No.

The Tigray Water Resources, Mines and Energy Bureau (TWRMEB)
The Government of Tigray Regional State
The Federal Democratic Republic of Ethiopia

# IMPLEMENTATION REVIEW STUDY REPORT
# ON
# THE PROJECT FOR RURAL WATER SUPPLY
# IN TIGRAY REGION
# IN
# THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

**January 2010**


**JAPAN INTERNATIONAL COOPERATION AGENCY**

**KOKUSAI KOGYO CO., LTD.**


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# PREFACE

Japan International Cooperation Agency (JICA) conducted the implementation review study on the Project for Rural Water Supply in Tigray Region in the Federal Democratic Republic of Ethiopia.

JICA sent to Ethiopia a study team from August 2, 2009 to September 2, 2009.

The team held discussions with the officials concerned of the Government of Ethiopia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, 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 Democratic Republic of Ethiopia for their close cooperation extended to the teams.

January, 2010

Shigenari KOGA
Director General, Financing Facilitation and
Procurement Supervision Department
Japan International Cooperation Agency

January 2010

# LETTER OF TRANSMITTAL

We are pleased to submit to you the implementation review study report on the Project for Rural Water Supply in Tigray Region in the Federal Democratic Republic of Ethiopia.

This study was conducted by Kokusai Kogyo Co., Ltd., under a contract to JICA, during the period from July 2009 to January 2010. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Ethiopia and formulated the most appropriate outline 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,

Shuji YAMASHITA
Project manager,
Implementation Review Study Team on the Project for
Rural Water Supply in Tigray Region
in the Federal Democratic Republic of Ethiopia
Kokusai Kogyo Co., Ltd.

# Summary

The Federal Democratic Republic of Ethiopia (hereafter, “Ethiopia”) is a landlocked nation in the heart of what is known as “the Horn of Africa” in eastern Africa, and covers an area of approximately 1,104,000 sq km (World Bank, 2008; approx. 3 times the size of Japan) with a population of 80.7 million (World Bank, 2008). The Tigray Region, the target area, is located in the northern part of Ethiopia, and covers approximately 52,000 sq km of land and has a population of 4.31 million (CSA: Ethiopian Central Statistic Agency, 2007).

The target region of the survey is located in the western edge of the African Great Rift Valley. This region has a complex distribution of wide-ranging geology, and a topography that features mountain ranges and highlands at an elevation of about 2,000m. Annual average rainfall is 200 to 800mm concentrated in the rainy season from June through September. Due to this, the rivers in the region are almost entirely seasonal streams that only flow in the rainy season. The region is known to suffer severe damage from dry weather and many of the residents suffer from chronic water shortages.

The GNI economic indicator of Ethiopia is 22.7 billion dollars, 280 dollars GNI per capita (World Bank, 2008), and a real economic growth rate of 11.3% (World Bank, 2008). The economy of Ethiopia has been sluggish due to civil war and drought which lasted 17 years, but stability was recovered after 1995. However, having suffered a blow from drought damage and a large number of refugees/evacuees due to the border conflict with Eritrea, in 2000 the Ethiopian national government issued the "Second National Development 5-Year Plan (2000-2005)", and made efforts to stabilize the economy with "Sustainable Development and Poverty Reduction Program (SDPRP) " in 2002. In 2006, "A Plan for Accelerated and Sustained Development to End Poverty (PASDEP)" and "2nd phase of SDRPI (2005-2010 year) " was approved by the National Diet. The national objectives for improvement in the water supply ratio was achieved in 2005, ahead of schedule, and thus the present objectives for the water sector have been specified for the year 2012 with the “Universal Access Program (UAP)”. In order for the Tigray Water Resources, Mines and Energy Bureau to independently solve the problems mentioned above in the water sector, they have released a plan based on the ‘Universal Access Program (UAP)” which calls for the village water supply ratio to be raised from the current ratio of 33.3% to that of 88% by 2011/2012.

In Ethiopia, it is estimated that about 22% of the population has access to safe potable water, which is immensely lower than the 56% average of Sub-Saharan countries (UNDP, 2004). Also, the Tigray Region water supply ratio for 2005 was at 33.3%, lower than the Ethiopian national water supply standard of 35% (UAP).

The complex topographic and geologic backdrop of the target region makes it difficult to guarantee safe and sustainable water sources. Also, it is often too late to either repair or rehabilitate existing water sources and run-down equipment, and given the severity of problems due to water shortages, such as water-borne diseases and the burden of labor put on women and children to fetch water, the Ministry of Finance and Economic Development made a request to the Government of Japan for the implementation of the "Project for Rural Water Supply and Rehabilitation" in the Tigray Region which aims at constructing mainly groundwater fed water supply facilities (including rehabilitation), and the supply of related equipment and materials.

In response to the request, the Government of Japan entrusted the study to examine the viability of the Project to the Japan International Cooperation Agency (JICA). Hence, JICA dispatched the Study team to conduct a preliminary Study for one month in June 2006. In the preliminary study, the Preliminary Study team were able to: 1) Clarify the contents of the request, 2) Confirm the environment and social considerations, and 3) Sort out the points of concern for the basic design study; confirming uniform validity for the project request, for the implementation of this study. Also, JICA dispatched the Study Team to conduct a Basic Design Study to Ethiopia from December 2006 through March 2007. In the Basic Design Study, the effect of the project and validity as grant aid were verified and a basic design regarding scope that was most suitable for the implementation of the project was made.

The Detailed Design was conducted on the basis of the Basic Design Study in 2007, and the Tendering for the Project were conducted in September, 2008 and January, 2009. However, the Tendering ended up in failure. The detail of the Tendering is as follows:

1) 1st Tendering dated 11 September 2008

   The Tendering was closed due to the uncompleted tender documents submitted by bidder.

   Three companies bought the tender document, however only one participated.

2) 2nd Tendering dated 25 September 2008

   The submitted tender was opened, but the price exceeded the sealing price and the negotiations failed.

   Tender was opened for the one company which bought the tender document for the previous Tendering.

3) 3rd Tendering dated 28 January 2009

   The company which bought the Tender document cancelled their participation in the Tendering.

Based on the results mentioned above, necessary duration for the construction work went over the end of the term agreed in the Exchange of Notes. Based on the rules of Grant Aid scheme, the

Government of Japan decided to end up the Exchange of Notes and start with the new Exchange of Notes to secure the certain conditions to reach the outcomes of the Project. The Government of Japan decided to conduct the Implementation Review Study and entrust JICA with the study to re-examine the viability of the Project.

Based on the background and result of the Detailed Design above, JICA dispatched the Implementation Review Study team to Ethiopia from 2 August 2009 through 2 September 2009.

These results are shown along with the contents of the plan of the Detailed Design the comparative table below.

Table-1 Original Requests and Survey Results

| Item | Plan of the Detailed Design | Results of Implementation Review Survey | Remarks |
|---|---|---|---|
| Facility construction | Level 1[*1] 75 facilities<br>Level 2[*2] 9 facilities<br>Rehabilitate 3 facilities<br>Total 87 facilities | Level 1 82 facilities<br>Level 2 9 facilities<br>Rehabilitate 3 facilities<br>Total 94 facilities | Three wells for Level 2 facilities done during the basic design study. Six wells for Level 2 facilities will construct at the design stage of consulting service. |
| Equipment supply | Service Rig with Accessories 1 Unit<br>Materials for pumping test 1 Unit<br>Truck with Crane 2 Units | Service Rig with Accessories 1 Unit<br>Materials for pumping test 1Unit<br>Truck with Crane 2 Unites | |
| Technical support | The soft component trains 86 water committees and provides education for operations and maintenance at the Regional/Woreda level. | The soft component trains 91 water committees and provides education for operations and maintenance at the Regional/Woreda level. | |

[*1] Level 1 means “water supply system by borehole with hand pump”
[*2] Level 2 means “water supply system by distributed public faucet with pipeline”

Once the E/N for the work schedule for the project is concluded between both governments, it is planned that the detailed design and bid for tenderers would be given 8.8 months and the equipment supply period would be 11 months. Also, approximately 29.3 months are anticipated for the construction of water supply facilities. The soft component will be executed during the same period, with a 12.3 month period anticipated.

The total cost for Ethiopia side including the fence work, construction of access roads, construction of primary distribution of commercial electricity, budget of tax exemption and so on, is approximately 28.4 million Ethiopia Birr.

The output expected from implementation of this project is compiled in the Table below.

Table-2 Output of Project Implementation

| Current conditions and problem areas | Countermeasures through cooperation of project target | Direct Output/Improvements | Indirect Output/Improvements |
|---|---|---|---|
| The residents of the target region suffer from chronic water shortages. As a result, the problems of water-borne disease and the burden of labor on women and children have become severe. | Develop water sources and construct water supply facilities. | The construction of water supply facilities at the Region will improve the water supply ration to 38% from the current ration of 33%, and provide water to an additional 62,294 people in the targeted 10 Woredas. | 1) Securing safe water supply will reduce water-borne disease and assist in the health of residents.<br>2) Water sources will be closer, thus reducing the time spent by women and children to fetch water, and increasing their social participation and education opportunities. |
| With few water sources, the wells have not been repaired as planned, and thus the water supply conditions threaten to worsen. | Supply materials and equipment for well rehabilitation. | With the supply of well rehabilitation materials, the progress ratio to rehabilitate existing wells can be improved. | With the rehabilitation of existing wells, recovering well functionality, the improved operation ratio lifts the overall water supply ratio. |
| Although regional and woreda staff has experience and knowledge about operation and maintenance of village water supply, the roles are unclear. Also, there is not enough manpower to provide management education to start village water committees of local residents. | The soft component is designed to clarify organization and improve operation capabilities. Also, instruct and educate residents. | 1) Clarify and perform operation and management system in the water supply sector. Improve technical skills needed for operation and management of water supply facilities.<br>2) Put into practice the activity of resident-driven maintenance. | Residents gain a sense of ownership of the project and deepen their understanding of safe and sanitary water. As a result, there will be progress in residents' understanding of measures to prevent water-borne disease. |

On the basis of this output, this project is deemed valid for implementation through grand aid according to the following points.

