No.

MINISTRY OF WATER RESOURCE (MoWR)
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

PREPARATORY SURVEY REPORT
ON
THE PROGRAMME FOR
EMERGENCY WATER SUPPLY FOR
ADDRESSING CLIMATE CHANGE
IN
THE FEDERAL DEMOCRATIC REPUBLIC OF
ETHIOPIA

August 2009

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

KOKUSAI KOGYO CO., LTD.

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Preface

In response to a request from the Government of the Federal Democratic Republic of Ethiopia, the Government of Japan decided to conduct an outline design study on Emergency Water Supply for Addressing Climate Change and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Ethiopia a study team from April 13 to May 21, 2009.

The team held discussions with the officials concerned of the Government of Ethiopia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Ethiopia from July 20 to July 24, 2009 in order to discuss a draft outline design, and as a result, the present report was finalized.

I hope that this report will contribute to the promotion of the programme 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 2009

Izumi TAKASHIMA

Vice President

Japan International Cooperation Agency

August 2009

Letter of Transmittal

We are pleased to submit to you the preparatory survey report on on the programme for Emergency water supply for addressing climate change in the federal democratic republic of Ethiopia.

This study was conducted by Kokusai Kogyo Co., Ltd., under contract to JICA, during the period from March 31, 2009 to August 31, 2009. In conducting the study, we have examined the feasibility and rationale of the programme with due consideration to the present situation of Ethiopia and formulated the most appropriate basic design for the programme under Japan's grant aid scheme.

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

Very truly yours,

Hiroshi FUJITA

Chief Consultant,

Preparatory survey team on the programme
for Emergency water supply for addressing climate change

Kokusai Kogyo Co., Ltd.

Summary

1. Background of the Programme

(1) Superior Plans and Programmes

The most superior long-term development plan in Ethiopia is The Second Five-Year National Development Plan 2000-2005 (2002). In addition to that, the Second Sustainable Development and Poverty Reduction Paper: The SDPRP (2002) was promulgated for the steady development of the Ethiopian economy. Moreover, the Plan for Accelerated and Sustained Development to End Poverty 2005-2010 (PASDEP) was drawn up in 2006, as a replacement of the SDPRP.

While the government of Ethiopia is trying to develop its economy steadily, the government has also aimed to achieve 76% water supply rate by actions developed in the Water Sector Development Program, 2002-2016 (WSDP). In 2005, a more specific program which takes account of the recipients' circumstances, the Universal Access Programme (UAP) was formulated. The target water supply rate in rural areas is 98%, whereas that of urban areas is 100%, by the year 2012.

The common points of UAP and measures to mitigate effects of climate change are as follows: to prevent and eliminate damage caused by drought by effective and applicable measures of water development and utilization described in the water development strategy of the government of Ethiopia; and to prevent flooding by sustainable prevention and control measures, and recovery measures after floods.

(2) Present Status and Issues

Climate of the most part of Ethiopia is classified as semi-arid, and is susceptible to concurrent drought. The access rate to safe water is still low, with a national average of 53.45% (Source: MoWR Year Report 2007). Not only concurrent drought, but serious floods occurred interchangeably to drought, whose cause could be attributed to climate change in recent years. The drought and floods damage water supply facilities, and aggravate health environment of the affected area (Table 1). In last year's drought (2008), there were reports of degradation of hygiene, food scarcity, malnutrition, death of domestic animals, outbreak of contagious diseases, such as acute watery diarrhoea (AWD) and osteomyelitis in regions such as Oromia, Tigray, SNNPR, Amhara, Afar, and Somali. In order to improve these circumstances, procurement of the water supply facilities are necessary to support superior plans in the short and medium term.

