No. 1

Federal Ministry of Water Resources
The Federal Republic of Nigeria

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR THE SUPPLY OF EQUIPMENTS FOR GROUNDWATER EXPLOITATION TOWARDS POTABLE WATER SUPPLY AND HEALTH DELIVERY

IN

YOBE STATE

IN

THE FEDERAL REPUBLIC OF NIGERIA

JULY 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

YACHIYO ENGINEERING CO., LTD.

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PREFACE

In response to a request from the Government of the Federal Republic of Nigeria, the Government of Japan decided to conduct a basic design study on the Project for the Supply of Equipments for Groundwater Exploitation towards Potable Water Supply and Health Delivery in Yobe State in the Federal Republic of Nigeria and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Nigeria a study team from December 3 to December 30, 2006.

The team held discussions with the officials concerned of the Government of Nigeria, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Nigeria in order to discuss a draft basic design, and as this result, 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.

I wish to express my sincere appreciation to the officials concerned of the Government of the Federal Republic of Nigeria for their close cooperation extended to the teams.

July 2007

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

July 2007

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for the Supply of Equipments for Groundwater Exploitation towards Potable Water Supply and Health Delivery in Yobe State in the Federal Republic of Nigeria.

This study was conducted by Yachiyo Engineering Co., Ltd., under a contract to JICA, during the period from November, 2006 to July, 2007. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Nigeria and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Kenji Yoshida
Project manager,
Basic design study team on
the Project for the Supply of Equipments for
Groundwater Exploitation towards Potable
Water Supply and Health Delivery
Yachiyo Engineering Co., Ltd.

SUMMARY

SUMMARY

① Overview of the Country

The Federal Republic of Nigeria (hereinafter referred to as "Nigeria") borders the Gulf of Guinea in central West Africa and is a leading oil producing nation with a population of approximately 140 million people (2006 National Population Commission in Nigeria). The country is comprised of more than 250 ethnic groups and more than 500 confirmed spoken languages, giving it a very multi-racial quality. Nigeria is two and a half times (2.5) larger than Japan and its territory is divided into two characteristic regions by the Niger and Benue Rivers — a semi-arid zone to the north and a wet (damp) zone to the south. Accordingly, lifestyles, etc. have a major impact on the cultural fabric of the nation, which can be roughly classified into north and south.

② Background, History and Outline of the Requested Japanese Assistance

Since its independence in 1960, Nigeria has experienced civil war as well as a series of military coup d'etats. The oil resources discovered in southern Nigeria in the 1960's brought about a brief period of economic development but the excessive dependence of the national economy on oil and lax economic management have resulted in a chronic fiscal deficit and the accumulation of huge debts.The Obasanjo administration, a civilian administration established in May, 1999 with the transition of power from the military, introduced its "Economic Policy for 1999 to 2003" and "National Economic Empowerment and Development Strategy" (hereinafter referred to as "NEEDS") (2004) with the aim of reforming a failing economy. NEEDS supports the six major sectors of (1) agriculture and rural development, (2) roads, (3) education, (4) health, (5) water supply, and (6) electricity. Water supply including rural water supply is one of important sectors.

As for national policy regarding water supply and sanitation in rural communities, the National Water Supply and Sanitation Policy was compiled in 1999 and the Regional Water Supply and Sanitation Program (strategic plan) was established in 2004. These policies aim to raise the water supply rate to 60% by 2003, 80% by 2007 and to supply safe water to all citizens to 2011. Within this goal, it is intended to secure 30 liters of water supply per person per day, to keep water carrying distances to no more than 250 m and to provide water supply points for every 250~500 people in all rural communities with population of no more than 5,000.

Yobe State, which is the Project area, is located in the northeast of the country on the border with Niger and is one of the poorest states in the country. In the northern part of Nigeria, the ratio of safe water utilization is lower than the national average and the water supply rate in rural communities in Yobe State is just 47%. Not only are residents subjected to chronic outbreaks of water-borne diseases such as diarrhea and cholera due to the use of insanitary water, but also this area is at risk of droughts

and desertification. Accordingly, the supply of safe water is an urgent issue in Yobe State. It was under such circumstances that the Government of Nigeria requested the Project with the primary objective of procuring equipment and materials for the construction of deep wells.

However, because only limited information was available from RUWASA and the implementation capacity on the local side was unknown, JICA conducted a preliminary study from June to September 2006 in order to examine aspects such as appropriateness of the Project as an equipment supply undertaking (as opposed to necessity to implement the project as a facilities undertaking). As a result of the preliminary study, the following points were confirmed regarding RUWASA.

- RUWASA is hoping for the procurement of borehole drilling equipment and materials, and it intends to construct facilities following said procurement under its own resources.
- RUWASA has plans to utilize the procured borehole drilling equipment and materials in order to construct 100 hand pump boreholes.
- RUWASA currently owns two fairly deteriorated drilling machines (one made in Russia in 1993 and one made in Sweden in1978), which it keeps in working order in spite of difficulties obtaining spare parts and preventing breakdowns.
- RUWASA has sufficient engineers of a certain level to secure three drilling teams, and it has drilled 38 boreholes over the past five years in spite of the obsolescence of its drilling machines.

In consideration of the above points, it was confirmed as appropriate to implement the Project as an equipment supply undertaking.

③ Outline of the Study Results and Contents of the Project

In response to this request, the Government of Japan decided to carry out a Basic Design Study and the Japan International Cooperation Agency (JICA) dispatched a Basic Design Study Team to Nigeria from December 3 to December 30, 2006 in order to confirm the components being requested and to carry out a site survey, etc. After returning to Japan, a draft final report was compiled based on the necessity and the social and economic effects, and the relevance of the Project was examined based on materials collected during the field survey and an analysis conducted in Japan. The Basic Design Study Team was again dispatched to the said country from May 17 to 26, 2007 in order to explain the draft final report. The Basic Design Study Report was then prepared based on the draft final report.

The requested Japanese assistance formulated from the results of the study includes the procurement of equipment and materials for construction of borehole water supply facilities and technical support via the soft component. As for the construction of water supply facilities including the selection of sites, both governments have agreed that the Nigerian side will take responsibility.

After the Basic Design Study Team returned to Japan, the basic design compiled its finding from a field survey and discussions with the Nigerian side as outlined in the following table.

Outline of the Basic Plan

No.	Description	Quantity	
1.	Drilling Equipment		
(1)	Drilling rig	1	Unit
(2)	High pressure air compressor	1	Unit
(3)	Cargo truck with crane	1	Unit
2.	Survey Equipment		
(1)	Geophysical survey equipment	1	Unit
(2)	Water analysis equipment	1	Unit
(3)	Pumping test equipment	1	Unit
3.	Borehole Construction Materials		
(1)	Hand pump	89	Sets
(2)	Village level mechanic tool	89	Sets
(3)	LGA level mechanic tool	17	Sets
(4)	Casing and screen pipe for 89 boreholes	1	lot

The "Soft Component" of the project consists of the following two components:

- Technical Training for Construction Management
- Strengthening of O&M System for Supply Facility

④ Project Schedule

The responsible agency in the recipient country is the Federal Ministry of Water Resources and the implementing agency is the RUWASA.

The project, when implemented as a grant aid, will require about 33 months in total, with 24 months as facility construction period by the Nigerian side, 9 months as procurement period of equipment and materials and 3 months for "Soft Component".

As for the construction of water supply facilities including the selection of sites by the geophysical survey, the Nigerian side will take responsibility. In order to effectively utilize and operate the procured drilling equipment by the Nigerian side so as to improve the water supply rate and ensure safe water supply to residents in rural areas, it is necessary for Yobe State to secure the water supply utility budget and to sustain the organization and technical capability of RUWASA, which is in charge of the regional water supply service.

⑤ Verification of the Relevance of Japan's Grant Aid Scheme

Upon the completion of this project, 89 boreholes will be constructed and 32,000 people will receive safe water. Furthermore, RUWASA will have a new up-to-date drilling rig with good work efficiency and this rig will be continuously utilized for borehole constructions after this project. It is expected that the facilities constructed for over three years (2009 to 2012) benefit a population of approximately 54,000. The ability of RUWASA personal on construction management and operation and maintenance of water supply facilities will increase by guidance of construction management and strengthening of operation and maintenance system of water supply facilities through the "Soft Component" of the project. In addition, the system for water supply and sanitation services will be strengthened and technical knowledge and skills for these services will be improved.

As an indirect effect, the number of patients with water borne diseases in the project sites will decrease. Furthermore, owning to reduced distance of carrying water, workload of woman and children for obtaining water will be reduced.

The effects mentioned above can be expected under the Project and therefore implementation of Japan's Grant Aid is judged to be appropriate.

In order to execute the maintenance of equipment procured under the Project and manage the sustainable rural water supply project, it is indispensable to consider the following aspects.

- Securing budget for rural water supply and enforcement of organization structure of RUWASA
- Improvement of operation & maintenance and monitoring systems of water supply facilities
- Establishment of collection system of water charge by community
- Collaboration with UNICEF and EU projects
- Collaboration with technical assistance (local domestic training)

In addition to the above, in order to execute the project smoothly and effectively, the following matters must be improved and enhanced.

- Community participation to rural water supply and sanitation project
- Public education by RUWASA and officials concerned

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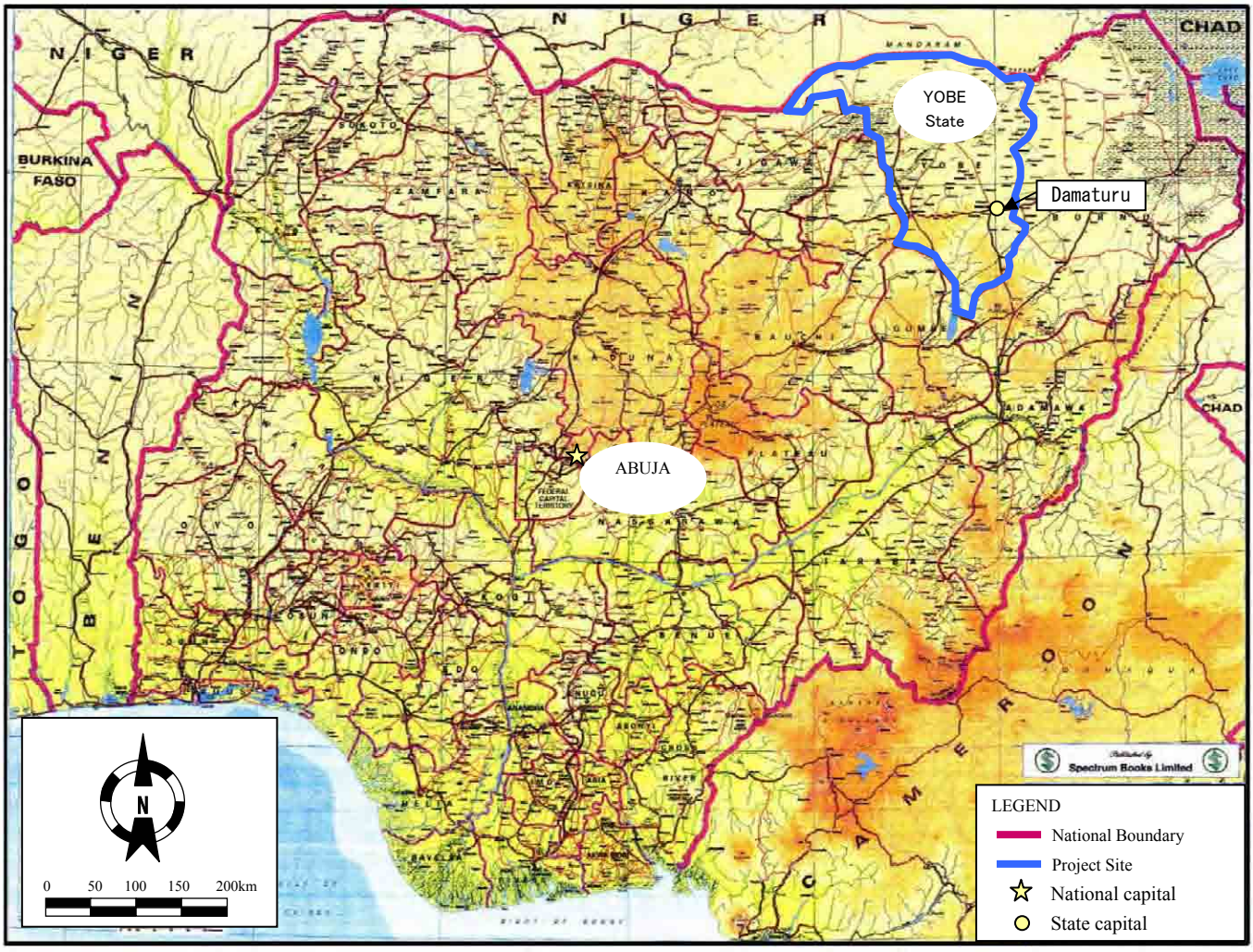

Location Map of Study Area

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ABBREVIATIONS

A/P	Authorization to Pay
ASTM	American Society for Testing and Materials
B/A	Banking Arrangement
BS	British Standard
DTH	Down The Hole hammer
DIN	Deutsche Industrie -Norm
EC	Electric Conductivity
E/N	Exchange of Note
EU	European Union
FMWR	Federal Ministry of Water Resources
JIS	Japanese Industrial Standards
JICA	Japan International Cooperation Agency
LGA	Local Government Areas
LGA Unit	LGA Water and Sanitation Unit
M/D	Minutes of Discussion
NEEDS	National Economic Empowerment and Development Strategy
NGN	Nigerian Naira
NPC	National Planning Commission
OJT	On-the-Job Training
O&M	Operation and Maintenance
PDM	Project Design Matrix
PVC	Polyvinyl Chloride
RUWASA	Rural Water Supply and Sanitation Agency
UNICEF	United Nations International Children's Fund
uPVC	Unplastised polyvinyl Chloride
VLOM	Village Level Operation and Maintenance
VWESC	Village Water and Environment Sanitation Committee
WHO	World Health Organization

CHAPTER 1

BACKGROUND OF THE PROJECT

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The Federal Republic of Nigeria (hereinafter referred to as "Nigeria") borders the Gulf of Guinea in central West Africa and is a leading oil producing nation with a population of approximately 140 million people (2006 National Population Commission in Nigeria). The country is comprised of more than 250 ethnic groups and more than 500 confirmed spoken languages, giving it a very multi-racial quality. Nigeria is two and a half times (2.5) larger than Japan and its territory is divided into two characteristic regions by the Niger and Benue Rivers — a semi-arid zone to the north and a wet (damp) zone to the south. Accordingly, lifestyles, etc. have a major impact on the cultural fabric of the nation, which can be roughly classified into north and south.

The Obasanjo administration, a civilian administration established in May, 1999 with the transition of power from the military, introduced its "Economic Policy for 1999 to 2003" and "National Economic Empowerment and Development Strategy" (hereinafter referred to as "NEEDS") (2004) with the aim of reforming a failing economy. NEEDS supports the six major sectors of (1) agriculture and rural development, (2) roads, (3) education, (4) health, (5) water supply, and (6) electricity. Water supply including rural water supply is one of important sectors. As for national policy regarding water supply and sanitation in rural communities, the National Water Supply and Sanitation Policy was compiled in 1999 and the Regional Water Supply and Sanitation Program (strategic plan) was established in 2004. These policies aim to raise the water supply rate to 60% by 2003, 80% by 2007 and to supply safe water to all citizens to 2011. Within this goal, it is intended to secure 30 liters of water supply per person per day, to keep water carrying distances to no more than 250 m and to provide water supply points for every 250~500 people in all rural communities with population of no more than 5,000.

Yobe State, which is the target area of the request, is located in the northeast of the country on the border with Niger and is one of the poorest states in the country. In the northern part of Nigeria, the ratio of safe water utilization is lower than the national average and the water supply rate in rural communities in Yobe State is just 47%. Not only are residents subjected to chronic outbreaks of water-borne diseases such as diarrhea and cholera due to the use of insanitary water, but also this area is at risk of droughts and desertification. Accordingly, the supply of safe water is an urgent issue in Yobe State. It was under such circumstances that the Government of Nigeria requested the Project with the primary objective of procuring equipment and materials for the construction of water supply boreholes.

However, because only limited information was available from RUWASA (Rural Water Supply and Sanitation Agency) and the implementation capacity on the local side was unknown, JICA conducted a preliminary study from June to September 2006 in order to examine aspects such as appropriateness of the Project as an equipment supply undertaking (as opposed to necessity to implement the project as a facilities undertaking). As a result of the preliminary study, the

following points were confirmed regarding RUWASA.

- RUWASA is hoping for the procurement of borehole drilling equipment and materials, and it intends to construct facilities following said procurement under its own resources.
- RUWASA has plans to utilize the procured borehole drilling equipment and materials in order to construct 100 hand pump boreholes.
- RUWASA currently owns two fairly deteriorated drilling machines (one made in Russia in 1993 and one made in Sweden in 1978), which it keeps in working order in spite of difficulties obtaining spare parts and preventing breakdowns.
- RUWASA has sufficient engineers of a certain level to secure three drilling teams, and it has drilled 38 boreholes over the past five years in spite of the obsolescence of its drilling machines.

In consideration of the above points, it was confirmed as appropriate to implement the Project as an equipment supply undertaking.

The Study in hand intends to: 1) gauge the background, objectives and contents of the Project, 2) implement basic design of the most appropriate contents, scale and expenses, etc. required to secure the outputs of the cooperation upon verifying the status and effect of Japan's grant aid in Project implementation as well as the technical and economic validity of the Project, 3) conduct a rough cost estimation of the project, and 4) recommend the scope of works of the local side, the implementation plan and consideration points necessary in order to realize the outputs and targets of the Project.

CHAPTER 2

CONTENTS OF THE PROJECT

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CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

(1) Superior Targets

The superior national development plans to the project are Vision 2010 and the National Economic Empowerment and Development Strategy (NEEDS) that revised this in 2004. NEEDS, which aims to "create a new Nigeria," raises eradication of poverty, creation of employment and construction of wealth, etc. as priority goals. As for national policy regarding water supply and sanitation in rural communities, the National Water Supply and Sanitation Policy was compiled in 1999 and the Regional Water Supply and Sanitation Program (strategic plan) was established in 2004. These policies aim to raise the water supply rate to 60% by 2003, 80% by 2007 and to supply safe water to all citizens to 2011.

(2) Project Targets

RUWASA aims to raise the village water supply rate, which was 47% in 2005, to 75% by 2009. In order to realize this goal, it is planning to install 52 mechanized boreholes, 220 hand pump boreholes and 200 contamination control hand dug wells over four years from 2006 to 2009.

The Project aims to provide equipment supply and equipment operation and maintenance support over an appropriate scope as a grant aid undertaking of the Government of Japan in order to contribute to the realization of the above rural village water supply facilities construction plan. However, the base unit of water supply shall be 20 liters per person per day and the benefitting population per supply point shall be 360 people. Numerous Japanese grant aid projects conducted in Africa in the past have set a water supply volume of 15~20 liters per person and a benefitting population per supply point of 450~500 people. Moreover, UNICEF has established 20 liters per person and benefitting population of 500 people as targets, so considering the urgency of the project, the above values are considered to be appropriate.

In order to realize the above plans in the Project, it is planned to drill 89 hand pump boreholes over two years using the supplied equipment, and these facilities will benefit a population of approximately 32,000 and raise water supply rate by 5.7%.

After 2009, RUWASA continues to construct the boreholes by a procured drilling rig. It is expected that the facilities constructed for over three years (2009 to 2012) benefit a population of approximately 54,000

2-1-2 Outline of the Project

The Project is composed of equipment and materials procurement and the soft component.

The equipment and materials procurement part will entail the procurement of equipment and materials for the drilling and construction of boreholes, and the said equipment and materials will be used to support the construction of 89 boreholes by the Nigeria side. The outline of basin design is as follows:

Table 2-1-1 Contents of Procured Equipment and Materials (Draft)

	Category	Contents of equipment and materials, Quantity
①	Drilling equipment	Drilling rig (1 unit), High pressure air compressor (1 unit)、Cargo truck with crane (1unit)
②	Survey equipment	Geophysical survey equipment (1 unit)、Water analysis equipment(1 unit)、Pumping test equipment (1 unit)
③	Borehole construction materials	Hand pump (89 set)、Village level mechanic tools (89 sets)、LGA level machanic tools (17 sets)、Casing pipe (1,682 pcs.)、Screen pipe (297 pcs.)

The Japanese consultant will take the initiative in implementing the soft component, which will comprise the implementation of technical training for construction management and provision of support for strengthening of the operation and maintenance system for the water supply facilities.

The following outputs are anticipated as a result of the above Project activities.

① The equipment required in order to build borehole water supply facilities will be made available in Yobe State.

② The water supply and sanitation utility implementation and organizational setup of RUWASA in Yobe State will be reinforced.

Table 2-1-2 shows the Project Design Matrix (PDM) for the Project.

Table 2-1-2 Project Design Matrix（PDM）

Project：The Supply of Equipments for Groundwater Exploitation towards Potable Water Supply and Health Delivery in Yobe State in The Federal Republic of Nigeria
Project Duration：2008～2009
Target Area：89 sites of 17LGA in Yobe State　　Target Group：Communities in the Study Area

Design Summary	Project Monitoring Indicators	Source of Indicators	External Condition
［Ultimate Goal］ • Improvement of water supply and sanitation condition in rural area in Yobe State	• Ratio of increased of water supply in rural area o f Yobe state • Ratio of decreased patients with water-borne diseases in the rural area of Yobe state	• Statistical data of water supply • Statistical data of water-borne diseases • Statistical data published by Ministry of Health	• There is no change in the policy of the national and state about rural water supply. • The health environment irrelevant to water supply and health facilities does not deteriorate remarkably.
［Purpose］ • To keep functioning installed boreholes with appropriated maintenance in the target area • To establish Village Water & Environment Sanitation Committee (VWESC) in the communities of the target area and to encourage the VWESC keep managing and maintaining the relevant water supply facilities in the target area	• 89 boreholes will be constructed and water supply condtion of 89 communities will be improved. • VWESCs will be established in 89 commnunities. • Daily participating extent of VWESC members to take part in the communities. • School enrollment rate will be increased in target villages.	• Progress report of borehole construction of RUWASA • Inventories of borehole management by RUWASA • Monitoring report by LGA Unit • Survey result on school enrollement rate in target villages	• Assuming no radical economic change in the contry. • Assuming operation and maintenance system of water facilities will be maintained.
［Outputs］ • Necessary equipment and materials for the drilling and construction of boreholes will be provided in RUWASA. • Technical level of RUWASA for the construction of borehole and O&M will be improved in Yobe State. • The water supply and sanitation services system and management system of RUWASA in Yobe State will be strengthened. • VEWSC in the communities system will be strengthened.	• The extent of procurement equipment and materials as planned. • The number of borehole construction by the Nigerian side. • The number of established VWESCs in the target villages	• The shipping document of equipments • The delivery of goods/receipts of equipments • Construction record etc. • Project progress report • Monitoring record by the LGA water health administration unit submitted to RUWASA	• Assuming the rural water supply project will continue to be implemented after this study.

Design Summary	Project Monitoring Indicators	Source of Indicators	External Condition
[Activities] <Japanease Side> • Equipments and materials supply for well drilling • OJT which performs operation and control-of-maintenance instruction of the above-mentioned equipment and materials. • Supply of equipment and materials for 89 water supply facilities. • Construction management support (soft component) • Strengthening of operation and maintenance system of water supply facilities (soft component) <Nigerian Side> • Construction of 89 borehole construction • Operation and maintenance of water supply facilites by commuities	**[Inputs]** (Japanease Side) • Equipment and materials for borehole construction • Technical assistance by Soft Component • Human resources and project cost (Nigerian Side) • Construction of water facilities (installation of 89 boreholes) • Borehole construction materials such as cemment gravel and fuel etc. • Human resources and project cost		• Assuming that intensive inflation and exchange fluctuation do not occur during planned implementation. • Assuming that remarkable natural disaster does not oocure and security situation does not change during planned implementation.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Concept

The basic concept of the Project is described below.

1) Scope of the cooperation

- Considering the effective realization of the grant aid, the scope of the aid shall cover the following: ① procurement of drilling machines and other borehole construction equipment and materials, ② transfer of technology (OJT) by the supplier regarding the operation and handling of the procured equipment and materials, ③ soft component by the consultant to support the operation and maintenance activities.
- RUWASA will construct the borehole facilities using construction equipment and materials (hand pumps, casing and screen pipes) supplied by the Japanese side for two years. After that, RUWASA will continue to construct the borehole facilities by a procured drilling rig.
- The Nigerian side will bear the cost of bentonite, mud control additive, cement, gravel, reinforcing bars, fuel, water, other borehole construction materials and labor.

2) Site selection

- The borehole construction period for 89 boreholes shall be set at two years in consideration of the possible storage time for borehole construction materials such as casing pipes, etc. procured by the Japanese side.
- For the first two years, boreholes shall be constructed in 89 sites selected according to the implementation capacity of the counterpart agency based on the results of survey of social conditions and natural conditions in 100 prioritized villages.
- RUWASA will determine the borehole drilling locations upon implementing detailed electrical sounding surveys.

(2) Concept regarding Natural Condition

The climate in Yobe State is divided into the dry season and rainy season with most rain falling during the rainy season from July to September. Since road conditions deteriorate and it is predicted that implementation of construction works will be difficult due to rainfall during the rainy season, the works implementation plan will be compiled upon taking this into account.

Groundwater in the target area is largely derived from aquifers situated mostly in sandy soil. Therefore, the borehole drilling plan and borehole structures will be planned while taking these geological conditions into account. Concerning water volume, the average value in data from existing boreholes is 3 liters/second, so there shouldn't be a problem in that respect. Concerning water quality, there is a possibility that some areas will have boreholes that contain high levels of fluorine and iron. In cases where borehole water quality values exceed WHO standards, the boreholes in question will be examined for exclusion from the groundwater development plans.

(3) Concept regarding Social Conditions

Many of the people in Yobe State are devout Muslims. Men are mainly in charge of economic activities outside of the household. This also includes fetching water. On the other hand, women mainly take care of household activities. Such social/religious factors will be taking into account for conducting water and sanitation education and promoting peoples' participation to village water environmental and sanitation committees (VWESC), which will mainly be in charge of operating and maintaining the water supply facilities.

(4) Concept regarding the Construction Situation and Utilization of Local Contractors, Equipment and Materials

- Since being established in 2000, RUWASA has so far independently constructed 38 motor powered boreholes using two deteriorated drilling rigs. Boreholes are drilled by teams of 10, and RUWASA currently has the capacity to organize three such drilling teams. Accordingly, it has enough personnel to operate the new rig scheduled for procurement in the Project in addition to the two existing rigs. Furthermore, judging from the past drilling experience and record of RUWASA employees, they are deemed to possess the basic technology required to drill boreholes and to implement the Project activities.
- According to the field surveys, there are no private sector borehole drilling operators in Yobe State, so it will be necessary to consign work to operators in neighboring Kano or Borno States. Private sector operators, too, generally do not have abundant capital and possess obsolete equipment in limited numbers and without sufficient equipment and spare parts. Moreover, the technical levels of private sector operators are not high. Accordingly, when implementing the Project, the construction of facilities shall be entrusted to RUWASA, which has the necessary implementation capacity, and there shall be no utilization of local contractors.
- In order to secure quality, equipment and materials required for the facilities works shall be selected from products that comply with international standards as much as possible.
- In consideration of service and maintenance, major items of equipment such as drilling machines and vehicles shall be purchased from makers that have agents based in Nigeria and can readily supply parts.

(5) Concept regarding the Operation and Maintenance Capacity of the Implementing Agency

- Support shall be provided in compilation of the works implementation plan regarding areas such as the borehole construction procedure, schedule management, and quality control of facilities construction.
- Technical support will be provided regarding the handling and maintenance of newly procured equipment and materials.
- RUWASA (the implementing agency) does not possess a manual regarding operation and maintenance in the water supply and sanitation utility. Moreover, it conducts no education activities regarding its planned construction and maintenance of water supply facilities.

Furthermore, because it does not conduct adequate public relations activities in the LGA and villages regarding construction of water supply facilities, it does not have good links with the LGA. It will be necessary to iron out such issues on the management front in order to implement the Project, and support will be provided for that purpose.

(6) Concept regarding the Grading of Equipment

- The rig shall be selected to cover both mud circulation rotary and DTH drilling methods for various geological conditions ranging from hard rock to soft rock.
- Truck-mounted rig and compressor shall be selected to ensure easy accessibility and mobility.
- 4-wheel-drive type vehicles shall be selected for small trucks and crane cargo trucks in consideration of bad road conditions.
- Indian Mark III (VLOM type), which is the standard of RUWASA, shall be selected for hand pumps.
- Plans for equipment, drilling methods and structure of boreholes matching the local geological conditions shall be proposed.
- Peripheral structures such as platforms, drainage ditches and soakage pits shall be designed with consideration to prevent infiltration of domestic waste water, in order to avoid adverse impact on water quality.

(7) Concept regarding Works and Procurement Methods and Works Period

- Both mud circulation rotary and DTH methods shall be applied as the drilling method depending on geological conditions.
- Drilling schedule shall be prepared taking into account the past record of RUWASA and slower progress of borehole drilling in the rainy season due to deterioration in access to the drilling sites and so forth.
- The total Project period shall be conservatively scheduled taking into account the time necessary for procurement, the capacity of RUWASA and the period for conducting the soft component.

2-2-2 Basic Plan

2-2-2-1 Overall Plan

RUWASA currently owns two fairly deteriorated drilling machines (one made in Russia in 1993 and one made in Sweden in 1978), and keeps these in working order in spite of difficulties obtaining spare parts and preventing breakdowns. It has used these drilling machines to drill 26 boreholes over the past five years. In total it has constructed 38 boreholes over the past five years, however, 12 of these were consigned to private sector operators. Moreover, RUWASA has the staff and basic technology needed to construct boreholes.

RUWASA currently has three drilling teams of 10. These are the only borehole drilling teams in Yobe State and since they are also dispatched to drill boreholes under the jurisdiction of the

Federal Ministry of Water Resources, they possess ample basic technology for drilling. Moreover, RUWASA implements OJT and conducts workshops aimed at improving theoretical ability in order to improve drilling capacity (quality).

In view of the above points, it is deemed that RUWASA will have sufficient project implementation capacity providing that the necessary technical guidance is conducted. The Project will be limited to the supply of equipment and materials, whereas the Nigerian side will execute the construction of facilities using the equipment and materials provided under the Project and those currently owned by RUWASA.

(1) Target Villages

As is shown in Table 2-2-1, upon narrowing down the target villages from the viewpoints of groundwater potential and evaluation of social conditions, 89 villages in 17 LGA shall be targeted for the drilling of one borehole in each village. Figure 2-2-1 shows the location of target villages.

Table 2-2-1 Target Village (1/2)

ID/ No	LGA	Village	Population in 1991	No. of Requested Boreholes	Geology	Groundwater Develoment Potential Evaluation		Social Condtion Evaluation Rank	Total Evaluation
						Estimated Drilling Depth(m)	Estimated Water Level (m)		Not Suitable for Handpump Scheme
A-1	BADE	Dala	527	1	Chad	60	30	C	
A-2	BADE	Azbak	2,822	1	〃	50	20	B	
A-3	BADE	Usur	644	1	〃	50	20	B	
A-4	BADE	Ngelbuwa	763	1	〃	50	20	B	
B-1	BURSARI	Jawa	679	1	Chad	60	20	B	
B-2	BURSARI	Illela Garun Dole	1,096	1	〃	50	20	B	
B-3	BURSARI	Danga Kanamma	612	1	〃	55	25	B	
B-4	BURSARI	Harunari	519	1	〃	55	25	B	
B-5	BURSARI	Bururu	359	1	〃	50	20	B	
B-6	BURSARI	Mala Wango Fulatari	890	1	〃	50	20	B	
B-7	BURSARI	Bayamari	2,168	1	〃	60	30	A	
B-8	BURSARI	Koromari	958	1	〃	55	25	B	
B-9	BURSARI	Bonegaral	373	1	〃	55	25	B	
C-1	DAMATURU	Maisandari	4,000	1	Chad	60	20	B	
C-2	DAMATURU	Dikumari	1,500	1	〃	130	≧40	B	X
C-3	DAMATURU	Maduri	970	1	〃	60	15	B	
C-4	DAMATURU	Mallam Matari	543	1	〃	≧140	≧40	B	X
D-1	FIKA	Tadangara	4,500	1	Gongila	70	30	B	
D-2	FIKA	Sabon Fegi Fika	536	1	Gombe Sandstone	≧170	≧100	A	X
D-3	FIKA	Fusami	2,065	1	Kerri-Kerri	120	≧40	B	X
D-4	FIKA	Garin Balde	1,351	1	〃	130	≧65	B	X
D-5	FIKA	Gurjaje	655	1	〃	80	35	B	
D-6	FIKA	Yaba-Ngalda	1,425	1	Gongila	70	30	B	
D-7	FIKA	Garin Chindo	2,760	1	〃	70	30	A	
E-1	FUNE	Jajere (SG)	523	1	Chad	120	≧40	B	X
E-2	FUNE	Ngelshengele	545	1	〃	90	≧40	C	X
E-3	FUNE	Dumbulwa	557	1	〃	55	20	C	
E-4	FUNE	Nyakire	1,261	1	〃	60	25	B	
F-1	KARASUWA	Bukarti	2,700	1	Chad	70	30	B	
F-2	KARASUWA	Askinari & otheres	688	1	〃	55	25	A	
F-3	KARASUWA	Garin Gawo	456	1	〃	50	20	B	
F-4	KARASUWA	Gasma	906	1	〃	60	20	A	
F-5	KARASUWA	Karasuwa Galu B	374	1	〃	50	15	B	
F-6	KARASUWA	Karasuwa Garin Guna	1,568	1	〃	50	15	B	
F-7	KARASUWA	Dogon Jeji	512	1	〃	50	15	B	
F-8	KARASUWA	Wachakal 'B'	1,315	1	〃	60	30	B	
G-1	MACHINA	Tauna	575	1	Chad	60	30	B	
G-2	MACHINA	Taganama	1,100	1	〃	60	30	B	
G-3	MACHINA	Damai	1,387	1	〃	60	30	A	
G-4	MACHINA	Majeri	683	1	〃	60	30	B	
G-5	MACHINA	Bogo	1,901	1	〃	60	30	A	
H-1	NGURU	Yamdugo	881	1	Chad	55	15	B	
H-2	NGURU	Dumsai	554	1	〃	55	15	B	
H-3	NGURU	Bambori	2,106	1	〃	55	15	B	
H-4	NGURU	Maja Kura	602	1	〃	55	15	B	
I-1	NANGERE	Garin Gada	876	1	Chad	70	35	A	
I-2	NANGERE	Garin Baba	898	1	Kerri-Kerri	90	≧40	A	X
I-3	NANGERE	Dawasa	4,120	1	〃	90	≧40	B	X
I-4	NANGERE	Gamarum	1,236	1	〃	80	35	A	
I-5	NANGERE	Duddaye B	396	1	Kerri-Kerri	80	35	B	
J-1	POTISKUM	Adaya	1,112	1	Kerri-Kerri	50	15	A	
J-2	POTISKUM	Mazagane	520	1	〃	65	30	A	
J-3	POTISKUM	Mamudo	2,399	1	〃	50	15	B	
J-4	POTISKUM	Lai-Lai	1,350	1	〃	65	30	A	
J-5	POTISKUM	Lakwaya	415	1	〃	65	30	B	
J-6	POTISKUM	Dumbulwa	732	1	〃	65	30	A	
K-1	GEIDAM	Kawari Lawanti	504	1	Chad	60	20	B	
K-2	GEIDAM	Dajina	330	1	〃	60	20	B	
K-3	GEIDAM	Damakarwa	1,200	1	〃	60	20	B	
K-4	GEIDAM	Kelluri	2,692	1	〃	60	20	A	
K-5	GEIDAM	Nguluri	385	1	〃	60	20	B	
K-6	GEIDAM	Borko	370	1	〃	60	20	B	
K-7	GEIDAM	Ajiri	275	1	〃	60	20	A	
L-1	GULANI	Tetteba	2,945	1	Gongila	≧90	≧40	B	X
L-2	GULANI	Sollari	526	1	Fika	55	25	B	
L-3	GULANI	Chandam	872	1	〃	50	20	A	
L-4	GULANI	Badago/Badigore	721	1	〃	60	30	B	
L-5	GULANI	Bagardo	427	1	〃	50	20	B	

Table 2-2-1 Target Village (2/2)

ID/ No	LGA	Village	Population in 1991	No. of Requested Boreholes	Geology	Groundwater Develoment Potential Evaluation		Social Condtion Evaluation Rank	Total Evaluation
						Estimated Drilling Depth(m)	Estimated Water Level (m)		Not Suitable for Handpump Scheme
M-1	GUJBA	Katarko	2,535	1	Chad	50	25	B	
M-2	GUJBA	Daddawel	1,162	1	Fika	50	15	B	
M-3	GUJBA	Horanyiwa	914	1	Kerri-Kerri	70	35	B	
M-4	GUJBA	Ligdir	671	1	OlderGranite	60	30	B	
M-5	GUJBA	Kukuwa	2,172	1	Gongila	60	30	B	
N-1	JAKUSKO	Yin	776	1	Chad	50	20	A	
N-2	JAKUSKO	Adiya	842	1	〃	50	20	B	
N-3	JAKUSKO	Kajuwa	1,425	1	〃	50	20	B	
N-4	JAKUSKO	Jammel	1,692	1	〃	50	20	A	
N-5	JAKUSKO	Tajuwa	824	1	〃	50	20	A	
N-6	JAKUSKO	Tasga	572	1	〃	50	20	B	
N-7	JAKUSKO	Jabba	1,990	1	〃	60	30	B	
O-1	TARMUWA	Dabalam	385	1	Chad	≧100	≧60	B	X
O-2	TARMUWA	Koriyel	1,137	1	〃	60	30	B	
O-3	TARMUWA	Dumbari	296	1	〃	60	30	A	
O-4	TARMUWA	Manda-da'a	445	1	〃	55	25	B	
P-1	YUSUFARI	Mayori West	615	1	Chad	50	20	B	
P-2	YUSUFARI	Mayori East	2,008	1	〃	50	20	B	
P-3	YUSUFARI	Shetimari (Abbagari & others)	475	1	〃	50	15	A	
P-4	YUSUFARI	Tulo-tulowa	3,166	1	〃	50	10	A	
P-5	YUSUFARI	Bukora	895	1	〃	50	15	B	
P-6	YUSUFARI	Kaluwa	521	1	〃	50	20	B	
P-7	YUSUFARI	Garin Tsangai	1,438	1	〃	50	20	B	
P-8	YUSUFARI	Maidashi	4,370		〃	50	20	B	
Q-1	YUNUSARI	Bula Moduye	583	1	Chad	50	20	B	
Q-2	YUNUSARI	Kalgi	974	1	〃	55	25	A	
Q-3	YUNUSARI	Toshia	1,584	1	〃	50	20	A	
Q-4	YUNUSARI	Dalari	360	1	〃	50	20	B	
Q-5	YUNUSARI	Buhari	287	1	〃	50	20	B	
Q-6	YUNUSARI	Bultuwa	234	1	〃	50	20	B	
Q-7	YUNUSARI	Ngormadi	320	1	〃	50	20	A	
Q-8	YUNUSARI	Bulabulin	1,139	1	〃	50	20	A	

*comment
≧40：40 meters and over

A: Higher evaluation points (12 to 15)
B: High evaluation points (8 to 11)
C: Satisfied evaluation points (5 to 7)

Breakdown of LGA

No	LGA	Requested	Evaluation result
		No of boreholes	No of boreholes
1	BADE	4	4
2	BURSARI	9	9
3	DAMATURU	4	2
4	FIKA	7	4
5	FUNE	4	2
6	KARASUWA	8	8
7	MACHINA	5	5
8	NGURU	4	4
9	NANGERE	5	3
10	POTISKUM	6	6
11	GEIDAM	7	7
12	GULANI	5	4
13	GUJBA	5	5
14	JAKUSKO	7	7
15	TARMUWA	4	3
16	YUSUFARI	8	8
17	YUNUSARI	8	8
Total		100	89

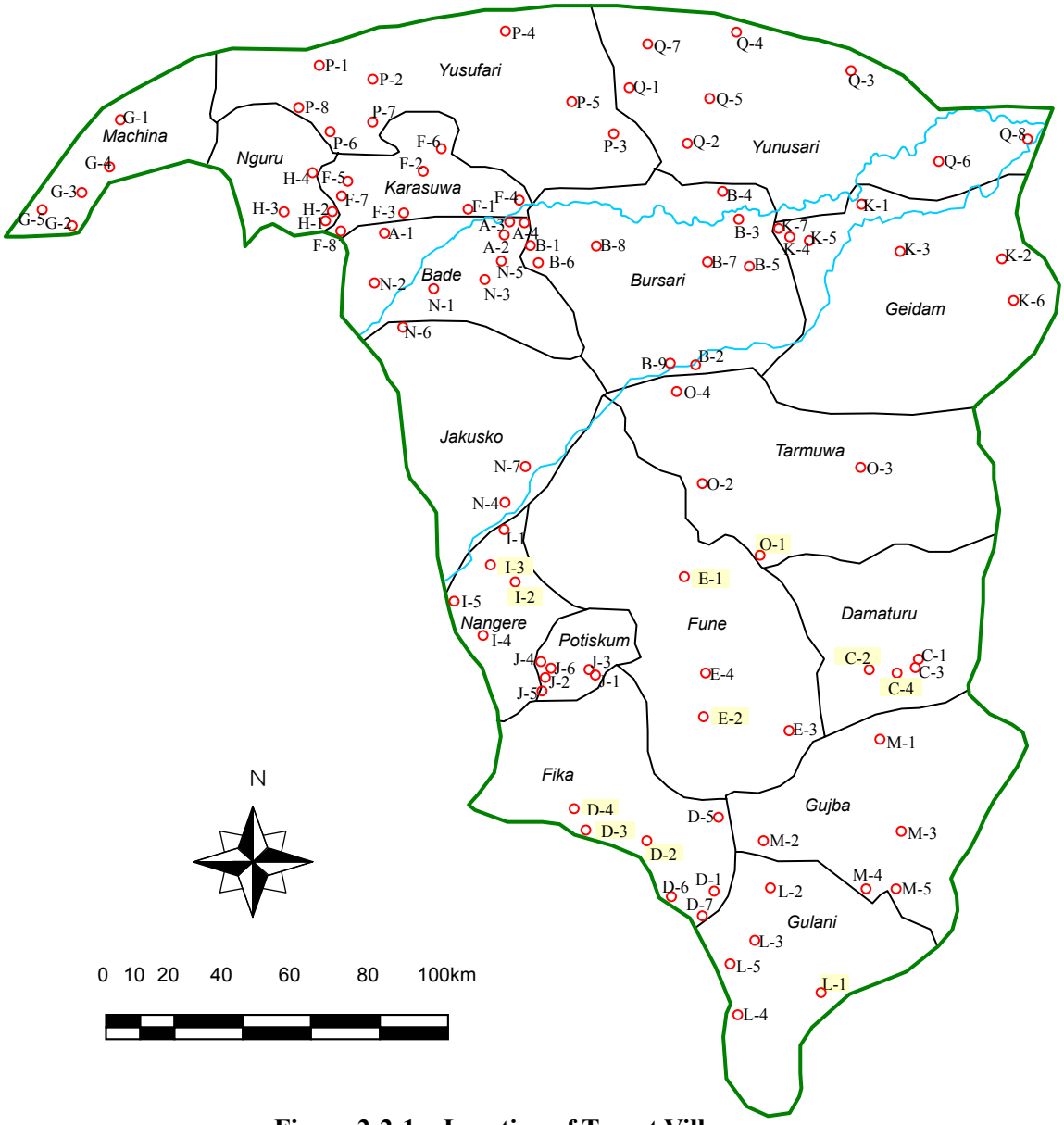


Figure 2-2-1 Location of Target Village

1) Groundwater Potential Evaluation Criteria

Types of hand pump include Indian Mark and Afrideph. The proper lifting capacity of such pumps is considered to be around 40 m in a static water lovel. When the groundwater level becomes deeper than this, hand pumps suffer from deteriorated durability and a higher breakdown rate, so they are no longer considered appropriate. In the survey of existing boreholes, the static water level was found to be deep (around 40 m) in Fika, Fune and Nangere districts. Based on the results of geophysical prospecting analysis, hand pumps shall not be installed in areas where the static water depth is estimated to be greater than 40 m; moreover, the districts of Nangere (Kerri-Kerri layer) and Gujba (Fika Shale layer) are deemed unsuitable for installation of hand pumps because of the deep groundwater level. Summing up these areas, the following 11 villages on the threshold of hand pump installation were deemed unsuitable for pumping by hand pump, so out of the originally requested 100

villages, 89 were deemed appropriate for the drilling of hand pump boreholes. Table 2-2-2 shows the reasoning behind this decision.