1) The construction of 94 water supply facilities in this project will guarantee the stabilization of safe drinking water to 91 villages (97 sites) that previously experienced access difficulty to safe drinking water.

2) The supply of well rehabilitation materials offered in the project will act as a significant contribution to improving the water supply ratio of the Tigray region through the sustainable repair of well facilities,

together with the above-mentioned new water sources.
3) The operation and maintenance of the facilities is possible with budget allocations and human resources provided by the Ethiopian Government.
4) Significant contribution to achieving the objectives for water supply put forth in UAP strategy for the Ethiopian water sector, and coincides with Ethiopian national policies.
5) Significant contribution to realizing improved water supply coverage, central to the advancement of the U.N. Millennium Development Goals.
6) With the implementation of this project, the possibility of exerting any negative impact on the environment is low.

We were able to ascertain through the results of the basic design study that operation and maintenance activities water sector in the Tigray Region are generally adequate, and, furthermore, that if organizational roles and the system are clarified, as well as a more efficient work implementation system put into place, we may conclude that no large obstacles will be encountered for the operation of the facilities and equipment provided in this project over an extended period of time. In particular, by heeding the points below, we expect the smooth and efficient execution of this project will be promoted, contributing to the long-term use of facilities for future operations.

① **The smooth and secure execution of items entrusted to the Tigray Regional Government in this project**,

The conditions for smooth project implementation are that the Ethiopian counterpart in charge of operations will provide an access road to the regional government, the primary distribution of commercial electricity, fulfill measures for tax exception, secure the budget to carry out the project, and ensure local citizen participation in the project. Should these items be fulfilled with certainty by the Ethiopian side, the work schedule will be carried out smoothly.

② **Operations and Management Education and Practice including government employees and local citizens**

Operations and Management Education and Practice including government employees and local citizens with the objective of strengthening the government system for operations in the regional/Woreda governments, an improvement of the technical skill of managing staff is required. Also, sufficient confirmation of the roles pertaining to planning and operations so that there are no obstacles to prevent the participation of local residents in activities. For this, the soft component for ideal for structural assistance will be implemented. Particularly, in cooperation with the "Ethiopia Water Technology Center (hereafter, EWTEC)" and related donor organizations, the basic technical level of managing staff will be lifted to handle the establishment of an effective

operation and maintenance system.

In this project, advanced work schedule management and quality management, as well as supply management of necessary materials is indispensable. Thus, the Japanese Government input of advanced management techniques, through Grant Aid, will be exceedingly significant. Also, providing well repair materials to assist Ethiopia to achieve it's national goals through self-supporting endeavors, this project coincides with the Japanese government's concept of self-supporting efforts through Grant Aid, as well as the movement in the international community for assistance to accomplish the MDGs.

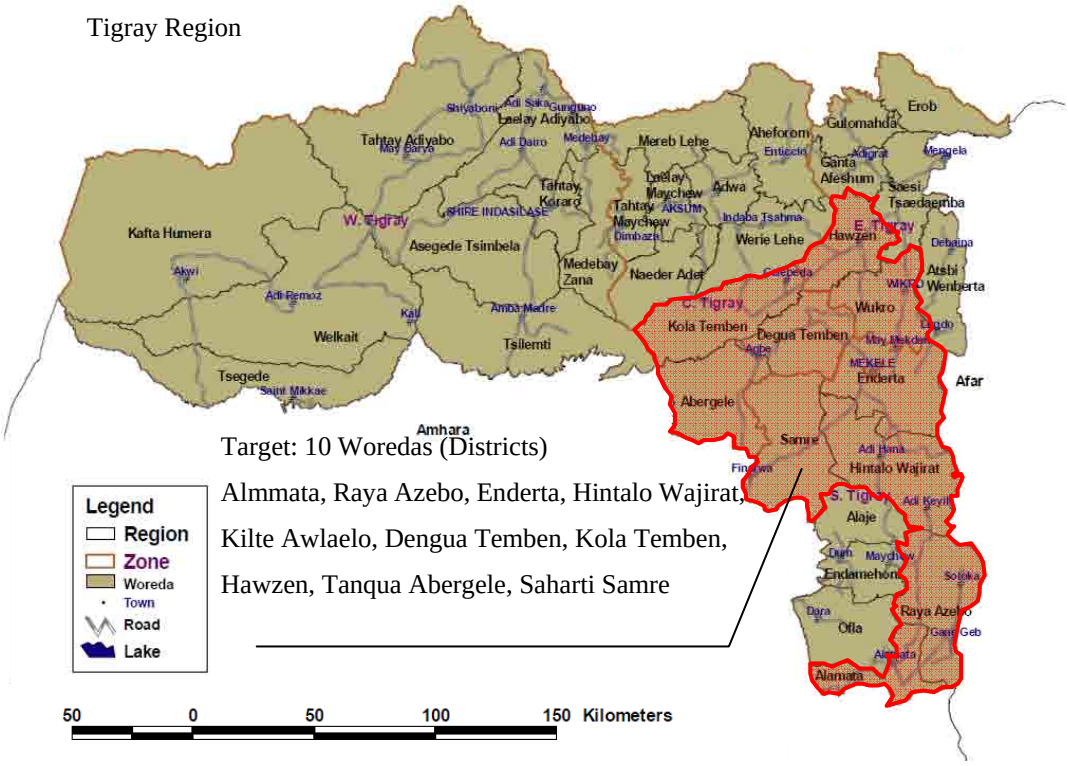
# Contents

## [Appendices]

Federal Democratic Republic of Ethiopia



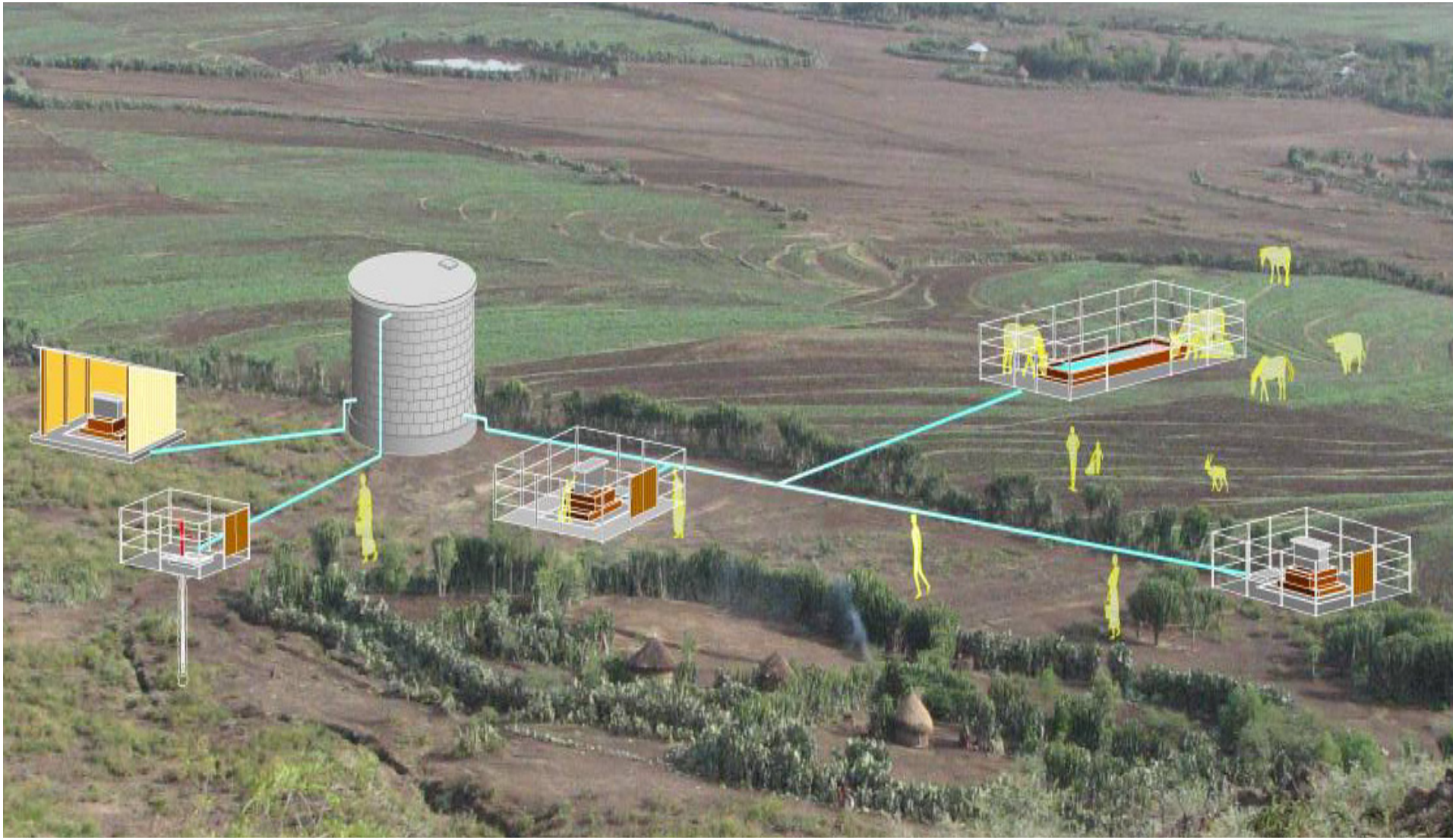
Tigray Region




Target: 10 Woredas (Districts)

