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

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR RURAL WATER SUPPLY AND REHABILITATION IN TIGRAY REGION
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

July 2007

JAPAN INTERNATIONAL COOPERATION AGENCY

KOKUSAI KOGYO CO.LTD.

PREFACE

In response to a request from the Government of the Federal Democratic Republic of Ethiopia, the Government of Japan decided to conduct a basic design study on the Project for Rural Water Supply and Rehabilitation in Tigray Region in the Federal Democratic Republic of Ethiopia and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ethiopia a study team from December 9, 2006 to March 4, 2007.

The team held discussions with the officials concerned in the Government of Ethiopia, 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 Ethiopia in order to discuss the 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 Democratic Republic of Ethiopia 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 Rural Water Supply and Rehabilitation 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 December 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 Ethiopia 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,

Kensuke ICHIKAWA
Chief Consultant,
Basic Design Study Team on the Project for
Rural Water Supply and Rehabilitation 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 1,097,000 sq km (approx. 3 times the size of Japan) with a population of 75 million (World Bank, 2006). 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 4.33 million (CSA (Ethiopian Central Statistic Agency), 2005).

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 11.2 billion dollars, 160 dollars GNI per capita (World Bank, 2005), and a real economic growth rate of 13.4% (World Bank, 2004). 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 Povety 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 24% of the population has access to safe potable water, which is immensly lower than the 54% average of Sub-Saharan countries (UNDP, 2002). Also, the Tigray Region water supply ratio for 2005 was at 33.3%, lower than the Ethiopian national water suply 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.

The content of the initial request from Ethiopia (i.e. basic information of the target sites and requested facilities) contained several uncertainties, included a "B" in the Environmental category, and so on, so that JICA dispatched the Study Team to conduct a preliminary study for one month in June 2006 mainly to, 1) Clarify the content of the request and collect related data, 2) Points of concern regarding environment and social considerations, and 3) Sort out the points of concern and constraint factors of the basic design survey.

In the preliminary study, from meeting with local stakeholders as well as the field study, the Preliminary Study Team were able to 1) Clarify the contents of the request, (2) Change the Environmental category from "B" to "C" following analysis in Japan after the study, and furthermore, (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.

Based on the backround and result of the preliminary study above, JICA responded to the request by dispatching the Basic Design Study Team to Ethiopia from 9 December 2006 through 4 March 2007.

The Basic Design Study Team conducted a survey of natural and social conditions of the Tigray Region, and verified the content of the request. The results, 1) A necessity to concentrate the project on sites with the potential for smooth work implementation given the results of the survey on natural and social conditions, and 2) A necessity to provide the equipment and materials requested according to specifications applicable to the site, were clarified and the appropriate scale for the project was investigated. These results are shown along with the contents of the original request in the comparitive table below.

Table-1 Original Requests and Survey Results

Item	Original Requests	Results of Basic Survey	Remarks
Facility construction	Level 1[*1] 200 facilities Level 2[*2] 13 facilities Rehabilitate 17 facilities Total 230 facilities	Level 1 85 facilities Level 2 10 facilities Rehabilitate 4 facilities Total 99 facilities	Water yield volume for Level 2 facilities was confirmed in the drilling test of this survey
Equipment supply	Service Rig 1 Unit (for well depth up to 450m) Pick-up 3 Units Motorbike 20 Units	Serviec Rig with Accsesaly 1 Unit Mterials for drawdown test 1Unit Truck with Crane 2 Unites	
Technical support	Training for village water committees of 213 sites	The soft component trains 98 water committees and provides education for operations and maintenance at the Regional/Woreda level.	

[*1] Level 1 means "water supply system by borehole with handpump"
[*2] Level 2 means "water supply system by distributed public faucet with pipeline"

With the results of this survey, JICA dispatched a team to give an explanation of the Basic Design Study from 27 May 2006 to 7 June 2006 through meetings with the regional government and reach consensus on the scope of the basic design.

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 10.3 months and the equipment supply period would be 11 months. Also, approximately 16.5 months are anticipated for the construction of water supply facilities. The soft component will be executed during the same period, with a 12 month period anticipated.

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 66,230 people in the targeted 10 Woredas.	1) Securing safe water supply will reduce water-borne disease and assist in the health of residents. 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. 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 99 water supply facilities in this project will guarantee the stabilization of safe drinking water to 98 villages (102 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 field survey 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**,

Tthe 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 fullfilled 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 obsticals 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.

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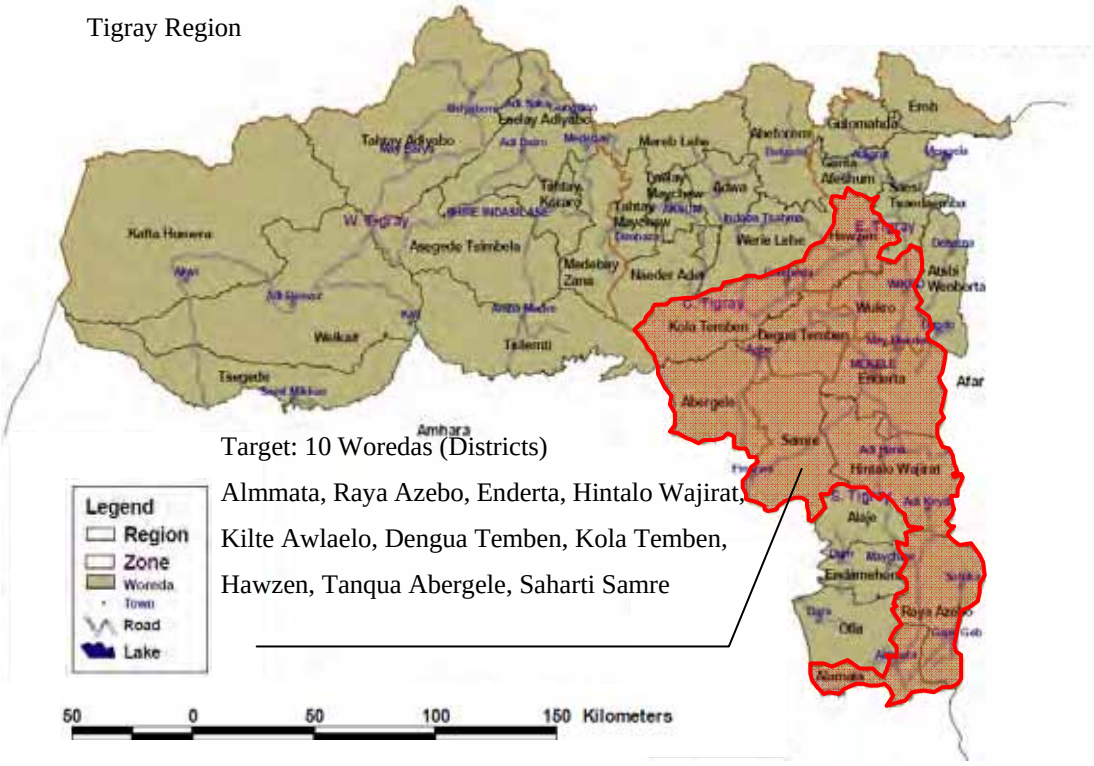
Federal Democratic
Republic of Ethiopia

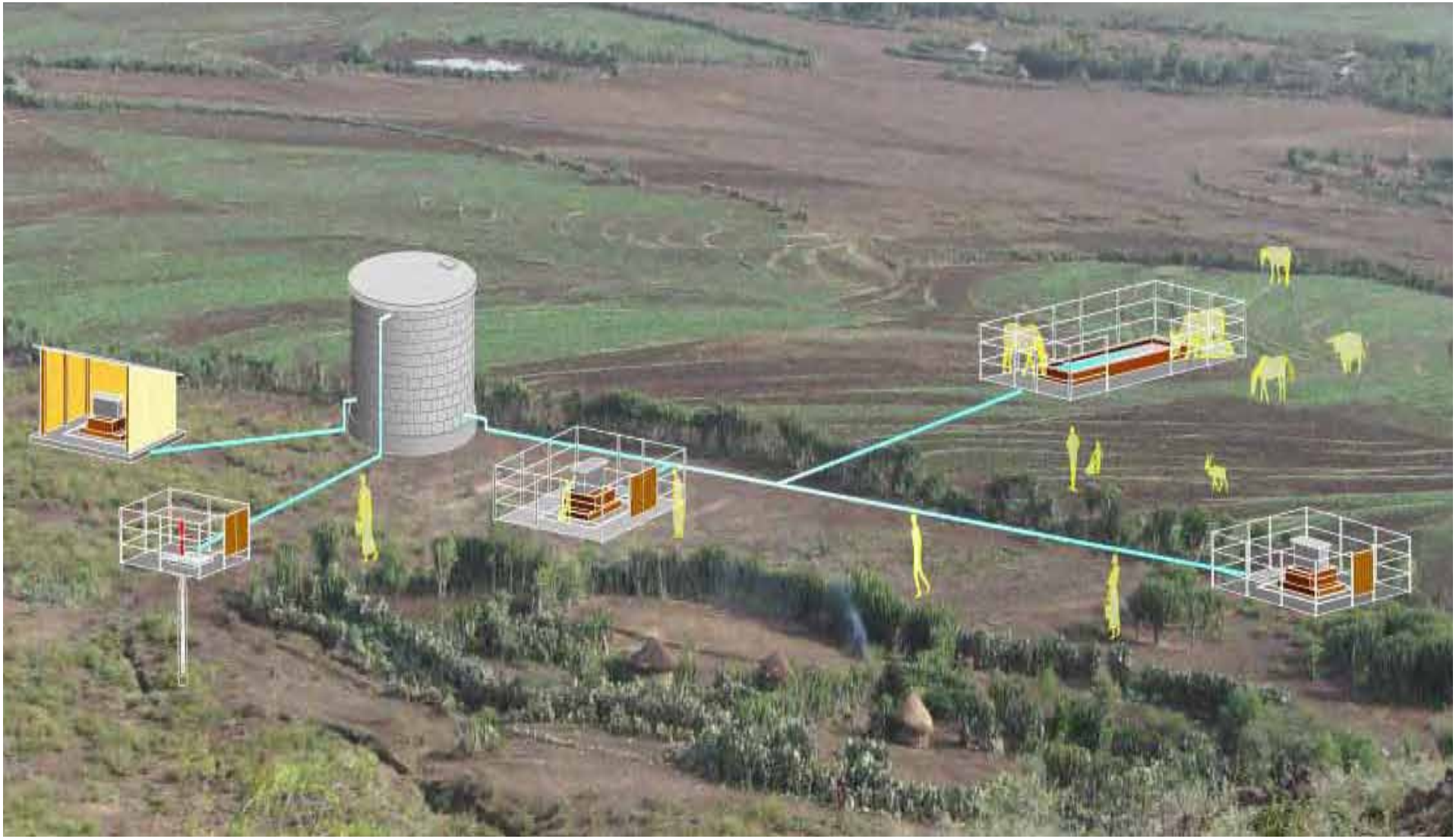
Tigray Region



Target: 10 Woredas (Districts)

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

Location Map



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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
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

1-1 Background

In the Federal Democratic Republic of Ethiopia covers an area of approximately 1,097,000 km2 and has a population of 68.6 million with a per capita GNI (Gross National Income) of approximately US$90. Only 34.5% 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 54 % (UNDP: 2002). 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 3.98 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, JICA dispatched the Study Team to conduct a preliminary study for one month from June 2006.

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.

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

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 village water committees (VWCs)

1-2-2 Confirmed Request

(1) Selected Sites

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

No.	Woreda (District)	Level 1	Level 2		Rehab	Total
			Small Scale Ind. Water Supply	Multi village Water Supply		
1	Hawzen	9	0	0	0	9
2	Kilte awlaelo	10	0	0	0	10
3	Kola Temben	9	0	0	0	9
4	Degua Temben	8	0	0	0	8
5	Tanqua abergele	9	0	0	0	9
6	Seharti Samre	4	0	0	0	4
7	Enderta	14	0	0	0	14
8	Hintalo wajirat	5	0	0	0	5
9	Raya Azebo	2	5	2	4	13
10	Alamata	15	3	0	0	18
Total sum		85	8	2	4	99

(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 GVW: 20-28ton pay load: 15-20ton 6×6 drive mast: 12m hoisting: 5ton	1 Unit	Vehicle	All-Wheel-Drive Accessories Truck	1 Unit
		Compressor	Discharge Pressure: 3.5Mpa Air Discharge: 13.5m3/min	1 Set	Compressor	Discharge Pressure: 1.0Mpa or up Air Discharge: 8.0m3/min	1 Set
		Storage Box	Storage box for submersible pump Storage box for cable Storage box for pipe	1 Set	Storage box		0 Set
		Support Tools	Cutting Torches Steam Cleaner Decontamination Trough Sand Content Testers Flow and Totalizing Meters	1 Set	Support Tools	Cutting Torches Steam Cleaner Decontamination Trough Sand Content Testers Flow and Totalizing Meters	0
		Mat'l to insert pump	Troubleshooting Service Pump Sizing and Selection Pump Installation tools Control Box Installation	1 Set	Mat'l to insert pump	Troubleshooting Service Pump Sizing and Selection Pump Installation tools Control Box Installation	0
		Well washing equipmer	Well Brushing Nylon Soft Brushing Well Jetting Chemical Treatment Debris/Blockage Removal	1 Set	Well washing equipment	For Brushing For Jetting	1 Set
		Other	Inspection lamp Cable winder Traveling block Lifting Strap Crown bar Pry bar Grease gun Hoisting cable Sand line cable Guy line cable Turn buckler Guy line anchors Lifting plugs	1 Set	Other	Inspection lamp Cable winder Traveling block Lifting Strap Crown bar Pry bar Grease gun Hoisting cable Sand line cable Guy line cable Turn buckler Guy line anchors 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 GVW:3000kg SAE standard (2100m elevations)	3 Unit	Truck with Crane		2 Unit
		Spare parts	100,000kms of operation or the value of 15% of order	3 Set			
Autobike	20 Unit	Autobike			Autobike		0 Unit
		Main Unit	Maximum dry mass of 105kg Seating capacity 2 persons power output: not less than 17.50HP / 7,000rpm and minimum torque output 1.9kgm / 5,500rpm. Fual tank: 8 liters minimum	20 Unit			
		Accessory	front wind shieled glass mudguards	20 Set			

1-2-3 Natural Condition

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.

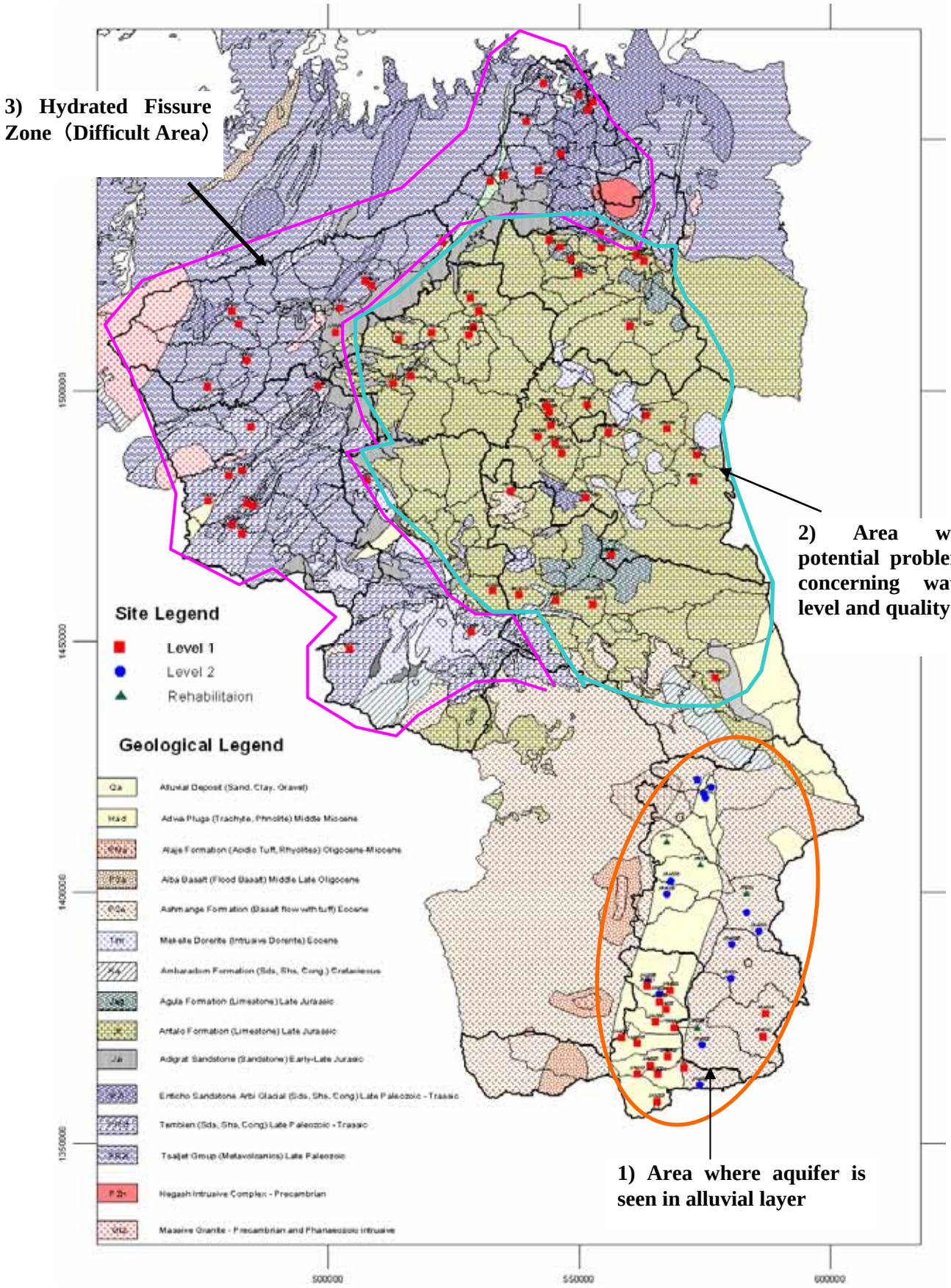


Figure 1-1: Groundwater Development Potential by Hydrogeological Zones

1-2-4 Environmental Social Consideration

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

2-1 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 99 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 achive 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 85 hand-pump facilities (Level 1), and 10 motorized facilities (Level 2), and 4 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	85	wells	
Target: 82 villages (85 sites)	Facility	Hand Pump Installation	85	sets	
No. of facilities: 85		Platform Construction	85	sets	
Well with Motorized Pump	Water Source	Well Construction	4	well	pump capacity confirmed
Target: 12 villages (13 sites)		Used to Test Production Wells	6	wells	test well done during BD
No. of facilities: 10	Distr. Reservoir	Ground-Level Distr. Reservoir	10	sets	25㎥: 6 set, 50㎥: 3 set, 100㎥: 1set
		Elevated Tank	2	sets	concrete: 1 set, 4㎥ ROTO tank: 1 set
	Facility Const.	Generator Room	7	sets	generator installation: 7 sets
		Booster Pump Room	1	set	generator installation: 1 set
		Control Box Room	3	sets	commercial electricity usage: 3 loc.
	Pipeline	Supply: GS、DIP、φ40-150mm	23.8	km	
		Distr.: GS、φ40-150mm	12.3	km	
	Motorized Pump	Submersible Pump	10	sets	
		Booster Pump	1	set	
	Power Source	Diesel generator installation	7	sets	
		Cm. Power secondary wiring	4	loc.	C/P responsible for primary wiring
	Pub. Water Pump	pub. Water pump construction	24	sets	1 will be cnct'd to existing public pump
	Drinking Area for Domestic Animals		10	sets	one set for each site
Rehab of Existing Water Supply Facilities	Distr. Reservoir	Elevated Tank	4	sets	one set for each site 10㎥ tank: 1 set, 4㎥ tank: 3 sets
	Facility Const.	Replace submersible pump	4	loc.	
Target: 4 villages (4 sites)	Pipeline	Supply: GS、φ25-40mm	0.06	km	
No. of facilities: 4		Distr.: GS、φ25-40mm	0.35	km	
	Motorized facility	Diesel generator replace/install	4	sets	
		submersible pump replace/instal	4	sets	
	Pub. Water Pump	Raise no. of public water pumps	4	sets	
	Drinking Area for Domestic Animals		4	sets	

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

Note 2: Definition of village and site: a collection of sites is a village, so that sites (local lang.: gote) was used in this request (image belov

Note 3: The number of Rehab, Level 2 facilitites: Calculated by considering a closed facility between the water source and distr. reservoir as one water supply system.

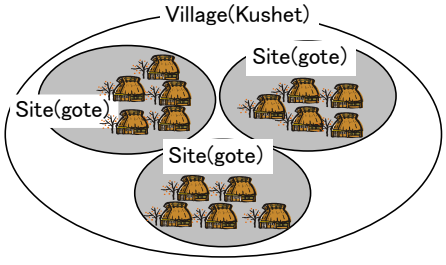


Table 2-2: Equipment Plan

No.	Equipment Name	Configuration/Specification	Qty
A	Equipment for Well Rehabilitation		
A1	Service Rig	Service rig vehicle： 4×4 or 6×4 truck Suitable for airlift, brushing, jetting Including accsessories (well dia. 4", 6", 8") Water pump (Pressure 1.96Mpa or more, discharge 500L/min or more) 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 3ton max. crane lift capacity	1 Unit
B2	Submersible Pump	Hd=140m, Q=400l/min(for well diameter6", 8"): one Hd=80m, Q=100l/min (for well diameter 4"): one 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 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 Improvements of the sanitary environment of residents.	Reduction of water-borne diseases ratio among residents……A	・Statistical data on sanitation ・Resident survey	
Project Objective 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 1. Arrange water supply facilities in target areas. 2. Establish an independent maintenance system by the residents, and the sustainable use of water supply facilities by residents. 3. Improve maintenance instruction and service of implementation organization	1-1. Maintenance ratio of water supply facilities in the area..... C 1-2. Reduction of working hours time to draw water..... D 2-1. Activities of water committee . E 2-2. Collection ratio of maintenance fee .....F 2-3. Usage ratio of water supply facilities ..... G 3-1. Number of visits by implementation organization ..... H 3-2. Resident satisfaction with service of implementation organization.....I	1-1. Water committee facility operation record Resident survey 1-2. Resident survey 2-1. Water committee activity record 2-2. Collection fee registry 2-3. Facility operation registry water committee user directory 3-1. Implementation organization activity record 3-2. Resident survey	No sudden population increase or movement.
Activity (Number applies to output number) **<u>Japanese Side</u>** 1-1. Construct Deep Well with Hand Pump. 1-2. Construct Deep Well with Motorized Pump. 1-3. Rehabilitate existing water supply facilities. 2-1. Establish maintenance system for residents. 2-2. Resident guidance for maintenance methods. 3-1. Guidance for implementation organization for maintenance techniques. 3-2. Strengthen implementation organization spare parts supply system and repair system. **<u>Ethiopian Side</u>** 1-1. Target residents prepare access roads. 1-2. Explain project to residents. 1-3. Implement measures for tax exemption concerning material and equipment supply. 2-1. Assist establishing village water committees. 2-2. Sanitation education for village water committees. 2-3. Assistance for monitoring and village water committees.	**Input** (Japanese Side) ・ Water supply facility construction work ・ Maintenance Materials ・ Soft component ・ Consultant services	(Ethiopian Side) ・ Budget measures, personnel distribution ・ Secure construction sites ・ Prepare access roads ・ Secure place to store materials that have been procured.	No reduction in groundwater level or droughts that exceed forecast **Prerequisite** Residents have desire to implement project.

2-2 Basic Design of the Requested Japanese Assisitance

2-2-1 Design Policy

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

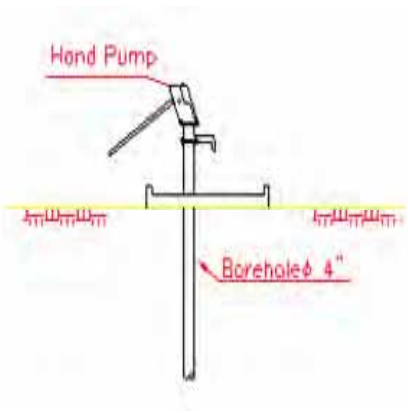
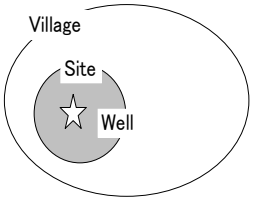
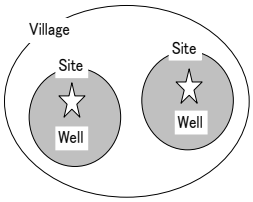
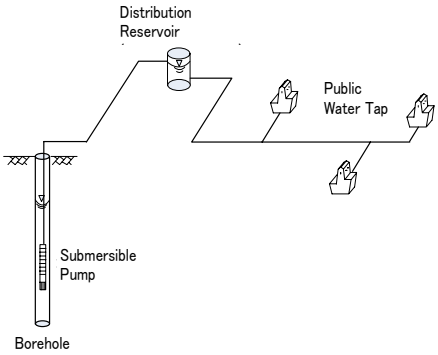
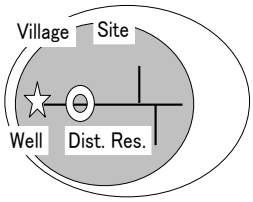
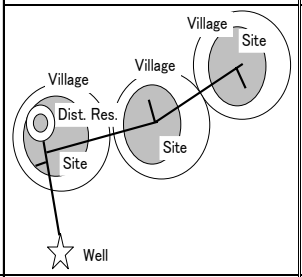
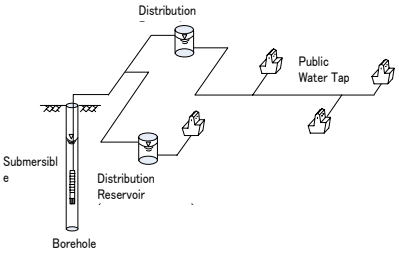
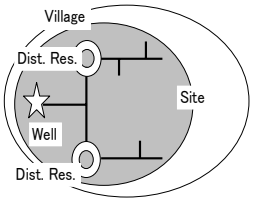
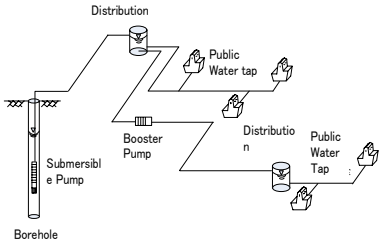
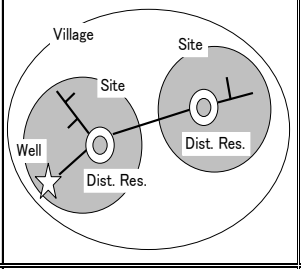
The Ethiopian side requested the water supply facilities a total of 230 sites (Gote). Based on the results of the surveys for natural and social conditions, screening was carried out (see below) to narrow down the selection number to 102 sites. The number of sites breaks down to 85 Level 1 sites, and 13 Level 2 sites. In addition, a total of 4 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 99 (Level 1 = 85, Level 2 = 10, Rehabilitation = 4). 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 98.

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

No.	Woreda (District)	Level 1	Level 2		Rehab	Total
			Small Scale Ind. Water Supply	Multi village Water Supply		
1	Hawzen	9	0	0	0	9
2	Kilte awlaelo	10	0	0	0	10
3	Kola Temben	9	0	0	0	9
4	Degua Temben	8	0	0	0	8
5	Tanqua abergele	9	0	0	0	9
6	Seharti Samre	4	0	0	0	4
7	Enderta	14	0	0	0	14
8	Hintalo wajirat	5	0	0	0	5
9	Raya Azebo	2	5	2	4	13
10	Alamata	15	3	0	0	18
Total sum		85	8	2	4	99

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

Facility Type			Water Supply Facility Components	Water distribution pattern to target villages	Target villages		Target sites		Facilities	
					Q'ty	Total	Q'ty	Total	Q'ty	Total
Level 1		a			79	82	79	85	79	85
		b			3		6		6	
Level 2	No.1	a			7	10	7	10	7	10
		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	4	4	4	4	4	4
Total					98		102		99	

(1) Level 1 Facilities

Two step screening was applied to narrow down the total of 85 sites for Level 1 facilities.

1) First Screening

The first screening was carried out from the perspectives of safety and access (by map research) and development potential (publications and existing well data) to select 130 sites.

Table 2-6: the Criteria Items for First Screening

Items	Screening Method	Remarks
Security	Discussion with TWRMEB、WWRMO	No serious security condition has been identified
Access to the Site	By the topographical map	
Water Source Development Potential	By review of existing materials and data	
Overlap with implementation form other donors or NGOs	Interview to the TWRMEB、WWRMOE、WB、UNICEF、REST and others	

2) Second Screening

The second screening was carried out on the selected 130 sites based on the results of the field survey for water source potential and socio-economic studies for each village. The 3 criteria items for the second screening are shown below.

- Access (by field survey)

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.

- Water source development potential

Water source potential was scored according to a 4 level grading for water quality, water level, and quantity. Selection criteria was set at those which scored 3 or higher for all of the items. However, an exception was made if water quality can be improved by countermeasure work at the implementation stage.

- Operation and Maintenance Capability

A quantitative evaluation was made of the operation and maintenance (O&M) capability from the village socio-economic study, (incl. the house hold survey). The scouring index of O&M for evaluation are shown Table 2-7.

a) Urgency for water (water demand)

b) O&M system

c) Project experience

d) Ability to pay / Willingness to pay.

Table 2-7: Scouring Index of Operation and Maintenance

Selection Criteria	Selection Items	Selection Indicators	Point Allocation
1. Degree of water urgency (Water demand)	1) Water supply ratio (Existing supply facilities e.g. handpumps, pipe network)	more than 50%	0
		10 – 50%	1
		up to 10%	3
	2) Water consumption (per day per person: lpd)	more than 20 lpd	0
		15 – 20 lpd	1
		up to 15 lpd	2
2. O&M System	Has a Village (Kushet) Office	1) No	0
		2) Yes	1
	Has an active water committee	1) No	0
		2) Yes	1
	Distance from Woreda center (access to bank, parts supply center)	1) beyond 30 km	0
		2) within 30 km	1
3. Project Experience	Past water supply project	Almost no project experience	0
		Past water supply project, active resident participation	3
	Other past projects	Almost no project experience	0
		Past project (other), active resident participation	1
4. Capacity to pay, intent to pay	1) Ability to pay (5% of monthly earnings) ＊Note	up to 10 Birr	1
		10 – 14 Birr	2
		more than 14 Birr	3
	2) Intent to pay (fee per container)	up to 10 cents, or no response	0
		10 cents	1
		10 – 20 cents	2
		more than 20 cents	3
	Note: water fee indicator (unit of water supply: 15L) 1) When 10 cents per container: 9 Birr per month 2) When 15 cents: 13.5 Birr per month 3) When 20 cents: 18 Birr per month		

(2) Level 2 Facilities

The conditions that served as criteria for the selection of 13 Level 2 sites out of 16 sites requested by the Ethiopian side are shown below.

a) No other donor assistance nor project overlap, and an urgent need for the construction of a water supply facility.

b) Planned water supply population (year of 2015) to the extent of more or less 1,500 people.

c) Yield of the well shall satisfy the expected water supply amount in respective sites within the maximum pump drive of 7 hours/day or greater from the pumping test result.

d) Water quality of test well fulfills Ethiopian standards.

(3) Rehabilitation Facilities

Grant Aid Project of Japan is granted based on its urgency in the short term. Therefore, selection criteria for rehabilitation target villages were selected taking into consideration short-term urgency and relevance according to the conditions below.

a) No plans to receive service from another enterprise.

b) No problems on borehole on water quality, yield and level.

c) No access to another water supply system.

d) No rehabilitation work has been made since the year 2000 and currently not functioning.

e) Data and information exists on borehole and pump system.

However, the selected site has no or old information on their discharge capacity of existing wells. Therefore, the specification of the motorized facility will be surveyed in the detail design stage.

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

a) The 10 water supply system will be constructed to 12 villages (13 sites). 8 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 ten level 2 wells in this project.

c) 6 boreholes out of 9 success test drilling boreholes will be utilized as the production well.

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

e) Bedena Leko site was nominated as a target site for drilling. However, a functioning well was discovered in the village during the survey. Because of the damaged well casing, murky water was extracted. Therefore, new 6 inch diameter hole will be constructed as well as new water supply facility.

It was concluded that 6 test drilling boreholes will be utilized as is, and 4 will be drilled for the well utilized for the Level 2 facility

Table 2-8: Water Sources of Level 2 Facilities

Fac. No.	Target Site for Water Supply			Water Source	No. of wells	Well diameter
	Woreda	Village	Site			
1	Alamata	Bedena leko	Bedena leko	drill new well	1	6inches
2		Gerjele town	Gerjele town	diverted test well	1	6inches
3		Ula	Ula	diverted test well	1	6inches
4	Raya Azebo	Hadealga	Hadealga	drill new well	1	8inches
			Keyih tekli			
5		Hirka	Hirka	drill new well	1	8inches
		Adialebachele	Adialebachele			
		Bechenrkatan	Bechenrkatan			
6		Fondel	Fondel	diverted test well	1	6inches
7		Dodota	Dodota	diverted test well	1	6inches
8		Arva	Hadishkign	diverted test well	1	6inches
9		Gendiajo	Gemed dadi	drill new well	1	6inches
10		Hadishkign	Tachgubegala	diverted test well	1	6inches
Total	2	12	13	-	10	-

2-2-1-3 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.

2-2-1-4 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.

2-2-1-5 Policy Pertaining to Procurement Conditions

The materials and equipment required for the project shall be procured locally wherever possible. However, for some facilities, 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.

2-2-1-6 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.

2-2-1-7 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 85 Level 1 facilities in consideration of the standardization and easy procurement of the spareparts.

(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.

2-2-1-8 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 equipemnet including one service rig, material for drawdown testing and equipment for work and traonportation.

(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 Western 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.

2-2-1-9 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.

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

2-2-2-1 Construction Plan

(1) Overall Plan

1) Target Year of Plan

Target year of this project is set to year of 2015, which the year about 4 to 5 years after the completion of the facility construction.

2) Target Site

a. Water supply facilities with hand pump

85 sites were selected through the screening by the criteria

b. Motorized Pump water supply system with pipe facilities

13 sites were selected after the field survey and test drilling

c. Rehabilitation of water supply system

4 sites were selected through field survey and screening by the criteria

3) Target Served Population

Target served population was calculated based on the site population listed in the requested list (2006) by TWRMEB. The annual population growth rate of 2.23% (Source: Technical Design Standard in Tigray Region) has been applied.