Table 2-2-2 List of Unsuitable Villages for Hand Pump Scheme

ID/ No	LGA	Villages	Reason
C-2	DAMATURU	Dikumari	It is presumed the groundwater level around these villages to exceed a proper value of the pumping ability in the general hand pump scheme.
C-4	DAMATURU	Mallam Matari	
D-2	FIKA	Sabon Fegi Fika	
D-3	FIKA	Fusami	
D-4	FIKA	Garin Balde	
E-1	FUNE	Jajere (SG)	
E-2	FUNE	Ngelshengele	
I-2	NANGERE	Garin Baba	
I-3	NANGERE	Dawasa	
L.-1	GULIT.ANI	Tetteba	
O-1	TARMUWA	Dabalam	

2) Criteria for Evaluation of Social Conditions

As a result of surveying social conditions in the 100 requested villages, all 100 were confirmed to be suitable for the installation of hand pumps. The suitability of villages was classified into three ranks according to the water supply rate of existing boreholes, distance of main water sources from village centers, problem awareness of villagers to water and sanitation, operation and maintenance setups, and the management capacity of the LGA in charge.

- Evaluation Items and Evaluation Scores

a) Water supply rate of village boreholes

0~35%: 3 points, 36~75%: 2 points, more than 75%: 1 point

Incidentally, water supply rate was calculated using the following formula:

Water supply rate (%) =

(number of existing boreholes x 250 people) ÷ village population (people)

b) Distance of main water source from village center

1,500 m or more: 3 points, 500~1499 m: 2 points, less than 500 m: 1 point

c) Problem awareness of village to water and sanitation

Very strong (select three items), fairly strong (select 2 items), normal (select 1 item)

d) Operation and maintenance setup

Operated by VWESC: 3 points, planned at establish a VWESC: 2 points,
under examination: 1 point

e) Village management capacity of the LGA in charge *

Excellent: 3 points, Good: 2 points, Ordinary: 1 point

Note) *Evaluate from the actual state of management found in the survey of social conditions in villages in this study.

- Ranking

Based on the total evaluation scores from above, the suitability of social conditions was divided into three ranks as indicated in Table 2-2-3.

Table 2-2-3 Adaptability Rank of the Social Conditions of a Village

The point evaluating [sum total]	15～12	11～8	7～5
Rank	A	B	C

(2) Base Unit of Water Supply

The Federal Ministry of Water Resources in 1997 compiled the National Water Supply and Sanitation Policy, in which the supply of 30 liters per person per day is raised as the water supply target in villages of less than 5,000 people. However, in consideration of the urgency of the Project, the securing of benefits for more residents, past grant aid projects in Nigeria and the target value of UNICEF, 20 liters per person per day is set as the base unit of water supply here. Table 2-2-4 shows the base units of water supply that are used by related agencies.

Table 2-2-4 Unit Water Supply

	Service Population	Unit Water Supply (liters)
National Water Policy	250～500	30
UNICEF	500	20
WHO	-	5～25
Japanese Grant Aid Projects	450～500	15～20
RUWASA	500	30

According to hearings conducted in the survey of social conditions, it is estimated that the combined population of the target villages increased approximately three times from 116,000 as given on the request to 350,000, representing an average annual increase of approximately 8% over 15 years. Although it is suspected that this average annual increase is rather high, the total population of the target villages is assumed to be 350,000 and the daily average supply volume can be calculated as follows:

Design water supply population (350,000) x base unit of water supply (20 liters/person/day)

= 70,000,000 liters/day

Therefore, the daily average water supply can be estimated as 70 million liters per day.

(3) Design Operating Time of Hand Pumps and Beneficiary Population

In villages with large population, queues form at water supply points and hearing surveys have confirmed that pumps have to keep operating more 12 or more hours per day. Under

Japan's grant aid, operating time of 8 hours per day is set in general while the maximum operating time is given as 10 hours per day. In the Project, considering the current state of facilities use, a maximum operating time of 10 hours per day shall be set.

Assuming that hand pumps have an operating time of 10 hours per day and capacity of 12 liters/minute, the number of beneficiaries per borehole will be as follows:

12 liters/minute x 10 hours = 7,200 liters/day

7,200 liters/day ÷ 20 liters/person/day = 360 people

(4) Examination of Water Sources

In the project target areas, it will be necessary to select water sources that are capable of supplying sanitary and safe water in the necessary quantity and on a sustained basis. Available water sources in the target areas are river water, ponds, shallow wells and boreholes, etc. These sources are derived from clean and stable deep layer groundwater that is largely recharged by rainwater. The groundwater recharging rate is thought to be a certain percentage of rainfall. Annual rainfall in the target area is 500~800 mm, and it is assumed that 1% of this is recharged as groundwater. Assuming that the base unit of water supply from boreholes is 20 liters per person per day and the beneficiary population is 360 people, the pumping volume and recharging volume of 89 boreholes can be calculated as follows.

Necessary pumping volume (Q) = 7,200 liters/day per borehole x 89 boreholes x 365 days = 233,892,000 ≒ 0.23 x 10^6 m^3/year

Annual groundwater recharge R = [500 mm (annual rainfall)] x [1% (groundwater recharge volume)] x [45,502 x 10^6 m^2 (17 LGA area)] ≒ 227.51 x 10^6 m^3/year

In other words: Q = 0.23 x million m^3/year <R = 227.51 x million m/year.

Since this is just 0.10% of the recharge volume, there is deemed to be sufficient recharge capacity with respect to the design water supply.

(5) Raw Water Quality

Water quality tests were conducted at the O/M (operation and maintenance) water quality laboratory of the Ministry of Water Resources based on the WHO water quality standard. However, until now water quality tests following the installation of boreholes have not been implemented rigorously and boreholes are considered to be successful provided that there is no pollution.

It is mainly fluoride and iron that are discussed in relation to water quality problems. Fluoride taken in proper quantities can prevent tooth decay, however, excessive consumption leads to symptoms such as softening of the bones and mottled teeth. Therefore, if fluoride levels in excess of the standard are found in water quality testing, it is necessary to consider a major revision of drilling points. Furthermore, concerning iron, the WHO standard states that raw water containing iron in the range of 2~3 mg/liter does not pose a health problem. In future, since it is thought that water quality issues will be discussed in unison with

improvement in water supply rate, water quality inspections shall be implemented on the items indicated in table 2-2-5. Moreover, on-site analysis will be implemented in all water tests. However, since the Yobe State government aims to increase the water supply rate in villages from 47% at present to 75% by 2009, it intends to use water supply facilities providing that the results of inspection show that residents are suffering from no health damage.

Table 2-2-5 Water Quality Items

No.	Item	Standard (WHO)
1	Color	Nomal
2	EC	*1000μS/cm
3	p H	*7.0
4	Turbidity	Nomal
5	Taste	Nomal
6	Smell	Nomal
7	Iron	0.3mg/Lit.
8	Floride	1.5mg/Lit.
9	Manganise	0.1mg/Lit.
10	Nitrate	10mg/Lit.
11	Bacterium coli	not detectable in 100m/l
12	Ammonia	0.5mg/Lit.

* Normal value

(6) Facilities Construction

RUWASA has responsibility for the construction of facilities. The specifications of the facilities are as follows:

- Since there are no problems in terms of the size and structures of conventional platforms, and RUWASA is well experienced with them, the conventional specifications of RUWASA (identical to that of UNICEF) will be basically applied.
- Although the drainage distance of drainage channel from the borehole is 3 m for existing facilities constructed by RUWASA, it is recommended to have longer distances than the existing facility in consideration of water contamination.
- According to the electrical sounding results, average drilling depth is inferred as between 30~600 m. Drilling depths range between 30~150 m in the north of Yobe State and between 60~600 m in the south, indicating a general trend of shallow levels in the north and deep in the south. According to the results of the field surveys, the drilling depth of hand pump boreholes in the target villages is 50~80 m. Although the final decision of drilling depth for each site will be determined based on geological features and groundwater conditions at the drilling stage, design depth will be set as 60 m on average.
- The casing program will be decided based on the observation and level of groundwater in the drilling stage and electrical logging results.
- Drilling diameter is to be 10” for the surface layer which easily collapses and requires

guide pipes, and 6” below the guide pipe end. The diameter of casing and screen pipes will be 4”. Gravel packing in the screen portion is necessary to avoid plugging of screen slits by silt.

- Cementing and sealing in the shallow extent of the borehole is necessary to prevent infiltration of contaminated water.
- Since some villages do not have drainage channels for rainwater and wastewater, and pools of water were observed near the boreholes, a soakage pit is to be installed at the end of drain to infiltrate wastewater into the ground. The size of soakage pit is 1m (width) × 1m (length) × 1m (depth) in line with the UNICEF standard.
- Installation of fences around the borehole will be instructed to prevent cattle from entering borehole areas.
- Proper operation and maintenance of facilities will be instructed through the soft component during the implementation stage.

(7) Success of Borehole Construction

Table 2-2-6 shows the success rate of motorized pump boreholes in five representative geological formations in Yobe State (information provided by RUWASA).

Table 2-2-6 Borehole Success Rate in Yobe State

Geology	Success Rate	Drilling depth(m)	Depth to aquifer (m)
Chad formation	More than 90%	35-80,130-160	20-55
Kerri-Kerri formation	About 70%	20-40,75-100	25
Sediments in Cretaceous period	About 40%	30	25
Basement complex (granite gneiss)	Bellow 50%		
Natural levee deposits	More than 90%	15-45	20

The borehole success rate in the Chad formation and Kerri-Kerri formation is high at more than 70% because hydrological conditions are advantageous, i.e. rain percolates and is stored in the sandstone and conglomerate.

Regarding geological conditions from the Mesozoic Era and before, rock erosion and cracking have led to the formation of groundwater channels. Most of the boreholes drilled so far have targeted this type of groundwater and the success rate greatly changes depending on whether or not a rock crack with good groundwater content is selected. In terms of geological distribution, boreholes are situated in the Chad formation in 74 villages, in the Keri-Kerri-formation in 14 villages, in sedimentary layers from the Mesozoic era Cretaceous period in 11 villages and in granite gneiss in 1 village. By applying the borehole success rates for each geological classification, the number of successful boreholes can be calculated through the following formula:

Number of successful boreholes = 69 x 0.9 + 10 x 0.7 + 9 x 0.4 + 1 x 0.5

= 62.1 + 7 + 3.6 + 0.5 = 73.2

Therefore, it works out that the number of successful boreholes in the 89 target villages is

roughly 73, giving a success rate of approximately 82%.

However, this estimate applies only to power pump boreholes at deep levels, and the success rate should increase even more in the case of shallow hand pump boreholes. Moreover, RUWASA plans to utilize electrical sounding instrument supplied under the Project in selecting borehole positions and to construct hand pump boreholes under its own resources. Through implementing groundwater development while utilizing such electrical sounding instruments, the above borehole success rate should become even higher. Accordingly, the planned success rate for the Project is set at 90%.

In order to maintain the estimated borehole success rate, concerning villages where boreholes have been unsuccessful, considering that electrical sounding instruments were used to select the optimum positions of the boreholes based on hydrological and geological analysis, it is estimated that the success rate will be even lower from the second borehole onwards. In the Project, in cases where unsuccessful boreholes have been drilled in target villages, it is proposed that renewed sounding, site selection and drilling be implemented from the second borehole onwards. However, if the results of sounding indicate there is no possibility of groundwater, transferring to the next village may be considered. The utilization of electrical sounding instruments for drilling site selection is an important factor in raising the success rate of boreholes.

2-2-2-2 Equipment Plan

(1) Procured Equipment

RUWASA currently owns two used drilling rigs that were passed down from the state government, however, these are 14 and 29 years old respectively and are in badly deteriorated condition. These rigs are suited to drilling deep boreholes of 750~850 m (power pump boreholes), however, when it comes to drilling shallow hand pump boreholes, the current rigs require a lot of setup time and are inefficient.

The original request from the Nigerian side was for the drilling of 100 boreholes, however, the number of sites was narrowed down to 89 following screening of geological and social conditions. Accordingly, the equipment to be procured in the Project will consist of the following: a)borehole drilling equipment and materials (drilling rig, tools, accessories and compressor), b)survey and observation equipment and materials (geophysical survey equipment, water level meter, GPS and pump test equipment), c)support vehicle (crane truck), d)water quality test apparatus (water quality analyzers), and e)borehole construction equipment and materials (hand pumps, screen pipes, casing pipes, maintenance kits).

Table 2-2-7 shows the equipment and materials to be procured taking into account the purpose of use, the types, quantities and operating conditions of owned equipment and future plans of use, etc.

Table 2-2-7 Procured Equipment and Materials

No.	Name of Equipment	Specification/Description	Unit	Quantity
		Drilling Equipment and Tools		
1	Drilling Rig	Type : Truck mounted rig（including standard spare parts）Top head drive type Drilling Method : Mud circulation rotary and DTH drilling methods. Capable Drilling Depth : 100m Capable Drilling Diameter : Mud Drilling : 10 - 5/８″ ,DTH : 6 - 1/4″ Applicable Geology : Un-consolidated strata to hard bedrock Mobilization Method : Truck mounted. Truck Specification : 4 x 4（Front 1 axis and after 1 axis / 2 axis drives） or 6 x 4（Front 1 axis and after 2 axis / 2 axis drives ）	lot	1
2	Drilling Tools	Drill ppipe, hammer bits, work casing and all other necessary tools for the rig above described.	set	1
3	High Pressure Compressor	Supply Air Pressure : 2.01MPa（20.5kg/cm^2）or more/High pressure Supply Air Volume : 11.3m^3/min or more. Mobilization Method : Truck mounted Truck Specification : 4 x 4（Front 1 axis and after 1 axis / 2 axis drives ）or 6 x 4（Front 1 axis and after 2 axis / 2 axis drives ）	lot	1
4	Cargo Truck with Crane	Specification : 4 x 4（Front 1 axis and after 1 axis / 2 axis drives ） Load Capacity : 6.0tons or more Engine : Gasoline（water cooling） Length Carrier : 6.0m or more Crane Capacity : 2.9tons（3.0tons）	lot	1
		Survey Equipment		
5	Pumping Test Equipment	Submersible motor pump : Discharge of 30Lit./min. 70m head (1.5kW/50Hz) Engine Generator : 5kVA or more Groundwater Level Meter : Measurable Depth of 100m or more	set	1
6	Water Analysis Equipment	Measurement Items : pH, DO, EC, T.D.S, Chlorides, and Water temperature	lot	1
7	Geophysical Survey Equipmet	1) Resistivity survey equipment Electrical Sounding Instrument of Measurable depth : 100m Measuring Item : Apparent resitivity and spontaneous potential Measurable range : 0.1mV～10V Accessory : Software for interpretation Others : Applicable for logging work for 100m depth borehole (with cable and probe) 2) GPS : Measuring Item : Latitude, longitude, and an altitude Tolerance: 15 RMS	lot	1
		Borehole Construction Materials		
8	Hand Pump	VLOM type, Indian Mark III, which is the standard model of UNICEF and RUWASA	lots	89
		Repair tools for hand pump : Tools used by villagers for simple repair work	sets	89
		Repair tools for hand pump : LGA mechanics for serious repair such as parts replacement that cannot be coped by villagers.	sets	17
9	Cading Pipe	Materials : uPVC (Unplastised polyvinyl chloride) Dimension : φ4″ (O.D.114.4mm1) x 3.0m Wall thickness : 5.5mm or more Connection : screw type	pieces	1,682
10	Screen Pipe	Materials : uPVC (Unplastised polyvinyl chloride) Dimension : φ4″ (O.D.114.4mm1) x 3.0m Wall thickness : 5.5mm or more Connection : screw type Screen type : Slit type (0.8-1.0mm in width) Opening Ratio : 3% or more	pieces	297

(2) Necessity of the Equipment for Procurement and Basis for Quantities

Table 2-2-8 shows the necessity and basis for quantities of the Project equipment.

Table 2-2-8 Necessity and Basis of Quantity for Equipmement and Matrials

No	Item	Purpose	Basis of Quantity
1	Drilling rig	For drilling borehles	Existing rigs of RUWASA only are expected to drill 20 boreholes per year. In order to conduct this project (89 boreholes during 2 years, approx. 50 boreholes per year after the completion) and to improve the capacity of groundwater development, one new drilling rig is planned.
2	Drilling tools	Tools and accessories for drilling with the above rig	The quantity of tools and accessories such as drilling rods, hammer bits and casing is planned for the minimum requirements of the above rig. Consumable material will be for 98 drillings in regard of the success rate (90%).
3	High pressure air compressor	To supply compressed air to DTH hammer of drilling rig and remove cutting skim.	The existing compressors cannot be shared wit the new rig. Therefore, one air compressor is planned exclusively for the DTH hammer of the procured drilling rig.
4	Cargo truck with crane	For transportation of drilling tools and materials such as casing pipes, etc. and for supprting drilling activities at site.	One set for the one drilling rig to be procured. Therefore, One cargo truck with crane is planned for transportation and of drilling equipment, fuel, etc.
5	Pumping test equipment	For confirmation of safe yield to confirm whether drilled borehole is successful or not.	One complete set is estimated for the new rig.
6	Water analysis equipment	To confirm groundwater quality and to confirm whether drilled borehole is successful or not from the viewpoint of water quality	General items for potable water analysis will be consigned to the Water Board for testing. A portable testing set will be planned to confirm water quality at the site. The items to be tested are: pH, DO, EC, T.D.S, Chlorines, and Water temperature. One complete set will be used by pumping test team.
7	Resistivity survey equipment	For investigating geological features, depth, width of the aquifer and its depth.	In regard of maneuverability, an instrument capable to investigate the depth of 100m, and could be also used for electrical logging is planned. Additional 100m cable and sonde necessary for electrical logging is also planned as accessory. One new set of Resistivity Survey Equipment is planned.
8	Hand pump	For groundwater extraction from boreholes and for daily maintenance by village and LGA levels.	VLOM type Indian Mark III hand pump, which is standard for UNICEF and RUWASA, repair tools for community level (used for daily maintenance) and standard tools for LGA level (used by LGA mechanics for ambulant repair and for serious repair that cannot be coped by villagers) is planned for the number of boreholes to be drilled (89sets) for two years.
9	Casing pipe	Fore securing borehole and retaining groundwater.	The quantity is estimated based on 90% success rate. In regard of the average borehole depth of 60 m, the average casing length will be estimated as 51 m. Total length of casing = 51m × 89 sites / 0.9 = 5,043m 5,043m/3m = 1,682 pieces
10	Screen pipe	For groundwater extraction from aquifer	The quantity is estimated based on 90% success rate. In regard of the average borehole depth of 60 m, the average screen length will be estimated as 9m Total length of screen = 9m × 89 sites / 0.9 = 890 m 890 m/3 m = 297 pieces

(3) Specifications of Major Equipment and Materials

1) Borehole Drilling Equipment

- Drilling Rig

The specification of the drilling rig is decided based on following requirements:

①Borehole structure

The borehole is the tube well type with casing and screen pipe, as shown in the basic design drawing.

②Geological features

The geology of the area consists of very hard bedrock and sedimentary rock comprising mainly gneiss and granite. Several to tens of meters of collapsible soft and unconsolidated layer (top soil and weathered layer) are on the surface. The rig should be capable of drilling in a wide range of geological features; from soft unconsolidated layer to soft rocks, medium hard rocks and hard rocks.

③Drilling method

The drilling method is DTH drilling for the bed rock layer (hard rock such as gneiss and granite) rock, and mud rotary drilling for sedimentary layers (Chad, etc.) near the surface.

④Drilling diameter

The drilling diameter will be 10" for the relatively soft layers and weathered layers near the surface (average depth up to 10m), and 6" for deeper layers. Tri-cone bits of 10-5/8" will be used for mud rotary drilling, and 6-1/4" (156mm) hammer bits will be used for DTH drilling.

⑤Drilling depth

According to past borehole drilling records, the average drilling depth of boreholes is relatively shallow at 30~150 m in the north, whereas in the south many wells are more than 60 m deep and some reach depths of up to 600 m. Almost all these deep boreholes are motor powered, however, the estimated depth of hand pump boreholes in the Project is between 50~80 m. Accordingly, taking into account the hydrogeological conditions and potential for groundwater development, the drilling capacity of the drilling rig will be set at 100m in the Project. However, in consideration of the difficult geological conditions in the southern area containing the Keri-Keri layer and the possibility of layer collapse during drilling and so on, a rig with the lifting capacity over 6,000 kg (equivalent to 200m depth for 4-3/4") is planned.

⑥Truck to be mounted with rig

- Load capacity: the rig generally weighs nearly 10 tons in total. The truck will have the load capacity compatible to this weight.
- Drive: 4 x 4 (front 1 axis, rear 1 axis/2 axis drive) or 6 x 4 (front 1 axis, rear 2 axis/2 axis drive

- High Pressure Air Compressor

The necessary air pressure and volume is decided based on the following conditions:

①Calculation of necessary air pressure

Necessary pressure of compressor is calculated from the sum of the minimum operating pressure and water head.

· Minimum operating pressure：10.5 kg/cm^2（1.03MPa）

· Water head pressure：10.0 kg/cm^2（0.98MPa：maximum drilling depth of 100m）

Necessary air pressure = Lowest operation pressure + Water head pressure = 10.5+ 10.0 = 20.5 kg/cm^2 (2.01MPa)

②Calculation of necessary air volume

The necessary air volume is calculated using the following formula.

· Flow velocity in the space between rod and drilled wall in borehole.（V）＝ Necessary air volume (m^3/min)（Q）/ Space area between the rod and the wall of the borehole (m^2)（A）

· Space area between the rod and the wall of the borehole (m^2)（A）=1/4× π ×{（Borehole diameter (m) (D))^2－（Rod diameter (m) (D))^2}

· The flow velocity in the space between rod and drilled wall in borehole is generally from 1,200 to 1,500 m/min. The average value of 1,350 m/min is used for this calculation in the Project.

· Borehole diameter：6"（0.159m）

· Rod diameter：4-3/4"（0.121）

· The necessary air volume（Q）＝ Flow velocity in the space between rod and drilled wall in borehole.（V）×Space area between the rod and the wall of the borehole (m^2)（A）

＝ 1,350m/min×1/4× π ×{ (0.159) ^{2}－(0.121)^2}

＝ 11.3m^3/min

Thus the air compressor is planned to be a high pressure type (necessary air pressure 2.01 MPa or more) with supply air volume of 11.3 m^3/min or more.

③Truck

The air compressor requires the same mobility as the drilling rig. In consideration of the poor road conditions and long transportation distances, it should be mounted on a truck.

· Load capacity: The air compressor, along with accessories and reserve fuel weighs approximately 6.2 tons. The truck will have load capacity compatible to this weight.

· Drive: 4 x 4 (front 1 axis, rear 1 axis/2 axis drive)

- Cargo Truck with Crane (drilling support vehicle)

The cargo truck with crane is planned with the following specifications:

In regard of the weight of necessary drilling tools, casing pipes, etc., the load capacity of the cargo truck will be no less than 6 tons.

Drive : In regard of road conditions, driving conditions, travelling distance, weight of cargo, the cargo truck should be 4WD (front 1 axis, rear 1 axis/2 axis drive) with high durability.

Size of carrier : In regard of the size of the pipes, the size should be no less than 6.0 m.

Crane capacity : The load capacity of 2.9 tons (nearly 3 tons) will be planned in consideration of the general capacity of the trucks manufactured.

2) Survey and Observation Equipment

- Pumping Test Equipment

①Submersible pump : The planned extraction from the borehole is 12 liters per minute and the maximum dynamic water level is 40~60 m below ground level. Thus the specification of the pump is as follows.

・Specification：30Lit./min×70m×1.5kW×50Hz

②Generator : In regard of the load capacity (submersible pump : 1.5kW) 5kVA is planned.

③Groundwater Level Indicator : The indicator should be capable of measure up to the maximum drilling depth of 100m with a buzzer or a red lamp used as the indicator. Power should be supplied from batteries in regard of its portability, and the measuring rope should be metal cable.

(4) The Main Equipment and Materials Procurement Sources

The main equipment and materials will be procured from sources shown in the following table. The procurement prices will be decided by comparing the cost estimates from these procurement sources.

Table 2-2-9 Procurement Sources of Main Equipment and Materials

Item		Supply classification			Means
		Japan	Third Country	Nigeria	
Drilling Equipment and Tools	• Drilling Rig	●	●		These items are not produced in Nigeria. Therefore, these equipments will be procured from Japan or third country.
	• Drilling Tools	●	●		
	• High Pressure Air Compressor	●	●		
Supporting Vehicle	• Cargo Truck with Crane	●	●		This item is not produced in Nigeria. Therefore, this will be procured from Japan or third country.
Instrument and Materials	• Well Development Equipment	●	●		These items are not produced in Nigeria. Therefore, these equipments will be procured from Japan or third country.
	• Pumping test Equipment	●	●		
Survey Equipment	• Water Analysis Equipment	●	●		These items are not produced in Nigeria. Therefore, these equipments will be procured from Japan or third country.
	• Resistivity survey equipment	●	●		
Materials for construction borecholes	• Hand Pump		●	●	These items are produced in Nigeria. In this project, it is planning to be procured in Nigeria. However, need to be confirmed the quality beforehand.
	• Casing Pipe		●	●	
	• Screen Pipe		●	●	

2-2-3 Basic Design Drawings

The design drawings for the basic design are shown as follows:

- Figure 2-2-2 Standard Structure of Borehole
- Figure 2-2-3 Hand Pump Platform
- Figure 2-2-4 Soakage Pit
- Figure 2-2-5 Standard Structure of Platform Plan

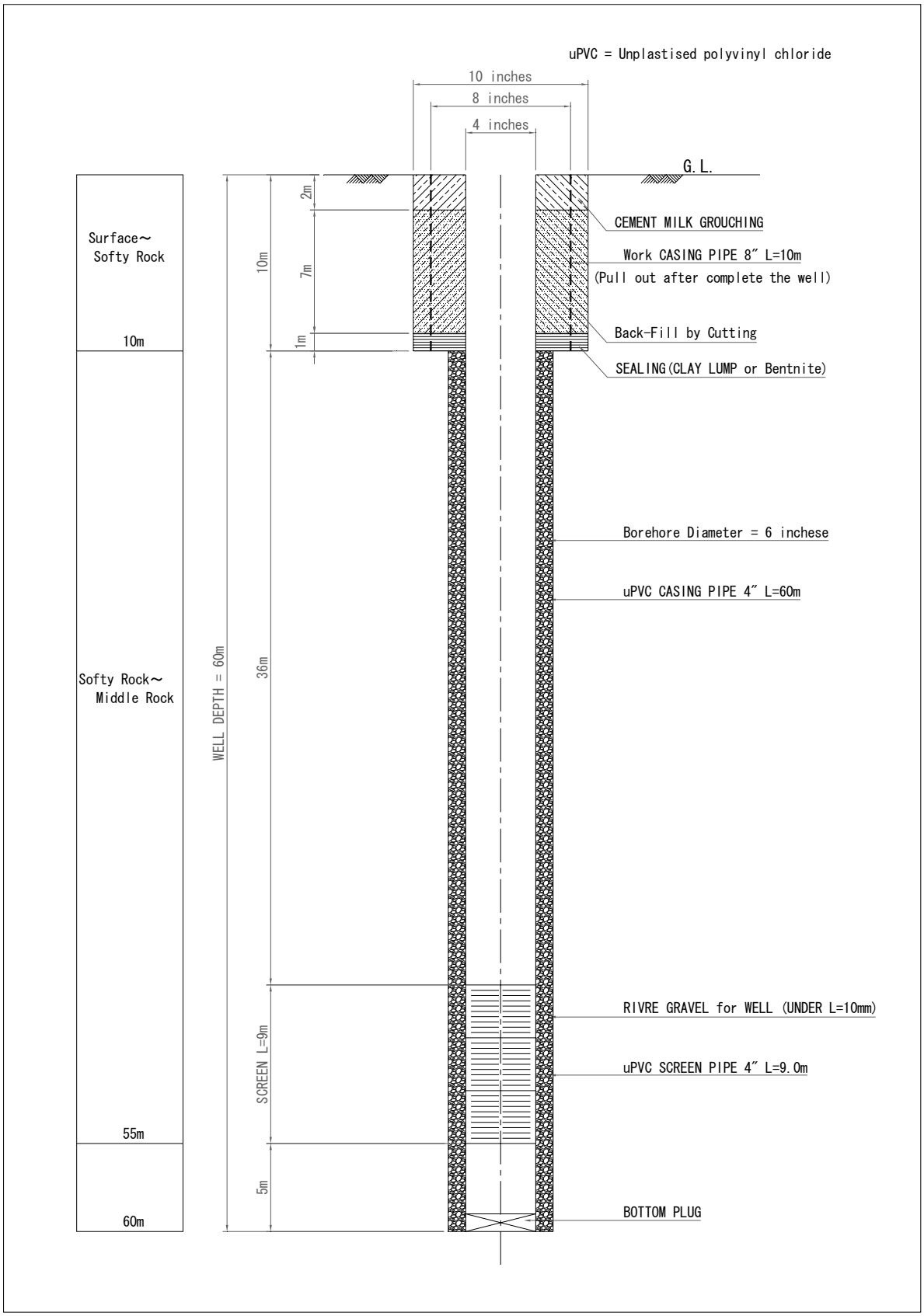


Figure 2-2-2 Standard Structure of Borehole

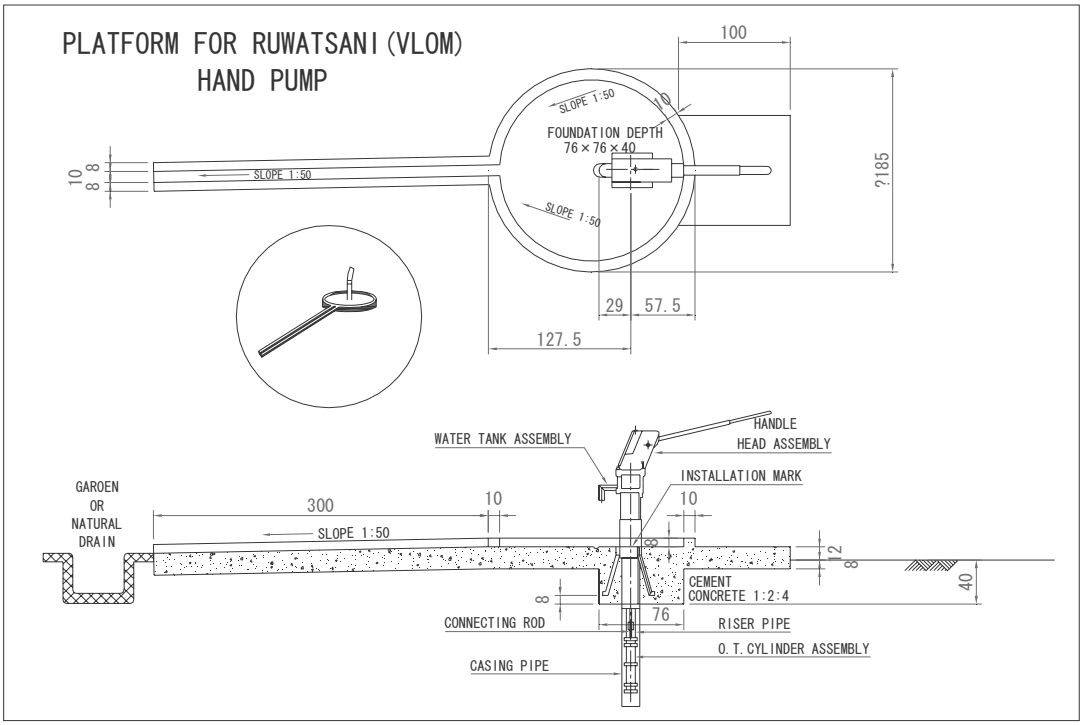


Figure 2-2-3 Hand Pump Platform

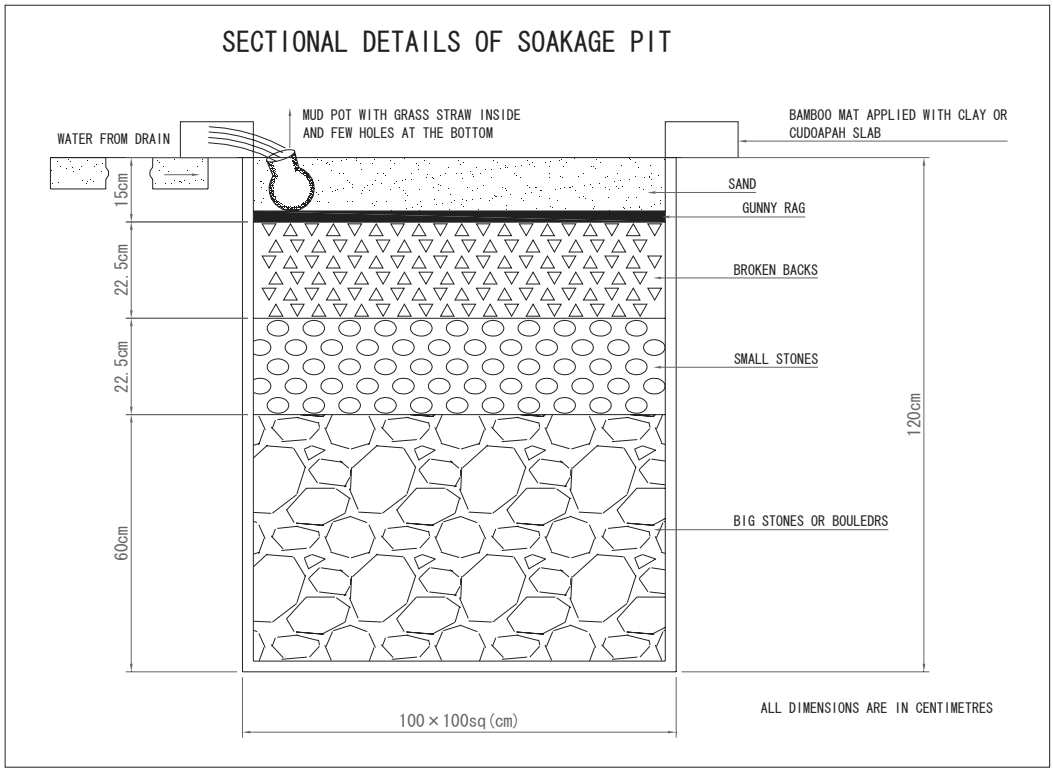


Figure 2-2-4 Soakage Pit

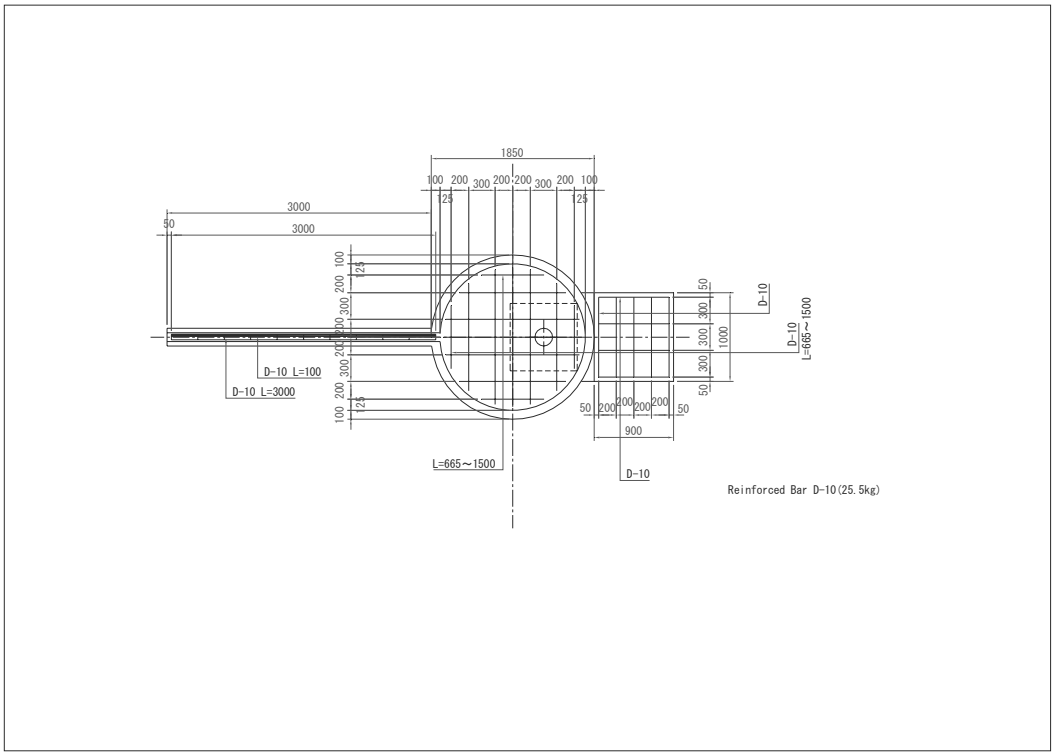


Figure 2-2-5 Standard Structure of Platform Plan

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The procurement plan will be planned based on following policy:

1) The procurement plan of equipment and materials should be suited to the construction schedule of RUWASA.
2) Selection of the equipment and materials should consider the availability and acquisition routes of spare parts and consumables, environmental conditions of use in Nigeria and the system of maintenance.
3) The most advantageous procurement source of equipment and materials for Nigeria shall be selected out of Nigeria, third countries and Japan with consideration given to technical levels and operation and maintenance conditions of RUWASA.
4) The equipment and materials shall be selected under the international standards of BS, DIN, ASTM, JIS and so on in consideration of easier quality control and schedule management, however, materials that have been approved under local standards shall be included in the procurement scope.
5) RUWASA will have responsibility for operation and maintenance of procured equipment and materials.
6) Each community will have responsibility for the operation and maintenance of water supply facilities.

2-2-4-2 Implementation Conditions

On procurement of equipment and materials, attention should be paid to the following points.

1) Smooth custom clearance of equipment and materials, and registration of vehicles by the Nigerian side for inspection and commissioning for operation and maintenance of the equipment by the engineers dispatched by the supplier.
2) Approval of import, customs clearance, and other import procedures by the Nigerian side.
3) Confirmation of progress of transportation by the supplier, customs clearance and any troubles during and after handover and storage.
4) Confirmation of conditions regarding complex procedures at the port of unloading (Lagos) in Nigeria.

2-2-4-3 Scope of Works and Responsibilities

The Japanese side has responsibility for work until handing over the equipment and materials to RUWASA. The Nigerian side has responsibility for operation and maintenance of the equipment and materials after handover. The Nigerian side will be also responsible for management of construction works utilizing the procured equipment and materials, and

operation and maintenance of the completed water supply facilities.

The Japanese side shall carry out the transfer of technology for quality control, construction method, schedule management and work management to RUWASA through the soft component. However, the Japanese side will not be responsible for supervising the construction works. The responsibility for procurement of necessary materials for construction of water supply facilities shall be allocated as shown in the following table.

Table 2-2-10 Allocation of the Procurement

Materials	Nigerian side	Japanese side
Casing pipe		○
Screen pipe		○
Hand pump		○
Consumable materials for drilling such as bentonite, cement, gravel, sand, steel bar and fuel	○	

2-2-4-4 Consultant Supervision

Consultant and Contractor will collaborate and execute the following procurement supervision to secure the smooth execution of tendering, design, procurement/manufacture, transportation, delivery and installation, etc. of the equipment and materials.

1) Procurement Planner of Consultant
   - Preliminary discussions with contractors
   - Checking of approval documents, etc.
   - Confirmation of the ordering contents
   - Inspection and confirmation at the plant
   - Pre-shipping inspection
   - Confirmation and witnessing of the handover of equipment and materials
   - Confirmation of transfer of technology (OJT), user manuals and maintenance manuals, etc. provided by the contractor

2) Contractor
   - Dispatch of engineers to Nigeria for confirmation of equipment and materials when they arrive at Lagos port
   - Contractor shall give explanations to engineer staffs of RUWASA concerning the operation and usage of rig, trucks, and resistivity survey equipment, etc.

2-2-4-5 Procurement Plan

In principle, procurement plan for equipment and materials will consider the possibility of procurement from Nigeria and third countries so as to secure aftercare services and reduce cost.

1) Rig and drilling tools

Rig and drilling tools are neither manufactured nor assembled in Nigeria. Thus these equipment and materials will be procured from Japan or a third country. Procurement will be performed through a rig manufacturer that is capable of local aftercare service.

2) Equipment and Materials for Construction of Boreholes

- Hand Pump

  Standardization of hand pumps is currently being advanced in Nigeria under support from UNICEF, and repair skills are high. Acquisition of spare parts is easy, and thus the same type of products will be procured in the Project. Since hand pumps are manufactured in Nigeria and there are local importers, they will be procured locally or from a third country.
- Casing and Screen Pipes

  Casing pipes and screen pipes made of un-plasticized polyvinyl chloride (uPVC) can be procured in Nigeria. Some companies are capable of producing pipes that meet international standards. Therefore, these pipes shall be procured locally in Nigeria

2-2-4-6 Quality Control Plan

Since the quality of borehole is greatly influenced by the finishing procedure following drilling, advice shall be provided on incidental facilities such as the apron and drainage system to ensure that the borehole water supply facilities can be used over the long term. Therefore, the consultant and procurement contractor will implement the following guidance before and after the handover of equipment and materials.

1) The consultant's person in charge of the "soft component" (before supply of equipment)

- Hold a workshop on quality control in order to convey the importance of quality control to the local side.
- Prepare and utilize a check list for quality control.

2) The procurement contractor's person in charge of guidance for construction method

- Implement OJT regarding borehole drilling technology, i.e. the method of borehole drilling and finishing.
- The apron should be constructed in conformity with standard drawings, and guidance of concrete work will be carried out.
- Provide guidance on the sure installation of drainage ditches and soakage pits, etc.

2-2-4-7 Soft Component (Technical Asssitance) Plan

There is deemed to be no problem regarding the willingness and capability of Yobe State government, RUWASA and local residents to operate and maintain the Project equipment

and materials. Therefore, in order to ensure the sustained operation and maintenance of water supply facilities through the efficient operation of procured equipment, technical support shall be conducted in the following two areas under the "Soft Component" of the Project.

① Technical training for construction management

② Strengthening of operation and maintenance system for water supply facilities

The above soft component shall be kept to a minimum in terms of scale. Concerning the implementation method, the Japanese consultant shall conduct overall supervision and guidance, while the local consultant shall be responsible for some of the activities. The soft component will be completed before the handover of procurement equipment and materials.

(1) Necessity for Introduction of the Soft Component

1) Technical Training for Construction Management

In the Project, construction of 89 boreholes is planned for two years. Then RUWASA continues to construct boreholes after that by a procured drilling rig. The training of management in areas such as preparation of implementation plans for construction, as well as the strengthening of the technical side such as handling of equipment, operation and maintenance of equipment, drilling technique of boreholes and capacity of supervision, is essential for effective implementation of construction through the efficient utilization of equipment and materials procured in this project. Such training will enable the effective utilization of the limited human and financial resources of RUWASA for construction management. Through implementing construction based on a planned and controlled construction period, the Project will be smoothly implemented with minimized time loss due to idling, insufficiency of equipment and accidents, thereby enabling the Project effect to be realized to the full.

Also, regarding the maintenance situation of existing equipment in RUWASA, there is a repetitive pattern of breakdowns and repairs. RUWASA has no systematic maintenance inventory (record) and there are no routine maintenance activities for the prevention of breakdowns. For these reasons, equipment breakdowns occur frequently, disturbing the progress of drilling.

Therefore, it is necessary to provide guidance on the preparation of maintenance records based on a standard format and compilation of appropriate plans for maintenance and renewal of equipment. Equipment breakdowns can be prevented to a certain extent through implementing daily inspections and preventive maintenance.