Table 1: Natural Disasters in Ethiopia Presumably Caused by Climate Change

Year/Month	Location	Disaster Type	Damages
2008/8	Gambella	Flood	91,764 affected, 5 dead
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2005/5	Dire Dawa	Flood	42 dead, $1,200,000 US damaged
2005/4	Somali	Flood	235,418 affected, 156 affected , $5,000,000 US damaged

Source： Emergency Disasters Database

(3) Purpose of the Programme

The purpose of this programme is to procure necessary goods and machinery, and to provide necessary soft-components for the operation and maintenance in order to support the actions toward goals which were set by superior plans. As a result of these procurements, it is presumed that capacities of the local governments will be strengthened in conducting (adjusting) measures for climate changes, and living environment will be improved. Components to be procured are consisted of emergency water supply facilities; materials for extending the existing water supply facilities; machinery and goods for groundwater pumping facilities; and flood control measures.

2. Result of the Study and Contents of the Programme

(1) Summary of Result of the Outline Design Study

Japan International Cooperation Agency (JICA) dispatched the preparatory study team (the Study team) to Ethiopia in a period between April 13th, 2009 and 11th May, 2009. The Study team conducted natural condition surveys, such as water quality tests, and topographic surveys, and social surveys in the target six regions, namely, Tigray, Oromia, Afar, Amhara, Somali, and SNNPR.

The Study team examined appropriateness of a procurement list in the official request from the government of Ethiopia. The examinations were carried out according to the design policy, described in (2), and specification of the procurement was summarized. After a study period in Japan, the representatives from the Study team visited Ethiopia for the explanation of a Summary of Outline Design Report from July 20 to 24, 2009.

(2) Design Policy

The procurement will be conducted for the purpose of strengthening the six (6) regions' capabilities in conducting adjusting measures for effects of climate change. In addition to that, the requested items are examined if they will contribute for improvement of hygienic environment in the six regions. The results of surveys and through discussions held with the Ethiopian government, design policies are developed as follows.

Design Policy 1: To clarify the relevance of the equipment to support for addressing climate change

The equipment to be procured shall be 1) used as equipment for recovery from disasters in the water sector that are presumed to have been caused by climate change and to provide relief for the victims of such disasters, 2) used as equipment to cope with water shortages resulting from drought caused by climate change, and 3) effective as a measure to mitigate climate change. Also, equipment directly relevant to the above-mentioned objectives shall be selected.

Design Policy 2: To confirm quantity needed, the applicability, and sustainability of the equipment

(a) Drilling rig and associated tools

- There should be no overlapping of the similar procurement scheme or well construction plan of other donors.
- There should be a clear well-construction plan at the site.
- The users should have sufficient technical skill for operation of the machinery, to be procured.
- There should be a substantial organization for operation and maintenance.

(b) Water purification chemicals

- Procurement and distribution are expected to be done in equal and transparent manner.
- The chemicals to be procured should be well-known as effective agent and satisfactory records of past procurement.
- There should be places for storage of the procured chemicals.
- The amount of chemicals should be appropriate.
- The distribution routes should be defined.

(c) Water tank trucks（5 – 10 m3）

- The expected users (organization) have sufficient level of operation skill.

- There should be a clear mandate and organization for operation and management.
- There should be places for storage of the procured trucks.
- There should be a clear plan and recipients.

(d) Plastic tank for water storage

[In case of water supply by water tank trucks]

- There should be a clear plan and recipients.
- There should be a source of plastic tanks for water storage to be procured.
- There should be places for storage of the plastic tank for water storage.

[In case of water supply by water purification plants]

- There should be a sufficient amount of water supply from the water sources.
- There should be a plan to supply safe and sustainable water in the subject area.

(e) Portable water purification plants

- There should be asufficient amount of water supply from the water sources.
- There should be a plan to supply safe and sustainable water in the subject area.

(f) Equipment for flood management

- There should be an organization with a mandate for operation and maintenance.
- The organization is capable for operation and maintenance.
- Spare parts can be procured within the country.
- There should be places for storage of the disaster control equipment.

(g) Equipment for water supply facilities

- The recipients are able to afford operation and management fee.
- The recipientsintend to carry out operation and maintenance.
- The local government is able to construct the facilities by materials to be procured.