4) Planned Water Supply

Planned water supply will be calculated by using the figure of water supply standard (liter/capita/day) and planned served population. Demand for the public facilities such as hospials and schools are also considered. Water supply for livestock is not considered, as requested. Table 2-9 shows planned water supply in 2015 for Level 2 for the respective villages and Table 2-10 shows planned water supply for rehabilitation facility

Table 2-9: Planned Water Supply Population and Planned Water Supply
(New Facility with Pipe System)

Fac. No.	Target Region for Water Supply		Present Water Supply Population (yr 2006)	Planned Water Supply Population (yr 2015)	No. of Teachers, Students	No. of patients, staff	Churches	Mosque	Avg water supply/day (per facility)	Max. water supply/day (per site)	Max. water supply/day (per facility)	Time max. water supply (per facility)	Source capacity※
	Woreda	Site							(L/s)	(L/s)	(L/s)	(L/s)	(L/s)
1	Alamata	Bedena leko	2,240	2,732	622	57	240	21	0.713	0.856	0.856	2.054	5.000
2		Gerjele town	4,100	5,000	1,280	111	61	79	1.253	1.504	1.504	3.610	5.600
3		Ula	2,150	2,622	500				0.601	0.721	0.721	1.730	3.000
4	Raya Azebo	Hadealga	2,000	2,439	551	48			1.373	0.703	1.647	3.953	5.600
		Keyih tekli	3,000	3,659	231					0.944			
5		Hirka	1,500	1,829					1.601	0.458	1.920	4.608	5.600
		Adialebachele	3,000	3,659	500					0.980			
		Bechenrkatan	1,580	1,927						0.482			
6		Fondel	1,250	1,524					0.318	0.382	0.382	0.917	1.000
7		Dodota	1,750	2,134	240				0.470	0.564	0.564	1.354	1.000
8		Hadishkign	1,685	2,055	258				0.457	0.548	0.548	1.315	2.000
9		Gemed dadi	1,035	1,262					0.263	0.316	0.316	0.758	5.000
10		Tachgubegala	1,135	1,384					0.288	0.346	0.346	0.830	5.600
Total			26,425	32,226	4,182	216	301	100					

Rate of population increas 2.23%

※Water source for Bedena leko has BH, estimated hydrogeological estimate given for discharge amount as discharge capacity is unclear.

Source: Study by present study team.

Table 2-10: Planned Water Supply Population and Planned Water Supply
(Rehabilitation Facility)

Fac. No.	Target Region for Water Supply		Present Water Supply Population (yr 2006)	Planned Water Supply Populatio n (yr 2015)	No. of Teachers, Students	No. of patients, staff	Churches	Mosque	Avg water supply/day	Max. water supply/day	Time max. water supply/day	Source Capacity※
	Woreda	Site							(L/s)	(L/s)	(L/s)	(L/s)
11	Raya Azebo	Deletie	255	311					0.065	0.078	0.156	1.000
12		Bandera	200	244					0.050	0.060	0.120	2.000
13		Kepan	600	732					0.152	0.182	0.365	7.000
14		Genete	226	276					0.058	0.070	0.139	2.000
Total			1,281	1,563	0	0	0	0				

Rate of population increas 2.23%

※Discharge rate based on discharge capacity of existing water sources through interviews.

Source: Study by present study team.

(2) Condition of Well Design

1) Well construction sites

a. Level 1

Where the aquifer is distributed homogeneously in alluvial deposits and in sedimentary rock, the drilling point will be decided based on the morphological feature of the village and the opinion of the residents, by ease of access to the community in the area. In the basement rock area, the sites for well construction will be decided from the analysis of tectonic lines (from aerial photo interpretation) in the detailed design stage, and its relation to existing wells.

b. Level 2

Basically, the boreholes drilled in this study of the basic design will be used. In case those boreholes were not drilled in this study or borehole diameter is too small for fitting required pump

specification, new boreholes will be drilled in surrounding existing boreholes.

2) Well minimum discharge

a. Level 1

Taking into account Afridev type hand pump actual yield capability and operating ratio, the minimal output should be 15 liters/minute (0.25 liters/second).

b. Level 2

In principal, the water volume at each facility shall be able to satisfy water demand with 7 hours of pumping.

3) Water Quality Conditions

For this project, the Ethiopian drinking water quality standard based on the WHO standard shall be applied as is.

a. Water quality test at site

- The on-site water quality test will be conducted using portable water quality meters.
- The on-site water quality test will be conducted after water sampling without delay.
- The testing parameter meausurement values for the four items shown below, pH, EC (electric conductivity), arsenic, and water temperature shall be those at the time of water sampling.
- Any abnormalty seen in the measurement value when conducting the on-site water quality test shall be re-tested for the corresponding parameter in a laboratory.

Table 2-11: Criteria for target items and water quality estimation (Site Analysis)

Item	Ethiopian Standard	Instrument used
Water Temp (℃)	-	Portable temp gauge
pH	6.5 to 8.5	Portable pH meter
EC (electric conductivity)	-	Portable EC meter
Arsenic	0.01mg/L	Field Kit

b. Water quality test at laboratory

- Laboratory water testing, in principal, will be trusted to an analysis institution in Addis Ababa (Ethiopia Geological Survey, or Water Works Design and Supervision Enterprise Laboratory Service).
- Concerning the method of transportation and storage of test water, testing will be conducted under appropriate conditions as directed by the analysis institution. These methods will be reported to the consultant for approval.
- The parameters targeted for laboratory water testing shall be the following 23 items.

Table 2-12: Criteria for target items and water quality estimation (Laboratory Analysis)

Items to be tested	Ethiopian Standard		Exam Place Lab	Remarks
	Health-hazardous Substances (Maximum allowable value)	Objectionable Level		
Boron	0.3 mg/ℓ	-	○	
Chromium	0.003 mg/ℓ	-	○	
Copper	5 mg/ℓ	-	○	
Fluoride	3.0 mg/ℓ	-	○	
Manganese	0.8 mg/ℓ	-	○	
Nitrate	50 mg/ℓ	-	○	
Nitrite	6 mg/ℓ	-	○	
Aluminum	-	0.4 mg/ℓ	○	
Ammonia	-	2 mg/ℓ	○	
Chloride	-	533 mg/ℓ	○	
Hardness	-	392 mg/ℓ	○	
Iron	-	0.4 mg/ℓ	○	
Hydrogen Sulfide		0.07 mg/ℓ		
Sodium	-	358 mg/ℓ	○	
Sulfate	-	483 mg/ℓ	○	
Total dissolved solids	-	1776 mg/ℓ	○	
Calcium	-	-	○	
Alkalinity	-	-	○	
E. coli	Not tested	-	○	
Chromaticity	-	22 TCU	○	
Odor	-	No odor	○	
Taste	-	Not unpleasant	○	
Turbidity	-	7 NTU	○	

Also, in limestone areas of the concerned area, the groundwater distribution originating in the gypsum layer contains comparatively high concentrations of calcium sulfate. In some of the villages where the water tastes bad, as abandoned wells can be found, for groundwater that has been polluted with calcium sulfate shall 1) use the sealing for the gypsum layer 2) examine avoidance measures to at the time of well construction such as selecting a separate water-intake aquifer.

4) Well Structure Criteria

The geological conditions of each site, drilling depth and well type is shown in Table 2-13.

1. Geological Character of Drilling Site

Within the 89 locations for drill target sites, there are three types of formation that appear which can be generally categorized as a loose layer (gravel mixed with boulder), sedimentary rock/basalt (soft rock), and a sedimentary/basement rock (hard rock).

2. Well Drilling Method

The following two types of drilling methods will be used to drill the wells.

- Down-the-Hole drilling method using an air hammer (hereinafter, DTH method)
- Mud Rotary Drilling method (hereinafter, Mud drilling)

In the project area concerned, the two methods are used; however with the prevalence of semi-hard - hard rock area, the DTH method will be used for a large part of the drilling. The loose layer drilling will fundamentally be Mud drilling, however where boulders are mixed in, the DTH method may be used where applicable.

For loose layers (gravel mixed with boulder), which are susceptible to borehole collapse during drilling, the drilling should employ a protective support casing which is lowered into the borehole and using the DTH method as a countermeasure against collapse (drilling is done at a large diameter, installing the support casing, and then continuing to drill to a lower level using a hammer bit with a diameter smaller than the casing). For Mud drilling, making adjustments for the specific gravity of the circulated mud, the mud acts to stabilize the borehole wall.

From the viewpoint of efficiency, basement rock favors the DTH method whereas a loose layer favors Mud drilling, but locations that exhibit a mixture of both strata, rather than modifying the method halfway, selecting one uniform method is more efficient. Due to this fact, Mud drilling and DTH method will be employed consistently as applies to the make up of strata as shown below.

From this, it can be seen that the proportion of drilling depth will be roughly 30% Mud drilling and 70% DTH method.

- Mud Rotary Drilling method
  - －A site where a loose layer continues to the base of the borehole
  - －a site where 50 m or more of loose layer drilling is followed by basement rock
- DTH Hammer method
  - －A site where, excluding the surface layer, nearly the entire area is made up of sedimentary and basalt rock
  - －A site where there is the appearance of basement rock within 20m below the surface

The drilling method for each site was determined based on the result of resistivity distribution gained from the electrical sounding results and hydro-geological field reconnaissance.

Table 2-13: Well Type of Each Geologic Sector, Drill Method, Quantity, Avg. Drill Depth

Geological Layer Classification	Well Type	Drilling Method	No. of Drilling	Avg. Drilling Depth (m)
Alluvial Layer (gravel mixed with boulder – sandy soil mixed with gravel)	Type I	Mud Rotary Drilling	19	97
Sedimentary Rock (mostly limestone) and Basalt Rock	Type II	DTH Hammer	24	97
Other Sedimentary/Basement Rock	Type III1	DTH Hammer	42	84
Alluvial Layer (gravel mixed with boulder – sandy soil mixed with gravel	Type Ⅳ-1	Mud Rotary Drilling	1	130
	Type Ⅳ-2	Mud Rotary Drilling	3	116
Total			89	-

5) Well Drilling Depth

The composition of each geologic layer and the existing well inventory offered hints to estimate groundwater aquifers and determine well depth. From those results, the minimum drilling depth is 60m, and the maximum length of drilling depth is 150m, giving an average depth of 92m. In basement rock areas, because drilling will be done basically targeting fissure type aquifers, the intersections with the fissure system of water tapped fissure is important. Accordingly, it is necessary to grasp the tectonic line by interpreting aerial photos and from geological field exploration. Because of the obscurity of potential groundwater reserves that accompanies this type of fissure system, the drill extension shall be deeper so that the chance to intersect water bearing fissures becomes higher.

6) Screen Casing

Due to the many cases in this project where the aquifer distribution of this area is uneven, the screen position and estimating the range is difficult. Therefore, with the well inventory as reference, the ratio of the total length of the screen has been estimated at 10:3.

When the drilling is being executed, the drilling slime will be judged, discharge during drilling will be recorded periodical and the electrical logging will be executed, and after specifying the depth of aquifer, the screen will be installed in the appropriate location.

Table 2-14: Drill Extension and Comprehensive Screen Length by Well Type

Geological Layer Classification	Well Type	No. of Drilling	Avg. Drilling Depth (m)	Drilling Depth Aggregation (m)	Total Screen Length (m)
Alluvial Layer (gravel mixed with boulder – sandy soil mixed with gravel)	Type I	19	97	1,843	553
Sedimentary Rock (mostly limestone) and Basalt Rock	Type II	24	97	2,328	699
Other Sedimentary/Basement Rock	Type III1	42	84	3,528	1059
Alluvial Layer (gravel mixed with boulder – sandy soil mixed with gravel	Type Ⅳ-1	1	130	130	39
	Type Ⅳ-2	3	116	348	105
Total			89	-	2,455

7) Well Structure and Borehole Diameter

Basically there are 4 patterns for well structure, shown below per geologic layer type.

Table 2-15: Type of Well Structure and Bore Diameter

Structure Type	Geological Layer	Target Well	Borehole Diameter
Type I	Alluvial Layer	4-inch PVC for hand pump	8-1/2 inch or greater
Type II	Sedimentary Rock and Basalt Rock	4-inch PVC for hand pump	8-1/2 inch or greater
Type III	Other Sedimentary and Basement Rock	4-inch PVC for hand pump	6-1/2 inch or greater
Type IV	Alluvial Layer	6～8-inch PVC for submersible pump	8-7/8 to 12-1/4 inch or greater

Because the possibility for collapse of borehole wall is high for Type I and Type II above, as a necessary measure to extend the lifespan of the well, gravel fill is placed around the circumference of the screen (while this ensures that water passes through, it protects against sand penetrating and the stabilization fill also defends against borehole collapse). A clearance of 3 to 4 cm in width is necessary around the outer circumference of a 4-inch diameter casing, so that the borehole diameter comes to 18 cm or more. Furthermore, in the Type II, cement grouting is done to prevent contamination from the gypsum layer.

In Type III, the borehole wall is highly self-reliant in the basement rock, and support using grouting and the like is unnecessary so that the drilling outer diameter should measure 6 ½ inches or greater.

In order to guarantee the clearance which is necessary in order to insert a submersible pump in regard to a Type IV (for Level 2), the casing is made to be 6 ~ 8 inches.

Also, especially in alluvium deposit areas, where the well structure is damaged, sand invades the well. As this becomes a large problem in regard to maintenance control, thick-walled casing is used to increase tolerance against borehole collapse, devised to extend the life of the well. The standard well structure which is best suited for particular areas is shown below classified by type.

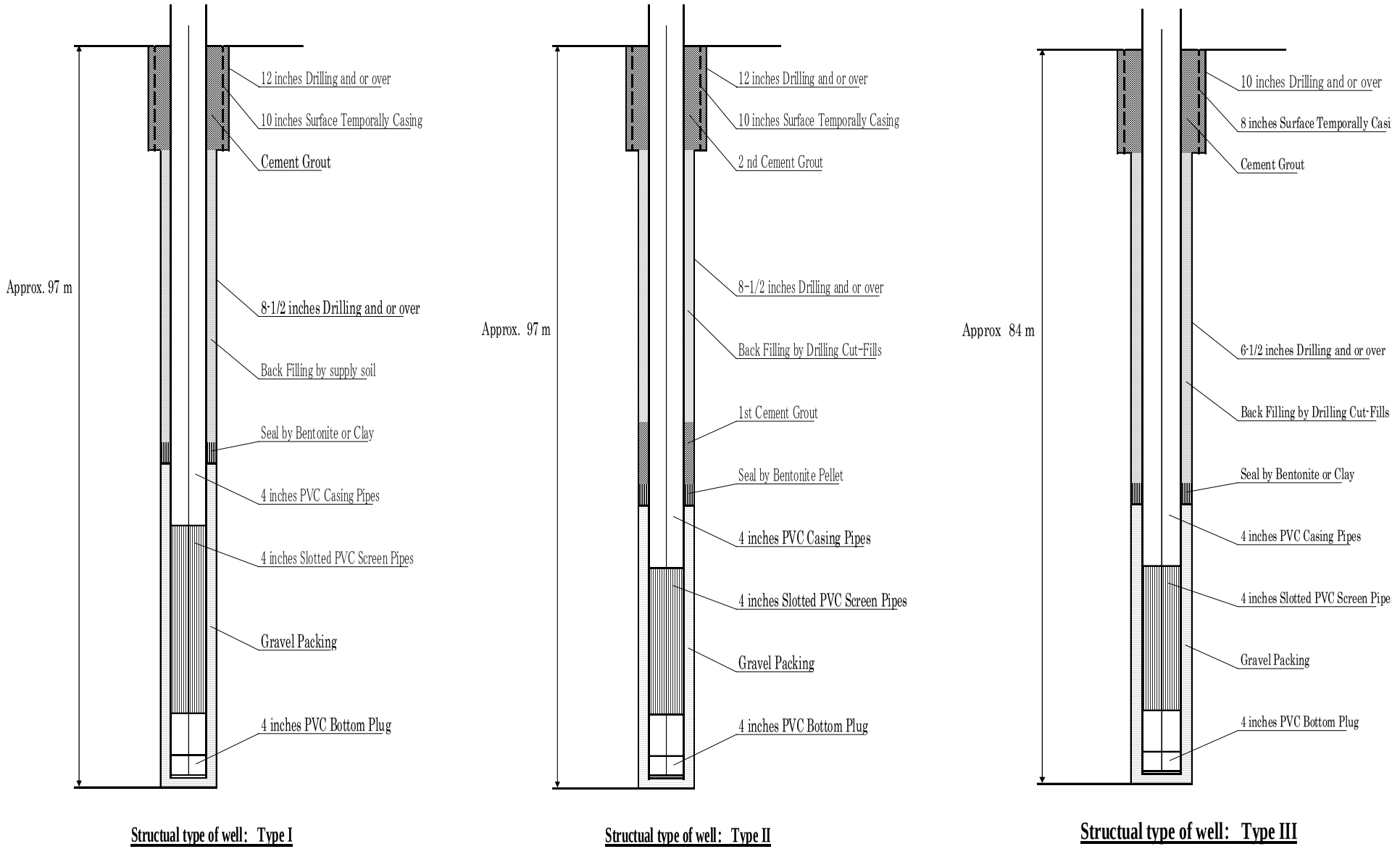


Figure 2-1: Standard Well Structure for Hand Pump by Geologic Type

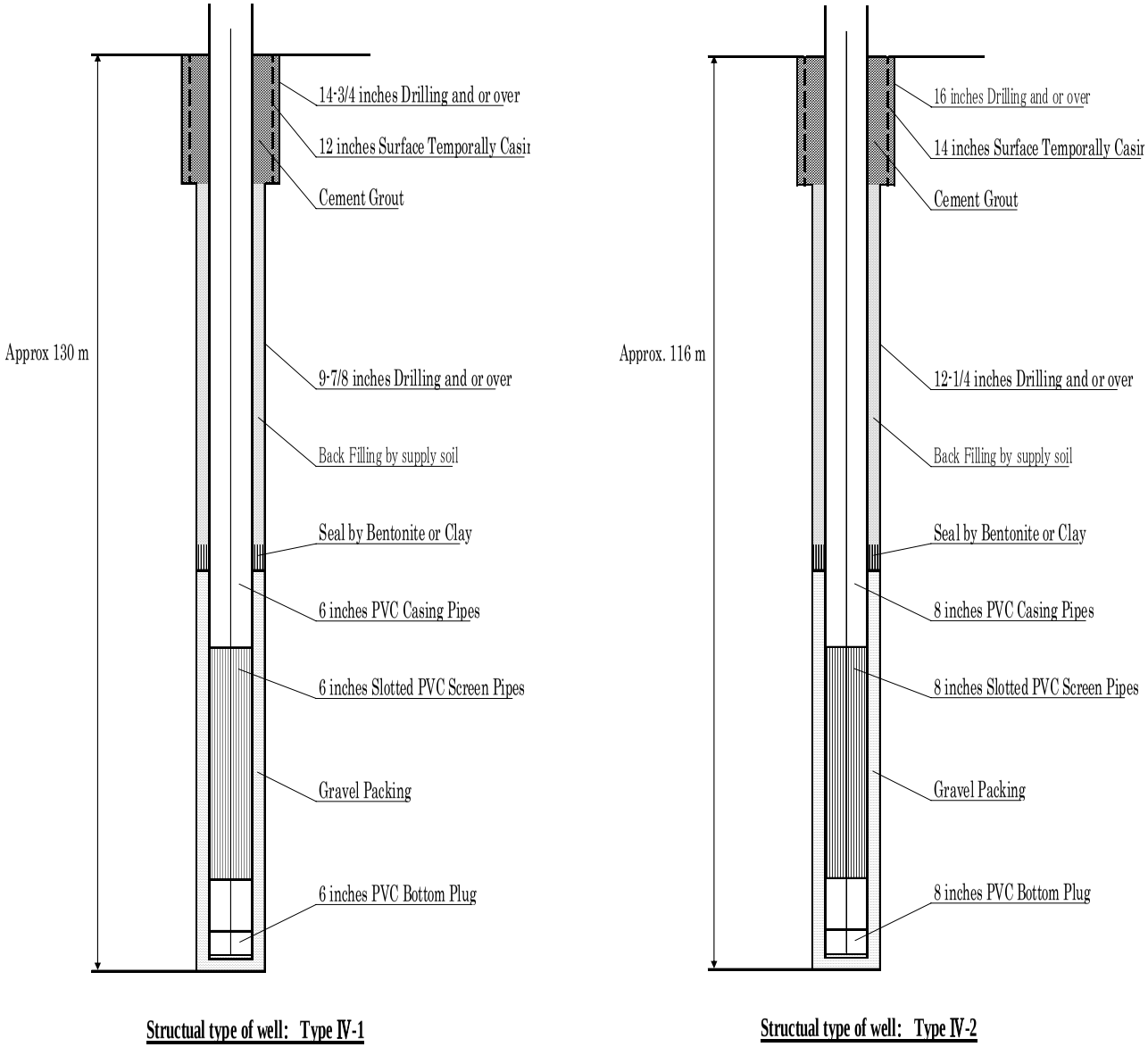


Figure 2-2: Standard Well Structure for Motorized Pump by Geologic Type

8) Well Drilling Success Ratio

Computation of the success ratio of the well used the drilling results from the past 5 years of the Tigray Water Works Construction Enterprise (TWWCE) containing data for 197 wells. The result was a 71% success ratio overall, almost equal to the latest drill testing survey results (69%).

For this project, the success ratio is divided into the two categories below from the constitution of the geological features of each Woreda.

Table 2-16: Well Success Ratio by Geology Target

Geologic Section by Region	Woreda Name	TWCCE Data		Success Ratio (%)
		Wells Drilled	Failure	
Alluvial Deposits, Sedimentary Rock and Basalt Rock Region	Kilte Awlealo, Enderta, Hintaro Wajirat, Raya Azebo, Alamata	90	21	Alluvial Deposits, Sedimentary Rock and Basalt Rock Region
Basement rock Region	Hawzen, Kola Temben, Degua Temben, Tanqua Abergele, Sharti Samre	107	36	Basement rock Region

Source: TWWCE (year of 2001～2006)

9) Well Success/Failure

The flow chart to determine the success or failure of the wells is shown below.

Table 2-17: Condition of Well Success

Item	Condition
Pumping Yield	・Level 1: in principal, 15L/min or greater is successful ・Level 2: in principal, provides enough to cover 7 hours of water demand at each site
Water quality	Anything that exceeds the Ethiopian water quality standards shall be unsuccessful.
Water level	・Level 1: Dynamic level of 45m or less from surface

10) Treatment of Failed Well

Table 2-18: Treatment of Failed Well

Item	Treatment
Treatment of Failed Wells	Backfilling after filling with sand, hydraulic filling and compacting
Maximum drilling number per one site (Gote)	A maximum of 2 wells drilled per site. If both wells fail, an alternative site shall be considered.

Candidate Villages (Alternative Drilling Site)	Candidate villages shall be from the top 20 sites selected in the social condition survey criteria (see table below).

Table 2-19 below shows the additional candidate villages.

Table 2-19: Additional Candidate Village

Priority	PJ ID	Woreda	Tabia	Kushet (village)	Gote (site)	2015 supply pop.	Facility Type
1	JSS007	Seharti Samre	Lemlem Aren	Seberye	Laelay Seberia	244	Level 1
2	JSS003	Seharti Samre	Neber Hadne	Fenarewa	Tahitay Teshalew	238	Level 1
3	JTA001	Tanqua Abergele	Lem'at	Abiyaquo	Abiyaquo	2,237	Level 1
4	JKA020	Kilte Awlaelo	Gemade	Tsaedanaele	Emhabi	476	Level 1
5	JKA002	Kilte Awlaelo	Mai quiha	Maidaero	Maakedi	439	Level 1
6	JHW018	Hawzen	Meztey	Meztey	-	549	Level 1
7	JHW012	Hawzen	Simret	Adibeles	-	1,483	Level 1
8	JTA010	Tanqua Abergele	Siye	Gomenge	Gomenge	470	Level 1
9	JKT015	Kola Temben	Debregenet	Debrehafash	Deda	390	Level 1
10	JAL016	Alamata	Selam bikalsi	Gendagaro	Gendagaro	528	Level 1
11	JHW020	Hintalo Wajirat	Waza Adiawena	Waza	Keyh hamed	366	Level 1
12	JHW019	Hintalo Wajirat	Waza Adiawena	Gerawa	Nazgi	610	Level 1
13	JKT018	Kola Temben	Guya	Dansemere	Dansemere	390	Level 1
14	JDT002	Degua Temben	Mahiberesilase	Mahibere mereb	Adinefti	390	Level 1
15	JKA011	Kilte Awlaelo	Awolo	Adibtsiat	Adibtsiat	354	Level 1
16	JKA006	Kilte Awlaelo	Aynalem	Adiwerema	Adiwerema	1,464	Level 1
17	JSS016	Seharti Samre	Adis Alem	Hantebat	Hantebat	366	Level 1
18	JTA004	Tanqua Abergele	Felegehiwot	Misaza	Misaza	732	Level 1
19	JTA017	Tanqua Abergele	Jijique	Jijique	Jijique	512	Level 1
20	JTA016	Tanqua Abergele	Tseyqueme	Tseyqueme	Tseyqueme	488	Level 1

(3) Policy for Water Supply Facility Design

The policy for Level 1 and Level 2 designs are, in principal, in accordance with the Technical Design Standard by Tigray Reigion.

Level 1 Facilities (with hand pump)

The policy for the design of water supply facility with hand pump is shown in the table below.

Table 2-20: Project Conditions of Facilities with Hand Pump

Item		Criteria
Unit for water source design		15L/person/day
Population for supply design		400 persons per day/well
Hand Pump operation time		8.5 hours per day
Borehole Depth (estimate)	(average)	92m
	(maximum)	150m
Borehole drilling diameter		6-1/2"to 8-1/2"
Casing and screen diameter		4"
Hand pump		Afridev type
Hand pump yield capacity		12 to 20 L per minute
Structure surrounding well		Pump foundation, apron, drainage ditch
Livestock trough		Outside project design
Fence surrounding well		Responsibility of users

Source: Tigray Region Technical Design Standard and Survey by Study Team

New and Rehabilitation Water Supply Facilities which accompany Pipeline Network

The following table shows the principal conditions among those which were confirmed through discussion with TWRMEB.

Table 2-21: Design and Project Conditions

Item			Design/Project Conditions
Planned Daily Average Supply	Effective Amount	Domestic use	15 L/person/day
		Schools	8 L/person/day
		Medical Clinics	25 L/person/day
		Churches	15 L/person/day
		Mosques	15 L/person/day
	Unaccounted for Water		20% of the above effective amount
Planned Daily Max. Supply			1.2 times the planned daily average supply
Planned Peak Hourly Supply			2.4 times the planned daily max. supply
Effective Head in Distribution Pipes			Effective head of about 5m at water point
Operation Time of submersible pump			In principle 7 hours
Operation Time of Public Taps			3 hours each in the morning and afternoon and 4 hours in the evening for a total of 10 hours.
Capacity of Service Reservoir			Allowance for 40% of daily max. supply in consideration of tap operation hours
Hydraulic Calculation Method for Water Pipelines			Hazen-Williams formula
Distribution pipes			In consideration with a period (15 years) of durability
Coefficient of velocity used for above calculation			C value: 110 (DIP and GS)

Source: Tigray Province Technical Design Standard and Survey by Study Team

(4) Conditions for Well Design

Initially, other than facilities with hand pump, the two types of facilities were requested; on-spot facility and multiple site water supply facility. An overview of these facilities is given below:

- On-spot facility: When the groundwater level is too low that a hand pump cannot be

used, the borehole and motorized pump, as well as nearby elevated water tank, public tap and livestock trough will be maintained as one unit, regardless of the shape of the site, due to restrictions on work expenses and the like.

- Multiple-site water supply facility: These are small-scale facilities that cover multiple sites. One of these facilities is comprised of the water source (e.g. borehole), motorized pump, distribution reservoir (incl. elevated water tank), public tap and livestock trough.

Either of the facilities described above, regardless of scale, are attached to the pipeline and thus their structure is described as the Level 2 type by definition. When these supply facilities are designed, under the condition that sufficient water source capacity can be expected, the Level 2 design is applied to the two types mentioned above.

The supply method is designed so that water is delivered from the borehole using a submersible pump and taken to the distribution reservoir. Nonetheless, in some of the facilities (Raya Azebo district: Hadealga site), judging from the location, shape of the site and terrain conditions, it won't be possible to send water directly to the one of the two distribution reservoirs, and thus a booster pump will be used.

However, the method of distribution will use the flow of gravity in order to economize maintenance costs and undertake sustainable operations. The figure below outlines the concept for a Level 2 facility.

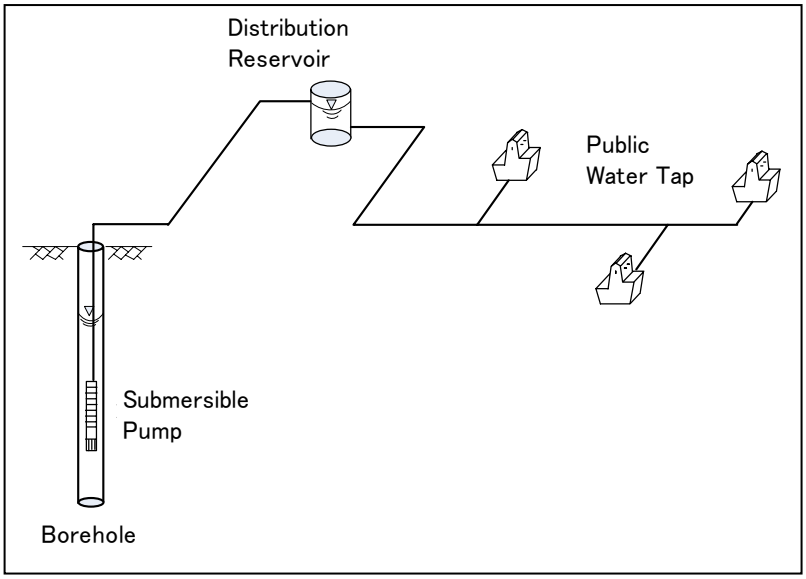


Figure 2-2: Conceptual Illustration of Water Supply Facility (No. 1)

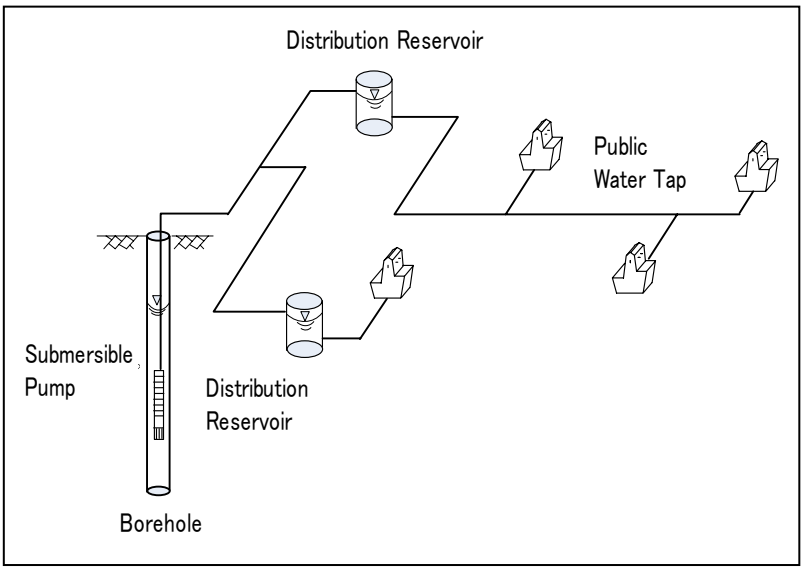


Figure 2-3: Conceptual Illustration of Water Supply Facility (No. 2)

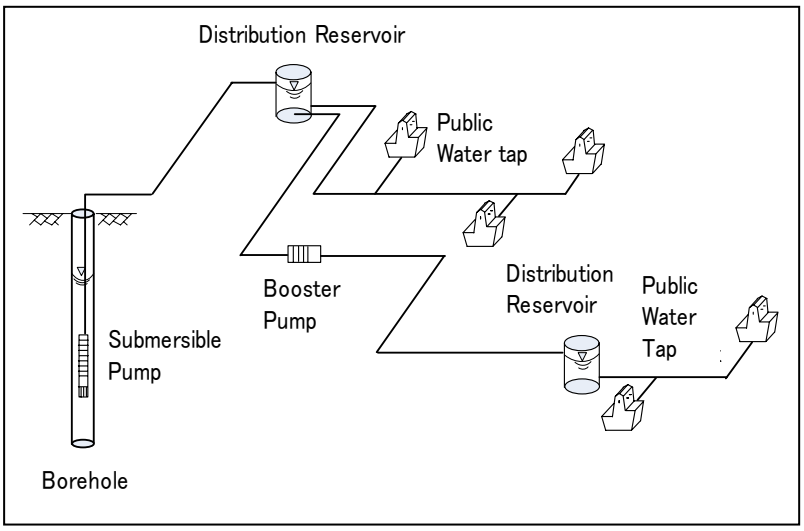


Figure 2-4: Conceptual Illustration of Water Supply Facility (No. 3)

Type No. 1 delivers water from the borehole with a submersible pump to the distribution reservoir, then by the force of gravity the water is distributed to one or multiple locations. The target facilities for type No. 1 are, as shown in Table 2-22, are new facilities in Raya Azebo district excluding No. 4 site (the Hadealga site and Keyih tekli site) and No. 7 site (Dodota site) for a total of 8 facilities, and an additional 4 facilities targeted for rehabilitation sites.

There is one site targeted for type No. 2, but because it is somewhat disjointed, the system has been divided into two distribution zones. Both zones draw water from the borehole which is sent to the respective reservoirs, where water is distributed by gravity to multiple public taps. The only target site for type No. 2 is Raya Azebo district No. 7 site (the Dodota site).

For type No. 3, the terrain conditions are such that it extends into two target sites and has been divided into two distribution zones. Because of that, it delivers water from the borehole using a submerged pump temporarily to reservoir of the Hadealga site, and from there using a booster pump, distributes water to the Keyih tekli site reservoir. Type No. 3 is only targeted for Raya Azebo district No. 4 site (the Hadealga site and Keyih tekli site).

(5) Facility Components

1) Hand Pump Water Facilities

a. Hand pump

Afridev type pumps (max. lift 45m) will be employed. Further, the length of the lift pipe was set at maximum pump capacity of 45m, taking into consideration the drop in water level in the dry season.

b. Platform

- A concrete platform will be used, as it is already widespread in the Tigray Region. Furthermore, for the wells with hand pumps which produce a low yield and for which the general purpose is designated as drinking water, a policy was made not to establish a trough for domestic animals.
- With the aim to maintain sanitary conditions around the pump, protective measures are established to prevent animals from trespassing, although this will require the self-supporting efforts of the residents.

2) Motor Pump Water Facilities

a. Borehole

The inner diameter in the final stage of completing the borehole will be 6 inches or 8 inches, according to specifications of the motorized submersible pump.

- Under the challenging geographical and social environment, attempting to decrease the construction risk for the durability of the structure, sandwich type that concrete and stone masonry are combined is applied for above-ground distribution reservoirs at 25, 50 and 100m^3. This construction, when done on a small-scale (ground distribution reservoirs of 100m^3 or less), has become the standardized type in all of the Ethiopian regions.
- Concerning elevated tanks at or below 10m^3, designs call for a Roto tank made of polyethylene, currently being used in many other regions with positive results. The steel used in existing elevated tanks has a tendency to corrode, causing notable leakage as a result, combined with the ready availability of the Roto tank, led to this decision.
- Concerning the elevated tanks that exceed capacity of 10m^3, the structure will be reinforced concrete. Furthermore, a flow meter will be installed on the outlet side of the distribution reservoir.

b. Submersible pump

Concerning the water source pump, the readiness of supply for the pump body and spare parts in the Tigray Region often decide whether to renew the Mono pumps, etc., of existing boreholes with motorized submersible pumps depending on the occasion. Therefore, in this project, in order to ensure the standardization of basic specifications and the manufacturer, it has been planned to use motorized submersible pumps. In order to conduct output yield control, a flow meter has been installed on the pump outflow side.

c. Booster Pump

The booster pump which supplies water to Keyih tekli employs a land pump that is used in parts of the Tigray Region. In addition, the operation method is a push style, making use of the distributing reservoir for Hadealga.

d. Distribution Reservoir

- Under the challenging geographical and social environment, attempting to decrease the construction risk and reduce costs for the durability of the structure, a stratified method is applied to sandwich concrete and masonry for above-ground distributing reservoirs at 25, 50 and 100$m^{3.}$ This construction, when done on a small-scale (above-ground and 100m^3 or less), has become the standardized type in all of the Ethiopian regions.
- Concerning elevated types at or below 10m^3, designs call for a Roto tank made of polyethylene, currently being used in many other regions with positive results. The steel used in existing elevated tanks has a tendency to corrode, causing notable leakage as a result, combined with the ready availability of the Roto tank, led to this decision.
- Concerning the elevated types that exceed capacity of 10m^3, the structure will be reinforced concrete. Furthermore, a flow meter will be installed on the outflow section of the distributing reservoir.

e. Public Taps

There are currently a variety of types of public water pumps in the Tigray Region. In this project, the convenience of the public taps structure has been set forth. Six faucet public taps have been planned in such a way that users should be able to shoulder the supply containers (poly- tank) from a reasonable height, and a designated spot will guarantee the ability to fill the drums. An apron and drain will be constructed around the public taps. Also, a water meter will be installed on the inlet side of the public taps.

f. Rising and Distribution Pipelines

- A gravity system is planned for the water supply system to decrease such maintenance expenses, and additionally, allow for a sustainable maintenance plan.
- In the Tigray Region, GS (galvanized steel pipes) is mainly utilized. In this plan, GS was selected due to its ready local availability and to prevent stealing for domestic use or irrigation. However, ductile cast iron pipe is employed where water pressure must be adjusted to match hydrostatic pressure and water-hammer pressure in parts of the route that

exceed 1.6Mpa. The smallest diameter planned for the pipeline, taking into consideration future expansion plans, is one inch.

