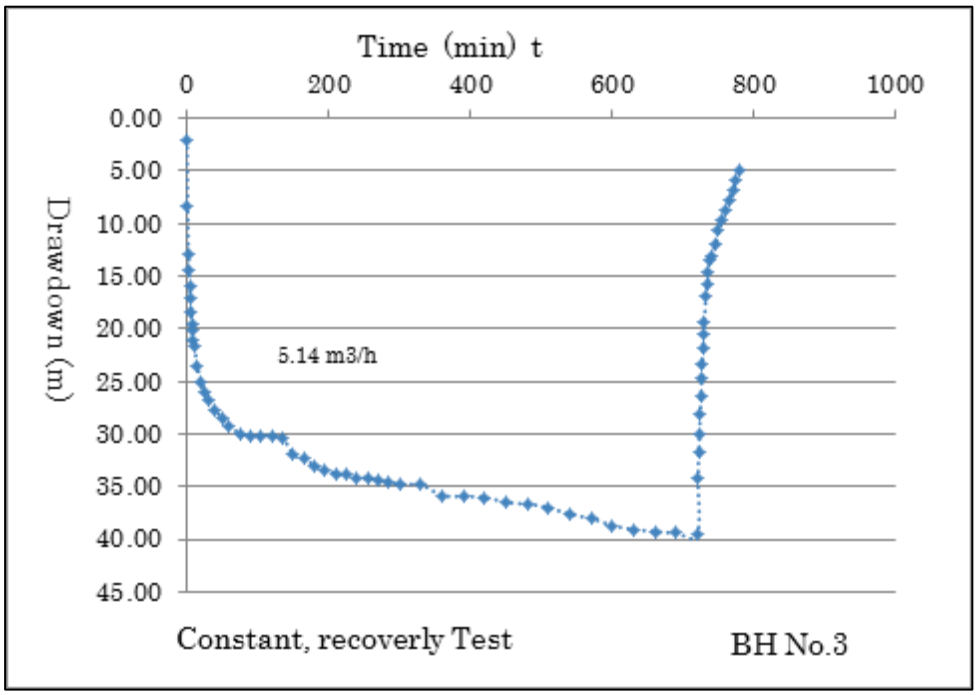
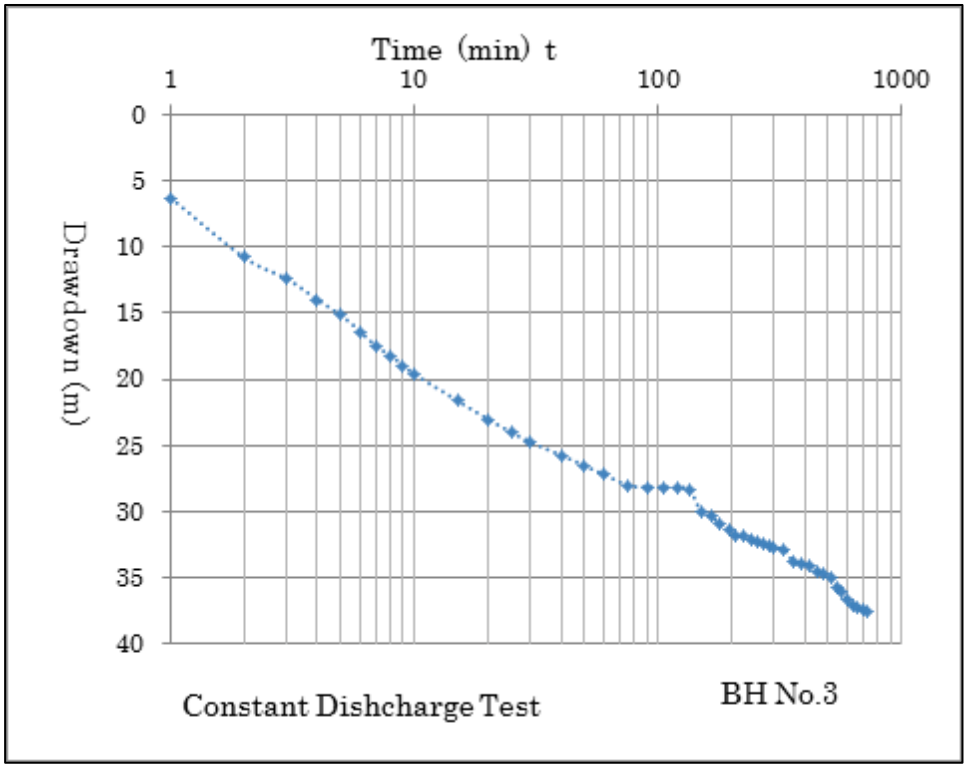
10
100
1000
0
5
10
15
20
25
30
35
40
45
Drawdown (m)
Constant Dishcharge Test
BH No.2


t/t'
1.0
10.0
100.0
1000.0
0
5
10
15
20
25
30
35
40
Residual Drawdown (m) s
Recovery Test
BH No.2


Time (min) t
0
50
100
150
200
250
300
Water level (m)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
2.6 m3/h
3.13m3/h
4.0 m3/h
5.14 m3/h
Step pumping Test
BH No.3


100
10
1
Drawdown (m)
1
Pumping rate (m3/h)
10
Step pumping Test
BH No.3


Time (min) t
0
200
400
600
800
1000
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
Drawdown (m)
5.14 m3/h
Constant, recoverly Test
BH No.3


Time (min) t
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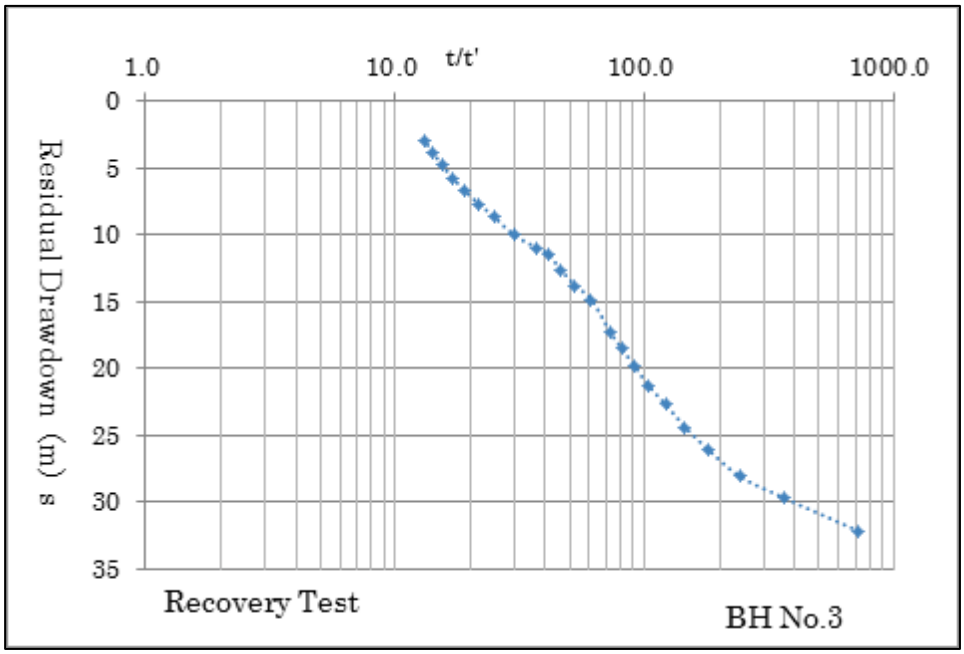
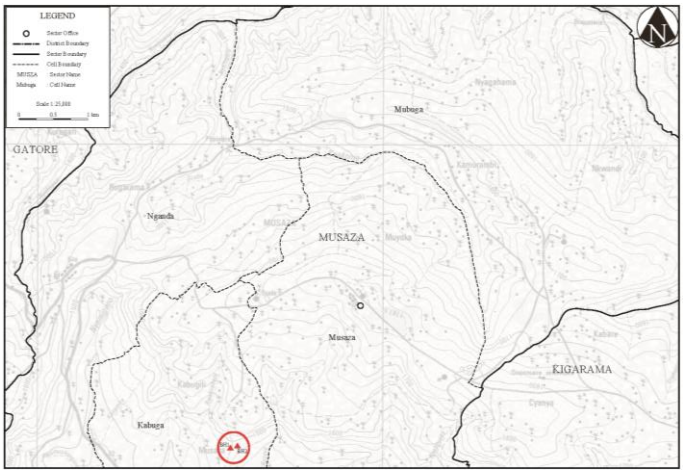
10
100
1000
0
5
10
15
20
25
30
35
40
Drawdown (m)
Constant Dishcharge Test
BH No.3