(h) Equipment for borehole maintenance

- The well must be repairable.
- The present status of wells must be recognized.
- The user (organization) has skill to operate the equipment.
- The organization is capable for operation and maintenance.

Design Policy 3: To confirm necessity of technical assistance for the machinery

Whether it is necessary to provide technical assistances for the machinery are decided by hearings at the respective organizations on the past records of the utilization of the same equipment or the

materials. The appropriateness off the materials can be judged by their reputation because they may be widely used in the region, or the user organization may possess, or uses the same materials.

Design Policy 4: To procure machinery suitable for the natural conditions of the sites

Unpaved roads, widely seen in Ethiopia except its trunk roads, could be muddy and slippery during the rainy seasons and they are hindering the water supply activities. The vehicles to be procured should be four-wheel drives.

Design Policy 5: Suitability for procurement condition in Ethiopia

When selecting the machinery, availability of spare parts are confirmed, and selection is to be made according to accessibility to the spare parts.

This programme is 'untied,' and therefore there is no restriction of the origin of the products.

Design Policy 6: To pay sufficient consideration for operation and maintenance

The procurement will be done only if the recipient organizations have sufficient skills for operation and maintenance. However, disaster control machinery will be considered individually, without this policy.

Design Policy 7: To procure machinery with easy operation

It is observed that skills of operating equipment and machinery are reaching certain level at respective organizations; however, most of the equipment that they use is old. Therefore, new equipment should require simple operation. Machinery with complex electric panels should be avoided as much as possible.

(3) Contents and Scale of the Programme

Since Exchange of Notes between Japan and Ethiopia was already concluded, a ceiling on price in this programme was set up. Then, appropriate high priority equipment shall be selected. Additional procurements of equipment, selected from the appropriate list, are to be made if there is a budget surplus as a result of a bid below the E/N limit.

Priority equipment to be procured and additional equipment to be procured are shown in the table below.

Table 2: List of priority equipment to be procured

No	Equipment Name	Unit	Total		Tigray		Oromia		Afar		Amhara		Somali		SNNP	
			Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result
A. Deep well drilling equipment																
A.1-1	Drilling rig (300m)	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.1-2	Accessaries for the above Rig	Ls	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.1-3	High pressure Air compressor with Truck	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.2	Cargo truck with crane (3t rifting)	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
B. Emargency water supply equipment																
B.1	Water purification chemicals (per 1,000 pcs)	Box	4,800	5,422	700	718	1,100	1,008	500	630	1,000	1,134	600	924	900	1,008
B.2	Water tank truck (6m3)	Unit	-	4	-	1	-	-	-	1	-	-	-	1	-	1
B.3	Water tank truck (15m3)	Unit	10	9	5	1	2	5	1	1	-	-	1	1	1	1
B.4	Movable Water Purifier（8,000 litre/hr）	Unit	26	46	2	12	5	2	5	7	5	5	5	7	4	13
B.5	Movable Water Purifier（12,000 litre/hr）	Unit	26	31	2	8	5	3	5	1	5	6	5	5	4	8
B.6	Plastic tank (5m3)	Unit	120	106	20	17	20	16	30	15		27	30	14	20	17
	For water tank truck	Unit		36		4		13		8		0		6		5
	For movable water pulifier	Unit		70		13		3		7		27		8		12
B.7	Plastic tank (10m3)	Unit	120	106	20	17	20	16	30	15		27	30	14	20	17
	For water tank truck	Unit		36		4		13		8		0		6		5
	For movable water pulifier	Unit		70		13		3		7		27		8		12
C. Disaster control equipment																
C.1	Bulldozer (10t)	Unit	2	0	-	-	-	-	1	-	-	-	1	-	-	-
C.2	Bulldozer (20t)	Unit	-	1	-	-	-	-	-	1	-	-	-	-	-	-
C.3	Heavy equipment transport vehicle	Unit	-	1	-	-	-	-	1	1	-	-	-	-	-	-
D. Equipment and materials to expand the facility for practical application of production wells in drought-affected areas																
D.1	Material for water supply facility construction A	Ls	1	1	-	-	-	-	-	-	-	-	-	-	1	1
D.2	Material for water supply facility construction B	Ls	1	1	-	-	-	-	-	-	-	-	-	-	1	1
D.3	Material for water supply facility construction C	Ls	1	0	-	-	-	-	-	-	-	-	-	-	1	-
E. Service rig																
E.1-1	Service Rig	Unit	-	1	-	-	-	-	-	-	-	-	1	1	-	-
E.1-2	Tools the above service rig	Ls	-	1	-	-	-	-	-	-	-	-	1	1	-	-
E.2	Mobil work shop	Unit	-	0	-	-	-	-	-	-	-	-	1	-	-	-