- Concerning laying the pipelines, at planned target areas where large vehicles do not pass, the minimum earth covering depth of 80cm (digging width: 60cm) is used based on technical design standards of the Tigray Region. Even where there is basement rock, in principle there are no plans for exposed pipes, and the basement rock will be chipped away to 20-30cm and, further, the distribution pipes will be covered with concrete. This policy was taken as damage to the pipelines due to such factors as human activity or animal movement will be avoided.

g. Wash-out Valves

The wash-out valve is installed in order for the smooth discharge of sludge, etc., in the pipeline sections where there are depression points.

h. Livestock troughs

Although future water demands are not estimated for supply for livestock, reservoir overflow and drain water from public taps will be available for livestock and a livestock trough and its surrounding pipes have been planned. There shall be one trough per facility.

i. Motorized equipment for Electrical submersible pumps

- In sites with existing commercial power supply in the vicinity of pump facilities, a policy is taken for the future supply of commercial electricity in order to reduce maintenance costs.

For other pump facilities, a generator will be used.

Table 2-22: Level 2 Facility Plan Summary

Fac. No.	Target Supply Region		BH (No.)		Water Main Pumps (No.)		Power Source		Rising Pipe		Machine Room (No.)		Distribution Reservoir (m3)		Distribution Pipes		Public Taps (No.)*2	
	Woreda	Site			Submersible	Booster	Type	Distance between Power Source and Pump House (m)	Diameter (mm)	Pipe Length (m)			Surface	Elevated*1	Diameter (mm)	Pipe Length (m)		
1	Alamata	Bedena leko	1	To be drilled	1	0	Generator	-	75	295	1	Generator Rm	0	50	75-100	574	1	(1)
2		Gerjele town	1	Test drilling	1	0	Commercial	400	150	906	1	Switchboard	50	0	40-75	391	3	
3		Ula	1	Test drilling	1	0	Generator	-	75	717	1	Generator Rm	25	0	50-75	638	2	
4	Raya Azebo	Hadealga	1	To be drilled	1	1	Commercial	1,400	100-150	6,140	2	Switchboard Pump House	50×2	0	40-75	3,016	5	
		Keyih tekli						850										
5		Hirka Adialebachele Bechenrkatan	1	To be drilled	1	0	Commercial	50	150	8,456	1	Switchboard	100	0	40-150	4,604	4	
6		Fondel	1	Test drilling	1	0	Generator	-	75	2,136	1	Generator Rm	25	0	50	129	1	
7		Dodota	1	Test drilling	1	0	Generator	-	40-100	2,384	1	Generator Rm	25	4	40-75	1,166	3	
8		Hadishkign	1	Test drilling	1	0	Generator	-	75	681	1	Generator Rm	25	0	75	280	1	
9		Gemed dadi	1	To be drilled	1	0	Generator	-	75	1,326	1	Generator Rm	25	0	40-75	1,410	2	
10		Tachgubegala	1	Test drilling	1	0	Generator	-	75	771	1	Generator Rm	25	0	75	127	1	
	Total		10		10	1				23,813	11					11,171	23	(1)

*1: Bedena leko uses a concrete elevated tank, Dodota uses a Roto elevated tank

*2: Number shown in ( ) will be connected to existing public tap

Table 2-23: Rehabilitation Facility Plan Summary

Fac No.	Target Supply Region		BH (No.)		Water Main Pumps (No.)		Power Source		Rising Pipe		Machine Room (No.)		Distribution Reservoir (m3)		Distribution Pipeline		Public Tap (No.)*2	
	Woreda	Site			Submersible	Booster	Type	Distance between Power Source and Pump House (m)	Diameter (mm)	Pipe Length (m)			Surface	Elevated*1	Diameter (mm)	Pipe Length (m)		
11	Raya Azebo	Deletie	1	Use existing	1	0	Generator	-	25	15	1	Generator Rm.		4	40	200	1	
12		Bandera	1	Use existing	1	0	Generator	-	25	15	1	Generator Rm.		4	25	50	1	
13		Kepan	1	Use existing	1	0	Generator	-	40	15	1	Generator Rm.		10	40	50	1	
14		Genete	1	Use existing	1	0	Generator	-	25	15	1	Generator Rm.		4	40	70	1	
	Total		4		4	0				60	17					370	4	

*1: Roto elevated tank

2-2-2-2 Equipment Plan

(1) Material Procurement

The following list shows the equipment that will be provided for this project.

Table 2-24: Equipment List

No.	Equipment Name	Content (Specifications, Measurements) Use	Qty
A1	Service Rig	Vehicle: 4×4 or 6×4 Hydraulic lift mast (Height = at least 9m) Hoisting Line (Lift weight: 5.0 tons or higher) Sand reel (Lift weight: 2.5 tons or higher) Water pump (discharge: 500L/min or more, Pressure: 1.96Mpa or more) Low Pressure Compressor (Air delivery: 8m3 or more, Pressure: 1.0Mpa or High elevation engine specifications	1
B1	Truck with Crane (for transp. pump test equipment)	Gross Vehicle Weight: 10 tons or higher Drive: 4×4 Truck bed: 4.0m, iron flooring Diesel engine Crane lift capacity: 3 ton (max.) High elevation engine specifications	1
B2	Submersible Pump	400L/min × 140mH: 1 unit Lifting pipe (above): 140m or more 200L/min × 80mH: 1 unit Lifting pump (above): 80m or more Pump control panel Well cover, Well bend pipe, etc.	1
B3	Generator	380V, 50Hz, 50KVA or more 3-phase 4-wire High elevation specifications	1
B4	V-Notch Wier	Max. Discharge: 450L/min	1
B5	Water Level Meter	Portable Measurement depth: 150m	1
B6	pH Meter	Portable Measurement range: 0 to 14	1
B7	Conductance/TDS Meter	Portable Measurement range: 0 to 19.9mS/cm or more (Conductance) Measurement range: 0 to 100mg/L or more (TDS)	1
B8	ORP Meter	Portable Measurement range: 0 to ±1999mV	1
B9	Turbidity Meter	Portable Measurement range: 0 to 800NTU or more	1
C1	Truck with Crane (for repair handpump wells)	Gross Vehicle Weight: 10 tons or higher Drive: 4×4 Truck bed: 4.0m, iron flooring Diesel engine Crane lift capacity: 3 ton (max.) High elevation engine specifications	2

(2) Necessity of Equipment and Basis for Quantity

1) Materials for well maintenance

A-1 Service Rig: 1 unit

The implementation organization TWREMB currently has one service rig used to repair existing wells, but the rig being an old model and the difficulty in obtaining spare parts has been an obstacle to conducting repair work. Thus, in order to promote continued service and maintenance, a request has been placed with the Government of Japan in order to renew the rig, although the content of that request was for a rig with extremely high capabilities of 12 inch well diameter and depth of 250 m to cover city water supply. Afterwards, discussions with the counterpart during the project resulted in agreement to request equipment that is capable of well repair for a maximum well diameter of 8 inches and depth of 150 m to cover the existing wells in villages and the test wells for this project. The selected equipment of a service rig for repair of maximum 8 inch diameter and 150 m depth was chosen based on prior experience.

- Vehicle Specifications

The service rig selected is one that has the necessary accessories with consideration to functionality and operating efficiency. The engine specifications are for high altitude (maximum altitude 2500m) with 4×4 or 6×4 drive.

- Well Repair Equipment

The repair method generally done in the Tigray Region are washing methods – bearings, brushing, and jetting – so equipment which covers these methods has been selected. Furthermore, the equipment was selected in consideration of the various diameters of existing wells; 4 inches, 6 inches and 8 inches.

- Compressor

Considerations for a well depth of 150 m are estimated for the following compressor capacity

Discharge pressure: 1Mpa or higher (10kgf/cm^2 or higher)

Air Discharge rate: 8.0m^3/min or higher

2) Pumping Test Materials

B1 Truck with Crane: 1 unit

This piece of equipment will mainly be used to transport equipment for well tests and to install submersible pumps. Also, when used together with the service rig,, it can be used to transport extra materials. Furthermore, it is not foreseen that well washing and pumping tests would be carried out on the same schdule, so the carrying capacity may be reduced (or reduce the number to be procured).

- Vehicle Specifications

For the carrying capacity, considerations were made for pumping test equipment with an overall load of 3 tons or higher and vehicle bed length of 4 meters or longer with consideration to the lift

pipes for submersible pumps.

Also, 4-wheel drive capability is selected because of poor road conditions in the rainy season.

- Crane Capability

The lifting capacity of the crane shall be able to handle the submersible pump for level 2 wells (140m X 400L/min) provided in this project, and the lift weight and operating radius of generators of 3 tons (operating radius 2.5m) or more.

B2 Submersible Pump: 2 units

A pumping test will be implemented after well washing is completed in order to assess well capability (specify the pump discharge). The quantity to be supplied takes into consideration both planned and existing wells in the Tigray Region, one for each Level 1 well and Level 2 well.

a) The type specified which corresponds with the Level 1 wells (4 inches) is for a depth of 80m and discharge of 100L/min with consideration to the pump discharge of the planned and existing wells, and the largest lift of the hand pump wells.

b) The type specified which corresponds to the Level 2 wells (6 and 8 inches) is for a depth of 140m and a maximum discharge of 400L/min with consideration to the water level and pump discharge of the existing wells and test wells.

B3 Generator: 1 unit

This has been planned for the power source for the above-mentioned submersible pumps. The specifications are for the necessary capacity (kVA) to start the above mentioned Level 2 submersible pumps.

B4 V-notch weir: 1 unit

This equipment is a measuring square to measure the discharge amount for pump tests. It is the easiest and most accurate instrument (method) to do so. The specifications are for 450L/min with consideration to the maximum discharge of the Level 2 well submersible pump.

B5 Water level meter: 1 unit

Groundwater levels will change with the season and furthermore over a span of several years due to seasonal changes, so this is an essential item for regular monitoring which is easy to carry. Specifications are for a hight of 150m giving a 10 m allowance above the overall 140m of Level 2 submersible pumps mentioned above.

B6 pH meter: 1 unit

This portable instrument for water quality measurement is easy to operate and will be used to obtain the minimum required water quality data for the file when conducting a pumping test.

B7 Conductance/TDS meter: 1 unit

Electric Conductivity (EC) is a desireable water quality analysis item for on-site measurement because EC values fluctuate immediately after coming into contact with the atmosphere. Specifications call for a meter which can measure 0~19.9ms/cm. TDS is something which measures

the quantity of all dissolved substances, measureing 0~100mg/L. Also, a portable type is chosen for on-site usage.

B8 ORP meter: 1 unit

Oxidation Reduction Potential (ORP) shows the state of oxidation restoration of water quality, and is closely related to water quality items iron and arsenic, etc. It is desirable to take this measurement on-site since the values fluctuate immediately after being exposed to the atmosphere. This equipment, used for analysis of redox potential, has a general standard of measurment of 0~±1999mv. Also, a portable type is chosen for on-site usage.

B9 Turbidity meter: 1 unit

Water quality analysis for turbidity is best done on-site as the values will fluctuate immediately after being exposed to the atmosphere. This equipment, used for turbidity analysis, has a general specification to be able to measure 0~800NTU. Also, a portable type is chosen for on-site usage.

3) Operation and Transport Equipment: 2 Units

C1 Truck with Crane

This equipment is used primarily for the transportaion, installation and lifting of hand pumps. In addition, it will be used to transport handpumps for upgrade and supplemental parts to the north and central zone from the central maintenance workshop.

- Crane Capability

The operating radius shall be 5m with consideration to the outrigger extension for the platform width stipulated in the Tigray region technical standard. The lifting capacity will be 1 ton or higher in anticipation of the allowance for the hand pump lifting pipe (when H = 80 m). Furthermore, among the cranes for truck loading on the market, a crane with nominal lifting capacity of 2.9 tons will satisfy the above-mentioned matters, and thus is the same as the truck with crane designated for the pumping test (B1).

- Vehicle Specification

A 4-wheel drive vehicle that can carry the above-mentioned crane is selected. The overall load of the vehicle will be 10 tons or higher in order to transport hand pump equipment.

(3) Division of Principal Equipment Procurement

None of the equipment to be supplied in this plan is produced domestically in Ethiopia and, therefore, will be procured in Japan or a third country. The decision of what country the equipment will be purchased in will take into consideration quality assurance, reliable delivery and readiness of supply. The country in which the equipment will be procured is shown in the table below.

Table 2-25: Division of Equipment Procurement

Equipment	Japan	Third Country	Remarks
O&M Equipment			
Service Rig	○		
Drawdown Test Equipment			
Truck with crane	○		
Submersible pump set	○	○	Procure from Japan or EU country
Generator	○	○	Procure from Japan or EU country
V-shaped weir	○		
Water level meter	○		
pH meter	○		
Conductance/TDS meter	○		
ORP meter	○		
Turbidity meter	○		
Work/Transport Equipment			
Truck with crane	○		

2-2-3 Basic Design Drawing

The basic design drawings for this project are shown the pages that follow.

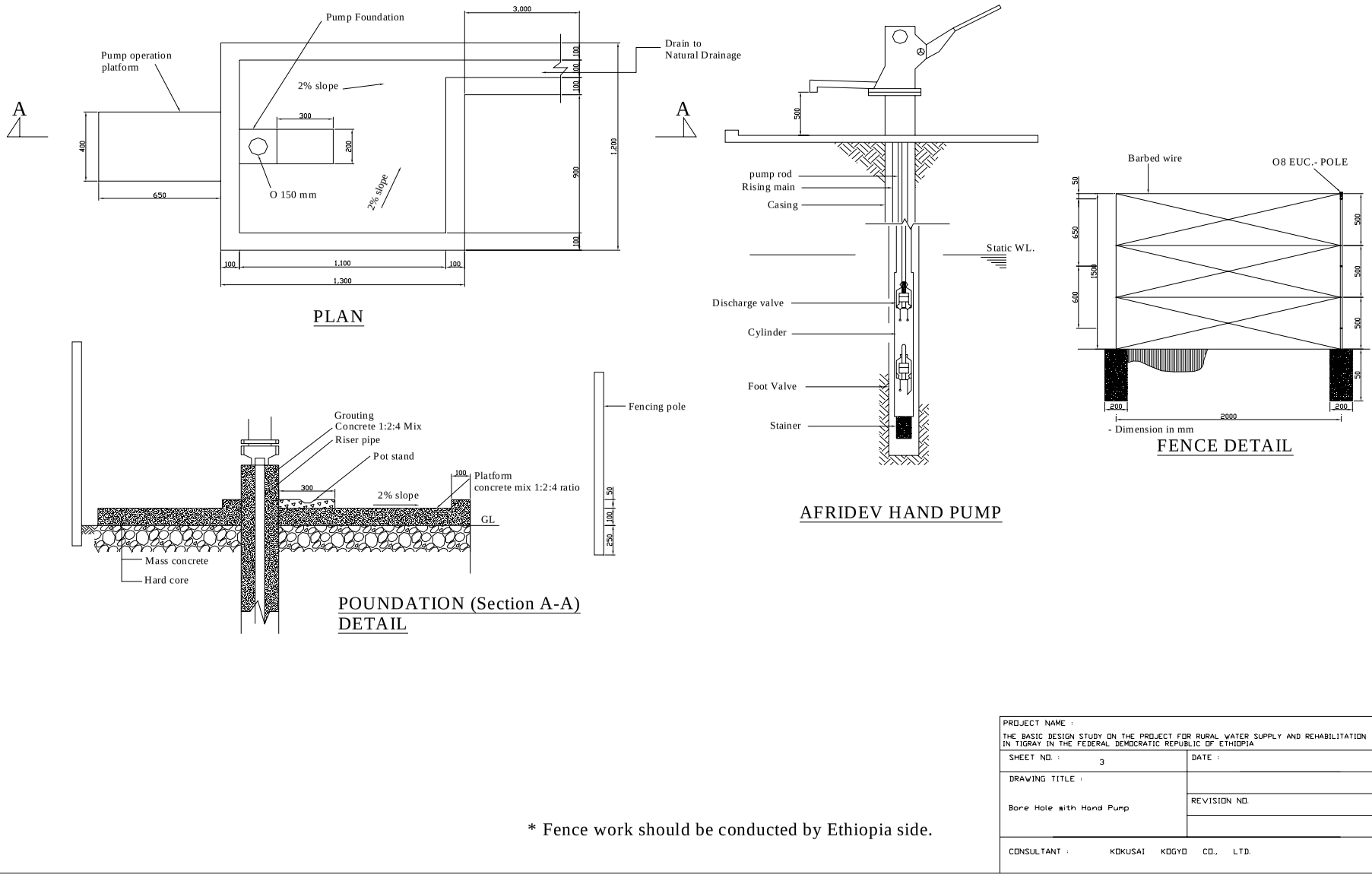


Figure 2-5: Borehole with Hand Pump

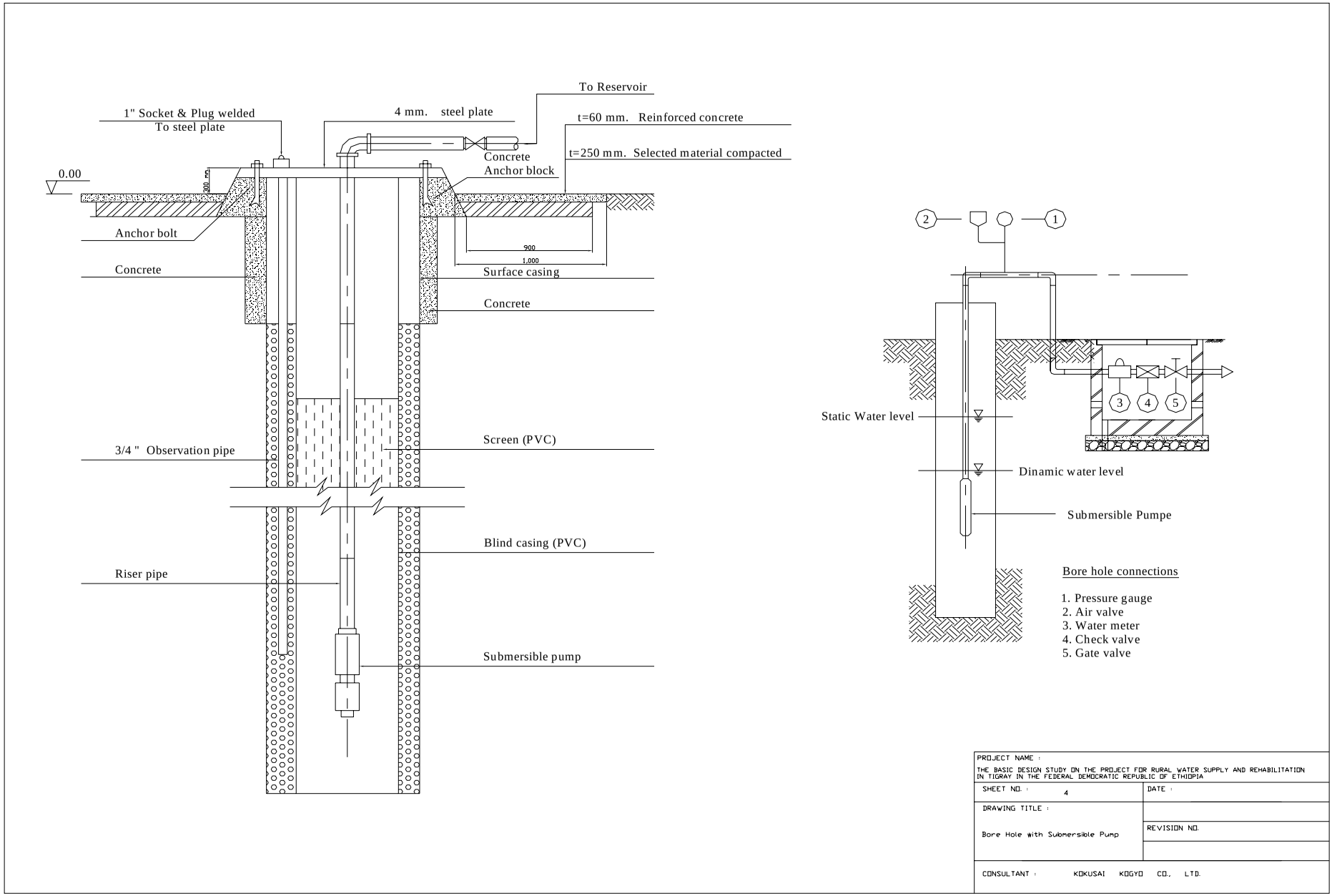
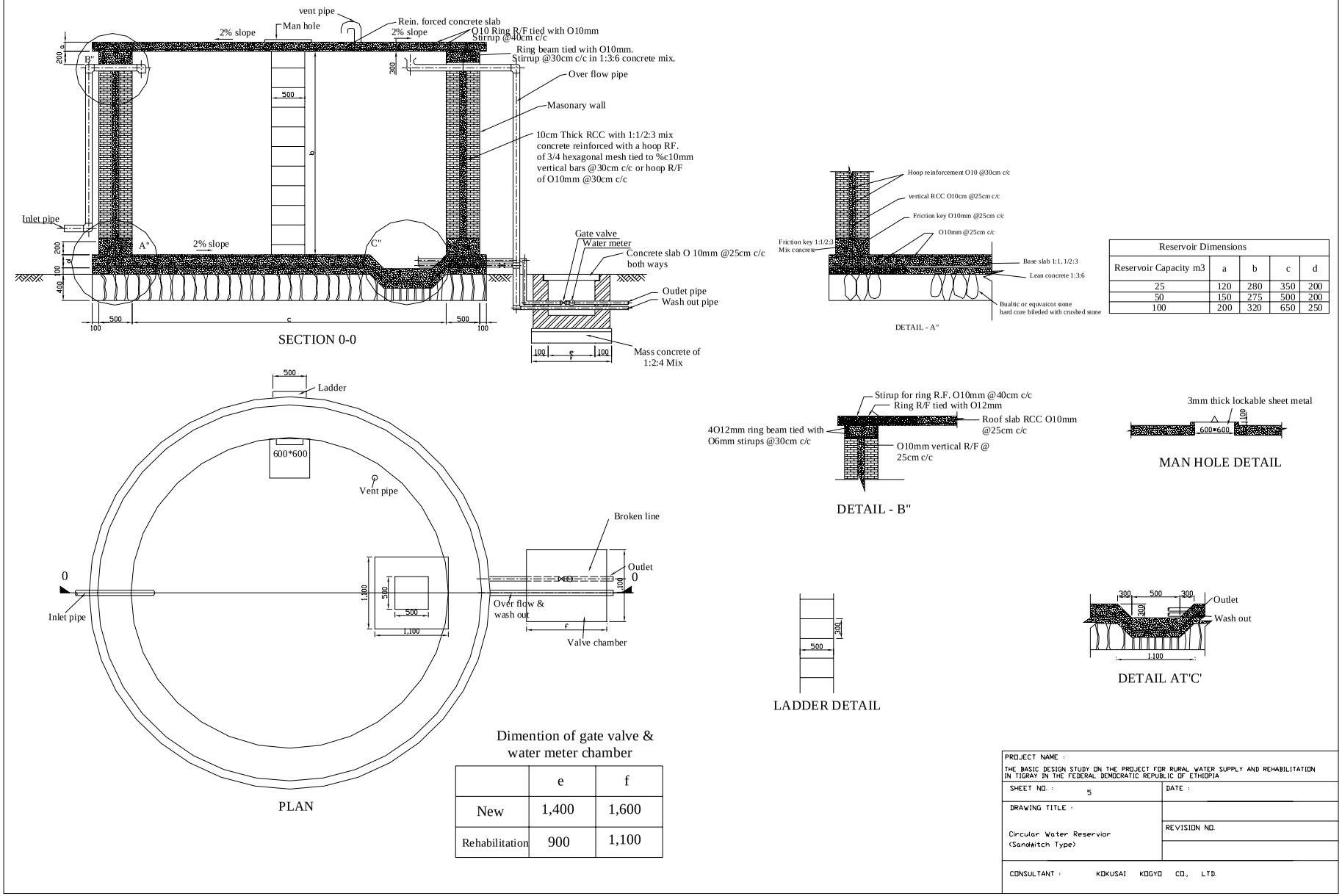


Figure 2-6: Borehole with submersible Pump



Reservoir Dimensions				
Reservoir Capacity m3	a	b	c	d
25	120	280	350	200
50	150	275	500	200
100	200	320	650	250

Dimention of gate valve & water meter chamber

	e	f
New	1,400	1,600
Rehabilitation	900	1,100

PROJECT NAME :
THE BASIC DESIGN STUDY ON THE PROJECT FOR RURAL WATER SUPPLY AND REHABILITATION IN TIGRAY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

SHEET NO. : 5

DATE :

DRAWING TITLE :
Circular Water Reservior
(Sandwitch Type)

REVISION NO.

CONSULTANT : KOKUSAI KOGYO CO., LTD.

Figure 2-7: Circular Water Reservoir

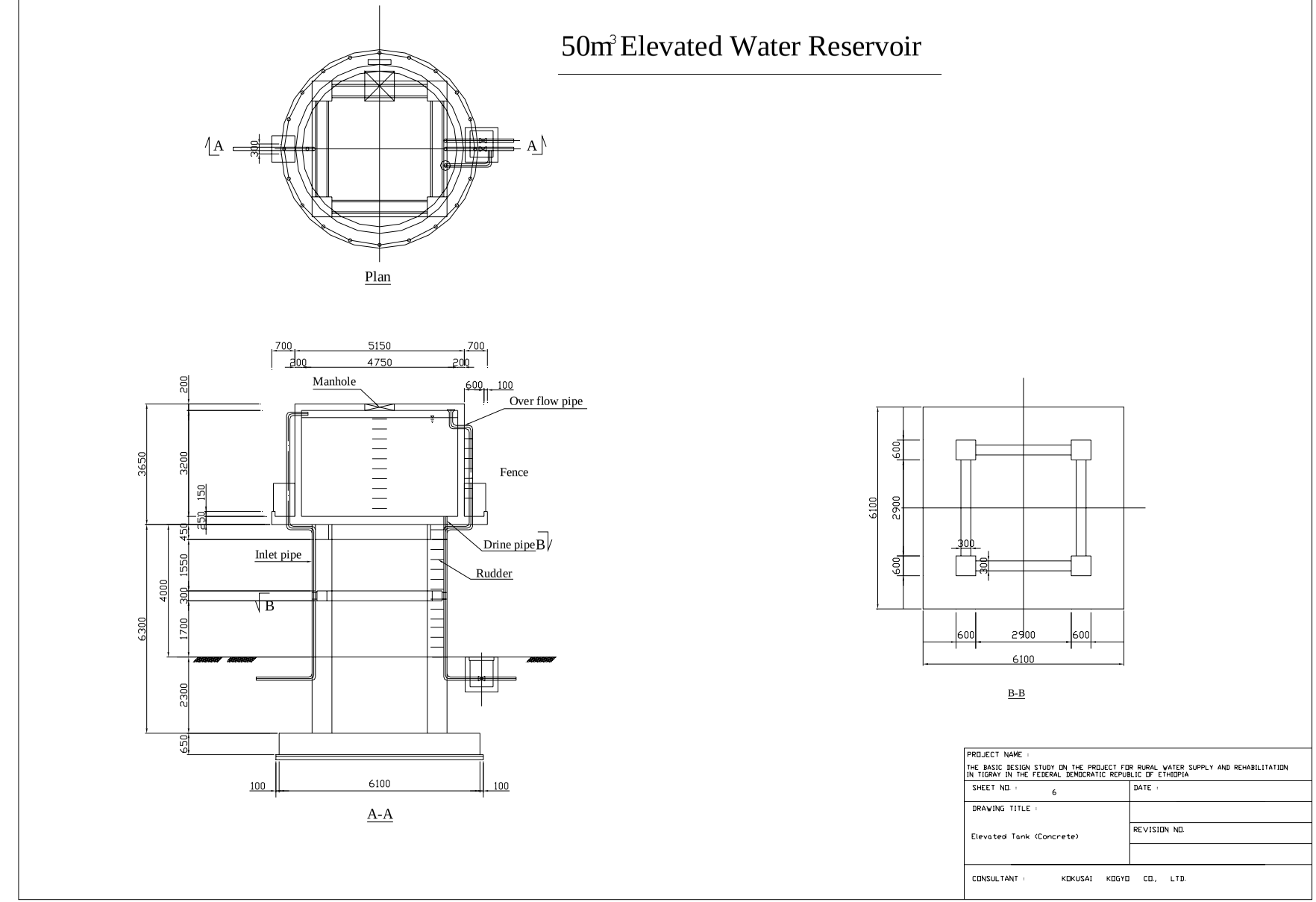


Figure 2-8: Elevated Water Reservoir

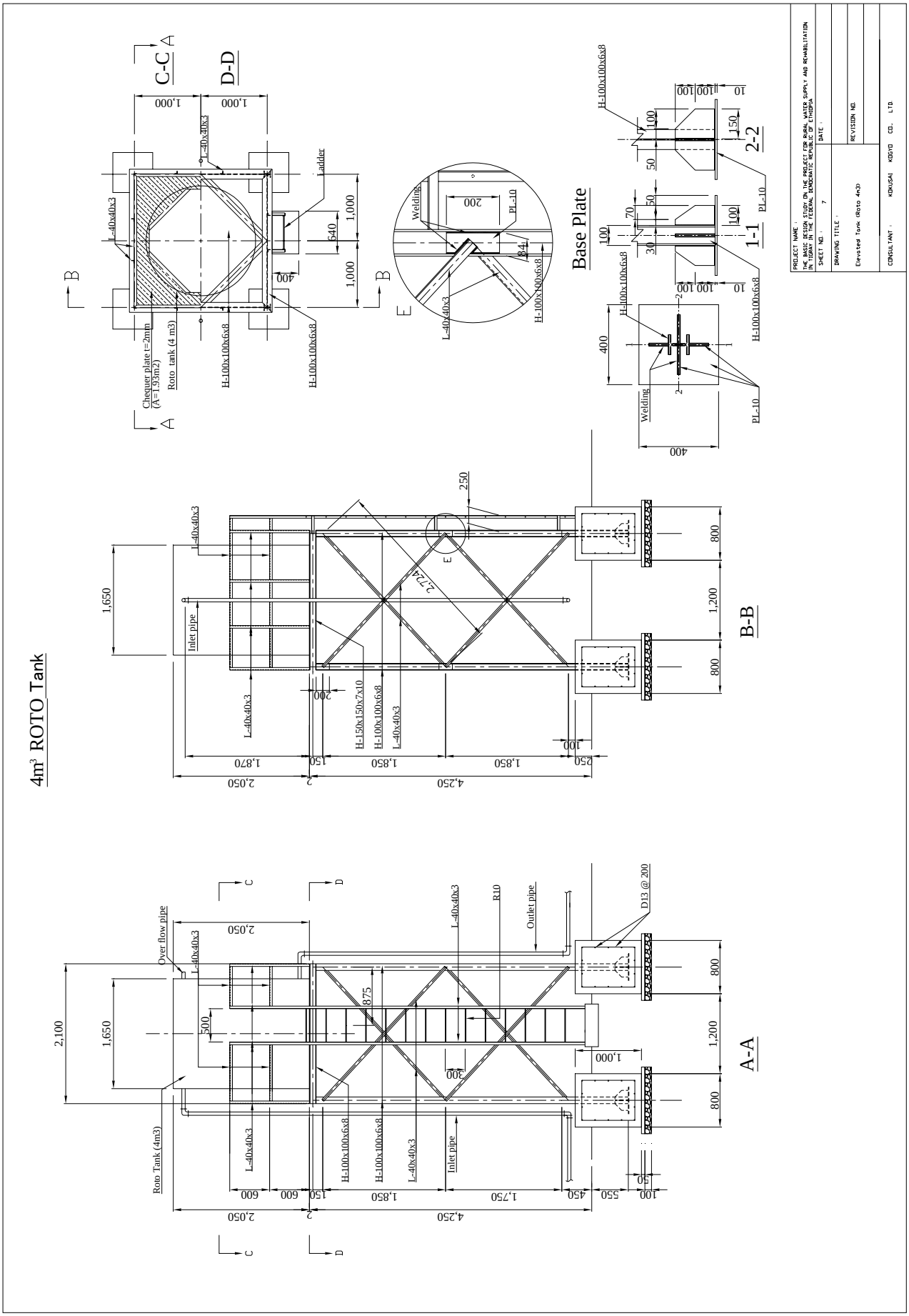


Figure 2-9: Elevated Water Tank (Roto tank 4m^3)