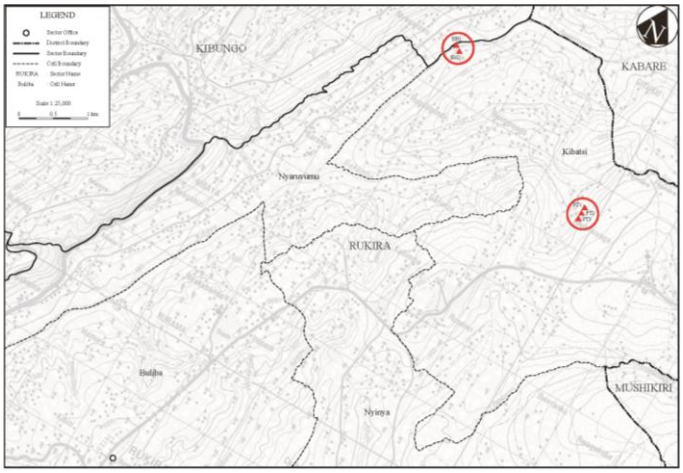

1.0
10.0
t/t'
100.0
1000.0
0
5
10
15
20
25
30
35
Residual Drawdown (m) s
Recovery Test
BH No.3

Appendix-6(5) Result of Geotechnical Survey

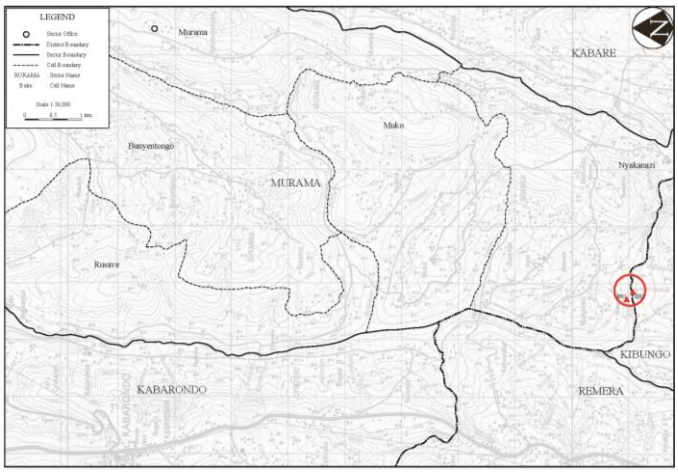
LOCATION



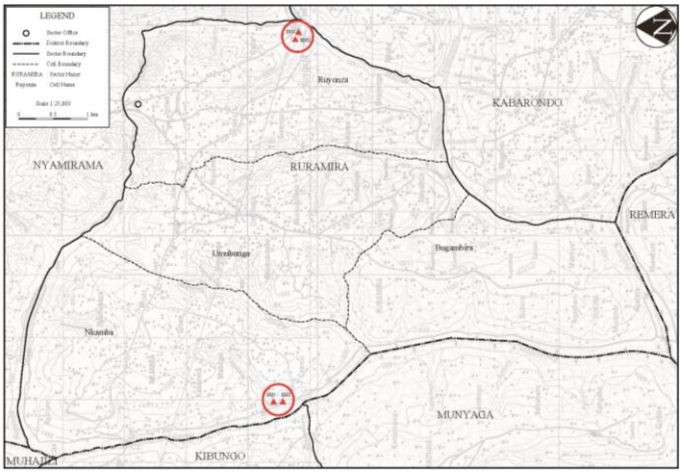
MUSAZA



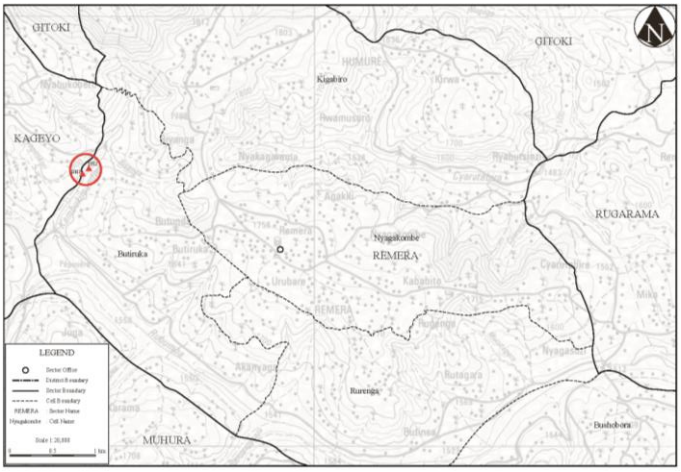
RUKIRA



MURAMA



RURAMIRA



REMERA

Summary of Result of Geotechnical Survey

Ref. No.			1-1-1	1-1-2	2-2-1	2-2-2	3-1-1	3-1-2	4-1-1	4-1-2	4-2-1	4-2-2	5-1-1	5-1-2
Site name			No.1 Musaza		No. Rukira		No.3 Murama		No.4 Ruramira				No.5 Remera	
District			Kirehe				Kayonza	Ngoma	Kayonza				Gatsibo	
Sector			Musaza		Kibungo		Murama	Kibungo	Ruramira				Remera	
Test Hole Virage name			Kabuga		Gatonde		Nyakanazi	Gatonde	Nkamba		Ruyonza		Kageho	
Test Hole No.			BH-1	BH-2	BH-1	BH-2	BH-1	BH-2	BH-1	BH-2	BH-1	BH-2	BH-1	BH-2
Date	Start		13/07/2013	13/07/2013	16/07/2013	17/07/2013	09/07/2013	10/07/2013	01/07/2013	02/07/2013	07/07/2013	06/07/2013	25/06/2013	28/06/2013
	Finish		14/07/2013	13/07/2013	16/07/2013	17/07/2013	10/07/2013	10/07/2013	01/07/2013	02/07/2013	08/07/2013	06/07/2013	26/06/2013	29/06/2013
LAN.			-2.349611111	-2.349472222	-2.120527778	-2.1205	-2.092055556	-2.092166667	-1.994777778	-1.994861111	-2.001305556	-2.001527778	-1.691710556	-1.691710556
LON.			30.61119444	30.61136111	30.60213889	30.60216667	30.58558333	30.58556111	30.47486111	30.47486111	30.52983333	30.52980556	30.29128083	30.29128083
Depth (m)	WL	(GL-m)	no water	no water	0.50	0.65	0.30	0.50	1.96	3.20	1.85	2.75	1.25	1.34
1.0		N値	15	13	2	3	3	1	32	28	53	46	7	22
まで	End bearing capacity	(kPa)	1,851.1	925.5	462.8	462.8	462.8	462.8	1,851.1	2,313.9	3,702.2	4,627.7	925.5	2,313.9
	Bearing Capacity ※	**(tf/m2)**	**9.4**	**4.7**	**2.4**	**2.4**	**2.4**	**2.4**	**9.4**	**11.8**	**18.9**	**23.6**	**4.7**	**11.8**
	A/20	(kPa)	92.56	46.28	23.14	23.14	23.14	23.14	92.56	115.70	185.11	231.39	46.28	115.70
	Converted from N-value	**(tf/m2)**	**9.0**	**7.8**	**1.2**	**1.8**	**1.8**	**0.6**	**19.2**	**16.8**	**31.8**	**27.6**	**4.2**	**13.2**
		(kPa)	88.26	76.49	11.77	17.65	17.65	5.88	188.29	164.75	311.85	270.66	41.19	129.45
2.0		N値	13	18	3	5	1	1	28	25	51	39	7	31
Up to	End bearing capacity	(kPa)	1,388.3	1,388.3	462.8	462.8	462.8	462.8	1,851.1	2,313.9	5,553.3	5,553.3	925.5	3,702.2
	Bearing Capacity ※	**(tf/m2)**	**7.1**	**7.1**	**2.4**	**2.4**	**2.4**	**2.4**	**9.4**	**11.8**	**28.3**	**28.3**	**4.7**	**18.9**
	A/20	(kPa)	69.42	69.42	23.14	23.14	23.14	23.14	92.56	115.70	277.67	277.67	46.28	185.11
	Converted from N-value	**(tf/m2)**	**7.8**	**10.8**	**1.8**	**3.0**	**0.6**	**0.6**	**16.8**	**15.0**	**30.6**	**23.4**	**4.2**	**18.6**
		(kPa)	76.49	105.91	17.65	29.42	5.88	5.88	164.75	147.10	300.08	229.48	41.19	182.40
3.0		N値	16	17	4	7	1	3	29	32	25	43	11	38
Up to	End bearing capacity	(kPa)	1,851.1	925.5	462.8	462.8	462.8	462.8	2,313.9	2,776.6	3,239.4	3,239.4	1,851.1	5,090.5
	Bearing Capacity ※	**(tf/m2)**	**9.4**	**4.7**	**2.4**	**2.4**	**2.4**	**2.4**	**11.8**	**14.2**	**16.5**	**16.5**	**9.4**	**26.0**
	A/20	(kPa)	92.56	46.28	23.14	23.14	23.14	23.14	115.70	138.83	161.97	161.97	92.56	254.53
	Converted from N-value	**(tf/m2)**	**9.6**	**10.2**	**2.4**	**4.2**	**0.6**	**1.8**	**17.4**	**19.2**	**15.0**	**25.8**	**6.6**	**22.8**
		(kPa)	94.14	100.03	23.54	41.19	5.88	17.65	170.64	188.29	147.10	253.01	64.72	223.59
Lab test	自然含水比	(%)	13.8	13.4	22.0	17.0	26.0	18.4	15.3	13.2	13.4	13.6	14.8	14.4
	単位重量	(kg/m3)	1,998	1,992	1,688	1,796	1,634	1,708	1,785	1,908	1,894	1,896	1,868	1,872
	pH		4.84	4.78	4.74	4.70	5.78	4.82	4.72	4.82	4.78	4.70	5.59	5.45
4.0		N値	15	12	5	8	1	5	35	39	31	59	10	28
Up to	End bearing capacity	(kPa)	1,388.3	1,388.3	462.8	925.5	462.8	462.8	2,776.6	4,165.0	1,851.1	5,090.5	925.5	3,239.4
	Bearing Capacity ※	**(tf/m2)**	**7.1**	**7.1**	**2.4**	**4.7**	**2.4**	**2.4**	**14.2**	**21.2**	**9.4**	**26.0**	**4.7**	**16.5**
	A/20	(kPa)	69.42	69.42	23.14	46.28	23.14	23.14	138.83	208.25	92.56	254.53	46.28	161.97
	Converted from N-value	**(tf/m2)**	**9.0**	**7.2**	**3.0**	**4.8**	**0.6**	**3.0**	**21.0**	**23.4**	**18.6**	**35.4**	**6.0**	**16.8**
		(kPa)	88.26	70.61	29.42	47.07	5.88	29.42	205.94	229.48	182.40	347.16	58.84	164.75
5.0		N値	11	11	7	13	3	19	36	27	34	75	18	24
Up to	End bearing capacity	(kPa)	1,851.1	1,388.3	462.8	925.5	462.8	1,388.3	3,239.4	2,313.9	3,239.4	5,090.5	1,851.1	2,776.6
	Bearing Capacity ※	**(tf/m2)**	**9.4**	**7.1**	**2.4**	**4.7**	**2.4**	**7.1**	**16.5**	**11.8**	**16.5**	**26.0**	**9.4**	**14.2**
	A/20	(kPa)	92.56	69.42	23.14	46.28	23.14	69.42	161.97	115.70	161.97	254.53	92.56	138.83
	Converted from N-value	**(tf/m2)**	**6.6**	**6.6**	**4.2**	**7.8**	**1.8**	**11.4**	**21.6**	**16.2**	**20.4**	**45.0**	**10.8**	**14.4**
		(kPa)	64.72	64.72	41.19	76.49	17.65	111.80	211.82	158.87	200.06	441.30	105.91	141.22