Almmata, Raya Azebo, Enderta, Hintalo Wajirat, Kilte Awlaelo, Dengua Temben, Kola Temben, Hawzen, Tanqua Abergele, Saharti Samre

# Location Map



Perspective

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# Abbreviations

BoFED : Bureau of Finance and Economic Development
BH : Bore Hole
CPP : Community Participation Promoters
DIP : Ductile Iron Pipe
DTH : Down the Hole
EC : Electric Conductivity
ECA : Ethiopia Customs Authority
EEPC : Ethiopia Electric Power Corporation
E/N : Exchange of Notes
EU : European Union
EWTEC : Ethiopia Water Technology Center
FAO : Food and Agricultural Organization
GA : Grant Agreement
GDP : Gross Domestic Product
GNI : Gross National Income
GS : Galvanized Steel Pipe
GTZ : Deutsche Gesellschaft fÜr Technische Zusammenarbeit
H/H : House Holder
HP : Hand pump
IMF : International Monetary Fund
JICA : Japan International Cooperation Agency
MDGs : Millennium Development Goals
MoFED : Ministry of Finance and Economic Development
MOU : Memorandum of Understanding
MoWR : Ministry of Water Resources
NGO : Non Governmental Organization
O&M : Operation and Maintenance
ODA : Official Development Assistance
PDM : Project Design Matrix
PRSP : Poverty Reduction Strategy Paper
PVC : Polyvinyl Chloride
RBA : Revenue Board Authority
REST : Relief Society of Tigray
SDPRP : Sustainable Development and Poverty Reduction Program

TWRMEB : Tigray Water Resources, Mines and Energy Bureau

TWWCE : Tigray Water Works Construction Enterprise

UAP : Universal Access Plan

UNDP : United Nations Development Programme

UNICEF : United Nations Children's Fund

uPVC : Unplasticised Polyvinyl Chloride

VES : Vertical Electrical Sounding

VWC : Village Water Committee

WB : World Bank

WHO : World Health Organization

WPC : Water Point Committee

WSDP : Water Sector Development Program

WUAs : Water User Associations

WUGs : Water User Groups

WWDE : Water Works Drilling Enterprise

WWRMEO : Woreda Water Resources, Mines & Energy Bureau

# *1. Background of the Project*

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## 1-1 Background

In the Federal Democratic Republic of Ethiopia covers an area of approximately 1,104,000 km2 and has a population of 80.7 million with a per capita GNI (Gross National Income) of approximately US$280. Only 22% of the total population in rural areas has access to safe drinking water, which is much lower than the average of other sub-Saharan African countries which have a rate of 56 % (UNDP: 2004). The inhabitants of the rural area, in which 85% of the total population resides, have to spend a lot of time and energy getting safe water for domestic use. This is one of the causes of poverty. In particular, water shortage has had a serious influence on society and economy due to the repeated large drought in recent years, and supply of safe drinking water has been a cross sectional problem relevant to basic education, medical care, rural development, and so on.

Tigray Region, which requested this Project, is located in the northern part of Ethiopia and covers an area of approximately 52,000 $km^2$ and has a population of 4.31 million. The life expectancy of the inhabitants of this region is as low as 49.5 years old in the rural area and 49.9 years old in the urban area. In addition, the child mortality rate of less than 5 years old in the rural area shows a high value at 18.2% and from these numeric values, severe poverty and an inferior health environment have also been found. Furthermore, this region is a recognized area where damage from drought is serious, and many inhabitants have been troubled by a chronic water shortage. Therefore, the hazard from waterborne diseases and the work load burden of rural women and children collecting water have been extremely serious so finding solutions to this has been an urgent issue.

Under these circumstances, the Government of Ethiopia made a request to the Government of Japan for Grant Aid to the Government of Japan for implementation of the Project for Rural Water Supply in the Tigray Region which aims at constructing water supply facilities for which the source is mainly groundwater, rehabilitation of existing facilities and procurement of related equipment.

In response to the request, the Government of Japan entrusted the study to examine the viability of the Project to the Japan International Cooperation Agency (JICA). Hence, JICA dispatched the Study team to conduct a preliminary Study for one month in June 2006. In the preliminary study, the Preliminary Study team were able to 1) Clarify the contents of the request, 2) Confirm the environment and social considerations, and 3) Sort out the points of concern for the basic design study, confirming uniform validity for the project request, for the implementation of this study. Also, JICA dispatched the Study Team to conduct a Basic Design Study to Ethiopia from December 2006 through March 2007. In the Basic Design Study, the effect of the project and validity as grant aid were verified and a basic design regarding scope that was most suitable for the implementation of the project was made.

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## 1-2 Changes in Requested Items

### 1-2-1 Original request

**≪Contents of the request≫**

① Construction of 13 deep wells with related facilities (level-2[1]) and rehabilitation of 17 existing facilities.

② Construction of 200 deep wells with hand pumps (level-1[2])

③ Procurement of equipment (1 rehabilitation rig, 20 motorbikes, 3 vehicles)

④ O&M training for 213 village water committees (VWCs)

**≪Contents of the Basic Design≫**

① Construction of 10 deep wells with related facilities (level-2) and rehabilitation of 4 existing facilities.

[1] Level-1 means “Water supply system by deep well with hand pump”.

② Construction of 85 deep wells with hand pumps (level-1)

③ Procurement of equipment (1 rehabilitation rig)

④ O&M training for 99 village water committees (VWCs)

**<Contents of the Detailed Design>**

① Construction of 9 deep wells with related facilities (level-2) and rehabilitation of 3 existing facilities.

② Construction of 75 deep wells with hand pumps (level-1)

③ Procurement of equipment (1 rehabilitation rig)

④ O&M training for 87 village water committees (VWCs)

### 1-2-2 Confirmed Request

(1) Selected Sites

Table 1-1: Comprehensive Table of Selected Sites (per facility)

| No. | Woreda (Disrict) | Level 1 | Level 2 | | Rehab. | Total |
|---|---|---|---|---|---|---|
| | | | Small Scale lnd. Water Supply | Multi village Water Supply | | |
| 1 | Hawzen | 9 | 0 | 0 | 0 | 9 |
| 2 | Kilte awlaelo | 9 | 0 | 0 | 0 | 9 |
| 3 | Kola Temben | 8 | 0 | 0 | 0 | 8 |
| 4 | Degua Temben | 8 | 0 | 0 | 0 | 8 |
| 5 | Tanqua abergele | 10 | 0 | 0 | 0 | 10 |
| 6 | Seharti Samre | 6 | 0 | 0 | 0 | 6 |
| 7 | Enderta | 11 | 0 | 0 | 0 | 11 |
| 8 | Hintalo wajirat | 4 | 0 | 0 | 0 | 4 |
| 9 | Raya Azebo | 2 | 5 | 2 | 3 | 12 |
| 10 | Alamata | 15 | 2 | 0 | 0 | 17 |
| Total sum | | 82 | 7 | 2 | 3 | 94 |

(2) Equipment

[2] Lebel-2 means “Water supply system by distributed public faucet system”.

Table 1-2: Chart of Request Contents and Changes

| Request Form | | Content of Request (Checked before start of study) | | | Modifications | | |
|---|---|---|---|---|---|---|---|
| Service Rig | 1 Unit | Service Rig | | | Service Rig | | |
| | | Vehicle | All-Wheel-Drive Accessories Truc<br>GVW: 20-28ton<br>pay load: 15-20ton<br>6×6 drive<br>mast: 12m<br>hoisting: 5ton | 1 Unit | Vehicle | All-Wheel-Drive Accessories Truck | 1 Unit |
| | | Compressor | Discharge Pressure: 3.5Mpa<br>Air Discharge: 13.5m3/min | 1 Set | Compressor | Discharge Pressure: 1.0Mpa or up<br>Air Discharge: 8.0m3/min | 1 Set |
| | | Storage Box | Storage box for submersible pump<br>Storage box for cable<br>Storage box for pipe | 1 Set | Storage box | | 0 Set |
| | | Support Tools | Cutting Torches<br>Steam Cleaner<br>Decontamination Trough<br>Sand Content Testers<br>Flow and Totalizing Meters | 1 Set | Support Tools | Cutting Torches<br>Steam Cleaner<br>Decontamination Trough<br>Sand Content Testers<br>Flow and Totalizing Meters | 0 |
| | | Mat'l to insert pump | Troubleshooting Service<br>Pump Sizing and Selection<br>Pump Installation tools<br>Control Box Installation | 1 Set | Mat'l to insert pump | Troubleshooting Service<br>Pump Sizing and Selection<br>Pump Installation tools<br>Control Box Installation | 0 |
| | | Well washing equipmen | Well Brushing<br>Nylon Soft Brushing<br>Well Jetting<br>Chemical Treatment<br>Debris/Blockage Removal | 1 Set | Well washing equipment | For Brushing<br>For Jetting | 1 Set |
| | | Other | Inspection lamp<br>Cable winder<br>Traveling block<br>Lifting Strap<br>Crown bar<br>Pry bar<br>Grease gun<br>Hoisting cable<br>Sand line cable<br>Guy line cable<br>Turn buckler<br>Guy line anchors<br>Lifting plugs | 1 Set | Other | Inspection lamp<br>Cable winder<br>Traveling block<br>Lifting Strap<br>Crown bar<br>Pry bar<br>Grease gun<br>Hoisting cable<br>Sand line cable<br>Guy line cable<br>Turn buckler<br>Guy line anchors<br>Lifting plugs | 0 |
| | | Material for Drawdown Test | | | Material for Drawdown Test | | |
| | | Submersible pump | Hd=140m,Q=400l/min | 1 Unit | Submersible pump | Hd=140m,Q=400l/min | 1 Unit |
| | | | Hd=140m,Q=200l/min | 1 Unit | | Hd=80m,Q=1000l/min | 1 Unit |
| | | Welder+Generator | | 1 Unit | Generator | | 1 Unit |
| | | Water Quality Testing Meter | | 1 Set | Water Quality Testing Meter | | 1 Set |
| | | Not listed | | | Water Level Meter | | 1 Unit |
| | | Not listed | | | V-Notch Weir | | 1 Unit |
| | | Not listed | | | Truck with Crane | | 1 Unit |
| Pickup truck | 3 Unit | Pickup truck | | | Work/Transport Vehicle | | |
| | | Vehicle | pay load:1200kg<br>GVW:3000kg<br>SAE standard (2100m elevations) | 3 Unit | Truck with Crane | | 2 Unit |
| | | Spare parts | 100,000kms of operation<br>or the value of 15% of order | 3 Set | | | |
| Autobike | 20 Unit | Autobike | | | Autobike | | 0 Unit |
| | | Main Unit | Maximum dry mass of 105kg<br>Seating capacity 2 persons<br>power output: not less than<br>17.50HP / 7,000rpm and minimum<br>torque output 1.9kgm / 5,500rpm.<br>Fual tank: 8 liters minimum | 20 Unit | | | |
| | | Accessory | front wind shieled glass<br>mudguards | 20 Set | | | |