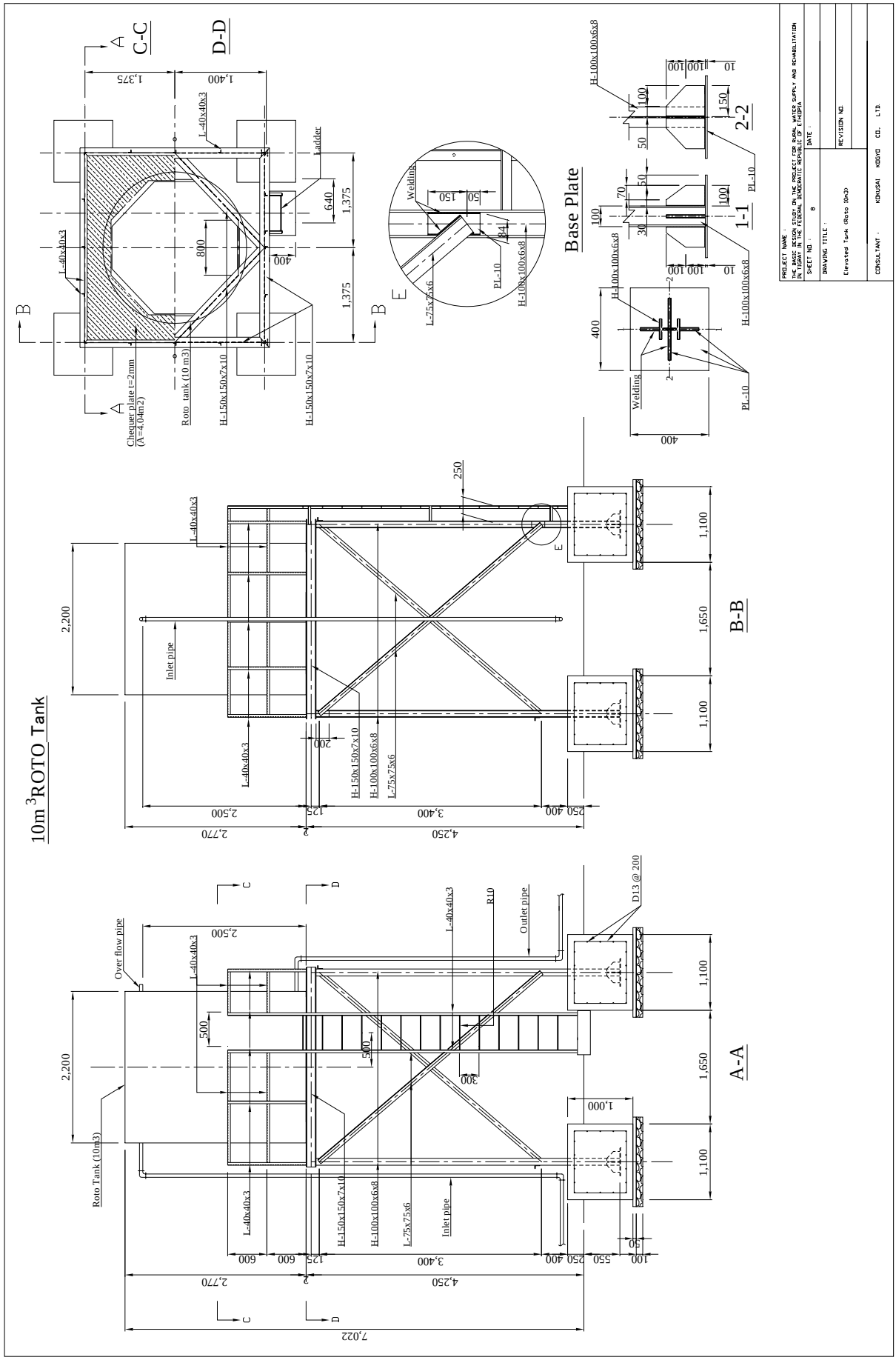


Figure 2-10: Elevated Water Tank (Roto tank 10m^3)

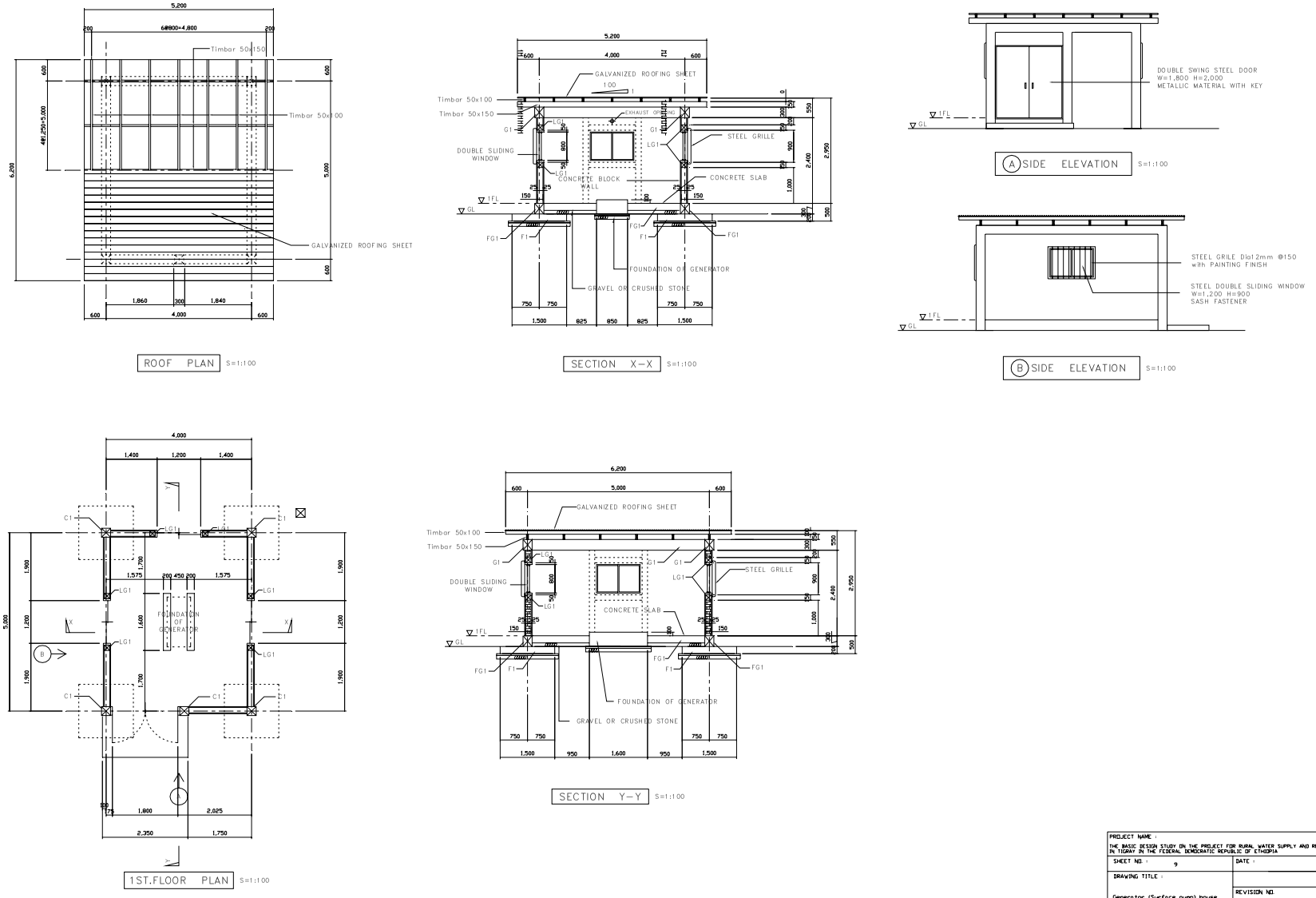
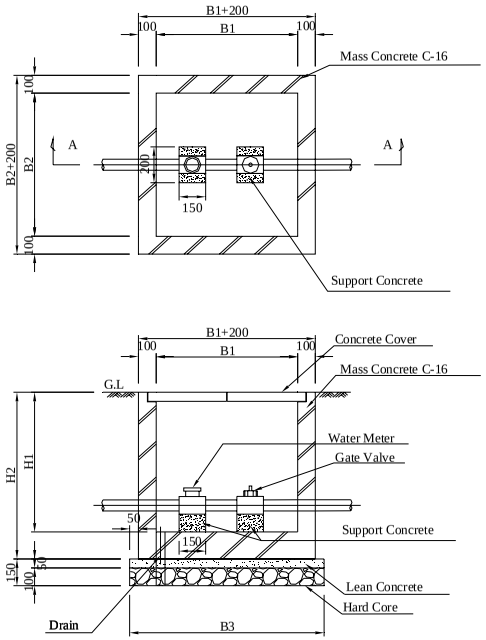


Figure 2-11: Generator (Surface Pump) House

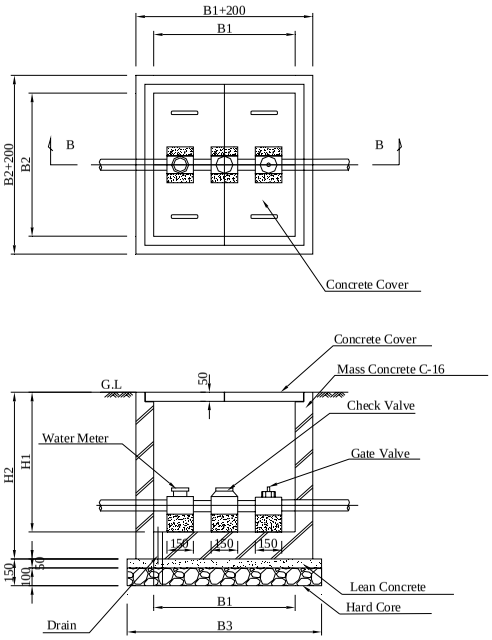
(New facilities)	B1	B2	B3	H1	H2
Chamber for gate valve and water meter (at service reservoirs)	1400	800	1700	1300	1450
Chamber for gate valve and water meter (at public taps)	800	800	1100	1300	1450
Chamber for gate valve, water meter and check valve	1900	800	2200	1300	1450
Chamber for gate valve, wash out valve and air valve	800	800	1050	900	-
(Rehabilitation facilities)					
Chamber for gate valve and water meter (at service reservoirs)	900	800	1200	1000	1150
Chamber for gate valve and water meter (at public taps)	800	800	1100	1000	1150
Chamber for gate valve, water meter and check valve	1200	800	1500	1000	1150
Chamber for gate valve, wash out valve and air valve	500	500	750	500	-

(New facilities)	B1	B2	B3	H1
Air valve, wash out valve and gate valve each	800	800	1050	900
(Rehabilitation)				
Wash out valve and gate valve each	500	500	750	500



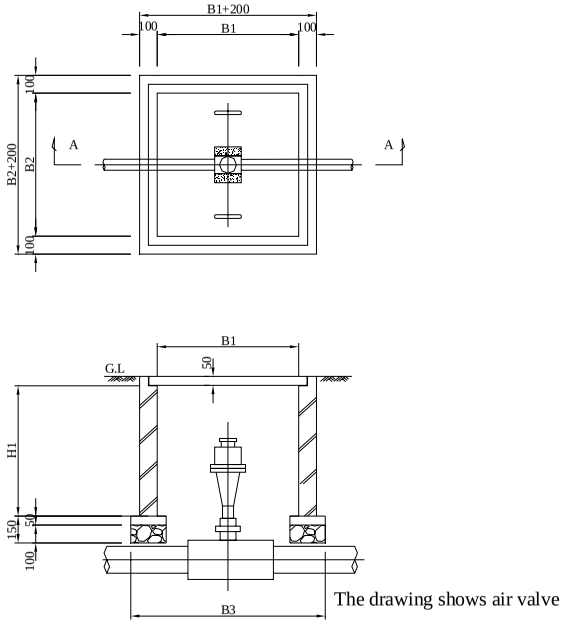
A-A

Water Meter & Gate Valve chamber
S=1:20



B-B

Water Meter, check and Gate Valve chamber
S=1:20



B-B

Air valve, wash-out valve and gate valve chamber
S=1:20

PROJECT NAME : THE BASIC DESIGN STUDY ON THE PROJECT FOR RURAL WATER SUPPLY AND REHABILITATION IN TIGRAY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA	
SHEET NO. : 10	DATE :
DRAWING TITLE : Chamber for gate valve, air valve chech valve and water meter	REVISION NO.
CONSULTANT : KOKUSAI KOGYO CO., LTD.	

Figure 2-12: Chamber for Gate Valve, Air Valve, Check Valve, and Water Meter

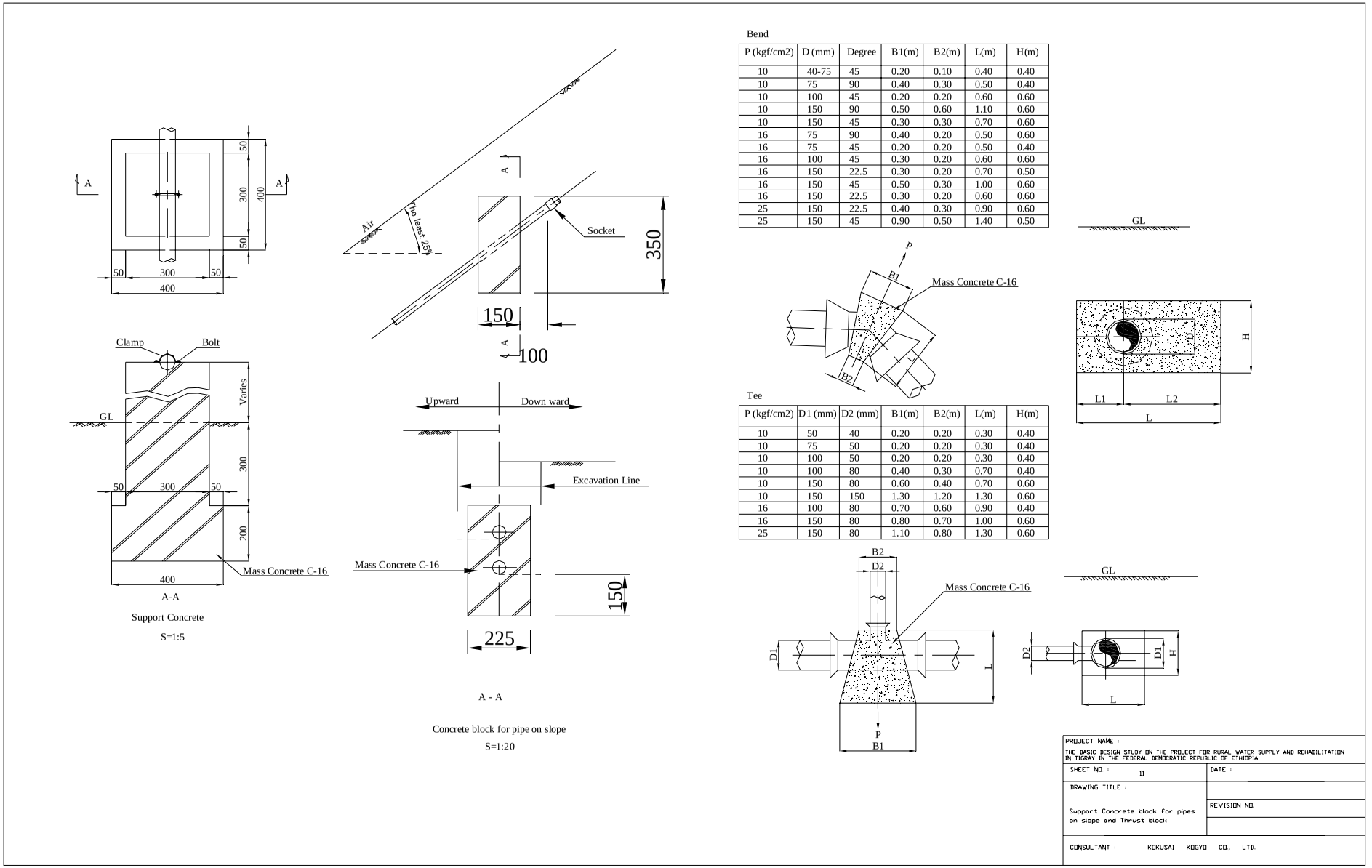
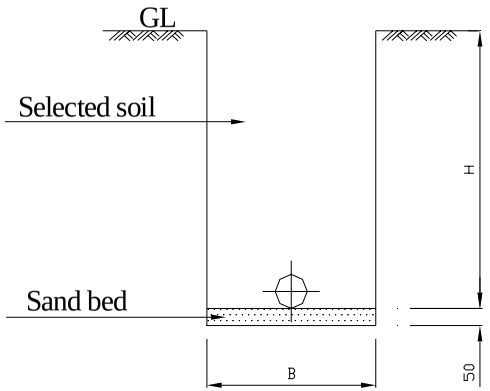


Figure 2-13: Support Concrete Block for Pipes on Slope and Thrust Block

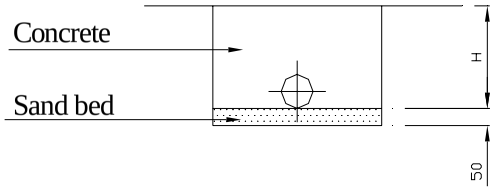
Unit:mm

H	1,120	1,120	880	890
B	690	680	600	600
System	Rising	Distribution	Rising	Distribution
	New		Rehabilitation	



Typical section of soil excavation

H	300	200
System	Rising	Distribution



Typical section of rock excavation

PROJECT NAME :
THE BASIC DESIGN STUDY ON THE PROJECT FOR RURAL WATER SUPPLY AND REHABILITATION IN TIGRAY IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

SHEET NO. : 12 | DATE :

DRAWING TITLE :
Typical section of earth work for pipe laying

REVISION NO.

CONSULTANT : KOKUSAI KOGYO CO., LTD.