※End bearing capacity × safety factor 5%

$$q_d = \frac{M^2 \cdot H \cdot N}{A \cdot e(M+P)}$$

qd(kPa)	Cone end resistance	
M(kN)	Weight of hammer	0.635
H(m)	Height of	0.76
A(m2)	Section area of the cone	0.0010287
P(kN)		3.6566
e(m)		0.15
N	Sum of the 15cm blows (N-value)	

Ref. No.		2-1-1	2-1-2	2-1-3
Site name		No.2 Rukira		
District		Ngoma		
Sector		Rukira		
Test Hole Virage name		Kabuye		
Test Hole No.		PD-1	PD-2	PD-3
Date	Start	03/08/2013	03/08/2013	03/08/2013
	Finish	03/08/2013	03/08/2013	03/08/2013
LAN.		-2.123611111		
LON.		30.63294444		
Depth (mm)		Resistance		
100 (bar)		47	19	14
	(kPa)	4,700	1,900	1,400
200 (bar)		56	23	117
	(kPa)	5,600	2,300	11,700
300 (bar)		33	23	206
	(kPa)	3,300	2,300	20,600
400 (bar)		52	19	234
	(kPa)	5,200	1,900	23,400
500 (bar)		234	9	Bedrock
	(kPa)	23,400	900	
600 (bar)		Bedrock	19	-
	(kPa)		1,900	
700 (bar)		-	19	-
	(kPa)		1,900	
800 (bar)		-	14	-
	(kPa)		1,400	
900 (bar)		-	56	-
	(kPa)		5,600	
1000 (bar)		-	167	-
	(kPa)		16,700	
1100 (bar)		-	217	-
	(kPa)		21,700	
1200 (bar)		-	231	-
	(kPa)		23,100	
1300 (bar)		-	Bedrock	-
	(kPa)			

APPENDIX -6(6) RESULT OF SOCIO-ECONOMIC SURVEY

1) Objectives of the survey

Socio-Economic Survey in this preparatory survey was implemented on the following objectives:

1. To acquire the following information on the present state of socio-economic conditions of the target sites to formulate the plans of Water Supply / Construction, and Operation and Maintenance at the Outline Design level
   - ① Basic information for living standards of residents
   - ② Socio-economic conditions
   - ③ Present situations of water use
   - ④ Conditions of poverty group
   - ⑤ Current situation of operation and maintenance of existing water supply facilities
   - ⑥ People's consciousness about water supply facilities (including willingness and capacity to pay water tariff)
   - ⑦ Current systems to set water tariff and to collect it in the sites
   - ⑧ Access conditions to the sites
   - ⑨ Activities' Status of Donor or NGOs etc.
2. To compile baseline data on parameters to measure the project outputs effects

2) Survey description and methodologies

Survey description and methodologies is shown as below:

1. Survey target area

Survey was executed in at eight (8) sectors located in six (6) districts in Eastern Province.

Table : Survey target Area

District		Sector		Scheme No.
1	Kirehe	1	Musaza	①
2	Ngoma	2	Rukira	②
3	Kayonza	3	Murama	③
		4	Ruramira	④
4	Gatsibo	5	Remera	⑤
5	Nyagatare	6	Katabagemu	⑥
	Gatsibo	7	Nyagihanga	
		8	Ngarama	

2. Survey description and methodologies

Survey description and methodologies is composed of the followings three (3) types:

① Sample household survey (Interview with Questionnaire)
② Workshop with Participatory Rural Appraisal (PRA) tool, and
③ Direct Observation Survey.

① Interview with Questionnaire

Survey Site :	the above 8 sectors
Number of samples required :	240 samples in total : 8 sectors×30 samples per sector 30 samples include 15 men and 15 women including Key Informant.
Survey method :	The structured interview with questionnaire to the above targeted people will be employed in the survey with questionnaire prepared by the Client.
Items to be surveyed :	➢ General information of village: administrative category, etc ➢ Water demand in the village: demographic condition, type of water usage, etc ➢ Socio-economic conditions in the village: means of living, income / expenditure pattern, practice of savings, etc., ➢ Existing organization and communal activities: water committee, other project activities, etc. ➢ Present situation of sanitation and hygiene in the village: water use by residents, perception of residents

	towards existing water supply and sanitation conditions, diseases pattern, needs and priority for residents in improvement of their living conditions, etc. ➢ Present situation of water supply: existing water source in the village, existence of water vending, etc. ➢ Willingness and capacity to contribute for maintenance of water supply facilities in the village: willingness to have new borehole, willingness and capacity to participate in operation and maintenance of borehole to be constructed, etc. ➢ Operation and Maintenance conditions for existing water scheme

② Workshop with Participatory Rural Appraisal (PRA) tool, and

Survey Site :	the above 8 sectors
Number of samples required :	16 groups in total : 8 sectors×2 groups per sector 2 groups include 10 persons for each gender group.
Survey method :	The semi-structured interview with questionnaire to participants including site leaders will be employed in the survey with questionnaire sheets prepared by the Client. Daily Calendar, Seasonal / Annual Calendar, Venn diagram and Mapping etc.
Items to be surveyed :	Same as 1)

③ Direct Observation Survey.