2) Strengthening of Operation and Maintenance System for Water Supply Facilities

The RUWASA system of water and sanitation services consists of the following: request of construction of boreholes, securing of budget for implementation, site survey (natural conditions, social conditions), construction of facilities, water quality testing, and

community mobilization immediately after construction. After handing over of the water supply facilities to the community, a VWESC (Village Water and Environment Sanitation Committee) is organized by residents of the community, and VWESC carries out the operation and maintenance of the facility. Staff of the LGA Unit, which belong to O/M Department of LGA, assist the VWESC. This system is not appropriately functioning, as it is not well understood by the staff of RUWASA, LGAs and residents of the communities.

The causes of these problems are namely: insufficient cooperation among relevant stakeholders, inadequate management due to insufficient technical knowledge and skill of RUWASA staff, and absence of guidance and training for RUWASA staff. In order to establish a sustainable operation and maintenance system for water supply facilities, it is necessary to review the system of water supply and sanitation services by RUWASA and to strengthen the cooperation system between relevant stakeholders. Furthermore, in order to aid the establishment of resident organizations and ensure the proper implementation of community mobilization activities, capacity building for RUWASA staffs shall be promoted through supporting their acquisition of specialist know-how and skills.

(2) Soft Component Targets

1) Technical training for construction management

① Construction of boreholes will be implemented continuously based on the construction plan.

② Sustainable supporting system for borehole construction will be established by improvement of management system for equipment and materials.

③ Operation and maintenance system for water supply and sanitation services will be established through development of a borehole inventory.

④ Borehole management capacity will be enhanced.

2) Strengthening of operation and maintenance system for water supply facilities

① The system and contents of water supply facilities operation and maintenance work will be clarified, thereby enabling the sustained operation and maintenance of facilities to be implemented.

② Educational activity toward VWESC and support for establishment of resident organizations through cooperation between RUWASA and LGA Units will be implemented continuously.

③ VWESC will be established in each community for the autonomous operation and maintenance of water supply facilities.

④ Community selection and monitoring of operation and maintenance system based on manuals will be implemented continuously.

⑤ Capacity building of LGA Unit staffs in water supply and sanitation sector will be conducted by RUWASA staffs.

(3) Outputs of the Soft Component

The direct outputs of the soft component in the Project will be as follows.

1) Technical training for construction management
   ① Construction periods of boreholes will be adhered to and borehole construction plans will be compiled.
   ② Maintenance plans for equipments and materials will be prepared.
   ③ Borehole inventories will be developed.
   ④ Pumping test data will be effectively utilized.

2) Strengthening of operation and maintenance system for water supply facilities
   ① Comprehensive system for water supply and sanitation services will be established, and work contents will be made clear.
   ② Work management rules will be established for support of VWESC by RUWASA and LGA Units, and the division of support responsibilities will be clarified.
   ③ VWESC will be established in model communities, while at the same time RUWASA and model LGA Unit employees will acquire know-how on organizing residents and conducting mobilization activities.
   ④ Monitoring implementation methods will be determined and compiled into manuals.

(4) Soft Component Activities

Contents of Activities

The support activities will consist of the following two items.

1) Technical training for construction management

Before start of construction, the Japanese consultant will provide guidance on compilation of borehole construction plans and equipment and materials maintenance plans to the staffs of the Technical Services Department, Drilling Section and Planning Section of Rural Water Supply Department of RUWASA with a view to strengthening the works management capacity of RUWASA. Moreover, the Japanese consultant will carry out capacity building for RUWASA personnel through conducting guidance on borehole database management and pumping testing analysis to staffs of the Hydrogeology Section of Rural Water Supply Department.

2) Strengthening of operation and maintenance system for water supply facilities

It is necessary to strengthen the operation and maintenance system to ensure the long-term use of water supply facilities. Support will be provided in order to consolidate the water supply and sanitation services of RUWASA and to bolster the organizations of RUWASA, LGA Units and VWESC and cooperation between the stakeholders.

Table 2-2-11 shows the contents of activities.

Table 2-2-11 Contents of Soft Component Activities

1) Techical Training for Construction Management

Activities	Contents	Detail contents	Output
1.Planning of borehole construction	1-1. Scheduling of engineers and management plan for the construction 1-2. Olanning of a work schedule for the construction. 1-3. Planning of safety management	① To organize a construction planning team in RUWASA ② To make a working plan for the construction ③ To share related construction work as reference, and then to make a list of quality control ④ To make a work schedule of the construction ⑤ To make safety management plan for the construction work （see Note 1 for detail）	1. Construction period of borehole will be kept on the basis of the established borehole construction plan. 2. Management plan for equipments and materials will be prepared. 3. Borehole inventory will be constructed. 4. Pumping test data will be used efficiently.
2. Maintenance planning of equipment and materials.	2-1. Planning of maintenance work	①To organize a maintenance planning team in RUWASA. ②To make a management list for maintenance work such as, working plan, list of maintenance records etc. ③To maintain equipments and materials beforehand to avoid any accident. （see Note 2 for detail）	Inputs / Equipment 1. Japanese Consultant (1person) Local Consultant (1person) 2. Vehicle rent： for Japanese consultant x 37 days 3. Preparation of documents 1 set
3. Administrative procedure of borehole inventories	3-1. Preparation of borehole inventories	①To collect esisting boreholes data、create data format ②To input existing borehole data into a computer.	
4. Pumping test analysis	4-1. Methodology of pumping test analysis	①To understand the methodology of pumping test analysis ②To organize usage plan of pumping test data	
Facilitator 1.Japanease Consultant (1 person) 2.Local Consultant (1person) Target group : Staff of RUWASA 1.Construction Planning team： Water supply section 5 persons 2. Maintenance planning team： Technical service section 5 persons 3. Borehole inventory team： Planning and evaluation section 4 persons 4. Pumping test team： Rural water supply setion 5 persons	Note 1.Training for borehole construction planning (a) Explanation of outline of the project, importance of responsibility of personnel in charge and cooperation among related departments (b) Preparation of a list of the contents in the construction plan (c) Questions and answers (d) Instruction on quality, work period and safety management (e) Advice on organization of borehole team (f) Advice on the construction period (g) Preparation of a check list of quality control (h) Sharing related constructions as examples among participants (i) Making construction plan 2.Training for maintenance planning of equipments and materials (a) Explaining the importance of maintenance of equipments (b) Explaining the necessity of setting up maintenance standard and conducting regular maintenance for a certain period and daily maintenance (c) Questions and answers (e) Preparation of a digital stock list (f) Filing of stack list and documents. Keep this file in right place that easy to handle by any staff (g) Training of how to make a annual maintenance plan by maintenance records		

2) Strengthening of O & M System for Water Supply Facility

Activities	Contents	Detail contents	Out put
1. Reviewing and arrangement of the Water supply and sanitation service by RUWASA	1-1. Verification of water supply and sanitation service system	① To select a LGA as model and organize a working team (see Note 1) ② To review the existing service of water supply and sanitation ③ To clarify work of O/M system ④ To define demarcation of work among RUWASA, LGA Unit and VWESC	1. Contents of water supply and sanitation services will be made clear within RUWASA. 2. Demarcation of responsibility on supporting VWESC between RUWASA and LGA will be made clear by the regulations of work management. 3. VWESC will be established in a model community and RUWASA staffs will learn know-how of community organization. 4. O&M manual for water supply system including criteria of community selection and implementation method of monitoring O&M system will be prepared.
2. Strengthening of cooperation between RUWASA and LGA	2-1. Verification of role between RUWASA and LGA in the service.	① To hold a meeting with selected LGA Unit (Introduction of the project, request of cooperation and confirmation of LGA unit condtion)	
	2-2. Setting up regulations for O&M of work	① Consideration of regulation for O/M work, such as system to supply spare parts, regulary meeting, supporting to VWESC ② Setting up regulation for O/M work	
3. Organization of VWESC, and activity of community mobilization in model community (see Note 2)	3-1. Verification of work sharing	① To select one targeted village as model community of LGA ② To introduce the water supply and sanitation service of RUWASA to the targeted community.	
	3-2. Setting up VWESC	① To explain necessary and role of VWESC, and O&M of water supply facility. ② To select relevant members of VWESC, and preparing the member list	
	3-3. Community mobilization for O&M cost	① To explain O&M cost for water supply facility ② To discuss about O&M cost (cost of water charge, frequency of payment, the method of payment, the way of collecting and keeping money in the committee, etc.) ③ To make a rule for O&M cost in VWESC through workshop in the community	Inputs / Equipment 1. Japanese Consultant (1person) Local Consultant (1person) 2. Vehicle rent : for Japanese consultant x 35 days for Local consultant x 3 days 3. Preparation of documents 1 set
	3-4. Promotion of hygiene education（see Note 4）	① To promote hygiene education on environment around water supply facilities and households, etc	
	3-5. Training for maintenance and technique of water supply facility (see Note 5)	① To explain how to cope with broken boreholes (demarcation of roles and communication system) ② To train local borehole engineers how to check and maintain boreholes (including distribution of manuals)	
4. Clearification of procedure of monitoring	4-1. Procedure of monitoring	① To examine the approach of monitoring and the report format ② To conduct monitoring survey in model community (regarding VWESC, water facility, water-borne disease, population etc.) ③ To make a report on the results of the monitoring by staff of LGA ④ To understand current issues and examine improvement of problems based on monitoring report, and to prepare a manual for monitoring	

<Working team> 1. Japanease consultant: Facilitator (1 person) 2. Staffs of RUWASA 3 to 5 persons 3. Staff of LGA Unit 2 persons Total 8 persons <Adviser> 1.Staff of UNICEF (Rural water supply system, Hygiene education) Target group：Staff of RUWASA Participation：1 model LGA, 1 model community	Notes: 1. Working team is composed of 3～5 members from selected each department in RUWASA, 2 members of model LGA Unit, and Japanese consultant (1 person) : totally 8 members. 2. Interviewees of the survey is members of VWESC constructed by RUWASA (1or 2 persons) and members of LGA Unit. 3. The staff of Planning and mobilization division and staff of LGA Unit carry out the workshop in community. 4. Promotion activities of hygiene education are carried out twice, and one of the project target encourages participation of women. 5. Training of maintenance technique is conducted to Local Hand pump mechanics and VWESC members in community of model LGA that have existing water facility constructed by RUWASA

Detailed Input Plan

Table 2-2-12 shows the input plan of human resources and equipment and materials, etc. required in the soft component.

Table 2-2-12 Detailed Assignment Plan

	Supporting item	Activities	Contents	1	2	3	4	5	Place	Output	Documents
Technical Training for Construction Management	Guidance of Construction Management	Preparation	Preparation of text						Japan		・Training text
		Mobilization							Mobilization		
		Planning of borehole construction	Planning of personel and management program						Damaturu city	・To comply with the constructio period of the water supply facility is preserved. ・Construction plan for borehole is prepared accordingly.	・Borehole construction manageneent manual (Construction plan) ・Safety control manual (Safety control plan)
			Planning of construction program								
			Planning of safety control program								
		Maintenance planning of equipment and materials	Planning of maintenance program							・Management plan for equipment and materials is prepared.	・Planning of management for equipment and materials
		Administrative procedure of borehole inventories (facilitated by local engineer)	Preparation of hand pump wells records							・Borehole inventories record is arranged.	・Format of borehole inventory record
		Pumping test analysis	Methodology of pumping test analysis							・Pumping test data is used efficiently.	・Manual of pumping test analysis
	Evaluation and reporting of activities	Evaluation and reporting of activities									・Final report of activity ・Activity record photo
Strengthening O/M system for water supply facility	Cooperation of strengthening O/M system for water supply facility	Preparation	Preparation text						Japan		・Training text
		Mobilization							Mobilization		
		Reviewing and arrangement of the Water supply and sanitation service by RUWASA	Preparation, establishment of working team						Damaturu city、Model 1 LGA, Model 1 community	・The system of water supply and sanitation sevice is prepared and the contents is defined.	・Brochure of water supply and sanitation service
			Preparing manual for water supply and sanitation institution								
		Stengthening of cooperation between RUWASA and LGA	Verfication of work sharing, and Preparing regulation for O&M of work.							・The regulations of management to assist VWESC by RUWASA and LGA is made and burden sharing is defined.	・Regulations of management to assist VWESC
		Clarification of criteria of site selection and procedure of monitoring (facilitated by local engineer)	Setting for basis of site selection, Monitoring							・The criteria for site selection is established and a way of monitoring is chosen and those manual are prepared.	・Manual for monitoring of water facility
		Organization of VWESC, and activity of community mobilization in model community	Strengthening of VWESC and Training for Community mobilization activity							・VWESC is established in a model commnunity. Also staffs of RUWASA and LGA unit are lean the know how of commnunity mobolization acitivity.	・Member list of VWESC, Regulations of management for VWESC. ・Hand pump maintenance manual ・Document and poster for hygiene education and community mobilization
	Evaluation and reporting of activities	Evaluation and reporting of activities									・Final report of activity ・Activity record photo
Evaluation	Evaluation for accomplishment of output about soft component	Mobilization							Mobilization		
		Evaluation for accomplishment of Output							Damaturu city		・Final report of soft component (JICA)

Assignment Plan	Human resouce		1	2	3	4	5	Quantity	Note
	Japanese side	Techinical Training for Construction Management: Japanese consultant (1)						1.89M/M	In Japan : 0.23M/M In Nigeria : 1.69M/M
		Techinical Training for Construction Management: Local consultant (1)						5 days	Local consultant (Administrative procedure of borehole inventories)
		Strengthening of O&M System for Water Supply Facility: Japanese consultant (1)						1.46M/M	In Japan : 0.23M/M In Nigeria : 1.33M/M
		Strengthening of O&M System for Water Supply Facility: Local consultant (1)						6 days	Local consultant (Administrative procedure of borehole inventories)
	Nigerian side	Working team of construction management (4～8 in each activi							Water supply section、Technical survice section、Planning and evaluation section、hydrogeology section 4～8 persons
		Working team for strengthening of O/M system for water supply facility (7)							RUWASA : 5 persons LGA : 2 persons (Hand pump mechanics 1 person、Health care women 1 person)
		Adviser from UNICEF						2 days	UNICEF expert
	Vehicle		1	2	3	4	5	Quantity	Note
	Japanese side	4WD						7 days	For Japanese consultant: Strengthening of O&M System for Water Supply Facility
								3 days	For Local consultant: Strengthening of O&M System for Water Supply Facility
		Sedan						40 days (35+5)	For Japanese consultant: Techinical Training for Construction Management
								25 days	For Japanese consultant: Strengthening of O&M System for Water Supply Facility
	Working space, meeting room and others		1	2	3	4	5	Quantity	Note
	Nigerian side	Working room						About 3 month	
		Meeting room						2 days	Meeting with LGA
		Others							

(5) Procurement of Implementation Resources for the Soft Component Activities

The support items and methods of procurement for implementation resources under the soft component in the Project are as indicated below.

Table 2-2-13 Implementation Resource for Soft Component

Assitance Item	Activity	Formation	Implementation Resource
1）Techinical Training for Construction Management	①Guidance of Construction Management	Management Assistance	Japanese consultant (a part of activities will be carried out by local consultant resource)
2）Strengthening of O&M System for Water Supply Facility	①Cooperation Strengthening of O&M System for Water Supply Facility	Management Assistance	Japanese consultant (a part of activities will be carried out by local consultant resource)

1) The Japanese consultant and local consultant will implement the technical training for construction management with respect to RUWASA employees of the Borehole Section, Hydrogeology Section of Rural Water Supply Department and Technical Service Department. The main support areas will be items directly relating to the practical work of borehole construction planning, equipment and materials maintenance planning, borehole inventory preparation and analysis of pumping test data, etc. The support will be conducted with the goal of promoting the efficient construction of facilities within time constraints by utilizing the equipment procured in the Project. The local consultant will implement support for the analysis of pumping test data.

2) The Japanese consultant and local consultant will implement guidance on the strengthening of operation and maintenance system for water supply facilities with respect to RUWASA employees of the Regional Water Supply Department, Engineering Services Department and Public Sanitation Department prior to the procurement of new equipment and materials and construction of water supply facilities. The main support areas will be items directly relating to establishment of the RUWASA water supply facilities operation and maintenance system, strengthening of links between RUWASA and LGA, organization of VWESC and mobilization of residents in villages, and monitoring work. The local consultant will implement support relating to the promotion of monitoring.

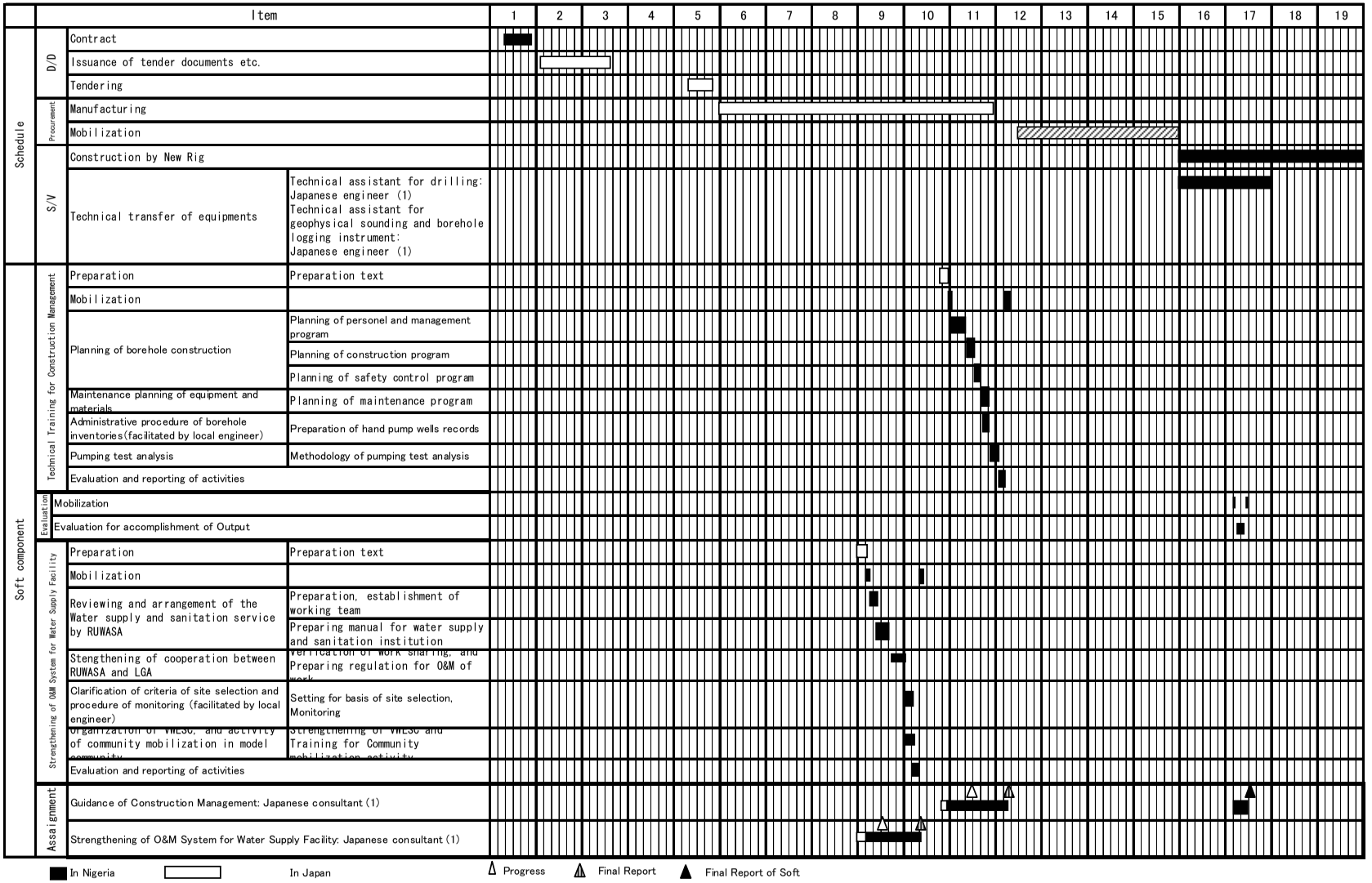
(6) Soft Component Implementation Process

The soft component will be implemented before the start of borehole construction works. Guidance will be conducted in the two areas of technical training for construction management and strengthening of operation and maintenance system for water supply facilities during the rainy season when the RUWASA staffs have more freedom to participate. It is planned to implement the guidance for strengthening of operation and maintenance system for water supply facilities for 1.4 months from 8 months after conclusion of the consultant contract. Immediately after that, technical training for construction management will be implemented for 1.5 months. Confirmation of the degree of achievement of the overall soft component outputs will be implemented for 0.3 months

approximately 5 months after completion of the soft component activities.

Table 2-2-14 shows the implementation schedule of the soft component.

Table 2-2-14 Implementation Schedule of Soft Component



2-2-4-8 Implementation Schedule

The equipment and materials will be procured from Japan, a third country or in Nigeria. If procuring from Japan, it will require approximately 9 months comprising 6 months to manufacture the equipment (drilling rig) and 3 months for transportation including customs clearance.

The newly procured rig will be used to drill the 89 boreholes. The standard construction schedule for one borehole is as follows.

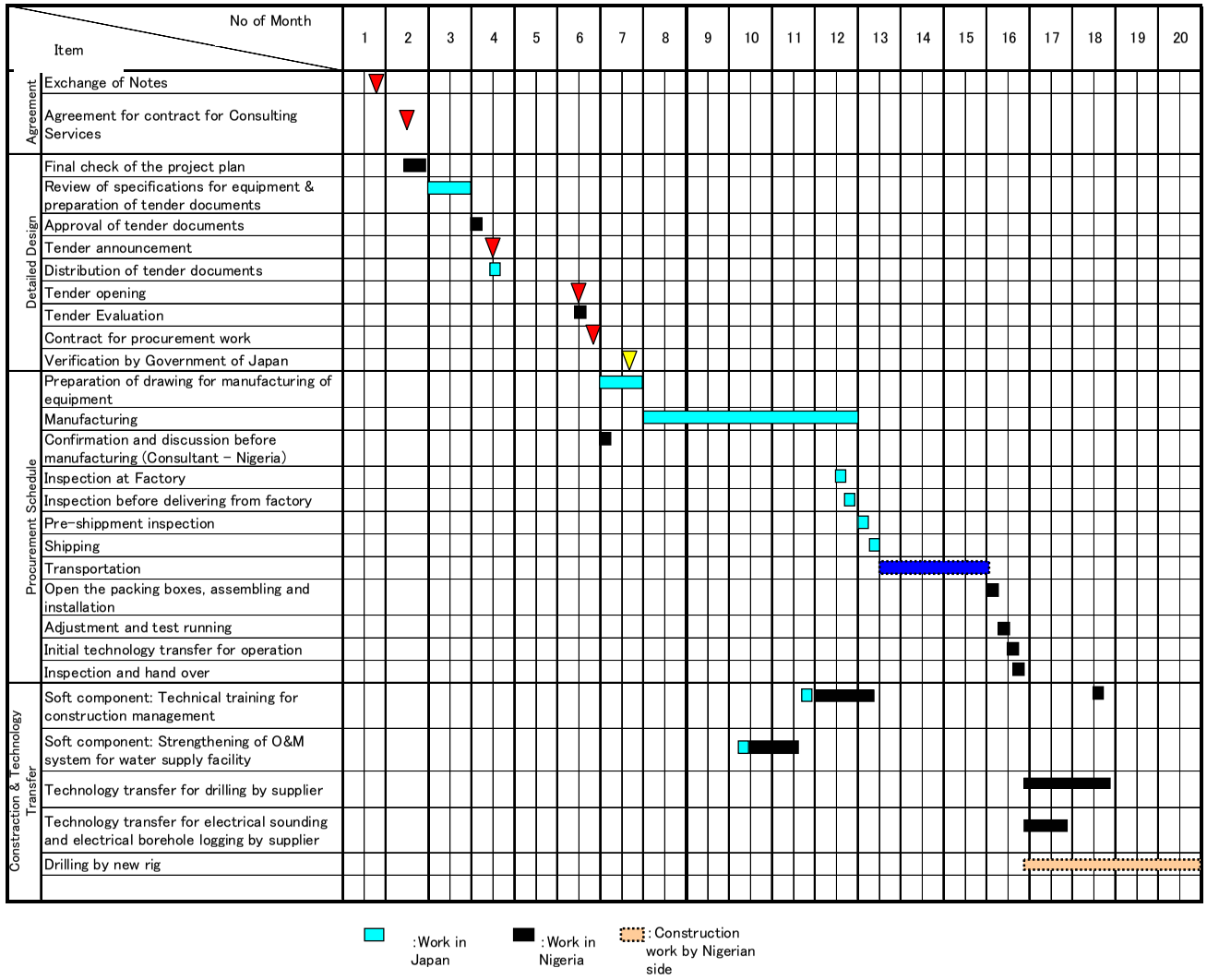
- Drilling work (4.0~6.0 days)
- Pumping test (4.0 days)
- Platform construction (2.0 days)
- Hand pump installation (4.0~6.0 days)
- Handover and fence installation (by residents)

Separate teams will be organized to implement each item of work. Taking into account the drilling period during which the rig is in use, it will be possible to construct between 60~84 boreholes per year using the new rig. Taking into account the rainy season, the actual figure will be more like 50~70.

In other words, conservatively assuming the drilling capacity of the new rig to be 50 boreholes per year, it should be amply possible to drill 100 new boreholes over two years.

Table 2-2-15 shows the draft implementation schedule.

Table 2-2-15 Implementation Schedule (Draft)



2-3 Obligations of the Government of Nigeria

The scope of works of the Japanese side in the Project covers the procurement of equipment and materials for construction of borehole water supply facilities and technical support via the soft component. As for the construction of water supply facilities including the selection of sites, both governments have agreed that the Nigerian side will take responsibility. The specific scope of works of the Nigerian side is as indicated below.

(1) Construction of Borehole Facilities

Item	Obligations of Nigerian Side
Borehole Construction Work	・ Mobilization of drilling rig, setting and dismantling, ・ Drilling, electrical logging, casing pipe installation, gravel packing, backfilling, cementing, pumping test, water quality analysis, finishing ・ Hand pump installation, platform construction ・ Necessary equipment & materials for construction such as fuel, bentonite, chemical agent, sand and gravel, reinforcement steel bar, lubricant, water, and cost of other consumables etc. ・ Vehicle and labor expense for construction work. ・ Common temporary work expense ・ Site expenditure, etc
Cost	・ The cost for construction work and management.
Construction Period	・ Preparation of construction schedule. ・ Completion of 89 boreholes construction within the period of two years. After that, continuous construction for three years. If the construction will not be completed, Nigerian side will take up the responsibility to complete the construction.
Sitting	・ Prior to commencement of construction, the sitting for the sites will be conducted by Nigerian side.
Quantities of construction materials	・ Nigeria side will be responsible for construction materials exceeding 89 sites.
The method of delivery Materials	・ Transportation of equipment & materials from RUWASA office in Damaturu, Yobe state to each site. ・ Management of the equipment and materials.
Exemption of taxes	・ Nigeria side will prepare the necessary documents for custom clearance before arrival of the equipment and materials at Lagos port, and Nigeria side will carry out customs clearance.
Quality control and Inspection	・ Nigeria side will undertake the responsibility of quality control and compliance to specifications, etc.
Safety/ Security measures	・ Responsible for any accident during construction. ・ Anti-theft measures of the equipment and materials at the sites.
Special Attention	・ The progress report of the work shall report monthly to Japanese side.
Others	・ Improvement of access road ・ Construction of fences around the boreholes.

（2） Others

- To provide necessary data and information for the implementation of the Project
- To secure the construction sites for the Project, and to clear, level and reclaim them prior to the commencement of the construction.
- To provide office and counterparts free of charge to Japanese consultant.
- To bear the following fees to arising in accordance with the Banking Arrangement (B/A) and the Authorization to Pay (A/P)
- To ensure prompt unloading and customs clearance of the materials and equipment procured by the Project on arrival in Nigeria.
- To exempt Japanese officials from customs duties, internal taxes and other fiscal levies, which may be imposed in Nigeria with respect to the supply of products and services under the verified contracts
- To acquire number plate registration numbers for the vehicles procured in the Project
- To maintain and use properly and effectively the facilities constructed and equipment provided under the Project.
- To take the measures necessary for the safety and security of the Japanese engineers.
- To provide counterparts to the soft component activities as a working team, and to participate in the training workshop for RUWASA employees.
- To set up the pumping test team.

In order to effectively utilize and operate the drilling equipment procured by the Nigerian side so as to improve the water supply rate and ensure safe water supply to residents in rural areas, it is necessary for Yobe State to secure the water supply utility budget and to sustain the organization and technical capability of RUWASA, which is in charge of the regional water supply service.

2-4 Project Operation Plan

2-4-1 Operation and Maintenance of Borehole Drilling Equipment

< Management >

The construction procedure for boreholes utilizing the Project equipment is composed of geophysical survey, drilling, pumping test, construction of apron and hand pump installation. RUWASA is responsible for execution of the construction works, and the equipment and materials procured are to be set up in the RUWASA office. The necessary staffs of RUWASA for the Project are shown Table 2-4-1. It is judged that the present RUWASA staff will be able to conduct the work.

Table 2-4-1 Necessary Staff for the Implimentation of the Project

Work contents	Team component	No of present staff	Necessary staff for the Project	Remark
①Geophysical survey (Siting)	Geophysist 1 Assistant 3	Hydrogeology team is planned	2 (2 workers at site)	Water supply dep・hydrogeology section (5)
②Drilling	Chief driller 1 Assistant driller 1 Mechanics 1 Driver 2	30	5	Water supply dep・drilling team
③Pumping test	Engineer 1 Plumber 1 Assistant technitians 2	Drilling team is planned	4	Water supply dep・hydrogeology section (5)・drilling section (27)
④Hand pump installation	Engineer 1 Assistant technitians 2	1 2	1 2	Water supply section・pump installation team
Total		33	14	

① Geophysical survey equipment

An electrical sounding instrument, which can also be used for logging work, will be introduced in the Project. RUWASA currently does not have geophysical survey equipment and does not implement geophysical sounding in site selection. However, because the staff of the responsible section (Hydrogeology Section of Rural Water Supply Department) in RUWASA has good computer skills and a solid knowledge in geophysical sounding, it is considered that they can implement electrical sounding. It will be necessary to make up for their lack of experience in the field through providing technical guidance in electrical sounding instrument operation via OJT.

② Borehole drilling

The RUWASA drilling engineers have basic knowledge of drilling technology judging by the results of the field study. Therefore, it is considered the staff of RUWASA will be able to operate the new rig and drilling equipment procured in the Project. However, transfer of technology will need to be conducted regarding mud circulation rotary drilling using the new rig, guide pipe installation and removal, and DTH drilling through OJT on the ground.

③ Hand pump installation

The RUWASA engineers are considered to possess ample experience and ability to install hand pumps. However, regarding the maintenance of facilities following construction, support will need to be provided under the soft component in order to improve sustainable operation and maintenance by the VWESC.

< Maintenance System >

The scope of maintenance work pertaining to the drilling equipment, support vehicles and geophysical sounding instruments, etc. to be procured in the Project is as follows.

- Daily and regular inspection of the equipment
- Maintenance inspection and repair of the equipment on works sites
- Maintenance and storage of construction tools

- Repair of breakdowns
- Management and storage of the materials
- Arrangement of manuals and technical documents

The Rural Water Supply Department Hydrology and Geology Section will be responsible for the maintenance of the geophysical sounding equipment, whereas the Engineering Services Department will be in charge of the other procured equipment and materials. As is shown in Table 2-4-2, the RUWASA repair workshop has personnel capable of conducting simple vehicle repairs, welding work, and maintenance of compressor engines and generators, etc. Although the Project will lead to RUWASA having more equipment on its hands, it will be able to handle the extra maintenance thanks to the implementation of operation and maintenance guidance in the soft component.

Table 2-4-2 Staff of Workshop in RUWASA

Section	No of staff	Contents
Management of stored materials	1	Administration and service section is responsible
Mechanices	7	Check and repair for rig, trucks and compressor. Assembling and processing simple machines
Electrician	3	Welding works
Operator for the equipment	6	Maintenance of compressor and generator, etc.

2-4-2 Operation and Maintenance of Water Supply Facilities

Regarding the current maintenance situation of water supply facilities in Yobe State, instead of collecting water charges from beneficiaries, the necessary costs are levied whenever facility repairs become necessary. In the future, Yobe State intends to pass the burden for operation and maintenance of water supply facilities onto the beneficiaries through levying water charges.

However, concerning the water supply facilities (hand pump boreholes) targeted in the Project, it is necessary to immediately establish the operation and maintenance system and handle the procured equipment based on this. Accordingly, it is recommended that VWESC members selected from residents take responsibility for saving, collecting and managing operation and maintenance funds, purchasing necessary parts and conducting light maintenance work such as the periodic replacement of parts, etc. Moreover, the LGA in charge and RUWASA will take responsibility for the renewal of boreholes that are difficult to repair, however, since communities will also need to bear these costs, it will be necessary to secure the full understanding of citizens when setting up the VWESC.

Furthermore, in accordance with the scope of works shown in Table 2-4-3, the tools for light maintenance work on hand pumps will be provided to each community, whereas other maintenance

tools and spare parts will be supplied to each responsible LGA.

Table 2-4-3 Sharing of Maintenance Cost

Expense item	RUWASA	LGA	Community	Remarks
Daily inspection and cleaing			○	
Water charge collection and management			○	
Periodic replacement of pump consumable parts		○	○	Purchase of parts, Replacement work
Repair of unexpected failure of pump	○		○	Major repair done by RUWASA, Residents bare the actual expenses
O&M of ancillary facilities			○	Provision of fence, Repair of platform, etc.
Replacement of old pump	○		○	Once in 10 years, Residents bare the actual expenses
Water quality monitoring		○	△	

○ : Do the work and/ or bare the cost △ : Partial bearing the cost

Incidentally, since RUWASA will not be able to directly implement operation and maintenance guidance and sanitation education to village residents, each responsible LGA will fulfill these responsibilities.

2-5 Other Relevant Issues

(1) Exemption of Taxes

Regarding the procedure that needs to be followed on the Nigerian side to secure exemption of taxes for the Project equipment and materials, the contractor needs to submit an application form to the Federal Ministry Water Resources, and this is processed through the NPC (National Planning Commision)) before approval is granted by the Ministry of Finance. Care will be required to ensure that delays in the granting of exemption do not impact the progress of the Project.

(2) Others

An issue of concern in Project implementation is whether or not the procured equipment and materials can be promptly unloaded and processed through customs upon arrival in Nigeria. In past grant aid projects implemented by Japan in Nigeria, holdups in the unloading and customs clearance stage have greatly impacted the implementation schedule. In order to prevent this and ensure the smooth passage of equipment and materials through customs, it will be important to make sure the necessary procedures are taken in advance.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3
PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effects

The expected effects of the Project are described as follows.

(1) Direct Effects

Current Situation and Problems	Remedial Measures under the Project (Requested Japanese Assistance)	Positive Effects and Degree of Improvement
Most people in target villages depend on ponds and shallow wells for drinking water which are often contaminated. Therefore, there are many cases of water-borne diseases and poor sanitation conditions.	・ Procurement of drilling equipment and materials and technical assistance for construction of 89 hand pump boreholes.	・ Provide safe drinking water to 32,000 people to be covered under the Project. ・ Raise water supply rate by 5.7%.
Due to the deterioration of existing drilling rigs owned by RUWASA, the efficiency of work is low. In addition, one drilling rig made in Russia in 1993 is not suitable for construction of hand pump borehole.	・ Procurement of one drilling rig, high pressure compressor and crane truck for borehole construction.	・ RUWASA will have the drilling rig of the latest model with high drilling efficiency. This rig can be used by RUWASA to continue the rural water supply project in Yobe state after the completion of the Project.
RUWASA does not have geophysical survey equipment, and has to determine the drilling point by own field experience. This causes low borehole success rate.	・ Procurement of one set of geophysical survey equipment.	・ Groundwater investigation technique will be improved in RUWASA.
RUWASA does not have borehole logging and pumping test equipments, and has to carry the casing program depending on their experience only.	・ Procurement of one set of borehole logging and one set of pumping test equipment. ・ Methodology of pumping test analysis will be instructed during the soft component program.	・ Upgrade the capability of borehole construction by RUWASA.
The operation and maintenance system of borehole construction equipment is very unreliable and borehole construction work is not efficient in RUWASA	・ To conduct the soft component program on borehole construction management.	・ Management skill of borehole construction in RUWASA will be improved. ・ Operation and maintenance skill for the drilling equipment will be improved. ・ Borehole inventory will be prepared.
Awareness of operation and maintenance of water supply facility by community is very low. Relationship between community, LGA and RUWASA in operation and maintenance system is inadequate. Monitoring system of water supply facilities is not established.	・ To conduct the soft component programs on the operation and maintenance of water supply facilities.	・ The role of works among RUWASA, LGA and community will be shared more clearly and their mutual cooperation will be promoted and strengthened. ・ Technical knowledge and techniques which are necessary for water supply project will be enhanced in RUWASA.

(2) Indirect Effects

Current Situation and Problems	Remedial Measures under the Project (Requested Japanese Assistance)	Positive Effects and Degree of Improvement
Women and children have to draw and carry water from distant water source, sometimes even from a distance of several km away from their residence. They are forced to spend considerable time and effort to obtain water.	Procurement of drilling equipment and materials and technical assistance for 89 hand pump borehole construction by Nigerian side.	The average distance to carry water will be reduced than the existing condition in target villages.

3-2 Recommendations

3-2-1 Recommendations to be Taken by Recipient Country

In order to execute the maintenance of procured equipment and materials related to the borehole drilling and constructed water supply facilities under the Project sustainable and smoothly, and to execute the water supply project by RUWASA efficiently, it is indispensable to consider the following aspects.

(1) Securing budget for rural water supply and enforcement of organization structure of RUWASA

It is necessary for Yobe State to secure the budget for the water supply project and for RUWASA in charge of rural water supply project to maintain its organization and techniques to operate the procured equipment and materials efficiently related to the borehole construction.

(2) Improvement of operation & maintenance and monitoring systems of water supply facilities

Operation and maintenance system of water supply facilities is important factor to use the constructed water supply facilities for a long period. Therefore, cooperation between the communities, LGA and RUWASA shall be required for the operation and maintenance. It is also important for communities to establish VWESC for water sanitation and the communities themselves operate and maintain it on their own initiatives. RUWASA will be required to establish the monitoring system of water supply facilities by which they can continuously do periodic check of water supply facilities, guide repairing skills, and monitor water quality periodically through LGA which directly supports the communities.

(3) Establishment of collection system of water charge by community

Once the management system of water supply facilities by VWESC is established, an extra expenditure will be required for any unforeseen breakdown or obsolescence of the boreholes by

usage of long period, flushing boreholes, cleaning of sediments deposit, and so on. To cope up with such situation, it is important for VWESC to collect water fee properly and completely as well as to pay enough attention to the reserve fund and bookkeeping. In particular, the accounting system must be independent and transparent to prevent embezzlement and/or misappropriations.

3-2-2 Technical Cooperation and Coordination with Other Donors

(1) Collaboration with UNICEF and EU projects

UNICEF and EU are agencies to support rural water supply and sanitation project in Yobe State. UNICEF projects include borehole constructions, latrine construction in schools, seminars for improvement of abilities in water supply and sanitation at the community level. EU selected 4LGA's of Bade, FIKA, NGURU, and BURSARI as project area in Yobe state, and is confirming the selection criteria of 114 communities in these LGA's and contents of activities. In regard to the collaboration with UNICEF, it is scheduled to obtain assistance for the soft component activities of strengthening of operation and maintenance system for water supply facilities.

It is scheduled to obtain cooperation from UNICEF in the soft component on the water supply facilities maintenance management system strengthening of this project. It is essential that the cooperation from UNICEF in the support of the public health field, and in the standardization of various water related manuals. Moreover, it is necessary to continue to discuss with EU for effective cooperation for both projects in the future.

(2) Collaboration with technical assistance (local domestic training)

In this project, soft component on borehole construction management and operation and maintenance system for water supply facilities is carried out for RUWASA. To compliment this activity, implementation of technical assistances such as local domestic training is recommendable. After the completion of 89 borehole construction, RUWASA shall continue to construct the boreholes by a procured drilling rig at least for three years. Borehole construction materials such as hand pumps and PVC casing & screen are only procured for the first two years. It is necessary, therefore, to carry out the technical assistance continuously after the completion of 89 borehole construction in order to assist management of borehole construction and the water supply facilities.

APPENDICES

1. MEMBER LIST OF THE STUDY TEAM

Appendix 1

Members of the Team (Basic Design Study)

No	Name	Job Title	Occupation
1	Mr. YAMAGATA Shigeo	Team Leader	Resident Representative Nigeria Office JICA
2	Mr. MURAKAMI Jun	Planning Management Officer	Water Renouncement Development and Environmental Management Team Project Management Group 3 Grant Aid Management Department JICA
3	Dr. YOSHIDA Kenji	Chief Consultant/ Groundwater Development/ Organisational Strength	Yachiyo Engineering Co., Ltd.
4	Mr. ISHIKAWA Tsugio	Hydrogeology/Geophysical Survey	Mitsui Mineral Development Engineering CO., LTD.
5	Mr. YATSU Tetsuo	Equipment and Procurement Planning/Cost Estimation	Yachiyo Engineering Co., Ltd.
6	Mr. SHIMIZU Kiyoshi	Social Condition Survey/ Management for Operation & Maintenance of Facility	Yachiyo Engineering Co., Ltd.

Members of the Team (Explanation of Draft Final Report)

No	Name	Job Title	Occupation
1	Mr. MIMA Kyojin	Team Leader/ Planning Management	Resident Representative Nigeria Office JICA
2	Dr. YOSHIDA Kenji	Chief Consultant/ Groundwater Development/ Organisational Strength	Yachiyo Engineering Co., Ltd.
3	Mr. YATSU Tetsuo	Equipment and Procurement Planning/Cost Estimation	Yachiyo Engineering Co., Ltd.