Table 3: List of backup equipment to be procured

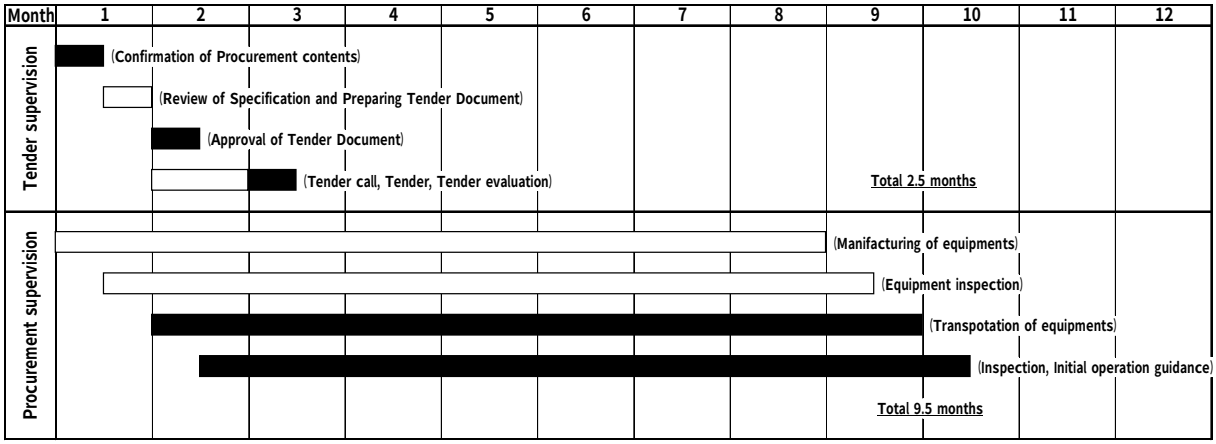
No	Equipment Name	Unit	Total		Tigray		Oromia		Afar		Amhara		Somali		SNNP	
			Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result
B. Emargency water supply equipment																
B.2	Water tank truck (6m3)	Unit		5		2		0		0		0		1		2
B.3	Water tank truck (15m3)	Unit		7		2		2		0		0		2		1
B.6	Plastic tank (5m3)	Unit		24		3		5		0		0		8		8
	For water tank truck	Unit		24		3		5		0		0		8		8
B.7	Plastic tank (10m3)	Unit		24		3		5		0		0		8		8
	For water tank truck	Unit		24		3		5		0		0		8		8

3. Implementing Schedule and Programme Cost Estimation

(1) Implementation Schedule

The implementation schedule of this programme is shown in Table 4.

Table 4: Implementation Schedule



(2) Programme Cost Estimation

This cost estimate is provisional and is to be further examined by the Government of Japan for approval of the Grant.

■ Obligation of Ethiopian side

The following cost shall be born by the Ethiopian side.