### 1-2-3 Natural Condition

The following confirmation was accomplished by the Basic Design Study.

The average rainfall in the survey target area is 200mm to 800mm, with a trend towards little precipitation in the north and more in the southern part of the target area. According to the monthly average of rainfall distribution, data from the 9 weather observation points distributed in the vicinity of the survey area shows a concentration of precipitation in a rainy season that lasts from June through September. The months of October through February are largely dry with very little rainfall. Because of this, the rivers in the area mostly seasonal rivers which flow only in the rainy season, so that the only water source that can be used year-round is groundwater.

The Tigray Region is located on the western edge of the great rift valley of Africa, where geologic activity has generated valleys in the north-north-east and south-south-west. Also, Palaeogene (Eocene epoch) basalt rock has been widely distributed in this region from the west to the southeast, and this basalt is also found in the southern part of the target area for this project. Where the basalt rock is distributed in the southern part of the target area, a basin has formed in the vast valley which is buried by an alluvial layer. At the same time, in the central part of the target area, we find limestone and shale from the Mesozoic era (latter Jurassic period) surrounded by early/later Jurassic period and latter Paleozoic-Triassic sandstone. In addition, pre-Cambrian period basement rock is distributed in the north and west sections.

The hydrogeological features of the target area (10 Woredas) allow it to be divided into three general areas (see Figure 1-1):

1) Alluvium and New Tertiary period volcanic rock (Raya Azebo, Alamata)
2) Palaeogene volcanic rocks - basalt, volcaniclastic material, alternating tuff (Hintalo Wajirat, Enderta, Kilte awlaelo, Degua Tembien, Northern Seharti Samre)
3) Sedimentary rock and metamorphic rock older than Mesozoic era (Hawzen, Kola Tembien, Tanqua Abergele, Southern Seharti Samre)

The assessment for water source potential becomes lower in order from 1) > 2) > 3), respectively. Also, part of the limestone and tuff in alternating layers of alluvium and sedimentary rock is thought to be the aquifer, and we will generally target fissure water (water between fissures, etc.) of the remaining layers. This difference in the underground water potential of each Woreda accounts for the large difference in the number of villages targeted in each Woreda. Furthermore, we have confirmed the existence of a gypsum layer in the limestone layer which exists in the stratiform water, as mentioned above, where wells with a high density of calcium sulfate (unsuitable for drinking) are inadequate as a water source.

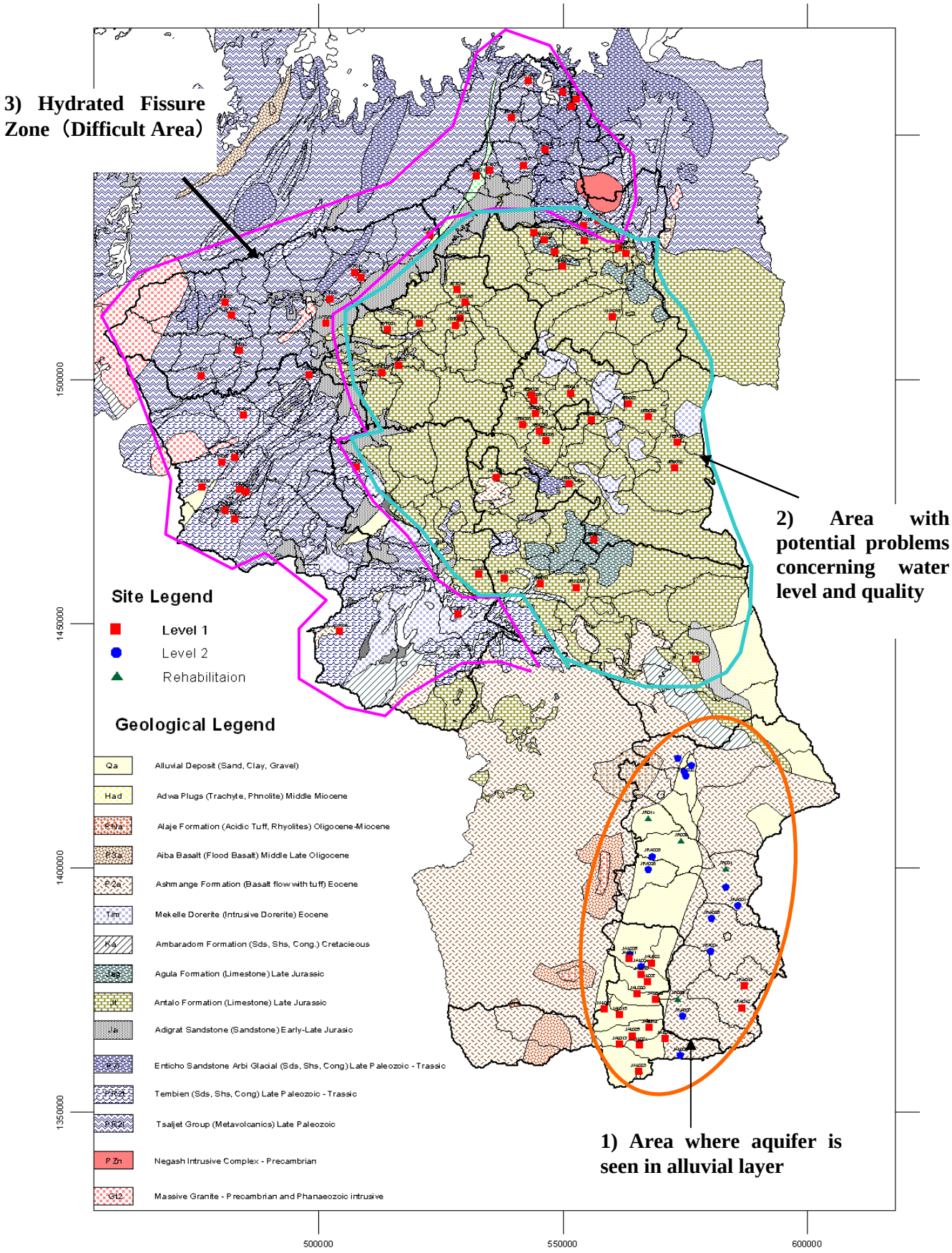



Figure 1-1: Groundwater Development Potential by Hydrogeological Zones

## 1-2-4 Environmental Social Consideration

The following confirmation was accomplished by the Basic Design Study.

The project carried out environmental and social considerations during the preliminary report, and the main points contained in that preliminary report are listed below.

(1) Criteria and regulations pertaining to environmental and social considerations

1) National Environmental Policy

The Environmental Policy was adopted 2 April 1997 by the Environmental Protection Authority in cooperation with the Ministry of Finance and Economic Development. Environmental policy related to water resources are as follows:

- To ensure that the control of environmental health hazards be a necessary condition in the design, construction and use of dams and irrigation systems;
- To recognize that natural ecosystems, particularly wetlands and upstream forests, are fundamental in regulating water quality and quantity and to integrate their rehabilitation and protection into the conservation, development and management of water resources;
- To ensure that any proposed introduction of exotic species into water ecosystems be subject to detailed ecological studies and environmental impact assessment;
- To promote the protection of the interface between water bodies and land (e.g. lake shores, river banks and wetlands);
- As most large and medium scale irrigation potential is located in the rangelands of the lowlands occupied by pastoralists, to consider the opportunity costs of irrigating important dry season grazing areas of the pastoralists for crop production in any cost benefit analysis of such irrigation projects;
- To involve water resource users, particularly women and animal herders, in the planning, design, implementation and follow up in their localities of water policies, programmes and projects so as to carry them out without affecting the ecological balance;
- To subject all major water conservation, development and management projects to the environmental impact assessment process and to include the costs and benefits of protecting watershed forests, wetlands and other relevant key ecosystems in the economic analysis of such water projects; and
- To promote, through on-site training, effective water management techniques at the farm level for improved performance of medium to large-scale irrigation schemes.
- To promote, to the extent possible, viable measures to artificially recharge ground and surface water resources.
- To recycle waste water when it has been found to be safe for health and the environment or when it has been made safe without entailing high cost.