Figure 2-14: Typical Section of Earth Work for Pipe laying

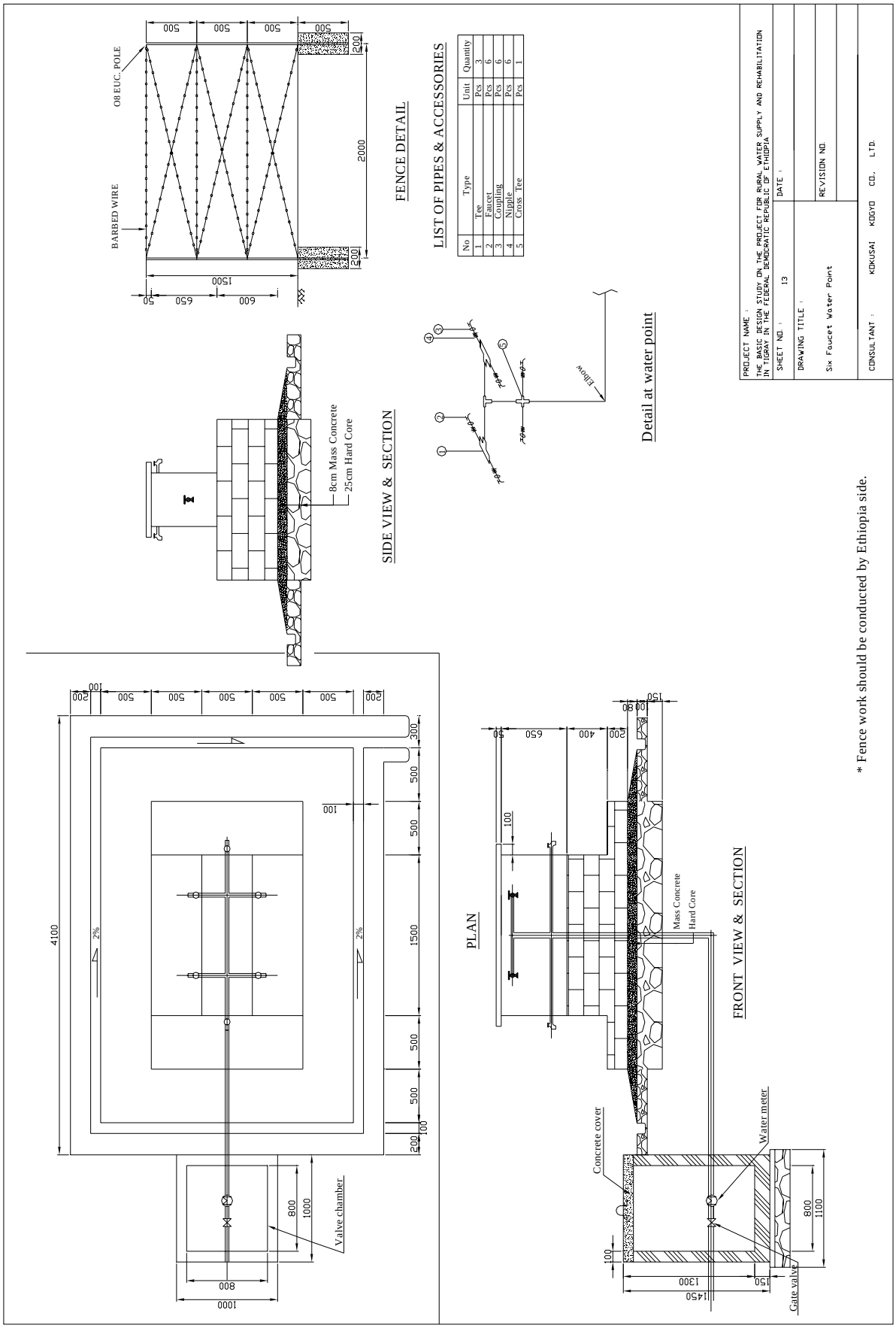


Figure 2-15: Six Faucet Water Point

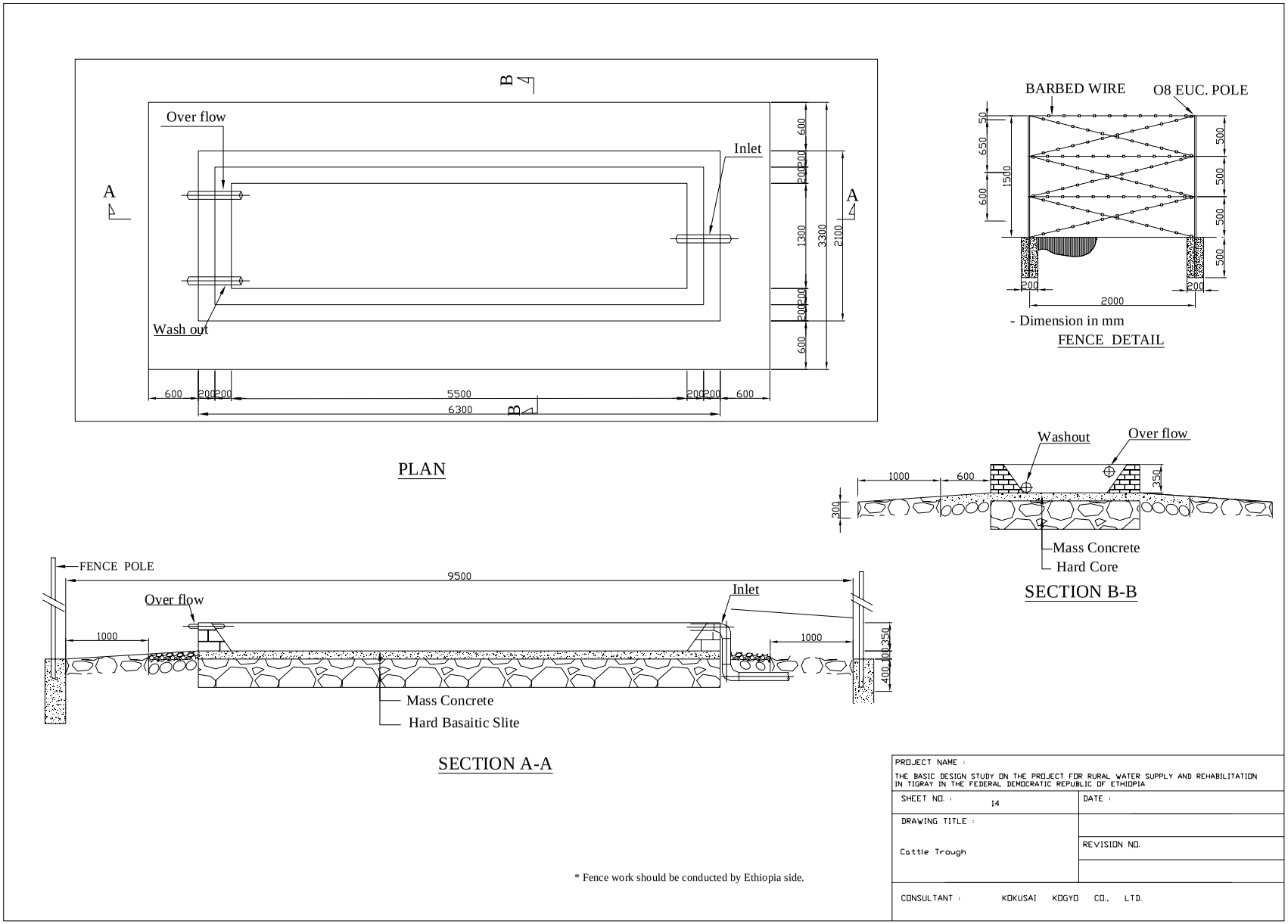


Figure 2-16: Cattle Trough

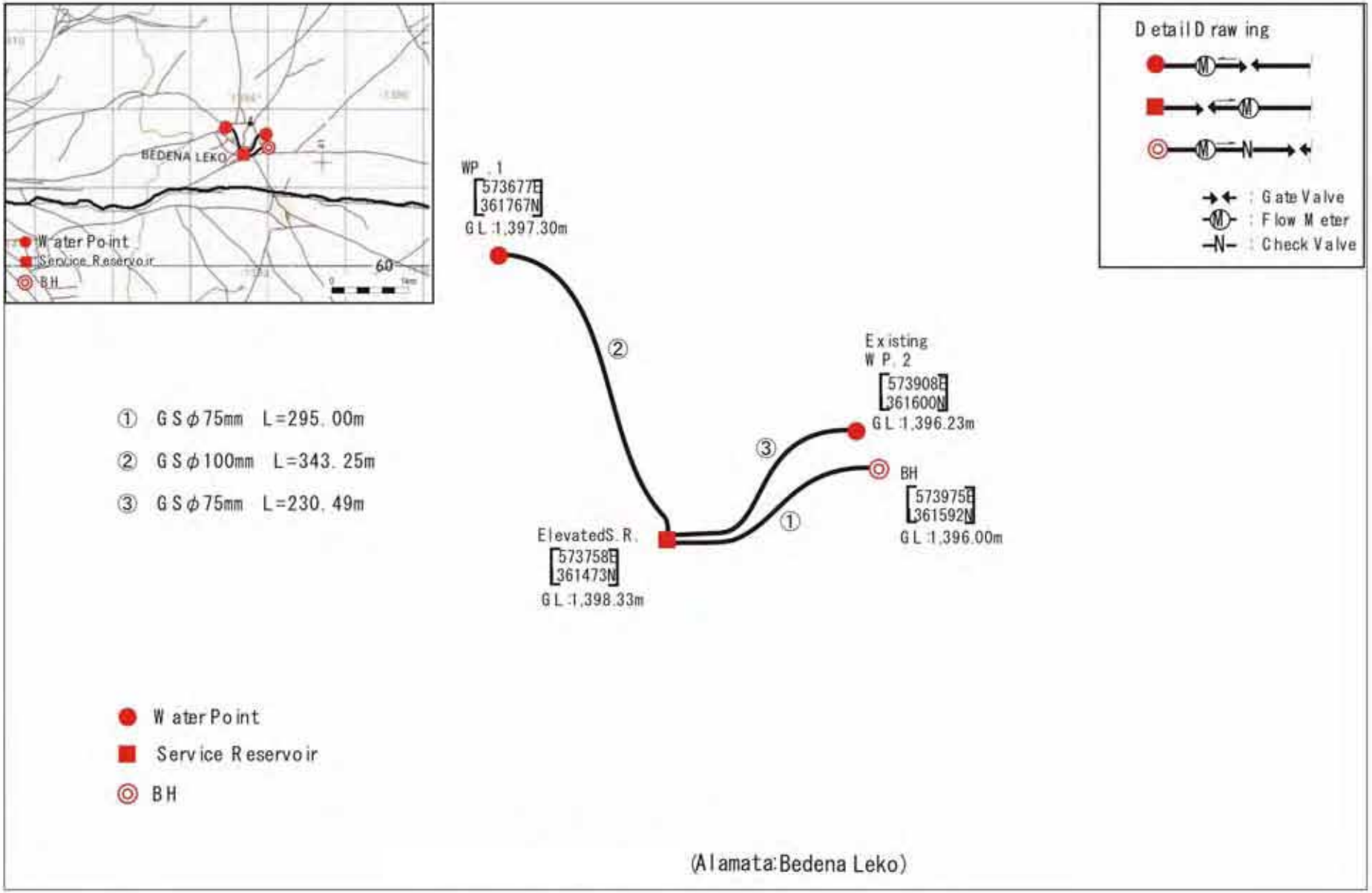


Figure 2-17: Layout for Water Supply Facility at Bedena Leko

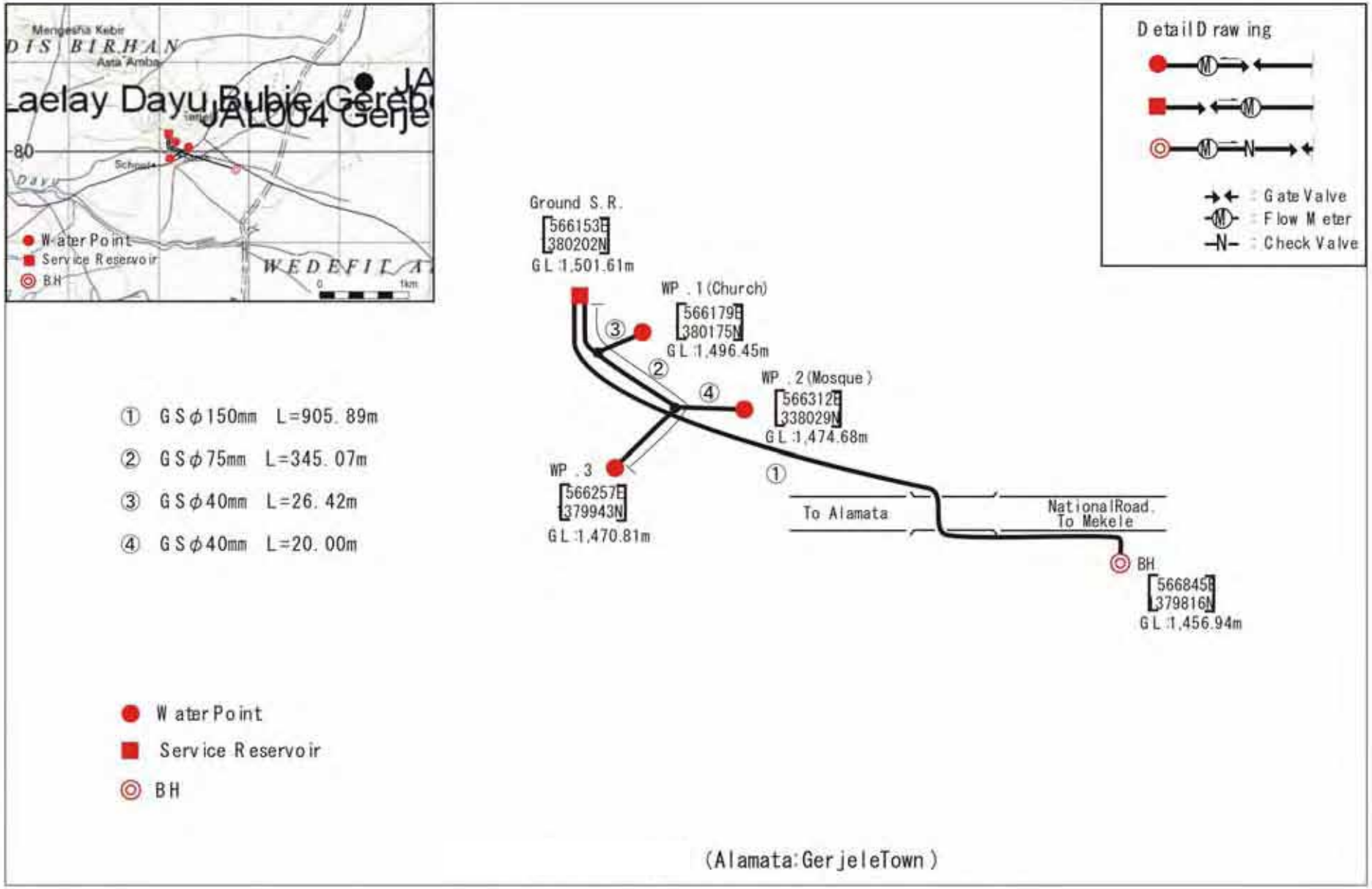


Figure 2-18: Layout for Water Supply Facility at Gerjele Town

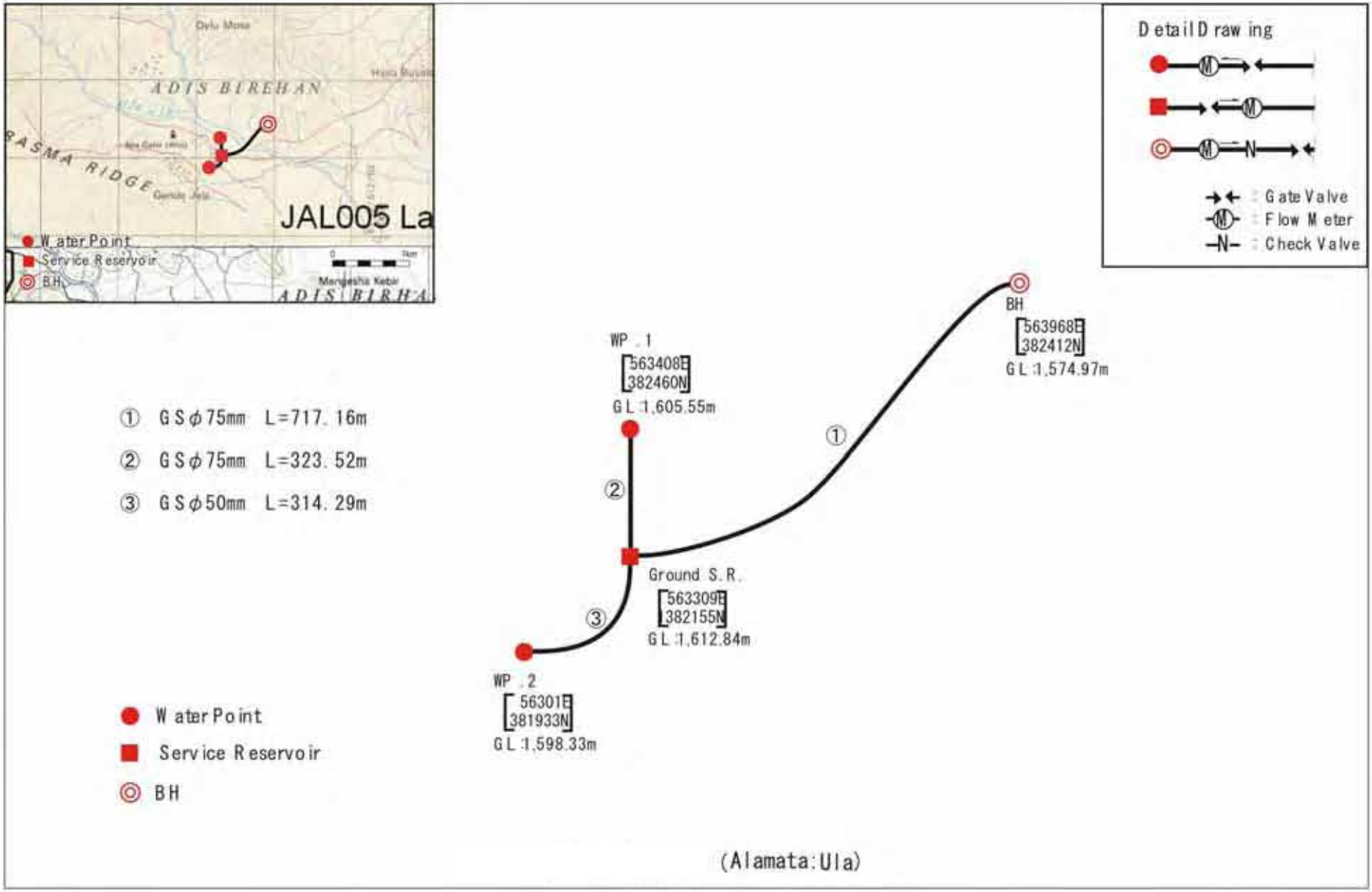


Figure 2-19: Layout for Water Supply Facility at Ula

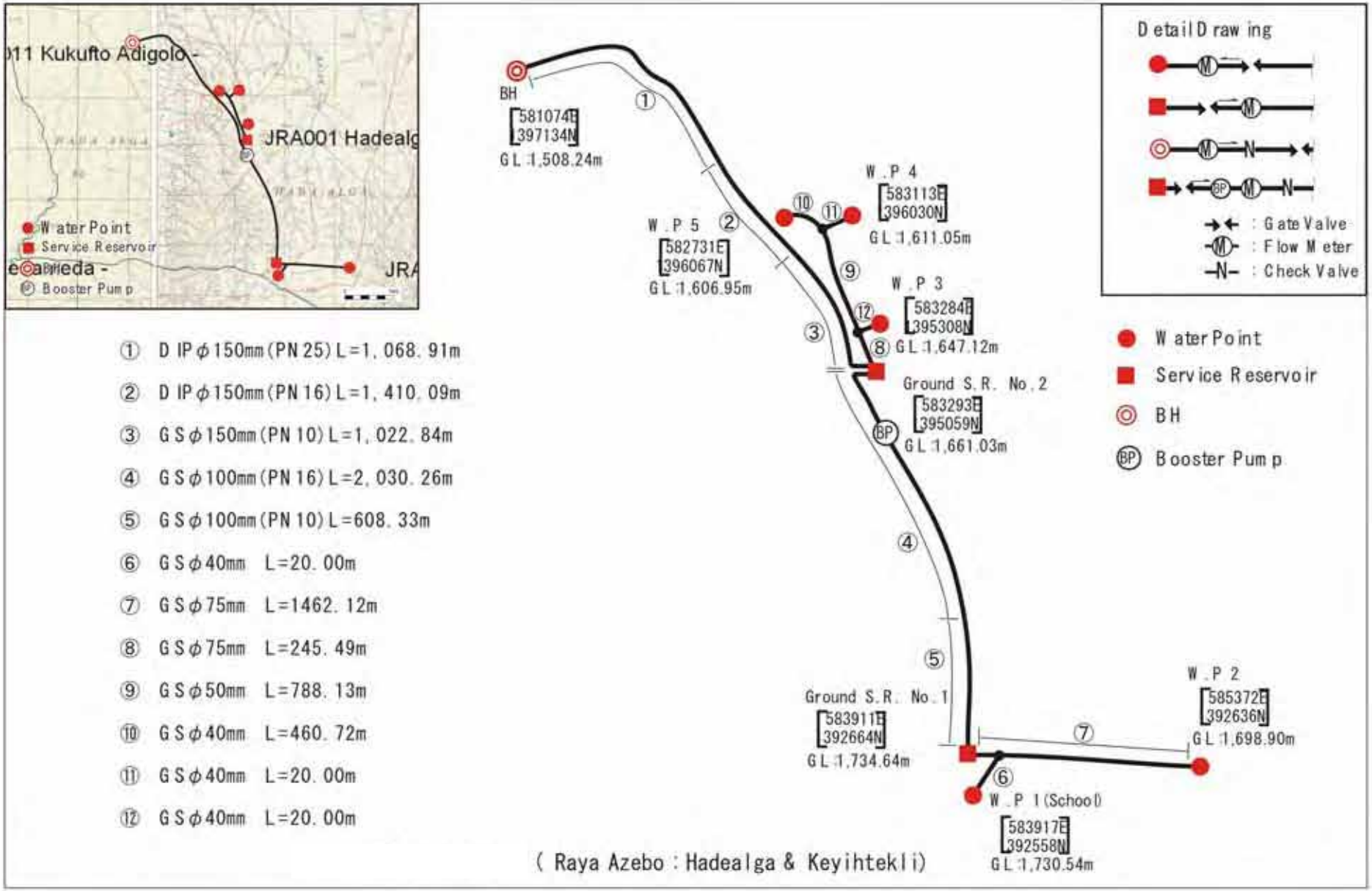


Figure 2-20: Layout for Water Supply Facility at Hadealga and Keyihtekli

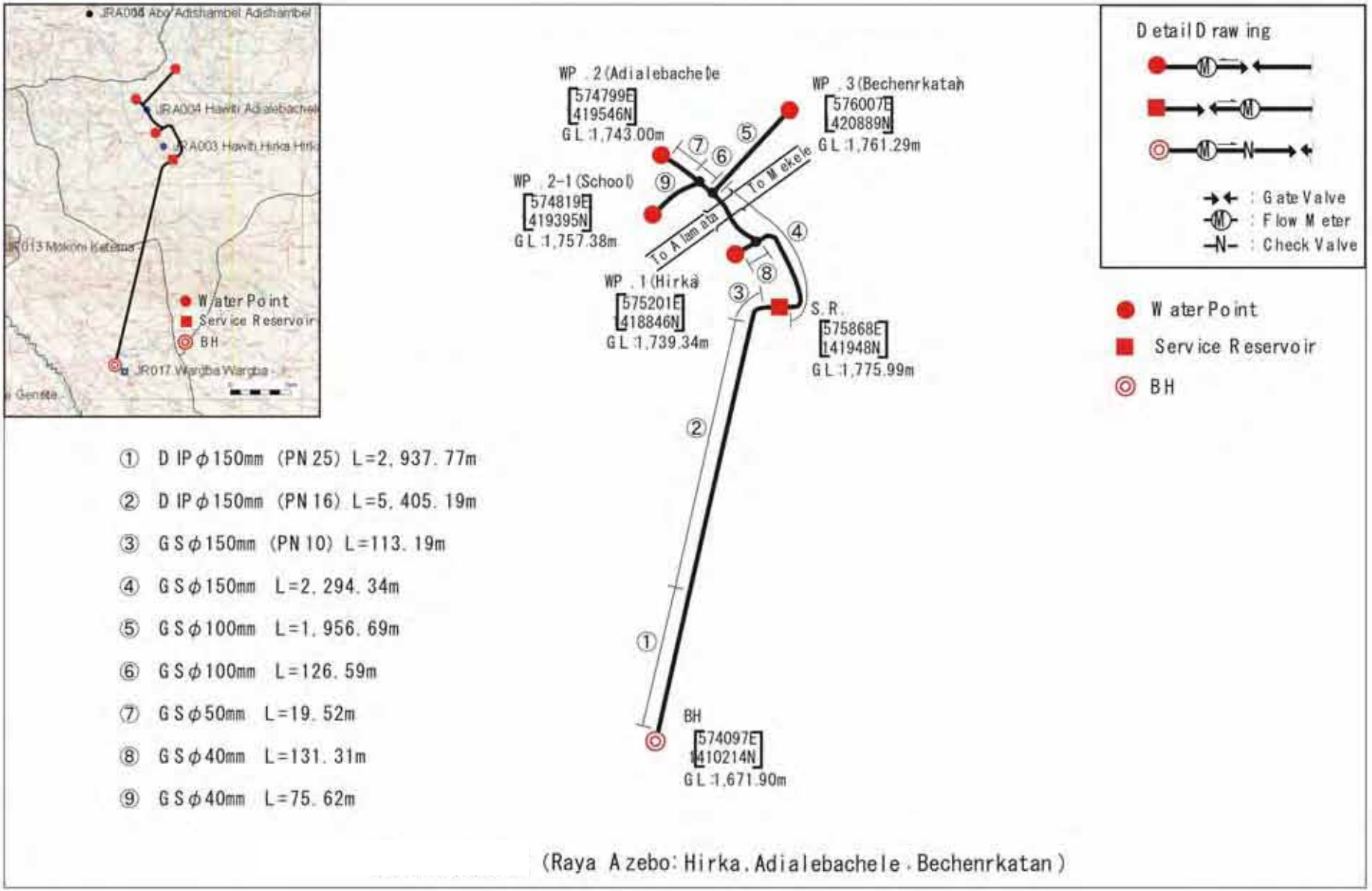


Figure 2-21: Layout for Water Supply Facility at Hirka and Adialebachele and Becherkatan

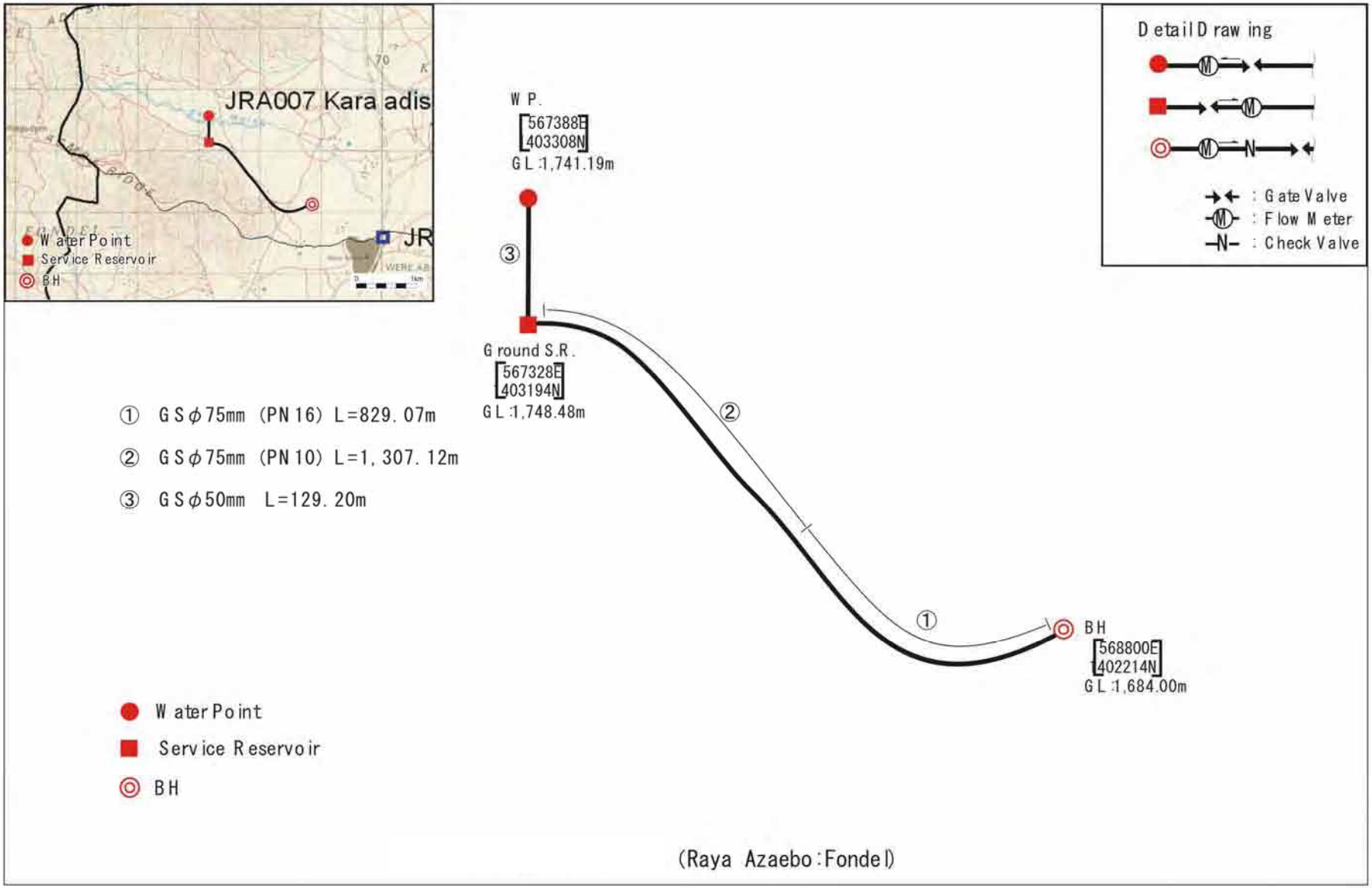


Figure 2-22: Layout for Water Supply Facility at Fondel

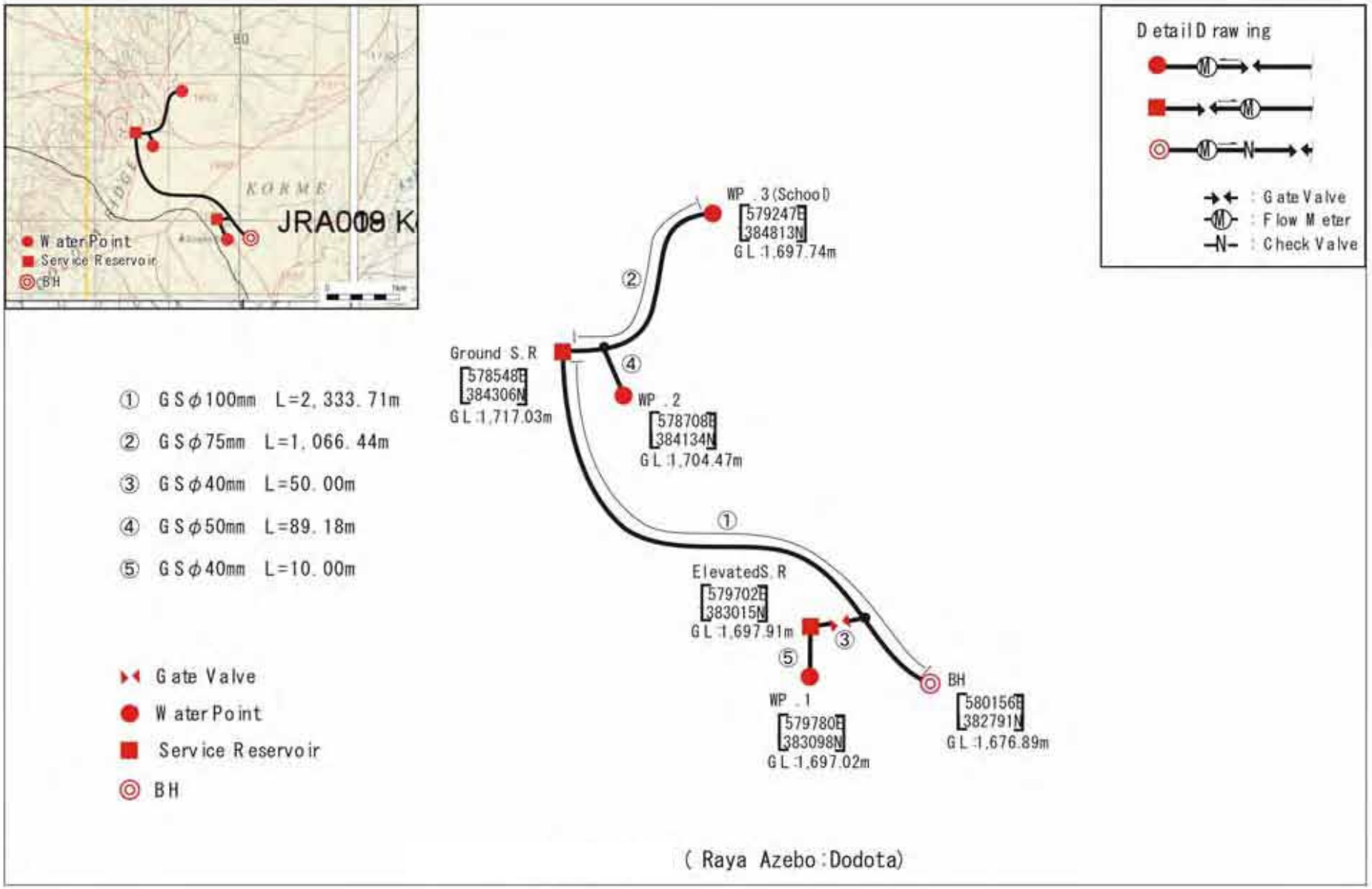


Figure 2-23: Layout for Water Supply Facility at Dodota

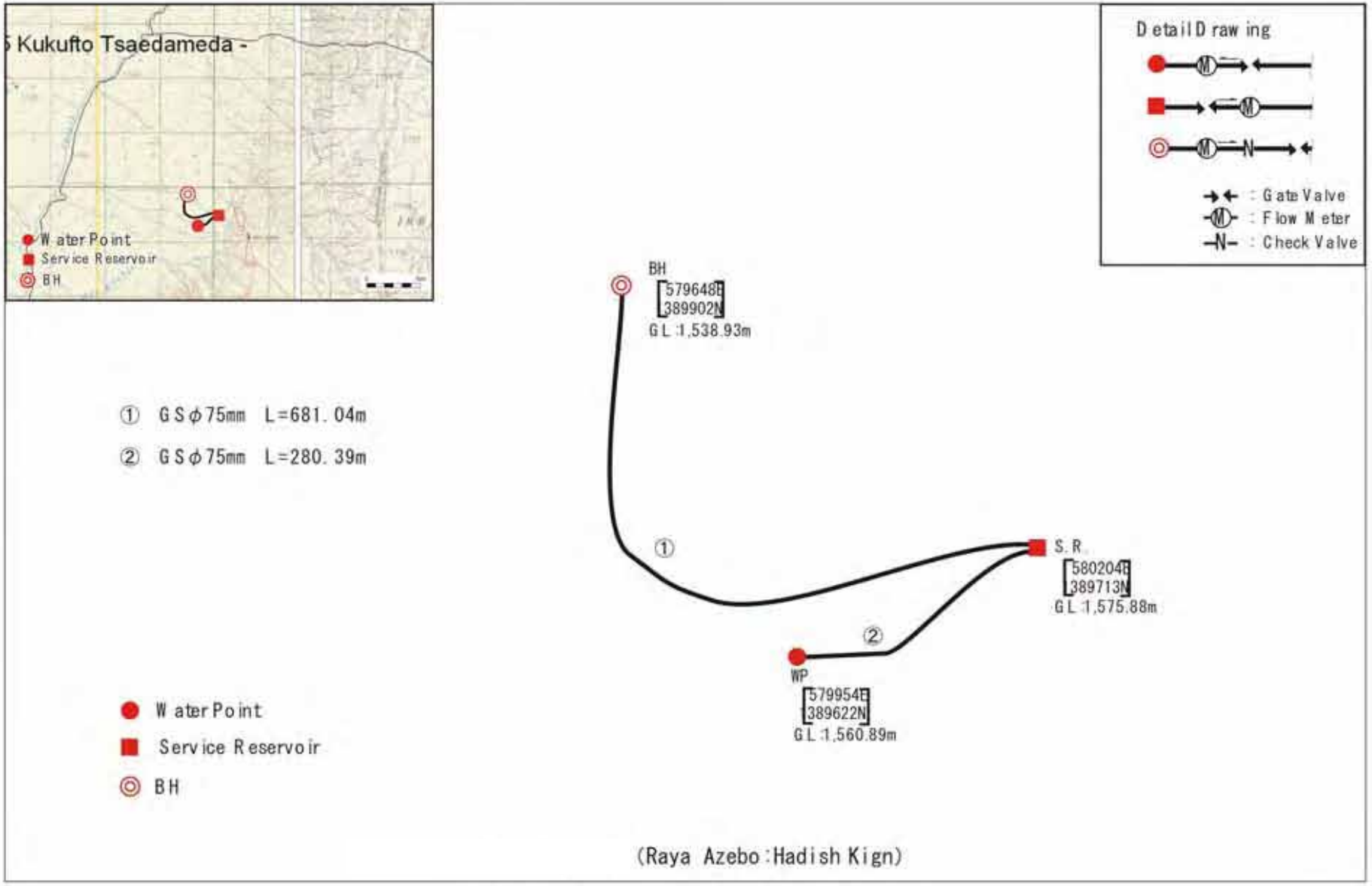


Figure 2-24: Layout for Water Supply Facility at Hadish Kign

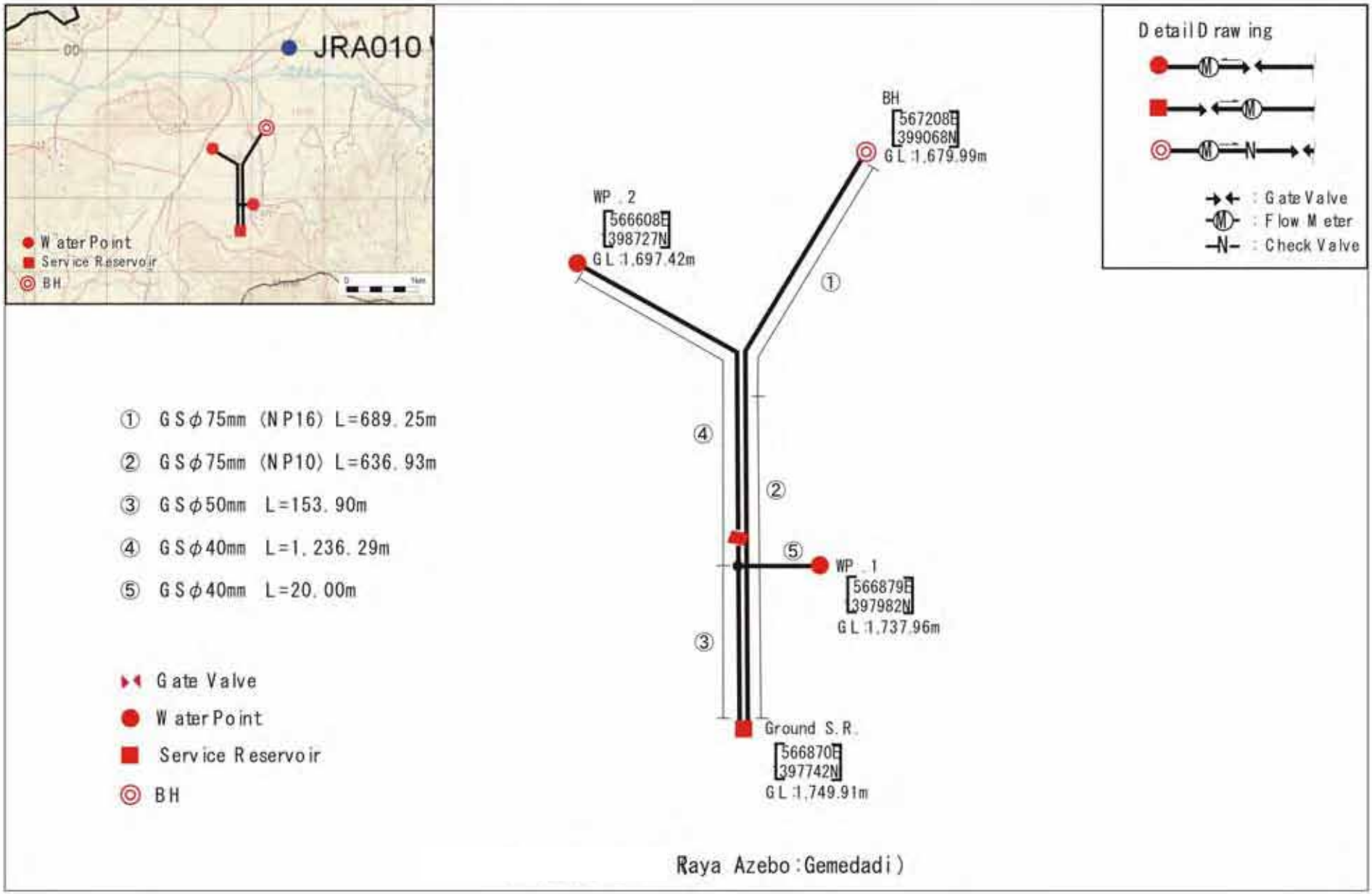


Figure 2-25: Layout for Water Supply Facility at Gemedadi

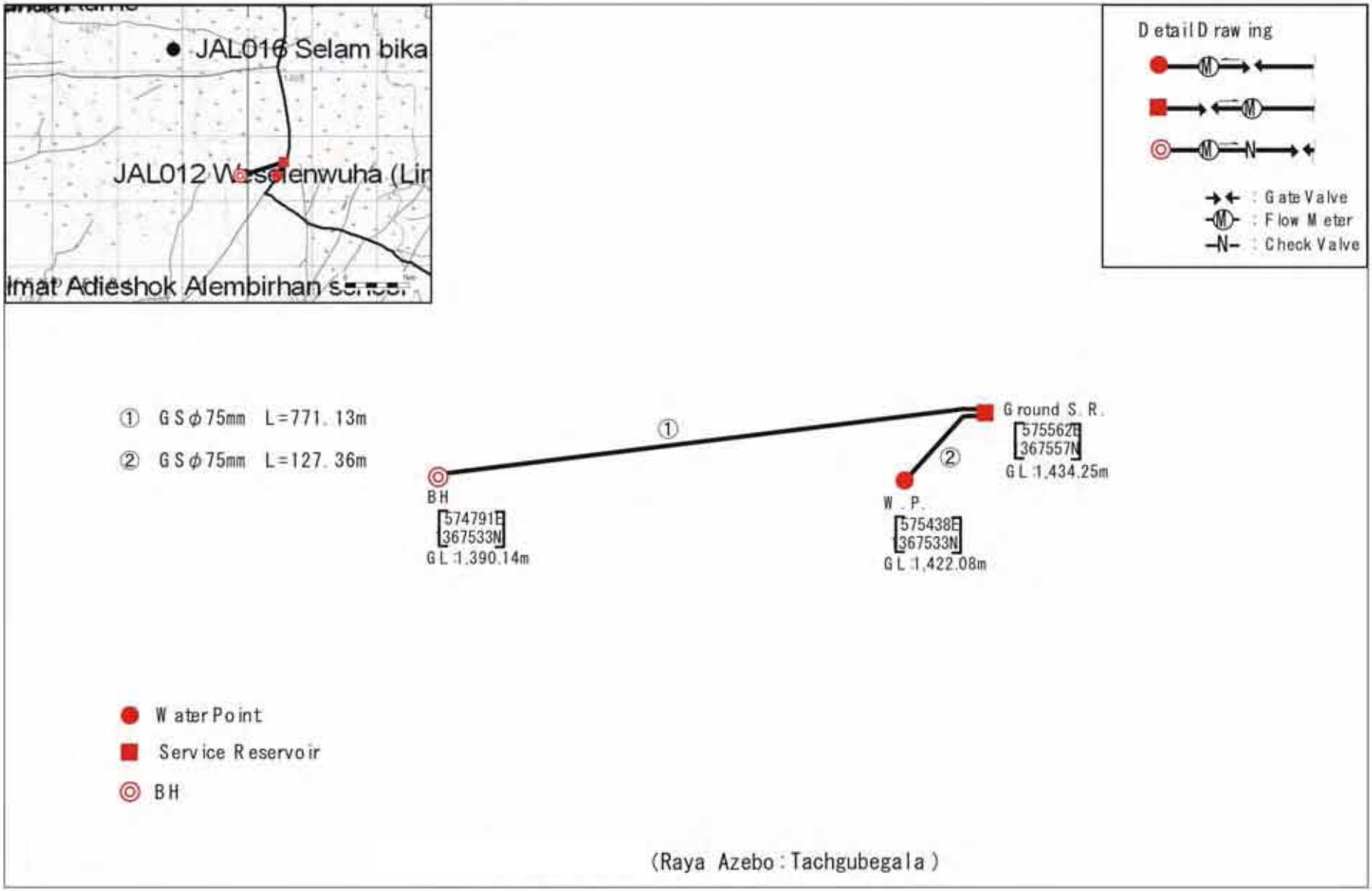


Figure 2-26: Layout for Water Supply Facility at Tachgubegala

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The policy of the implementation plan of the project is formulated based on Japan's grant aid scheme. The policy of the implementation plan is as follows:

(1) Implementation Structure

1) The implementation organization of the project is Tigray Water Resources, Mines and Energy Bureau (TWRMEB).
2) TWRMEB will hire a Japanese consultant to reserve services such as detail design execution, description of tender documents, support on bidding, supervision of facility construction and procurement of materials and equipment.
3) TWRMEB will exchange a contract agreement with the Japanese contractor, and the supervision of the contract will be carried out by the Japanese contractor.
4) Control of the operation and maintenance of water supply facilities and equipment will be transferred to TWRMEB after the completion of the project

The flow chart of implementation is shown in the following figure:

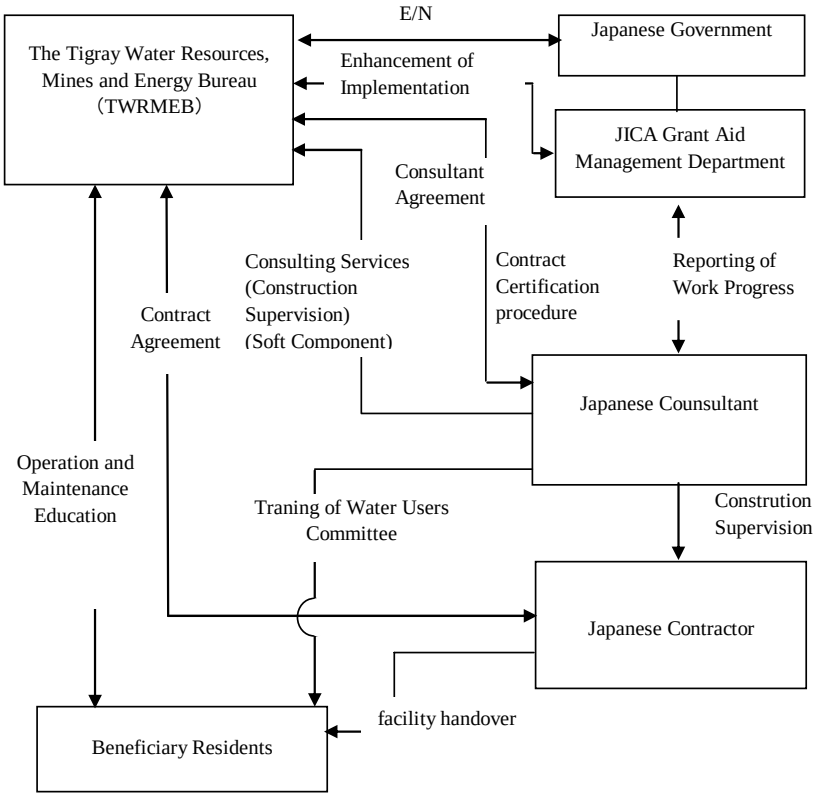


Figure 2-27: Project Implementation Structure

(2) Implementation Policy

1) The work period for this plan, from the fact that supply/transport of the maintenance

equipment and materials for water supply facility construction is included, will require a substantial 16.5 months from the time of contract to completion.

2) Good judgement is needed during construction of wells because, on top of the sites being scattered and a large number of wells to drill, the hydrogeological conditions are complicated. For some of the sites, special drilling technologies such as sealing techniques are required for layers contaminated with high concentrations of sulfate. Therefore,in this project, well drilling will be done by a local contractor under the guidance of Japanese drilling engineers.

3) The overall work schedule includes critical work for facility construction of installing pump equipment and electrical equipment, and concrete work required for watertight distribution reservoirs and elevated water tanks, as well as laying down approximately 36km of pipeline overall, which will require scrupulous schedule management, material and quality management. Thus, in this project, a local contractor will be used under the management of a Japanese engineer capable of comprehensively managing the three elements of quality, schedule and safety, and technician capabilities as the work management system.

4) There are few mechanic and electrical engineers in Ethioipa who can couduct the comprehensive installation of a motorized pump and electric power distribution equipment, thererfore a Japanese skill worker for mecanical and electrical work is despatched occasionally.

2-2-4-2 Implementation Conditions

(1) Accessibility to the Site

There is no concern about accessing target communities in the dry period; however, road conditions worsen in the rainy season and it is expected that access to certain locations will be difficult. It is necessary to carry out an adequate investigation into the accessibility of each community, followed by a plan for the construction schedule.

(2) Safety control

The northern part of the Tigray Region located near the border with Eritrea of the northern is an evacuation area and also the east side of the main road which connects Mekele to Alamata is specified as Level 3 by the safety standards of the United Nations. Although the project site is located in the southeast part of Tigray , there is no siginificant issue on safety. However with respect to the communication conditions, it is a very poor area, therefore, it is necessary to secure a satellite cellular phone for emergency contact.

(3) Procedure for Tax Exemption

It is anticipated that a great deal of time will be required to perform the procedures necessary

for tax exeptions, which effect a number of organizations, starting with TWRMEB, RBA, ECA and so forth. TWRMEB will take the initiative to implement the tax exemption procedures for this project, however it is necessary that the consultant and contractor side sufficiently understand the laws and regulations of Ethiopia concerning tax exemption, promptly prepare documents and carry out application procedures.

2-2-4-3 Scope of Work

Should this plan be executed through grant aid provided by Japan, the division of responsibilities for operation/supply and installation between the Ethiopian-side and the Japanese-side will be as shown below.

Table 2-26: Division of Work provided by Japan and Ethiopia

Division of Labor Duties	Japanese Side	Ethiopian Side
1. Hand Pump Well Facilities		
1.1. Secure land for facilities		○
1.2. Prepare access roads		○
1.3. Provide temporary construction site		○
1.4. Well construction	○	
1.5. Platform construction, installation of hand pumps	○	
1.6. Construction of fence	○	
2. Motorized Pump Well Facilities		
2.1. Well construction		
2.1.1. Secure land for construction		○
2.1.2. Prepare access road		○
2.1.3. Provide temporary construction site		○
2.1.4. Construct well	○	
2.2. Construct distribution reservoir		
2.2.1. Secure land for construction		○
2.2.2. Prepare access road		○
2.2.3. Contract distribution reservoir	○	
2.3 Generator room, public tap, livestock trough construction		
2.3.1. Secure land for construction		○
2.3.2. Prepare access road		○
2.3.3. Construct generator room	○	
2.3.4. Construct public tap and livestock trough	○	
2.3.5. Construct fence and gate	○	
2.4. Laying Water Main and Distribution Pipework		
2.4.1. Secure land for construction		○
2.4.2. Prepare access road		○
2.4.3. Lay water main and distribution pipework	○	
2.5 Motorized pump and generator installation		
2.5.1 Install motorized pump and generator		○
2.5.2 Lay electric transmission and distribution lead-in lines		○
3. Rehabilitation Work		
3.1. Secure land for construction		○
3.2. Prepare access road		○
3.3. Lay supply and distribution pipeline	○	

3.4. Construct generator room, public tap and livestock trough	○	
3.5. Install motorized pump and generator	○	
3.6. Construct fence and gate	○	

2-2-4-4 Consultant Supervision Plan and Procurement Management Plan

(1) Detail Design

1) Confirm budgetary provisions for the construction paid by the Ethiopia side
2) Implementation of supplementary survey for hydrogeology
3) Decide the final location for drilling point of new well facilities
4) Verify points of concern from the study of all target villages and work plan
5) Check and cooperate with EWTEC side for the soft component of this project
6) Verify the route for the pipeline
7) Confirm prospective construction sites for buildings
8) Coordinate any design changes from the basic design
9) Verify each the meteorological, topographic and geologic conditions
10) Carry out pumping test in target villages for rehabilitation
11) Verify condition of test-drilling wells drilled at the time of basic design
12) Verify constructions materials, cost of labor and equipment rental fees, etc
13) Confirm a place to store materials of implementation organization

(2) Preparation of Tender Document

Together with the preparation of the tender document based on project designs, documents required for tender will be prepared and their content discussed with the Ethiopian side before approval.

(3) Tendering (On behalf of Ethiopian side)

The Ethiopian side will undertake public announcement of the tender, audit of tender qualification, distribution of tender specifications and accept, analyse and evaluate the bids. Assistance will be given to conclude the contract between the Ethiopian government and the sucessful party.

(4) Supervision of Construction / Procurement of Equipment and Soft Component

The consultant will conduct supervision over the construction of water supply facilities, supervise procurement of provisional equipment and undertake the soft component.

1) Construction Supervision

a) Inspect and approve construction diagrams and such

b) Examine and approve quality management

c) Handle cases of faulty wells

d) Examine and provide guidance for policy to deal with problems that arise

e) Final inspection

f) Approve payment

g) Inspection following completion of construction

2) Procurement Supervision

a) Approve instrument production drawings

b) Factory visit

c) Meeting concerning cross-check for inspection prior to shipment

d) Oversee guidance on initial operation

e) Oversee inspection of delivered goods and handover

(5) Personnel assignment

The personnel required for construction supervision, procurement supervision and the soft component, which will be conducted by the consultant, is listed in the Table below.