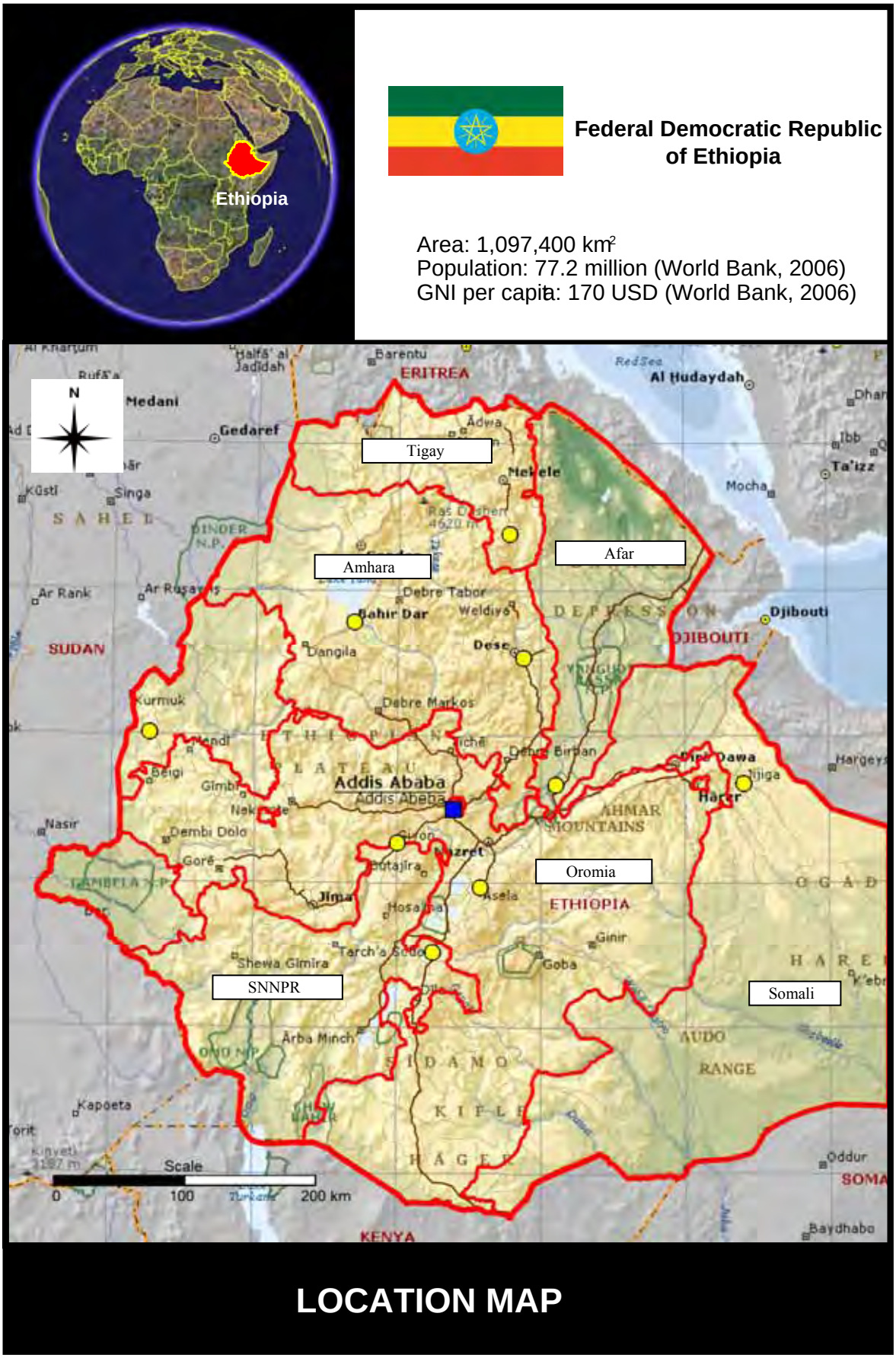
15,501,500 Birr （Approximately 136.41million JPY）

Cost born by the Ethiopian Side	Amount（Birr）
Bank Processing Fee (From account of the Government of Ethiopia to account of procurement organization)	45,500
Complement to tax wavering	13,636,000
Construction of water supply facilities (in SNNPR)	1,820,000
Total	15,501,500

Note: VAT amount is estimated 15% of procurement cost. If VAT will exempt, the cost shall be not required.