2. SURVEY SCHEDULE

Appendix 2　Study Schedule

(1) Basic Design Study

			Official Member		Consultant Team Member			
Day	Date		Mr.Yamagata (Resident Representative JICA Nigeria Office)	Mr. Murakami (Planning Management)	Dr. Yoshida (Chief Consultant/ Groundwater Development)	Mr. Ishikawa (Hydrogeology/Geophysical Survey)	Mr. Shimizu (Social Condition Survey/ Management for Operation & Maintenance of Facility)	Mr. Yatsu (Equipment and Procurement Planning/Cost Estimation)
1	2-Dec	Sat			Narita – London			
2	3-Dec	Sun		Narita – London	London – Abuja, Preparation of Study, Negotiation with local consultants			
3	4-Dec	Mon	Courtesy calls on Embassy of Japan, Jica Office, NPC (Mr. Murakami arrives at Abuja in the morning)					
4	5-Dec	Tue	Courtesy call on FMWR, Discussion with FMWR					
5	6-Dec	Wed	Abuja – Damaturu (by car), Courtesy calls on Yobe State Ministry of Water Resources					
6	7-Dec	Thu	Courtesy call on RUWASA, Discussion with RUWASA			Courtesy call on RUWASA, Data collection (existing borehole data) analysing the data	Courtesy call on RUWASA, Negotioation with local consultants	
7	8-Dec	Fri	Discussion with RUWASA			Preparation of exiting well survey, Meeting with local consultant	Preparation of field survey (Social and O/M facility)	
8	9-Dec	Sat	Site Survey			Sitel survey	Field survey	
9	10-Dec	Sun	Damaturu – Abuja (by car)			Data arrengement		
10	11-Dec	Mon	Signing of M/D, Reporting to EOJ and JICA office			Site survey, Data collection	Field survey, Data collection	
11	12-Dec	Tue		Abuja – London	Data collection at FMWR	Site survey, Data collection	Field survey, Data collection	
12	13-Dec	Wed		London – Narita	Abuja – Lagos –Ibadan (By air and car)	Site survey, Data collection	Field survey, Data collection	
13	14-Dec	Thu			Visit WATSAN office, site survey (Oyo project)	Site survey, Data collection	Field survey, Data collection	
14	15-Dec	Fri			Site survey (Oyo project)	Metting with RUWASA, Data collection		
15	16-Dec	Sat			Site survey (Oyo project)	Data arrengement	Field survey, Data collection	Narita – London
16	17-Dec	Sun			Ibadan – Lagos– Abuja (By air and car)	Data arrengement		London – Abuja
17	18-Dec	Mon			Abuja – Damaturu (by car)	Site survey, Data collection	Field survey, Data collection	Abuja – Damaturu (by car)
18	19-Dec	Tue			Site survey	Site survey, Data collection	Field survey, Data collection	Field survey (equipment & material)
19	20-Dec	Wed			Site survey, Data collection	Site survey, Data collection	Field survey, Data collection	Field survey (equipment & material)
20	21-Dec	Thu			Meeting with UNICEF	Site survey, Data collection	Meeting with UNICEF	Field survey (equipment & material)
21	22-Dec	Fri			Meeting with RUWASA, Team meeting			Field survey (equipment & material), Team meeting
22	23-Dec	Sat			Field survey (existing well and social)			Market survey
23	24-Dec	Sun			Arrengement of survey result	Arrengement of data and survey result	Arrengement of data and survey result	Field survey (equipment & material), Team meeting
24	25-Dec	Mon			Damaturu – Abuja (by car)			
25	26-Dec	Tue			Data Collection, Preparation of Field Reprt to FMWR			Market and procurement survey
26	27-Dec	Wed			Data Collection, Preparation of Field Reprt to FMWR			
27	28-Dec	Thu			Reporting to Embassy of Japan, JICA office			
28	29-Dec	Fri			Explanation of field report and discussion with FMWR			
29	30-Dec	Sat			Abuja – London			
30	31-Dec	Sun			London – Narita			

(2) Explanation of Draft Final Report

			Official Member	Consultant Team Member	
Day	Date		Mr. Mima (Resident Representative JICA Nigeria Office)	Dr. Yoshida (Chief Consultant/ Groundwater Development)	Mr. Yatsu (Equipment and Procurement Planning/Cost Estimation)
1	16-May	Wed		Narita – London	
2	17-May	Thu		London – Abuja, Preparation of Study, Courtesy call on FMAWR, Discussion with FMAWR	
3	18-May	Fri	Courtesy calls on Embassy of Japan, Jica Office, NPC、FMAWR		
4	19-May	Sat	Abuja – Damaturu (by car), Courtesy calls on Yobe RUWASA		
5	20-May	Sun	Site Survey, Discussion with Yobe RUWASA		
6	21-May	Mon	Damaturu – Abuja (by car)		
7	22-May	Tue	Team Meeting/Arrangement Documents		
8	23-May	Wed	Discussion with FMAWR		
9	24-May	Thu	Signing of M/D, Reporting to EOJ and JICA office		
10	25-May	Fri	Data collectin, supplemental suvey		
11	26-May	Sat		Abuja – London	
12	27-May	Sun		London – Narita	

3. LIST OF PARTIES CONCERNED

IN THE RECIPIENT COUNTRY

Appendix 3. List of Parties Concerned in the Federal Republic of Nigeria

(Basic Design Study)

Institution/Organization		Name
Federal Ministry of Water Resources / FMWR		
Director of Department of Water Supply & Quality Control		Engr. M. A. K. Abubakar
Deputy Director of Rural Water Supply		Mr. Akin Aletan
Assistant Director of Rural Water Supply		Mr. Adetungi Idown
National Planning Commission / NPC		
Director of Department for International Sector and Development Cooperation		Mr. E.P. Odiachi
Assistant Chief Planning Officer		Mr. Nwozuzu Samuel
Rural Water Supply and Sanitary Agency / RUWASA		
General Manager		Engr. Shuaibu Musa
Director of Rural Water Supply		Mr. Idriss F. Dauda
Director of Sanitation		Mr. Hamidu M. Alhi
Director of Planning Research and Statistics		Mr. Musa Lagide
Inspector of Principal Community Development		Mr. Al Haji Abba
Officer of Community Development		Mr. Dauda Abatcha
Water Analyst		Mr. Saidu Idi mamman
Chief Hydrogeologist		Mr. Abakar Bake
Yobe State Water Corporation		
General Manager		Dr. A. G. Iliya
UNICEF (United Nations International Children's Fund)		
Consultant of UNICEF in Jigawa State		Mr. Uba Lawal
Local Government Authority/LGA		
A. Bade	Chairman	Mr. Al Haji Gafo Maizasu Bizi
B. Bursari	Deputy Head of Agriculture	Mr. Kallan Dabuwa Dapct
C. Damaturu	Accountant, Works Department	Mr. Ali Mohammed Bollo
D. Fika	Deputy Head of Administration	Mr. Ajiya Gimbh Genk
	Head of Treasure	Mr. Abdullahi M. Daya

Institution/Organization		Name
E. Fune	Head of General Administration	Mr. M.Adamn Buhama Sani
F. Karasuwa	Principal Personnel Assistant II	Mr. Mohd Usman Kawata
G. Machina	Director Personnel Management	Mr. Al Haji Gaba Bogo
	Head of Treasury Department	Mr. Al Haji Galadima Bukar
H. Nguru	Secretary	Mr. Al Haji Al Makinta
	Assist. Head of Works	Mr. Hamma Gana
I. Nangere	Principal Personnel Assistant I	Mr. Yusup Mamman Tikau
J. Potiskum	Staff Officer	Mr. Adamn Mohammed K.G
K. Geidam	Works Department	Mr. Abdullah Abba
L. Gulani	Head of Works	Mr. Wakic Maidaca Bularafd
M. Gujba	Chairman	Mr. Goni Ali Gujuba
	Secretary	Mr. Al Haji Kolomi Ali Gano
N. Jakusko	Chairman	Mr. Al Haji Saleh Kagama
O. Tarmuwa	Permanent Secretary	Mr. Mai Al Haji Usman
	Director Personnel Management	Mr. Bayem Mohiel Shanwa
P. Yusufari	Chairman	Mr. Al Haji Uygni
	Secretary Head of Water	Mr. Al Haji Uygni
Q. Yunusari	Director Personnel Management	Mr. Al Haji Ibrahim Tosia
	Works Department	Mr. Margwami Kujariry
Embassy of Japan in Nigeria		
Economic Cooperation		Mr. Yasuhiro Yamauchi
JICA Nigeria Office		
Resident Representative of JICA Nigeria		Mr. Shigeo Yamagata
Assistant Resident Representative		Mr. Kuniaki Amatsu

(Explanation on Draft Final Report)

Institution/Organization	Name
Federal Ministry of Water Resources / FMWR	
Director of Department of Water Supply & Quality Control	Engr. M. A. K. Abubakar
Deputy Director of Rural Water Supply	Mr. Akin Aletan
Assistant Director of Rural Water Supply	Mr. Adetungi Idown
National Planning Commission / NPC	
Director of Department for International Sector and Development Cooperation	Mr. E.P. Odiachi
Assistant Chief Planning Officer	Mr. Nwozuzu Samuel
Rural Water Supply and Sanitary Agency / RUWASA	
General Manager	Engr. Shuaibu Musa
Director of Rural Water Supply	Mr. Idriss F. Dauda
Director of Sanitation	Mr. Hamidu M. Alhi
Director of Planning Research and Statistics	Mr. Musa Lagide
Inspector of Principal Community Development	Mr. Al Haji Abba
Officer of Community Development	Mr. Dauda Abatcha
Water Analyst	Mr. Saidu Idi mamman
Chief Hydrogeologist	Mr. Abakar Bake
Yobe State Water Corporation	
General Manager	Dr. A. G. Iliya
UNICEF (United Nations International Children's Fund)	
Consultant of UNICEF in Yobe State	Mr. Baffa Buhari
Embassy of Japan in Nigeria	
Economic Cooperation	Mr. Yasuhiro Yamauchi
Economic Cooperation	Mr. Tomoyuki Oshino
JICA Nigeria Office	
Resident Representative of JICA Nigeria	Mr. Kyojin Mima
Assistant Resident Representative	Mr. Kuniaki Amatsu

4. MINUTES OF DISCUSSIONS

MINUTES OF DISCUSSIONS

ON THE BASIC DESIGN STUDY
ON THE PROJECT FOR
THE SUPPLY OF EQUIPMENTS FOR GROUNDWATER EXPLOITATION TOWARDS POTABLE WATER SUPPLY AND HEALTH DELIVERY IN YOBE STATE IN THE FEDERAL REPUBLIC OF NIGERIA

Based on the results of the Preliminary Study, the Government of Japan has decided to conduct a basic design study on the Supply of Equipments for Groundwater Exploitation towards Portable Water Supply and Health Delivery in Yobe State (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Federal Republic of Nigeria (hereinafter referred to as "Nigeria") the Basic Design Study Team (hereinafter referred to as "the Team") which is dispatched by the Grant Aid Management Department, JICA headquarters and is scheduled to stay in the country from December 3rd to December 30th, 2006.

The Team held discussions with the concerned officials of the Government of Nigeria, and conducted a field survey at the study site.

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

Abuja, 11 December 2006

Mr. Shigeo Yamagata
Resident Representative
Nigeria Office
Japan International Cooperation Agency
Japan

Engr. M.A.K. Abubakar, MFR, FNSE
Director
Water Supply and Water Quality
Federal Ministry of Water Resources
Federal Republic of Nigeria

Mr. U. S. Nwozuzu
Assistant Chief Planning Officer
International Sector Development Cooperation
National Planning Commission
Federal Republic of Nigeria

Engr. Shuaibu Musa, MNSE
General Manager
Rural Water Supply and Sanitation Agency
Ministry of Water Resources
Yobe State, Federal Republic of Nigeria

ATTACHMENT

1. Objective

The Objective of the Project is the improvement of water supply and sanitation in Yobe state through provision of equipment and materials necessary for construction of hand pump boreholes.

2. Project sites

The Project sites requested by the Nigerian side are located at the 17 (Seventeen) Local Government Areas in Yobe State as shown in Annex-1.

3. Responsible and Implementing Agencies

3-1 The responsible organization for the Project is the Federal Ministry of Water Resources (FMWR).

3-2 The implementing organization of the Project is Yobe State Rural Water Supply and Sanitation Agency (RUWASA).

4. Items Requested by the Government of Nigeria

After discussions between the Nigerian side and the Team, the items described in Annex-2 were finally requested by the Government of Nigeria.

Both sides confirmed that the appropriateness of the request shall be assessed in accordance with the further studies and analysis in Japan and the final components of the Project shall be decided by the Japanese side after the assessment.

5. Japan's Grant Aid System

The Nigerian side understood Japan's Grant Aid system and the necessary measures to be taken by the Government of Nigeria as explained by the Team and described in Annex-3, for smooth implementation of the Project, on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

6-1 The consultants of the Team will proceed to carry out further studies such as interviews/surveys on socio-economy, hydrogeological investigation, existing borehole survey, management condition of the existing machinery and equipment and so on, in Nigeria until December 30, 2006.

6-2 The JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around May 2007.

6-3 In case that the contents of the draft report are accepted in principle by the Nigerian side, JICA will proceed to complete the final report and send it to the Nigerian side around August 2007.

7. Other Relevant Issues

The following issues were discussed and confirmed by both sides.

(1) Responsibility of each Organization concerning the Project

The FMWR shall collaborate with National Planning Commission and other Federal bodies to facilitate the implementation of the Project in such areas as exemption from taxes and so on, while the Yobe RUWASA shall take responsibility of operation and maintenance of facilities and equipment and borehole construction through mobilization of Local Government Areas.

(2) Rural Water Supply in Yobe State

Yobe RUWASA has a plan to improve the water supply coverage in Yobe state from 47% in 2005 to 75% by 2009. In order to attain above mentioned goal, Yobe RUWASA will implement construction of 52 mechanized boreholes, 220 hand pump boreholes and 200 cement open wells.

(3) Usage of Procured Equipments and Materials

Procured equipments and materials are to be used for the construction of 100 (one hundred) hand pump boreholes as a part of the implementation for rural water supply plan of RUWASA mentioned in 7 (2).

(4) Responsibilities with regard to the Borehole Construction

Both sides agreed that the construction work of the hand pump boreholes shall be executed by the Nigerian side with its full responsibility. Furthermore, it was agreed as follows that:

- The number of boreholes to be constructed by the Nigerian side using materials to be procured by the Japanese side would be confirmed by both sides based on the capability of Yobe RUWASA, referring to the result of the hydrogeological investigation and socio-economic survey in the Basic Design Study.

  However, the construction period of the Project is put at 2 (two) years after deliveries of equipment and materials from the view points of deterioration and proper management.

- The Nigerian side shall secure budget for the Project timely and submit monthly report of progress of the construction work to the Japanese side.

(5) Equipment and Materials requested for Procurement

Both sides agreed that the necessity of the equipment and materials requested by the Nigerian side as stated in Annex-3 shall be examined from the view points of purpose of use, future project plan, technical and budgetary availability for operation and maintenance, conditions of the existing equipment, etc. The type, quantity and specification of these equipment and materials shall be determined on the minimum required and the easiest operation level.

(6) Screening of Sites for Borehole Construction

The list of the candidate sites for borehole construction is shown in Annex-4.
Both sides agreed that the sites of 100 (One Hundred) boreholes from the list are to be examined taking into consideration criteria below;

- suitability for hand pump borehole (shallow water level and drilling depth)
- demographic condition

- assistance from Local Government Areas
- existing water facilities
- accessibility
- hydrogeological conditions
- water quality (applying WHO guidelines)
- capacity for operation and maintenance of the facilities at community level
- willingness to pay for operation and maintenance of water supply facilities by community
- absence of water projects by other donors
- sanitation and hygienic conditions

Among the criteria, emphasis would be placed on demographic condition, suitability for hand pump borehole and existing water facilities. And number of drilling sites will be selected in the Basic Design Study in consideration of RUWASA's capacity.

(7) Operation and Maintenance of Facilities, Equipment and Materials

The water supply facilities constructed by the Nigerian side shall be properly operated and maintained by the respective communities and Local Government Areas with support by Yobe RUWASA. The equipment and materials requested by the Nigerian side shall be properly operated and maintained by Yobe RUWASA.

(8) Utilization Plan for Procured Drilling Rig

RUWASA Submitted the action plan which is shown in Annex-5 to drill boreholes from 2005 to 2014 and explained the utilization plan for procured drilling rig in the action plan. Both sides confirmed that the number of boreholes RUWASA intends to drill the boreholes for hand pump by procured drilling rigs for this project is 50 in 2008 and 2009, 54 in 2009, 70 in 2010, and 64 in 2011.

(9) Budgetary Allocation for the Project by the Nigerian side

The concrete amount of budget to be born by the Nigerian side for the Project including operation and maintenance cost shall be assessed through the study and analysis in Japan.
The Nigerian side accepted that appropriate budgetary allocation will be put in place to meet the assistance from the Japanese side.
Thus the Nigerian side gave assurance that adequate fund will be provided for the Project except for those materials to be procured by the Japanese side.
The progress of the budgetary allocation and the total project cost to be born by the Nigerian side shall be confirmed by both sides when the draft final report of the Project will be discussed.

(10) Storage for Construction Materials

The materials for the construction work requested by Nigerian side would be properly stored by Yobe RUWASA and the recipient Local Government Areas with support by Yobe RUWASA. The Nigerian side shall make preparation for adequate stores to keep the materials before the commencement of the Project. Both sides agreed that the arrangement of proper storage for the materials should be confirmed when the draft final report of the Project will be discussed.

(11) Technical Assistance

The Nigerian side requested technical cooperation of dispatch of expert(s), training for

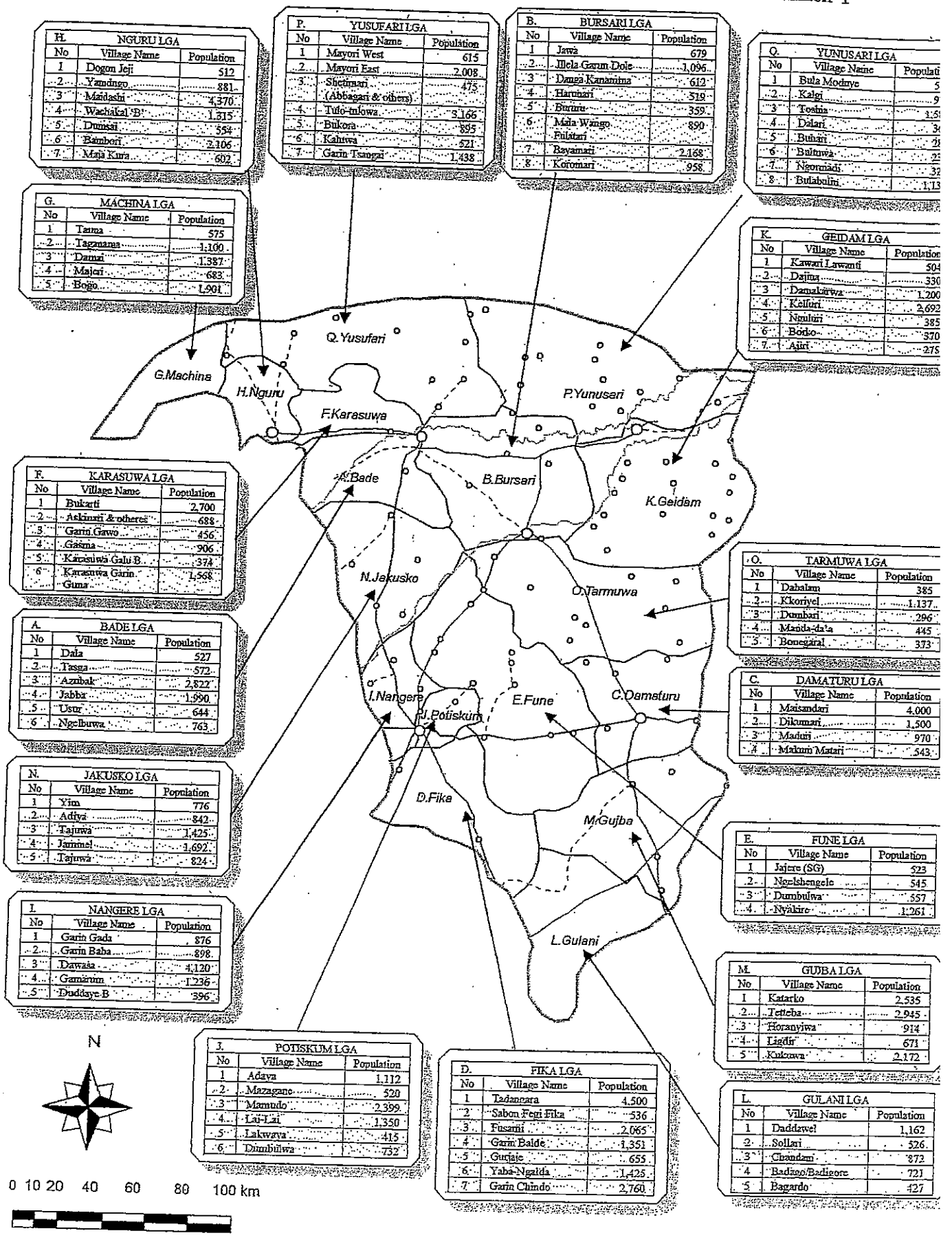
staff of RUWASA and technical assistance as soft component in this project.

(12) Overlapping with other project

Nigerian side explained that this project would not be overlapped with any other project supported by the other donor agencies, NGO and Nigerian official organization(s).

(13) Safety and Security

The Nigerian side agreed to take measures to secure the safety of the member of the Team.



H.	NGURU LGA	
No	Village Name	Population
1	Dogon Jeji	512
2	Yamdingo	881
3	Maidashi	4,370
4	Wachakal 'B'	1,315
5	Dumsai	554
6	Bambori	2,106
7	Maja Kura	602

P.	YUSUFARI LGA	
No	Village Name	Population
1	Mayori West	615
2	Mayori East	2,008
3	Shettimari (Abbagari & others)	475
4	Tulo-mlowa	3,166
5	Bukora	895
6	Kahuwa	521
7	Garin Tsangai	1,438

B.	BURSARI LGA	
No	Village Name	Population
1	Jawa	679
2	Illela Garim Dole	1,096
3	Danga Kananima	612
4	Harmari	519
5	Burura	359
6	Mala Wango Fulatari	890
7	Bayamari	2,168
8	Koromari	958

Q.	YUNUSARI LGA	
No	Village Name	Populati
1	Bula Modnye	5
2	Kalgi	9
3	Tosina	1,5
4	Dalari	3
5	Buhari	2
6	Bultuwa	2
7	Ngomadi	32
8	Bulabulin	1,13

G.	MACHINA LGA	
No	Village Name	Population
1	Tama	575
2	Tagamana	1,100
3	Damai	1,387
4	Majari	683
5	Bogo	1,901

K.	GEIDAM LGA	
No	Village Name	Population
1	Kawari Lawanti	504
2	Dajina	330
3	Damakarwa	1,200
4	Kelluri	2,692
5	Ngulari	385
6	Bodo	370
7	Ajiri	275

F.	KARASUWA LGA	
No	Village Name	Population
1	Bukarti	2,700
2	Askinari & others	688
3	Garin Gawo	456
4	Gaisma	906
5	Karasuwa Galu B	374
6	Karasuwa Garin Guna	1,568

O.	TARMUWA LGA	
No	Village Name	Population
1	Dabalam	385
2	Kkoriyel	1,137
3	Dumbari	296
4	Manda-da'a	445
5	Bonegaral	373

A.	BADE LGA	
No	Village Name	Population
1	Dala	527
2	Tasna	572
3	Azmbak	2,822
4	Jabba	1,990
5	Usur	644
6	Ngelbuwa	763

C.	DAMATURU LGA	
No	Village Name	Population
1	Maisandari	4,000
2	Dikumari	1,500
3	Maduri	970
4	Makun Matari	543

N.	JAKUSKO LGA	
No	Village Name	Population
1	Yim	776
2	Adiya	842
3	Tajuwa	1,425
4	Jammel	1,692
5	Tajuwa	824

E.	FUNE LGA	
No	Village Name	Population
1	Jajere (SG)	523
2	Ngelshengele	545
3	Dumbulwa	557
4	Nyakire	1,261

I.	NANGERE LGA	
No	Village Name	Population
1	Garin Gada	876
2	Garin Baba	898
3	Dawasa	4,120
4	Gamarum	1,236
5	Daddaye B	396

M.	GUJBA LGA	
No	Village Name	Population
1	Katarko	2,535
2	Tetteba	2,945
3	Horanyiwa	914
4	Ligdi	671
5	Kukuwa	2,172

J.	POTISKUM LGA	
No	Village Name	Population
1	Adaya	1,112
2	Mazagane	520
3	Mamudo	2,399
4	Lai-Lai	1,350
5	Lakwaya	415
6	Dumbulwa	732

D.	FIKA LGA	
No	Village Name	Population
1	Tadanaara	4,500
2	Sabon Fegi Fika	536
3	Fusami	2,065
4	Garin Balde	1,351
5	Gurjaje	655
6	Yaba-Ngalda	1,425
7	Garin Chindo	2,760

L.	GULANI LGA	
No	Village Name	Population
1	Daddawel	1,162
2	Sollari	526
3	Chandam	873
4	Badago/Badigore	721
5	Bagardo	427

Project Site

ITEMS REQUESTED BY THE YOBE STATE GOVERNMENT OF NIGERIA

List of Equipment and Materials Requested

No.	Items	Features	Quantity
1	Drilling Rig	(1) Driilling Rig Hydraulically powered machine applicable to air/mud rotary drilling and down the hole drilling. Maximum capability to drill approximately 200m to 250m	2 units
		(2) Standard Accessories and tools for Rig	2 lots
2	Compressor	(1) With air delivery of 350~500liters/s and normal operating pressureof 11-12 bar	2 units
		(2) 6 or 10 wheel diesel engine truck sspecially using for Compressor	2 units
3	Vehicle	(1) 4×4 Truck with 6 ton Crane	2 units
4	Geophysical and Topographical Survey/ Research Equipment etc.	(1) Electromagnetic Survey Instrument	2 sets
		(2) Electric Resistively Survey Instrument	2 sets
		(3) Electric Logging Instrument	2 sets
		(4) Water Level Indicator	4 units
		(5) GPS Instrument	4 units
5	Water Testing Kit	(1) Spectrophotometer Test Kit	1 unit
		(2) Water Quality Analysis Equipment	2 sets
		(3) Distillation Machine	1 unit
		(4) Chemical and Bacteriological Reagents	1 lot
6	Hand pumps and Tools	(1) Hand pumps for deep wells	100 units
		(2) Operation and Maintenance Tools	1 lot
7	Casing and Screen Pipes	(1) Casing pipes (PVC) 4″ ϕ Casing pipes (PVC) 4″ ϕ	100 sets
		(2) Screen pipes (PVC) 4″ ϕ Screen pipes (PVC) 8″ ϕ	100 sets

JAPAN'S GRANT AID

2.1 Japan's Grant Aid Scheme

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

(1) Grant Aid Procedures

Japan's Grant Aid Program is executed through the following procedures:

• Application	(Request made by a recipient county)
• Study	(Basic Design Study conducted by JICA)
• Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
• Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

Firstly, the application or a request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for the Grand Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the recipient country.

Finally, for the smooth implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

(2) Basic Design Study

1) Contents of the Study

The aim of the Basic Design Study (hereafter referred to as "the Study") conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

i) Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
ii) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
iii) Confirmation of items agreed upon by both parties concerning the basic concept of the Project.
iv) Preparation of a Basic Design of the Project,
v) Estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the

contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

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

2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

The consulting firm(s) used for the Study is (are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

(3) Japan's Grant Aid Scheme

1) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

2) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consulting firm(s) and (a) contractor(s) and final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as natural disaster, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

3) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments 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, consulting, constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

4) Necessity of the "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 the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

5) Undertakings required to 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 the following:

i) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
ii) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
iii) To secure buildings prior to the procurement in case the installation of the equipment.
iv) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.
v) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.
vi) To accord Japanese nationals, whose services may be required in connection with the supply of the products and services under the Verified contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

6) "Proper Use"

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

7) "Re-export"

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

8) Banking Arrangement (B/A)

a) The Government of the recipient country or it's designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan 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 the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or it's designated authority.

9) Authorization to Pay (A/P)

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

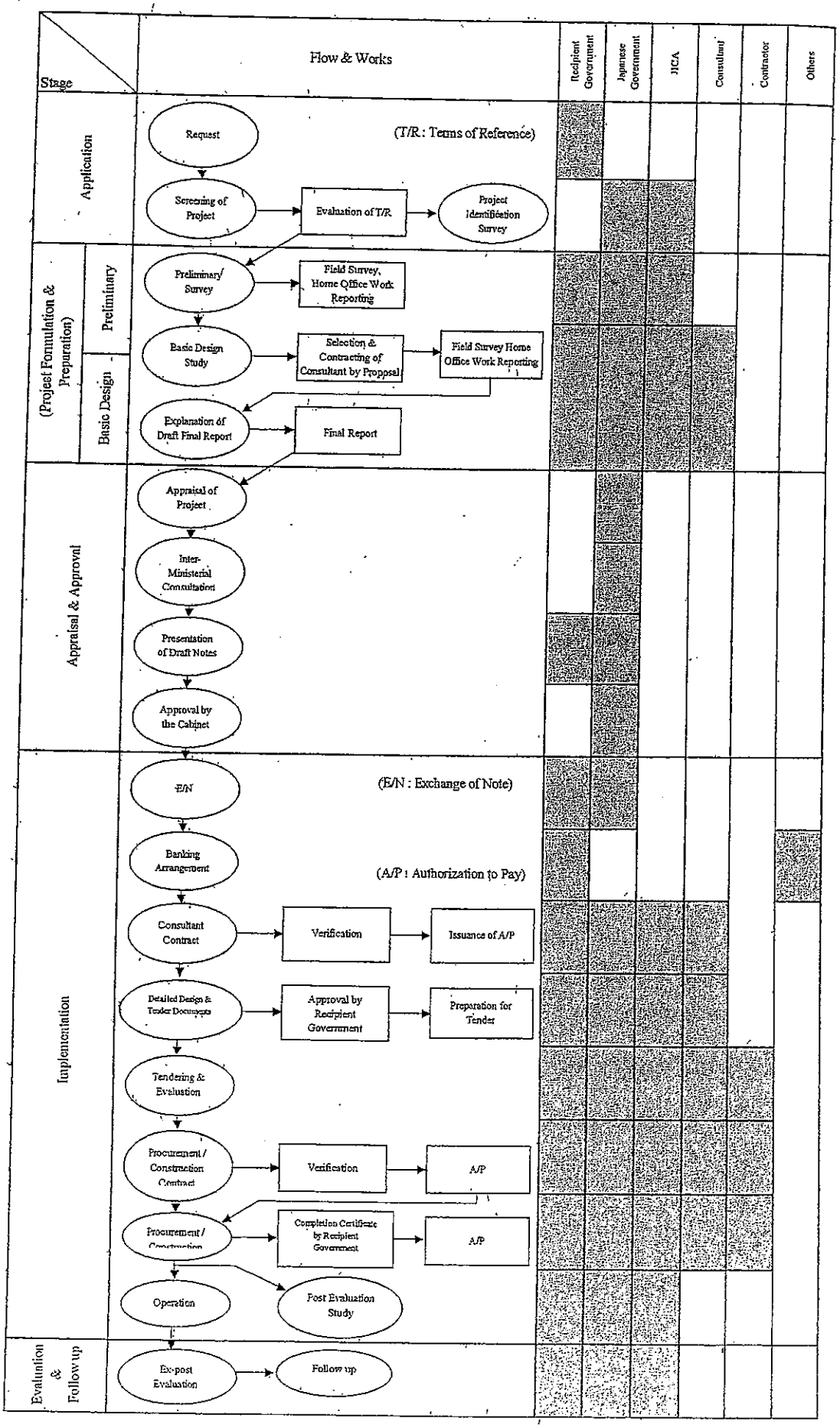
2.2 Grant Aid Procedures

(1) Flowchart of Japan's Grant Aid Procedures
Refer to Figure.

(2) Major Undertaking to be taken by Each Government

Refer to Table.

Figure Flowchart of Japan's Grant Aid Procedures



Major Undertakings to be Taken by Each Governments

No.	Items	To be Covered by Grant Aid	To be Covered by Recipient Side
1	To bear the following commissions to the Japanese bank for the backing services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
2	To ensure unloading and customs clearance at port of disembarkation in the recipient country		
	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 accord Japanese nationals, whose services may be required in connection with the supply of the products and the services under the verified contact, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.		●
4	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts		●
5	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
6	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the transportation and installation of the equipment		●

B/A : Banking Arrangement

A/P : Authorization to Pay

Target Villages

ID/ No	LGA	Village/Ward	Population	No. of Requested Boreholes
A-1	BADE	Dala	527	1
A-2	BADE	Tasga	572	1
A-3	BADE	Azubak	2,822	1
A-4	BADE	Jabba	1,990	1
A-5	BADE	Usur	644	1
A-6	BADE	Ngelbuwa	763	1
B-1	BURSARI	Jawa	679	1
B-2	BURSARI	Illela Garun Dole	1,096	1
B-3	BURSARI	Danga Kanamma	612	1
B-4	BURSARI	Harunari	519	1
B-5	BURSARI	Bururu	359	1
B-6	BURSARI	Mala Wango Fulatari	890	1
B-7	BURSARI	Bayamari	2,168	1
B-8	BURSARI	Koromari	958	1
C-1	DAMATURU	Maisandari	4,000	1
C-2	DAMATURU	Dikumari	1,500	1
C-3	DAMATURU	Maduri	970	1
C-4	DAMATURU	Makum Matari	543	1
D-1	FIKA	Tadangara	4,500	1
D-2	FIKA	Sabon Fegi Fika	536	1
D-3	FIKA	Fusarni	2,065	1
D-4	FIKA	Garin Balde	1,351	1
D-5	FIKA	Gurjaje	655	1
D-6	FIKA	Yaba-Ngalda	1,425	1
D-7	FIKA	Garin Chindo	2,760	1
E-1	FUNE	Jajere (SG)	523	1
E-2	FUNE	Ngelshengele	545	1
E-3	FUNE	Dumbulwa	557	1
E-4	FUNE	Nyakire	1,261	1
F-1	KARASUWA	Bukarti	2,700	1
F-2	KARASUWA	Askinari & otheres	688	1
F-3	KARASUWA	Garin Gawo	456	1
F-4	KARASUWA	Gasma	906	1
F-5	KARASUWA	Karasuwa Galu B	374	1
F-6	KARASUWA	Karasuwa Garin Guna	1,568	1
G-1	MACHINA	Tauna	575	1
G-2	MACHINA	Taganama	1,100	1
G-3	MACHINA	Damai	1,387	1
G-4	MACHINA	Majeri	683	1
G-5	MACHINA	Bogo	1,901	1
H-1	NGURU	Dogon Jeji	512	1
H-2	NGURU	Yamdugo	881	1
H-3	NGURU	Maidashi	4,370	1
H-4	NGURU	Wachakal 'B'	1,315	1
H-5	NGURU	Dumsai	554	1
H-6	NGURU	Bambori	2,106	1
H-7	NGURU	Maja Kura	602	1
I-1	NANGERE	Garin Gada	876	1
I-2	NANGERE	Garin Baba	898	1
I-3	NANGERE	Dawasa	4,120	1

ID/ No	LGA	Village/Ward	Population	No. of Requested Boreholes
I-4	NANGERE	Gamarum	1,236	1
I-5	NANGERE	Duddaye B	396	1
J-1	POTISKUM	Adaya	1,112	1
J-2	POTISKUM	Mazagane	520	1
J-3	POTISKUM	Mamudo	2,399	1
J-4	POTISKUM	Lai-Lai	1,350	1
J-5	POTISKUM	Lakwaya	415	1
J-6	POTISKUM	Dumbulwa	732	1
K-1	GEIDAM	Kawari Lawanti	504	1
K-2	GEIDAM	Dajina	330	1
K-3	GEIDAM	Damakarwa	1,200	1
K-4	GEIDAM	Kelluri	2,692	1
K-5	GEIDAM	Nguluri	385	1
K-6	GEIDAM	Borko	370	1
K-7	GEIDAM	Ajiri	275	1
L-1	GULUNI	Daddawel	1,162	1
L-2	GULUNI	Sollari	526	1
L-3	GULUNI	Chandam	872	1
L-4	GULUNI	Badago/Badigore	721	1
L-5	GULUNI	Bagardo	427	1
M-1	GUJBA	Katarko	2,535	1
M-2	GUJBA	Tetteba	2,945	1
M-3	GUJBA	Horanyiwa	914	1
M-4	GUJBA	Ligdir	671	1
M-5	GUJBA	Kukuwa	2,172	1
N-1	JAKUSKO	Yim	776	1
N-2	JAKUSKO	Adiya	842	1
N-3	JAKUSKO	Tajuwa	1,425	1
N-4	JAKUSKO	Jammel	1,692	1
N-5	JAKUSKO	Tajuwa	824	1
O-1	TARMUWA	Dabalam	385	1
O-2	TARMUWA	Kkoriyel	1,137	1
O-3	TARMUWA	Dumbari	296	1
O-4	TARMUWA	Manda-da'a	445	1
O-5	TARMUWA	Bonegaral	373	1
P-1	YUSUFARI	Mayori West	615	1
P-2	YUSUFARI	Mayori East	2,008	1
P-3	YUSUFARI	Shetimari (Abbagari & others)	475	1
P-4	YUSUFARI	Tulo-tulowa	3,166	1
P-5	YUSUFARI	Bukora	895	1
P-6	YUSUFARI	Kaluwa	521	1
P-7	YUSUFARI	Garin Tsangai	1,438	1
Q-1	YUNUSARI	Bula Moduye	583	1
Q-2	YUNUSARI	Kalgi	974	1
Q-3	YUNUSARI	Toshia	1,584	1
Q-4	YUNUSARI	Dalari	360	1
Q-5	YUNUSARI	Buhari	287	1
Q-6	YUNUSARI	Bultuwa	234	1
Q-7	YUNUSARI	Ngormadi	320	1
Q-8	YUNUSARI	Bulabulin	1,139	1

YOBE STATE RURAL WATER SUPPLY PLAN

Year	Rural Population In Yobe Sate	Number of Safe Water Resources (nos)						People Access to Safe Water In Rural Areas (nos)				Total Coverage Rate In Yobe State (%)			
		Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pump			Total	Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pumps	Total	Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pumps	Total
				Amount of number	drilled by JICA rig	drilled by another rig									
2005	710, 000	320	80	220			620	64, 000	160, 000	110, 000	334, 000	9	22.5	15.5	47
2006	727, 750	370	92	250			712	74, 000	184, 000	125, 000	383, 000	10.2	25.3	17.2	52.6
2007	745, 944	420	104	280			804	84,000	208,000	140, 000	432, 000	11.3	27.9	18.8	57.9
2008	764, 592	470	118	360	60	30	948	94, 000	236, 000	180, 000	510, 000	12.3	30.9	23.5	66.7
2009	783, 707	520	132	440	50	30	1,092	104,000	264, 000	220, 000	588, 000	13.3	33.7	28.1	75
2010	803, 300	560	142	494	54	-	1, 196	112, 000	284, 000	247, 000	643, 000	14	35.5	30.8	80.4
2011	825; 792	575	153	564	70	-	1, 292	115, 000	305, 000	282, 000	702, 000	13.9	36.9	34.1	85
2012	846, 346	585	166	628	64	-	1; 379	117, 000	331; 000	314, 000	762; 000	13.8	39.09	37.08	90
2013	867, 592	-	210	810	RUWASA will plan later on the basis of the situation		1, 020	-	420,000	405, 000	825,.000	-	48.38	46.65	95.1
2014	889,.287	-	230	856			1, 088	-	460, 000	429, 281	889, 281	-	51.67	48.22	99.9
2015	YEAR 2015 IS RESERVED FOR ANY SHORTCOMINGS THAT MAY ARISE AFTER REVIEW & APPRAISAL OF THE PROJECTS AT THE END OF 2014.														

PLAN PARAMETERS:

The overall calculations / parameters is based on the following assumptions:

a) That In rural areas of Yobe state, the average consumption is 25 liter / capita/ day

b) Open cement well has an average discharge of 5000l/day covering 200 people

c) Hand pump has a discharge of 0.2litres/second i.e-8640 liters/ day covering 500 people

d) Boreholes in rural areas has an average discharge of 2.5 liters/second i.e 43, 200 liter/day covering 2000 people

NOTE

It is anticipated that JICA will provide 100 Handpumps that will contribute a total of 5.63% in 2008 and 2009

UNICEF has provided 200 boreholes that is expected to contribute a total of 11.27% to hand pumps in 2007 and 2008

WSSSRP/SRIP will also cover 4 local Governments in the state which is yet to be integrated into the master plan

Yearly increase in rural population is estimated to be 2.5%

A4-15

MINUTES OF DISCUSSIONS

ON THE BASIC DESIGN STUDY ON THE PROJECT FOR THE SUPPLY OF EQUIPMENTS FOR GROUNDWATER EXPLOITATION TOWARDS POTABLE WATER SUPPLY AND HEALTH DELIVERY IN YOBE STATE IN THE FEDERAL REPUBLIC OF NIGERIA

(EXPLANATION ON DRAFT REPORT)

In December 2006, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for the Supply of Equipments for Groundwater Exploitation towards Portable Water Supply and Health Delivery in Yobe State (hereinafter referred to as "the Project") to the Federal Republic of Nigeria (hereinafter referred to as "Nigeria") and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult the Nigeria on the components of the draft report, JICA sent to the Nigeria the Draft Report Explanation Team (hereinafter referred to as " the Team "), which is headed by Mr. Kyojin Mima, Resident Representative, Nigeria Office, JICA, from 17th May to 26th May.

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

Abuja, 24 May 2007

Mr. Kyojin Mima
Leader
Draft Report Explanation Team
Japan International Cooperation Agency

Japan

Engr. M.A.K. Abubakar, MFR, FNSE
Director
Water Supply and Water Quality
Federal Ministry of Agriculture and Water Resources

Federal Republic of Nigeria

Mr. U. S. Nwozuzu
Assistant Chief Planning Officer
International Sector Development Cooperation

National Planning Commission
Federal Republic of Nigeria

Engr. Shuaibu Musa, MNSE
General Manager
Rural Water Supply and Sanitation Agency

Ministry of Water Resources
Yobe State, Federal Republic of Nigeria

ATTACHMENT

1. Components of the Draft Report

The Government of the Nigeria agreed and accepted in principle the components of the draft report explained by the Team.

2. Japan's Grant Aid scheme

The Nigerian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of the Nigeria as explained by the Team and described in Annex-3 of the Minutes of Discussions signed by both parties on 11th December 2006.

3. Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of Nigeria by August 2007

4. Other Relevant Issues

The following issues were discussed and confirmed by both sides.

(1) Components of the Project

Both sides agreed that the Project would be composed of the following components when the Japanese Government finally decides to implement the Project.

- Procurement of equipment and materials listed in **Annex -1.**
- "Soft Component" which is composed of 1) Technical training for construction management and 2) Strengthening of operation and maintenance system for water supply facilities.

(2) Responsibilities of the Borehole Construction Work

The Nigerian side promised that the construction work of the Project shall be executed by Nigerian side as described in ATTACHMENT 7 (4) of the Minutes of Discussions signed on 11th December 2006. Both sides agreed that the target villages for borehole construction by the Nigerian side under the Project would be eighty-nine, which are listed in **Annex-2.**
The Nigerian side promised to secure budget for the Project timely and submit monthly progress report to Japanese side. The format of progress report is shown in **Annex-3.** After the construction of eighty-nine boreholes, the Nigerian side shall continue to use a procured drilling rig along the "YOBE STATE RURAL WATER SUPPLY PLAN" in **Annex-4**

(3) Budgetary Arrangement for the Implementation of the Project

The Nigerian side agreed and promised to provide necessary budgetary allocation to cover the required amount of cost described in **Annex-5.**

(4) Storage for Construction Materials

Both sides confirmed that the construction materials delivered to Yobe RUWASA would be managed under the supervision of the General Manger of Yobe RUWASA and kept in adequate stores.

(5) Safety and Security

The Nigerian side will ensure that necessary measures are taken for the safety and security of the Japanese nationals involved in the Project.

(6) The Draft Technical Specification of the Equipment

The Team handed one copy of the draft technical specification of the equipment to the Nigerian side. Both sides agreed that this draft specification is confidential and should not be duplicated or released to any parties.

(7) Project Cost Estimation

Both sides agreed that the Project Cost Estimation, as attached in Annex-5 should never be duplicated or released to any outside parties before the signing of all the Contract(s) for the Project.