Table 2-27: Japanese-side Supervision Personnel for Construction & Supply

Supervising Personnel	Area of Supervision	Dispatch Period
Construction Supervisor	Supervise overall duties Administration of final inspection of supply facilities and material provision	Spot supervision
Resident Supervisor	Site supervision during construction, response to change in design, etc.	Resident
Well Drilling Specialist	Initial period of well construction, mid-term spot supervision	Spot supervision
Equipment Procurement Supervisor	Equipment procurement plan, inspection, handover	Spot supervision
Completion Inspector	Final inspection upon completion of work	Spot supervision
O&M/Sanitation Ed./Evaluation	Guidance for maintenance control	Spot supervision

2-2-4-5 Quality Control Plan

Quality control tests will be conducted on the following items.

Table 2-28: Quality Control Test

Type of Work	Quality Control Test	Amount of Tests
Well Construction	Water quality analysis	89 points
Pipe Distribution	Water pressure test	Pipe distributed area
Concrete Casting	Aggregate material testing	Every purchasing contractor
	Reinforcing bar tensile test	Every purchasing contractor
	Concrete mixture test	Before construction
	Concrete testing (slump, air volume, salinity, compression test)	Per casting
Distribution reservoir Construction	Leakage test	11 facilities
Elevated Tank Construction	Soil bearing test	6 facilities

2-2-4-6 Procurement Plan

(1) Construction Equipment/Material

Of the materials required for the project, the fundamental materials such as cement, aggregate, iron reinforcement, steel frame, and timber, as well as secondary goods generally available such as GS (galvanized steel) pipe 75mm or less in diameter, block, and tile, shall be procured locally wherever possible. However, it has been assumed that the procurement of ductile pipe (DIP), GS pipe 100mm or more in diameter and other special pipe fittings and valves, measurement instruments such as pressure gauges and flow meters, electricity and machine parts for pump facilities will be difficult to obtain in the limited time frame due to the small number of agents at the local. Because of this, these items shall be procured in Japan or a third country. The procurement source of construction materials and equipment for the project will be carried out as shown in Table 2-29.

Table 2-29: Construction materials procurement source

Equipment and Materials	Procurement Source			Remarks
	Japan	Ethiopia	3rd Country	
Cement		○		
Fine aggregate		○		
Coarse aggregate		○		
Steel material		○		
Formwork material		○		
timber		○		
Fuel		○		
GS pipe (galvanized steel pipe)		○	○	
Ductile pipe (DIP)	○		○	
Valves	○		○	
PVC		○		
Hand pump		○	○	

submersible pump with accessory	○		○	
Generator with accessory	○		○	

(2) Intercontinent Transportation

Djibouti Port will be used for the import and export of materials and equipment. In the Tigray Region, general customs procedures take place at the customs office in the regional capital of Makele. Therefore, in this plan as well, direct transit will be arranged from Djibouti to Makele, designating Makele as the principal location to handle these procedures.

Moreover, the distance of transportation from Djibouti to Makele is approximately 940 km (of that, approx. 580 km is paved road).

(3) Labor

In Ethiopia, concerning the utilization of construction technicians, carpenters, plasterers, and simple labor for construction works, their services will be employed wherever applicable. However, there are few technicians and construction engineers in Mekele that are able to execute comprehensive construction, so these technicians will be employed in Addis Abeba.

(4) Construction Equipment

Commonly used equipment such as drilling rigs, backhoes, dump trucks, and truck-mounted cranes are available locally for leasing. Therefore, the equipment will basically be leased locally.

2-2-4-7 Operational Guidance Plan

The service rig for the project is a specific type that requires initial operation instruction by the manufacturer. Instruction will given to the operator staff in the Central Workshop of TWRMEB. Instruction on the generator, control panel, inital operation of submersible pump, bulbs, flowmeter, operation and maintenance of handpump, replacement of spareparts and trouble shooting will also be conducted in the soft component programme. The following table indicates the plan for operational guidance.

Table 2-30: Initial Operation Instruction and Guidance

Facility Type		Contents	Target
Equipment	Service Rig	Operation Method Maintenance Method	Engineer and /or operator in the Central Workshop
Hand pump and well facilities	Hand pump	Replacement of U seal, O ring	Water Users Group
Submersible pump and water	Intake facility	Operation of submersible pump, maintenance and inspection method	Water Users Group

supply facilities		Operation of generator, maintenance and inspection method. Replacement of consumable supplies and material	Water Users Group
		Operation of control panel, maintenance and inspection method	Water Users Group
	Pipe line	Operation of valve	Water Users Group
		Inspection of seepage	Water Users Group
	Public tap	Maintenance of flowmeter	Water Users Group

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

(1) Background

The objective of the Basic Design Study is to "increase the population that receives safe and reliable water supply in the target areas." The operation and maintenance of existing water supply facilities in the selected locations receives support from other donors and NGOs, and the facilities are deemed to be operating efficiently. However, the regional government's role in operation of village water supply facilities and the support system for O&M activities by residents are not clear. Furthermore, in the sites where new facilities are to be constructed in the Study, it is necessary to create a new organization for operation and maintenance of the facilities and to clarify the regional government's support system, in addition to providing assistance and technical guidance for O&M activities by residents. Therefore, by planning the Soft Component, it will be possible to provide assistance to ensure the smooth establishment of an operation and maintenance system so that villagers can receive sustainable water supply services.

(2) Objective

Based on the above background and the operational problems and countermeasures, the objective of the soft component is for "operation and maintenance by residents to be adequately carried out" during the project period. The top goal is for the water supply facilities constructed in the Study to be used long after the project is complete. That is, implementation of the soft component aims at the continued operation and maintenance of facilities by residents after assistance has ended, which has been a major problem in the past, and this is in line with the project objective stated above.

(3) Results and Means of Confirmation

The results are generally divided into five categories. The respective results are shown in Table 3.24 and the index and means confirmation are shown in the table below.

Table 2-31: Results and Means of Confirmation

Number	Results	Index of Achievement	Means of Confirmation (Draft)
1	Residents operate and maintain facilities with sense of ownership	1. Do the concerned organizations have a common understanding of residents' role in operation and maintenance?	1. Interviews with concerned organizations
2	Village Water Committees (VWC) and their support system and roles are clarified	1. Are the roles of each organization concerned with the O&M system clear?	1.Organizational chart of O&M system
		2. Does each organization concerned have a clear understanding of its role?	2.Interviews with concerned organizations
3	A resident-centered O&M plan is formulated and practiced in each village.	1. Have water use rules been established?	1.Water use rules
		2. Is the handling of maintenance/repairs clear?	2. Bylaws for maintenance/repair
		3. Is monitoring/ evaluation being implemented according to plan?	3. Monitoring records
4	The concerned organizations acquire the necessary skills for O&M	1. Is the period of breakdown shortened?	1.Records of WWRMEO activities
		2. Is the frequency of breakdown reduced?	2.Log of facility operation
		3. Have records of fee collection and facility operation been kept?	3.Various ledgers
5	Residents' concept of hygiene/sanitation is improved	1. Has resident's hygiene awareness been raised?	1. Questionnaires for residents

(4) Activities (Input Plan)

The content, target participant and implementer of the activities are summarized in the table below. While making effective use of local resources, in principle Japanese consultants (or local consultants subcontracted based on the guidance of Japanese consultants) are to take part in all activities. Depending on the activity content, the activities will be implemented with the cooperation of regional government staff such as TWRMEB, WWRMEO, etc. and EWTEC.

Table 2-32: Input Plan

Activity	Content	Form	Target participant	Implementer (collaborator) = Input
1	Provide education on resident participation to concerned organizations	Workshop	TWRMWO staff, WWRMEO staff	Japanese consultant （someone who has participated in EWTEC or EWTEC）
	Organize village meeting to obtain understanding about the Study	Resident meeting	VWC, WUGs, residents	WWRMEO staff (local consultant)
2	Review activities of VWC thus far and re-examine how they are conducted	Workshop	VWC, residents	Local consultant (WWRMEO, WUGs）
	Establish resident -centered	Workshop	VWC, residents,	Japanese consultant

	O&M system including support through coordination with concerned organizations.		TWRMEB staff、WWRMEO staff, etc.	（WWRMEO, NGO, other donors）
	Organize joint committee meeting based on the concerned organizations	Joint committee meeting	Constituent members of O&M system	Local consultant (Japanese consultant)
3	Formulate an O&M plan including water use rules, response to breakdown, etc. in each village	Workshop/OJT	WWRMEO staff, residents	Local consultant (Japanese consultant)
	Implement O&M activities according to formulated plan	Monitoring/activity records	Residents, constituent members of O&M system	Local consultant (Japanese consultant)
	Monitor/Evaluate activities and revise the plan	Joint committee meeting	Members of O&M system	Japanese consultant (Local consultant)
4	Conduct training on methods of resident participation for concerned organizations	Seminar, on-site OJT	WWRMEO staff, VWC, WUGs	Local consultant (Japanese consultant)
	Conduct technical training for facility repair.	Seminar/Practical training	TWRMEB staff, WWRMEB staff	Japanese consultant （someone who has participated in EWTEC or EWTEC）
	Conduct technical training on facility repair for VWC Facility Caretaker	Practical training	VWC Facility Caretaker	WWRMEO staff (Japanese consultant)
	Conduct training on administrative skills for VWC Treasurer.	Practical training/ Seminar	VWC Treasurer	Local consultant (Japanese consultant)
5	Provide hygiene education to residents.	Seminar	Residents	WWRMEO Community Development Officer (Local consultant)
	Provide guidance on hygiene patrols to residents.	Guidance on hygiene patrols	VWC	WWRMEO staff

(5) Procurement Method of Implementation Resources

Regarding the Input Plan in the Soft Component, the Japanese consultant (spot supervision) for operation and maintenance will essentially participate with the local consultant at the initial and final stage of the activities in each phase, confirming the purpose and direction of the activities with the local consultant.

The following are being considered for the local consultant.

① Professional Consulting and Business PLC （local subcontractor that conducted the socio-economic study in Basic Design Study; members consist mainly of professors and graduate students from Mekele University）

② Private consultant; retired TWRMEB worker involved in O&M activities of village water supply

(6) Implementation Schedule

The O&M activities consist of a total of four field works by the Japanese consultant. The contents to be implemented in the Soft Component are generally divided into the following two

phases:

- Activities for launching a new organizational system (Phase I, mainly before construction)
- Practical training/On-site guidance and OJT (Phase II, during and after construction)

The activites before construction (Phase I) are expected to take approximatly 4.5 months. However, in order for government staff to take part in launching a new organizational system at sites that do not yet have a management system such as village water committees, in the initial one month period the Japanese consultant will explain the plan for O&M and the concrete Soft Component plan to mainly regional and woreda government staff. Based on that plan, local staff will go to the target sites with the responsible government staff and implement the overall activities for launching the new system, although it is determined to be unproductive for the Japanese consultant to stay on-site during this period. The Japanese consultant will return to the site in the final stage of this process to examine the methods of coping with the problems encountered and if necessary, revise the O&M plan. The follow up work is to be entrusted to the regional/woreda government staff.

In Phase II, the Japanese consultant will provide practical training on management techniques and education on administrative methods to the O&M organizations. In the inital stage of Phase II, on-site OJT will be conducted based on the constructed facilities (in some cases, existing facilities) for facilities that are relativly difficult to operate and maintain, such as Level 2 systems. Subsequently, the Japanese consultant will provide the same training to the government staff in charge of the local consultant for each village. In the final stage, the Japanese consultant will conduct a review based on the results of “the new organizational system launch”, “O&M practice”, and “monitoring” implemented thus far and if necessary, reconsider the operational method of the organizational system to produce a system that can be handed over to the responsible regional government staff.

The schedule consists of 1) before construction (4.5 months) and 2) during and after construction (10 months), and of the overall 15 month implementaion schedule, the Japanese consultant will conduct four field activities (4 months) at the beginning and end of each phase. The activities of the local consultant are expected to take 12 months.

(7) Results

The results of the Soft Component with respect to each activity are set as follows:

Table 2-33: List of Activities and Results

Activity	Results
1.1 Provide education on resident participation to the concerned organization.	Workshop reports
1.2 Organize village meetings to gain understanding of the Study.	Minutes of meeting
2.1 Review the activities of the VWC thus far and re-examine how they are conducted.	Written agreement on VWC
2.2 Establish a resident-centered O&M system including support through coordination with the concerned organizations	Organizational chart of O&M system
2.3 Organize joint committee meeting based on concerned organizations.	Minutes of meeting
3.1 Formulate an O&M plan including water use rules, response to breakdowns, etc. in each village.	O&M Plan Monitoring sheets
3.2 Conduct O&M activities according to formulated plan.	Activity records
3.3 Monitor/Evaluate activities and revise plan.	Monitoring results Evaluation result Revised O&M plan
4.1Conduct training on resident participation methods to concerned organizations.	Training Implementation Reports
4.2 Conduct technical training on facility repair for TWRMEB, WWRMEO.	Training Implementation Reports
4.3 Conduct technical training on facility repair to VWC Caretaker	Training Implementation Reports
4.4 Conduct training on administrative skills for VWC Treasurer.	Training Implementation Reports
5.1 Provide hygiene education to residents.	Hygiene Education Implementation Report
5.2 Provide guidance on hygiene patrols to residents.	Records on patrol guidance

The above activities will be evaluated and examined, and the reports below will be submitted during and after implementation of the Soft Component.

1． Soft Component Implementation Report

2． Soft Component Completion Report

(8) Responsibilities of the Ethiopian Government

①Notify and make preparations for each woreda and target village regarding the contents to be implmentd in this plan

③ During implementation of the plan, secure the necessary workspace and bear the expenses for preparation of materials, etc.

④ Assign government staff concerned with the project

⑤ Bear the expenses of on-site activities, transportation, accommodation and daily allowance for government staff concerned with the project

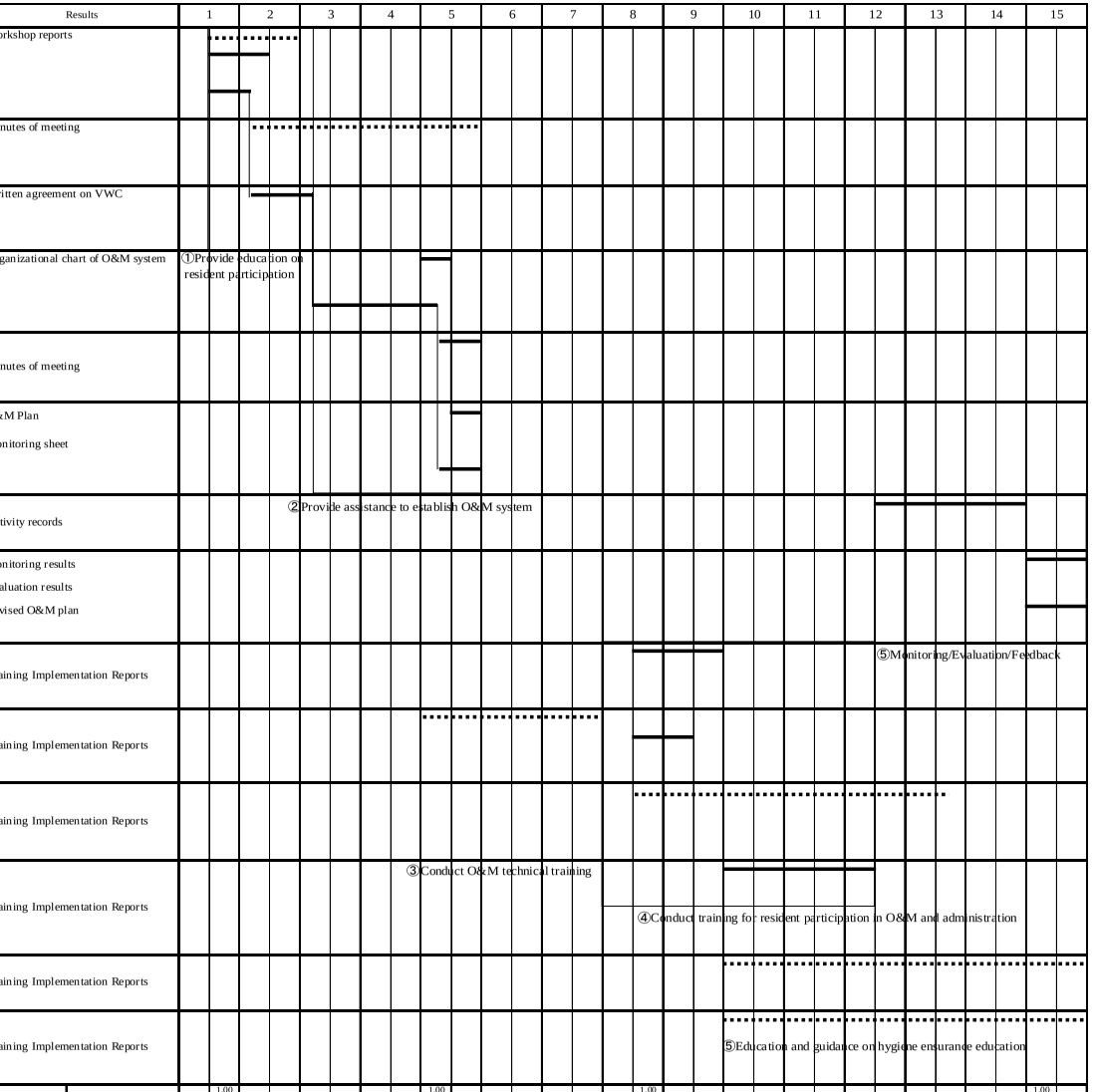
⑥ Request and obtain permission from the central government for activities concerned with EWTEC

⑦ Bear the expense for activities concerned with EWTEC

⑧ Prepare venue for workshops, etc. and bear the expense of holding workshops

Table 2-34: Activity Schedule for Soft Component

Activity No.	Content	Target	Stage/Place/Period	Input	Results
1.1	1.1 Provide education on resident participation to the concerned organization.	TWRMEB[2] WWRMEO[3]	・Before construction ・Region, each Woreda (10 Woredas) ・20 days	・EWTEC[1] ・Japanese consultant (O&M management supervisor) ・Local consultant ・vehicle	Workshop reports
1.2	1.2 Organize village meetings to gain understanding of the Study.	Residents of target villages, Village council	・Before construction ・Target village for facility construction (98 villages) ・1 day	・WWRMEO (local consultant) ・vehicle, design diagram	Minutes of meeting
2.1	2.1 Review the activities of the VWC thus far and re-examine how they are conducted.	VWC (and residents) of target village ＜Observer＞ WWRMEO, Village Council	・Before construction ・Target village for facility construction (10 woredas X 1.5 days) ・15 days	・Local consultant ・vehicle	Written agreement on VWC
2.2	2.2 Establish a resident-centered O&M system including support through coordination with the concerned organizations	Resident, WC, TWRMEB, WWRMEO NGO, Other donor, Village council	・Pre-construction ・Target village for facility construction (98 X 0.6 days) ・60 days (3 days for preparations)	・Japanese consultant (O&M management supervisor) ・Local consultant ◇Vehicle	Organizational chart of O&M system
2.3	2.3 Organize joint committee meeting based on concerned organizations.	Members of O&M system	・Once per quarter, pre-, mid- and post-construction ・Target village for facility construction (10 woreda x 2 days) ・20 days	・Local consultant ・Vehicle	Minutes of meeting
3.1	3.1 Formulate an O&M plan including water use rules, response to breakdowns, etc. in each village.	Residents of target villages, Village council WWRMEO	・ Pre-construction (agricultural off-season) ・Target village for facility construction (10 woreda x 2 days) ・20 days	・Japanese consultant (O&M management supervisor) ・Local consultant ・Vehicle	O&M Plan Monitoring sheet
3.2	3.2 Conduct O&M activities according to formulated plan.	WC, TWRMEB, WWRMEO, MoH NGO, Village council	・Post-construction ・Target village for facility construction ・Continual	・Local consultant ・O&M Equipment and Materials	Activity records
3.3	3.3 Monitor/Evaluate activities and revise plan.	Resident, WC, TWRMEB, WWRMEO, MoH NGO, Village council	・Post-construction ・Target village for facility construction ・ Quarterly monitoring, Evaluation Once/year	・Japanese consultant (O&M) ・Local consultant ・Vehicle	Monitoring results Evaluation results Revised O&M plan
4.1	4.1Conduct training on resident participation methods to concerned organizations.	WWRMEO, WC, Village council	・Pre-construction ・Each Woreda (10 woreda) ・1 day	・Local consultant ・ Vehicle, Materials for resident participation methods	Training Implementation Reports
4.2	4.2 Conduct technical training on facility repair for TWRMEB, WWRMEO.	TWRMEB、WWRMEO	・Mid-construction ・Each woreda (10 woreda) ・2 days	・EWTEC ・Japanese consultant (Facility supervisor) ・Vehicle, Repair equipment	Training Implementation Reports
4.3	4.3 Conduct technical training on facility repair to VWC Caretaker	Facility Supervisor of WC	・Mid-construction ・ Assemble and train supervisors in each Woreda ・1 day	・WWRMEO (local consultant) ・Vehicle, repair equipment ・ Participant travel cost, daily allowance	Training Implementation Reports
4.4	4.4 Conduct training on administrative skills for VWC Treasurer.	Accountant for WC, Committee Chair	・Mid-construction ・ Assemble and train supervisors in each Woreda ・2 days x 10 woreda	・Local consultant ・Vehicle ・ Participant travel cost, daily allowance ・Training materials	Training Implementation Reports
5.1	5.1 Provide hygiene education to residents.	Residents of target village for facility construction	・Project implementation period ・Target village for facility construction ・1 day X 2 times	・Woreda Insurance Staff ・Vehicle ・Materials for hygiene education	Training Implementation Reports
5.2	5.2 Provide guidance on hygiene patrols to residents.	Resident groups of target village for facility construction	・Project implementation period ・Target village for facility construction ・ Patrol once in two months (bi-monthly)	・NGO, village volunteers ・Vehicle ・Bicycle	Training Implementation Reports



LEGEND

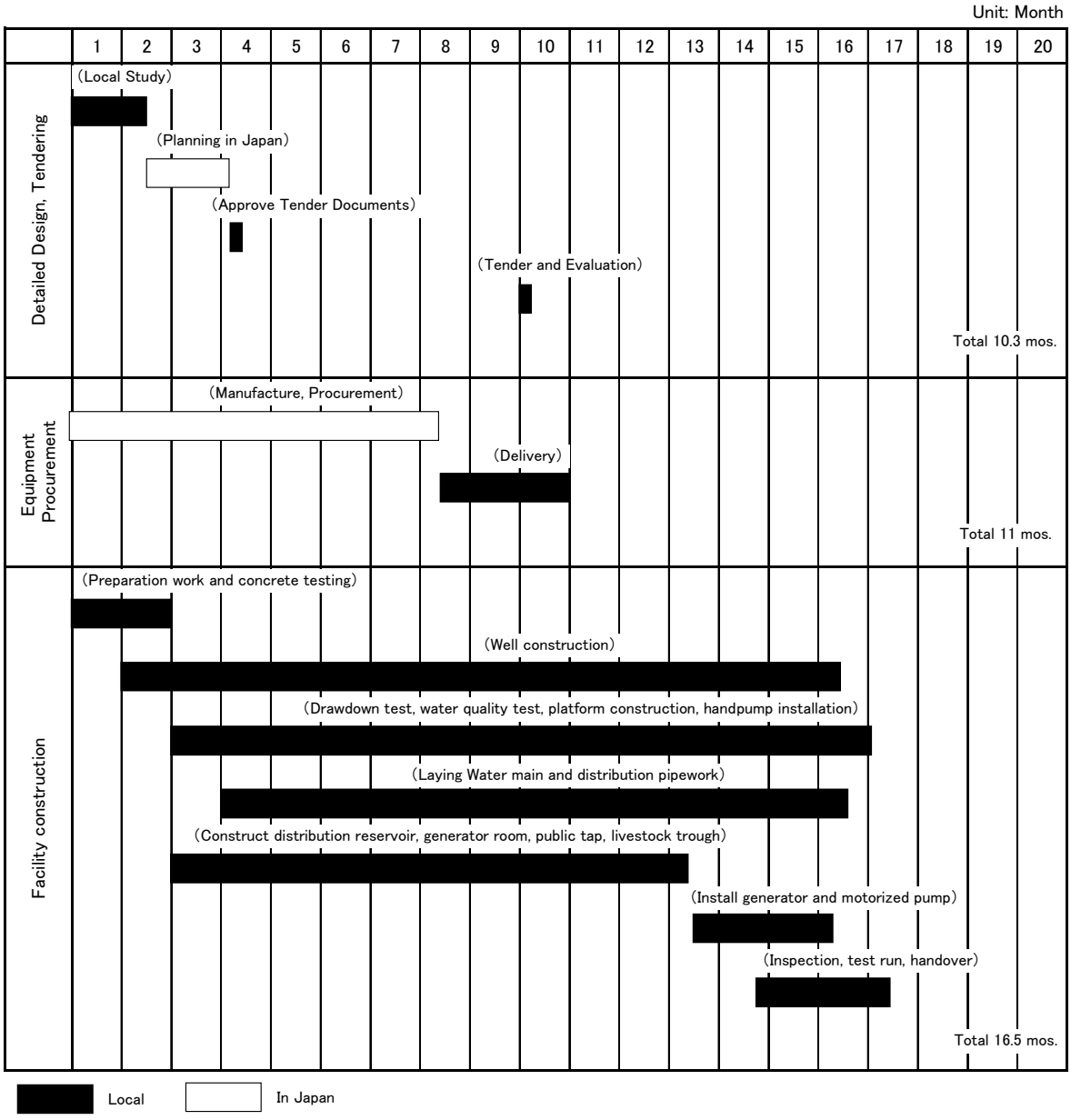
Note
1 EWTEC = Ethiopia Water Technology Center
2 TWRMEB = Tigray Water Resource Mines & Energy Bureau
3 WWRMEO = Woreda Water Resource Mines & Energy Bureau

Soft-component schedule: Japan side
Soft component support framework of local resources

2-2-4-9 Implementation Schedule

The implementation schedule for the project will require 10.3 months for the basic design and bidding process after the exchange of note by both countries. The works for the procurement is scheduled as 11 months. A substantial 16.5 months scheduled for water supply facility construction from the time of contract to completion.

Table 2-35: Implementation Schedule



2-3 Obligations of Recipient Country

The Recipient Country of Ethiopia shall fulfill the following obligations:

① Provide relevant data, information and materials necessary for the execution of the project

② Accord Japanese nationals engaged in the Project such facilities as may be necessary for their entry into Ethiopia and stay therein for the performance of work as well as ensure their safety at the project site

③ Expedite the clearance procedures in connection with equipment procured for the project

④ Exempt Japanese nationals from customs duties, internal taxes and other fiscal levies imposed in the recipient country with respect to the supply of equipment and materials

⑤ Obtain the vehicle identification numbers for vehicles procured for the project

⑥ Provide facilities for office space as well as a Counterpart for the Japanese consultants

⑦ Provide facilities for office space and motor pool space for the Japanese construction work contractor

⑧ Lend equipment which is maintained by the Ethiopian-side as well as required personnel for OJT to the Japanese-side construction work contractor as has been agreed upon previously

⑨ Maintain proper use of materials and equipment procured and see to the appropriate maintenance of facilities constructed for this project

⑩ Bear the initial costs for wiring installation by Ethiopia Electric Power Company to the electrical pump in the case commercial power is used for Level 2 facilities

⑪ Bear responsibility for the following costs which according to the rules and regulations for Grant Aid cannot be borne by the Japanese-side;

- D/D, soft component, and labor costs for necessary personnel OJT participation
- Payment of processing fees pertaining to Banking Arrangement (B/A) and Authorization to Pay (A/P)
- Facilities for workshop as well as the storage of procured equipment and materials
- Land for well construction and development/land improvements for access to well construction locations
- Heavy machinery costs pertaining to road construction in those cases where heavy machinery is necessary for the construction of access roads
- C/P daily allowances, etc., such as estimated expenses for counterpart engineers, pertaining to the project.

2-4 Project Operation Plan

The structure for operation and maintenance has been divided into two levels; the implementation organizations (TWRMEB, WWRMEO) and the villages or communities (see Figure 2-28)

The implementation organizations will assist in the structure of the citizen operation and maintenance organization, provide support and education on sanitation to the communities or villages. Also, the division of roles has been clarified so that major repairs will be the responsibility of TWRMEB and minor repairs will be handled by WWRMEO.

At the village level, a Water Committee (hereinafter WC) will be established at each water source[3], and undertake daily facility operation, collection of the water fee, cleaning, repairs and so on. Also, a Village Water Committee (hereinafter VWC) will be established at each village, and will oversee the WC as well as act as the representative body to make request to the operation support organizations TWRMEB, WWRMEO for facility repairs and spare part supply.

(1) Water Supply Facility Operation and Maintenance Plan

1) Burden Sharing Pertaining to Maintenance

a. Minor Repairs (damage with no affect on packing, etc., of pump structure, cylinder structure)

WUG will analyze and examine the problem area → VWC will make required arrangements and parts replacement.

b. Major Repairs (required repair due to pump damage, cylinder replacement)

WUG、VWC will make examinations → WWREMO、TWRMEB will make required arrangements and parts replacement.

c. Problem Solutions in Relation to Organization Management Aspects

VWC acknowledges problematic points, grasps the situation and draws up countermeasures, with guidance from WWREMO where necessity applies.

2) Maintenance System

i. Management System of technical aspects

- For government promoted unification of material and equipment, inventory at the Central maintenance workshop and southern zone workshop shall be managed to account for the stock of principle parts.
- However, because the purchase revenue source is not guaranteed, while receiving the public finance support of TWRMEB, the collection system of the GTZ service fee, and the distribution and buying plan will be respected.
- For Level 1 facilities, WWRMO shall make necessary arrangements based on cooperation with WUG and VWC.
- For Level 2 facilities, WUG, VWC and WWRMO shall make arrangements in cooperation with TERMEB.
- EWTEC shall enhance cooperation with other donors to master skills pertaining to the above items.

j. Management System of water supply organizational operation

[3] At each water pump for Level 1, and at each public water tap for Level 2

- Although there are differences between some of the project regions pertaining to the O&M system, the functionality is favorable in general.
- Cooperation is planned with aid organizations (Community Facilitation Team, Woreda Water Desk) operated by WB, UNICEF and such, aiming for UAP achievement.
- Re-examine the activity support system of the community support supervisor in WWRMO, making community support activities a core issue.
- EWTEC shall enhance cooperation with a regional consultant in order to master skills pertaining to community support.

k. WUG Activity Assistance

- O&M is considered to be functioning effectively due to WC, excluding some villages.
- Therefore the current system is utilized to its maximum limit, and furthermore to take measures to correct the ability differences between communities and strengthen the current system.
- In detail, implementing an information campaign and training of community support supervisors in WWRMO, and support to plan and implement those activities provided by TWRMEB.

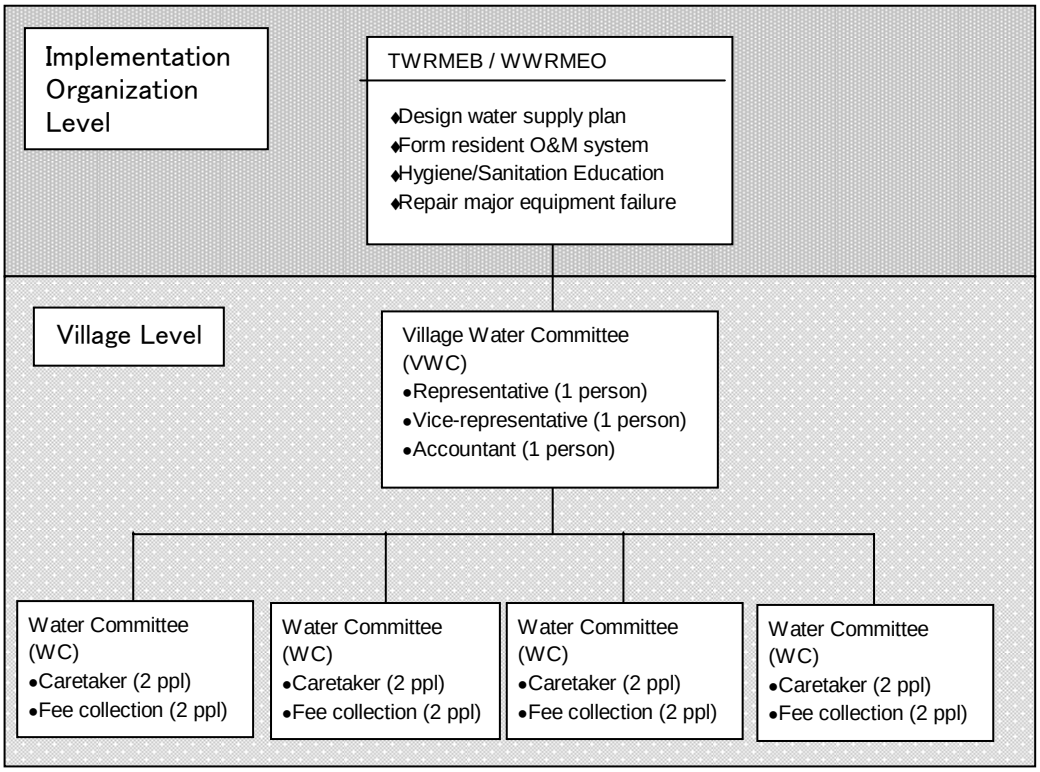


Figure 2-28: O & M Organization

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The total cost for Ethiopia side including the fence work, construction of access roads and construction of primary distribution of commercial electricity, is approximately 1.5 million Ethiopia Birr.

Table 2-36: Estimation of costs borne by the Ethiopia side

Item	Cost (in million Ethiopia Birr)
Fence work	0.2
Construction of access roads	1.0
Primary distribution of commercial electricity	0.3
Total	1.5

2-5-2 Operation and Maintenance Cost

2-5-2-1 Operation and Maintenance Cost

(1) Level 1 Facilities

The monthly operation fee for Level 1 facilities is shown in Table 2-37.

The results of the socio-economic study showed that 19 Birr is 5%[4] of the average household income. Therefore, imposing a maintenance fee of 2.8 Birr as shown in Table 2-37 is not seen to pose any obstacle.

Table 2-37: O & M Cost per Month for Hand Pump Facility

(Per One Facility, Unit: Birr)

No.	Item	Unit Cost	Quantity	Total	Remarks
①	Procurement of spare parts	850	1 set	850	Unit cost: from quotation of shop
②	hand pump repair deposit	6,048	5% of main unit cost	300	Unit cost: from quotation of shop
③	caretaker salary	100	1 person/12 mos.	1,200	Unit cost: result of study
④	Patrol/inspection fee	70	Twice/year	140	Unit cost: from job card by TWRMEB
⑤	Transportation fee	50	Twice/year X 2hrs(1hr R-T)	200	Unit cost: from. job card by TWRMEB
⑥	Maintenance mg't cost (Annual)			2,690	Grand Total ① - ⑤
⑦	Maintenance mg't cost (Monthly)			224	⑥÷12
⑧	Monthly cost per household			2.8	⑦÷80 household[*1]

*1 Calculated as 400 users per hand pump location and five persons per household

(2) Level 2 Water Supply Facilities

The operation and maintenance cost of a level 2 facility will be calculated for each individual site on account of the variable fuel costs depending on the specifications of the motorized pump installed at the site. The montly O&M fee and water fee trial balance sheet is shown as calculated

for Level 2 facilities in Table 2-38. The water fee, taking into consideration operation costs, was set below the current cost of 0.1~0.15 per jerrican currently paid in any of the targeted sites, an amount that should not cause any notable burden on the citizens.

Also, the power source primarily used in this project is a generator, however local governments were advised to consider commercial power sources from the view point of cost reduction. As a result, 3 of the facilities have done so. The cost estimation below shows that in comparisson with facilities that use generators, those that have utilized commercial power enjoy an approximate 30% reduction in costs.