Contents

【Appendices】



LOCATION MAP

List of Figures & Tables

Abbreviations

ADRA	Adventist Development and Relief Agency
AfDB	African Development Bank
AIDS	Acquired Immune Deficiency Syndrome
AWD	Acute Watery Diarrhea
AWRB	Afar Water Resource Bureau
AWRDB	Amhara Water Resource Development Bureau
AWWCE	Amhara Water Works Construction Enterprise
BPR	Business Process Re-engineering
CHF	Canadian Hunger Foundation
CISP	Cooperative Registnalee Produzione Alimentare
CRS	Catholic Relief Services
DFID	Department for International Development
DTH	Down the Hole Hammer
EEPCo	Ethiopian Electric Power Cooperation
EIA	Environmental Impact Assessment
E/N	Exchange of Note
EPA	Environmental Protection Authority
EPRDF	The Ethiopian Peoples' Revolutionary Democratic Front
EWTEC	Ethiopia Water Technology Centre
FAO	Food and Agriculture Organization of the United Nation
FEWS NET	Famine Early Warning System Network
GNI	Gross National Income
HIV	Human Immunodeficiency Virus
IMC	International Medical Corps
JICA	Japan International Cooperation Agency
MoFED	Ministry of Finance and Economical Development
MoME	Ministry of Mine and Energy
NGO	Non-Governmental Organization
OCHA	United Nation Office for Coordination of Humanitarian Affairs
ONLF	Ogaden National Liberation Front
OWRB	Oromia Water Resource Bureau
PASDEP	Plan for Accelerated and Sustainable Development to End Poverty
PPP	Public Private Partnership
SC	Save the Children
SDPRP	Sustainable Development and Poverty Reduction Programme
SNNPR	Southern Nations, Nationalities, and People's Region
SNNPWRDB	Southern Nations, Nationalities, and People's Water Resource Development Bureau
SWWCE	Somali Water Works Construction Enterprise
TNRS	Tigray National Regional State
TWRMEB	Tigray Water Resource, Mines and Energy Bureau
TWWCE	Tigray Water Works Construction Enterprise
UAP	Universal Access Programme
UNCHR	United Nation Health Commissioner for Refugees

UNDP	United Nation Development Plan
UNICEF	United Nations Children's Fund
USAID	US Agency for International Development
WASH	Water, Sanitation and Hygiene
WATSAN	Water and Sanitation
WB	World Bank
WRMEDB	Water resource, Mining and Energy Development Bureau
WSDP	Water Sector Development Programme
WWDA	Water Well Drilling Authority

Chapter 1 Background of the Programme

Chapter 1 Background of the Programme[1]

1-1 Present Status and Issues in Water Supply Sector

Climate of the most part of Ethiopia is classified as semi-arid, and is susceptible to concurrent drought. The access rate to the safe water is still low, with a national average of 53.45% (Source: MoRW Year Report 2007). In recent years, in addition to this concurrent drought, there have been serious floods, which may be attributed to climate change. The drought and floods damage water supply facilities, and aggravate the health environment of the affected area (Table 1-1). In last years' drought (2008), there were reports of degradation of hygiene, food scarcity, malnutrition, death of domestic animals, outbreak of contagious diseases, such as acute watery diarrhoea (AWD) and osteomyelitis in regions such as Oromia, Tigray, SNNPR, Amhara, Afar, and Somali. In order to improve these circumstances, procurement of the water supply facilities are necessary to support superior plans in the short and medium term.

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Source: Emergency Disasters Database

[1] The title of the project is “the Programme for Emergency Water Supply for Addressing Climate Change”. Here “prpgramme” is used to convey the same meaning as “project”, it is commonly used JICA.