Survey Site :	the above 8 sectors
Survey method :	The survey regarding the accessibility shall be conducted to recognise the surrounding conditions of the villages which could affect the implementation of the Project in rainy season by the direct observation and by questions to the villages. The important points shall be identified by using GPS and Digital Cameras.
Items to be surveyed :	➢ Condition of access to village: Distance from semi-urban centre to the village and from the main road to the village, and condition of the main roads for construction machineries (ex. Drilling rigs), existence of bridges and its condition etc. ➢ Present situation of water supply: Existing water source, existence of water vending, etc. ➢ Center point of the village

3) Results of the survey

Results of the survey shall be shown as follows:

Respondent Characteristics

Table 1 Sex of Respondent

Site	Male	Female
Musaza	33%	67%
Rukira	30%	70%
Murama	50%	50%
Ruramira	33%	67%
Remera	43%	57%
Nyagihanga	73%	27%
Ngarama	47%	53%
Katabagemu	77%	23%
Total	48%	52%

Table 2 Age of Respondent

Site	10's	20's	30's	40's	50's	60's	70's and above
Musaza	3%	13%	30%	20%	10%	10%	13%
Rukira	0%	11%	30%	26%	11%	15%	7%
Murama	3%	13%	17%	27%	17%	10%	13%
Ruramira	0%	13%	30%	27%	13%	10%	7%
Remera	3%	23%	23%	20%	10%	10%	10%
Nyagihanga	0%	23%	37%	20%	17%	0%	3%
Ngarama	0%	13%	37%	13%	17%	20%	0%
Katabagemu	0%	33%	23%	17%	27%	0%	0%
Total	1%	18%	28%	21%	15%	9%	7%

Household Characteristics

Table 3 Sex of Household

Site	Male	Female
Musaza	87%	13%
Rukira	87%	13%
Murama	70%	30%
Ruramira	77%	23%
Remera	87%	13%
Nyagihanga	93%	7%
Ngarama	77%	23%
Katabagemu	93%	7%
Total	84%	16%

Table 4 Age of Household

Site	10's	20's	30's	40's	50's	60's	70's and above
Musaza	0%	7%	20%	33%	17%	13%	10%
Rukira	0%	10%	27%	20%	20%	7%	17%
Murama	0%	7%	23%	23%	23%	10%	13%
Ruramira	0%	10%	30%	27%	13%	10%	10%
Remera	0%	7%	27%	17%	17%	20%	13%
Nyagihanga	0%	23%	37%	17%	20%	3%	0%
Ngarama	0%	13%	33%	13%	17%	23%	0%
Katabagemu	0%	23%	23%	23%	30%	0%	0%
Total	0%	13%	28%	22%	20%	11%	8%

Table 5 No. of Household Members by Age Group

Site	Other infant (under 5)	Infant (under 5)	Other Children (age 5-18)	Children (age 5-18)	Adult Women (age 18 and above)	Adult men (age 18 and above)	Total
Musaza	1.30	1.37	1.57	0.30	0.70	0.03	5.27
Rukira	1.23	1.30	1.20	0.50	0.60	0.13	4.97
Murama	1.13	1.47	1.43	0.37	0.57	0.17	5.13
Ruramira	1.03	1.50	1.60	0.17	0.50	0.13	4.93
Remera	1.17	1.63	1.17	0.23	0.53	0.07	4.80
Nyagihanga	1.13	1.27	2.10	0.17	0.43	0.00	5.10
Ngarama	1.13	1.47	1.57	0.10	0.47	0.20	4.93
Katabagemu	1.13	1.13	2.63	0.43	0.67	0.10	6.10
Total	1.16	1.39	1.66	0.28	0.56	0.10	5.15

Priority for Improvement of Living Conditions

Table 6 1st Priority to improve Conditions of Household

Site	Power Supply	Health facility and services	School facility and education	Water supply facility and service	Sanitation and sewerage system	Disposal of garbage	Access road	Don't know	Other	Total
Musaza	33%	0%	0%	60%	3%	0%	0%	0%	3%	100%
Rukira	10%	3%	0%	83%	0%	0%	0%	3%	0%	100%
Murama	17%	0%	0%	80%	3%	0%	0%	0%	0%	100%
Ruramira	10%	0%	0%	87%	0%	0%	3%	0%	0%	100%
Remera	10%	0%	0%	87%	0%	0%	0%	0%	3%	100%
Nyagihanga	13%	3%	3%	57%	0%	0%	17%	0%	7%	100%
Ngarama	3%	3%	3%	87%	0%	0%	0%	0%	3%	100%
Katabagemu	0%	3%	0%	97%	0%	0%	0%	0%	0%	100%
Total	12%	2%	1%	80%	1%	0%	3%	0%	2%	100%

Table 7 2nd Priority to improve Conditions of Household

Site	Power Supply	Health facility and services	School facility and education	Water supply facility and service	Sanitation and sewerage system	Disposal of garbage	Access road	Don't know	Other	Total
Musaza	47%	7%	0%	10%	3%	0%	27%	0%	7%	100%
Rukira	57%	3%	3%	10%	0%	3%	13%	3%	7%	100%
Murama	50%	3%	7%	17%	10%	0%	10%	0%	3%	100%
Ruramira	63%	0%	0%	10%	13%	0%	13%	0%	0%	100%
Remera	67%	3%	0%	7%	0%	0%	23%	0%	0%	100%
Nyagihanga	27%	0%	0%	23%	3%	0%	27%	0%	20%	100%
Ngarama	37%	7%	3%	10%	0%	7%	27%	0%	10%	100%
Katabagemu	10%	7%	10%	3%	10%	7%	27%	0%	27%	100%
Total	45%	4%	3%	11%	5%	2%	21%	0%	9%	100%

Water Use Conditions

・Type of Water Resources

Table 8 Present Water Source for Domestic Use (in Dry Season)

Water Source	Musaza	Rukira	Murama	Ruramira	Remera	Nyagihanga	Ngarama	Katabagemu	Total
Borehole with hand pump	0%	0%	20%	3%	0%	0%	0%	0%	3%
Borehole piped into public tap	30%	13%	13%	40%	33%	0%	13%	23%	21%
Borehole piped into housing premises	0%	0%	0%	0%	0%	0%	0%	0%	0%
Protected spring (Point Source)	27%	17%	23%	23%	10%	20%	17%	3%	18%
Protected spring piped into public tap	3%	0%	13%	0%	3%	0%	0%	0%	3%
Protected spring piped into housing	0%	0%	0%	0%	0%	0%	0%	0%	0%
Unprotected spring (Point Source)	3%	0%	7%	27%	0%	17%	0%	17%	9%
Rainwater collection	0%	0%	3%	0%	0%	0%	0%	0%	0%
Protected dug well	0%	0%	13%	0%	3%	0%	3%	0%	3%
Unprotected dug well	27%	17%	7%	0%	10%	23%	30%	33%	18%
Pond, river or stream	10%	53%	0%	7%	40%	40%	33%	20%	25%
Water Vender (Handcart)	0%	0%	0%	0%	0%	0%	0%	3%	0%
Water Vender (Tanker)	0%	0%	0%	0%	0%	0%	3%	0%	0%
Other	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 9 Present Water Source for Domestic Use (in Rain Season)

Water Source	Musaza	Rukira	Murama	Ruramira	Remera	Nyagihanga	Ngarama	Katabagemu	Total
Borehole with hand pump	0%	0%	13%	3%	0%	0%	0%	0%	2%
Borehole piped into public tap	30%	13%	13%	50%	7%	10%	7%	23%	19%
Borehole piped into housing premises	0%	0%	0%	0%	0%	0%	0%	0%	0%
Protected spring (Point Source)	23%	17%	7%	17%	0%	13%	0%	0%	10%
Protected spring piped into public tap	3%	0%	10%	0%	3%	0%	0%	0%	2%
Protected spring piped into housing	0%	0%	3%	0%	0%	0%	0%	0%	0%
Unprotected spring (Point Source)	3%	0%	3%	13%	0%	13%	0%	7%	5%
Rainwater collection	3%	7%	30%	13%	57%	13%	43%	47%	27%
Protected dug well	0%	0%	20%	0%	3%	7%	3%	0%	4%
Unprotected dug well	27%	17%	3%	0%	7%	20%	17%	7%	12%
Pond, river or stream	10%	47%	0%	3%	20%	23%	30%	13%	18%
Water Vender (Handcart)	0%	0%	0%	0%	0%	0%	0%	3%	0%
Water Vender (Tanker)	0%	0%	0%	0%	3%	0%	0%	0%	0%
Other	0%	0%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	103%	100%	100%	100%	100%	100%	100%

Table 10 Perception on Water Quality of the Main Source

Site	Dry Season					Rain Season				
	Very Good	Good	Fair	Bad	Very Bad	Very Good	Good	Fair	Bad	Very Bad
Musaza	27%	27%	20%	7%	20%	17%	27%	30%	7%	20%
Rukira	3%	23%	10%	33%	30%	3%	30%	3%	30%	30%
Murama	10%	60%	7%	20%	3%	3%	17%	7%	37%	37%
Ruramira	23%	60%	13%	3%	0%	0%	30%	17%	27%	27%
Remera	3%	33%	7%	23%	33%	3%	13%	23%	33%	27%
Nyagihanga	7%	17%	17%	27%	33%	0%	7%	13%	23%	57%
Ngarama	0%	17%	23%	47%	13%	0%	3%	40%	43%	13%
Katabagemu	0%	23%	17%	43%	17%	3%	40%	13%	20%	23%
Total	9%	33%	14%	25%	19%	4%	21%	18%	28%	29%