Table 2-38: O & M Cost per Month for Motorized Pump Facility

Unit: Birr

Fac. No.	Village	Site	Monthly cost required for Maintenance (Note 1)	Water Fee (per 20L jerrican)		Water fee estimate		Total ability to pay /per site (Note 2)	Remarks
						Total amount collected per month/ per site			
				Required basic fee	Current water fee (Note 2)	Established fee			
						0.1 Birr	0.15 Birr		
1	Bedena leko	Bedena leko	5,616	0.05	0.1～0.15	6,147	9,221	42,088	Uses generator
2	Gerjele town	Gerjele town	1,758	0.01	0.10	11,250	16,875	18,254	Uses commercial power
3	Ula	Ula	8,424	0.08	0.1～0.15	5,900	8,849	13,430	Uses generator
4	Hadealga	Hadealga	4,204	0.02	0.1～0.15	5,488	8,232	8,780	Uses commercial power
		Keyih tekli	1,433			8,233	12,349	62,203	
5	Hirka	Hirka	4,545	0.02	0.1～0.15	4,115	6,173	12,803	Uses commercial power
	Adialebachele	Adialebachele				8,233	12,349	18,295	
	Bechenrkatan	Bechenrkatan				4,336	6,504	7,708	
6	Fondel	Fondel	4,914	0.09	0.1～0.15	3,429	5,144	13,716	Uses generator
7	Dodota	Dodota	4,446	0.05	0.1～0.15	4,802	7,202	13,917	Uses generator
8	Arva	Hadishkign	5,616	0.07	0.1～0.15	4,624	6,936	15,755	Uses generator
9	Gendiajo	Gemed dadi	3,510	0.07	0.1～0.15	2,840	4,259	7,572	Uses generator
10	Hadishkign	Tachgubegala	2,340	0.05	0.1～0.15	3,114	4,671	12,733	Uses generator

Note 1: Amount required for maintenance per month (using a generator) = fuel cost X 1.3
(--> 30% increase estimated for caretaker salary, equipment consumables (motor pump, generator), spare parts, and accessories)
Amount required for monthly maintenance (using commercial power) = electricity cost X 1.3
(--> 30% increase estimated for caretaker salary, equipment consumables (motor pump), spare parts and accessories)

Note 2: From results of socio-economic study

2-5-2-2 Cost Estimation of Water Fee

As a management maintenance expense of the level 2 facilities, the monthly amount for the water fee to be collected and monthly amount for maintenance cost when set to 0.1 Birr and 0.15 Birr per jerrican, was compared to the monthly payment possible for citizens according to the socio-economic study (Table 2-38 as reference). As a result, the citizens' ability to pay for the monthly payment far exceeded the monthly maintenance costs in each case. In addition, when setting the water fee to 0.15 Birr, the monthly amount that would be collected exceeded the

[4] The ratio for the water fee per overall monthly income per household (empirical value)

monthly maintenance cost in all villages. From this, the set water fee is sufficient with current price level, and this price is seen as valid from the economic conditions.

On the other hand, the water fee for the Level 1 facilities is relatively low in comparisson with Level 2 facilities because fuel and electric power are not used. Because of that, the water fee amount will be based on the monthly or annual income of each household and adjusted with the economic conditions of each site, taking existing facilities as a reference.

Management methods of the O&M costs are shown below.

(1) At present O&M management is primarily that the water commission will a) REST takes the initiative, and a community fund bank is established, or b) funds are managed by each individual of the WC. Basically, as in the first example, an account is opened at a bank nearby and funds for repair and maintenance are managed jointly, but when there is no financial institution in the vicinity of the village, then the water committee will observe flexible fund management under the guidance of WWRMO.

(2) Prior to well construction, the water management committee or water commission collects the amount established as the O&M reserve fund and opens an account. Furthermore, giving sufficient explanation in regard to the necessity of operation and management, a water usage fee is put in place. In addition, as part of community education, guidance will be given concerning “a safe and continuous water supply” with sufficient explanation so that no one defaults on payment during seasonal dry periods or the the rainy season.

(3) There are some poor families in villages which cannot pay water fees. The water control committee or water committee wil decide on policy and follow-up measures to construct a system so that even these poor families are able to use the water (such as providing them with the opportunity to clean around the well or assist with the transport of water).

(4) The salary for the caretaker of the above-mentioned fund includes transportation costs for fund management, but funds will be reserved for large-scale repairs, and a collection will be conducted for minor repairs from citizens who will benefit when it is necessary.

2-6 Other Relevant Issue

For the smooth implementation of the project, the following issues shall be given special consideration by the Ethiopian Side.

1) Exemption of value added taxes (VAT) and other fiscal levies imposed in the recipient country with respect to the procurement of equipment and materials
2) Bear the initial costs and implementation of primary installation of power supply by Ethiopia Electric Power Company to the project sites where commercial power is used for Level 2

facilities (preparation of budget before construction is started).

3) Well drilling and acquisition of land to construct facilities (right of usage)
4) Construction and maintenance of roads for the transport of materials and equipment to be used for the construction of wells (manpower, prepare budget)
5) Increase capacity of technicians in the field of water supply at the State and Provincial level
6) Establish and provide guidance to citizen organizations in the target villages
7) Secure the budget and personnel from government staff that will be needed to conduct activities pertaining to the soft component of the project
8) Secure a space for a local site office

3. Project Evaluation and Recommendation

3-1 Project Effect

The effect of the project is summarized in Table 3-1.

Table 3-1: Improvement to the current situation through implementation of the Project

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 66,230 people in the targeted 10 Woredas.	1) Securing safe water supply will reduce water-borne disease and assist in the health of residents. 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 (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. 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.

3-2 Recommendations

The following considerations shall be made for the smooth and effective implementation of the project.

3-2-1 Recommendations for the Ethiopian side

(1) Improvement of access road to the site

The sites are mainly distributed along badly maintained mountainous roads. Some roads to the drilling sites cross ephemeral rivers, which may cause difficulties for transportation during the wet season. Furthermore, a new road shall be constructed from the site to the main road as the drilling point is not always located nearby the main road. Construction of the transportation road by the community and concerned government agency shall be necessary for the smooth implementation of the project. As road construction work is the obligation of the Ethiopian side, the work shall be completed at least one month before the commencement of the drilling work.

(2) Primary distribution of commercial power supply

Some of the selected sites for the Level 2 system will utilize commercial power supply. The primary extension/distribution from the closest power supply point to the site is the obligation of the Ethiopian side. This issue has been discussed and confirmed with the Ethiopian side, who will take responsibility to fulfill the requirement of the primary distribution before the commencement of the project. It is anticipated that Ethiopian Electrical Power Corporation will implement this primary distribution to the selected sites smoothly so that the project can start the secondary power connection in the limited time frame.

(3) Setup of Tax Exemption System

Some past projects experienced the fact that no attention was given to the subcontractor's exemption of tax for project implementation. This is due to lack of flexibility on the tax exemption system for small purchases at local shops and/or lack of a sophisticated purchasing system for tax exemption. An efficient purchase system for tax exemption shall be studied by both the Ethiopian and Japanese sides before implementation. The Ethiopian side shall also be advised to monitor the system in case tax exemption is not applicable.

(4) Budget and personnel acquisition

A suitable arrangement shall be made on the budget and personnel acquisition from the local government to assist and support the construction works and activities for the soft component.

(5) Contribution to the project by local residents

It is important to develop the resident's sense of ownership of the water supply facilities through their participation in the construction of facilities to contribute to long term operation and maintenance. Accordingly, light duties such as fence construction, road rehabilitation to the site and ditch excavation work for water supply pipes shall be carried out by the residents. These duties shall be agreed upon with the residents.

3-2-2 Technical Cooperation and Partnership with other Donors and NGOs

Educational and motivational activities on operation and maintenance of the facilities for the communities will be implemented especially for the Level 2 system, which requires greater knowledge of operation and maintenance, its management and technical matters. The project plan for effective cooperation will be utilizing the following resources based on the results of the survey.

(1) Work together with Ethiopia Water Technology Center (EWTEC)

EWTEC's activities are not yet scheduled in detail at the time of the expected implementation stage (year 2008). Therefore, a request for assistance will be made with reference to their activities of a two year project since 2006.

- Seminar on high grade repair techniques of Level 2 facilities for TWRMWB staff.
- Seminar on repair techniques of hand pump facilities for WWRMEO
- Seminar on community development and sanitation education for Woreda Community Coordinator

The schedule and contents of the seminars will be discussed and the detailed program plan will be organized through talks with EWTEC. Basically, the seminars will be scheduled before the implementation of facility construction. The members who attend these seminars will take the initiative in the activities on maintenance and operation at the project sites.

(2) Work together with system established by Donors and NGOs

The survey conducted in the target area revealed that the operation and maintenance activities are of satisfactory condition at the present stage. One of the reasons for this is the advanced support of manpower and human resources by WB and UNICEF based on their organization planning for water sector projects. Therefore, the current organization control by the local government will be respected. The goal of the project concerning the operation and maintenance system will be to upgrade and setup a stronger structure of the existing organization control through the technical support of this project.

[Appendices]

1. ***Member List of the Study Team***
2. ***Study Schedule***
3. ***List of the Parties Concerned in the Recipient Country***
4. ***Minutes of Discussions***
5. ***References and Documents***

(1) Basic Design Study (9th Dec, 2006 – 3rdMar, 2007)

No	Member	Duty	Organization
1.	Mr. Yuji MARUO	Team Leader	JICA
2.	Mr. Yutaka FUKASE	Planning Management	JICA
3.	Mr. Kensuke ICHIKAWA	Chief Consultant/ Groundwater Development Planning	KOKUSAI KOGYO
4.	Mr. Taketoshi FUJIYAMA	Water Supply Facility Planning	KOKUSAI KOGYO
5.	Mr. Sinsuke SUGINO	Test Boring/Geophysical Survey	KOKUSAI KOGYO
6.	Mr. Shoji MASUMURA	Social Survey/O&M Planning	KOKUSAI KOGYO
7.	Mr. Takeshi YOSHIKAWA	Construction & Equipment Planning/ Cost Estimation/Project Coordination	KOKUSAI KOGYO
8.	Mr. Yuji MARUO	Team Leader	JICA

(2) Discussion of Basic Design Study Draft Report (27thMay, 2007 - 7 Jun, 2006)

No	Member	Duty	Organization
1.	Mr. Yutaka FUKASE	Team Leader	JICA
2.	Mr. Kensuke ICHIKAWA	Chief Consultant/ Groundwater Development Planning	KOKUSAI KOGYO
3.	Mr. Taketoshi FUJIYAMA	Water Supply Facility Planning	KOKUSAI KOGYO

（1）Basic Design Study

date		Mr. Yuji MARUO Team Leader	Mr. Yutaka FUKASE Project Coordinator	Mr. Kensuke ICHIKAWA Project Manager/ Groundwater Development Plan	Mr. Taketoshi FUJIYAMA Water Supply Facility Design	Mr. Sinsuke SUGINO Well Drilling Works/ Geophysical Exploration	Mr. Shoji MASUMURA Social Survey/O&M Plan	Mr. Takeshi YOSHIKAWA Implementation& Procurement Plan/ Cost Estimation/ Team Coordinator
9-Dec	Sat	DAR→ADD	KIX→DXB			KIX→DXB		
10-Dec	Sun	Teem meeting	DXB→ADD Teem meeting			DXB→ADD Teem meeting		
11-Dec	Mon	Courtesy call on EoJ, JICA and MoFED				Courtesy call on EoJ, JICA and MoFED		
12-Dec	Tue	Courtesy call on TWRMEB and meeting with TWRMEB				Courtesy call on TWRMEB and meeting with TWRMEB		
13-Dec	Wed	Signing of Minutes of Meeting with TWRMEB				Preparation for site surver		
14-Dec	Thu	Report to EoJ and JICA ADD→DXB		Report to EoJ and JICA		Preparation for site surver		Preparation for local contract
15-Dec	Fri	DXB→KIX		Discussion with other Donors, NGOs, etc		Preparation for local contract		Preparation for local contract
16-Dec	Sat			ADD→Mekele Site survey		ADD→Mekele Site survey		
17-Dec	Sun			Preparation for site survey		Preparation for site survey		
18-Dec	Mon			Meeting with TWRMEB		Meeting with TWRMEB		
19-Dec	Tue			Site survey		Site survey	Site survey	Assistance of site survey
20-Dec	Wed			Site survey		Site survey	Site survey	Meeting with local contracter
21-Dec	Thu			Site survey		Site survey	Site survey	Assistance of site survey Mekele→ADD
22-Dec	Fri			Site survey		Site survey	Site survey	Assistance of site survey
23-Dec	Sat			Site survey		Site survey	Site survey	Assistance of site survey
24-Dec	Sun			Arrangement of survey result		Arrangement of survey result		
25-Dec	Mon			Site survey		Site survey	Site survey	Assistance of site survey
26-Dec	Tue			Site survey		Site survey	Site survey	Meeting with local contracter ADD→Mekele
27-Dec	Wed			Site survey		Site survey	Site survey	Meeting with local contracter
28-Dec	Thu			Site survey		Site survey	Site survey	Meeting with local contracter
29-Dec	Fri			Site survey		Site survey	Site survey	Meeting with local contracter
30-Dec	Sat			Site survey		Site survey	Site survey	Arrangement of survey result
31-Dec	Sun			Arrangement of survey result		Arrangement of survey result		
1-Jan	Mon			Site survey		Site survey	Site survey	Meeting with local contracter
2-Jan	Tue			Site survey		Site survey	Site survey	Assistance of site survey
3-Jan	Wed			Site survey		Site survey	Site survey	Assistance of site survey
4-Jan	Thu			Team meeting Mekele→ADD		Team meeting		Team meeting Mekele→ADD
5-Jan	Fri			Report to JICA		Site survey	Site survey	Report to JICA
6-Jan	Sat			ADD→DXB		Site survey	Site survey	ADD→DXB
7-Jan	Sun			DXB→KIX		Arrangement of survey result		DXB→KIX
8-Jan	Mon					Site survey	Arrangement of survey result Mekele→ADD	
9-Jan	Tue					Site survey	ADD→DXB	
10-Jan	Wed					Site survey	DXB→KIX	
11-Jan	Thu					Site survey		
12-Jan	Fri					Site survey		
13-Jan	Sat					Site survey		
14-Jan	Sun					Arrangement of survey result		
15-Jan	Mon					Site survey		
16-Jan	Tue					Site survey		
17-Jan	Wed					Site survey		
18-Jan	Thu					Site survey		
19-Jan	Fri					Site survey		

[Abbreviation] DAR: Dal es salaam KIX: Kansai
ADD: Addis Ababa MoFED: Ministry of Finance and Ecnomic Development
DXB: Dubai TWRMEB: Tigray Water Resources, Mines and Enagy Bureau

date		Mr. Yuji MARUO Team Leader	Mr. Yutaka FUKASE Project Coordinator	Mr. Kensuke ICHIKAWA Project Manager/ Groundwater Development Plan	Mr. Taketoshi FUJIYAMA Water Supply Facility Design	Mr. Sinsuke SUGINO Well Drilling Works/ Geophysical Exploration	Mr. Shoji MASUMURA Social Survey/O&M Plan	Mr. Takeshi YOSHIKAWA Implementation& Procurement Plan/ Cost Estimation/ Team Coordinator
20-Jan	Sat					Site survey		
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22-Jan	Mon					Site survey		
23-Jan	Tue					Site survey		
24-Jan	Wed					Site survey		
25-Jan	Thu					Site survey		
26-Jan	Fri					Site survey		
27-Jan	Sat				NRT→NGO→DXB	Site survey		NRT→NGO→DXB
28-Jan	Sun				DXB→ADD	Arrangement of survey result		DXB→ADD
29-Jan	Mon				Courtesy call on JICA, Meeting with MoWR	Site survey		Courtesy call on JICA, Preparation for site survey
30-Jan	Tue				Market survey	Site survey		Site survey
31-Jan	Wed				Maket survey ADD→Mekele	Site survey		Site survey
1-Feb	Thu				Site survey	Site survey		Site survey
2-Feb	Fri				Site survey	Site survey		Site survey
3-Feb	Sat				Site survey	Site survey		Site survey
4-Feb	Sun				Arrangement of survey result			Arrangement of survey result
5-Feb	Mon				Site survey	Site survey		Meeting with local contracter
6-Feb	Tue				Site survey	Site survey		Market survey ADD→Mekele
7-Feb	Wed			KIX→DXB	Site survey	Site survey		Site survey
8-Feb	Thu			DXB→ADD	Site survey	Site survey		Site survey
9-Feb	Fri			Report to JICA	Site survey	Site survey		Site survey
10-Feb	Sat			ADD→Mekele Preparation for site survey	Site survey	Site survey		Site survey
11-Feb	Sun			Arrangement of survey result				Arrangement of survey result
12-Feb	Mon			Site survey	Site survey	Site survey		Site survey
13-Feb	Tue			Site survey	Site survey	Site survey		Site survey
14-Feb	Wed			Site survey	Site survey	Site survey		Site survey
15-Feb	Thu			Site survey	Site survey	Site survey		Site survey
16-Feb	Fri			Site survey	Site survey	Site survey		Site survey
17-Feb	Sat			Site survey	Site survey	Site survey		Site survey
18-Feb	Sun			Arrangement of survey result				Arrangement of survey result
19-Feb	Mon			Site survey	Site survey	Site survey		Market survey
20-Feb	Tue			Site survey	Site survey	Discussion with TWRMEB		Discussion with TWRMEB
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22-Feb	Thu			Site survey	Discussion with TWRMEB Mekele→ADD	ADD→DXB		Market survey
23-Feb	Fri			Site survey	Arrangement of survey result	DXB→NGO		Discussion with TWRMEB
24-Feb	Sat			Site survey	ADD→DXB			Arrangement of survey result
25-Feb	Sun			Arrangement of survey result	DXB→KIX			Arrangement of survey result Mekele→ADD
26-Feb	Mon			Site survey				Market survey
27-Feb	Tue			Site survey				Market survey
28-Feb	Wed			Arrangement of survey result				Market survey
1-Mar	Thu			Meeting with TWRMEB Mekele→ADD				Arrangement of survey result
2-Mar	Fri			Report to JICA				Report to JICA
3-Mar	Sat			ADD→DXB				ADD→DXB
4-Mar	Sun			DXB→KIX				DXB→KIX

（2）Discussion of Basic Design Study Draft Report

No.	date		Mr. Yutaka FUKASE Team Leader	Mr. Kensuke ICHIKAWA Project Manager/ Groundwater Development Plan	Mr. Taketoshi FUJIYAMA Water Supply Facility Design
1	27-May	Sun	NGO→DXB		
2	28-May	Mon	DXB→ADD Courtesy call to JICA and EoJ		
3	29-May	Tue	Courtesy call to MoWR and MoFED Discussion with representatives of Tigray State		
4	30-May	Wed	Discussion with Tigray State about M/D		
5	31-May	Thu	Signing on M/D Report to JICA and EoJ ADD→DXB	Signing on M/D Report to JICA and EoJ	
6	1-Jun	Fri	DXB→KIX	ADD→Mekele Courtesy call to TWRMEB	
7	2-Jun	Sat		Site survey	
8	3-Jun	Sun		Site survey	
9	4-Jun	Mon		Explanation of outline of the Study to TWRMEB	
10	5-Jun	Tue		Explanation of outline of the Study to TWRMEB	
11	6-Jun	Wed		Report and discussion TWRMEB Mekele→ADD→DXB	
12	7-Jun	Thu		DXB→NGO	

[Abbreviation] NGO： Nagoya
ADD： Addis Ababa
DXB： Dubai
KIX： Kansai
EoJ： Embassy of Japan
MoWR： Ministry of Water Resources
MoFED： Ministry of Finance and Ecnomic Development
TWRMEB： Tigray Water Resources, Mines and Enagy Bureau

＜Japanese Parties＞

（1） Japanese Embassy

Mr. Yoshiyuki Mihogi	Second Secretary

（2） JICA Ethiopia office

Mr. Naoki Saito	Resident Representative
Mr. Naoki Ando	Deputy Resident Representative
Mr. Hiroyuki Yakushi	Assistant resident Representative

（3） Ethiopia Water Technology Center

Dr. Akira Kamata	Kokusai Kogyo Co., Ltd
Mr. Masahiko Ikemoto	Kokusai Kogyo Co., Ltd

＜Ethiopia Parties＞

（1） Ministry of Finance and Economic Development

Mr. Hailemichael Kinfu	Head, Bilateral Cooperation Department

（2） Ministry of Water Resources

Mr. Getachew Abdi Zerefu	Head Rural Water Supply and Sanitation Services

（3） Tigray Water Resources, Mines and Energy Bureau

Mr. Samson Tareke	Bureau Head
Mr. Kiros Neqash	Deputy Bureau Head
Mr. Yemane G.Egziabher	Department Head of O&M Supervision for Water Supply
Mr. Gebreslasie Gebremariam	Department Head of Public Relation and Civil Service Reform
Mr. Solomon Amar	Water Quality Control Team Leader
Mrs. Alganesh	Water Supply Engineer
Mr. Hailay	Head of Central Work Shop

（4） Bureau of Finance and Economic Development

Mr. Haile Yohannes	Deputy Bureau Head

（5） Tigray Water Works Construction Enterprise

Mr. Gebru desta	General Manger
Mr. Ardom Kisamu	Department head of Hydrogeology

（6） Wareda Water Resources, Mines & Energy Bureau

Mr. Wendwoson Niguse	Head of Raya Azebo Woreda Water Resource, Mines & Energy Office
Mr. Solomon Hadush aseme	Head of Alamata Woreda Water Resource, Mines & Energy Office
Mr. Amanuel Tadesse	Head of Enderta Woreda Water Resource, Mines & Energy Office
Mr. Brhane G. Gergise	Head of Hawzen Woreda Water Resource, Mines & Energy Office
Mr. Gebre Hiwot Sumure	Head of kilte Awlaelo Woreda Water Resource, Mines & Energy Office
Mr. Kiros T. Kiros	Head of Saharti Samre Woreda Water Resource, Mines & Energy Office
Mr. Siraj Mohamed	Head of Tanqua Aberegele Woreda Water Resource, Mines & Energy Office

Mr. Asfaw Desta	Head of Degua Temben Woreda Water Resource, Mines & Energy Office
Mr. Gedey Melse	Head of Kola Temben Woreda Water Resource, Mines & Energy Office

（7）UNICEF

Ms. Belinda Abraham	Project Officer Water, Sanitation and Hygiene Programme, Addis Ababa
Mr. Bruck W. Aregai	Water, Sanitation and Hygiene Officer

（8）World Bank

Mr. Tesfaye Bekalu	Consultant, Water Supply and Sanitation Project
Mr. Nigus Berhe	WSSP Coordinator

（9）REST（Relief Society of Tigray）

Mr. Getachew Haile	Head, Water Resource Development Department

（10）Ethiopia Geophysical Survey

Mr. Sisay	Department Head of Water Quality Laboratory

Minutes of Discussion -1（M/D-1/3）

MINUTES OF DISCUSSIONS
ON THE BASIC DESIGN STUDY
ON THE PROJECT FOR RURAL WATER SUPPLY and RHABILITATION
IN TIGRAY REGION IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Based on the results of the Preparatory Study on the project for water supply, which was held on July 3, 2006, the Government of Japan decided to conduct a Basic Design Study on the Project for Rural Water Supply and Rehabilitation in Tigray Region in the Federal Democratic Republic of Ethiopia (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 Democratic Republic of ETHIOPIA the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Dr.Yuji Maruo, Senior Advisor, Institute for International Cooperation, JICA and is scheduled to stay in the country from 8 December to beginning of March, 2006.

The Team held discussions with the officials concerned of the Government of Ethiopia and conducted a field survey in the study area.

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

Addis Ababa, December 12, 2006

Yuji Maruo
Leader,
Preparatory Study Team,
Japan International Cooperation Agency

Samson Tareke
Bureau Head,
Water Resources, Mines and Energy Bureau,
Tigray National Regional Sate
Federal Democratic Republic of Ethiopia

Witnessed by

Hailemichael Kinfu
Head,
Bilateral Cooperation Department,
Ministry of Finance and Economic Development
Federal Democratic Republic of Ethiopia

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve the health and living standard of the people by providing the potable water through the construction of water supply facilities and/or the procurement of equipment related to groundwater development.

2. Project sites

The sites of the Project requested by the Ethiopian side are on the request document "Project Proposal for Rural Water Supply Development" which was sent to JICA from Ethiopian side dated on 26 July,2006(hereinafter referred to as "Request Document")

3. Responsible and Implementing Agency

3-1.The Responsible Agency is Tigray National Regional State

3-2.The Implementing Agency is Water Resources, Mines and Energy Bureau, Tigray National Regional State.

4. Items requested by the Government of Ethiopia

After discussions with the Team, the items described in the Request Document were finally requested by Ethiopian side. JICA will assess the appropriateness of the request and will consider contents of the Project. Among the requested item, the Team explained as to the equipment, that unless necessary data and information on following issues will be submitted, it is difficult to include equipment in the Project.

1) Budget allocation
2) Technical availability
3) Concrete operation plan

5. Japan's Grant Aid Scheme

Ethiopian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Ethiopia as explained by the Team and described in Annex-2 and Annex-3 of the Minutes of Discussion signed by both parties on 3rd July 2006.

6. Schedule of the Study

6-1. The consultants will proceed to further studies in Ethiopia until the beginning of March.

6-2. JICA will prepare the draft report in English and dispatch a mission in order to explain its contents around the middle of May, 2006.

6-3. In case that the contents of the report is accepted in principle by the Government of Ethiopia, JICA will complete the final report and send it to the Government of Ethiopia by August, 2006.

7. Other relevant issues

(1)Inception Report

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

(2)Arrangements for the Study

As a response to the request by the Team, Ethiopian side agreed to arrange counterpart personnel for the study and to provide all the data and information relevant to the Project for the smooth implementation of the study.

(3)Prioritization and Selection for the Project

Both side agreed that the candidate site or the contents of the project would be prioritized and selected for the Japan Grant Aid Scheme in accordance with following criteria;

a)Urgent needs for water supply facilities

b) Operation and Maintenance Capability of the facilities
c) Water Resource Potential
d) Security Conditions

(4) Operation and Maintenance of facilities and equipments

Ethiopian side agreed to take any necessary measures and to allocate the necessary budget to operate and maintain the facilities and equipments under the Project.

(5) Tax Payment

Value Added Tax(VAT), custom duties and any other taxes and fiscal levies in Ethiopia arisen from the Project activities will be born by beneficiary institution(Tigray National Regional State).

(6) Safety and Security

Ethiopian side agreed to take any necessary measures deemed necessary to secure the safety of the member of the Team and promised that Counterpart Personnel from implementing agency would accompany with the Team member on field survey during the Basic Design Study.

(7) Overlapping with other project

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

Minutes of Discussions-2 （M/D-1/4）

4 JUN 2007

MINUTES OF DISCUSSIONS
ON THE BASIC DESIGN STUDY
ON THE PROJECT FOR RURAL WATER SUPPLY AND RHABILITATION
IN TIGRAY REGION IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
(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 Rural Water Supply and Rehabilitation in Tigray Region (hereinafter referred to as "the Project") to the Federal Democratic Republic of ETHIOPIA (hereinafter referred to as "ETHIOPIA"), 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 ETHIOPIA on the components of the draft report, JICA sent to ETHIOPIA the Draft report Explanation Team (hereinafter referred to as " the Team "), which is headed by Mr. Yutaka Fukase, Project Management Group III, Grant Aid Management Department, JICA from 27 May to 7 June 2007.

As a result of discussions, the both sides have agreed the main items described on the attached sheets. The Team will proceed to further works and prepare the Basic Design Study Report.

Addis Ababa, 30 May, 2007

Yutaka Fukase
Leader
Study Team,
Japan International Cooperation Agency

for Samson Tareke
Bureau Head,
Water Resources, Mines and Energy Bureau,
Tigray National Regional Sate
Federal Democratic Republic of Ethiopia

Witnessed by

Hailemichael Kinfu
Head,
Bilateral Cooperation Department,
Ministry of Finance and Economic Development
Federal Democratic Republic of Ethiopia

ATTACHMENT

1. Components of the Project described in the Draft Report

The Government of ETHIOPIA and Water Resources Mines & Energy Bureau, of the Tigray National Regional State (the implementing organization of the Project) (hereinafter referred to as " the Ethiopian side") agreed and accepted in principle the components of the Project described in the draft report as explained by the Team.

2. Japan's Grant Aid scheme

The Ethiopian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of ETHIOPIA as explained by the Team and described in Annex-2 and Annex-3 of the Minutes of Discussions signed by both parties on 3rd July, 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 ETHIOPIA by the beginning of August 2007.

4. Other relevant issues

(1) Tax Payment

Value Added Tax (VAT), custom duties and any other taxes and fiscal levies in Ethiopia arisen from the Project activities will be born by the Ethiopian implementing organization of the Project.

(2) Major Components of the Project on the Basic Design

The both sides have agreed that the Project on the Basic Design would consist of the following components

a) Construction of water supply facilities using groundwater resources in 99 sites of the 10 Woredas in the Tigray National Regional State.

b) Procurement of equipment consisting of:

- One (1) set of rig equipped with low pressure compressor for operation and maintenance of well.
- One (1) set of cargo truck equipped with 10-ton crane, submersible pump, generator, notch and accessories and devices for pumping test and water quality test.
- Two (2) set of cargo truck equipped with 10-tone crane.

c) Technical Assistances for capacity building ("Soft Component")

- Enhancement for sustainable operation and maintenance manners of water supply facilities in each target site.

d) Phasing of the implementation of the Project

The both sides have agreed that the Project would be implemented in the following two phases based on the Japanese budgetary system taking into account of the scale of the Project.

- Detailed Design Phase: The detailed design including preparation of the tender document of the Project will be implemented.
- Tender and Project Implementation Phase: The tender for the Project, the construction of the planned facilities, the Soft Component activities, and other relevant works will be implemented.

e) Project Cost Estimation (tentative)

Both sides agreed that the Tentative Project Cost Estimation, as attached in ANNEX-1 should

never be duplicated or released to any outside parties before the signing of all the Contract(s) for the Project.

f) Other subjects confirmed on the Component of the Project

(3) Undertakings of the Ethiopian side

The Ethiopian side agreed to undertake the following works on the occasion of the implementation of the Project.

- To secure access roads to the sites of the proposed facilities.
- To provide lands for temporary site management offices for the Contractor in accordance with requests of it.
- To appoint and deploy counterpart personnel who will participate as trainees to the Soft Component program.
- To bear daily allowance and transportation costs for the counterpart personnel who will participate to each component of the Project.
- To bear all the expenses for consumables such as fuel, oil, others to be necessary for operation and transportation of all the equipment and machinery to be used in the Soft Component program.
- To bear all the expenses for repairing equipment and machinery which belongs to Ethiopian side, if necessary, to be used in the Soft Component program.
- To organize Water Committees in each target town through the Soft Component program.
- To bear the initial costs for wiring installation by Ethiopia Electric Power Company to the electrical pump in the case commercial power is used for motorized pump facilities.
- To carry out the works proposed for the Ethiopian side in the draft report, which is not mentioned above.