1-2 Background of Request for Japan's Grant Aid

At the annual meeting of the World Economic Forum held in Davos, Switzerland in January 2008, former Prime Minister Yasuo FUKUDA gave a speech to announce the *Cool Earth Partnership* initiative as a measure to assist developing countries that are aiming to achieve both emissions reductions and economic development. This means that Japan had decided to actively cooperate on energy conservation and other efforts for emissions reduction by developing countries and support developing countries that are seriously affected by climate change.

As part of this initiative, the Grant Aid for Environment and Climate Change Programme was introduced in fiscal 2008 to support developing countries that are short of capacity and funds for making the reduction of greenhouse gas emissions compatible with economic development, despite having the desire to contribute to climate stability.

To extend support to Ethiopia, with which Japan had newly established the Cool Earth Partnership, the Ministry of Foreign Affairs instructed JICA to conduct a field survey to ascertain the urgent need for mitigating climate change and for water supply equipment (hereinafter referred to as a needs survey) from December 14 to December 28, 2008. In this programme, references of tender documents will be prepared for equipment and materials, found to be effective in needs survey, through examinations on the appropriateness and sustainability; and, to decide quantities and the specifications.

1-3 Environmental and Social Consideration

(1) Organization, Laws and Regulations

Organization responsible for conducting EIA:	Inter-regional projects, or whose impact affects more than two regions → Environmental Protection Authority (EPA) Projects within a region →Environmental Section of Regional Government
Act giving authority to EPA:	Proclamation No. 9/1995
Environmental Impact Assessment Guideline:	EPA (July, 2000)
Proclamation gives lawful power to Environmental Impact Assessment EIA:	Proclamation No.299/2002

Table 1-2 Environmental Impact Assessment Procedural Guideline

Categories	EIA Guideline (November, 2003 Draft)
Schedule 1 Projects, which may have adverse and significant environmental impacts, and may, therefore, require full EIA/EA	[Water Supply Sector] ➢ 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 100 hectares ➢ Groundwater development for industrial, agricultural or urban water supply of greater than 4,000 m3 /day ➢ Drainage Plans in towns close to water bodies
Schedule 2 Projects whose type, scale or other relevant characteristics have potential to cause some significant environmental impacts but not likely to warrant an environmental impact study. Therefore, these types of projects will require a preliminary environmental impact study.	[Water Supply Sector, etc] ➢ Rain water harvesting ➢ Rural water supply and sanitation ➢ Land drainage (small scale) ➢ Sewerage system
Schedule 3 Projects that would have no impact and does not require environmental impact assessment	[Water Supply Sector, etc] ➢ Surface water fed irrigation projects covering less than 50 hectares ➢ Groundwater fed irrigation projects covering less than 50 hectares

Source: Environmental Impact Assessment Guideline, EPA (November, 2003)

(2) Contents of Programme

Contents of this programme are procurement of water supply facilities and recreated materials, as shown in Table 1-3.

Table 1-3: Request List of the Ethiopian Government

Names of Equipment and Machinery
Drilling Rigs (d=200m) and the accessories
Water Tank Trucks (10 m^3)
Plastic Water Tanks (10 m^3)
Plastic Water Tanks (5 m^3)
Movable Water Purifier (8,000 litre/hr)
Movable Water Purifier (12,000 litre/hr)
Bulldozer
Water purification chemicals
Materials of construction of water supply facilities

(3) Initial Environmental Examination

EIA/EA or preliminary environmental examinations are not necessary for this programme, according to Ethiopia's EIA guidelines in Table 1-2.

The study team also conducted an Initial Environmental Examination (IEE) utilizing JICA guideline; however, there was no significant impact found either. So it is determined that no further environmental reports will be necessary for this programme.