Annex 1

List of Procured Equipment and Materials

No.	Items	Features	Quantity
1	Drilling Rig	(1) Driilling Rig Hydraulically powered machine applicable to air/mud rotary drilling and down the hole drilling . Drilling capability: Not less than 100m with 6-1/4" to 10-5/8" borehole diameter with 4-3/4"OD drill pipe Mobilisation method: By truck mounted Truck specification: 4x4 or 6x4 (2) Standard Accessories and tools for Rig	1 unit 1 lot
2	High Pressure Air Compressor	Supply air pressure: More than 2.1MPa (=20.5kg/cm2) Supply air volume: 11.3m3/min or more Mobilisation method: By truck mounted Truck specification: 4x4 or 6x4	1 unit
3	Cargo Truck with Crane	Load capacity: More than 6.0ton Specification: 4x4, Diesel water cooling engine Length of carrier: More than 6.0m Crane capacity: 2.9ton (3.0ton)	1 unit
4	Pumping Test Equipment	(1) Submersible motor pump: Diameter of 2.5". Discharge of 30 liters/min. 70m head (1.5kW/50Hz) (2) Engine generator: 5kVA (3) Water level meter: Measurable depth of 100m	1 set 1 set 1 set
5	Water Analysis Equipment	Measurement items: pH, DO, EC, TDS and Temperature	1 unit
6	Geophysical Survey Equipment	(1) Electrical sounding instrument: Measurable depth 100m Measuring item: Apparent resistivity and spontaneous potential Measurable range: 0.1mV- 10V Accessory : Software for interpretation Others: Applicable for logging work for 100m depth borehole (with cable and probe) (2) GPS unit Measuring items: Latitude, Longtitude, Alutitude Tolerance: 15 RMS	1 unit 1 unit
7	Hand Pump	Hand pump & maintenance kit: VLOM type, Indian Mark III Toos for repair by village level and LGA level	89 sets 1 unit
8	Casing Pipe	Materials: Un-plasticised polyvinyl chloride Dimension: Diameter of 4" O.D. of 114.4mm, length of 3m Wall thickness: More than 5 mm Connection: Threading method	1,682 pieces
9	Screen Pipe	Materials: Un-plasticised polyvinyl chloride Dimension: Diameter of 4" O.D. of 114.4mm, length of 3m Wall thickness: More than 5 mm Connection: Threading method Opening ratio of 3% or more	297 pieces

Target Villages for Borehole Construction (1)

No	ID	LGA	Village	Population in 1991	No. of Requested Boreholes	Geology	Groundwater Develoment Potential Evaluation		Social Condtion Evaluation Rank
							Estimated Drilling Depth(m)	Estimated Water Level (m)	
1	A-1	BADE	Dala	527	1	Chad	60	30	C
2	A-2	BADE	Azbak	2,822	1	〃	50	20	B
3	A-3	BADE	Usur	644	1	〃	50	20	B
4	A-4	BADE	Ngelbuwa	763	1	〃	50	20	B
5	B-1	BURSARI	Jawa	679	1	Chad	60	20	B
6	B-2	BURSARI	Illela Garun Dole	1,096	1	〃	50	20	B
7	B-3	BURSARI	Danga Kanamma	612	1	〃	55	25	B
8	B-4	BURSARI	Harunari	519	1	〃	55	25	B
9	B-5	BURSARI	Bururu	359	1	〃	50	20	B
10	B-6	BURSARI	Mala Wango Fulatari	890	1	〃	50	20	B
11	B-7	BURSARI	Bayamari	2,168	1	〃	60	30	A
12	B-8	BURSARI	Koromari	958	1	〃	55	25	B
13	B-9	BURSARI	Bonegaral	373	1	〃	55	25	B
14	C-1	DAMATURU	Maisandari	4,000	1	Chad	60	20	B
15	C-3	DAMATURU	Maduri	970	1	〃	60	15	B
16	D-1	FIKA	Tadangara	4,500	1	Gongila	70	30	B
17	D-5	FIKA	Gurjaje	655	1	Kerri-Kerri	80	35	B
18	D-6	FIKA	Yaba-Ngalda	1,425	1	Gongila	70	30	B
19	D-7	FIKA	Garin Chindo	2,760	1	〃	70	30	A
20	E-3	FUNE	Dumbulwa	557	1	Chad	55	20	C
21	E-4	FUNE	Nyakire	1,261	1	〃	60	25	B
22	F-1	KARASUWA	Bukarti	2,700	1	Chad	70	30	B
23	F-2	KARASUWA	Askinari & otheres	688	1	〃	55	25	A
24	F-3	KARASUWA	Garin Gawo	456	1	〃	50	20	B
25	F-4	KARASUWA	Gasma	906	1	〃	60	20	A
26	F-5	KARASUWA	Karasuwa Galu B	374	1	〃	50	15	B
27	F-6	KARASUWA	Karasuwa Garin Guna	1,568	1	〃	50	15	B
28	F-7	KARASUWA	Dogon Jeji	512	1	〃	50	15	B
29	F-8	KARASUWA	Wachakal 'B'	1,315	1	〃	60	30	B
30	G-1	MACHINA	Tauna	575	1	Chad	60	30	B
31	G-2	MACHINA	Taganama	1,100	1	〃	60	30	B
32	G-3	MACHINA	Damai	1,387	1	〃	60	30	A
33	G-4	MACHINA	Majeri	683	1	〃	60	30	B
34	G-5	MACHINA	Bogo	1,901	1	〃	60	30	A
35	H-1	NGURU	Yamdugo	881	1	Chad	55	15	B
36	H-2	NGURU	Dumsai	554	1	〃	55	15	B
37	H-3	NGURU	Bambori	2,106	1	〃	55	15	B
38	H-4	NGURU	Maja Kura	602	1	〃	55	15	B
39	I-1	NANGERE	Garin Gada	876	1	Chad	70	35	A
40	I-4	NANGERE	Gamarum	1,236	1	Kerri-Kerri	80	35	A
41	I-5	NANGERE	Duddaye B	396	1	〃	80	35	B
42	J-1	POTISKUM	Adaya	1,112	1	Kerri-Kerri	50	15	A
43	J-2	POTISKUM	Mazagane	520	1	〃	65	30	A
44	J-3	POTISKUM	Mamudo	2,399	1	〃	50	15	B
45	J-4	POTISKUM	Lai-Lai	1,350	1	〃	65	30	A
46	J-5	POTISKUM	Lakwaya	415	1	〃	65	30	B
47	J-6	POTISKUM	Dumbulwa	732	1	〃	65	30	A
48	K-1	GEIDAM	Kawari Lawanti	504	1	Chad	60	20	B
49	K-2	GEIDAM	Dajina	330	1	〃	60	20	B
50	K-3	GEIDAM	Damakarwa	1,200	1	〃	60	20	B
51	K-4	GEIDAM	Kelluri	2,692	1	〃	60	20	A
52	K-5	GEIDAM	Nguluri	385	1	〃	60	20	B
53	K-6	GEIDAM	Borko	370	1	〃	60	20	B
54	K-7	GEIDAM	Ajiri	275	1	〃	60	20	A
55	L-2	GULANI	Sollari	526	1	Fika	55	25	B
56	L-3	GULANI	Chandam	872	1	〃	50	20	A
57	L-4	GULANI	Badago/Badigore	721	1	〃	60	30	B
58	L-5	GULANI	Bagardo	427	1	〃	50	20	B

Target Villages for Borehole Construction (2)

ID/ No		LGA	Village	Population in 1991	No. of Requested Boreholes	Geology	Groundwater Develoment Potential Evaluation		Social Condtion Evaluation Rank
							Estimated Drilling Depth(m)	Estimated Water Level (m)	
59	M-1	GUJBA	Katarko	2,535	1	Chad	50	25	B
60	M-2	GUJBA	Daddawel	1,162	1	Fika	50	15	B
61	M-3	GUJBA	Horanyiwa	914	1	Kerri-Kerri	70	35	B
62	M-4	GUJBA	Ligdir	671	1	OlderGranite	60	30	B
63	M-5	GUJBA	Kukuwa	2,172	1	Gongila	60	30	B
64	N-1	JAKUSKO	Yin	776	1	Chad	50	20	A
65	N-2	JAKUSKO	Adiya	842	1	〃	50	20	B
66	N-3	JAKUSKO	Kajuwa	1,425	1	〃	50	20	B
67	N-4	JAKUSKO	Jammel	1,692	1	〃	50	20	A
68	N-5	JAKUSKO	Tajuwa	824	1	〃	50	20	A
69	N-6	JAKUSKO	Tasga	572	1	〃	50	20	B
70	N-7	JAKUSKO	Jabba	1,990	1	〃	60	30	B
71	O-2	TARMUWA	Koriyel	1,137	1	Chad	60	30	B
72	O-3	TARMUWA	Dumbari	296	1	〃	60	30	A
73	O-4	TARMUWA	Manda-da'a	445	1	〃	55	25	B
74	P-1	YUSUFARI	Mayori West	615	1	Chad	50	20	B
75	P-2	YUSUFARI	Mayori East	2,008	1	〃	50	20	B
76	P-3	YUSUFARI	Shetimari (Abbagari & others)	475	1	〃	50	15	A
77	P-4	YUSUFARI	Tulo-tulowa	3,166	1	〃	50	10	A
78	P-5	YUSUFARI	Bukora	895	1	〃	50	15	B
79	P-6	YUSUFARI	Kaluwa	521	1	〃	50	20	B
80	P-7	YUSUFARI	Garin Tsangai	1,438	1	〃	50	20	B
81	P-8	YUSUFARI	Maidashi	4,370		〃	50	20	B
82	Q-1	YUNUSARI	Bula Moduye	583	1	Chad	50	20	B
83	Q-2	YUNUSARI	Kalgi	974	1	〃	55	25	A
84	Q-3	YUNUSARI	Toshia	1,584	1	〃	50	20	A
85	Q-4	YUNUSARI	Dalari	360	1	〃	50	20	B
86	Q-5	YUNUSARI	Buhari	287	1	〃	50	20	B
87	Q-6	YUNUSARI	Bultuwa	234	1	〃	50	20	B
88	Q-7	YUNUSARI	Ngormadi	320	1	〃	50	20	A
89	Q-8	YUNUSARI	Bulabulin	1,139	1	〃	50	20	A

A: Higher evaluation points (12 to 15)
B: High evaluation points (8 to 11)
C: Satisfied evaluation points (5 to 7)

Format of Monthly Progress Report for Borehole Construction

ID	LGA	Community	Latitude	Longitude	Date	Depth (m)	Screen Position (m)	Yield (l/min)	S.W.L (m)	Pump Depth (m)	WASCOM	Sanitation facilities

Monthly/ Cumulative- Total

Progress	Number of Borehole	No of Pumps installed	Productive Boreholes	Abortive Boreholes	Depth (m)	Casings (m)	
						Blind	Screen

YOBE STATE RURAL WATER SUPPLY PLAN

Year	Rural Population in Yobe Sate	Number of Safe Water Resources (nos)						People Access to Safe Water in Rural Areas (nos)				Total Coverage Rate in Yobe State (%)			
		Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pump			Total	Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pumps	Total	Open Cement Wells	Boreholes for mechanized pump	Borehole for Hand Pumps	Total
				Amount of number	drilled by JICA rig	drilled by another rig									
2005	710, 000	320	80	220			620	64, 000	160, 000	110, 000	334, 000	9	22.5	15.5	47
2006	727, 750	370	92	250			712	74, 000	184, 000	125, 000	383, 000	10.2	25.3	17.2	52.6
2007	745, 944	420	104	280			804	84,000	208,000	140, 000	432, 000	11.3	27.9	18.8	57.9
2008	764, 592	470	118	360	46	36	948	94, 000	236, 000	180, 000	510, 000	12.3	30.9	23.5	66.7
2009	783, 707	520	132	440	45	35	1,092	104,000	264, 000	220, 000	588, 000	13.3	33.7	28.1	75
2010	803, 300	560	142	494	50	4	1, 196	112, 000	284, 000	247, 000	643, 000	14	35.5	30.8	80.4
2011	825, 792	575	153	564	50	20	1, 292	115, 000	305, 000	282, 000	702, 000	13.9	36.9	34.1	85
2012	846, 346	585	166	628	50	14	1, 379	117, 000	331, 000	314, 000	762, 000	13.8	39.09	37.08	90
2013	867, 592	-	210	810	RUWASA will plan later on the basis of the situation		1, 020	-	420,000	405, 000	825, 000	-	48.38	46.65	95.1
2014	889, 287	-	230	856			1, 088	-	460, 000	429, 281	889, 281	-	51.67	48.22	99.9
2015	YEAR 2015 IS RESERVED FOR ANY SHORTCOMINGS THAT MAY ARISE AFTER REVIEW & APPRAISAL OF THE PROJECTS AT THE END OF 2014.														

PLAN PARAMETERS:

The overall calculations / parameters is based on the following assumptions:

a) That in rural areas of Yobe state, the average consumption is 25 liter / capita/ day

b) Open cement well has an average discharge of 5000l/day covering 200 people

c) Hand pump has a discharge of 0.2litres/second i.e 8640 liters/ day covering 500 people

d) Boreholes in rural areas has an average discharge of 2.5 liters/second i.e 43, 200 liter/day covering 2000 people

NOTE

It is anticipated that JICA will provide 100 Handpumps that will contribute a total of 5.63% in 2008 and 2009

UNICEF has provided 200 boreholes that is expected to contribute a total of 11.27% to hand pumps in 2007 and 2008

WSSSRP/SRIP will also cover 4 local Governments in the state which is yet to be integrated into the master plan

Yearly increase in rural population is estimated to be 2.5%

5. RESULT OF GEOPHYSICAL SURVEY

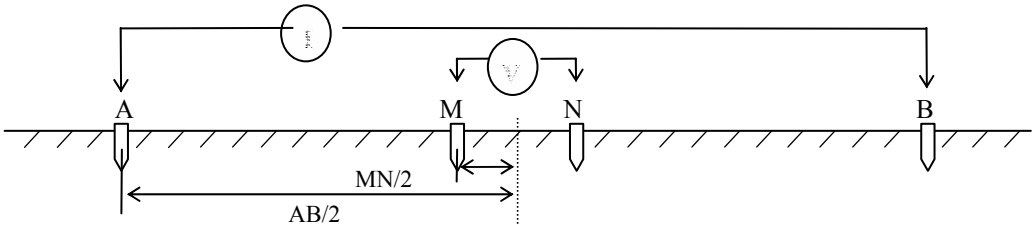
5. Results of Geophysical Survey

1. Purpose of the Project

Geophysical survey (electrical prospecting) was carried out in order to understand the hydrogeological conditions in the target areas and establish standards for water wells. Ten villages were selected for prospecting from among 100 candidate villages. Figure 2 shows the rough measuring locations, and Figure 3 shows more detailed locations. The villages were selected to supplement existing well data and were concentrated from the central to southern regions of the Yobe State, a geologically complex area. The geophysical survey was subcontracted to local companies, while the analysis was conducted by the JICA study team's hydrogeologist.

2. Prospecting method

The method used for the geophysical survey was vertical electric sounding (VES), which probes the structures of horizontal layers below the ground surface. Electrodes were arranged following the Schlumberger method (Fig. 1). When the distance between current electrode and potential electrode is short, the value for apparent resistivity can reflect the structure of shallow sections; a longer distance can yield values to reflect deeper sections. Therefore, a series of measurements was taken by varying the distance between electrodes.



$\rho a = \pi/4 \times ((AB^2 - MN^2)/MN) \times (V/I)$, ρa=apparent resistivity (ohm-m), I：current between of A and B(A), V：potential between of M and N(V), AB：current electrode, MN：potential electrode

Figure 1 Schlumberger arrangement of electrodes

By deriving the apparent resistivity as a coefficient of electrode spacing (ρa), it became possible to analyze the underground structure. In the Schlumberger method, an electric current is sent to two current electrodes (A and B) that are placed in different positions on the measuring line in order to measure the difference in electrical potential of the potential electrodes (M and N) set between the current electrodes. The ρa value of each electrode interval used in this survey was obtained. Table 1 shows the combinations of current electrode intervals (AB/2) and potential electrode intervals (MN/2) used in the survey.

Table 1 Combinations of intervals for current electrodes and potential electrodes

(AB/2)	1	1.5	2	2.5	3	4	5	6.5
(MN/2)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
(AB/2)	8	10	13	16	20	25	30	40
(MN/2)	0.2/1.5	0.2/1.5	1.5	1.5	1.5	1.5	1.5	1.5
(AB/2)	50	65	80	100	130	160	200	—
(MN/2)	1.5	1.5	1.5/16	1.5/16	16	16	16	—

3. Measuring equipment

The measuring equipment and specifications used in the surveys were as follows:

Prospecting apparatus： ABEM TERRAMETER SAS300C

Amperage： 0.2-500mA

Investigation depth： AB/2=200m

Analytical method： Horizontal multi-layer automatic analysis software

4. Results of the analysis

As shown in the table below, the measurements were taken at a total of 20 points (2 points in each of the 10 villages), which were in 7 different LGAs.

Table 2 Geophysical survey areas and measuring points

LGA	Village	Geology	Points
DAMATURU	MADORI	CHAD	2
FIKA	GARIN BALDE	GOMBE SANDSTONE	2
FUNE	NGELSHENGELE	CHAD	2
FUNE	NYAKIRE	CHAD	2
NANGERE	GAMARAM	CHAD	2
POTISKUM	LAI-LAI	KERRI-KERRI	2
GUJBA	DADDAWEL	SANDSTON	2
GUJBA	LIGDIR	SANDSTON	2
GUJBA	KATARKO	CHAD	2
TARUMUWA	DUMBARI	CHAD	2
	total		20

The measured apparent resistivity ranged from 5 to 9,820 (ohm-m). Table 3 shows the measured data, while Table 4 show the analytical results and a diagram of the analyzed structure, respectively. The analytical results table shows, from left to right, LGA name, village name, geological distribution, measuring point number, GPS coordinates, analyzed items (resistivity, layer thickness, depth from the surface) and the valaues for each layer. The colors in the layers have the following meanings: yellow shows surface and weathered layers, light blue shows assumed aquifers, and gray shows dry soil and rock.

The analysis of resistivity showed a structure of 2～6 layers, with about 75% of the measuring points consisting of 3 or 4 layers. At 18 of the 20 measuring points, the low resistivity (light blue layers) suggests the existence of groundwater. The depth of the groundwater was estimated to range from 10m to 100m. Areas that appeared to have particularly deep groundwater (around 100m deep) were FUNE, POTISKUMU, GUJBA, and TARMUWA.

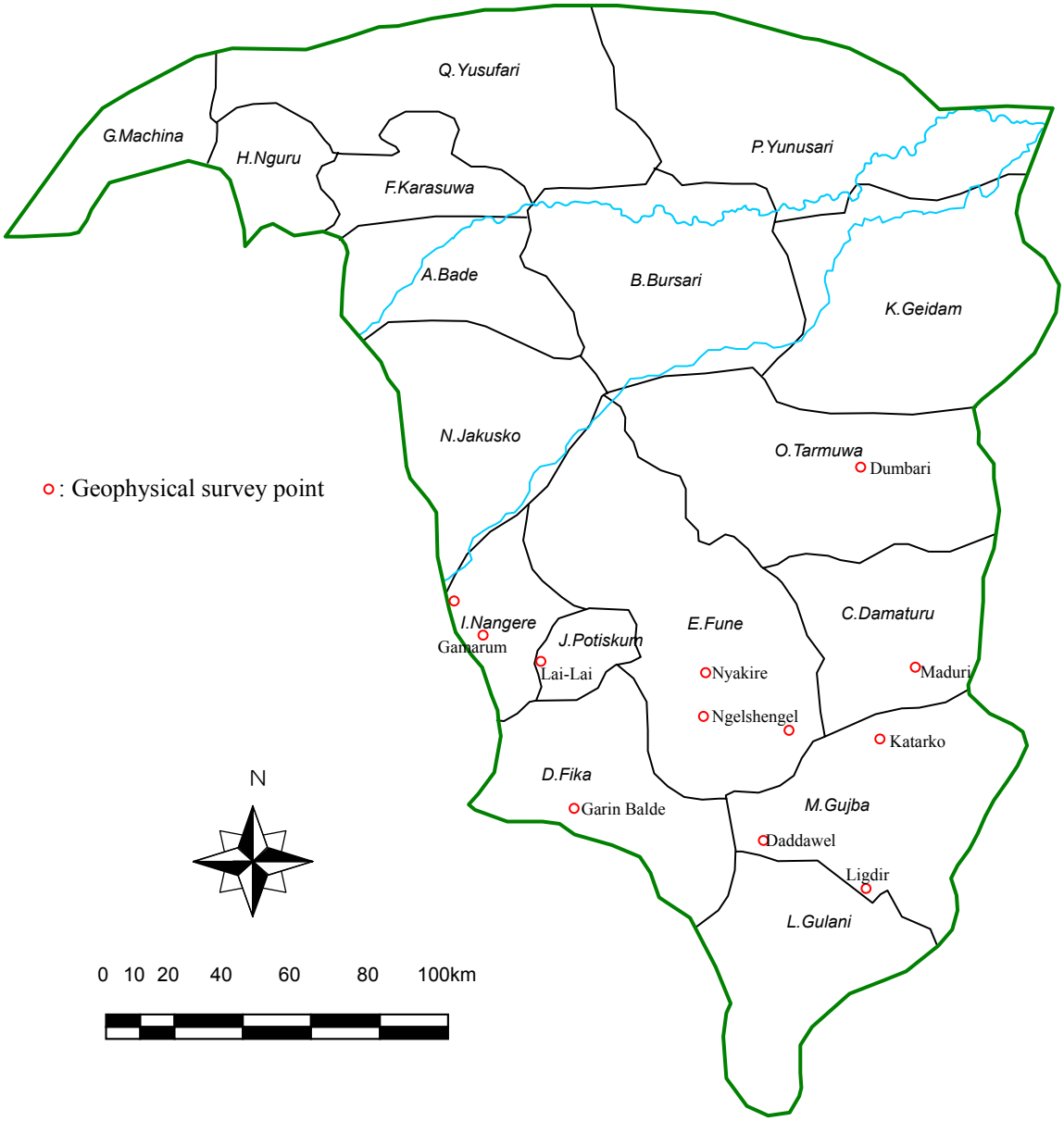
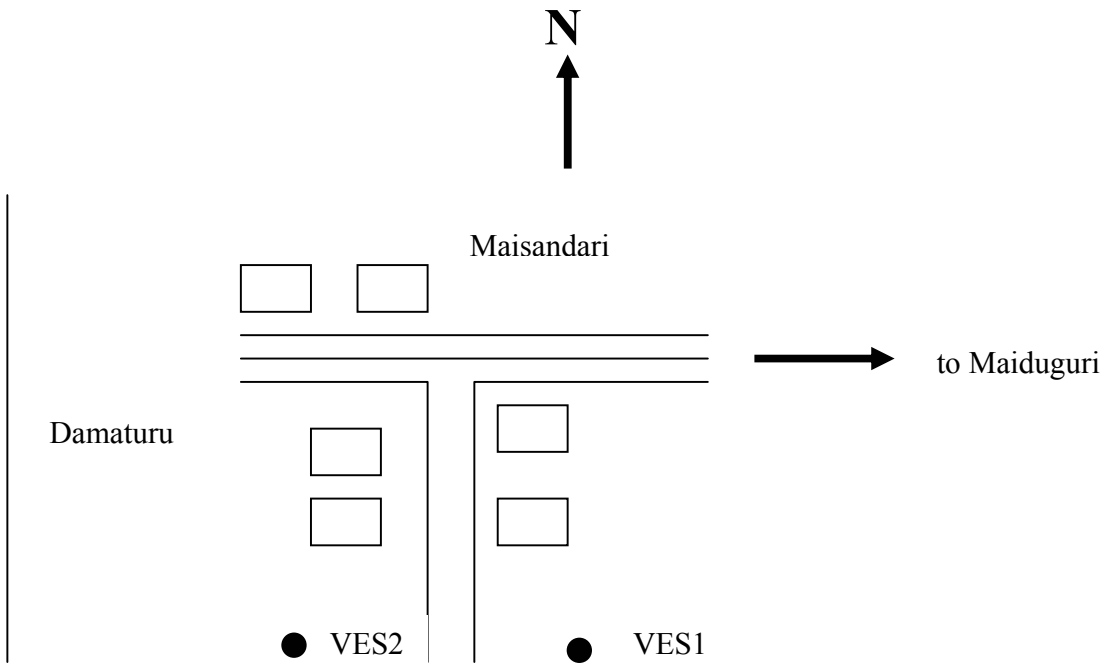