Table 11 Approximate time to fetch water from house to watar source (Round trip)

Site	Dry Season					Rain Season				
	less than 15mins	15-30 mins	30-60 mins	60-120 mins	more than 120 mins	less than 15mins	15-30 mins	30-60 mins	60-120 mins	more than 120 mins
Musaza	23%	13%	23%	30%	10%	30%	17%	27%	17%	10%
Rukira	3%	3%	37%	47%	10%	7%	7%	40%	40%	7%
Murama	0%	13%	17%	30%	40%	0%	17%	20%	37%	27%
Ruramira	0%	13%	43%	43%	0%	3%	20%	43%	33%	0%
Remera	13%	20%	10%	50%	7%	30%	20%	10%	33%	7%
Nyagihanga	23%	23%	37%	7%	10%	27%	23%	37%	7%	7%
Ngarama	20%	30%	37%	10%	3%	20%	30%	33%	13%	3%
Katabagemu	3%	13%	37%	30%	17%	23%	10%	33%	20%	13%
Total	11%	16%	30%	31%	12%	18%	18%	30%	25%	9%

Table 12 Distance from house to watar source

Site	Dry Season					Rain Season				
	within 100m	100-500m	500m-1km	1-2km	more than 2km	within 100m	100-500m	500m-1km	1-2km	more than 2km
Musaza	13%	47%	13%	20%	7%	13%	47%	13%	20%	7%
Rukira	0%	17%	17%	40%	27%	3%	17%	17%	37%	27%
Murama	0%	0%	13%	27%	60%	3%	0%	13%	23%	60%
Ruramira	0%	7%	30%	53%	10%	0%	7%	30%	53%	10%
Remera	3%	13%	23%	40%	20%	23%	13%	20%	27%	17%
Nyagihanga	13%	37%	27%	17%	7%	17%	40%	20%	17%	7%
Ngarama	7%	33%	40%	17%	3%	7%	33%	37%	20%	3%
Katabagemu	10%	13%	17%	23%	37%	27%	13%	23%	17%	20%
Total	6%	21%	23%	30%	21%	12%	21%	22%	27%	19%

Table 14 Perception on the distance from house to water souce

Site	Dry Season					Rain Season				
	Very Convenient	Convenient	Fair	Inconvenient	Very inconvenient	Very Convenient	Convenient	Fair	Inconvenient	Very inconvenient
Musaza	40%	10%	13%	17%	20%	43%	17%	13%	17%	10%
Rukira	3%	20%	7%	63%	7%	3%	20%	7%	63%	7%
Murama	0%	0%	17%	17%	67%	0%	17%	30%	27%	27%
Ruramira	0%	3%	13%	60%	23%	3%	33%	20%	43%	0%
Remera	0%	10%	17%	67%	7%	13%	17%	17%	50%	3%
Nyagihanga	10%	23%	27%	13%	27%	10%	27%	30%	13%	20%
Ngarama	0%	17%	55%	21%	7%	0%	17%	52%	28%	3%
Katabagemu	7%	10%	17%	43%	23%	20%	17%	13%	23%	27%
Total	8%	12%	21%	38%	23%	12%	20%	23%	33%	12%

Table 15 Frequencty to fetch water from the source in a week

Site	Dry Season					Rain Season				
	0	1、2	3、4、5	6、7	more than 8	0	1、2	3、4、5	6、7	more than 8
Musaza	0%	3%	3%	93%	0%	7%	3%	13%	77%	0%
Rukira	0%	0%	13%	87%	0%	0%	3%	23%	73%	0%
Murama	0%	0%	3%	93%	3%	0%	20%	43%	37%	0%
Ruramira	0%	3%	3%	93%	0%	3%	17%	17%	63%	0%
Remera	0%	0%	7%	93%	0%	13%	27%	47%	13%	0%
Nyagihanga	0%	0%	0%	97%	3%	7%	7%	27%	60%	0%
Ngarama	0%	0%	3%	97%	0%	0%	23%	37%	40%	0%
Katabagemu	0%	3%	13%	83%	0%	17%	20%	33%	30%	0%
Total	0%	1%	6%	92%	1%	6%	15%	30%	49%	0%

Table 16 Perception on frequency to fetch water from the source

Site	Dry Season					Rain Season				
	Very Convenient	Convenient	Fair	Inconvenient	Very inconvenient	Very Convenient	Convenient	Fair	Inconvenient	Very inconvenient
Musaza	27%	13%	13%	27%	20%	50%	23%	3%	20%	3%
Rukira	3%	20%	10%	60%	7%	3%	23%	33%	37%	3%
Murama	0%	3%	10%	30%	57%	0%	37%	23%	33%	7%
Ruramira	0%	10%	20%	50%	20%	7%	47%	30%	17%	0%
Remera	0%	7%	23%	63%	7%	13%	27%	43%	13%	3%
Nyagihanga	13%	13%	17%	40%	17%	27%	23%	23%	20%	7%
Ngarama	3%	17%	47%	30%	3%	3%	37%	57%	3%	0%
Katabagemu	13%	13%	23%	40%	10%	23%	30%	17%	30%	0%
Total	8%	12%	20%	43%	18%	16%	31%	29%	22%	3%

Table 17 Willingness to pay for domestic water

Site	Dry Season		Rain Season	
	Yes	No	Yes	No
Musaza	17%	83%	17%	83%
Rukira	27%	73%	20%	80%
Murama	13%	87%	7%	93%
Ruramira	13%	87%	27%	73%
Remera	47%	53%	53%	47%
Nyagihanga	7%	93%	7%	93%
Ngarama	17%	83%	17%	83%
Katabagemu	30%	70%	30%	70%
Total	21%	79%	22%	78%

Table 18 Contribution cost for domestic water

Site	Dry Season		Rain Season	
	RWF/jerry can	RWF/month	RWF/jerry can	RWF/month
Musaza	18.77	1,612.33	16.70	889.00
Rukira	15.00	1,098.33	13.83	793.67
Murama	21.50	1,796.67	15.17	1,387.33
Ruramira	15.83	1,175.00	13.17	521.33
Remera	12.83	820.00	10.50	625.67
Nyagihanga	10.23	751.67	8.90	557.33
Ngarama	11.83	1,225.00	9.33	990.00
Katabagemu	21.67	775.33	11.50	634.67
Total	15.96	1,156.79	12.39	799.88

Table 19 Practice to treat water before drinking

Site	Yes	Yes, only in dry season	Yes, only in rain season	No
Musaza	83%	0%	0%	17%
Rukira	77%	0%	0%	23%
Murama	60%	0%	3%	37%
Ruramira	43%	0%	7%	50%
Remera	53%	3%	0%	43%
Nyagihanga	53%	0%	7%	40%
Ngarama	60%	0%	0%	40%
Katabagemu	62%	3%	0%	34%
Total	62%	1%	2%	36%

Table 20 Means for treatment of water before drinking

Site	Filtering	Settling	Boiling	Putting chlorine	Other
Musaza	0%	0%	60%	40%	0%
Rukira	0%	4%	52%	43%	0%
Murama	0%	0%	68%	32%	0%
Ruramira	0%	0%	80%	20%	0%
Remera	0%	6%	71%	24%	0%
Nyagihanga	0%	0%	83%	17%	0%
Ngarama	0%	11%	44%	44%	0%
Katabagemu	5%	0%	45%	45%	5%
Total	1%	3%	63%	33%	1%

Table 21 Responsible person for fetching water

Site	Adult men	Adult women	Boy Children	Girl children	Vendors	Other
Musaza	17%	7%	33%	37%	7%	0%
Rukira	27%	30%	20%	17%	3%	3%
Murama	20%	3%	10%	63%	3%	0%
Ruramira	13%	13%	27%	43%	0%	3%
Remera	23%	23%	20%	23%	10%	0%
Nyagihanga	20%	20%	20%	37%	0%	3%
Ngarama	10%	30%	23%	13%	23%	0%
Katabagemu	30%	13%	7%	40%	10%	0%
Total	20%	18%	20%	34%	7%	1%

Valuation for the Improved Water Supply

Table 22 Perception on present water supply conditions

Site	Satisfied	Fair	Unsatisfied
Musaza	40%	20%	40%
Rukira	23%	20%	57%
Murama	7%	10%	83%
Ruramira	20%	23%	57%
Remera	10%	20%	70%
Nyagihanga	33%	30%	37%
Ngarama	13%	40%	47%
Katabagemu	13%	23%	63%
Total	20%	23%	57%