2) Basic laws and guidelines pertaining to environmental assessment

Below is a list of projects and categories that require environmental impact assessment. However, this chart is not of general categories, but uses Schedule 1, 2, 3. Particularly, projects in areas susceptive to environmental impact are all categorized under Schedule 1 (equivalent to Category A), though the concrete areas are not yet decided.

Table 1-3: Categories of Environmental Impact Assessment for the Water Source Development

| Category | Environmental Impact Assessment Guideline (July 2000) | Environmental Impact Assessment Procedural Guidelines (December 2003 Draft) |
|---|---|---|
| Schedule 1 (Category A concurrent) | Water supply projects including the following items:<br>・Construction of dams, impounding reservoirs with a surface area of 100ha<br>・Ground water development for industrial, agricultural or urban water supply of greater than 4000㎥/day<br>・Large scale water channel and flood control works<br>・Drainage Plans in towns close to water bodies<br><br>Agriculture projects including the following items:<br>・Construction of dams, man-made lakes, and artificial enlargement of lakes with a surface area of 250ha or more<br>・Ground water fed irrigation projects covering more than 100ha<br>・Surface water fed irrigation projects covering more than 100ha<br>・River diversions and water transfers between catchments<br>・Construction of dams, impounding reservoirs in low land areas<br>with a surface area of 100ha in low land areas | Water supply project including the following items:<br>・Canalization of water courses<br>・Diversion of normal flow of water<br>・Water transfers scheme<br>・Abstraction or utilization of ground and surface water for bulk supply<br>・Water treatment plants<br>・Construction of dams, impounding reservoirs with a surface area of 100ha<br>・Ground water development for industrial, agriculutre or urban water supply of greater than 4,000㎥/day<br>・Drainage plans in towns close to water bodies<br>・City sewage treatment center<br><br>Agricultural project including the following items:<br>・Canalization of water courses<br>・Construction of dams, man-made lakes, and artificial enlargement of lakes with surface areas of 200ha or more<br>・Surface water fed irrigation projects covering 100ha or more<br>・Ground water fed irrigation projects 100ha or more<br>・River diversions and water transfers between catchments<br><br>Other<br>・Any project in an Environmentally Sensitive Area |
| Schedule 2 (Category B concurrent) | Water supply projects including the following items<br>・Village water supply<br>・Small scale drainage<br>・Sewerage system<br><br>Agricultural projects including the following items<br>・50 to 100ha surface water fed irrigation project<br>・50 to 100ha ground water fed irrigation project | Water supply projects including the following items<br>・Rainwater utilization<br>・Village water supply<br>・Small scale drainage<br>・Sewerage<br><br>Agricultural projects including the following items<br>・Surface water fed irrigation projects covering 50 to 100ha<br>・Ground water fed irrigation projects covering 50 to 100ha |
| Schedule 3 (Category C concurrent) | ・Surface water fed irrigation project up to 50ha<br>・Ground water fed irrigation project up to 50ha | ・Surface water fed irrigation project up to 50ha<br>・Ground water fed irrigation project up to 50ha |

Furthermore, in the Tigray Region, EIA is governed by the Environmental Protection Section of the Environmental and Land Resources Department. However, only the environmental procedure of the water supply project will be necessary, done via internal investigation by the Judicial Affairs Division within TWRMEB who will execute this project.

3) System pertaining to land appropriation

In Ethiopia, the possession of land is not recognized, such that all lands are government property. In

cases where it becomes necessary to relocate residents, alternative lands will be provided. For this reason, no problems with past land appropriation have occurred in the village water supply project. Farm land and agricultural produce will incur damage from the access road and excavation site, and any claims will be guided by the woreda or village to negotiate with the beneficiary to resolve the majority of the cases.

(2) Conducting an Environmental Impact Assessment and the impact assessment outcome

In accordance with the items and methods of environment social consideration at the IEE level, the preliminary study group conducted IEE investigations of the candidate villages through the 25th of July 2006 and collected existing data during this period. The items given environmental consideration based on this assessment are listed below.

Table 1-4: Items of Environmental Consideration for Implementation of the Project

| Item | Details |
|---|---|
| Noise, vibration | There is nearly no residential housing in the vicinity of the drilling sites according to the results of the investigation. However, a second inspection will be conducted when deciding the site, along with adequate consideration to the surrounding area to clarify any problem areas and discuss them with the community. |
| Cultural assets | Although it was confirmed that there are no cultural assets in the vicinity of the drilling sites that would incur impact from the project, a second inspection will be conducted and problem areas discussed with the proper government authority. |
| Land subsidence | With an understanding of past cases, we shall examine the stratum so that no land subsidence will be caused during the drilling operations. |
| Groundwater | Comprehend whether or not any reduction in groundwater would occur based on current records and site survey. |
| Water use and water rights | Investigate any well interference with irrigation wells. |

# *2. Contents of the Project*

# 2. Contents of the Project

## 2-1 Basic Concept of the Project

### 2-1-1 Principle Objective and Project Objective

(1) Principle Objective

In order to achieve the Millennium Development Goals (MDGs) advocated by the UN, the Universal Access Program (UAP) entered into policy as the national policy for the water sector in 2005.

Based on the UAP, the Tigray Region aims to raise the village water supply ratio from 41% to 88% by the year 2012. At the Tigray Water Resources Department, in order to achieve this goal, they have laid plans for 436 dug wells, 2,838 protected shallow wells, 2,838 wells with hand-pumps, 1,700 rooftop rainwater wells, and the rehabilitation of 910 hand-pump wells.

The plan falls within the scope of the National and Regional Development.

(2) Project Objective

The target region will see the construction of 94 water supply facilities, improving the water supply of the 10 woredas in Tigray Region.

The project goal has been set, “To increase the population that receives safe and reliable water supply in target areas.”

### 2-1-2 Project Summary

This Grant Aid scheme, based on the Ethiopian National Policy, aims to achieve the project goal to improve sustainable and safe water conditions and the sanitary environment for residents in 10 woredas of the Tigray region, by construction of 82 hand-pump facilities (Level 1), and 9 motorized facilities (Level 2), and 3 rehabilitation of existing sites. The equipment for the rehabilitation of the well will be procured for the increase of the served population and raise the operation rate of water supply facilities. The soft component will be executed to clarify the organizational system, and the smooth launch of a new organization by assisting in the establishment of continued citizen-centered operational activities.

The detailed implementation of this plan is shown in the Table below.

## Table 2-1: Construction Plan

| Facility Name | | Details | Quantity | Application |
|---|---|---|---|---|
| Well with Hand Pump | Water Source | Well Construction | 82 wells | |
| Target: 77 villages (82 sites) | Facility | Hand pump Installation | 82 sets | |
| No. of facilities: 82 | | Platform Construction | 82 sets | |
| Well with Motorized Pump | Water Source | Well Construction | 6 wells | Construction by the design stage of consulting service |
| Target: 11 villages (12 sites) | | Used to Test Production Wells | 3 wells | Test well done during the basic design study |
| No. of facilities: 9 | Distr. Reservoir | Ground-Level Distr. Reservoir | 10 sets | $25m^3$: 6 sets, $50m^3$: 3 sets, $100m^3$: 1set |
| | | Elevated Tank | 1 set | $4m^3$ ROTO tank: 1 set |
| | Facility Const. | Generator House | 6 sets | Generator installation: 6 sets |
| | | Booster Pump House | 1 set | Commercial electricity usage: 1 set |
| | | Control Panel House | 3 sets | Commercial electricity usage: 3 sets |
| | Pipeline | Supply: GS, DIP $\phi$ 40-150mm | 23.6 km | |
| | | Distr.: GS, DIP $\phi$ 40-150mm | 11.8 km | |
| | Motorized Pump | Submersible Pump | 9 sets | |
| | | Booster Pump | 1 set | |
| | Power Source | Diesel generator installation | 6 sets | |
| | | Cm. Power secondary wiring | 4 loc. | C/P responsible for primary wiring |
| | Pub. Water tap | Pub. Water tap construction | 22 sets | |
| | Drinking Area for Domestic Animals | | 9 sets | one set for each site |
| Rehab. Of Existing Water Supply Facilities | Distr. Reservoir | Elevated Tank | 3 sets | One set for each site<br>$10m^3$ ROTO tank: 1set<br>$4m^3$ ROTO tank: 2 sets |
| Target: 3 villages (3 sites) | Facility Const. | Generator House | 3 sets | |
| No. of facilities: 3 | Pipeline | Supply: GS $\phi$ 25-40mm | 0.045 km | |
| | | Distr.: GS $\phi$ 25-40mm | 0.47 km | |
| | Motorized Pump | Diesel generator installation | 3 sets | |
| | | Submersible Pump replace | 3 sets | |
| | Pub. Water tap | Raise no. of public water tap | 3 sets | |
| | Drinking Area for Domestic Animals | | 3 sets | |

Note 1: Abbreviations in the table are GS for Galvanized Steel Pipe, and DIP for Ductile Iron Pipe.

Note 2: Abbreviations in the table are ROTO for Water tank made by polyethylene.

Note 3: Definition of village and site: a collection of sites is a village, so that sites (local lang.: gote) was used in this request (image below)

Note 4: The number of Rehab., Level 2 facilities: Calculated by considering a closed facility between the water source and distr. reservoir as one water supply system.