Figure 2. Geophysical Survey Location Map

Fig3. Location and Access

MADORI



GARIN BALDE

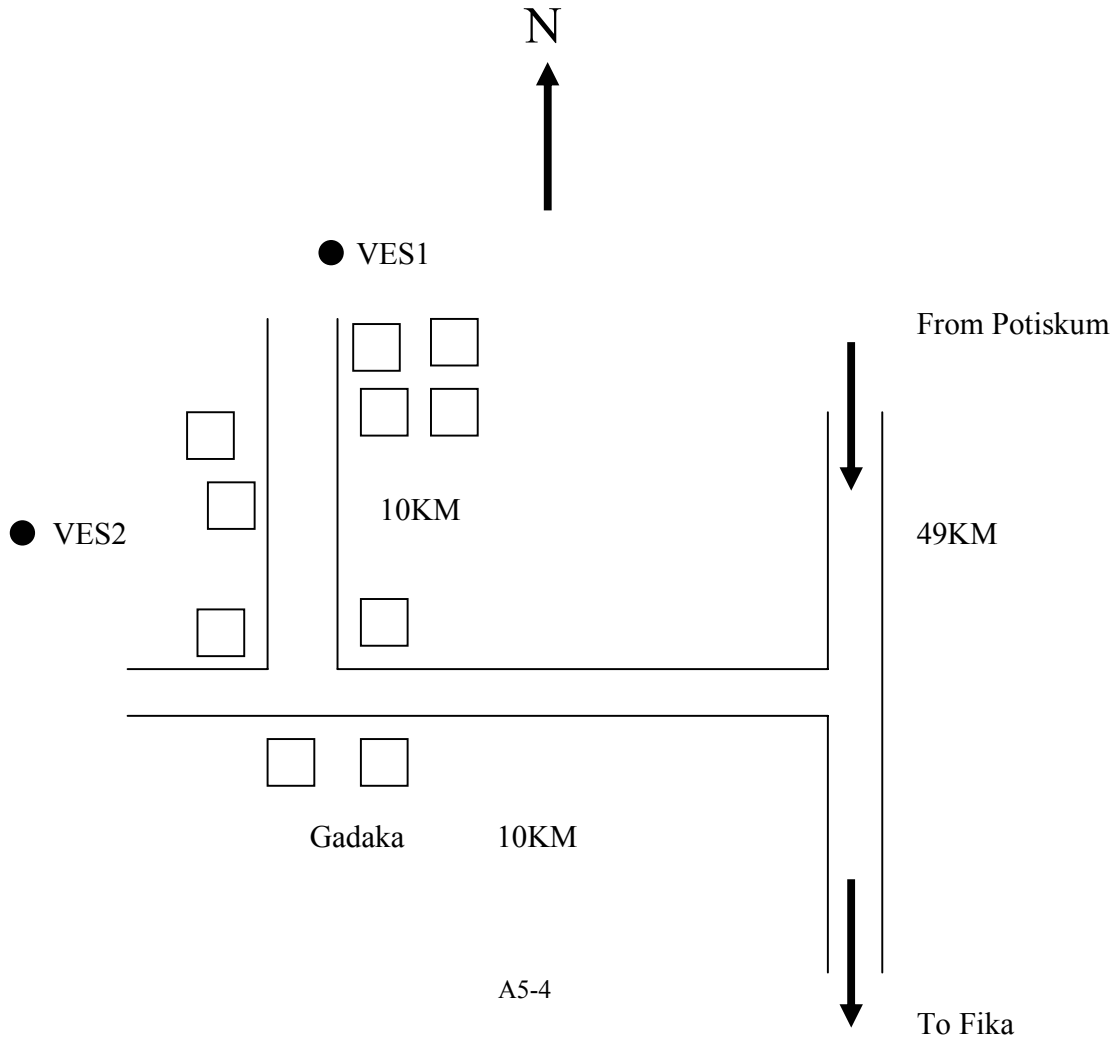


Fig3. Location and Access

NGELSHEGELE

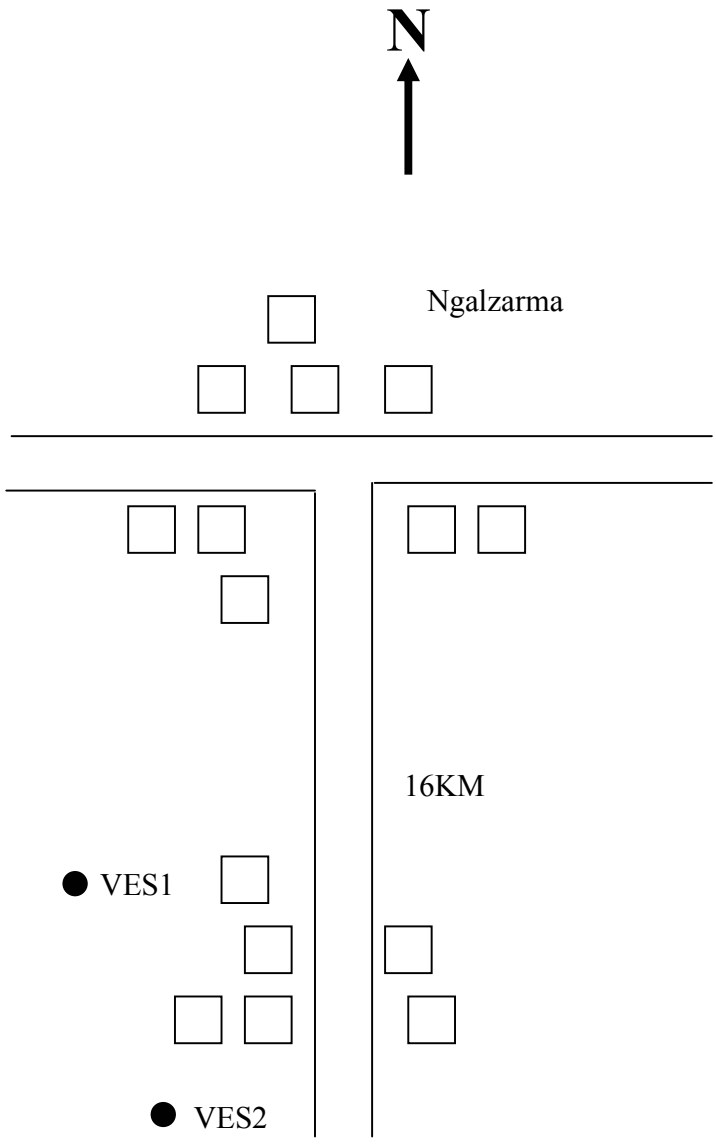


Fig3. Location and Access

NYAKIRE

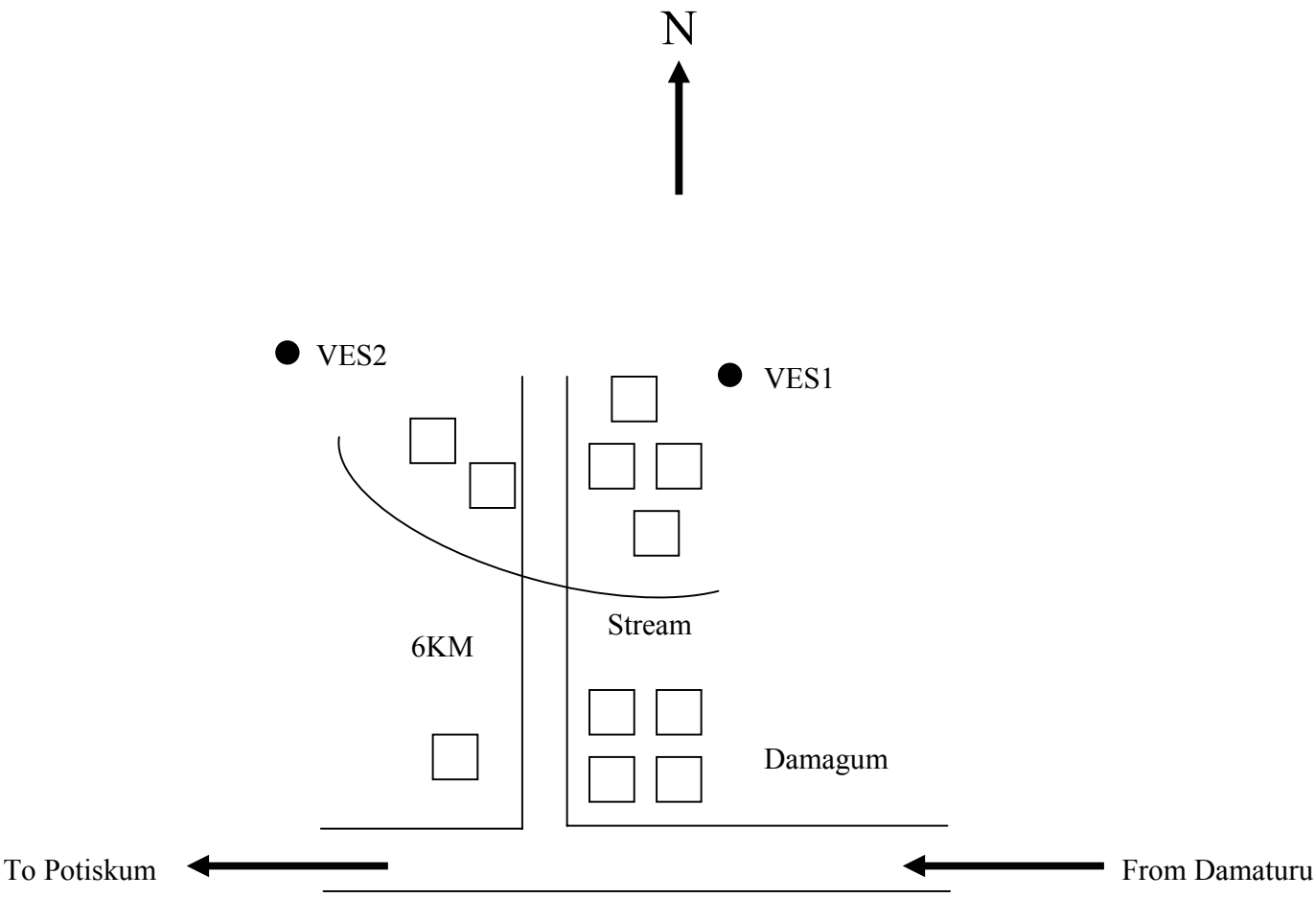


Fig3. Location and Access

GAMARAM

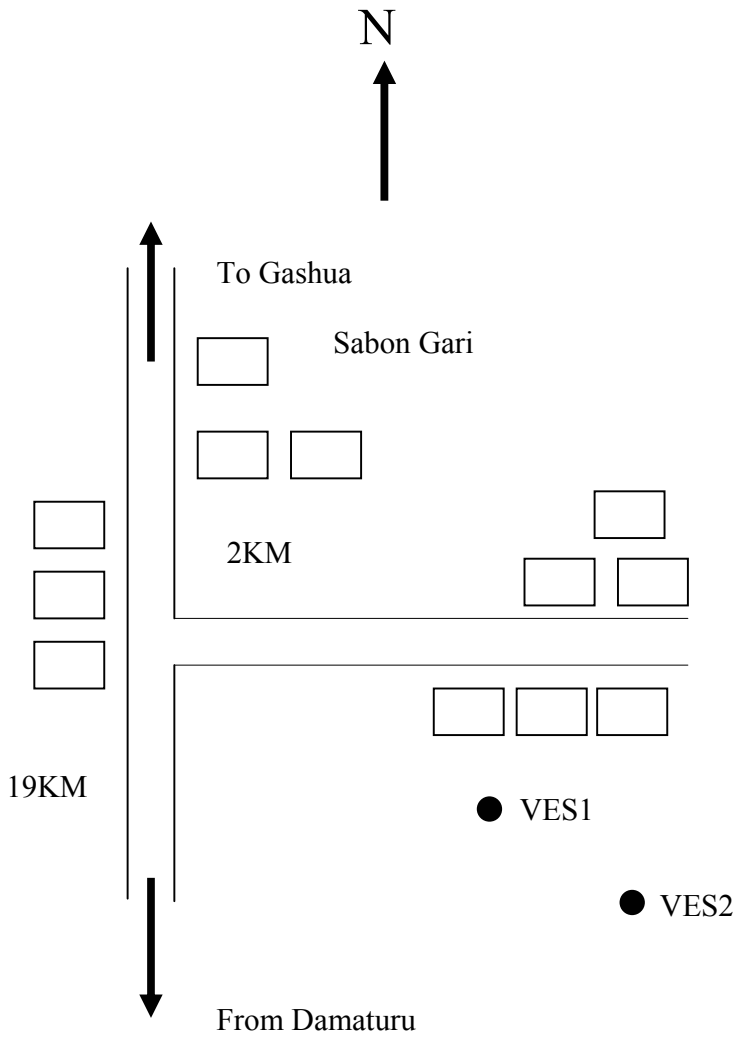


Fig3. Location and Access

LAILAI

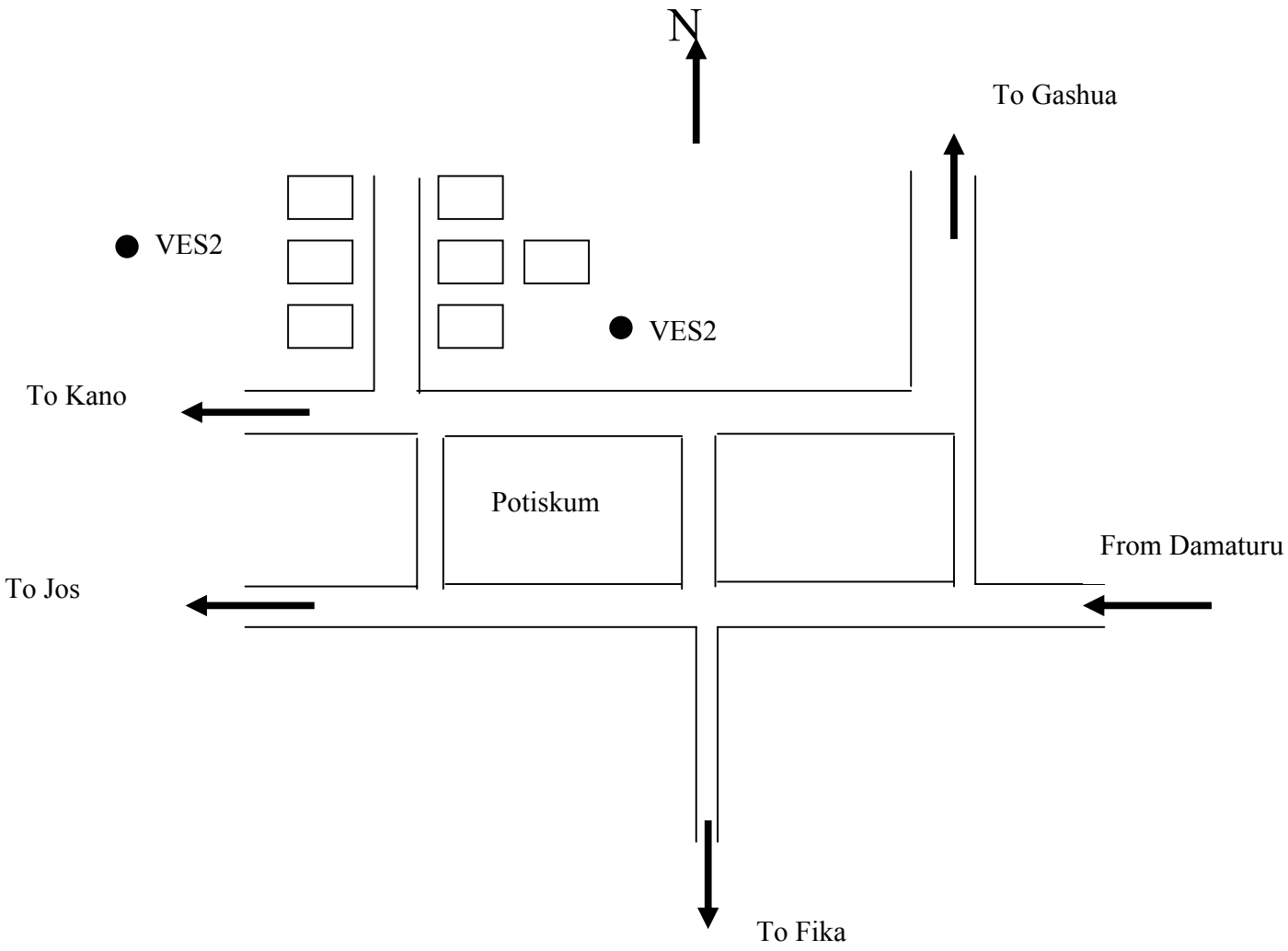


Fig3. Location and Access

DADDAWEL

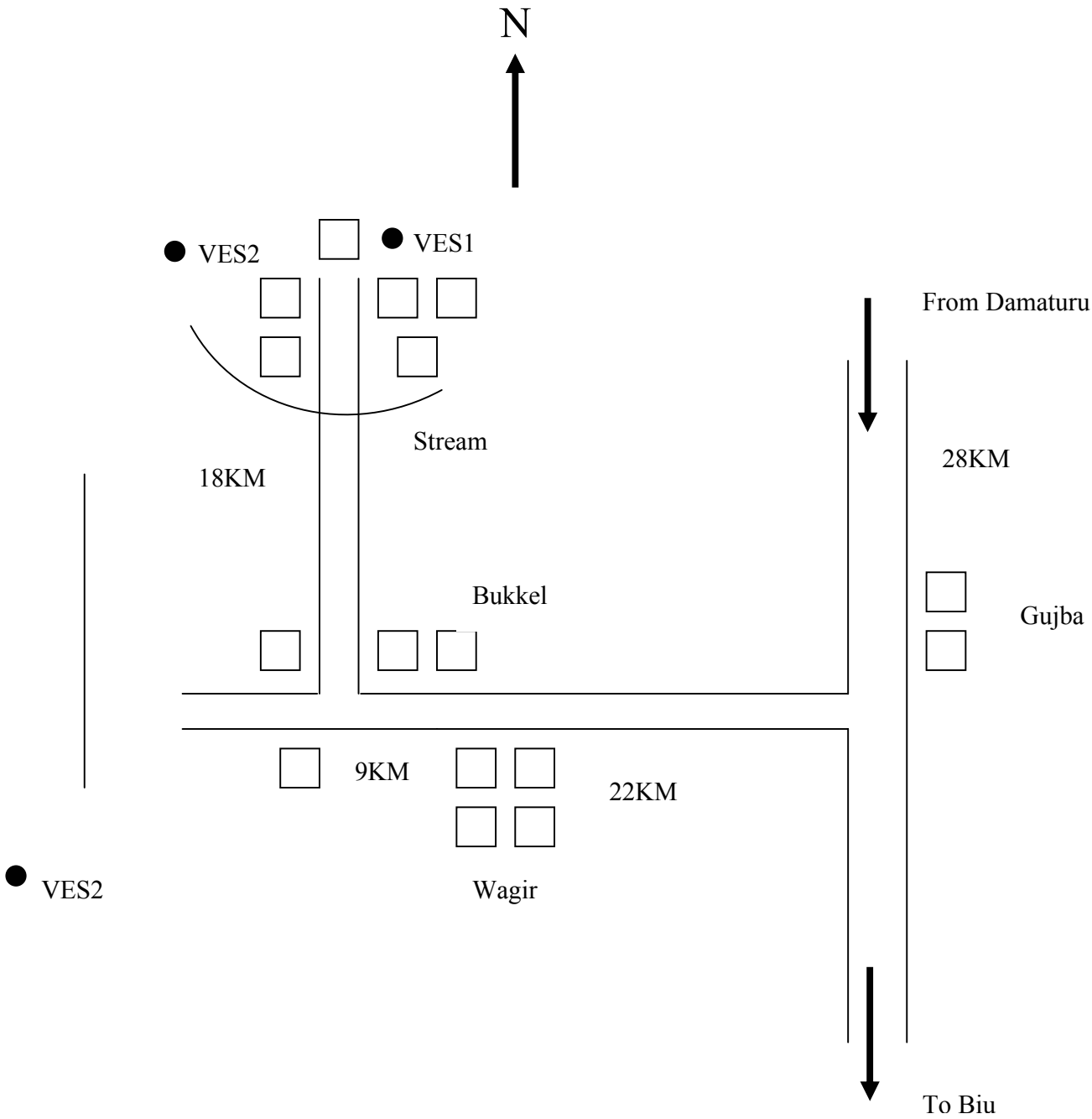


Fig3. Location and Access

LIGDIR

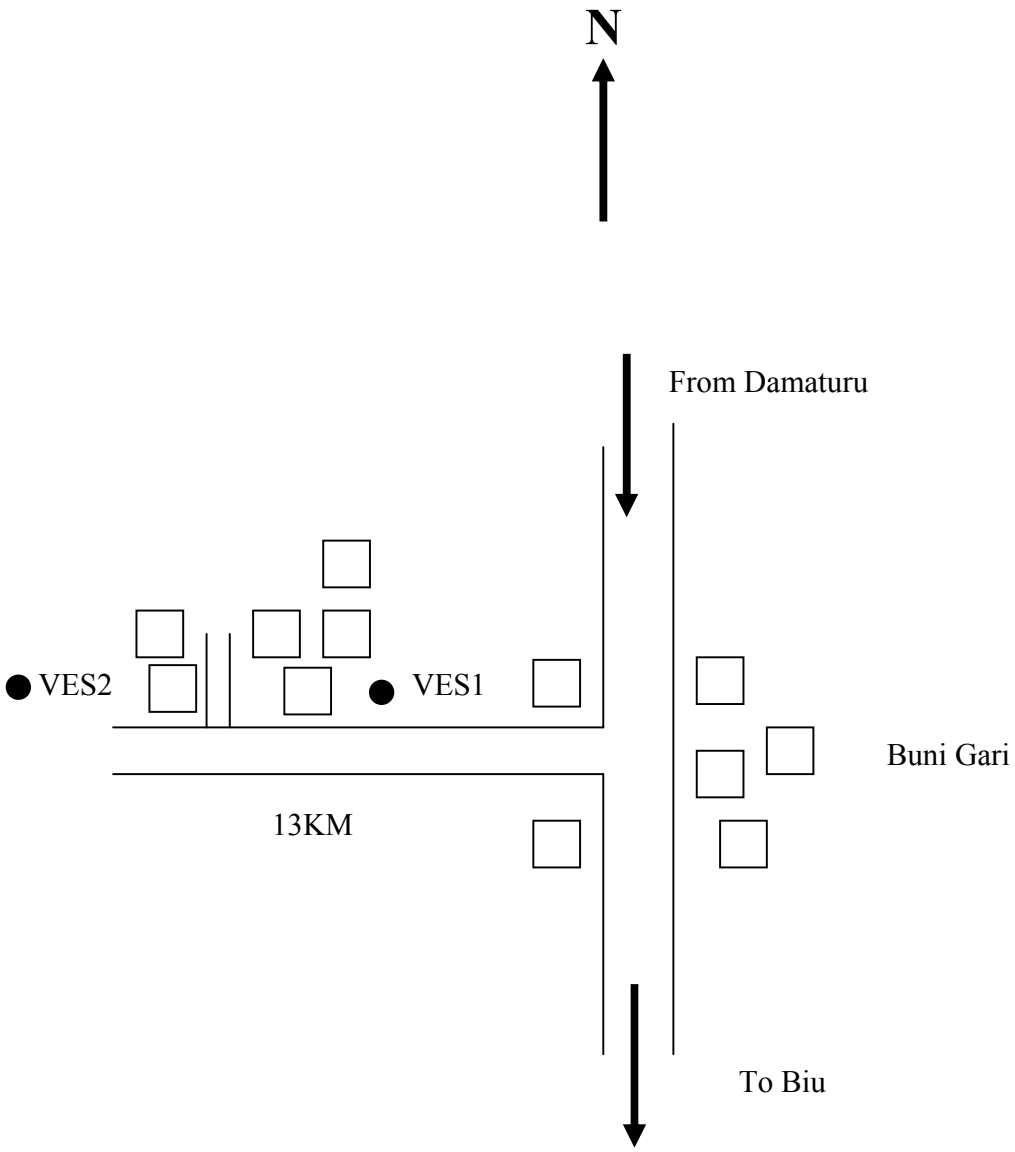
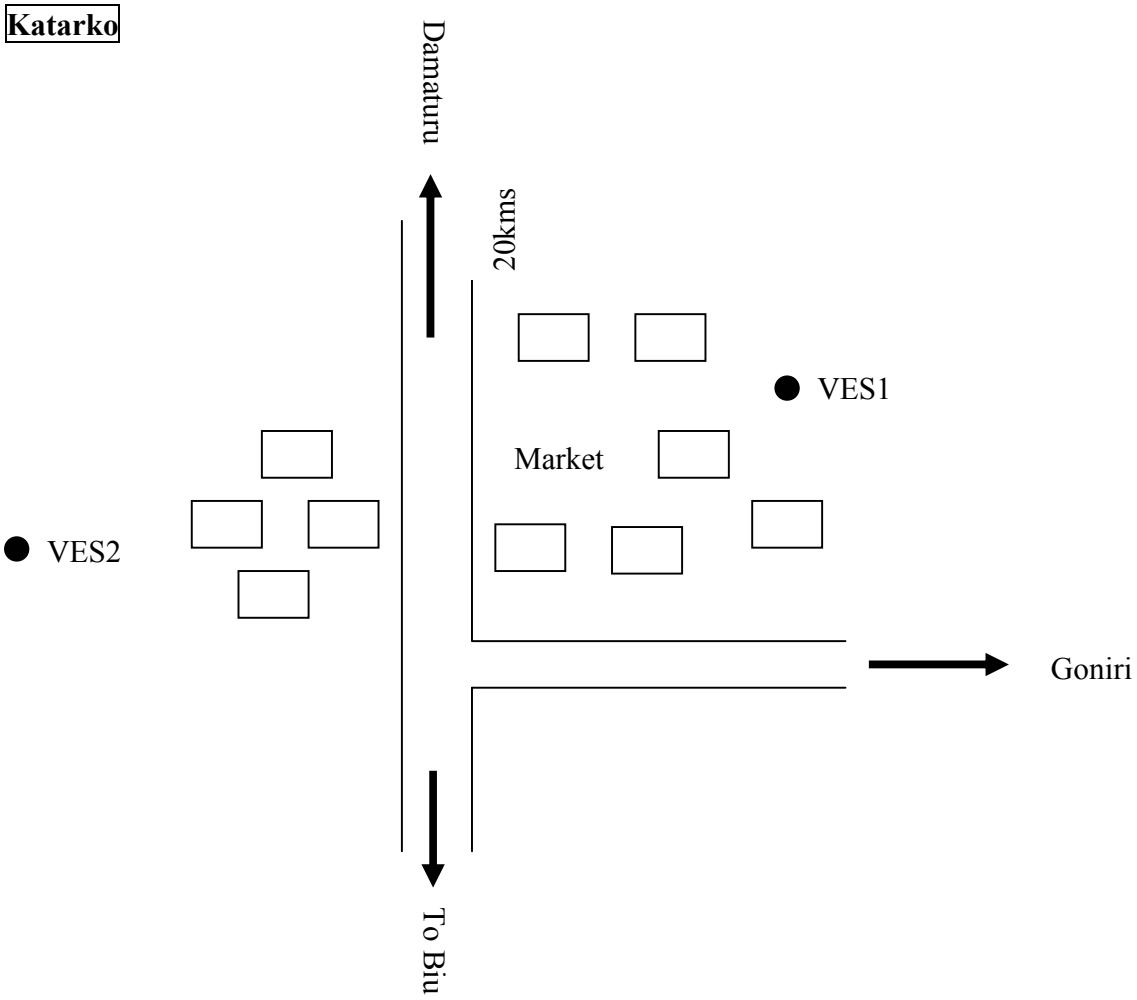
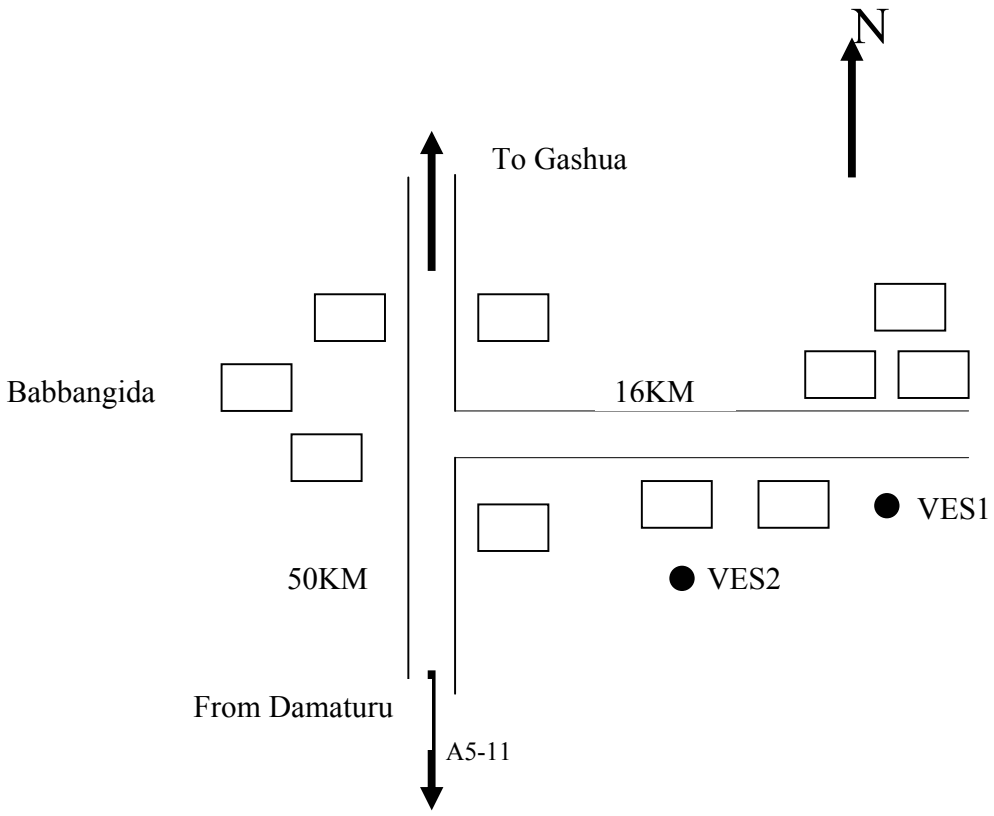


Fig3. Location and Access

Katarko



DUMBARI



DAMATURU MADORI

MADORI1 SCHL 0.000 0.000 1 1200871.000 1143845.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	926.0000
2	1.5000	546.0000
3	2.0000	481.0000
4	2.5000	335.0000
5	3.0000	239.0000
6	4.0000	165.0000
7	5.0000	78.0000
8	6.5000	66.0000
9	8.0000	62.0000
10	10.0000	71.0000
11	8.0000	42.0000
12	10.0000	45.0000
13	13.0000	53.0000
14	16.0000	65.0000
15	20.0000	72.0000
16	25.0000	83.0000
17	30.0000	80.0000
18	40.0000	72.0000
19	50.0000	78.0000
20	65.0000	106.0000
21	80.0000	60.0000
22	100.0000	42.0000
23	80.0000	60.0000
24	100.0000	38.0000
25	130.0000	33.0000
26	160.0000	25.0000
27	200.0000	36.0000

MADORI2 SCHL 0.000 0.000 1 1200879.000 1143857.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	879.0000
2	1.5000	538.0000
3	2.0000	430.0000
4	2.5000	320.0000
5	3.0000	198.0000
6	4.0000	158.0000
7	5.0000	80.0000
8	6.5000	67.0000
9	8.0000	61.0000
10	10.0000	61.0000
11	8.0000	38.0000
12	10.0000	38.0000
13	13.0000	43.0000
14	16.0000	53.0000
15	20.0000	69.0000
16	25.0000	71.0000
17	30.0000	69.0000
18	40.0000	63.0000
19	50.0000	65.0000
20	65.0000	85.0000
21	80.0000	56.0000
22	100.0000	37.0000
23	80.0000	51.0000
24	100.0000	36.0000
25	130.0000	30.0000
26	160.0000	23.0000
27	200.0000	30.0000

FIKA GARIN BALDE

GARINBA1 SCHL 0.000 0.000 1 1108646.000 1116989.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	9817.0000
2	1.5000	5898.0000
3	2.0000	5130.0000
4	2.5000	3523.0000
5	3.0000	2919.0000
6	4.0000	1718.0000
7	5.0000	945.0000
8	6.5000	479.0000
9	10.0000	264.0000
10	8.0000	396.0000
11	10.0000	397.0000
12	13.0000	333.0000
13	16.0000	313.0000
14	20.0000	356.0000
15	25.0000	636.0000
16	40.0000	301.0000
17	50.0000	1177.0000
18	65.0000	1605.0000
19	80.0000	3216.0000
20	100.0000	2659.0000
21	80.0000	802.0000
22	100.0000	843.0000

23	130.0000	1046.0000
24	160.0000	649.0000
25	200.0000	1483.0000

GARINBA2 SCHL 0.000 0.000 1 1108646.000 1116989.000

JICA
YOBE STATE
FEDERAL REPUBLIC NIGERIA
WATERSUPPLY & HEALTH DELIVERY

Dec, 2006
2
1
ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	7374.0000
2	1.5000	5150.0000
3	2.0000	3776.0000
4	2.5000	2871.0000
5	3.0000	3542.0000
6	4.0000	4775.0000
7	5.0000	3066.0000
8	6.5000	780.0000
9	8.0000	498.0000
10	10.0000	398.0000
11	8.0000	359.0000
12	10.0000	267.0000
13	13.0000	194.0000
14	16.0000	191.0000
15	20.0000	240.0000
16	25.0000	288.0000
17	30.0000	305.0000
18	40.0000	167.0000
19	50.0000	471.0000
20	80.0000	724.0000
21	80.0000	361.0000
22	100.0000	412.0000
23	130.0000	492.0000
24	160.0000	595.0000
25	200.0000	472.0000

FUNE NGELSHENGELE

NGELSHE1 SCHL 0.000 0.000 1 1136131.000 1132986.000

JICA
YOBE STATE
FEDERAL REPUBLIC NIGERIA
WATERSUPPLY & HEALTH DELIVERY

Dec, 2006
1
1
ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	78.0000
2	1.5000	64.0000
3	2.0000	53.0000
4	2.5000	50.0000
5	3.0000	46.0000
6	4.0000	43.0000
7	5.0000	38.0000
8	6.5000	38.0000
9	8.0000	32.0000
10	10.0000	20.0000
11	8.0000	30.0000
12	10.0000	23.0000
13	13.0000	13.0000
14	16.0000	6.0000
15	20.0000	9.0000
16	25.0000	16.0000
17	30.0000	7.0000
18	40.0000	5.0000
19	80.0000	7.0000
20	80.0000	6.0000
21	100.0000	10.0000
22	130.0000	16.0000
23	160.0000	25.0000
24	200.0000	39.0000

NGELSHE2 SCHL 0.000 0.000 1 1136184.000 1132861.000

JICA
YOBE STATE
FEDERAL REPUBLIC NIGERIA
WATERSUPPLY & HEALTH DELIVERY

Dec, 2006
2
1
ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	72.0000
2	1.5000	62.0000
3	2.0000	47.0000
4	2.5000	40.0000
5	3.0000	33.0000
6	4.0000	28.0000
7	5.0000	25.0000
8	6.5000	22.0000
9	8.0000	24.0000
10	10.0000	23.0000
11	8.0000	23.0000
12	10.0000	20.0000
13	13.0000	19.0000
14	16.0000	16.0000
15	20.0000	16.0000
16	25.0000	14.0000
17	30.0000	13.0000
18	80.0000	11.0000
19	100.0000	14.0000
20	130.0000	16.0000
21	160.0000	12.0000
22	200.0000	31.0000

FUNE NYAKERE

NYAKIRE1 SCHL 0.000 0.000 1 1118797.000 1143130.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	951.0000
2	1.5000	717.0000
3	2.0000	499.0000
4	2.5000	330.0000
5	3.0000	281.0000
6	4.0000	213.0000
7	5.0000	139.0000
8	6.5000	114.0000
9	8.0000	113.0000
10	10.0000	117.0000
11	8.0000	90.0000
12	10.0000	90.0000
13	13.0000	88.0000
14	16.0000	77.0000
15	20.0000	92.0000
16	25.0000	110.0000
17	30.0000	87.0000
18	40.0000	112.0000
19	50.0000	120.0000
20	65.0000	146.0000
21	80.0000	208.0000
22	100.0000	21.0000
23	80.0000	139.0000
24	100.0000	77.0000
25	130.0000	32.0000
26	160.0000	25.0000
27	200.0000	39.0000

NYAKIRE2 SCHL 0.000 0.000 1 1118762.000 1143074.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	444.0000
2	1.5000	316.0000
3	2.0000	240.0000
4	2.5000	223.0000
5	3.0000	205.0000
6	4.0000	164.0000
7	5.0000	137.0000
8	6.5000	117.0000
9	8.0000	102.0000
10	10.0000	86.0000
11	8.0000	94.0000
12	10.0000	106.0000
13	13.0000	78.0000
14	16.0000	81.0000
15	20.0000	90.0000
16	25.0000	108.0000
17	30.0000	118.0000
18	40.0000	120.0000
19	50.0000	70.0000
20	65.0000	40.0000
21	80.0000	72.0000
22	100.0000	86.0000
23	160.0000	100.0000
24	200.0000	78.0000

NANGER GAMARAM

GAMARAM1 SCHL 0.000 0.000 1 1105201.000 1150243.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	654.0000
2	1.5000	534.0000
3	2.0000	654.0000
4	2.5000	525.0000
5	3.0000	484.0000
6	4.0000	424.0000
7	5.0000	317.0000
8	6.5000	271.0000
9	10.0000	204.0000
10	8.0000	107.0000
11	10.0000	163.0000
12	8.0000	104.0000
13	13.0000	43.0000
14	16.0000	21.0000
15	20.0000	11.0000
16	25.0000	17.0000
17	30.0000	20.0000
18	40.0000	18.0000
19	50.0000	18.0000
20	65.0000	22.0000
21	80.0000	13.0000
22	100.0000	21.0000
23	80.0000	24.0000
24	100.0000	39.0000
25	130.0000	56.0000

26	160.0000	32.0000

GAMARAM2 SCHL 0.000 0.000 1 1105323.000 1150280.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	1546.0000
2	1.5000	1555.0000
3	2.0000	1556.0000
4	2.5000	1519.0000
5	3.0000	1428.0000
6	4.0000	1168.0000
7	5.0000	908.0000
8	6.5000	720.0000
9	10.0000	442.0000
10	8.0000	231.0000
11	10.0000	445.0000
12	8.0000	218.0000
13	13.0000	73.0000
14	16.0000	11.0000
15	20.0000	19.0000
16	25.0000	20.0000
17	30.0000	8.0000
18	40.0000	13.0000
19	50.0000	42.0000
20	65.0000	31.0000
21	80.0000	40.0000
22	100.0000	73.0000
23	80.0000	11.0000
24	100.0000	11.0000
25	130.0000	8.0000
26	160.0000	20.0000
27	200.0000	4.0000

POTISKUM LAI LAI
LAILAI1 SCHL 0.000 0.000 1 1102836.000 1143355.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	1021.0000
2	1.5000	729.0000
3	2.0000	707.0000
4	2.5000	713.0000
5	3.0000	705.0000
6	4.0000	603.0000
7	5.0000	534.0000
8	6.5000	533.0000
9	10.0000	494.0000
10	10.0000	474.0000
11	8.0000	464.0000
12	13.0000	480.0000
13	16.0000	516.0000
14	20.0000	517.0000
15	25.0000	586.0000
16	30.0000	639.0000
17	40.0000	666.0000
18	50.0000	656.0000
19	65.0000	703.0000
20	80.0000	764.0000
21	100.0000	744.0000
22	80.0000	712.0000
23	100.0000	594.0000
24	200.0000	581.0000

LAILAI2 SCHL 0.000 0.000 1 1102973.000 1143319.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	8445.0000
2	1.5000	7047.0000
3	2.0000	6479.0000
4	2.5000	4782.0000
5	3.0000	3115.0000
6	4.0000	3188.0000
7	5.0000	1994.0000
8	6.5000	1989.0000
9	8.0000	894.0000
10	10.0000	778.0000
11	13.0000	662.0000
12	16.0000	678.0000
13	20.0000	826.0000
14	25.0000	795.0000
15	30.0000	840.0000
16	40.0000	1047.0000
17	50.0000	1415.0000
18	65.0000	1070.0000
19	80.0000	549.0000
20	100.0000	603.0000
21	130.0000	409.0000
22	160.0000	398.0000
23	200.0000	546.0000

GUJBA DADDAWEL

DADDAWE1 SCHL 0.000 0.000 1 1135441.000 1117247.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	583.0000
2	1.5000	527.0000
3	2.0000	385.0000
4	2.5000	337.0000
5	3.0000	279.0000
6	4.0000	186.0000
7	5.0000	102.0000
8	6.5000	64.0000
9	8.0000	42.0000
10	10.0000	27.0000
11	8.0000	46.0000
12	10.0000	28.0000
13	13.0000	18.0000
14	16.0000	15.0000
15	20.0000	13.0000
16	25.0000	12.0000
17	30.0000	13.0000
18	40.0000	12.0000
19	50.0000	10.0000
20	100.0000	19.0000
21	80.0000	8.0000
22	100.0000	10.0000
23	130.0000	13.0000
24	160.0000	10.0000
25	200.0000	12.0000

DADDAWE2 SCHL 0.000 0.000 1 1135316.000 1117507.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	370.0000
2	1.5000	188.0000
3	2.0000	82.0000
4	2.5000	43.0000
5	3.0000	43.0000
6	4.0000	47.0000
7	5.0000	25.0000
8	6.5000	25.0000
9	8.0000	95.0000
10	10.0000	119.0000
11	8.0000	65.0000
12	10.0000	81.0000
13	13.0000	91.0000
14	16.0000	104.0000
15	20.0000	116.0000
16	25.0000	125.0000
17	30.0000	120.0000
18	40.0000	120.0000
19	50.0000	97.0000
20	100.0000	66.0000
21	100.0000	141.0000
22	130.0000	108.0000
23	160.0000	249.0000

GUJBA LIGDIR

LIGDIR1 SCHL 0.000 0.000 1 1155770.000 1108709.000
JICA Dec, 2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	28.0000
2	1.5000	32.0000
3	2.0000	36.0000
4	2.5000	42.0000
5	3.0000	48.0000
6	4.0000	58.0000
7	5.0000	67.0000
8	6.5000	75.0000
9	8.0000	50.0000
10	10.0000	39.0000
11	8.0000	31.0000
12	10.0000	70.0000
13	13.0000	62.0000
14	16.0000	21.0000
15	20.0000	33.0000
16	25.0000	34.0000
17	30.0000	26.0000
18	40.0000	33.0000
19	50.0000	26.0000
20	65.0000	40.0000
21	80.0000	27.0000
22	100.0000	32.0000

LIGDIR2 SCHL 0.000 0.000 1 1155608.000 1108681.000
JICA Dec, 2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	12.0000
2	1.5000	12.0000
3	2.0000	11.0000
4	2.5000	12.0000
5	3.0000	13.0000
6	4.0000	15.0000
7	5.0000	12.0000
8	6.5000	31.0000
9	8.0000	20.0000
10	10.0000	24.0000
11	8.0000	25.0000
12	10.0000	16.0000
13	16.0000	27.0000
14	20.0000	25.0000
15	30.0000	19.0000
16	40.0000	17.0000
17	50.0000	26.0000
18	65.0000	44.0000
19	80.0000	67.0000

GUJBA KATARKO

KATARK01 SCHL 0.000 0.000 1 1155189.000 1133921.000
JICA Dec,2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	1024.0000
2	1.5000	999.0000
3	2.0000	355.0000
4	2.5000	238.0000
5	3.0000	177.0000
6	4.0000	124.0000
7	5.0000	123.0000
8	6.5000	189.0000
9	8.0000	136.0000
10	10.0000	102.0000
11	8.0000	99.0000
12	10.0000	54.0000
13	13.0000	23.0000
14	16.0000	69.0000
15	20.0000	229.0000
16	25.0000	20.0000
17	30.0000	85.0000
18	40.0000	351.0000
19	50.0000	262.0000
20	65.0000	177.0000
21	80.0000	34.0000
22	100.0000	105.0000
23	80.0000	27.0000
24	130.0000	219.0000
25	160.0000	127.0000
26	200.0000	47.0000

KATARK02 SCHL 0.000 0.000 1 1155889.000 1133444.000
JICA Dec,2006
YOBE STATE 2
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	134.0000
2	1.5000	51.0000
3	2.0000	33.0000
4	2.5000	31.0000
5	3.0000	29.0000
6	4.0000	31.0000
7	5.0000	34.0000
8	6.5000	42.0000
9	8.0000	52.0000
10	10.0000	63.0000
11	8.0000	45.0000
12	10.0000	56.0000
13	13.0000	67.0000
14	16.0000	78.0000
15	20.0000	73.0000
16	25.0000	104.0000
17	30.0000	101.0000
18	40.0000	100.0000
19	50.0000	71.0000
20	65.0000	58.0000
21	80.0000	74.0000
22	80.0000	30.0000
23	100.0000	29.0000
24	130.0000	16.0000
25	160.0000	25.0000
26	200.0000	39.0000

TARUMUWA DUMBARI

DUMBARI1 SCHL 0.000 0.000 1 1152663.000 1214146.000
JICA Dec,2006
YOBE STATE 1
FEDERAL REPUBLIC NIGERIA 1
WATERSUPPLY & HEALTH DELIVERY ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	239.0000
2	1.5000	212.0000
3	2.0000	158.0000

4	2.5000	147.0000
5	3.0000	83.0000
6	4.0000	39.0000
7	5.0000	22.0000
8	6.5000	10.0000
9	8.0000	16.0000
10	10.0000	18.0000
11	8.0000	17.0000
12	10.0000	13.0000
13	13.0000	6.0000
14	16.0000	8.0000
15	20.0000	10.0000
16	25.0000	10.0000
17	30.0000	7.0000
18	40.0000	60.0000
19	50.0000	52.0000
20	65.0000	111.0000
21	80.0000	127.0000
22	100.0000	94.0000
23	100.0000	66.0000
24	130.0000	26.0000
25	160.0000	30.0000
26	200.0000	12.0000

DUMBARI2 SCHL 0.000 0.000 1 1153381.000 1214229.000

JICA — Dec, 2006
YOBE STATE — 2
FEDERAL REPUBLIC NIGERIA — 1
WATERSUPPLY & HEALTH DELIVERY — ABEM SAS 300C

No.	SPACING	RHO-A
1	1.0000	538.0000
2	1.5000	437.0000
3	2.0000	387.0000
4	2.5000	311.0000
5	3.0000	237.0000
6	4.0000	126.0000
7	5.0000	95.0000
8	6.5000	61.0000
9	8.0000	62.0000
10	10.0000	14.0000
11	8.0000	26.0000
12	10.0000	17.0000
13	13.0000	14.0000
14	20.0000	18.0000
15	25.0000	10.0000
16	30.0000	17.0000
17	40.0000	169.0000
18	50.0000	76.0000
19	65.0000	88.0000
20	80.0000	54.0000
21	80.0000	13.0000
22	100.0000	19.0000
23	130.0000	16.0000
24	160.0000	25.0000

Table4. Result of Geophysical Survey

: overburden,weathered layer
: dry layer, base rock
: low resistivity layer
(groundwater potential)

(1/2)

LGA	Village	Geology	No.	coordinates	Parameter	Layers					
						L1	L2	L3	L4	L5	L6
DAMATURU	MADORI	CHAD	1	N11° 43′ 50.7″	Resistivity(Ohm-m)	490	22.8	261	6.4	121	
				E12° 00′ 52.3″	Thickness(m)	1.1	4.7	12	34.3	-	
					Depth(m)	1.1	5.8	17.8	52.1	-	
			2	N11° 43′ 51.4″	Resistivity(Ohm-m)	490	22.8	203	5.8	38.9	
				E12° 06′ 52.7″	Thickness(m)	1.1	6.2	13.8	23.5	-	
					Depth(m)	1.1	7.3	21.1	44.6	-	
FIKA	GARIN BALDE	GOMBE SANDSTONE	1	N11° 16′ 59.3″	Resistivity(Ohm-m)	3668	87.2	108000			
				E11° 08′ 38.8″	Thickness(m)	1.4	12.3	-			
					Depth(m)	1.4	13.7	-			
			2	N11° 16′ 59.9″	Resistivity(Ohm-m)	2025	103	799			
				E11° 08′ 38.8″	Thickness(m)	1.9	23.5	-			
					Depth(m)	1.9	25.4	-			
FUNE	NGELSHENGELE	CHAD	1	N11° 32′ 59.2″	Resistivity(Ohm-m)	58.3	5.6	548			
				E11° 36′ 07.9″	Thickness(m)	3.6	48.0	-			
					Depth(m)	3.6	51.6	-			
			2	N11° 32′ 51.7″	Resistivity(Ohm-m)	56.6	16.2	68.8			
				E11° 36′ 11.0″	Thickness(m)	1.3	145	-			
					Depth(m)	1.3	146	-			
	NYAKIRE	CHAD	1	N11° 43′ 07.8″	Resistivity(Ohm-m)	2670	251	677	21.8		
				E11° 18′ 47.8″	Thickness(m)	1.1	5.5	20.1			
					Depth(m)	1.1	6.6	26.7	-		
			2	N11° 43′ 04.4″	Resistivity(Ohm-m)	428	84.3	426	28.3	130	
				E11° 18′ 45.7″	Thickness(m)	1.6	8.5	3.4	22.6	-	
					Depth(m)	1.6	10.1	13.5	36.1	-	
NANGERE	GAMARAM	CHAD	1	N11° 50′ 14.6″	Resistivity(Ohm-m)	838	27.2	62.2			
				E11° 05′ 12.1″	Thickness(m)	3.3	50.1	-			
					Depth(m)	3.3	53.4	-			
			2	N11° 50′ 16.8″	Resistivity(Ohm-m)	240	0.9	61.9	2.1		
				E11° 05′ 19.4″	Thickness(m)	3.0	8.9	37.0	-		
					Depth(m)	3.0	11.9	48.9	-		

Table4. Result of Geophysical Survey

(2/2)

LGA	Village	Geology	No.	coordinates	Parameter	Layers					
						L1	L2	L3	L4	L5	L6
POTISKUM	LAI-LAI	KERRI-KERRI	1	N11° 43′ 21.3″	Resistivity(Ohm-m)	705	356	770	546		
				E11° 02′ 50.2″	Thickness(m)	1.2	11.8	34.1	-		
					Depth(m)	1.2	13.0	47.1	-		
			2	N11° 43′ 19.1″	Resistivity(Ohm-m)	6956	506	3066	172	1694	
				E11° 02′ 58.4″	Thickness(m)	1.9	8.6	11.9	60.4	-	
					Depth(m)	1.9	10.5	22.4	82.8	-	
GUJBA	DADDAWEL	SANDSTON	1	N11° 17′ 14.8″	Resistivity(Ohm-m)	248	6.8	47.9			
				E11° 35′ 26.5″	Thickness(m)	2.0	76.4	-			
					Depth(m)	2.0	78.4	-			
			2	N11° 17′ 30.4″	Resistivity(Ohm-m)	1185	13.5	398	62.8	332	
				E11° 35′ 19.0″	Thickness(m)	0.5	0.7	22.4	46.8	-	
					Depth(m)	0.5	1.2	23.6	70.4	-	
	LIGDIR	SANDSTON	1	N11° 08′ 42.5″	Resistivity(Ohm-m)	34.8	139	23.3	37.6		
				E11° 55′ 46.2″	Thickness(m)	0.5	2.8	19.5	-		
					Depth(m)	0.5	3.3	22.8	-		
			2	N11° 08′ 40.9″	Resistivity(Ohm-m)	7.5	76.1	7.5	464		
				E11° 55′ 36.5″	Thickness(m)	3.0	4.6	10.0	-		
					Depth(m)	3.0	7.6	17.6	-		
	KATARKO	CHAD	1	N11° 33′ 55.3″	Resistivity(Ohm-m)	832	54.1	181			
				E11° 55′ 11.3″	Thickness(m)	0.6	34.1	-			
					Depth(m)	0.6	34.7	-			
			2	N11° 33′ 26.6″	Resistivity(Ohm-m)	72.8	3.6	96.1	4.5	156	
				E11° 55′ 53.3″	Thickness(m)	0.6	1.2	13.0	21.8	-	
					Depth(m)	0.6	1.8	14.8	36.6	-	
TARUMUWA	DUMBARI	CHAD	1	N12° 14′ 08.8″	Resistivity(Ohm-m)	152	5.6	191	4.1		
				E11° 52′ 37.8″	Thickness(m)	1.1	8.8	25.1	-		
					Depth(m)	1.1	9.9	35.0	-		
			2	N12° 14′ 13.7″	Resistivity(Ohm-m)	125	1.5	234	5.1		
				E11° 53′ 22.9″	Thickness(m)	2.0	6.0	24.7	-		
					Depth(m)	2.0	8.0	32.7	-		

6. RESULT OF EXISTING BOREHOLE

SURVEY

6. Results of Existing Borehole Survey

1. Purpose of the Surveys

Surveys were conducted to understand the state of existing wells in target areas and to provide data and materials for determining well standards for well drilling plans.

2. Contents of the Surveys

The existing well surveys were conducted at a total of 50 sites, including at least 1 site in every LGA. Figure 1 shows the locations of the sites. Types of wells included motorized boreholes, regular boreholes, hand pump boreholes, cement (shallow) wells, and open dug wells.

The items in the survey included well location (as measured by GPS), well specifications (date of excavation, depth, diameter, screen position), static water level, aquifer, local geology, water source, and number of existing wells, among other things. The survey results are shown in Table 3. Table 1 shows an overview of boreholes and hand pump boreholes that are drawing from deep groundwater.

Table 1 Overview of the Survey on Existing Well Conditions

ID/No.	LGA	drilling depth (m)	static water level (m)	aquifer
A	BADE	30-96	15-20	Chad
B	BURSARI	90-160	25-30	Chad
C	DAMATURU	150	40	Chad
D	FIKA	180-600	40	Sandstone, GombeSandstone, Gongila
E	FUNE	170-263	40-50	Chad
F	KARASUWA	55-120	30	Chad
G	MACHINA	45-125	20	Chad
H	NGURU	35-45	15	Chad
I	NANGERE	60-90	30-40	Chad
J	POTISKUM	40-100	15-30	Kerri-Kerri
K	GEIDAM	64	20	Chad
L	GULANI	90-115	15-30	Sandstone, Basement
M	GUJBA	67	30	Chad, Sandstone, Basement
N	JAKUSKO	66-120	25-40	Chad
O	TARMUWA	150	30	Chad
P	YUSUFARI	30-94	15	Chad
Q	YUNUSARI	90	20	Chad
	range	30-600	15-50	—

3. Survey results

The conditions of the wells are described below

① Current state of existing wells

In more than half of the villages, the wells had been abandoned. Reasons for the abandonment of the motorized borehole wells included 1) generators and/or pumps had broken down, 2) there was no money to buy the gasoline for the motor, 3) there was not enough electric current to power the equipment, and so on. Regarding the hand pumps, important pump parts broke or were lost and could not be replaced. It was found that there were many

abandoned wells like this.

The amount of water drawn from operating wells did not seem to fluctuate much in nearly all of the villages, and even if the groundwater level declined during the dry season, it was still possible to draw water for daily living throughout the year.

② Drilling depths

Excluding the shallow (cement) wells, wells were drilled to depths of 30m～600m. Well depths in the northern of Yobe State ranged from 30m～160m, while in the southern area they ranged from 30m～600m, with the average well being relatively shallow in the north and deep in the south. The deepest wells were at FIKA and FUNE.

③ Groundwater levels

Groundwater depth ranged from 15m～50m. Groundwater depth in the south also ranged from 15m～50m, while in the north the range was 15m～30m. Overall, groundwater was deeper in the south. As groundwater depth increased, so did drilling depth, so there was a correlation between groundwater depth and drilling depth.

4. Analysis of existing well data

Table 4 shows data on regular (deep) borehole wells that had been drilled in the past. Table 2, which is a compilation of the data in Table 4, lists information such as the drilling depth, static water level, amount of pumped water, etc., in the target areas.

Table.2 Outline of the existing wells (1960～2005)

ID/No.	LGA	No. of Boreholes	Total Depth Drilled(m)	Screen Position(m)		Static Water Level(m)	Approximately Discharge(l/s)
A	BADE	22	60.61	39.93	44.88	22.15	3.44
B	BURSARI	3	119.00	66.50	73.00	10.40	3.50
C	DAMATURU	41	163.36	112.90	121.79	51.23	3.74
D	FIKA	6	193.55	174.71	186.29	62.93	2.68
E	FUNE	38	131.77	93.66	110.38	43.77	3.31
F	KARASUWA	14	92.17	47.59	56.32	13.98	3.13
G	MACHINA	8	77.46	50.42	65.05	29.50	2.43
H	NGURU	42	63.35	51.24	59.12	14.15	4.03
I	NANGERE	7	80.33	63.00	70.33	54.00	2.60
J	POTISKUM	21	115.71	83.00	92.00	30.61	5.78
K	GEIDAM	7	117.33	73.65	82.65	20.00	4.78
L	GULANI	4	169.38	110.50	116.50	25.00	4.00
M	GUJBA	29	121.94	97.01	104.46	50.65	2.38
N	JAKUSKO	21	151.42	89.99	108.38	20.08	3.04
O	TARMUWA	5	138.63	77.75	80.50	60.00	3.00
P	YUSUFARI	3	84.00	56.00	66.33	15.55	2.60
Q	YUNUSARI	2	92.00	43.50	48.00	－	2.00
	sub-total	273	1972.00	1331.36	1485.99	525.04	56.45
	average	－	116.00	78.32	87.41	32.81	3.32

① Drilling depths of wells

The drilling depths of existing wells were 100m or less in the northern of state, and 100m or more in the southern of state. The deepest wells, which averaged 200m, were in FIKA.

② Groundwater depths

Groundwater depths ranged from 10m～30m in the north to 30m～60m in the south. Groundwater was at least 40m below the ground surface in the NANGERE, FUNE, TARMUWA, DAMATURU, GUJBA and FIKA areas.

③ Pumping volume

The existing well data are mainly for motorized boreholes. In order for such deep wells to be successful, they need to be able to pump at least 1L/s of water. Discharge ranges from 0.25L/s～15L/s, with the average being 3L/s, so this shouldn't be a problem.

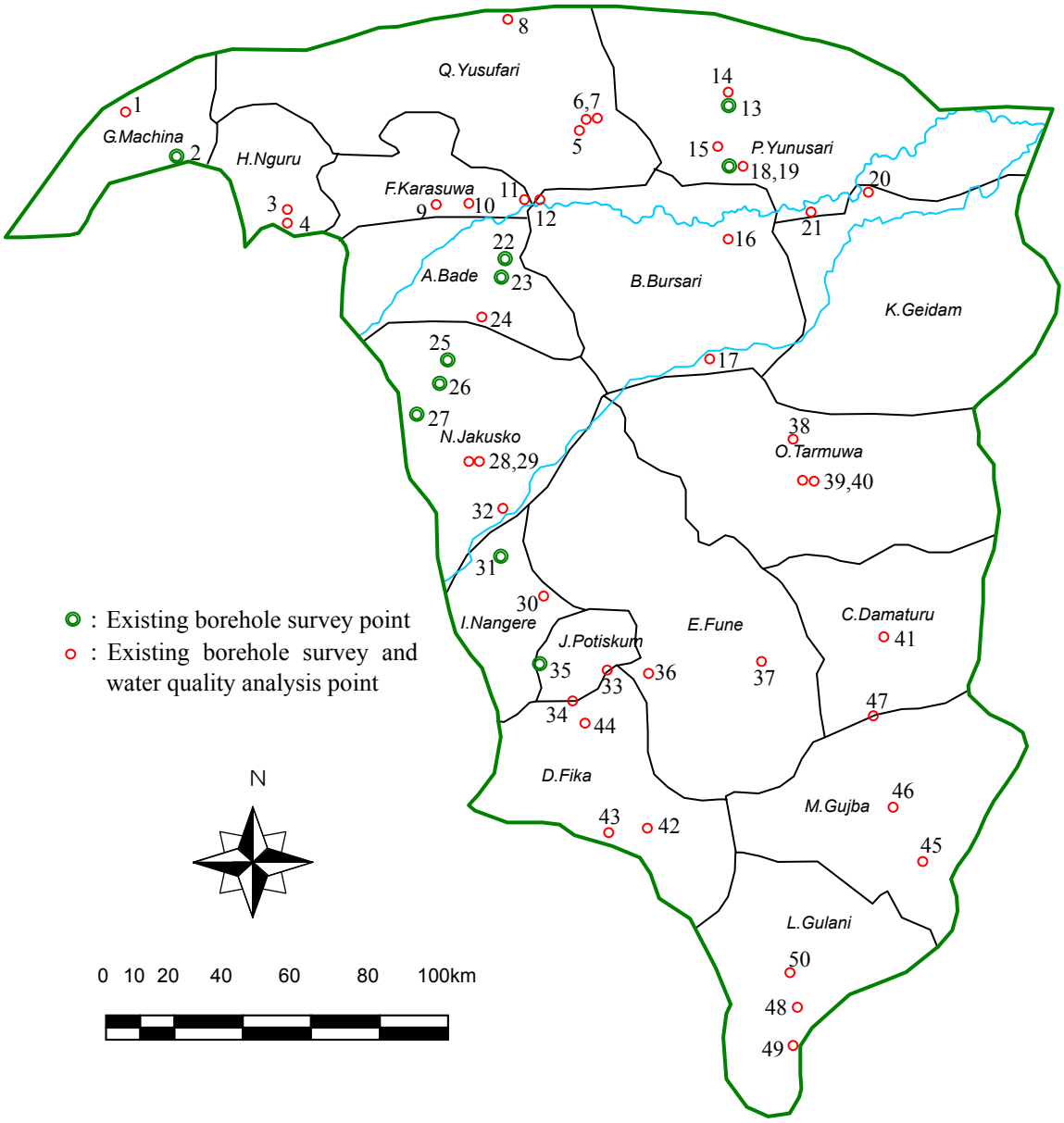


Figure 1. Existing borehole survey location map

Table3. Existing boreholes survey results

Location No.	Water quality analysis	LGA	Village	Well	Sealing condition	Drilling year	Well deph	Drilling diameter	Casing diameter (inch)	Screen position (m)	Static Water Level(m)	Aquifer	Water resorce	Remarks
1	○	MACHINA	MACHINA	Borehole	Sealed	1984	125	8inch	6inch	112-121	20	Chad	BH about 4km away Many Sement well	Basement from 45m depth Sementwell =S.W.L15m
2	—	MACHINA	LAMIS	Hund well	Open	-	45	-	-	-	-	Chad	-	-
3	○	NGURU	KULO GANDE	Hand Pump	Sealed	1/5/00	35	6inch	4inch	30	15	Chad	40 BH Many Hund pump	There is water all the year round
4	○	NGURU	GLA LOCAL GOV.SECRET	Hand Pump	Sealed	18/5/05	45	6inch	4inch	35-41	15	Chad		
5	○	YUSUFARI	YUSUFARI TOWN	Hand Pump	Sealed	16/10/06	30	6inch	4inch	20-26	15	Chad		
6	○	YUSUFARI	BULTUMARI-YUSUFARI TOWN	Hand Pump	Sealed	2006	30	6inch	4inch	20-26	15	Chad	9 Motor BH 6 HP 4Tube well	
7	○	YUSUFARI	IAWANTI	Borehole	Sealed	13/3/99	94	9 5/8inch	6inch	80-89	15	Chad		
8	○	YUSUFARI	TULO-TULOWA	Cementwell	Open	1992	8.25	-	1.2m	-	8.25	Chad	1 BH(broken down) 2 HP(broken down) 7 Sement well	
9	○	KARASUWA	NGELSHOND-JAJIMAJI	Borehole	Sealed	2004	55	8inch	6inch	50	30	Chad	5 Motor BH	There is water all the year round
10	○	KARASUWA	BUKARTI	Borehole	Sealed	2004	120	8inch	6inch	100-113	30	Chad		
11	○	BADE	GASHUA	Hand Pump	Sealed	2001	30	6inch	4inch	20-26	15	Chad	many Motor BH	
12	○	BADE	GASHUA CENTRAL MOSQUE	Borehole	Sealed	1996	96	4inch	3inch	80-89	20	Chad		kidney(40-50 ages)
13	—	YUNUSARI	MAINARI(BULA JUWULLO)	OpenWell	Open	-	-	-	-	-	15		2 open well	dry up in dryseason
14	○	YUNUSARI	YUNUSARI TOWN MARKET SQUARE	Borehole	Sealed	2002	90	8inch	6inch	78	20	Chad	5Motor BH(broken down 1MBH) 3HP(broken down) many Sement well	Sementwell∅S.W.L15m-20m There is water all the year round
15	○	YUNUSARI	JAJJAWARI	Cementwell	Open	2005	25.5	1.2m	-	-	25-30	Chad	1 Sement well	Geological formation:Clay→Sand
16	○	BURSARI	BAYAMARI	Borehole	Sealed	1997	90	9 5/8inch	6inch	80-86	25-30	Chad	3BH 1Hund pump(broken down) 4Sementwell	There is water all the year round
17	○	BURSARI	DAPCHI	Borehole	Sealed	19/9/97	160	6inch	4inch	150	25-30	Chad	1Solar BH 2Moter BH(broken down 1BH) 5Shallowwell	
18	○	BURSARI	KAKANDERI	OpenWell	Open	-	-	-	-	-	25-30		many open well	
19	—	BURSARI	KAKANDERI	Cementwell	Open	-	21	1.2m	-	-	-	Chad	3 Sement well	Water decreases in dryseasone
20	○	GEIDAM	HOSPITAL	Hand Pump	Sealed	1997	64	6inch	4inch	38-62	20	Chad	4MoterBH(broken down 3BH) 1Hund punp	There is water all the year round
21	○	GEIDAM	KELLURI	OpenWell	Open	2001	22	1.2m	1.2m	-	20	Chad	1 BH(broken down) 1 open well	dry up in about February. open well depth more than 30m(water is all season)
22	—	JAKUSKO	GASAMU	Borehole	Sealed	-	90	-	-	-	30-40	-	1Moter BH	average S.W.L 30m-40m There is water all the year round
23	—	JAKUSKO	GARINMALLAM	Cementwell	Open	-	53	-	-	-	25-30	-		average S.W.L 25m-30m There is water all the year round
24	○	JAKUSKO	GIRGIR	Hand Pump	Sealed	1980	113	5inch	4inch	87-106	25	Chad	3Moter BH(depth 204m、pump position 72m) 1Hund pump	average S.W.L 30m There is water all the year round
25	—	JAKUSKO	LAFIARI	Borehole	Sealed	-	80	-	-	-	30-40	-		average S.W.L 30m-40m There is water all the year round
26	—	JAKUSKO	BAYAM	Cementwell	Open	-	45	-	-	-	30	-	2Motor BH(broken down 1MBH) Many Hund dug well	average S.W.L 30m There is water all the year round
27	—	JAKUSKO	JAKUSKO	Borehole	Sealed	-	66	-	-	-	-	-	5 Motor BH(broken down 2MBH、pump position 30m) 0 HP many Hund dug well	There is water all the year round
28	○	JAKUSKO	BUDUWA	Borehole	Sealed	2005	120	8inch	6inch	80-90	30	Chad	2 Motor BH many Hund dug well	It doesn't have an influence on the body by fluorine
29	○	JAKUSKO	BUDUWA	OpenWell	Open	1974	25	1.2m	-	-	20-25	Chad		average S.W.L 20m-25m There is water all the year round
30	○	NANGERE	NANGERE(OLD)	Borehole	Sealed	6/99	90	8inch	6inch	80-86	30	Kerri-Kerri	2 Moter BH many Hund dug well	depth 90m、pump position 70m average S.W.L 40m
31	—	NANGERE	DAWASA	Borehole	Sealed	-	90	-	-	-	40	-	1Moter BH many Hund dug well	average S.W.L 40m There is water all the year round
32	○	NANGERE	GARINGADA	Hand Pump	Sealed	1998	60	40mm	4inch	50-56	30	Chad	1Motor BH(broken down) 1HP many Hund dug well	average S.W.L 20m There is water all the year round