Table 23 Resons on unsatisfaction for present water supply conditions

Site	Quality	Quantity	Reliabiilty throughout year	Distance	Queuing time	Other
Musaza	21%	7%	7%	43%	21%	0%
Rukira	21%	4%	0%	58%	17%	0%
Murama	10%	17%	5%	55%	7%	7%
Ruramira	0%	23%	3%	58%	16%	0%
Remera	0%	23%	8%	38%	31%	0%
Nyagihanga	11%	37%	5%	26%	0%	21%
Ngarama	4%	24%	12%	32%	24%	4%
Katabagemu	3%	40%	7%	23%	17%	10%
Total	9%	22%	6%	42%	17%	5%

Table 24 Willingness to contribute for improvement of water supply facility

Site	Yes, even if the rate is expensive	Yes, if the rate is reasonable	No, if the rate is expensive	No, even if the rate is reasonable	Satisfied with the current situations
Musaza	13%	60%	7%	7%	13%
Rukira	3%	70%	10%	3%	13%
Murama	53%	37%	3%	7%	0%
Ruramira	37%	27%	20%	7%	10%
Remera	40%	37%	3%	17%	3%
Nyagihanga	13%	63%	10%	10%	3%
Ngarama	17%	63%	10%	7%	3%
Katabagemu	13%	80%	7%	0%	0%
Total	24%	55%	9%	7%	6%

Table 25 Prefer type of improved water supply facilities

Site	Borehole with hand pump	Borehole piped into public tap	Borehole piped into housing premises	Protected spring (Point Source)	Protected spring piped into public tap	Protected spring piped into housing premises	Protected dug well	Other
Musaza	0%	88%	0%	4%	4%	4%	0%	0%
Rukira	4%	92%	0%	4%	0%	0%	0%	0%
Murama	3%	70%	13%	0%	0%	13%	0%	0%
Ruramira	0%	61%	18%	11%	4%	7%	0%	0%
Remera	0%	69%	24%	7%	0%	0%	0%	0%
Nyagihanga	3%	86%	3%	7%	0%	0%	0%	0%
Ngarama	7%	80%	7%	7%	0%	0%	0%	0%
Katabagemu	0%	80%	7%	0%	7%	7%	0%	0%
Total	2%	78%	9%	5%	2%	4%	0%	0%

Table 26 Willingness to pay for improved water supply facilities

Site	Yes	No	Don't know
Musaza	87%	10%	3%
Rukira	83%	17%	0%
Murama	90%	7%	3%
Ruramira	70%	20%	10%
Remera	97%	3%	0%
Nyagihanga	97%	3%	0%
Ngarama	97%	0%	3%
Katabagemu	100%	0%	0%
Total	90%	8%	2%

Table 27 Willingness to stop using existing source after improving water supply faclities

Site	Stop	Still use	Both use	Don't know
Musaza	93%	0%	3%	3%
Rukira	100%	0%	0%	0%
Murama	100%	0%	0%	0%
Ruramira	93%	7%	0%	0%
Remera	100%	0%	0%	0%
Nyagihanga	83%	10%	7%	0%
Ngarama	93%	3%	3%	0%
Katabagemu	100%	0%	0%	0%
Total	95%	3%	2%	0%

Table 28 Expectation for water conditions after improving the supply facilities

Site	Quality is good	Quantity is enough	Rate is affordable	Maintenance is kept properly	Distance is shortened	Queing time is shortened	Other
Musaza	21%	21%	14%	12%	14%	18%	0%
Rukira	35%	26%	11%	5%	9%	9%	5%
Murama	17%	26%	20%	11%	15%	8%	3%
Ruramira	15%	22%	12%	13%	18%	18%	2%
Remera	28%	36%	24%	3%	5%	3%	0%
Nyagihanga	21%	41%	13%	5%	16%	4%	0%
Ngarama	37%	44%	12%	12%	0%	0%	0%
Katabagemu	17%	35%	22%	7%	11%	7%	0%
Total	24%	31%	16%	9%	11%	8%	1%

Table 29 Wiilingness for contribution of improving water supply facilities

Site	Difficult	Cash	Labor	Cash and Labor
Musaza	3%	37%	40%	20%
Rukira	3%	30%	50%	17%
Murama	0%	63%	27%	10%
Ruramira	0%	43%	40%	17%
Remera	7%	23%	57%	13%
Nyagihanga	0%	13%	87%	0%
Ngarama	7%	33%	43%	17%
Katabagemu	10%	17%	50%	23%
Total	4%	33%	49%	15%

4) Questionnaire for Sample household survey

Questionnaire which was used for Sample household survey in this Socio-Economic Survey shall be described as follows:

HOUSEHOLD QUESTIONNAIRE

Section-A: Questionnaire Information Panel			
A1	Serial No.	A2	Day/Month/Year of Interview
A3	Name of Interviewer	A4	Name of Respondent
A5	Name of Site ☐01：Musaza ☐02：Rukira ☐03：Murama ☐04：Ruramira ☐05：Remera ☐06：Nyagihanga ☐07：Ngarama ☐08：Katabagemu 【Please Tick】	A6	Name of District ☐01：Kihere ☐02：Ngoma ☐03：Kayonza ☐04：Gatsibo ☐05：Nyagatare 【Please Tick】

Section-B: Interviewee Information Panel			
B1	Sex of Respondent	Male…….. 01 Female…….. 02	
B2	Age of Respondent		Yrs Old
B3	Relationship of Respondent to the Household Head	Household Head…….. 01 Spouse…….. 02 Father or Mother…….. 03 Son or Daughter…….. 04 Brother or Sister…….. 05 Other Relative…….. 06 Others (Specify) _____ 07	

Section-C: Household Information			
C1	Sex of Household Head	Male…….. 01 Female…….. 02	
C2	Age of Household Head		Yrs Old
C3	Marital Status of Household Head	Married (Monogamous)…….. 01 Married (Polygamous)…….. 02 Single/Never Married…….. 03 Widow / Divorced…….. 04 Separated…….. 05	
C4	How many persons usually live in your household?	Adult Men (age 18 and above)…….. [ ] Adult Women (age 18 and above)…….. [ ] Own Children (age 5 - 18)…….. [ ] Other Children (age 5 – 18)…….. [ ] Own Infant (under 5)…….. [ ] Other Infant (under 5)…….. [ ]	
C5	Duration of Living in This Area		Years
C6	Housing Type (Roofing Material) 【Interviewer's Observation】	Asbestos / Iron Sheet…….. 01 Straw Thatched …….. 02 Others (Specify) _____ 03	
C7	Housing Type (Wall Material) 【Interviewer's Observation】	Concrete Block…….. 01 Mud Bricks…….. 02 Dry Mud…….. 03 Others (Specify) _____ 04	
C8	Housing Ownership	Self-Owned House…….. 01 Rented House…….. 02 Others (Specify) _____ 03	

C9	Would you tell me which ones of these problems you are most concerned about <u>as the first and second priority</u> for improvement of living conditions of your village/community?	Improved electricity……..……	01	C9_f) 1st Priority
		Improve health clinics and services ….....	02	
		Improve schools and education …….....	03	
		Improve water supply facility and services..	04	
		Improve sanitation/sewerage system …….	05	
		Improve disposal of garbage (solid waste)..	06	C9_s) 2nd Priority
		Improve access road ……..……....	07	
		Don't Know/ Not Sure ……..……....	08	
		Other (specify) _____	09	