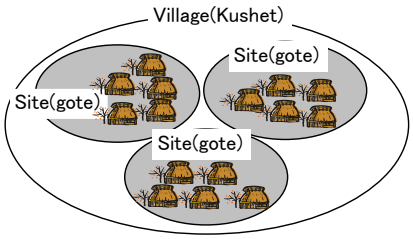


Table 2-2: Equipment Plan

| No. | Equipment Name | Configuration/Specification | Qty |
|---|---|---|---|
| A | Equipment for Well Rehabilitation | | |
| A1 | Service Rig | Service rig vehicle： 4×4 or 6×4 truck<br>Suitable for airlift, brushing, jetting<br>Including accsessories (well dia. 4", 6", 8")<br>Water pump (Pressure 1.96Mpa or more, discharge 500L/min or more)<br>Compressor (Pres. 1.0Mpa or more, air delivery 8.0m3/min or more) | 1 Unit |
| B | Materials for Drawdown Test | | |
| B1 | Truck with Crane | 4X4, GVW 10ton, bed: 4m, iron flooring<br>3ton max. crane lift capacity | 1 Unit |
| B2 | Submersible Pump | Hd=140m, Q=400l/min(for well diameter6", 8"): one<br>Hd=80m, Q=100l/min (for well diameter 4"): one<br>Including accsessories | 1 Set |
| B3 | Generator | Output 50kVA or more, 380V/50Hz/3phase | 1 Unit |
| B4 | V-Notch Weir | Maximum discharge 450l/min | 1 Unit |
| B5 | Water Level Meter | Measurement depth 150m | 1 Unit |
| B6 | pH Meter | Portable type | 1 Unit |
| B7 | Conductance/TDS Meter | Portable type | 1 Unit |
| B8 | ORP Meter | Portable type | 1 Unit |
| B9 | Turbidity Meter | Portable type | 1 Unit |
| C | Equipment for Work and Transportation of handpump well | | |
| C1 | Truck with Crane | 4X4, GVW 10ton, bed: 4m, iron flooring<br>3ton max crane lift capacity | 2 Units |

A PDM (Project Design Matrix) shows an overview of the tasks in this project, summarized as shown in Table 2-3.

Table 2-3: Orientation of Plan in PDM

| Project Summary | Index | Means of Acquisition | External Conditions |
|---|---|---|---|
| **Principal Objective**<br>Improvements of the sanitary environment of residents. | Reduction of water-borne diseases ratio among residents·····A | ・Statistical data on sanitation<br>・Resident survey | |
| **Project Objective**<br>To increase the population that receives safe and reliable water supply in target areas. | Population with safe water..... B | ・ Water users directory of water committee | No drastic change in Ethiopian National Policy for water and sanitation. |
| **Output**<br>1. Arrange water supply facilities in target areas.<br><br><br><br>2. Establish an independent maintenance system by the residents, and the sustainable use of water supply facilities by residents.<br><br><br><br>3. Improve maintenance instruction and service of implementation organization | 1-1. Maintenance ratio of water supply facilities in the area..... C<br>1-2. Reduction of working hours time to draw water..... D<br><br>2-1. Activities of water committee . E<br>2-2. Collection ratio of maintenance fee .....F<br>2-3. Usage ratio of water supply facilities ..... G<br><br>3-1. Number of visits by implementation organization ..... H<br>3-2. Resident satisfaction with service of implementation organization.....I | 1-1. Water committee facility operation record<br>Resident survey<br>1-2. Resident survey<br><br>2-1. Water committee activity record<br>2-2. Collection fee registry<br>2-3. Facility operation registry<br>water committee user directory<br><br>3-1. Implementation organization activity record<br><br>3-2. Resident survey | No sudden population increase or movement. |
| **Activity (Number applies to output number)**<br>**<u>Japanese Side</u>**<br>1-1. Construct Deep Well with Hand Pump.<br>1-2. Construct Deep Well with Motorized Pump.<br>1-3. Rehabilitate existing water supply facilities.<br><br>2-1. Establish maintenance system for residents.<br>2-2. Resident guidance for maintenance methods.<br><br>3-1. Guidance for implementation organization for maintenance techniques.<br>3-2. Strengthen implementation organization spare parts supply system and repair system.<br><br>**<u>Ethiopian Side</u>**<br>1-1. Target residents prepare access roads.<br>1-2. Explain project to residents.<br>1-3. Implement measures for tax exemption concerning material and equipment supply.<br><br>2-1. Assist establishing village water committees.<br>2-2. Sanitation education for village water committees.<br>2-3. Assistance for monitoring and village water committees. | **Input**<br>(Japanese Side)<br>・ Water supply facility construction work<br>・ Maintenance Materials<br>・ Soft component<br>・ Consultant services | (Ethiopian Side)<br>・ Budget measures, personnel distribution<br>・ Secure construction sites<br>・ Prepare access roads<br>・ Secure place to store materials that have been procured. | No reduction in groundwater level or droughts that exceed forecast<br><br>**Prerequisite**<br>Residents have desire to implement project. |

## 2-2 Basic Design of the Requested Japanese Assistance

### 2-2-1 Design Policy

#### 2-2-1-1 Basic Policy for Target Villages (Sites)

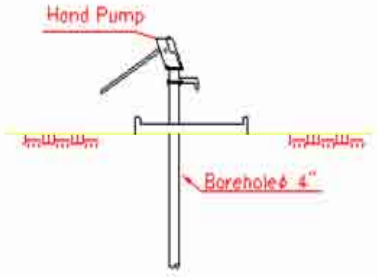
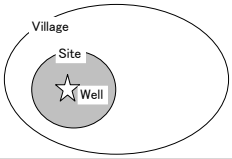
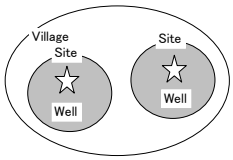
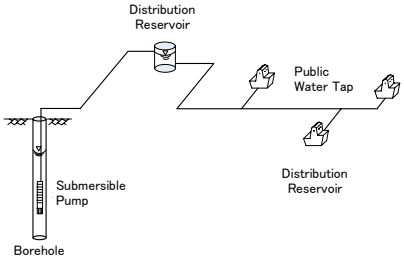
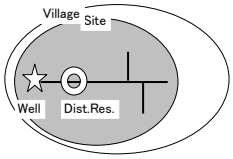
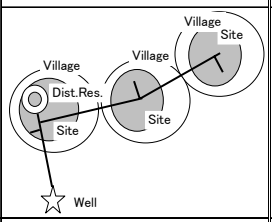
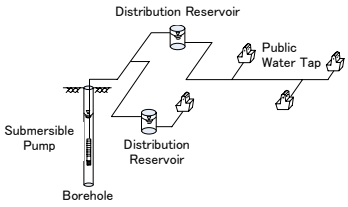
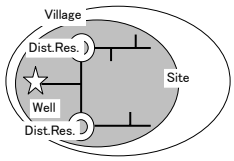
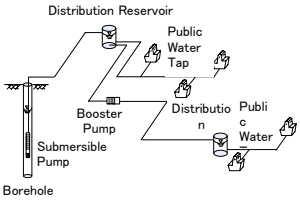
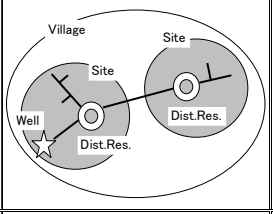
Based on the results of the Detailed Design Study and the survey, 97 water supply facility sites were selected. The number of sites breaks down to 82 Level 1 sites, and 12 Level 2 sites. In addition, a total of 3 sites were selected for rehabilitation, for which no drilling is required.

However, concerning the Level 2 facilities, two of the facilities include a pipeline that is straddle multiple sites, and therefore the planned facility is total of 94 (Level 1 = 82, Level 2 = 9, Rehabilitation = 3). The details of site selection procedure and number of selected villages were discussed with the implementation organization and acknowledged. The list of selected sites (listed by facility) is shown in Table 2-4. In addition, total targeted villages (kushet) number is 91.

Table 2-4: Comprehensive Table of Selected Sites (per facility)

| No. | Woreda (Disrict) | Level 1 | Level 2 | | Rehab. | Total |
|---|---|---|---|---|---|---|
| | | | Small Scale lnd. Water Supply | Multi village Water Supply | | |
| 1 | Hawzen | 9 | 0 | 0 | 0 | 9 |
| 2 | Kilte awlaelo | 9 | 0 | 0 | 0 | 9 |
| 3 | Kola Temben | 8 | 0 | 0 | 0 | 8 |
| 4 | Degua Temben | 8 | 0 | 0 | 0 | 8 |
| 5 | Tanqua abergele | 10 | 0 | 0 | 0 | 10 |
| 6 | Seharti Samre | 6 | 0 | 0 | 0 | 6 |
| 7 | Enderta | 11 | 0 | 0 | 0 | 11 |
| 8 | Hintalo wajirat | 4 | 0 | 0 | 0 | 4 |
| 9 | Raya Azebo | 2 | 5 | 2 | 3 | 12 |
| 10 | Alamata | 15 | 2 | 0 | 0 | 17 |
| Total sum | | 82 | 7 | 2 | 3 | 94 |

Table 2-5: Outline and the Total Number of the Respective Facilities

| Facility Type | | | Water Supply Facility Components | Water distribution pattern to target villeges | Target villege Q'ty | Target villege Total | Target sites Q'ty | Target sites Total | Facilities Q'ty | Facilities Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Level 1 | | a |  |  | 72 | 77 | 72 | 82 | 72 | 82 |
| | | b | |  | 5 | | 10 | | 10 | |
| Level 2 | No.1 | a |  |  | 6 | 9 | 6 | 9 | 6 | 9 |
| | | b | |  | 3 | | 3 | | 1 | |
| | No.2 | |  |  | 1 | 1 | 1 | 1 | 1 | |
| | No.3 | |  |  | 1 | 1 | 2 | 2 | 1 | |
| Rehabilitation | | | Same as No.1 Level 2 above | Same as No. 1a Level 2 above | 3 | 3 | 3 | 3 | 3 | 3 |
| Total | | | | | 91 | | 97 | | 94 | |

(1) Level 1 Facilities

Construction of Level 1 water supply facilities was applied to the total 82 sites, which includes the 7 sites that were deducted due to adjustment of the Project cost in the Detailed Design in 2007.