Table3. Existing boreholes survey results

Location No.	Water quality analysis	LGA	Village	Well	Sealing condition	Drilling year	Well deph	Drilling diameter	Casing diameter (inch)	Screen position (m)	Static Water Level(m)	Aquifer	Water resorce	Remarks
33	○	POTISKUM	GARIN BENGEL	Hand Pump	Sealed	1998	40	-	4inch	30-36	15	Kerri-Kerri	1 BH(broken down generater) 1 Hand pump many Hund dug well	There is water all the year round
34	○	POTISKUM	BADEJO	Hand Pump	Sealed	1998	70	6inch	4inch	60-66	30	Kerri-Kerri	0 BH 1Hund pump many Hund dug well	depth 80m-90m
35	—	POTISKUM	POTISKUM URBAN WATER SUPPLY	Borehole	Sealed	-	100	-	-	-	-	Kerri-Kerri	4Motor BH	depth 80m-120m
36	○	FUNE	DAMAGUM	Borehole	Sealed	2004	170	8inch	6inch	143-161	40	Kerri-Kerri	7 Moter BH(broken down 2BH) many Hund well	S.W.L is very shallow. Geological formation:Kerri-Kerri→Fika shall→Sand
37	○	FUNE	NGELZARMA	Borehole	Sealed	-	263	8inch	6inch	165-171 212-218 223-229	40-50	Kerri-Kerri	3Moter BH	depth 460m、263m、260m S.W.L40m-50m There is water all the year round Hand pump unacceptable (S.W.L is to low)
38	○	TARMUWA	LANTAIWA	Cementwell	Open	1990	86	1.2m	-	-	30	Chad	1Motor BH 2Sement well	Moter BH depth 120m、 pump position 102m There is water all the year round
39	○	TARMUWA	BABANGIDA	Borehole	Sealed	15/1/06	152	8inch	6inch	140-149	30	Chad/ Basement	4 Motor BH 5 Sement well	There is water all the year round. It doesn't have an influence on the body by fluorine.
40	○	TARMUWA	BABANGIDA	Borehole	Sealed	1970	150	6inch	4inch	138-147	30	Chad/ Basement		
41	○	DAMATURU	BABBAN TSANGAYA WARD	Borehole	Sealed	01/06/04	150	8inch	6inch	138-147	40	Chad	many Moter BH	It doesn't have an influence on the body by fluorine
42	○	FIKA	FIKA	OpenWell	Open	1992	10	1.2m	-	-	-	Unconformity Fika shale	2 Moter BH(broken down pump and starter) 0 Hund pump many Hund dug well	Moter BH average depth 600m、 Aquifer about 520m
43	○	FIKA	GADAKA	Borehole	Sealed	1983	180	6inch	4inch	160-172	40	Gombe Sandston	4 Motor BH many Hund dug well	Moter BH average depth 120m S.W.L 30m-40m There is water all the year round
44	○	FIKA	GASHAKA	Borehole	Sealed	09/79	180	6inch	4inch	165-174	40	Kerri-Kerri	1 BH 5 Hund dug well	depth 200m pump position 120m S.W.L 30m-40m
45	○	GUJBA	BUNIGARI GOVERNMENT GIRLS SECONDARY SCHOOL	Hand Pump	Sealed	2006	67	10inch	4inch	60-67	30	-	1Hund pump	Basement is in the deeper than 10m
46	○	GUJBA	GARINMALLAMADAMU	Pond	-	-	-	-	-	-	30-40	-	Pond (no source of water)	both human and animalmake dry up in about February.
47	○	GUJBA	KATARKO	Cementwell	Open	31/03/05	15	0.85m	-	-	-	Chad	1 Moter BH(broken down generater) 1 Hund pump(broken down) 6 Sement well	Geology is Sedimentary The southern part is Basement from here BH S.W.L40m
48	○	GULANI	TETEBA	Borehole	Sealed	2002	115	9inch	6inch	102-111	40	Alluvial Deposit	1BH	There is water all the year round
49	○	GULANI	GULANI	OpenWell	Open	2002	2	1.2m	-	-	-	-	1 Moter BH(broken down pump) 14 open dug well	There is water all the year round Water level is shallower than 10m
50	○	GULANI	BARA	Borehole	Sealed	21/4/99	90	8inch	6inch	80-86	30	Basement	1 Moter BH 2 BH(Abortive)	Alternative 50m-80m

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N - E		Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
BADE	1	SUGUM				82.00		55.00	67.00	12.00	4.00	06-01	Productive
	2	GASHUA				100.00		40.00	46.00	12.00	4.00		Productive
	3	JIGAWA				26.60				12.00	3.00		
	4	GASHUA				68.00		60.00	66.10		2.50	30-05-79	Productive
	5	GASHUA				65.00		55.80	61.90		3.80	14-01-78	Productive
	8	—				37.50		28.70	34.70		2.50	24-02-78	Productive
	11	GWIO KURA	12°40′ 35″	11°04′ 05″		33.80		24.10	25.90	9.94	0.70	16-11-78	Productive
								30.00	31.70				
	12	KURNAWA	12°42′ 38″	11°13′ 47″		34.90		25.80	29.60	10.30	3.00	12-08-78	Productive
	13	GASHUA	12°15′ 27″	11°01′ 47″	335	35.10		28.20	31.90	18.35	15.00	21-02-78	
	14	GASHUA	12°52′ 20″	11°01′ 56″	335	32.30		28.30	32.00	18.30	8.00	18-03-78	Productive
	15	GASHUA	12°52′ 18″	11°02′ 02″	335	35.10		28.30	31.80	18.30	1.50	23-03-78	Productive
	16	GWIO KURA	12°40′ 35″	11°04′ 05″		34.10		11.90	12.80	30.30	2.50	08-08-78	Productive
								29.70	31.50				
	17	GWIO KURA	12°40′ 35″	11°04′ 05″		42.10		11.80	13.60	38.60	0.25	31-08-78	Productive
								28.70	29.60				
	20	GASHNGURU				107.70		86.30	88.40	46.00	4.60	01-60	Productive
	21	MILE5						71.30	80.50	27.90	3.00		
	22	DEPANDE						30.80	36.30	30.65	2.00		
	26	GARIN K						18.30	23.80	29.31	3.00		
	27	MILE 29				121.90		55.50	57.60	42.40	1.00	05-60	
	28	GASHUA EXP.WELI				100.00							
	29	DAGONA				13.70				9.60	2.00		
	34	DUMSAI						49.54	58.79	10.60	2.50	28-08-81	Productive
	35	B121						49.00	54.00				
								63.00	67.00				
sub-total	22	—	—	—	—	969.80	—	758.64	852.69	376.55	68.85		
average		—	—	—	—	60.61	—	39.93	44.88	22.15	3.44		
BURSARI	1	KUCHI KUCHIR				124.00		91.00	94.00	8.00	4.50	23-07-01	Productive
	2	JULLURI				138.00		42.00	52.00	12.80	2.50	06-01	Productive
								60.00	63.00				
	3	BAYAMARI	12°45′ 55″	11°30′ 26″	336	95.00						22-04-05	Productive
sub-total	3	—	—	—	—	357.00	—	133.00	146.00	20.80	7.00		
average		—	—	—	—	119.00	—	66.50	73.00	10.40	3.50		
DAMATURU	1	ABUJA LAYOUT				148.19		119.60	122.60	46.00		20-11-95	Productive
	2	MANGARI				154.00		116.95	119.95	72.00	3.00	2-01	Productive
								143.00	149.00				
	3	DAMATURU ADP HQTR				158.00		137.00	155.00	64.00			
	5	FED. POLYTECHNIC				146.76		125.99	137.99	68.60		8-4-94	Productive
	6	DAMATURU				159.00		110.00	116.00	51.35	5.00		Productive
								122.00	131.00				
								134.00	137.00				

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	7	SASAWA				124.00		78.00	90.00			30-3-01	Productive
	8	DAMATURU COMM'S	11°44′ 03″	11°59′ 13″	388	140.50	137.00	121.00	133.00				Productive
	9	NAYINAWA				140.19		48.00	54.00	46.00	4.00		
								77.07	83.07				
								104.08	110.08				
								134.19	137.19			1992	Productive
	10	ALAJIRI				134.00		109.00	115.00		5.00	5-01	Productive
								122.00	128.00				
	13	GONI MAITARIMMATAR				193.90		158.20	176.20	66.86	3.00		Productive
	14	MALUMTI				125.30				39.50	2.14		
	15	DAMA KUSU				149.00		80.40	86.66	48.36	3.00		
								119.00	124.97				
								130.73	135.52				
	16	DAMATURU TOWN				172.00		105.00	111.00	43.00	6.00		
								126.00	132.00				
								152.00	158.00				
	17	STATE LOW COST DAMATURU				129.00		102.00	108.00	43.00	3.00		Productive
								111.00	123.00				
	18	GSSS DAMATURU				149.50		110.00	115.90	40.00	2.00		Productive
								121.80	133.00				
	20	AJIRI				200.00		48.80	62.80		3.00		
	21	KABANI NAWANT				199.00		135.00	147.00		2.00		
	22	DAMATURU (A)				142.00		108.00	120.00				
	23	DAMATURU (B)				142.27		117.86	130.53		3.00		
	24	JABA				190.00		78.00	84.00	29.80	3.00		Productive
	25	7/DA				190.72		112.57	127.59	88.48	4.00		
								163.00	175.00				Productive
	26	8/DA				176.00		137.00	149.00	46.25	4.00		Productive
	27	1/DA				252.00		243.64	195.34	47.56	5.00		Productive
	28	2/DA				284.00		137.64	195.34	44.42	6.00		Productive
	29	HOSING ESTATE				140.00		64.00	70.00				
								128.00	134.00				
	30	KUKARETA				80.00		64.00	70.00			18-09-98	
	31	PKM ROAD (Ytr)				126.00		114.00	126.00				
	32	KM 13 I				144.00	141.00	108.00	111.00			18-06-04	
								123.00	132.00				
	33	KM 13 II				150.00	147.12	123.00	134.00			01-00	
	34	SALLARI				108.00		98.00	105.00				
	35	STADIUM	10°44′ 37″	11°59′ 28″	392	138.00		123.00	135.00				
	36	FED.POLY DAMATURU				180.00	143.05	128.05	140.05	55.60			Productive
	37	MAFA				200.71	200.00	185.30	194.95	28.80	4.00	06-96	Productive
	38	GOV.S HOUSE	11°43′ 47″	11°58′ 49″	392	150.00		133.00	145.00	42.00	5.00	05-06	Productive

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N - E		Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	38	YOBE MO	11°44′ 36″	11°58′ 34″	390	153.00	147.00	132.00	144.00	56.00	5.00	06-06	Productive
	39	MARFA KALAM				412.00				59.58	2.20	17-12-82	Productive
	—	ALAJIRI				136.00		109.00	115.00				
								122.00	128.00				
								131.00	136.00				
	—	GOVERNMENT HOUSE				133.00		118.00					
	—	BINDIGARI Ⅰ・Ⅱ				136.00		109.00	115.00				
						175.00		127.00	133.00				
	—	NGAR BUSH HOUSE				150.00		133.00	145.00				
	—	PAYINAWA				150.00		135.00	147.00				
sub-total	41	—	—	—	—	6861.04	—	4516.00	4749.90	1127.16	82.34		
average		—	—	—	—	163.36	—	112.90	121.79	51.23	3.74		
FIKA	1	KUKAWA				162.12		117.64	121.64	114.00	1.50	30-11-95	Productive
	2	GODOWOLE				110.00		88.00	106.00	40.00			
	3	DUMBULWA				168.00	164.00	138.00	141.00	30.00	4.00	10-04	Productive
								144.00	147.00				
								156.00	162.00				
	4	FIKA MAIN TOWN	11°17′ 14″	11°18′ 16″	385	493.00	487.83	457.93	481.83			16-04-97	
	5	DAUYA GADAKA				102.00		72.00	81.00				Abortive
	—	GASHINGA	11°18′ 30″	11°07′ 30″		126.16				67.70	2.54	11-78	
sub-total	6	—	—	—	—	1161.28	—	873.57	931.47	251.70	8.04		
average		—	—	—	—	193.55	—	174.71	186.29	62.93	2.68		
FUNE	1	BINDIGI				134.00		102.00	105.00	93.00	3.00	01-02	Productive
								121.00	127.00				
	2	MASHIO				151.00		137.00	148.00	130.00	4.00	01-01	Productive
	3	DOGON KUKA	11°39′ 48″	11°25′ 10″	427	88.00		72.00	84.00	38.00	2.75	25-06-01	Productive
	4	SHANGA				100.00		66.00	75.00		4.00	31-10-01	Abortive
	5	NGELZARMA	11°40′ 39″	11°57′ 20″		249.50		165.56	171.66	81.00	2.00	03-78	Productive
								212.05	218.15				
								223.81	229.91				
	6	KORAWANOGA						254.00	260.00	72.00	3.00	26-05-80	Productive
								282.74	288.84				
								294.50	300.60				
	7	FUNE						141.25	147.35	77.00	12.00	05-06-80	Productive
								153.00	158.00				
								164.75	170.85				
	8	BABURAM						223.00	235.00	40.50	3.00	11-05-80	
	9	TELLO						91.00	94.00	24.00	2.50		Productive
								99.00	105.00				
								113.00	116.00				
	10	DAURA				76.00						04-04-79	Abortive

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N - E		Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	11	KAYERI						58.50	64.50	15.00	5.70	24-06-79	Productive
	12	DAMAGUM				189.00					4.00	22-01-78	
	13	DAMAGUM	11°41′	11°20′		60.40		43.60	44.20	7.40	2.00	02-04-78	Productive
								49.20	51.10				
								53.00	54.90				
	14	DAMAGUM	11°41′ 05″			48.40		38.40	42.20	11.10	3.00	23-03-78	Productive
								46.30	48.20				
	15	DAMAGUM				198.00		18.20			2.00	09-04-78	Productive
	16	DAMAGUM				164.50		18.20			2.00	10-04-78	Productive
	17	NGELZARMA				245.40		24.20			2.20	28-02-78	Productive
	18	NGELZARMA				248.80		18.30		81.00	2.00	13-03-78	
	19	NGELZARMA	11°43′	11°36′		74.70		12.00	13.90	24.40	2.20	20-02-78	Productive
								41.30	43.20				
								67.10	69.60				
								70.70	72.60				
	20	NGELZARMA	11°40′ 30″	11°37′ 20″		76.00		50.50	52.30	24.70	2.00	05-03-78	Productive
								64.60	66.50				
								68.20	70.10				
	21	DAMAGUM				90.00		79.60	85.60	20.10	4.60	23-09-77	Productive
	22	DAMAGUM				31.60		26.00	28.80	8.84		30-09-74	Productive
	23	NGAROHO				32.90		27.30	29.00	16.50	3.80		
								31.00	31.70				
	24	BORNO KOJO				71.60		64.60	70.70	30.50		17-12-77	Productive
	25	KOLLERE				70.40		63.70	69.80	7.30	1.90	03-04-77	Productive
	26	DAURA				356.00						31-08-77	Abortive
	27	ALAGARNC				91.44					4.60		
	28	KAFAYE				69.50		63.70	66.75		3.03	05-03-79	Productive
	29	SHANGA Ⅱ				105.00	102.00	78.00	81.00	35.00	3.00	17-09-79	Productive
								93.00	99.00			06-12-04	
	30	BINDIGI				164.00	130.00	102.00	105.00				
								121.00	125.00				
	31	NGELZARMA				246.43		165.00	168.00			23-03-05	
								180.00	183.00				
								201.00	204.00				
								225.00	228.00				
								234.00	237.00				
								237.00	240.00				
	32	DOGON KUKA	11°40′ 04″	11°24′ 52″	326		91.96	90.38	114.42	38.25	3.00	15-02-80	Productive
	33	MILES 5	11°40′ 52″	11°40′ 05″	419		236.27	233.85	263.94	91.56	3.00	14-02-80	Productive
	34	NGELZARMA Ⅰ					249.00	165.00	171.00				
								212.00	218.00				
								223.00	229.00				

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	35	NGELZARMA I					243.00	165.00	168.00				
								177.00	180.00				
								192.00	195.00				
								201.00	204.00				
								225.00	228.00				
								234.00	240.00				
	36	MASHIO I					140.00	131.00	137.00				
	37	MASHIO II				134.00	126.00	102.00	105.00				
								117.00	123.00				
	—	JAJERE	11°54′	11°22′	480	123.00				39.50	2.50	20-09-79	
sub-total	38	—	—	—	—	3689.57	—	3090.84	3201.12	1006.65	92.78		
average		—	—	—	—	131.77	—	93.66	110.38	43.77	3.31		
KARASUWA	1	KARASYWA GULLU						35.60	41.50	18.00	3.40	1984	
	2	KARASUWA						45.00	62.00		4.00	1988	
								119.70	125.40				
	3	KARASUWA				67.00		48.86	59.00	15.10	3.00	20-10-78	
	4	KARASUWA				138.00		45.60	62.70	11.60	4.00	23-08-88	
								117.70	125.40				
	5	KARASUWA						46.86	59.00	15.10	3.00	20-10-78	Productive
	6	MIRWA						10.05	16.13		1.50	23-08-78	Productive
	8	GASHUA ROAD						55.50	57.60		1.50	03-08-60	Productive
	9	GASHUA ROAD						86.30	88.40		3.60	15-06-60	Productive
	8	GARIN RAFI								10.00	2.00		
	9	ZAJI MAJI						57.00	68.00		4.00	1986	Productive
								74.00	79.00				
								85.00	91.00				
	5'	JAJIMAJI						57.00	68.00		4.00	1986	
	14	JAJIMAJI				84.04		34.90	40.99	6.00	3.50	07-05-78	
	15	JAJIMAJI				91.99		34.99	41.08	12.00	2.50	13-05-78	Productive
	30	BUKARTI	12°53′ 37″	10°54′ 39″	343	79.80		61.00	67.80	24.00	3.80	20-06-98	Productive
sub-total	14	—	—	—	—	460.83	—	618.66	732.20	111.80	43.80		
average		—	—	—	—	92.17	—	47.59	56.32	13.98	3.13		
MACHINA	1	DAMAI				92.83		79.42	85.45	40.00	4.00	21-02-95	
	2	KANGARWA				83.00		60.00	78.00				
	3	MACHINA				67.00		45.00	51.28	30.40	1.50	14-09-78	Productive
	4	DOLI MACHINA				67.00		53.15	59.23	40.70	1.30	05-09-78	
	5	DOLI MACHINA						19.95			1.20	09-09-78	
	6	MACHINA										10-09-78	Abortive
	7	MACHINA						45.00	51.28	30.40	1.50	14-09-78	Productive
	8	MACHINA								6.00	5.10	12-05-77	
sub-total	8	—	—	—	—	309.83	—	302.52	325.24	147.50	14.60		
average		—	—	—	—	77.46	—	50.42	65.05	29.50	2.43		

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N - E		Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
NGURU	1	TSOHON NGURU	12°53′ 04″	10°27′ 12″	353	82.48		56.00	59.00		6.00		Productive
								76.86	79.86				
	2	NGURU				80.00						09-08-96	Productive
	3	MATSENA				67.00		45.00	51.28	30.40	1.50	16-01-78	Productive
	4	TULOTU						163.50	175.50		1.00	1986	
								74.00	79.00				
	6	YAKUBARI						54.00	66.00				
								85.00	91.00			1983	
	7	NGURU				46.30		48.80	54.90		0.25	23-05-78	
	8	NGURU				46.40							
	9	MIRWA				59.00		10.05	16.13		1.50	20-10-78	
	10	MARIMARI				63.00		44.73	50.87	9.00	3.00	21-07-78	
								47.66	55.70				
	11	MAORI				76.00		13.00	25.16	4.60	1.20	11-07-78	
	12	MALAWI				55.00		41.75	47.83	25.00	1.50	30-08-78	
	13	TANGAMARAM				100.70		89.65	95.73	42.00	0.70	26-10-78	
	16	KUNGANAMA				50.60		50.30	56.40			05-04-78	
	17	MBORI						111.00	131.00	19.00		20-04-78	
	18	KIRIRAM						107.00	127.00			19-05-78	
	19	MAORI						13.00	25.16	4.60	1.20	19-07-78	Productive
	20	GASHUA KANO ROAD						41.49	47.57	7.35	8.00	28-05-78	Productive
								54.07	60.15				
	21	PIRAMO OILMILL						39.27	46.02	5.50	8.00	03-01-78	Productive
								58.22	62.22				
	22	PIRAMO OILMILL						32.15	44.80	7.90	7.00	15-01-78	Productive
	23	PIRAMO OILMILL						43.13	49.21	7.60	8.00	15-01-78	Productive
	24	MASAKURA						42.00	51.00	6.00	7.50	23-03-78	Productive
	25	GUMSI				45.50		36.42	42.50			08-08-78	Abortive
	26	MAIMALAM				61.46		49.66	55.70				
	27	GUSHUA ROAD M37				61.30		55.50	57.60		1.90	03-04-68	Productive
	28	GUSHUA ROAD M"				61.00		86.30	88.40		4.60	13-06-60	Productive
	29	MGURU ABBATOIR				61.00		48.50	56.70	9.10	1.90	20-07-60	Productive
	31	MASKAN DAURI				33.10		25.80	27.60	11.00	1.25	12-05-78	Productive
	32	YAKUBARI						54.20	66.40	12.73	2.50	30-02-80	Productive
	33	FALIMURAMI										2709-98	Abortive
	36	NGURU						44.20	51.80	32.00	6.70	04-03-52	Productive
	37	SABON GARI						31.00	44.00	6.00		12-05-77	
								49.00	52.00				
								57.00	60.00				
	38	AFONIRI						42.00	51.00			17-12-77	
	39	SABON GARI						49.00	58.00		5.10	12-05-77	
								63.00	66.00				

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
								71.00	74.00				
								79.00	82.00				
	40	MILE 33 GASHA ROAD				70.10		60.00	62.20		4.40	23-05-61	
	41	NGURU NESTLE				48.80		44.50	48.80		12.10	30-05-65	
	42	NGURU GRAZING				51.82				28.16	3.20	20-10-96	
	43	NGURU EXP. WELL				80.00				9.00	6.00		
	—	ABBATOIR				55.50		46.00	48.20		4.40	28-03-61	
	—	MGURU GASHU ROAD M26				62.50		56.40	58.50		2.50	16-04-61	
	—	MGURU GASHU ROAD M29				115.80		55.50	57.60		1.00	30-05-60	
	—	NGURU				55.47		20.00	40.00	6.00	4.40	23-03-78	
	—	NGURU				57.30		45.11	51.82		6.60		
sub-total	42	—	—	—	—	1647.13	—	1895.91	2187.38	282.94	124.90		
average		—	—	—	—	63.35	—	51.24	59.12	14.15	4.03		
NANGERE	1	DAZIGAU				69.00		57.00	68.00	48.00	2.20	23-07-01	Productive
	2	DAZIGAU				82.00		57.00	65.00				
	—	NANGERE (OLD)	11°50′ 04″	11°04′ 05″	392	90.00							
	—	NANGERE (NEW)	11°39′ 14″	11°42′ 15″	400								
	—	DAWASA	11°59′ 41″	11°57′ 04″	375								
	—	BRAMO NEAR POTISKUM	11°45′ 10″	11°05′ 35″	415								
	—	—						75.00	78.00	60.00	3.00	24-09-04	
sub-total	7	—	—	—	—	241.00	—	189.00	211.00	108.00	5.20		
average		—	—	—	—	80.33	—	63.00	70.33	54.00	2.60		
POTISKUM	1	DOROWA				78.00		60.00	72.00		4.00	7-97	Productive
	2	1.POTISKUM				46.30				22.00	6.00		Productive
	3	2.POTISKUM				46.30				22.00			Productive
	4	3.POTISKUM				45.39				24.06	6.00		Productive
	5	CATERING REST HOUSE				46.39				20.27	6.00		Productive
	6	HOSPITAL				47.10				17.88	4.00		Productive
	7	BRIDGE				48.63				37.15			Productive
	8	FILINID				89.00				44.99	10.00		Productive
	9	T･C ①				47.44				24.78	8.00		Productive
	10	T･C ②				44.99				26.11	6.00		Productive
	11	TANK SIDE ①				89.00				44.00	8.00		Productive
	12	TANK SIDE ②				100.00				24.78	6.00		Productive
	13	ARMY				47.44				24.78	3.00		Productive
	14	NASSARAWA				305.00				29.90	4.00		Productive
	15	KWATA				246.00				29.00	6.00		Productive
	16	GARIN MAJE				152.00					4.00		
	17	PKM EXPLORATORY WELL				80.00	71.50				10.00		
	18	ANGWAN BEDU				79.00	78.00	61.00	64.00			05-04	
								70.00	76.00				
	19	DAKASKU ALARABA				418.00				70.10	3.84	17-12-82	Productive

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	20	JUMMA YENDIAKI				229.00				27.92	3.50	17-12-82	Productive
	21	YAMBEL				145.00	142.00	128.00	140.00			02-04-02	Productive
sub-total	21	—	—	—	—	2429.98	—	249.00	276.00	489.72	98.34		
average		—	—	—	—	115.71	—	83.00	92.00	30.61	5.78		
GEIDAM	1	GUMSA	12°53′ 56″	11°56′ 43″	333	98.00				10.00			
	2	ALAJIRI				73.00				16.00	6.00		
	3	KAWURI	12°54′ 51″	11°56′ 11″	315		89.50			14.00	6.00		
	4	GEIDAM				80.00	62.25					09-96	
	5	KALGERI				179.00				24.90	5.05	17-12-82	Productive
	9	JAJERI				184.00				35.12	2.07	17-12-82	Productive
	10	AWASAI				90.00	85.65	73.65	82.65			31-03-05	Productive
sub-total	7	—	—	—	—	704.00	—	73.65	82.65	100.02	19.12		
average		—	—	—	—	117.33	—	73.65	82.65	20.00	4.78		
GULANI	1	NJIBULWA				201.00	200.00	146.00	149.00			8-06-05	
								185.00	197.00				
	2	RUHU				86.50		75.00	84.00	15.00	4.00	31-05-05	
	3	TETEBA	10°49′ 48″	11°43′ 36″	339	270.00				40.00	5.00	17-12-82	
	4	BARA	10°56′ 45″	11°41′ 59″	316	120.00				20.00	3.00	2002	Productive
sub-total	4	—	—	—	—	677.50	—	221.00	233.00	75.00	12.00		
average		—	—	—	—	169.38	—	110.50	116.50	25.00	4.00		
GUJBA	1	KADAURI				84.00	83.00	74.00	80.00		1.50	09-05-96	Productive
	2	WAGIR/NYAKIRE	11°31′ 39″	10°00′ 43″	120	143.00		57.00	60.00	5.00	2.00		
								66.00	69.00			01-01	Productive
								87.00	90.00				
								134.00	140.00				
	3	MALAM KURIA	11°26′ 17″		270	147.00		31.70	37.70	40.00	5.50	09-01	Productive
								64.96	67.76				
	4	GOTALA KUOBKAR				100.00		95.00	90.00		3.00	02-04	Productive
								97.82	102.16				
	5	UNGUWAN ISATALALA				81.00		66.00	88.00	63.00		06-93	
	6	FULATARI WARE	11°16′ 33″	10°00′ 35″	462	84.00		69.00	81.00			18-04-93	Abortive
	7	NGURBURWA				318.00		273.07	279.07	50.10	3.50		Productive
								290.39	296.39				
								324.40	330.40				
	8	BUNI YADI				93.00		69.00	81.00			30-11-92	Abortive
	9	ISATALALA				84.00		66.00	78.00	61.80		22-07-93	Productive
	10	GONIRI						328.00	335.00		1.60	1980-1989	
	11	BUNI YADI RAILWAY									2.50	1980-1989	
	12	GUJBA TOWN						298.00	322.00		3.20	1980-1989	
	13	BUNI GARI						34.00	39.00		2.50	1980-1989	
	14	BUNI YADI						72.00	82.00		1.00	1980-1989	
	15	GOTALA						64.00	76.00		1.00	1980-1989	

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	16	DADINGEL						52.00	58.00		1.00	1980-1989	
	17	GARIN ITACE						127.00	133.00		1.50	1980-1989	
	18	GOTALA—KUNDILIARI				160.00		84.00	90.00	84.00			Productive
								96.16	102.16				
	19	BULTURAM KURA				73.18	72.73	61.23	70.23			06-06	
	20	BUNI YADI EXPLOREATRY WELI				84.00							
	21	GOVERNER'S FARM GONIRI I				80.00		24.00	27.00				
								63.00	66.00			2004	Abortive
	22	GOVERNER'S FARM GONIRI II				96.00		69.00	72.00				
	23	GONIRI(MTI)				84.40						08-02-06	Productive
	24	NGBURWA				318.02		224.40	230.40		3.50		Productive
								273.07	279.07				
								290.39	296.39				
	25	2ND GORORI				81.25		16.00	21.00				
								26.00	29.00				
								44.00	59.25				
								65.50	74.50				
	26	KADAURI				84.00	83.00	74.00	78.00				
	27	BULTURAM I					72.00	61.50	69.50				
	28	NYAKIRE					143.00	57.00	60.00				
								61.00	64.00				
								84.00	90.00				
								137.00	140.00				
	29	BUNI YADI					80.20	75.35	78.10				
sub-total	29	—	—	—	—	2194.85	—	2522.25	2716.00	303.90	33.30		
average		—	—	—	—	121.94	—	97.01	104.46	50.65	2.38		
JAKUSKO	2	KAGAMU				60.00		30.00	55.00	14.00	1.67	23-05-01	Productive
	3	KARAGE				80.00		66.69	59.69	18.00		08-02	Productive
	4	DUMBARI				100.00		63.00	78.00	14.00	2.00	15-12-93	Productive
	5	JAKUSKO	12°22′ 11″	10°41′ 23″		107.80					3.00		
	6	KAGAMU				90.00		73.00	82.00			22-05-01	Productive
	7	NEAR BURKEL				235.00					1.67	04-040-75	
	8	DACHIA				439.64	375.14	41.04			2.80		Productive
	9	GIRGIR				298.89		39.83			3.00		Productive
	10	JAKUBARI				72.65		54.20	66.40	12.73	2.50	30-04-80	Productive
	11	JAKUSKO GRAZING				250.00		320.00	340.00		3.80	18-03-80	Productive
	12	BUDUWA GRAZING				310.00		280.00	300.00		3.80	15-03-80	Productive
	13	GIRGIR	12°53′ 50″	10°55′ 33″		84.00		78.00	82.00			15-12-87	Productive
	14	JAKUSKO	12°22′ 11″	10°41′ 23″		96.84		83.43	89.50	24.90	3.00	07-10-78	Productive
	15	GIRGIR	12°33′ 55″	10°55′ 03″		113.40		87.80	106.01	27.95	3.00	22-09-78	Productive
	16	LAFIYA LOI—LOI				97.07		96.00	110.00		2.80	24-02-98	Productive

Table4. Existing drilling data for Yobe state (1960 - 2005)

LGA	S/N0.	Location/ Villege	Co-ordinate N	Co-ordinate E	Elevetion (m)	Total Depth Drilled(m)	Total Depth Casing(m)	Screen Position(m)		Static Water Level(m)	Approx. Discharge (L/S)	Borehole Complete on by	Remarks
	17	BAYAM				224.00				22.50	3.51	12-12-82	Productive
	18	SAMINAKA				150.00				27.02	4.20	17-02-82	Productive
	19	JAKUSKO				137.00	106.80				3.00		
	9'	JAKUSKO	12°22′ 11″	10°41′ 23″		29.90		25.40	27.00		3.00	09-10-78	Productive
	10'	JAKUSKO	12°22′ 11″	10°41′ 23″		32.60		11.50	13.30		3.00	02-10-78	Productive
	30	—				171.00				19.60	5.00	17-12-92	
sub-total	21	—	—	—	—	3179.79	—	1349.89	1408.90	180.70	54.75		
average		—	—	—	—	151.42	—	89.99	108.38	20.08	3.04		
TARMUWA	1	SHEKAU				132.00		112.00	105.00	60.00	3.00	03-02	Productive
								121.00	127.00				
	2	BABBAN GIDA	12°06′ 29″	11°45′ 45″	220	156.00		38.00	41.00	62.10		18-08-78	Abortive
								48.00	51.00				
								51.00	54.00				
								145.00	151.00				
	3	LANTAIWA	12°16′ 10″	11°43′ 58″		145.50						16-08-76	Abortive
	4	GAREJE					135.00	124.00	133.00				Productive
	5	JUMBAN				121.00		37.00	43.00				
								109.00	111.00				
sub-total	5	—	—	—	—	554.50	—	311.00	322.00	122.10	3.00		
average		—	—	—	—	138.63	—	77.75	80.50	61.05	3.00		
YUSUFARI	1	SUNOMARI				90.00		51.00	54.00	12.00	2.20	01-02	Productive
								60.00	66.00				
	2	YUSUFARI				82.00	76.00	57.00	75.00				
	3	YUSUFARI				80.00		60.00	70.00	19.10	3.00	18-06-78	Productive
sub-total	3	—	—	—	—	252.00	—	168.00	199.00	31.10	5.20		
average		—	—	—	—	84.00	—	56.00	66.33	15.55	2.60		
YUNUSARI	1	TOSHIA				100.00		60.00	66.00		2.00	24-04-01	Productive
								69.00	75.00				
	2	BUHARI				84.00	81.00	27.00	30.00				
								56.00	59.00				
								75.00	78.00				
sub-total	2	—	—	—	—	184.00	—	87.00	96.00	—	2.00		
average		—	—	—	—	92.00	—	43.50	48.00	—	2.00		

7. RESULT OF WATER QUALITY ANALYSIS

7. Results of Water Quality Analysis

1. Purpose of the surveys

Simple hydrogeological prospecting was carried out in conjunction with surveys of existing wells at water intake sites in order to understand the hydrogeology of groundwater in target villages. The survey examined the following 13 items: water temperature, color, electrical conductivity, pH, degree of turbidity, taste, odor, iron, fluorine, manganese, nitric acid, types of colon bacilli, and ammonia. Six of these items (iron, fluorine, manganese, nitric acid, types of colon bacilli, and ammonia) were measured by pack test. Simple hydrological experiments were conducted at a total of 40 locations, including boreholes, hand pump wells, reservoirs, etc. The locations of survey points are shown in the map showing the locations of existing well surveys. Table 1 lists the results of on-site simple measurements, while the results of water quality tests are shown in Table 1 below.

Table1 Results of water quality tests

No.	Item	Water quality standard (WHO)	Range of a result of inspection(All wells)	Range of a result of inspection(borehole)	Range of a result of inspection (handpump, and other)
1	temperature	－	23.9～35.3℃	－	－
2	chromaticity	－	colorless-brown	－	－
3	electric conductivity(mS/m)	－	2.4～90（Ave 25.5）	2.4～58（Ave 22.4）	11.6～90（Ave 35.1）
4	ｐH	－	5.0～7.8（Ave 6.8）	5.0～7.8（Ave 6.7）	5.4～7.6（Ave 6.8）
5	turbidity	－	clearness-muddy	－	－
6	taste	normal	null-water containing iron	－	－
7	smell	－	null-livestock smell	－	－
8	iron(mg/l)	0.3mg/l	0～5.0（Ave 0.4）	0～4.0（Ave 0.4）	0～5.0（Ave 0.6）
9	fluorine(mg/l)	1.5mg/l	0～1.5（Ave 0.3）	0～1.5（Ave 0.3）	0～1.2（Ave 0.3）
10	manganese (mg/l)	0.1mg/l	0～1.0（Ave 0.1）	0～1.0（Ave 0.1）	0～1.0（Ave 0.1）
11	nitric (mg/l)	10mg/l	0～<45.0（Ave 11.4）	0～<45.0（Ave 8.0）	0～<45.0（Ave 21.4）
12	bacterium coli (mg/l)	not detectable in 100m/l	0～10 over	0～10 over	0～10 over
13	ammonia (mg/l)	0.5mg/l	0～0.5（Ave 0.1）	0～0.5（Ave 0.1）	0～0.2（Ave 0.1）

2. Test results

- According to the pack test for water quality, there were many instances where values for iron, nitric acid, manganese and colon bacilli in particular did not meet water quality standards.

- The value for iron exceeded the maximum water quality standard of 0.3mg/l at FIKA、GUJBA and GULANI of southern part of Yobe State, and it was at least 5mg/l at the GARINMALLAMADAMU reservoir (GUJBA LGA), which is the main source of water for this village.

- Areas where nitric acid was 20mg/l or more included MACHINA、NGURU、YUSUFARI、YUNUSARI,

BADE、BURUSARI, and GEIDAM, in southern part of Yobe State. It is likely that the values for these villages are high because nitrate-containing effluent from nearby livestock and crop farming may be percolating into the groundwater. It is also likely that household wastewater, fecal matter, etc., are contributing to the spread of groundwater contamination.

- Regarding manganese, the values in some areas were found to exceed maximum values for water quality standards.

- Sixteen survey points were found to have values that did not exceed the maximum standard value of 1.5mg/l. However, values for three of these sites (JAKUSKO、TARMUWA、and DAMATURU) were very close to 1.5mg/l.

- While colon bacilli were found in some of the boreholes, they were mostly detected in shallow and cement wells. This is because the wells were not sealed tightly, and fecal matter from livestock was flowing directly into the wells, helping to deteriorate the water quality.

- Regarding other items, electrical conductivity was higher than the maximum standard value. Although high electrical conductivity in and of itself has no adverse effect on human health, there is a chance that human health might be affected if a foreign substance was mixed in with the water.

- The pH was a neutral 7.0. For comparison, the pH for tap water in Japan ranges from 5.8 to 8.5.