Section-D Water Supply and Use

D1	What is the main source of water for domestic use in Dry Season and Rain Season, respectively?	Borehole with hand pump……..……...	01	D1_d) Dry Season
		Borehole piped into public tap……	02	
		Borehole piped into housing premises.……	03	
		Protected spring (Point Source)……	04	
		Protected spring piped into public tap……	05	
		Protected spring piped into housing premises……....	06	
		Unprotected spring (Point Source)……....	07	
		Rainwater collection…..…….....	08	D1_r) Rain Season
		Protected dug well……	09	
		Unprotected dug well……....	10	
		Pond, river or stream……	11	
		Water vender (Handcart)……....	12	
		Water vender (Tanker)..……	13	
		Other (specify) _____	14	
D2	How much water, from the main source above, does your family use per day in average in Dry Season and Rain Season, respectively?	D2-d) Dry Season ☐litre/day ☐Jerrycan/day 【tick the unit】		
		D2_r) Rain Season ☐litre/day ☐Jerrycan/day 【tick the unit】		
D3	What is your perception on quantity of water obtaining from the main source in Dry Season and Rain Season, respectively?	Very Good (Very Sufficient)……..……..	01	D3_d) Dry Season
		Good (Sufficient)……..……	02	
		Fair……..	03	
		Bad (Insufficient)……....	04	01,02,03 ⇒ D5
		Very Bad (Very Insufficient)……..……	05	D3_r) Rain Season
				01,02,03 ⇒ D5
D4	How much EXTRA water does your household require in a day in Dry Season and Rain Season, respectively?	D4_d) Dry Season ☐litre/day ☐Jerrycan/day 【tick the unit】		
		D4_r) Rain Season ☐litre/day ☐Jerrycan/day 【tick the unit】		
D5	What is your perception on water quality of the main source selected above in Dry Season and in Rain Season, respectively?	Very Good……..……..	01	D5_d) Dry Season
		Good……..……	02	
		Fair……..……	03	
		Bad……..	04	01,02,03 ⇒ D7
		Very Bad……	05	D5_r) Rain Season
				01,02,03 ⇒ D7
D6	Why do you perceive the water quality of the main source is bad in Rain Season and Dry Season, respectively? 【Multiple Answer】	Because it is salty……..……..	01	D6_d) Dry Season
		Because it is muddy……..……	02	
		Because it is rusty……..	03	
		Because it is not good for health……	04	D6_r) Rain Season
		Others (Specify) _____	05	
		Not Applicable……..	888	

D7	How long does it take to go there, get water, and come back in Dry Season and Rain Season, respectively?	Number of minutes…… →		D7_d) Dry Season min
		Water on premises……	888	D7_r) Rain Season min
D8	How long is the main water source from your house in Dry Season and Rain Season, respectively?	Distance…… →		D8_d) Dry Season meter
		Water on premises……	888	D8_r) Rain Season meter
D9	How long are you waiting for your turn to collect water in the source in Dry Season and Rain Season, respectively?	Number of minutes…… →		D9_d) Dry Season min
				D9_r) Rain Season min
D10	What is your perception on the distance to main water source in Dry Season and Rain Season, respectively?	Very Good (Very Convenient)……	01	D10_d) Dry Season
		Good (Convenient)……	02	
		Fair……	03	
		Bad (Inconvenient)……	04	D10_r) Rain Season
		Very Bad (Very Inconvenient)……	05	
D11	How often does your family fetch water from the main source in a day in Dry Season and Rain Season, respectively?	Number of times…… →		D11_d) Dry Season times/day
		Water on premises……	888	D11_r) Rain Season times/day
D12	What is your perception on the frequency of fetching water in Dry Season and Rain Season, respectively?	Very Good (Very Convenient)……	01	D12_d) Dry Season
		Good (Convenient)……	02	
		Fair……	03	
		Bad (Inconvenient)……	04	D12_r) Rain Season
		Very Bad (Very Inconvenient)……	05	
D13	Do you pay any money for obtaining water for domestic use in Dry Season and Rain Season, respectively?	Yes……	01	D13_d) Dry Season 02 ⇒ D18
		No……	02	D13_r) Rain Season 02→ D18
D14	What is the source for which you pay to obtain water in Dry Season and Rain Season, respectively?	Borehole with hand pump……	01	D14_d) Dry Season
		Borehole piped into public tap……	02	
		Borehole piped into housing premises….	03	
		Protected spring (Point Source)……	04	
		Protected spring piped into public tap……	05	
		Protected spring piped into housing premises……	06	
		Unprotected spring (Point Source)……	07	
		Rainwater collection……	08	D14_r) Rain Season
		Protected dug well……	09	
		Unprotected dug well……	10	
		Pond, river or stream……	11	
		Water vender (Handcart)……	12	
		Water vender (Tanker)……	13	
		Other (specify) _____	14	
		Not Applicable……	888	
D15	How much water, from the source paid, does your family use per day in average in Dry Season and Rain Season, respectively?	D15_d) Dry Season ☐litre/day ☐Jerrycan/day【tick the unit】		
		D15_r) Rain Season ☐litre/day ☐Jerrycan/day【tick the unit】		

D16	How much money do you spend for obtaining water from the source in Dry Season and Rain Season, respectively?	D16_d) Dry Season ☐ Rfr/jerrycan ☐ Rfr/month ☐ Rfr/day 【tick the unit】		
		D16_r) Rain Season ☐ Rfr/jerrycan ☐ Rfr/month ☐ Rfr/day 【tick the unit】		
D17	What is your perception on the amount paid for water in Dry Season and Rain Season, respectively?	Very Expensive……..	01	D17_d) Dry Season
		Expensive……..	02	
		Fair……..	03	
		Cheap……..	04	D17_r) Rain Season
		Very Cheap……	05	
		Not Applicable……	888	
D18	How much money do you think reasonable and affordable rate for drinking water in Dry Season and Rain Season, respectively?	D18_d) Dry Season ☐ Rfr/jerrycan ☐ Rfr/month ☐ Rfr/day 【tick the unit】		
		D18_r) Rain Season ☐ Rfr/jerrycan ☐ Rfr/month ☐ Rfr/day 【tick the unit】		
D19	What kind of container does your household use to fetch and carry water?	Jerrycan, plastic container with lid……..	01	
		Jerrycan, plastic container without lid……	02	
		Bucket, wash basin with lid……..	03	
		Bucket, wash basin without lid……	04	
		Others (Specify) _____	05	
D20	Does your household wash the container before fetching water?	Yes……	01	
		Frequently……	02	
		Sometime/When the container is stained	03	
		No……	04	
D21	Where does your household keep water fetched and carried?	In house……..	01	
		Outside of house……	02	
		Others (Specify) _____	03	
D22	How does your household keep water in your premises?	Jarrycan, plastic container with lid……..	01	
		Jerrycan, plastic container without lid…….	02	
		Bucket, wash basin, drum, pot with lid……	03	
		Bucket, wash basin, drum, pot without lid..	04	
		Others (Specify) _____	05	
D23	Is water treated before drinking in your household?	Yes……	01	
		Only in dry season……	02	
		Only in rain season……	03	
		No……..	04	04 ⇒ D25
D24	How does your family treat water?	Filtering……	01	
		Settling……	02	
		Boiling……..	03	
		Putting chlorine……..	04	
		Others (Specify) _____	05	
D25	Who usually fetch water in your household?	Adult men……	01	
		Adult women……	02	
		Boy children……	03	
		Girl children……	04	
		Vendors……	05	
		Others (Specify) _____	06	

D26	What is the main source of water for your livestock in Dry Season and Rain Season, respectively?	Borehole with hand pump…….....…….	01	D26_d) Dry Season
		Borehole piped into public tap……....	02	
		Borehole piped into housing premises….	03	
		Protected spring (Point Source)…….….	04	
		Protected spring piped into public tap…….	05	
		Protected spring piped into housing premises……...	06	888 ⇒ Section-E
		Unprotected spring (Point Source)……...	07	
		Rainwater collection…..……..	08	D26_r) Rain Season
		Protected dug well……..……..	09	
		Unprotected dug well…….....	10	
		Pond, river or stream……..……..	11	
		Other (specify) _____	12	
		Having no livestock…..……..	888	888 ⇒ Section-E
D27	Does your household pay for drinking water for your livestock in Dry Season and Rain Season, respectively?	Yes……..	01	D27_d) Dry Season
		No……..	02	02 ⇒ Section-E
				D27_r) Rain Season
				02 ⇒ Section-E
D28	How much money do you pay for drinking water for your livestock per cattle per day in Dry Season and Rain Season, respectively?	D27_d) Dry Season		Rfr[ ]/Cattle/Day
		D27_r) Rain Season		Rfr[ ]/Cattle/Day

Section-E: Users' Awareness and Valuation on the Improved Water Supply

E1	Do you satisfy current water supply situation?	Yes……..	01	
		Fair……..	02	
		No……..	03	01,02 ⇒ E3
E2	What are the reasons for dissatisfaction? 【Multiple Answer】	Quality……..	01	
		Quantity……..	02	
		Reliability throughout year……..	03	
		Distance……..	04	
		Queuing time……...	05	
		Others (specify) _____	06	
E3	Do you need the improved water supply facility, even if your family have to pay for fee? 【Chose from the item listed】	Yes, even if the rate is expensive…….....	01	
		Yes, if the rate is reasonable……..	02	
		No, if the rate is expensive……..	03	
		No, even if the rate is reasonable……..	04	
		I am satisfying the current water provision	05	05 ⇒ E5
E4	What type of improved water supply facilities do you prefer to?	Borehole with hand pump…….....……...	01	
		Borehole piped into public tap……....	02	
		Borehole piped into housing premises…	03	
		Protected spring (Point Source)……..	04	
		Protected spring piped into public tap……	05	
		Protected spring piped into housing premises……..	06	
		Protected dug well……...	07	
		Others (specify) _____	09	