Table 2-6: the Criteria Items for Site Selection

| Items | Judgment |
|---|---|
| Alternative site exist in the same villages | Alternative site within the same village will be selected |
| Alternative site does not exist in the same village | Alternative site will be selected based on the list of alternative sites by the Detailed Design in 2007 |

Access is judged by investigation of actual road surface conditions and whether or not a rig can be brought into the drilling site. In cases were the road is not prepared, it is judged by ability of the villagers to prepare the road, topographical condition of the site and the amount of work and distance remaining to reach the site required for completion.

(2) Level 2 Facilities

Site for construction of Level 2 water supply facilities was applied to the total 12 sites based on the Detailed Design in 2007.

Table 2-7: Level 2 Water Supply Facility

| Fac. No. | Woleda | Village | Site |
|---|---|---|---|
| 1 | Alamata | Gerjele town | Gerjele town |
| 2 | | Ula | Ula |
| 3 | Raya Azebo | Hadealga | Hadealga |
| | | | Keyih tekli |
| 4 | | Hirka | Hirka |
| | | Adialebachele | Adialebachele |
| | | Bechenrkatan | Bechenrkatan |
| 5 | | Fondel | Fondel |
| 6 | | Dodota | Dodota |
| 7 | | Arva | Hadishkign |
| 8 | | Gendiajo | Gemed dadi |
| 9 | | Hadishkign | Tachgubegala |

(3) Rehabilitation Facilities

Site for construction of rehabilitation facilities was applied to the total 3 sites based on the Detailed Design in 2007.

Table 2-8: Rehabilitation Facility

| Fac. No. | Woleda | Village |
|---|---|---|
| 10 | Raya Azebo | Deletie |
| 11 | | Kepan |
| 12 | | Genete |

### 2-2-1-2 Policy for Wells of Level 1

(1) Policy for Tender

The conventional contract for well drilling work had a risk that the success rate of the well is less than an assumption for the Contractor. Therefore this Project applies the Tenders by the Priced Bill of Quantity (hereafter, "BQ") for construction of Level 1 water facilities to reduce the above mentioned risk.

(2) Policy for Payment

The construction of well is conducted a direct cost of construction that tendered a bid for as the upper limit. The well drilling work is continued until the balance of the direct cost of construction becomes less than the cost of facilities (the total of the cost for well construction and the platform construction) for each site.

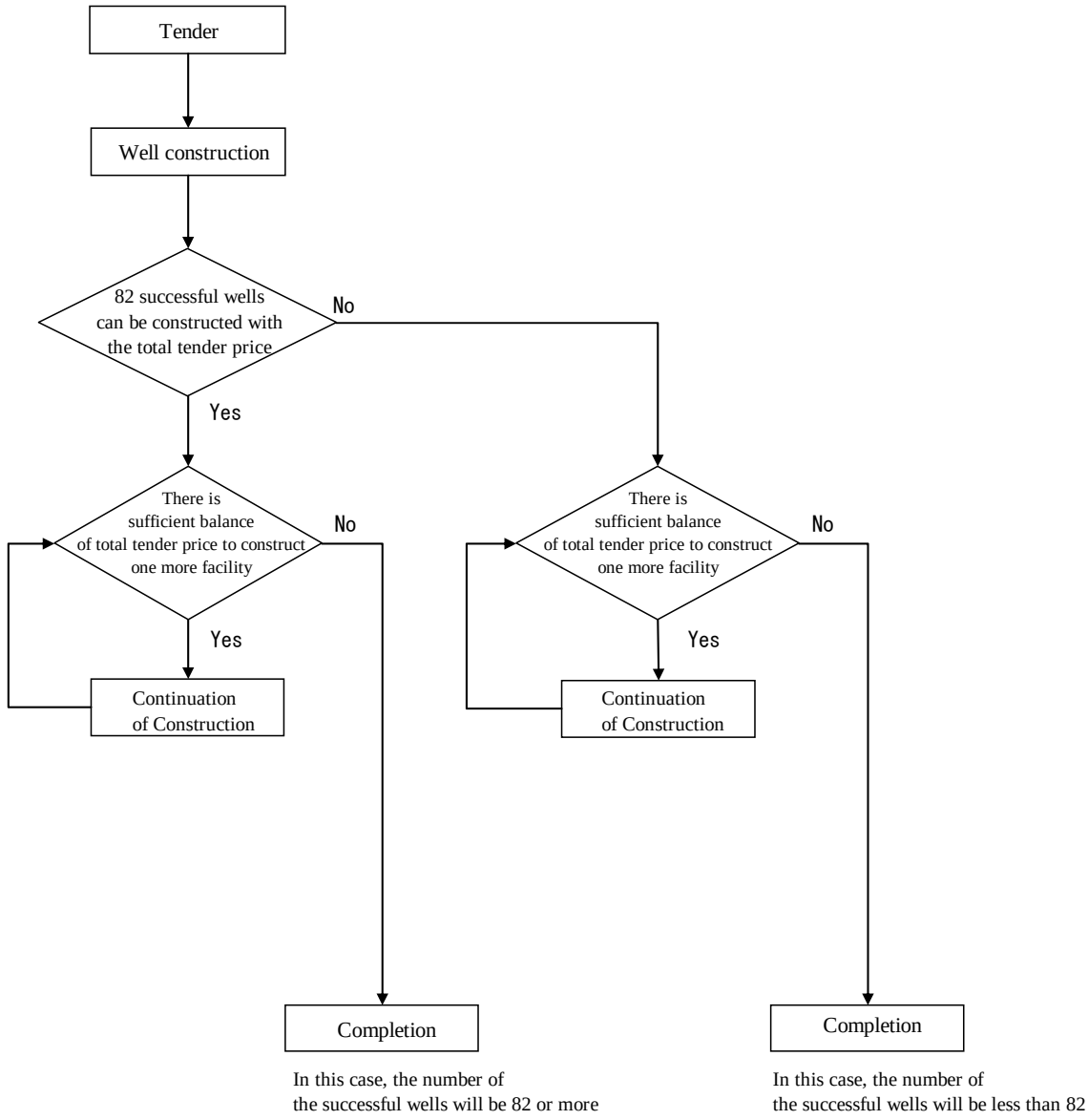



Figure 2-1: Flow chart of the well work

### 2-2-1-3 Policy for Wells of Level 2

a) The 9 water supply system will be constructed to 11 villages (12 sites). 7 facilities are for the single site and 2 facilities are for the multiple site system.

b) Water source for the water supply system is a well extracting groundwater. Each facility uses one well. In other words, there are nine level 2 wells in this project.

c) 3 boreholes out of 9 success test drilling boreholes in the Basic Design Study will be utilized as the production well.

d) 3 wells for Hadealga site, Hirka site and Gerjele town site will be re-drilled with 8 inch diameter hole to fit larger motor pump for adequate water supply amount and capacity. 3 wells for Ula site,

Fondel site and Tachgubegala site will be re-drilled with 6 inch diameter hole for block up by the sand and stone, because a long term passed after drilled test borehole.

e) It was concluded that 3 test drilling boreholes will be utilized as is, and 6 will be drilled for the well utilized for the Level 2 facility

Table 2-9: Water Sources of Level 2 Facilities

| Fac. No. | Target Site for Water Supply | | | Water Source | Discharge | No. of wells | Well diameter |
|---|---|---|---|---|---|---|---|
| | Woleda | Village | Site | | | | |
| 1 | Alamata | Gerjele town | Gerjele town | drill new well | 312 L/min | 1 | 8inches |
| 2 | | Ula | Ula | drill new well | 150 L/min | 1 | 6inches |
| 3 | Raya Azebo | Hadealga | Hadealga | drill new well | 336 L/min | 1 | 8inches |
| | | | Keyih tekli | | | | |
| 4 | | Hirka | Hirka | drill new well | 306 L/min | 1 | 8inches |
| | | Adialebachele | Adialebachele | | | | |
| | | Bechenrkatan | Bechenrkatan | | | | |
| 5 | | Fondel | Fondel | drill new well | 60 L/min | 1 | 6inches |
| 6 | | Dodota | Dodota | diverted test well | - | 1 | 6inches |
| 7 | | Arva | Hadishkign | diverted test well | - | 1 | 6inches |
| 8 | | Gendiajo | Gemed dadi | diverted test well | - | 1 | 6inches |
| 9 | | Hadishkign | Tachgubegala | drill new well | 72 L/min | 1 | 6inches |
| Total | 2 | 11 | 12 | - | | 9 | - |

f) In Level 2 water supply facilities with civil work, the success or failure the well affects the work schedule, because the civil work cannot be started until the water source has been fixed. These kind of delays to the civil works for Level 2 water supply facilities can be a critical factor in making Contractors reluctant to participate in the Tender. Therefore, to reduce the risk to the Contractor, it will conduct the well work of the above six sites in the design stage of consultant service, because there is a merit to the exclusion of well work from a scope of Level 2 water supply facilities.

g) When the test drilling borehole in the design stage of consultant service fails, re-drilling will be performed once. If re-drilling fails again, design changes to the facilities that avoid decreases to the population of beneficiaries as much as possible will be considered. However, it is thought that there is an aquifer of constant water level in the target site, because the target site is located in an area where an aquifer is seen in the alluvial layer. The test drilling borehole in the Basic Design Study estimated the static water level to be deeper than 45m, as shown in the table below. The maximum pump head of the Aflidev type hand pump is 45m, therefore, a condition of

success of the well construction for Level 1 is that dynamic water level is shallower than 45m, as shown in Table 2-19. It is difficult to change to the Level 1 water supply facilities in the water supply area, because the dynamic water level, that is the increased draw down in the estimated static water level in the target site, does not satisfy the conditions of a Level 1 well. As a result of test drilling, when a well is unsuccessful, the reduction and cutback of planned facilities cannot be avoided. The policies of concrete design change are as follows:

- When the pumping test reveals unsatisfactory yield, reduction of water supply facilities and modification of the scheme such as extension of the time for pumping will be considered.
- If there is no water in the well, construction of the water supply facilities for the target site will be abandoned.