Table2. Water quality analysis of existing boreholes

Location No.	LGA	Village	Well	Latitude			Logitude			Elevation(m)	Geology	Temperature	Smel	Teste	Color	EC (mS/m)	pH	Fe (mg/l)	F (mg/l)	Mn (mg/l)	No3 (mg/l)	Coliform (Nos/ml)	NH4 (mg/l)
1	MACHINA	MACHINA	Borehole	13	8	19	10	2	59	352	Chad/Basement	27.4	No	No	Clear	36.8	7.5	0	0.4	0	20	0	0
3	NGURU	KULO GANDE	Hand Pump	12	53	6	10	27	6	360	Chad	29.4	No		Clear	5.7	7	0.7	0	0	<45	0	0.2
4	NGURU	GLA LOCAL GOV.SECRET	Hand Pump	12	52	15	10	26	48	350	Chad	27.2	No	No	Clear	32.7	7.0	0.5	0	0	0	0	0.2
5	YUSUFARI	YUSUFARI TOWN	Hand Pump	13	3	46	11	10	17	341	Chad	30.3	No	No	Clear	13.6	7.2	0	0.2	0	<45	0	0
6	YUSUFARI	BULTUMARI-YUSUFARI TOWN	Hand Pump	13	4	16	11	10	30	344	Chad	31.3	No	No	Clear	13.9	6.6	0	0	0	30	0	0
7	YUSUFARI	IAWANTI	Borehole	13	4	22	11	10	28	344	Chad	30.5	No	No	Clear	9.4	7.1	0	0	0	1.5	0	0
8	YUSUFARI	TULO-TULOWA	Cementwell	13	22	11	11	0	29	347	Chad	29	No	No	Clear	85.3	6.9	0	0	0	<45	0	0.2
9	KARASUWA	NGELSHOND-JAJIMAJI	Borehole	12	54	14	10	48	8	346	Chad	29.3	No	No	Clear	16.7	7.3	0	0	0	0	0	0
10	KARASUWA	BUKARTI	Borehole	12	53	49	10	54	38	343		27.5	No	No	Clear	13.5	7.2	0	0	0	0	5	0
11	BADE	GASHUA	Hand Pump	12	52	28	11	2	42	341	Chad	30.4	No	No	Clear	46.4	6.3	1	0	1	<45	0	0.2
12	BADE	GASHUA CENTRAL MOSQUE	Borehole	12	52	18	11	2	36	345	Chad	29.9	No	No	Clear	20	7	0	0	0	5	3	0
14	YUNUSARI	YUNUSARI TOWN MARKET SQUARE	Borehole	13	9	11	11	32	24	326	Chad	30.5	No	No	Clear	26.3	7.3	0.3	0	0	1.8	many	0
15	YUNUSARI	JAJJAWARI	Cementwell	13	1	6	11	33	7	341	Chad	29.8	No	No	Clear	39	7.3	0	0	0	<45	many	0
16	BURSARI	BAYAMARI	Borehole	12	46	15	11	30	42	330	Chad	32	No	No	Clear	21.8	6.6	0	0	0	0	0	0
17	BURSARI	DAPCHI	Borehole	12	29	58	11	30	24	340	Chad	23.9	No	Iron	Clear	17.7	6.8	3	0.6	0	0	1	0.2
19	BURUSARI	KAKANDERI	Cementwell	12	58	13	11	32	13	341	Chad	29.8	No	A little	ittle cru	90	6.9	0	0	0	<45	many	0
20	GEIDAM	HOSPITAL	Hand Pump	12	53	44	11	55	12	338	Chad	29	No	No	Clear	19.3	6.7	0	0	1	0	many	<0.2
21	GEIDAM	KELLURI	OpenWell	12	50	40	11	45	12	340	Chad	30.2	No	No	ot so cle	40.4	6.8	0	0	0	45	many	0.1
24	JAKUSKO	GIRGIR	Hand Pump	12	34	2	10	55	24	346	Chad	29	No	No	Clear	17.55	6.9	0.8	0	0	0	0	0.1
28	JAKUSKO	BUDUWA	Borehole	12	12	31	10	52	42	368	Chad	31	No	No	Clear	11.84	7.2	0	1.2	0	0	0	0
29	JAKUSKO	BUDUWA	OpenWell	12	12	16	10	52	37	370	Chad	29.8	No	No	Clear	14.87	7.0	0	1.2	0	1.5	1	0.1
30	NANGERE	NANGERE(OLD)	Borehole	11	52	17	11	4	12	392	Kerri-Kerri	29.1	No	No	Clear	2.85	6.3	0	0	0	1	0	0.1
32	NANGERE	GARINGADA	Hand Pump	12	5	28	10	56	14	366	Chad	29.7	Fe smell	No	Clear	18.9	6.6	2	0.6	0	0	many	0.2
33	POTISKUM	GARIN BENGEL	Hand Pump	11	40	29	11	14	19	472	Kerri-Kerri	30	No	No	Clear	2.4	5.0	<0.2	0.2	<0.5	2	4	<0.2
34	POTISKUM	BADEJO	Hand Pump	11	39	35	11	6	5	443	Kerri-Kerri	29.8	No	No	Clear	6.6	5.3	0	0	0	20	0	0.1
36	FUNE	DAMAGUM	Borehole	11	40	55	11	19	44	422	Kerri-Kerri	35.2	No	No	Clear	16.3	6.1	0.3	0	0	0	2	0.1
37	FUNE	NGELZARMA	Borehole	11	41	15	11	37	21	411	Kerri-Kerri	35.3	No	No	Clear	57.7	7.2	0.2	0.2	0	0	2	0.3
38	TARMUWA	LANTAIWA	Cementwell	12	16	14	11	44	2	360	Chad	29.8	No	A little	Collode	25.3	6.9	0	0.4	0	20	many	0
39	TARMUWA	BABANGIDA	Borehole	12	10	4	11	46	23	359	Chad/Basement	31.8	No	No	Clear	29.8	6.9	0	1.5	0	0	0	0

Table2. Water quality analysis of existing boreholes

Location No.	LGA	Village	Well	Latitude			Logitude			Elevation(m)	Geology	Temperature	Smel	Teste	Color	EC (mS/m)	pH	Fe (mg/l)	F (mg/l)	Mn (mg/l)	No3 (mg/l)	Coliform (Nos/ml)	NH4 (mg/l)
40	TARMUWA	BABANGIDA	Borehole	12	9	23	11	46	21	359	Chad/Basement	31.4	No	No	Clear	29.9	7.2	0	1.5	0	0	0	0
41	DAMATURU	BABBAN TSANGAYA WARD	Borehole	11	45	11	11	57	38	364	Chad	28.1	No	No	Clear	26.7	6.8	0	1.3	0	5	0	0
42	FIKA	FIKA	OpenWell	11	17	27	11	18	15	376	Fika shale	29.8	No	No	Clear	18.5	6.8	0	0	0	1.5	many	0.1
43	FIKA	GADAKA	Borehole	11	17	23	11	13	10	365	Gombe sandstone	31.6	No	No	Clear	8.0	5.1	0	0	0	2	4	0
44	FIKA	GASHAKA	Borehole	11	34	2	11	9	42	477	Kerri-Kerri	29.1	Fe smell	Slight tes	Brown	18.8	6.5	4	0.6	0	0	1	0.5
45	GUJBA	BUNIGARI GOVERNMENT GIRLS SECONDARY SCHOOL	Hand Pump	11	12	3	12	1	30	454	Basement	28.7	No	No	Clear	38	6.8	0.3	0.5	0	1	0	0.1
46	GUJBA	GARINMALLAMADAMU	Pond	11	19	59	11	58	35	447	-	28.8	Animal dung	No	Brown	11.6	7.6	5	0	0	0	many	0.2
47	GUJBA	KATARKO	Cementwell	11	33	48	11	54	58	391	Sedimentary/Basement	30	No	No	Clear	12.8	6.4	0	0	0	0.5	many	0.1
48	GULANI	TETEBA	Borehole	10	49	0	11	43	35	304	Sedimentary	31.5	No	No	Clear	38.5	7.8	0	0	0	0	0	0.1
49	GULANI	GULANI	OpenWell	10	43	23	11	41	19	320	Sedimentary/Basalt	25.5	No	No	Clear	13.4	5.4	1	1	1	10	7	0
50	GULANI	BARA	Borehole	10	56	19	11	40	51	315	Alternation Limestone/Sandstone/Clay	30.9	No	No	Clear	52.8	7.1	0	0.1	0	15	0	0

8. RESULT OF SOCIAL CONDITIONS

SURVEY

Appendix 8 Results of the Social Conditions Survey

1. Outline of the survey

Regarding the social condition on the area targeted on this survey the survey of the following three items was done.

1) Village survey
2) Household survey
3) Detailed survey

As the way of the survey, for the village survey and household survey after the English questionnaire sheets as shown in Attachment 1 ,which contents are confirmed by RUWASA, the representatives of the villages and representative households selected as the questionees previously by the counterpart and LGA staffs, the hearings were done directly in local languages.

On the detailed survey with the local sub-contracting, to the villages selected by RUWASA, detailed interview survey was done.

Outline of the survey method and the main contents of the survey are shown in the Table 1.

Table 1 Items, methodologies, contents of the social conditions survey

Items of survey	Outline of the Survey methodology	Main contents of the survey
Village survey	<Questionnaire survey> Implement hearings to the representatives of the 100 villages through 17 LGAs	Status of the existing water facilities, status of insurance and hygiene, maintenance and control of the water supply equipment, cost for maintenance and control, etc.
Household survey	<Questionnaire survey> Implement hearings to the total 200 households, 2 households per village through 17 LGAs.	Status of the household economics, substance of the water supply use, conscience on the hygiene, conscience to the maintenance and control of the water equipment.
Detailed survey	<Interviewing survey> Implement survey to the 5 villages planed to be targeted to the soft component.	Status of the existing water supply facilities, status of the insurance and hygiene, maintenance and control of the water supply facilities, cost of maintenance and control, participatory intention of the residents, status of the economy, status of the women's activities, etc.

2. Schedule of the survey

Village survey and household survey were done in the same days to the same villages shown in the Table 2, and the detailed survey was done by subcontracting in parallel with previous surveys shown in the Table 3.

3. Results of the village survey and household survey

(1) List of the villages targeted for the final survey

As shown in the notes of the Table 2, LGAs under jurisdiction are changed from the time of the request in the 8 villages. the list of the final villages based on its contents is shown in Attachment 2.

(2) Total population of the village

From the interviews with the representatives of the villages, the population of the 100 requested villages are increased from 116,000 people as data in statistics in 1991 mentioned in the request document to tripled 350,000 people. Since this corresponds to about 8 % as the average annual rates of increase of the population of 15 years and seems rather over evaluated, it is to be confirmed as the statistics in 2005.

Table 2 Schedule of the social conditions survey (village survey, household survey)

Dates	No.	LGA		Research method*	No. of villages			Remarks (Change of concerned LGAs)
		Symbol	Name		Request	Questions	Answer	
11 Dec. 2006 Mon.	①	O	Tarmuwa	A	5	4	4 on 11 Dec.	O-5→Bursari
	②	B	Bursari	C	8	8	8 on 19 Dec.	
12 Dec. 2006 Tue.	③	K	Geidam	A	7	7	7 on 12 Dec.	
	④	Q	Yunusari	A	8	8	8 on 12 Dec.	
14 Dec. 2006 Thu	⑤	A	Bade	C	6	4	4 on 19 Dec.	A2, 4→Jakusko
	⑥	F	Karasuwa	C	6	6	6 on 19 Dec.	
	⑦	H	Nguru	B	7	4	4 on 14 Dec.	H-1,4→Karasuwa H-3→Yusufari
15 Dec. 2006 Fri.	⑧	N	Jakusko	C	5	5	5 on 19 Dec.	
18 Dec. 2006 Mon.	⑨	E	Fune	C	4	4	4 on 20 Dec.	
	⑩	D	Fika	A	6	6	6 on 18 Dec.	
	⑪	J	Potiskum	A	7	7	7 on 18 Dec.	
19 Dec. 2006 Tue.	⑫	I	Nangere	B	5	3	3 on 19 Dec.	
				C		2	2 on 21 Dec.	
	⑬	C	Damaturu	C	4	4	4 on 24 Dec.	
20 Dec. 2006 Wed.	⑭	M	Gujba	C	5	5	5 on 23 Dec.	M-2→Gulani
	⑮	L	Gulani	C	5	5	5 on 23 Dec.	L-1→Gujba
21 Dec. 2006 Thu	⑯	G	Machina	A	5	5	5 on 21 Dec.	
22 Dec. 2006 Fri.	⑰	P	Yusufari	A	7	7	7 on 22 Dec.	
			Total		100	94	94	

*A: Hearing at LGA office
B: Hearing at the villages
C: Hearing by LGA officials at later date

Table 3 Schedule of Social conditions survey (detailed survey)

Dates		No.	Villages to be surveyed		
			Symbol	Name of LGA	Name of the villages
14 Dec. 2006	Thu	①	C-2	Damaturu	Dikmari
15 Dec. 2006	Fri	②	N-4	Jakusko	Jammel
16 Dec. 2006	Sat	③	D-6	Fika	Ngalada
17 Dec. 2006	Sun	④	L-3	Guluni	Chandam
18 Dec. 2006	Mon	⑤	B-7	Burusari	Buyamari

(3) Status of use of the water source

According to the results of the village survey, although it is slightly different between rainy seasons and dry seasons, basically the water source as shown in Table 4, the rate of installation of the wells attached to the water pumps are about 20%.

Table 4 Rates of use of the water source in the villages

No.	Kind	Rainy season	Dry season
1.	Well with water pump	22%	16%
2.	Open well	47%	57%
3.	Pond	6%	5%
4.	River	14%	5%
5.	Rain water	11%	0%
6.	Others	0%	1%
	Total	100%	100%

(4) Problems in the daily lives

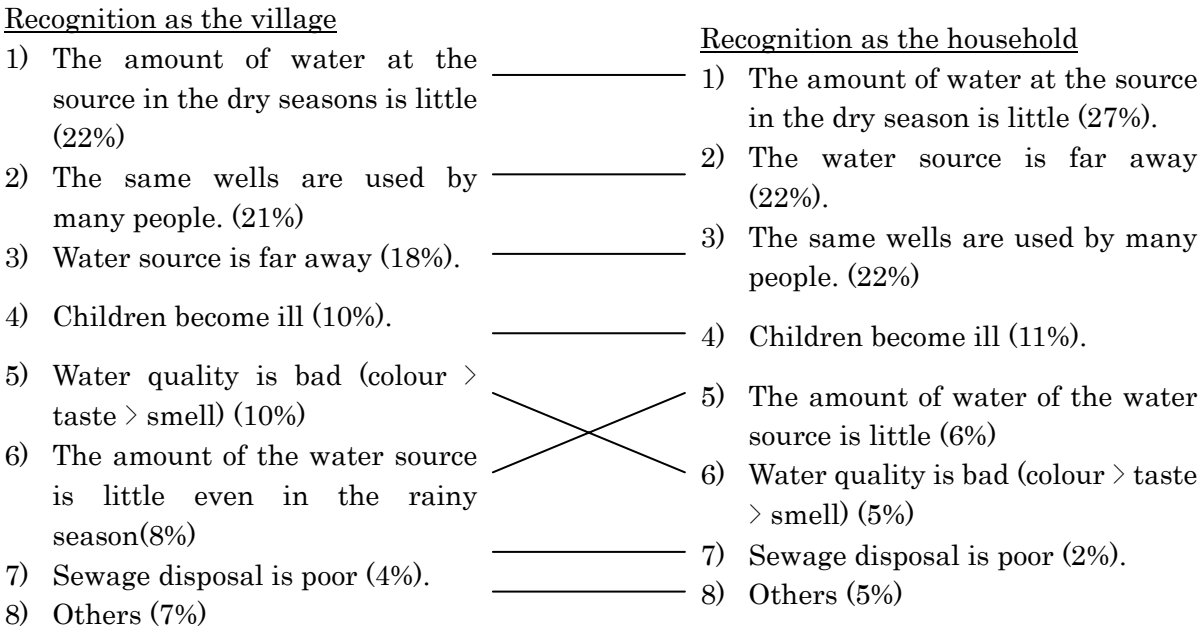
On the problems which each village and each household faces in our daily lives are as shown in the Table 5 and the one of the water and hygiene is the most mentioned.

Table 5 Problems of the daily lives in the villages and in the households

Survey	Ratio of problems raised by people (%)					
	Water / hygiene	Household budget	Education	Health	Others	Total
Village survey	40	16	14	28	2	100
Village survey	38	28	11	21	2	100

(5) Contents of the problems on the water and hygiene

The contents of the problems related to the water and hygiene are as follows in the order of majority.



(6) Kind of diseases occurred during the past 1 year

The ratio of the diseases occurred during the past 1 year is shown in Table 6. Malaria is the most typical disease as the village and the households.

Table 6 Ratio of the diseases occurred during the past 1 year in the villages and households

Survey	Ratio of diseases occurred (%)							
	Cholera	Guiana Worm	Malaria	Diarrhea	Typhoid	Dysentery	Others	Total
Village survey	11	1	45	15	18	4	6	100
Household survey	15	1	47	11	13	5	8	100

4. Results of the detailed survey

Considering the implementation of the technical support by the soft component one village is selected with the one installed with the well with hand pump in the 5 LGAs of Damaturu city (refer to Table 3). The results of the survey are mentioned below.

(1) Composition of the population

The average composition of the population of the surveyed 5 villages is shown in the Table 7. Village population is about 3,200 people and the composition of the families is 11 to 12 people.

Table 7 Composition of population of the village

No.	Item		Average population
1.	Village population	Men	1,356 (42%)
		Women	1,842 (58%)
		Total	3,198 (100%)
2.	Composition of the family	Husband(s)	1
		Wife/ves	2
		Children	8～10
		Total	11～13

(2) Status of the order of the facilities in the villages

The status of the order of the facilities in the surveyed 5 villages is shown in the Table 8.

Table 8 Status of the order of the facilities in the 5 villages (no. of installation)

Classification	Facilities	B-7	C-2	D-6	L-3	N-4
		Bursari-Bayamari	Damaturu-Dukumari	Fika-Ngalda	Gulani-Chamdam	Jakusko-Jammel
Water supply facilities	Cement well	6	2	80	15	3
	Well with hand pump	1	2	2	-	-
	Well with mobile pump	3	1	-	-	1
	Well with washing with water	-	-	4	-	-
Medical facilities	Dispensary	-	-	1	1	1
	Clinics	1	-	-	-	-
Educational facilities	Primary school	1	1	1	1	1
	Movie center	1	-	1	1	1
Public facilities	Roads	1	1	1		1
	Waste collection centre	-	-	-	-	-
	Public toilet	-	-	-	-	-
Commercial facilities	Banks			-	-	-
	Market	1	-	1	-	-
	Generator facilities	1	-	1	-	-

(3) Problems in the lives in the villages

The problems in the lives in each village are shown in Table 9. The first is the one of water and sanitation, the second is health problem, and the third is economical problem.

Table 9 Problems in the lives in the five villages

Problems	Water and sanitation	Economy	Education	Health	Road	Sewage	Electricity	Agriculture	Total
Ratio (%)	38	20	5	24	7	2	2	2	100

(4) Problems of the water and sanitation

The contents of the problems of the water and sanitation are follows in the majority order.

1) Water source is far away (19%).
2) Water quality is bad (19%, colour > taste > odor) (19%)
3) Malfunction of hand pump (19%)
4) The amount of water in the dry season is little (17%)
5) There is few toilets (9%).
6) The same well is used by many people (4%).
7) The houses are dirty (4%).
8) The amount of water at the source is few even in the rainy season (2%).
9) Many children become ill (2%).
10) Many adults become also ill (2%).
11) The sewage disposal is poor (1%).

(5) The amount of water and way of obtaining and maintenance of water

At the homes of household members 8 - 10 people, water of 120－240Lit. per day is used. This water is brought back home in the small plastic boxes before and after children go to school and is stocked in earthenware pot with cover.

Table 10 Rate of persons taking water in the each household

Persons taking water	Adults		Children		Others	Total
	Men	Women	Boys	Girls	Purchase	
Ratio (%)	18	16	27	27	12	100

(6) Participation to the VWESC

On this survey only in the community within the Bayamari village in Bursari LGA, in the other communities as shown in the Table 11, the importance of VWESC is recognized and they have the intention to install hand pumps.

Table A8-11 Status of installation and operation of VWESC

VWESC	Operating	Existed	Planned to install	Total
Ratio (%)	16	4	80	100

And the residents think that as the cost incurred, 100 to 200 Nila in the installation period, 30 ~ 100 Naira per month as the maintenance and control cost.

(7) Sense of sanitation of children

Children think that it is most important to wash hands sanitarily as shown in the Table 12.

Table 12 Sense of sanitation of children

Sense of sanitation	Strict enforcement of washing hands	Cleaning, keeping things neat and tidy of surroundings	Periodical bathing	Maintenance of health	Use of toilet	Hygiene and conservation of food and water	Total
Ratio (%)	40	21	15	13	8	3	100

The above matters are with 70% as the ratio of students taught by teachers, with 30% as the one taught by the parents. Other than Ngalda village there is no toilet other than the schools, most children defecate in the bush.

5. Appropriateness of the social conditions to the installation of the hand pump

The social conditions in the 100 villages are all confirmed to adapt to the installation of the hand pump as the result of the field survey, the degree of adaptation is divided into 3 ranks of the evaluation as follows, which is the reference data for selection of the villages to install hand pumps.

(1) Items of evaluation and marks of evaluation

1) Ratio of water supply by the village well

0 ~ 35% : 3 points, 36~ 75% : 2 points, over 75% : 1 point

Ratio of water supply is calculated as follows:

Ratio of water supply (%) = (existing no. of wells x 250 people) ÷ village population (people)

2) Distance from the village centre of the central water source

More than 1500 m: 3 points, more than 500 m less than 1500 m : 2 points, less than 500 m : 1 point

3) Awareness of issues of the villages to water and sanitation

Very much exist (selection of 3 items) : 3 points, much exist (selection of 2 items): 2 point, average (selection of 1 item) : 1 point

4) System of maintenance and control

VWESC is operating: 3 points, VWESC is planned to install: 2 points, Under consideration: 1 point

5) The control ability of the village of LGAs under jurisdiction

Superior: 3 points, Good: 2 points, Normal: 1 point

Note) It would be evaluated from the actual conditions of maintenance on the social conditions survey this time.

(2) Classification of the rank

By the total of the above evaluation it is planned to divide into 3 ranks as shown in Table 13:

Table 13 Rank of adaptation of the social conditions of the village

Total evaluation mark	15～12	11～8	7～5	Total
Rank	A	B	C	
Number of Village	27	70	3	100

6. Conclusion

The following matter has been confirmed through social condition survey.

1) The most serious problem on their life in 100-investigation village is related with "water and health."
2) The biggest concern in this "its water and health" problem is "a little amount of supply water in dry season".
3) Based on above-mentioned situation, all 100 villages are anxious for construction of hand pump type water supply facility.
4) Moreover, as for the adaptability of the social conditions about management and maintenance of the facility, there is no problem in particular.
5) As mentioned above, it can be said that the necessity for the request is enough and the contents of request is appropriate from viewpoint of social conditions.

Attachment 1

Village Survey to village representative

Village No._____ Village name_____ LGA_____

Enumerator_____ Respondent_____ (Respondent's) Position_____

A : Basic Questions

A1. Village Population: Total_____ / male (_____), female (_____)

A2. Total number of households:_____

A3. How are people getting income mainly by?

a. Agriculture b. Livestock c. Fishery d. Sale other item e. Labor work

f. Other ( )

A4. How much of average income can people get?

N _____/month

A5. How much products do people sell per year for income?

Agricultural products :

a-1. Yam (_____ /year) a-2. Maize (_____ /year)

a-3. Beans (_____ /year) a-4. Other : _____ (_____ /year)

Livestock products :

b-1. Chicken (_____ /year) b-2. Cow (_____ /year)

b-3. Goat (_____ /year) b-4. Other : _____ (_____ /year)

Fishery products :

c-1. Fresh water fish (_____ /year) c-2. Other: _____ (_____ /year)

Main sales Item :

d-1. Charcoal (_____ /year) d-2. Other: _____ (_____ /year)

A6. How much do people spend per month?

Average: N _____ /month

A7. How much do people spend for;

a. Food: N _____ /month

b. Clothes: N _____ /month

c. Water-related issues/matters (O&M, Buy Water, Jelly can, etc) N _____ /month

d. Sanitation and hygiene-related issues/matters (latrine construction, etc) N _____ /month

e. Health-related issues/matters (medicine, hospital, etc) N _____ /month

A8. Where do people buy necessities?

a. Rural Market b. City Market c. Peddler d. Other ( )

A9. What are the problems that people in village are facing every day?

a. Water & Sanitation b. Financial problem c. Education d. Health care

e. Other ( )

A10. What kind of Water & Sanitation problem does the village have?

(Circle (○) the ones that apply. Worst 3 problems)

a. Water source is too far

b. Little water in dry season

c. Little water as resource even in rainy season

d. Water quality is bad → d-1. Smell d-2. Color d-3. Taste d-4. Other ( )

e. Too many people use the same water resource

f. Poor water drainage

g. Be broken/stolen Hand pump

h. Many children are usually sick → (Ex. : _____)

i. Many adults are usually sick → (Ex. : _____)

j. Latrine: None/Too few

k. No clean clothes

l. No clean water-drawing containers

m. No clean house/compounds

n. Other ( )

B. Questions about Health Condition

B1. What kind of diseases did your village have for the last one year?

a. Cholera b. Guinea worm c. Malaria d. Diarrhea e. Typhoid

f. Dysentery g. Other ( )

B2. What are the causes of the diseases?

a. Dirty water b. Irregular weather c. Bad people d. Unsanitary food

e. Other ( )

B3. How did people cure the diseases?

a. Self treatment b. Local doctor c. Mosque/Church d. Hospital

e. No treatment f. Other ( )

B4. How the people can prevent diseases?

a. Clean water b. Good sanitary condition c. Good medicine

d. Other ( )

B5. Where do you think the patients should be treated?

a. Hospital b. Mosque/Church c. Local clinic d. Traditional treatment

e. Specialist of water-born diseases f. Other ( )

B6. What kinds of Medical facilities are in the village? (Please write the numbers.)

a. Hospitals_____ b. Clinics_____ c. Dispensaries _____

d. Health Center_____ e. Drug Shops_____ f. Traditional Doctors_____

C. Questions about Water Supply

C1. What is the main drinking water source in rainy season?

a. Borehole b. Dug Well c. Pond d. Stream/River

e. Rain Water f. Other ( )

C2. How far is a main water source from center of village in rainy season?

a. 200m b. 500m c. 1000m d. 1500m e. 2000m

f. Over 2000m

C3. How is the water quality of main source in rainy season? If "Bad", please choose the reason.

a. Good b. OK c. Bad → 1. Water amount 2. Color 3. Smell 4. Taste

C4. What is the main drinking water source in dry season?

a. Borehole b. Dug Well c. Pond d. Stream/River

e. Rain Water f. Other ( )

C5. How far is the main water source from center of Village in dry season?

a. 200m b. 500m c. 1000m d. 1500m e. 2000m

f. Over 2000m

C6. How is the water quality of main resource in dry season?

a. Good b. OK c. Bad → 1. Water amount 2. Color 3. Smell 4. Taste

C7. What kind of facility do people use to carry the water from water source?

a. Jelly can b. Plastic Bucket/Bowl c. Clay pot d. Calabash

e. Iron Pail f. Other ( )

C8. What kind of facility do people use to store the water?

a. Drum b. Plastic Container c. Clay Pot d. Clay pots fitted with taps

e. Buckets fitted with taps f. Calabash g. Other ( )

C9. How do people treat the water before drinking?

a. Boil b. No treatment c. Other ( )

D. Questions about Water & Sanitation/Hygiene

D1. Is there household or public latrine in the Village? a. Yes b. No

D2. What type of household latrine or public use latrine is in the village?

a. Traditional Pit Latrine b. Improved Traditional Pit Latrine

c. Ventilated Improved Pit Latrine d. Other ( )

D3. How do people dispose of the excreta from the facilities?

a. Bush b. Stream/River c. Pit latrine d. Gutter

e. Court yard/House surrounding f. Other ( )

D4. Do people wash their hands after using the latrine?

a. Yes b. No

D5. What type of ownership of latrine is preferred in your village?

a. Village ownership b. Private ownership c. Private compound ownership (Group)

d. Other ( )

D6. Would you be willing to build a public latrine?

a. Yes b. No

D7. (If yes) How much would you contribute for construction of the latrine?

a. less than N100 b. less than N200 c. less than N300

d. less than N400 e. less than N500 f. over N500

D8. (If No) Why would you not support a public latrine?

a. No money to contribute b. No interest c. Former efforts

d. Government responsibility e. Other ( )

D9. Do people wash their hands before eating?

a. Yes b. No

E. Questions about Public Participation

E1. Did/Does village have VWESC (Village Water & Environment Sanitation Committee)?

a. Yes, It was organized in (When _____) and still exists.

b. Yes, It was organized in (When _____) but dose not exist now.

c. No, but it will be organized in (When _____).

d. No, it will not be organized.

E2. (If "a") How much money does household pay as an initial contribution?

a. about N100 b. about N200 c. about N300 d. about N400

e. about N500 f. over N500 g. None h. don't know

i. donate (labor, material, etc)

E3. (If "a") Did/Does people pay money regularly for O&M?

a. Yes b. No

E4. (If "Yes") How much money did/does each household pays regularly for Water cost (O&M) per month?

a. about N20 b. about N30 c. about N40 d. about N50

e. about N60 f. about N100 g. over N100 h. None

i. don't know j. donate (labor, material, etc)

E5. (If "b") Why does VWESC not exist?

a. No money to O&M b. No knowledge for O&M c. No service from LGA

d. Other ( )

E6. (If "c") How much money will household pay as an initial contribution?

a. about N100 b. about N200 c. about N300 d. about N400

e. about N500 f. over N500 g. None h. don't know

i. donate (labor, material, etc)

E7. (If "c") How often will each household pay the water cost (O&M)?

a. Monthly b. weekly c. When boreholes brake

d. Other ( )

E8. (If "c") How much money will each household pay regularly for Water cost (O&M) per month?

a. about N20 b. about N30 c. about N40 d. about N50

e. about N60 f. about N100 g. over N100 h. None

i. don't know j. donate (labor, material, etc)

E9. (If "d") Why will you not have VWESC?

a. No money to contribute b. No interest c. Former efforts

d. Government responsibility e. Other ( )

E10. (If money will be/is collected regularly) Who does/will collect the money for VWESC?

a. Village Chairman b. VWESC leader c. Accouter of VWESC

d. Other ( )

E11. (If money will be/is collected regularly) Who does/will keep the money for VWESC?

a. Village Chairman b. VWESC leader c. Accouter of VWESC

d. Other ( )

E12. Does/Did the village receive service of O&M or Sanitation/hygiene Education?

a. Yes b. No

E13. (If "Yes") Who did/does support to Village?

a. LGA b. State Government c. NGO d. Other ( )

F. Questions about Others

F1. Do you have projects by other donor or NGO?

a. Yes b. No

F2. (If "Yes") What kind of project?

a. Water supply & Sanitation b. Education c. Health

d. Infrastructure (Ex. Road construct) e. Other ( )

F3. (If "Yes") Who is operation the project?

a. UNICEF b. NGO ( ) c. Other ( )

Household Survey to village residents

Village No._____ Village name_____ LGA_____

Enumerator _____ Respondent _____ Age _____

Sex: 1. Female 2. Male

A : Basic Questions

A1. Household Composition (number):

Total _____ / Male ( ), Female ( ) / Boys ( ), Girls ( )

A2. What kind of problems does your family have?

a. Water & Sanitation b. Low Income c. Education d. Health care

e. Other ( )

A3. How are you getting income mainly by?

a. Agriculture b. Livestock c. Fishery d. Sale other item

e. Labor work f. Other ( )

A4. How much of average income can you get?

N _____ /month

A5. How much products do you sell per year for income?

Agricultural products :

a-1. Yam (_____ /year) a-2. Maize (_____ /year)

a-3. Beans (_____ /year) a-4. Other : (_____ /year)

Livestock products :

b-1. Chicken (_____ /year) b-2. Cow (_____ /year)

b-3. Goat (_____ /year) b-4. Other : (_____ /year)

Fishery products :

c-1. Fresh water fish (_____ /year) c-2. Other: (_____ /year)

Main sales Item :

d-1. Charcoal (_____ /year) d-2. Other: (_____ /year)

A6. How much does your family spend per month?

Average: N _____ /month

A7. How much does your family spend for ;

a. Food: N _____ /month

b. Clothes: N _____ /month

c. Water-related issues/matters (O&M, Buy Water, Jelly can, etc) N _____ /month

d. Sanitation and hygiene-related issues/matters (latrine construction, etc) N _____ /month

e. Health-related issues/matters (medicine, hospital, etc) N _____ /month

A8. Where does your family buy necessities?

a. Rural Market b. City Market c. Peddler d. Other ( )

A9. What kind of Water & Sanitation problem does the village have?

(Circle (○) the ones that apply. Worst 3 problems)

a. Water source is too far

b. Little water in dry season

c. Little water at the souse even in rainy season

d. Water quality is bad → d-1. Smell d-2. Color d-3. Taste d-4. Other ( )

e. Too many people use the same water resource

f. Poor water drainage

g. Be broken/stolen Hand pump

h. Many children are usually sick → (Ex. : _____)

i. Many adults are usually sick → (Ex. : _____)

j. Latrines: None/Too few

k. Not clean clothes

l. Not clean water-drawing containers

m. Not clean house/compounds

n. Other ( )

B. Questions about Health Condition

B1. What kind of diseases did your family have for the last one year?

a. Cholera b. Guinea worm c. Malaria d. Diarrhea e. Typhoid

f. Dysentery g. Other ( )

B2. What are the causes of the disease?

a. Dirty water b. Irregular weather c. Bad people d. Unsanitary food

e. Other ( )

B3. How did you cure the diseases?

a. Self treatment b. Local doctor c. Mosque/Church d. Hospital

e. No treatment f. Other ( )

B4. How can you prevent diseases?

a. Clean water b. Good sanitary condition c. Good medicine

d. Other ( )

B5. Where should the patients be treated?

a. Hospital b. Mosque/Church c. Local clinic d. Traditional treatment

e. Specialist of water-born diseases f. Other ( )

C. Questions about Water Supply

C1. What is a main drinking water source in rainy season?

a. Borehole b. Dug Well c. Pond d. Stream/River

e. Rain Water f. Other ( )

C2. How far is a main water source from your house in rainy season?

a. 200m b. 500m c. 1000m d. 1500m e. 2000m

f. Over 2000m

C3. How is the water quality of main source in rainy season?

a. Good b. OK c. Bad → 1. Water amount 2. Color 3. Smell 4. Taste

C4. What is the main drinking water source in dry season?

a. Borehole b. Dug Well c. Pond d. Stream/River

e. Rain Water f. Other ( )

C5. How far is the main water source from your house in dry season?

a. 200m b. 500m c. 1000m d. 1500m e. 2000m

f. Over 2000m

C6. How is the water quality of main resource in the dry season?

a. Good b. OK c. Bad → 1. Water amount 2. Color 3. Smell 4. Taste

C7. Who usually does fetching water for your family?

a. Males b. Female c. Boys d. Girls e. Share by Family

f. Other ( )

C8. How many liters of water do your family use per day?

a. less than 40 l b. below 80 l c. below 120 l d. below 200 l

e. below 300 l f. over 300 l

C9. What kind of facility do you use to carry the water from water source?

a. Jelly cans b. Plastic Bucket/Bowl c. Clay pot d. Calabash

e. Iron Pail f. Other ( )

C10. What kind of facility do you use to store the water?

a. Drum b. Plastic Container c. Clay Pot d. Clay pots fitted with taps

e. Buckets fitted with taps f. Calabash g. Other ( )

C11. How do you treat the water before drinking?

a. Boil b. No treat c. Other ( )

C12. How many times do you clean the water fetching facility?

a. Every day b. Few times per week c. Few times per month

d. Never e. Other ( )

D. Questions about Water & Sanitation/Hygiene

D1. Do you have latrine in your house?

a. Yes b. No

D2. What type of latrine are you using?

a. Traditional Pit Latrine

b. Improved Traditional Pit Latrine

c. Ventilated Improved Pit Latrine

d. Other ( )

D3. How does your family dispose of the excreta from the facilities?

a. Bush b. Stream/River c. Pit latrine d. Gutter

e. Court yard/House surrounding f. Other ( )

D4. Do you wash your hands after using latrine?

a. Yes b. No

D5. What do you use to clean your hands after using the latrine?

a. Water only b. Water & leaves c. Paper & leaves

d. Water with soap e. Other ( )

D6. How many times do you usually clean your latrine?

a. Every day b. Few times per week c. Few times per month

d. Never e. Other ( )

D7. Would you be willing to build a public latrine?

a. Yes b. No

D8. (If yes) How much would you contribute?

a. less than N100 b. less than N200

c. less than N300 d. less than N400

e. less than N500 f. over N500

D9. (If No) Why would you not support a public latrine?

a. No money to contribute

b. No interest

c. Former efforts

d. Government responsibility

e. Other ( )

D10. Do you wash your hands before eating?

a. Yes b. No

E. Questions about Public Participation

E1. Did/Does your village have VWESC (Village Water & Sanitation Environment Committee)?

a. Yes, It was organized in (When _____) and still exists.

b. Yes, It was organized in (When _____) but dose not exist now.

c. No, but it will be organized in (When _____).

d. No, it will not be organized.

E2. (If "a") How much money do you pay as an initial contribution?

a. about N100 b. about N200 c. about N300 d. about N400

e. about N500 f. over N500 g. None h. don't know

i. donate (labor, material, etc)

E3. (If "a") Did/Do you pay money regularly for O&M?

a. Yes b. No

E4. (If "Yes") How much money did/do you pay regularly for Water cost (O&M) per month?

a. about N20 b. about N30 c. about N40 d. about N50 e. about N60

f. about N100 g. over N100 h. None i. don't know

j. donate (labor, material, etc)

E5. (If "b") Why do you think VWESC does not exist?

a. No money to O&M b. No knowledge for O&M c. No service from LGA

d. Other ( )

E6. (If "c") How much money will you pay as an initial contribution?

a. about N100 b. about N200 c. about N300 d. about N400

e. about N500 f. over N500 g. None h. don't know

i. donate (labor, material, etc)

E7. (If "c") How much money will you pay regularly for Water cost (O&M) per month?

a. about N20 b. about N30 c. about N40 d. about N50 e. about N60

f. about N100 g. over N100 h. None i. don't know

j. donate (labor, material, etc)

E8. (If "c") How often will you pay the water cost (O&M)?

a. Monthly b. weekly c. When boreholes brake

d. Other ( )

E9.(If "d") Why do you think you will not need VWESC ?

a. No money to contribute b. No interest c. Former efforts

d. Government responsibility e. Other ( )

E10. (If money will be/is collected regularly) Who does/will collect the money for VWESC?

a. Village Chairman b. VWESC leader c. Accouter of VWESC

d. Other ( )

E11. (If money will be/is collected regularly) Who does/will keep the money for VWESC?

a. Village Chairman b. VWESC leader c. Accouter of VWESC

d. Other ( )

E12. Does/Did the village receive service of O&M or Sanitation / hygiene Education?

a. Yes b. No

E13. (If "Yes") Who did/does support to Village?

a. LGA b. State Government c. NGO d. Other ( )

F. Questions about Other

(Answer only women)

F1. How many times do you spend doing housework?

a. Less than 2 hrs. b. Less than 3 hrs. c. Less than 4 hrs. d. Less than 5 hrs. e. Over 5 hrs.

F2. How often do you wash your family clothes in a week?

a. Every day b. 5 times c. 4 times d. 3 times e. 3 times f. once a week

F3. How many times do you spend doing washing clothes?

a. Less than 1 hrs. b. Less than 2 hrs. c. Less than 3 hrs. d. Less than 4 hrs. e. Over 4 hrs.

(Answer only by men)

F4. Do you help in housework?

a. Yes b. No

F5. (If "Yes") What kind of housework?

a. Repair house b. Fetching Water c. Other ( )

Attachment 2

Revised Village List

No.	ID/ No		LGA	Village	Population in 1991	Requested No.	Social Cond. Rank
	Revised	Original					
1	A-1	A-1	BADE	Dala	527	1	C
2	A-2	A-3	BADE	Azbak	2,822	1	B
3	A-3	A-5	BADE	Usur	644	1	B
4	A-4	A-6	BADE	Ngelbuwa	763	1	B
5	B-1	B-1	BURSARI	Jawa	679	1	B
6	B-2	B-2	BURSARI	Illela Garun Dole	1,096	1	B
7	B-3	B-3	BURSARI	Danga Kanamma	612	1	B
8	B-4	B-4	BURSARI	Harunari	519	1	B
9	B-5	B-5	BURSARI	Bururu	359	1	B
10	B-6	B-6	BURSARI	Mala Wango Fulatari	890	1	B
11	B-7	B-7	BURSARI	Bayamari	2,168	1	A
12	B-8	B-8	BURSARI	Koromari	958	1	B
13	B-9	O-5	BURSARI	Bonegaral	373	1	B
14	C-1	C-1	DAMATURU	Maisandari	4,000	1	B
15	C-2	C-2	DAMATURU	Dikumari	1,500	1	B
16	C-3	C-3	DAMATURU	Maduri	970	1	B
17	C-4	C-4	DAMATURU	Mallam Matari	543	1	B
18	D-1	D-1	FIKA	Tadangara	4,500	1	B
19	D-2	D-2	FIKA	Sabon Fegi Fika	536	1	A
20	D-3	D-3	FIKA	Fusami	2,065	1	B
21	D-4	D-4	FIKA	Garin Balde	1,351	1	B
22	D-5	D-5	FIKA	Gurjaje	655	1	B
23	D-6	D-6	FIKA	Yaba-Ngalda	1,425	1	B
24	D-7	D-7	FIKA	Garin Chindo	2,760	1	A
25	E-1	E-1	FUNE	Jajere (SG)	523	1	B
26	E-2	E-2	FUNE	Ngelshengele	545	1	C
27	E-3	E-3	FUNE	Dumbulwa	557	1	C
28	E-4	E-4	FUNE	Nyakire	1,261	1	B
29	F-1	F-1	KARASUWA	Bukarti	2,700	1	B
30	F-2	F-2	KARASUWA	Askinari & otheres	688	1	A
31	F-3	F-3	KARASUWA	Garin Gawo	456	1	B
32	F-4	F-4	KARASUWA	Gasma	906	1	A
33	F-5	F-5	KARASUWA	Karasuwa Galu B	374	1	B
34	F-6	F-6	KARASUWA	Karasuwa Garin Guna	1,568	1	B
35	F-7	H-1	KARASUWA	Dogon Jeji	512	1	B
36	F-8	H-4	KARASUWA	Wachakal ‘B’	1,315	1	B
37	G-1	G-1	MACHINA	Tauna	575	1	B
38	G-2	G-2	MACHINA	Taganama	1,100	1	B
39	G-3	G-3	MACHINA	Damai	1,387	1	A
40	G-4	G-4	MACHINA	Majeri	683	1	B
41	G-5	G-5	MACHINA	Bogo	1,901	1	A
42	H-1	H-2	NGURU	Yamdugo	881	1	B
43	H-2	H-5	NGURU	Dumsai	554	1	B
44	H-3	H-6	NGURU	Bambori	2,106	1	B
45	H-4	H-7	NGURU	Maja Kura	602	1	B
46	I-1	I-1	NANGERE	Garin Gada	876	1	A

No.	ID/ No		LGA	Village	Population in 1991	Requested No.	Social Cond. Rank
	Revised	Original					
47	I-2	I-2	NANGERE	Garin Baba	898	1	A
48	I-3	I-3	NANGERE	Dawasa	4,120	1	B
49	I-4	I-4	NANGERE	Gamarum	1,236	1	A
50	I-5	I-5	NANGERE	Duddaye B	396	1	B
51	J-1	J-1	POTISKUM	Adaya	1,112	1	A
52	J-2	J-2	POTISKUM	Mazagane	520	1	A
53	J-3	J-3	POTISKUM	Mamudo	2,399	1	B
54	J-4	J-4	POTISKUM	Lai-Lai	1,350	1	A
55	J-5	J-5	POTISKUM	Lakwaya	415	1	B
56	J-6	J-6	POTISKUM	Dumbulwa	732	1	A
57	K-1	K-1	GEIDAM	Kawari Lawanti	504	1	B
58	K-2	K-2	GEIDAM	Dajina	330	1	B
59	K-3	K-3	GEIDAM	Damakarwa	1,200	1	B
60	K-4	K-4	GEIDAM	Kelluri	2,692	1	A
61	K-5	K-5	GEIDAM	Nguluri	385	1	B
62	K-6	K-6	GEIDAM	Borko	370	1	B
63	K-7	K-7	GEIDAM	Ajiri	275	1	A
64	L-1	M-2	GULANI	Tetteba	2,945	1	B
65	L-2	L-2	GULANI	Sollari	526	1	B
66	L-3	L-3	GULANI	Chandam	872	1	A
67	L-4	L-4	GULANI	Badago/Badigore	721	1	B
68	L-5	L-5	GULANI	Bagardo	427	1	B
69	M-1	M-1	GUJBA	Katarko	2,535	1	B
70	M-2	L-1	GUJBA	Daddawel	1,162	1	B
71	M-3	M-3	GUJBA	Horanyiwa	914	1	B
72	M-4	M-4	GUJBA	Ligdir	671	1	B
73	M-5	M-5	GUJBA	Kukuwa	2,172	1	B
74	N-1	N-1	JAKUSKO	Yin	776	1	A
75	N-2	N-2	JAKUSKO	Adiya	842	1	B
76	N-3	N-3	JAKUSKO	Kajuwa	1,425	1	B
77	N-4	N-4	JAKUSKO	Jammel	1,692	1	A
78	N-5	N-5	JAKUSKO	Tajuwa	824	1	A
79	N-6	A-2	JAKUSKO	Tasga	572	1	B
80	N-7	A-4	JAKUSKO	Jabba	1,990	1	B
81	O-1	O-1	TARMUWA	Dabalam	385	1	B
82	O-2	O-2	TARMUWA	Koriyel	1,137	1	B
83	O-3	O-3	TARMUWA	Dumbari	296	1	A
84	O-4	O-4	TARMUWA	Manda-da'a	445	1	B
85	P-1	P-1	YUSUFARI	Mayori West	615	1	B
86	P-2	P-2	YUSUFARI	Mayori East	2,008	1	B
87	P-3	P-3	YUSUFARI	Shetimari (Abbagari &	475	1	A
88	P-4	P-4	YUSUFARI	Tulo-tulowa	3,166	1	A
89	P-5	P-5	YUSUFARI	Bulakura	895	1	B
90	P-6	P-6	YUSUFARI	Kaluwa	521	1	B
91	P-7	P-7	YUSUFARI	Garin Tsangai	1,438	1	B
92	P-8	H-3	YUSUFARI	Maidashi	4,370	1	B
93	Q-1	Q-1	YUNUSARI	Bula Moduye	583	1	B
94	Q-2	Q-2	YUNUSARI	Kalgi	974	1	A

No.	ID/ No		LGA	Village	Population in 1991	Requested No.	Social Cond. Rank
	Revised	Original					
95	Q-3	Q-3	YUNUSARI	Toshia	1,584	1	A
96	Q-4	Q-4	YUNUSARI	Dalari	360	1	B
97	Q-5	Q-5	YUNUSARI	Buhari	287	1	B
98	Q-6	Q-6	YUNUSARI	Bultuwa	234	1	B
99	Q-7	Q-7	YUNUSARI	Ngormadi	320	1	A
100	Q-8	Q-8	YUNUSARI	Bulabulin	1,139	1	A

A: Higher evaluation points (12 to 15), B: High evaluation points (8 to 11), C: Satisfied evaluation points (5 to 7)