E5	Who do you think operate and maintain the improved water supply facility?	Users……..…….. 01 VWMC/Village WUA……..... 02 Village Authority (Village Government) 03 Local Authority*……..….. 04 Government…… 05 Private Company…….. 06 Private Entity/Organization…… 07 I don't know…….. 08 Others (Specify) _____ * Division, District, Province authority, etc.	
E6	Is your household supposed to pay for obtaining water from the improved water supply facilities?	Yes……..... 01 No…… 02 I don't know…… 03	
E7	Whose money do you think shall cover the cost for operation and maintenance of the improved water supply facilities?	Users……..…….. 01 VWMC/Village WUA……..…… 02 Village Authority (Village Government)…. 03 Local Authority…… 04 Government…….. 05 Both Users and Authority/Government… 06 I don't know…….. 07 Others (Specify) _____ 08	
E8	How much do you think reasonable and affordable rate for water per jerrycan from the following improved water facilities?	Borehole with hand pump…….....……..	E8_a) [ ] Rfr/jerrycan
		Borehole piped into public tap……	E8_b) [ ] Rfr/jerrycan
		Protected spring piped into public tap……	E8_c) [ ] Rfr/jerrycan
E9	Is your household supposed to pay for drinking water for your livestock from improved water supply facility?	Yes……..…… 01 No…… 02 Having no livestock…….. 888	
E10	How much do you think reasonable and affordable rate for drinking water for livestock/cattle/day from the improved water supply facilities?		Rfr/Cattle/Day
E11	Do you think your household is going to stop using the existing water source when the improved water supply facilities are constructed and available in future?	Yes…….. 01 No…… 02 Use both existing water source and improved facilities…… 03 I don't know…… 04	
E12	What is your most important expectation, from the item listed, on the improved water supply facility? 【chose Two (2) item from the list】	That the water quality is good……..…… 01 That the quantity is enough and stable…….. 02 That the rate is affordable/ reasonable/ cheap…… 03 That the facilities are kept maintained and sustained in a proper manner…….. 04 That the facilities are located near to the house……. 05 That the queuing time is less……..…… 06 Others (Specify below)_____ 07	
E13	If the improved water supply system is constructed by the Project, in which form is your household able to contribute to construct kiosk, sokaway, and cattle trough?	Difficult to contribute……... 01 Cash only…..…… 02 Labour only……... 03 Both labour and cash……... 04	
E14	In case your household have to contribute labour force to construct kiosk, sokaway, and others, which month in a year you have difficulties to do so?	☐Jan ☐Feb ☐Mar ☐Apr ☐Mar ☐Jun ☐Jul ☐Aug ☐Sep ☐Oct ☐Nov ☐Dec 【Tick the month】	

Section-F Conditions and Awareness in Health and Sanitation				
F1	What kind of toilet does your family use?	Flush toilet with septic tank……..……	01	
		Pour flush latrine……..……	02	
		Traditional pit latrine……	03	
		Improved (ventilated) pit latrine……	04	
		Open pit……..……..	05	
		None / bush……..……	06	
		Others (specify) _____	07	06 ⇒ F3
F2	Is this facility located within your dwelling, or yard or compound?	Yes, in dwelling/yard/compound……	01	
		No, outside dwelling/yard/compound…...	02	
F3	What happens with the stools of young children (0-3 years) when they do not use the latrine or toilet facility?	Children always use toilet or latrine……	01	
		Thrown into toilet or latrine……	02	
		Thrown outside the yard……	03	
		Not disposed of or left on the ground……	04	
		Others (specify) _____	05	
		No young children in household……	888	
F4	Where does your household dispose the rubbish?	Pit in yard……..……..	01	
		Burned……..……	02	
		Bush……..……..	03	
		River, pond, stream……...……..	04	
		Others (specify) _____	05	
F5	How many times do you and your household practice hand washing in a day?			Times/Day
F6	When do you and your household members normally practice hand washing? 【Multiple Answer】	Before cooking……..……..	01	
		After cooking……	02	
		Before eating……..……..	03	
		After eating……	04	
		After going to toilet……..……..	05	
		After working outside……..…….	06	
		Not practicing hand washing……	07	
		Others (Specify) _____	08	07⇒F8
F7	How do you and your household members normally practice hand washing?	In a basin shared without soap……..……	01	
		In a basin not shared without soap……	02	
		In a basin shared with soap……	03	
		In a basin not shared with soap……	04	
		Pour water from cap/jar/ without soap….	05	
		Pour water from cap/jar with soap……..	06	
		Others (Specify) _____	07	
F8	What are the major diseases affecting your household? 【Multiple Answer】	Diarrhoea……	01	
		Eye disease……..	02	
		Skin disease……..	03	
		Malaria……	04	
		Respiratory diseases……	05	
		Others (Specify) _____	06	
F9	During the past three (3) months, did your household members have diarrhoea?	Yes……..	01	
		No……	02	02 ⇒ F12
F10	Who had diarrhoea in your household? 【Multiple Answer】	Adult men……..	01	
		Adult women……..	02	
		Children (5-14)……..	03	
		Children (Under 5)…….…...	04	
F11	How did your family treat diarrhoea? 【Multiple Answer】	Give medicine……	01	
		Give ORS……..	02	
		Give traditional herb……	03	
		Take to clinic/hospital……	04	
		Take to traditional healer……	05	
		Others (specify) _____	06	

F12	What kind of practice do you think causes diarrhoea? 【Multiple Answer】	Not washing hand……..….. Drinking/Using contaminated water…….. Handling food in inappropriate manner…. Not having hygiene toilet…….. Flies…… Witchcraft…… I don't know…… Others (specify) _____	01 02 03 04 05 06 07 08	
F13	Do you know any disease caused by drinking and using contaminated (unsafe) water source? 【Multiple Answer】	Diarrhoea…… Dysentery…… Typhoid…… Cholera…… Bilharzias…… Scabies…… Don't know…….. Others (specify) _____	01 02 03 04 05 06 07 08	
F14	Have you or/and your household members ever received any health and hygiene education by any organization?	Yes……..…… No……..……..	01 02	02 ⇒ F20
F15	Who provided health and sanitation education? 【Multiple Answer】	Clinic/Hospital……..…… From governmental health worker…….. From NGO staff……..….. From radio/TV……..…… At school…… Church…… Village/Community organization…….. Others (specify) _____	01 02 03 04 05 06 07	
F16	What was main message brought by the health and sanitation education? 【Multiple Answer】	Safe Water Use……..……... Hand washing practice…… Food safety……... Disposal of excreta: latrines……..….. Disposal of waste: garbage……..…… HIV/AIDS……..….. Reproductive Health……..…… Nutrition……..…… Vector Control……..….. Others (specify) _____	01 02 03 04 05 06 07 08 09 10	
F17	Was the information received through health and sanitation education useful for your household?	Yes…… Yes, if anything……..……..…… No, if anything……..……..…… No……..……..……	01 02 03 04	01,02 ⇒ F19
F18	Why was the health and sanitation education not useful? 【Multiple Answer】	Since we knew the information already….. Since the recommended practice is not affordable……... Since we are not the target group……..… Others (specify) _____	01 02 03 04	
F19	Receiving the education, have you and your household members changed some hygiene and sanitation practice?	Yes……..…… Yes, if anything……..……..…… No, if anything……..……..…… No……..……	01 02 03 04	
F20	How much money have your household spend for medical expenditure (including medicine, doctor fee, transport) for the past three (3) months			Rfr/past 3 months

Section-G Economic Status			
G1	What are the main income sources of your household, which bring cash income? 【Multiple Answers】	Farming…… 01 Livestock Farming…… 02 Own business…… 03 Salary from employer…… 04 Pension…… 05 Remittance from family working outside…… 06 Others (Specify) _____ 07	
G2	How much is your family expenditure per month in average?		Rfr/Month
G3	How much does your family spend for household fuel per month in average?		Rfr/Month Rfr.0 ⇒ G5
G4	What is your perception on the amount paid for household fuel?	Very Expensive…… 01 Expensive…… 02 Fair…… 03 Cheap…… 04 Very Cheap…… 05	
G5	How much is your family income per month in average?		Rfr/Month
G6	Which month in a year does your family have the most cash income? 【Multiple Answer】	☐Jan ☐Feb ☐Mar ☐Apr ☐Mar ☐Jun ☐Jul ☐Aug ☐Sep ☐Oct ☐Nov ☐Dec 【Tick the month】	
G7	How many livestock does your family own?	Cattle…… [ ] Donkey…… [ ] Goat…… [ ] Sheep…… [ ]	
G8	Does your household keep any savings or cash for the emergency?	Yes…… 01 No…… 02	