Table 2-10: Estimated Static Water Level in the site for Level 2 water supply facilities

| BH ID No. | Site | Test drilling borehole | | Water Point | |
|---|---|---|---|---|---|
| | | Elevation (m) | SWL*1 (m) | Ave.Elevation (m) | Estimated SWL*2 (m) |
| JAL004 | Gerjele town | 1456.94 | 23.71 | 1480.65 | 47.42 |
| JAL005 | Ula | 1574.97 | 46.28 | 1601.94 | 73.25 |
| JRA001 | Hadealga | 1508.24 | 34.74 | 1658.91 | 185.41 |
| JRA002 | Hirka | 1671.90 | 49.95 | 1750.25 | 128.30 |
| JRA003 | Fondel | 1684.00 | 77.50 | 1741.19 | 134.69 |
| JRA007 | Tachgubegala | 1390.14 | 18.10 | 1422.08 | 50.04 |

*1: SWL; Static Water Level of the test drilling borehole in the Basic Design Study

*2: Estimated SWL = Ave. Elevation at the water point－Elevation at the test drilling borehole＋SWL

### 2-2-1-4 Policy for Division of the Lot for Tender

By dividing the component of this project for Level 1 water supply facilities, Level 2 water supply facilities and procurement of equipment, it is thought that there is the merit which the Contractor is easy to come to tender, and competitiveness develops. Also, by dividing the Lot, the study of Level 1 water supply, which is small volume work, is able to end earlier than the study of level 2 water supply facilities in the design stage of consulting service; making execution of construction for Level 1 water supply facilities can be advanced. Therefore, the construction plan to divide into separate Lots: Level 1 water supply facilities, Level 2 water supply facilities, and procurement of equipment; is drafted and cost estimation for the project are performed properly.

### 2-2-1-5 Policy for Natural Conditions

(1) The average annual rainfall of 200mm to 800mm in the area is low, resulting in significant

seasonal variation for shallow groundwater. Accordingly, the target for water sources will fundamentally be deep groundwater.

(2) This is a mountainous area with an average elevation of 2000 m above sea level. The deep groundwater located in the boarder region of the rift valley and those potential reserves are limited due to the low water level (depending on geological conditions), and because of this, keeping in perspective the water intake from the artesian aquifer, an average drill depth of 90 m is estimated.

(3) There are differences in the hydro-geological characteristics in each of the 10 Woredas targeted in the survey. The northern area is abundant in basement rock, the central area mainly consist of sedimentary rock, and the southern area is occupied by volcanic rock and alluvial deposits. The suitable development of water sources will be carried out to meet these hydro-geological characteristics.

(4) Where there is sedimentary rock, some of the areas in the region where the concentration of sulfuric acid in the groundwater is high are ill-fitted for drinking water (central to southern area). In order to deal with this issue, sealing technology with a contamination prevention grouting will be introduced to complete the well.

(5) There is a seasonal river by the rain from June through September in Tigray region. After the rainy season, the Client is requested to immediately execute the maintenance of access roads to site approaches, because large vehicles such as well drilling rigs and materials handling trucks necessary for the construction of the water supply facilities need to access the sites. In addition, a work schedule in consideration of progress during the rainy season will be drafted.

### 2-2-1-6 Policy for Social Conditions

(1) It has been determined from the results of the socio-economic study that the capability of the village water committees for this area concerning O&M is adequate. Accordingly, with the effective usage of the current O&M framework and control system, the existing system shall be further developed.

(2) Specifically, WWRMEO will take the lead to introduce activities for the education and understanding of village water committees and communities. For this purpose, we seek to improve the skills (through Ethiopian Water Technology Center (herein after referred to as EWTEC) study and training) of TWRMEB and WWRMEO, as stakeholders in this capacity, and raise the abilities of operation support personnel in connection with community development (through study led by EWTEC and the Consultant).

(3) While there is a gap between villages, community operation capabilities are high, and in particular, there are no foreseen problems pertaining to the collection of fees. However, an educational campaign on sanitary and hygiene shall be implemented at the community level to

prevent nonpayment of simple maintenance fees due to periods of rain or dry spells.

### 2-2-1-7 Policy Pertaining to Procurement Conditions

The materials such as cement, aggregate, deformed bar, steel, timber, block, etc. and equipment required for the project shall be procured locally wherever possible. However, for some facilities, such as plumbing and pumping materials, it is not possible to obtain materials locally due to problems in quality and distribution or difficulty to obtain in the limited time frame due to the small number of local agents. Because of this, these items shall be procured in Japan or a third country.

Regarding plumbing materials, it was judged that supply was possible easily locally at the time of the Basic Design Study, so it was applied GS pipe, and a ductile cast iron pipe adopted in high pressure pipeline more than 1.6Mpa.

This survey was intended to confirm the change that was in condition on site, to review the cost estimation of the Project and to review the construction schedule based on the Detailed Design in 2007, therefore the quotation was collected it in a specification same as the Detailed Design in 2007.

As a result, it was recognized that a ductile cast iron pipe was cheaper than a GS pipe.

For the purpose of this study, it is submit approximate cost estimation for the Project to the Government of Japan immediately, thus it is difficult to conduct a design change of plumbing materials. Therefore, the design change of the plumbing materials is conducted in the design stage of consulting service scheduled in 2010.

However, the price of the straight pipe of the plumbing materials affects the rough cost estimation because the difference of the price of ductile cast iron pipe and GS pipe is great, thus in cost estimation of the Project, the adoption of the ductile cast iron pipe is reflected about a straight pipe.

In Ethiopia, the supply of construction materials is unstable due to local conditions such as a lack of foreign currency and electricity shortages. In the design stage of the consulting service, procurement sources of construction materials will be reexamined.

### 2-2-1-8 Policy Pertaining to Construction Conditions

The Ministry of Water Resources (MoWR) in Ethiopia established bidding constraints when selecting contractors for well drilling and construction of water supply facilities by obligating them to register and grading contractors by skill level and materials possessed, according to the project scale.

Local contractors will be utilized among those contractors of superior ranking, as it is felt they possess the most suitable technical abilities and equipment for the construction of wells and facilities, from the point of view of cost reduction.

### 2-2-1-9 Policy Pertaining to Construction and Equipment Grade

(1) The drilling rig for well construction will be selected depending on the ability to traverse the rough road of highland and mountainous terrain, able to set up in narrow slopes of the sites, and drill out hard rock at high speeds.

(2) Aside from the main road, the target region contains mostly unpaved trails and there are many slopes that suddenly become mountain roads. Also, plans for a 4-wheel drive vehicle have been made in consideration of the substandard surface conditions of the roads, particularly in the rainy season.

(3) Water supply standard shall be 15 liters/person/day referred to the UAP no matter the facility type is Level 1 or Level 2.

(4) Pump operation shall fundamentally be 7 hours a day from the survey result.

(5) Aflidev type hand pump will be applied for the 82 Level 1 facilities in consideration of the standardization and easy procurement of the spare parts.

(6) The detail water supply plan will be formulated based on the ability of the residents operation and maintenance capacity for Level 2 planned sites. Commercial power supply shall be also considered for the reduction of operation and maintenance cost.

### 2-2-1-10 Policy Pertaining to Procurement of Equipment / Material

The policy for equipment and material procurement was made among those requested in consideration of the poor progress of well repair work due to deteriorated equipment for well repair possessed by the region.

(1) Equipment component shall be well rehabilitation equipment including one service rig, material for drawdown testing and equipment for work and transportation.

(2) Materials for drawdown testing will not be loaded on the service rig but transported by a truck with crane provided for this purpose.

(3) The vehicle for work and transportation, supposing maintenance and repair work for hand-pumps, shall be the truck with crane.

(4) The well rehabilitation equipment and drawdown testing equipment will be kept at the central workshop at Mekele and maintained by TWRMEB.

(5) A truck with crane will be dispatched, one each, to the Central and Southern zones as input for work and transportation. The operation of will be the responsibility of each respective zone, but the primary utilization of maintenance and repair of hand-pumps shall be carried out by the Woreda.

(6) Equipment and material supplies that are not produced in Ethiopia will be purchased in Japan or third country. When deciding the place of purchase, the availability of spare parts and manufacturer’s warrantee will be considered with importance on the guarantee of

repair in the future.

### 2-2-1-11 Policy Pertaining to Construction Method / Period

(1) Concerning the utilization of local contractors, their services will be employed wherever applicable in terms of construction method feasibility.

(2) For the construction work sequence, although sufficient consideration was given to priority related to urgency of need, preference will be given in consideration of efficiency constraints and access in the rainy season.