(1) List of References and Documents

No	Name	Forms Print・Video Map ・ Photo etc	Original/ Copy	Published Organization	Year
1	Manual for Technical Design Standard for the Tigray Region	Print	Copy	TWRMEB	-
2	Water supply "Design Working standard Guidlines"	Print	Copy	TWRMEB Water resources Management, Regulatory and Database department	2005
3	Labor Proclamation No.377/2003	Print	Copy	Ministry of Labor and social Affairs	2004
4	Ethiopia: sustainable Development and Poverty Reduction Program (SDPRP) Interim annual Progress Report(2003/04)	Print	Copy	Ministry of Finance and Economic Development	2004
5	Explanation of the Geological Map of Ethiopia Scale 1:2,000,000, 2nd edition	Print	Copy	Ethiopia Geological survey	1996
6	A Proposal Paper for Hydro geological Mapping of Ethiopia	Print	Copy	Provisional Military Government of socialist Ethiopia Hydrogeology and Engineering Geology Division	1984
7	Evaluation of Aynalem Well Field and Selection of Prospective Well Fields around Mekele Town for Water supply source Draft final Report Volume Ⅱ: Evaluation of groundwater potential	Print	Copy	Water Works Design and supervision Enterprise	2006
8	Customs Tariff (Based on the 2002 version of the HS), Volume Ⅰ	Soft file	Original	ECA	2003
9	Customs Tariff (Based on the 2002 version of the HS), Volume Ⅱ	Soft file	Original	ECA	2003
10	Rural Water Supply and Sanitation Program Regional Implementation Guidelines Tigray Region	Soft file	Original	Federal Democratic Republic of Ethiopia Ministry of Water	2004

No	Name	Forms Print･Video Map ・ Photo etc	Original/ Copy	Published Organization	Year
				Resource	
11	Urban Water Supply and Sanitation Program Regional Implementation Guidelines Tigris Region	Soft file	Original	Federal Democratic Republic of Ethiopia Ministry of Water Resource	2004
12	Water Supply and Sanitation Program Implementation Manual	Soft file	Original	Federal Democratic Republic of Ethiopia Ministry of Water Resource	2004
13	Budget for Regional Rural WSS Program	Soft file	Original	-	-
14	Budget for Regional Urban WSS Program	Soft file	Original	-	-
15	Rainfall data in adigrat, alamata, hagerselam, korem, maichew, makele, senkata, waja, wedisemero	Soft file	Original	NMS	-
16	Maximum Temperature data in adigrat, alamata, hagerselam, korem, maichew, makele, senkata, waja, wedisemero	Soft file	Original	NMS	-
17	Minimaum Temperature in adigrat, alamata, hagerselam, korem, maichew, makele, senkata, waja, wedisemero	Soft file	Original	NMS	-
18	Ethiopia Map 1:50,000 （3913A～D、3912A～D）	Map	Original	Ethiopian Mapping Authority	-
19	Ethiopia Map 1:250,000 （37MC2～4、37MD10～16）	Map	Original	Ethiopian Mapping Authority	-
20	Contract Agreement Made Between Tigray Water Works construction Enterprise and Tigray Water Resources Development Commission For Tirkan, Shimeri, Shiglli, and Ruwassa Water Supply Projects	Print	コピー	Tigray Water Resources Development	2005
21	Memorandum of Understanding among the Tigray Region Government represented by the	Print	コピー	-	-

No	Name	Forms Print・Video Map ・ Photo etc	Original/ Copy	Published Organization	Year
	Bureau of Water and Mines Resources Development & Tigray Water works construction Enterpriser & UNICEFF on the cooperation for the development of the Rural Water Supply Sector inTigray				
22	Contract Agreement Between Tigray Water Resources Development Commission And Tigray Water Works Construction Enterprise for Construction of Adi-Gebru Water Supply System	Print	コピー	National Regional State of Tigray Water Resources Development Commission	2005

(2) List of Target Sites for drilling

Ⅰ. Construction Site for Hand pump well

No.	PJ ID	WOREDA	TABIA	KUSHET	GOTE	COORDINATION			Beneficiaries (2006) (Request Form)	Facility Type	Well Structure Type	Drilling Method	Estimated Drilling Depth (m)
						UTM E (m)	UTM N (m)	Level (m)					
1	JAL007	Alamata	Timuga	Kunkura	Maedo Ketema	565499	1357078	1437	428	Level 1	Type I	DMCD	100
2	JAL010	Alamata	Selenwuha	Kubiderba	Amgedel	570738	1365109	1407	299	Level 1	Type I	DMCD	100
3	JAL011	Alamata	Selenwuha	Gedera	Gedera	568138	1363597	1569	671	Level 1	Type I	DMCD	100
4	JAL012	Alamata	Weselenwuha (Limat)	Adi hagos tsegay	Endasilasie(Adihana)	567594	1367414	1460	323	Level 1	Type I	DMCD	100
5	JAL013	Alamata	Limat	Adiabogoja	Sifraamora	561298	1364409	1538	300	Level 1	Type I	DMCD	100
6	JAL014	Alamata	Limat	Hashiamariam	Hashiamariam	558766	1370039	1439	420	Level 1	Type I	DMCD	100
7	JAL015	Alamata	Selam bikalsi	Rarhe	Rarhe	561506	1370065	1524	819	Level 1	Type I	DMCD	100
8	JAL017	Alamata	Selam bikalsi	Adimohoye	Adimohoye	565809	1371093	-	900	Level 1	Type I	DMCD	100
9	JAL018	Alamata	Selam bikalsi	Hadis kigni	Hadis Kigni	566690	1372156	1580	308	Level 1	Type I	DMCD	100
10	JAL019	Alamata	Kululemlem	Adishihashim	Adishihashim	565230	1378203	1482	520	Level 1	Type I	DMCD	100
11	JAL020	Alamata	Kulugize Zemlem	Agamitie	Agamitie	566941	1376621	1463	461	Level 1	Type I	DMCD	100
12	JAL022	Alamata	Tao	Adihantia	Adihantia	568277	1380792	1453	429	Level 1	Type I	DMCD	100
13	JAL023	Alamata	Waja ketema	Waja ketema	Waja ketema	565335	1357958	1452	358	Level 1	Type I	DMCD	100
14	JAL024	Alamata	Selenwuha	Harle	Harle school	565270	1363686	1467	488	Level 1	Type I	DMCD	100
15	JAL025	Alamata	Limat	Adieshok	Alembirhan school	564126	1365675	1480	502	Level 1	Type I	DMCD	100
16	JED027	Enderta	Arato	Endarbashelema	Endarbashelema	563361	1495252	2341	760	Level 1	Type I	DMCD	80
17	JRA012	Raya Azebo	Bala Ulga	Butamrfeta	Buta	585379	1372176	1677	1,000	Level 1	Type I	DMCD	100
18	JRA013	Raya Azebo	Bala Ulga	Ulaga	Bisebir	587904	1375284	1604	900	Level 1	Type I	DMCD	100
19	JHW010	Hawzen	Meztey	Dabaseria	-	551969	1554971	2300	550	Level 1	Type I	DMCD	60
20	JED001	Enderta	Maianbesa	Maiumer	Around school	544738	1492526	2122	800	Level 1	Type II	DTH	90
21	JED003	Enderta	Maianbesa	Maiweyni	Maiayni	541577	1491125	2180	900	Level 1	Type II	DTH	60
22	JED005	Enderta	Maialem	Mishim	Mishm	543600	1495723	2016	1,300	Level 1	Type II	DTH	90
23	JED006	Enderta	Maialem	Zibanided	Zibanhided	543913	1496414	2059	700	Level 1	Type II	DTH	90
24	JED008	Enderta	Debri	Mekaih	Kokahi	545491	1488261	2094	600	Level 1	Type II	DTH	80
25	JED009	Enderta	Debri	Adiamik	Adiamik	544481	1499644	2127	795	Level 1	Type II	DTH	80
26	JED015	Enderta	Mariam dehan	Adikolkal	Adikolkus	551959	1496500	1982	570	Level 1	Type II	DTH	60
27	JED019	Enderta	Chelekot	Maekelgeza	Akeb demamu	550671	1478038	2016	800	Level 1	Type II	DTH	130
28	JED024	Enderta	Shibta	Randa	Randa	556070	1486658	2226	600	Level 1	Type II	DTH	100
29	JED025	Enderta	Shibta	Egriwenber	Egriwenber	555920	1491495	2238	890	Level 1	Type II	DTH	80
30	JED026	Enderta	Arato	Dean	Dean	567399	1492349	-	960	Level 1	Type II	DTH	80
31	JED032	Enderta	Lemlem	Lahama	Lahama	572860	1481986	-	790	Level 1	Type II	DTH	100
32	JED033	Enderta	Lemlem	Akeza	Akeza	572574	1485081	2473	800	Level 1	Type II	DTH	70

No.	PJ ID	WOREDA	TABIA	KUSHET	GOTE	COORDINATION			Beneficiaries (2006) (Request Form)	Facility Type	Well Structure Type	Drilling Method	Estimated Drilling Depth (m)
						UTM E (m)	UTM N (m)	Level (m)					
33	JKA001	Kilte Awlaelo	Mai quiha	Maidaero	Kembirto	554930	1525856	2102	680	Level 1	Type II	DTH	100
34	JKA003	Kilte Awlaelo	Debretsiyon	Debremear	Gelebet	546070	1528527	2104	300	Level 1	Type II	DTH	100
35	JKA004	Kilte Awlaelo	Debretsiyon	Debremear	Debremear	543903	1530533	2021	500	Level 1	Type II	DTH	100
36	JKA009	Kilte Awlaelo	Gemede	Tsahilo	Kokay	561369	1526922	-	600	Level 1	Type II	DTH	100
37	JKA012	Kilte Awlaelo	Awolo	Awolo	Ziban adi	549998	1520609	2081	395	Level 1	Type II	DTH	100
38	JKA015	Kilte Awlaelo	Myweini	Sherafo	Around church	560804	1513410	1980	400	Level 1	Type II	DTH	150
39	JKA016	Kilte Awlaelo	Genfel	Dengolo	Adiarbea	562457	1524640	2001	600	Level 1	Type II	DTH	100
40	JDT003	Degua Temben	Siret	Endamariam	Endamariam	512908	1501556	2624	370	Level 1	Type II	DTH	60
41	JDT011	Degua Temben	Selam	Adiwerho	Adiwerho	521155	1511001	2216	320	Level 1	Type II	DTH	100
42	JDT012	Degua Temben	A Kekn	Alasa	Alasa	529257	1512874	2415	310	Level 1	Type II	DTH	150
43	JDT013	Degua Temben	A Kekn	Raset	Raset	527934	1510859	2433	350	Level 1	Type II	DTH	150
44	JHW005	Hintalo Wajirat	Fikre Selam	Aderak	Mai slas	552401	1456945	2235	500	Level 1	Type III	DTH	150
45	JHW011	Hintalo Wajirat	Senale	Senale	Maikokho	576299	1444609	2345	521	Level 1	Type III	DTH	60
46	JHW012	Hintalo Wajirat	Senale	Genti	Maidimu	574845	1442355	2401	400	Level 1	Type III	DTH	60
47	JHW013	Hintalo Wajirat	Hareko	Hareqo	Adikiflom	538705	1461990	2083	300	Level 1	Type III	DTH	130
48	JHW021	Hintalo Wajirat	Metkei	Meseret	Netae	536194	1480072	-	300	Level 1	Type III	DTH	60
49	JKA017	Kilte Awlaelo	Abreha atsibha	Selam	Adikulala	556980	1532494	2016	320	Level 1	Type III	DTH	100
50	JKA018	Kilte Awlaelo	Abreha atsibha	Selam	Maichew	554153	1531491	1982	360	Level 1	Type III	DTH	60
51	JKA019	Kilte Awlaelo	Abreha atsibha	Mindae	Ekli	554277	1528505	-	500	Level 1	Type III	DTH	80
52	JDT001	Degua Temben	Mahiberesilase	Waseya	Waseya	513576	1510203	2583	350	Level 1	Type III	DTH	100
53	JDT004	Degua Temben	Siret	Mahibere Shih	Mahibereshih	516912	1503075	2601	250	Level 1	Type III	DTH	100
54	JDT018	Degua Temben	Arebay	Arebay	Arebay	528850	1516704	2631	350	Level 1	Type III	DTH	60
55	JDT019	Degua Temben	Arebay	Kelkele	Kelkele	528298	1518859	2442	350	Level 1	Type III	DTH	150
56	JKT001	Kola Temben	Merere	Chimate	Tsekente	481757	1512498	1946	250	Level 1	Type III	DTH	60
57	JKT003	Kola Temben	Merere	Guroro	Azewe	482194	1513216	-	250	Level 1	Type III	DTH	60
58	JKT005	Kola Temben	Santa gelebeda	Betro	Ater	522688	1529592	-	450	Level 1	Type III	DTH	60
59	JKT008	Kola Temben	Getsiki melsley	Endamariam	Sheka	500819	1511288	1892	240	Level 1	Type III	DTH	100
60	JKT009	Kola Temben	Getsiki melsley	Sataya	Wersege	502078	1516122	1844	440	Level 1	Type III	DTH	60
61	JKT012	Kola Temben	Simret	Adichelo	Tsami	487713	1505773	1952	215	Level 1	Type III	DTH	60
62	JKT013	Kola Temben	Adiha	Siken	Tahitay Siken	508235	1520534	1733	265	Level 1	Type III	DTH	60
63	JKT014	Kola Temben	Workemba	Etanzore	Guzara	504722	1519589	1831	240	Level 1	Type III	DTH	60
64	JKT017	Kola Temben	Shilumemni	Tsiwatsiwa	Tsewenya	476452	1503176	1691	315	Level 1	Type III	DTH	60
65	JTA002	Tanqua Abergele	Lem'at	Adimilale	Adimilale	497890	1501437	1743	1,200	Level 1	Type III	DTH	80
66	JTA005	Tanqua Abergele	Felegehiwot	Guftamne	Guftamne	483706	1468478	1228	520	Level 1	Type III	DTH	80

No.	PJ ID	WOREDA	TABIA	KUSHET	GOTE	COORDINATION			Beneficiaries (2006) (Request Form)	Facility Type	Well Structure Type	Drilling Method	Estimated Drilling Depth (m)
						UTM E (m)	UTM N (m)	Level (m)					
67	JTA006	Tanqua Abergele	Felegehiwot	Erezna	Erezna	489234	1467954	1298	460	Level 1	Type III	DTH	80
68	JTA007	Tanqua Abergele	Siye	Hidmo(1)	Hidmo(1)	483988	1485953	1446	600	Level 1	Type III	DTH	80
69	JTA008	Tanqua Abergele	Siye	Hidmo(2)	Hidmo(2)	481790	1483764	1501	400	Level 1	Type III	DTH	80
70	JTA009	Tanqua Abergele	Siye	Gomenge	Gomenge	478933	1481800	1445	510	Level 1	Type III	DTH	80
71	JTA011	Tanqua Abergele	Siye	Teklemkerira	Teklemkerira	483783	1477320	1277	600	Level 1	Type III	DTH	80
72	JTA012	Tanqua Abergele	Siye	Metere	Metere	487775	1482792	1385	500	Level 1	Type III	DTH	80
73	JTA018	Tanqua Abergele	Jijique	Jijique	Jijique	484252	1489519	1724	380	Level 1	Type III	DTH	80
74	JSS002	Seharti Samre	Neber Hadne	Fenarewa	Wete Kezena	503924	1447967	1493	175	Level 1	Type III	DTH	60
75	JSS008	Seharti Samre	Lemlem Aren	Seberye	Tahitay Seberia	527869	1451647	1693	250	Level 1	Type III	DTH	60
76	JSS009	Seharti Samre	May Tekli	Terezeba	Bereziba	-	-	2007	190	Level 1	Type III	DTH	60
77	JSS013	Seharti Samre	Bamba	Bamba	Harawa	507913	1482311	1611	180	Level 1	Type III	DTH	60
78	JHW001	Hawzen	Adibelow	Mererhuwa	-	531679	1541602	1915	700	Level 1	Type III	DTH	120
79	JHW003	Hawzen	Balieda	Adigefah	-	539525	1553409	1913	500	Level 1	Type III	DTH	150
80	JHW005	Hawzen	Debrebizen	Setet	-	541404	1560528	2107	410	Level 1	Type III	DTH	100
81	JHW007	Hawzen	Debreselam	Berakit	-	535172	1540214	1916	500	Level 1	Type III	DTH	120
82	JHW015	Hawzen	Degamba	Degemba	-	550791	1557153	2380	500	Level 1	Type III	DTH	80
83	JHW016	Hawzen	Degamba	Shikut	-	550654	1559471	2345	400	Level 1	Type III	DTH	100
84	JHW017	Hawzen	Debrehiwot	Awadu	-	541745	1543912	2080	550	Level 1	Type III	DTH	130
85	JHW019	Hawzen	Siluh	Debrehawaz	-	546528	1546447	2231	490	Level 1	Type III	DTH	60

Ⅱ. Construction Site for Motorized pump well

No.	PJ ID	WOREDA	TABIA	KUSHET	GOTE	COORDINATION			Beneficiaries (2006) (Request Form)	Facility Type	Well Structure Type	Drilling Method	Estimated Drilling Depth (m)
						UTM E (m)	UTM N (m)	Level (m)					
86	JAL002	Alamata	Selenwuha	Bedena leko	Bedena leko	578893	1361615	1391	2,240	Level 2	Type IV-1	DMCD	130
87	JRA001	Raya Azebo	Hadealga	Hadealga	Hadealga	583329	1395187	-	2,000	Level 2	Type IV-2	DMCD	135
88	JRA002	Raya Azebo	Hawlti	Hirka	Hirka	575382	1418205	1734	1,500	Level 2	Type IV-2	DMCD	82
89	JRA006	Raya Azebo	Werebaye	Gendiajo	Gemed dadi	567503	1400076	1671	1,035	Level 2	Type IV-2	DMCD	130

[Abbrevation]

＊ Facility Type
Level 1: Facility for hand pump well
Level 2: Facility for motorized pump well

＊ Well Structure Type
Type Ⅰ: Well Structure for Alluvium Deposits
Type Ⅱ: Well Structure for Limestone
Type Ⅲ: Well Structure for Sedimentary Rock and Bascement Rock
Type Ⅳ-1: Well Structure for Motorized pump of 6″ borehole
Type Ⅳ-2: Well Structure for Motorized pump of 8″ borehole

＊ Drilling Method
DTH: Down the hole hammer
DMCD: Dynamic Mudcap drilling

(3) Survey results of Rehabilitation sites

Summary sheet of rehabilitation sites

No.	Gote	Selection for project	General information											Water source				Pump						Reservoir	Pipe	Operation and maintenance						
			Gote population	On spot location			Construction	Fund source for construction	Functional / Not	Suspension	Problems on the current system	Suspension times yearly	The last rehabilitation	Distance between system and furthest households	Current alternative water sources	BH depth	BH capacity	BH Casing size	Pump capacity	Pump & engine manufacture	Estimated actual pump capacity	Times for taking to make water full in S.R.	Commercial power supply	Reservoir capacity	Pipe length	No. of Water committee member	Daily pump operation hours during fuction	Daily tap operation hours during fuction	Daily No. of poly-cans with water sold during function	Monthly operation cost	Monthly maintenance cost	Operation record notebook exists
			(year 2006)	UTM E (m)	UTM N (m)	Ground Level (m)	year			year			year	(km)		(m)	(L/s)	(inches)	(L/s)		(L/s)	(min)		(m3)	(m)		(hr)	(hr)		(Birr)	(Birr)	
1	**Deletie**	○	255	585463	1399546	1,558	1996	ESRDF	F		5,8,9,13	5		2	Pond	90	1	6	2-3	Mono & Lister	1.3	40	N.A.	3.2	200	3	5	7	200	2,200	500	No
2	Aditele	×	120	580822	1402681	1,528	1996	Water Bureau	F		5,6,9	2		2	Pond	N.A.	2	8	2-3	Mono & Lister	2.7	20	N.A.	3.2	50	3	N.A.	8	400	N.A.	80	No
3	Siloka	×	276	585959	1406081	1,546	1996	Water Bureau	F		4,7,8,9,13	4		2	Pond	140	2	6	2-3	Mono & Lister	2.7	25	N.A.	4	70	5	7	11	200	1,200	80	No
4	Hujira	×	200	569585	1401152	1,645	1979	Central Gov.	NF	1986	5,7,9,10,13		2004	2	Pond	93	N.A.	8	2-3	Mono & Lister	2.2	90	A (300m)	12	50	0	N.A.	N.A.	N.A.	N.A	N.A.	No
5	Tsaedameda	×	354	574717	1392628	1,523	1979	Central Gov.	F		7	4	2004	2	Other system	N.A.	2	6	2-3	Mono & Lister	2.8	60	N.A.	10	50	3	8	9	N.A.	3,600	400	No
6	Beru qalina	×	315	568335	1391864	1,623	1999	ESRDF	F		7,8,9,10,13	5	2006	2	Pond/Other system	110	2	6	2-3	Mono & Lister	1.8	30	N.A.	3.2	70	3	8	11	400	N.A.	400	No
7	Hadeshe qenei	×	445	575300	1370108	1,428	2001	Orthodox Church	F		5,7,8,9	4	2005	2	Pond/Other system	102	7	6	2-3	Mono & Lister	2.1	25	N.A.	3.2	1,000	5	8	11	700	2,000	1,200	No
8	**Bandera**	○	200	573007	1373114	1,402	1979	Central Gov.	F		7,8,9			2	Pond	200	2	6	2-3	Mono & Lister	1.8	30	N.A.	3.2	50	5	5	10	400	1,100	170	No
9	**Kepan**	○	600	574149	1405439	1,625	1996	Orthodox Church	F		8	1		4	Pond	140	7	6	4.0	Mono & Lister	3.3	20	N.A.	4	50	5	8	10	350	1,700	250	No
10	Chedo	×	140	583187	1399654	1,531	2001	Orthodox Church	F		5,9,13,14	4	2007	2	Pond	99	3	6	3.0	Mono & Lister	2.7	20	N.A.	3.2	100	5	9	11	350	1,900	120	Yes
11	Adigolo	×	139	577549	1396839	1,510	2002	Orthodox Church	NF	2004	7			2	Pond	120	6.5	6	N.A	Submersible & CGM	5.6	30	N.A.	10	50	4	N.A.	N.A.	300	N.A.	N.A.	No
12	Adimokoni	×	250	578404	1387098	1,523	2002	Orthodox Church	NF	2005	1,7,13			4	Pond	75	2	6	2.0	Submersible & CGM	1.4	120	N.A.	10	600	5	10	11	400	4,000	N.A.	No
13	Ketema	×	N.A.	568677	1416533	1,813	1999	ESRDF,orthodox Church	NF	2003	9,10,13,14		2007	1	Pond	N.A.	1.5	6	7.0	Grund & CGM	3.5	240	N.A.	50	200	0	N.A.	N.A.	N.A.	N.A.	N.A.	No
14	**Genete**	○	226	567876	1410406	1,774	1996	Orthodox Church	F		5,7,8,9	3		2	Pond	70	2	6	6.7	Mono & Lister	5.3	10	N.A.	3.2	70	5	0.3	7	270	370	70	No
15	Fechagama	×	210	577652	1402599	1,559	1979	Central Gov.	F		5	Suspended for long	1996	3	Pond	100	N.A	6	2-3	Mono & Lister	3.1	45	N.A.	8.5	50	3	5-6	8	200	2,400	1,000	Yes
16	Chekon	×	243	576586	1406683	1,600	1992	Water Bureau	F		5	5		5	Pond	N.A.	2	6	2-3	Mono & Lister	1.3	60	A (500m)	4.8	70	4	9	10	N.A.	1,300	800	Yes
17	Wargba	×	350	574112	1410871	1,661	1979	Water Bureau	NF	2007	5	2	1996	8	Pond/Other system	N.A.	7	8	2-3	Mono & Lister	2.2	90	A (500m)	12	30	3	8	11	300	1,500	500	Yes

The following site will not be involved in the rehabilitation project

A. : The site was cancelled by Woreda because it will be covered by the Town Water Supply Servi-
B. : There are problems on yeild or water quality with water source.
C. : Other on-spot systems are available.
D. : Since 2000s, systems were rehablitated and they are functional.
E. : Data and information on water source and pump s

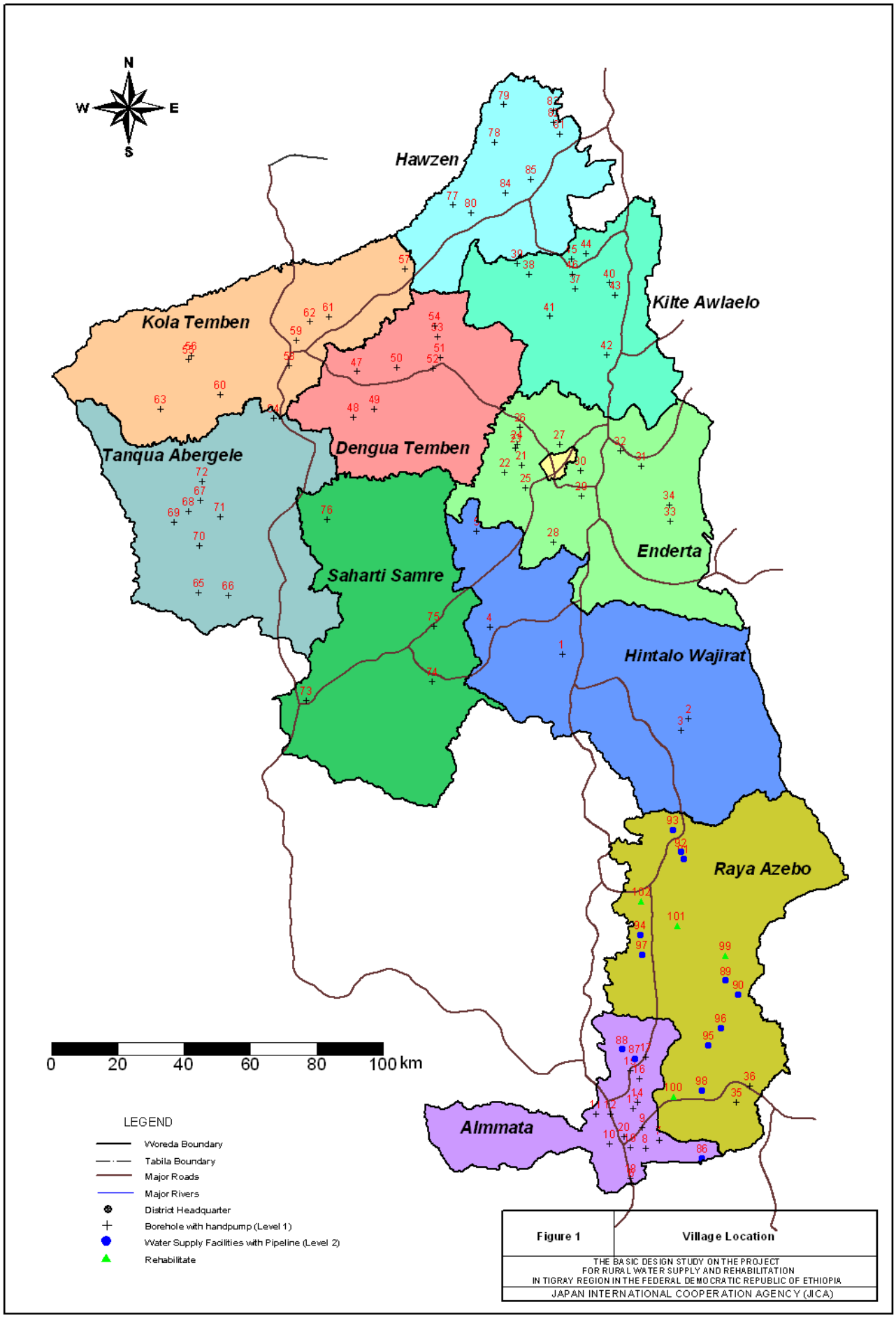
All the sites are common for the following items.

-No Maintenance records exist.
-Water tariff: 0.1 Birr for poly-cans of 20-30 L

Problems on the current system:

1. Dry up of BH
2. Lack of yield
3. Collapse of BH
4. Water quality issues
5. Pump damaged
6. Small capacity of pumps
7. Generator or engine damaged
8. Insufficient reservoir capacity
9. Rusted reservoirs and leakage
10. Pipe damaged
11. Pipe rusted
12. Insufficient pipe size
13. Taps damaged
14. Others

(4) List of Target Sites



Target site for the Project for the Rural Water Supply and Rehabilitation in Tigray

No	ID No.	Woreda	Tabia	Kushet (Village)	Gote (Site)	Coordinate value (UTM)			Type of facility
						X	Y	Z	
1	JHW005	Hintalo Wajirat	Fikre Selam	Aderak	Mai slas	552401	1456945	2235	level 1
2	JHW011	Hintalo Wajirat	Senale	Senale	Maikokho	576299	1444609	2345	level 1
3	JHW012	Hintalo Wajirat	Senale	Genti	Maidimu	574845	1442355	2401	level 1
4	JHW013	Hintalo Wajirat	Hareko	Hareqo	Adikiflom	538705	1461990	2083	level 1
5	JHW021	Hintalo Wajirat	Metkei	Meseret	Netae	536194	1480072		level 1
6	JAL007	Alamata	Timuga	Kunkura	Maedo Ketema	565499	1357078	1437	level 1
7	JAL010	Alamata	Selenwuha	Kubiderba	Amgedel	570738	1365109	1407	level 1
8	JAL011	Alamata	Selenwuha	Gedera	Gedera	568138	1363597	1569	level 1
9	JAL012	Alamata	Weselenwuha (Limat)	Adi hagos tsegay	Endasilasie(Adihana)	567594	1367414	1460	level 1
10	JAL013	Alamata	Limat	Adiabogoja	Sifraamora	561298	1364409	1538	level 1
11	JAL014	Alamata	Limat	Hashiamariam	Hashiamariam	558766	1370039	1439	level 1
12	JAL015	Alamata	Selam bikalsi	Rarhe	Rarhe	561506	1370065	1524	level 1
13	JAL017	Alamata	Selam bikalsi	Adimohoye	Adimohoye	565809	1371093	-	level 1
14	JAL018	Alamata	Selam bikalsi	Hadis kigni	Hadis Kigni	566690	1372156	1580	level 1
15	JAL019	Alamata	Kululemlem	Adishihashim	Adishihashim	565230	1378203	1482	level 1
16	JAL020	Alamata	Kulugize Zemlem	Agamitie	Agamitie	566941	1376621	1463	level 1
17	JAL022	Alamata	Tao	Adihantia	Adihantia	568277	1380792	1453	level 1
18	JAL023	Alamata	Waja ketema	Waja ketema	Waja ketema	565335	1357958	1452	level 1
19	JAL024	Alamata	Selenwuha	Harle	Harle school	565270	1363686	1467	level 1
20	JAL025	Alamata	Limat	Adieshok	Alembirhan school	564126	1365675	1480	level 1
21	JED001	Enderta	Maianbesa	Maiumer	Around school	544738	1492526	2122	level 1
22	JED003	Enderta	Maianbesa	Maiweyni	Maiayni	541577	1491125	2180	level 1
23	JED005	Enderta	Maialem	Mishim	Mishm	543600	1495723	2016	level 1
24	JED006	Enderta	Maialem	Zibanided	Zibanhided	543913	1496414	2059	level 1
25	JED008	Enderta	Debri	Mekaih	Kokahi	545491	1488261	2094	level 1
26	JED009	Enderta	Debri	Adiamik	Adiamik	544481	1499644	2127	level 1
27	JED015	Enderta	Mariam dehan	Adikolkal	Adikolkus	551959	1496500	1982	level 1
28	JED019	Enderta	Chelekot	Maekelgeza	Akeb demamu	550671	1478038	2016	level 1
29	JED024	Enderta	Shibta	Randa	Randa	556070	1486658	2226	level 1
30	JED025	Enderta	Shibta	Egriwenber	Egriwenber	555920	1491495	2238	level 1
31	JED026	Enderta	Arato	Dean	Dean	567399	1492349	-	level 1
32	JED027	Enderta	Arato	Endarbashelema	Endarbashelema	563361	1495252	2341	level 1
33	JED032	Enderta	Lemlem	Lahama	Lahama	572860	1481986	-	level 1
34	JED033	Enderta	Lemlem	Akeza	Akeza	572574	1485081	2473	level 1
35	JRA012	Raya Azebo	Bala Ulga	Butamrfeta	Buta	585379	1372176	1677	level 1
36	JRA013	Raya Azebo	Bala Ulga	Ulaga	Bisebir	587904	1375284	1604	level 1
37	JKA001	Kilte Awlaelo	Mai quiha	Maidaero	Kembirto	554930	1525856	2102	level 1
38	JKA003	Kilte Awlaelo	Debretsiyon	Debremear	Gelebet	546070	1528527	2104	level 1
39	JKA004	Kilte Awlaelo	Debretsiyon	Debremear	Debremear	543903	1530533	2021	level 1
40	JKA009	Kilte Awlaelo	Gemede	Tsahilo	Kokay	561369	1526922	-	level 1
41	JKA012	Kilte Awlaelo	Awolo	Awolo	Ziban adi	549998	1520609	2081	level 1
42	JKA015	Kilte Awlaelo	Myweini	Sherafo	Around church	560804	1513410	1980	level 1
43	JKA016	Kilte Awlaelo	Genfel	Dengolo	Adiarbea	562457	1524640	2001	level 1
44	JKA017	Kilte Awlaelo	Abreha atsibha	Selam	Adikulala	556980	1532494	2016	level 1
45	JKA018	Kilte Awlaelo	Abreha atsibha	Selam	Maichew	554153	1531491	1982	level 1
46	JKA019	Kilte Awlaelo	Abreha atsibha	Mindae	Ekli	554277	1528505	-	level 1
47	JDT001	Degua Temben	Mahiberesilase	Waseya	Waseya	513576	1510203	2583	level 1
48	JDT003	Degua Temben	Siret	Endamariam	Endamariam	512908	1501556	2624	level 1
49	JDT004	Degua Temben	Siret	Mahibere Shih	Mahibereshih	516912	1503075	2601	level 1
50	JDT011	Degua Temben	Selam	Adiwerho	Adiwerho	521155	1511001	2216	level 1
51	JDT012	Degua Temben	A Kekn	Alasa	Alasa	529257	1512874	2415	level 1
52	JDT013	Degua Temben	A Kekn	Raset	Raset	527934	1510859	2433	level 1
53	JDT018	Degua Temben	Arebay	Arebay	Arebay	528850	1516704	2631	level 1
54	JDT019	Degua Temben	Arebay	Kelkele	Kelkele	528298	1518859	2442	level 1
55	JKT001	Kola Temben	Merere	Chimate	Tsekente	481757	1512498	1946	level 1
56	JKT003	Kola Temben	Merere	Gururo	Azewe	482194	1513216	-	level 1
57	JKT005	Kola Temben	Santa gelebeda	Betro	Ater	522688	1529592	-	level 1
58	JKT008	Kola Temben	Getsiki melsley	Endamariam	Sheka	500819	1511288	1892	level 1
59	JKT009	Kola Temben	Getsiki melsley	Sataya	Wersege	502078	1516122	1844	level 1
60	JKT012	Kola Temben	Simret	Adichelo	Tsami	487713	1505773	1952	level 1
61	JKT013	Kola Temben	Adiha	Siken	Tahitay Siken	508235	1520534	1733	level 1
62	JKT014	Kola Temben	Workemba	Etanzore	Guzara	504722	1519589	1831	level 1
63	JKT017	Kola Temben	Shilumemni	Tsiwatsiwa	Tsewenya	476452	1503176	1691	level 1
64	JTA002	Tanqua Abergele	Lem'at	Adimilale	Adimilale	497890	1501437	1743	level 1
65	JTA005	Tanqua Abergele	Felegehiwot	Guftamne	Guftamne	483706	1468478	1228	level 1
66	JTA006	Tanqua Abergele	Felegehiwot	Erezna	Erezna	489234	1467954	1298	level 1
67	JTA007	Tanqua Abergele	Siye	Hidmo(1)	Hidmo(1)	483988	1485953	1446	level 1
68	JTA008	Tanqua Abergele	Siye	Hidmo(2)	Hidmo(2)	481790	1483764	1501	level 1
69	JTA009	Tanqua Abergele	Siye	Gomenge	Gomenge	478933	1481800	1445	level 1
70	JTA011	Tanqua Abergele	Siye	Teklemkerira	Teklemkerira	483783	1477320	1277	level 1
71	JTA012	Tanqua Abergele	Siye	Metere	Metere	487775	1482792	1385	level 1
72	JTA018	Tanqua Abergele	Jijique	Jijique	Jijique	484252	1489519	1724	level 1
73	JSS002	Seharti Samre	Neber Hadne	Fenarewa	Wete Kezena	503924	1447967	1493	level 1
74	JSS008	Seharti Samre	Lemlem Aren	Seberye	Tahitay Seberia	527869	1451647	1693	level 1
75	JSS009	Seharti Samre	May Tekli	Terezeba	Bereziba	528114	1462143	2007	level 1
76	JSS013	Seharti Samre	Bamba	Bamba	Harawa	507913	1482311	1611	level 1
77	JHW001	Hawzen	Adibelow	Mererhuwa	-	531679	1541602	1915	level 1
78	JHW003	Hawzen	Balieda	Adigefah	-	539525	1553409	1913	level 1
79	JHW005	Hawzen	Debrebizen	Setet	-	541404	1560528	2107	level 1
80	JHW007	Hawzen	Debreselam	Berakit	-	535172	1540214	1916	level 1
81	JHW010	Hawzen	Meztey	Dabaseria	-	551969	1554971	2300	level 1
82	JHW015	Hawzen	Degamba	Degemba	-	550791	1557153	2380	level 1
83	JHW016	Hawzen	Degamba	Shikut	-	550654	1559471	2345	level 1
84	JHW017	Hawzen	Debrehiwot	Awadu	-	541745	1543912	2080	level 1
85	JHW019	Hawzen	Siluh	Debrehawaz	-	546528	1546447	2231	level 1
86	JAL002	Alamata	Selenwuha	Bedena leko	Bedena leko	578893	1361615	1391	level 2
87	JAL004	Alamata	Gerjele	Gerjele	Gerjele town	566139	1380423	1475	level 2
88	JAL005	Alamata	Laelay Dayu	Ula	Ula	563716	1382219	1596	level 2
89	JRA001	Raya Azebo	Hadealga	Hadealga	Hadealga	583329	1395187	-	level 2
90		Raya Azebo	Hadealga	Hadealga	Keyih tekli	585735	1392560	-	level 2
91	JRA002	Raya Azebo	Hawlti	Hirka	Hirka	575382	1418205	1734	level 2
92		Raya Azebo	Hawlti	Adialebachele	Adialebachele	574831	1419414	1755	level 2
93		Raya Azebo	Abo	Bechenrkatan	Bechenrkatan	573316	1423662	1753	level 2
94	JRA003	Raya Azebo	Kara adishehu	Fondel	Fondel	567092	1403823	1705	level 2
95	JRA004	Raya Azebo	Korme	Dodota	Dodota	580079	1382937	1687	level 2
96	JRA005	Raya Azebo	Korme	Arva	Hadishkign	582325	1386253	1597	level 2
97	JRA006	Raya Azebo	Werebaye	Gendiajo	Gemed dadi	567503	1400076	1671	level 2
98	JRA007	Raya Azebo	Hadishkign	Hadishkign	Tachgubegala	578749	1374394	1406	level 2
99	JR001	Raya Azebo	Hadalga	Deletie	-	583283	1399841	-	Rehabilitation
100	JR008	Raya Azebo	Hadeshe qenei	Bandera	-	573432	1373189	-	Rehabilitation
101	JR009	Raya Azebo	Ka/;adishbo	Kepan	-	574125	1405575	-	Rehabilitation
102	JR014	Raya Azebo	Genete	Genete	-	567415	1410096	-	Rehabilitation

Legend:
level 1: water supply system by borehole with handpump
level 2: water supply system by distributed public faucet with pipeline
Rehabilitation: Rehabilitation and expansion of the existing facility