Table 1-4: Results of IEE (JICA)

Type of Impacts/ subject may affected			Grade	Remarks
Social Environment	1	Resettlement	D	No resettlement occur
	2	Local economy	D	Although procurement of water purification chemicals and other machinery may decrease commercial opportunities of local merchants and construction machine rental businesses, this is expected to be negligible.
	3	Land use and natural resources	D	There is no impact foreseen on land and natural resources.
	4	Social organization, unity	D	According to the nature of procurements, impacts such as division on the recipient community are not likely to occur.
	5	Existing infrastructure and public services	D	No negative impacts on present infrastructure expected.
	6	Socially weak group	D	This programme aims to support socially and economically weak people.
	7	Unequal distribution of benefit/ cost	D	Direct recipients are regional governments. It is confirmed that the local governments will distribute according to the necessity and degree of emergency.
	8	Cultural heritage	D	Procurements are all movable, and hence, there is no impact on cultural heritages.
	9	Dispute among stake holders	D	Disputes are not likely to occur because the procured products will be distributed from the central government to the regional government, and will be stored for distribution.
	10	Water rights and the usage	D	Positive impacts are expected due to safe water supply by the procured products.
	11	Public hygiene	D	Positive impacts are expected.
	12	Risk of HIV/AIDS and transmission disease	D	Strong positive impacts on decreasing water related diseases are expected.
	13	Accidents	D	There is no increase of accident expected by the procurement.
Natural Environment	14	Notable geology and topography	D	There is no modification on notable topographic or geologic sites.
	15	Soil erosion and accumulation	D	No erosion will be caused by the procurement.
	16	Groundwater	D	There is no impact expected by the procurement; however, if there is not sufficient groundwater supply for the new usage, the amount of pumping up is required to be decreased from the new plan.
	17	River flow rate and the temperature	D	No impact on river flow rate or its temperature is expected by the procurement.
	18	Coast	D	There is no coastal area in Ethiopia.
	19	Flora and fauna, ecosystem	D	There is no impact on flora, fauna and the ecosystem by the procurement.
	20	Meteorology	D	Climate will not changed by the procurement.
	21	Aesthetic beauty	D	There is no change on topography.
	22	Global warming	D	There is no acceleration of global warming by the procurement.
Pollution	23	Air pollution	D	Impact of emissions from the trucks and construction machines is negligible because of the scarce population of the surrounding area.
	24	Water pollution	D	Water pollution will not occur.
	25	Soil pollution	D	There is no soil pollution envisaged by the procurement.

Type of Impacts/ subject may affected			Grade	Remarks
	26	Solid waste	D	Sludge will be produced from water purification machine; however, it is a negligibly small amount.
	27	Noise/ vibration	D	Although trucks and rigs will emit noise and vibration, this is also negligible.
	28	Land subsidence	D	Although, theoretically speaking, land subsidence may occur if huge amount of groundwater is withdrawn in many places at the same time, and for a long time, there is no issue of land subsidence by wells in Ethiopia.
	29	Offensive odour	D	Offensive odour is not expected to be emitted.
	30	River/ lake bed sediment	D	There should be no degradation of sediments of river and lake bed.

Grade **A**: Significant impact(s) may occur.
B: Less significant impact may occur than Grade A
C: Degree of impacts are unknown, further research will be necessary.
D: The impact is negligibly small or no impact. Further study is unnecessary.

Chapter 2 Contents of the Programme

Chapter 2 Contents of the Programme

2-1 Basic Concept of the Programme

(1) Overall Goal and Programme Goal

The most superior long-term development plan in Ethiopia is the Second Five-Year National Development Plan 2000-2005 (2002). In addition to that, the Second Sustainable Development and Poverty Reduction Paper: SDPRP (2002), was promulgated for steady development of Ethiopian economy. Moreover, Plan for Accelerated and Sustained Development to End Poverty 2005-2010 (PASDEP) was drawn up in 2006, to replace SDPRP

While the government of Ethiopia is trying to develop its economy steadily, the government has also aimed to achieve 76% water supply rate by actions developed in the Water Sector Development Programme, 2002-2016 (WSDP). In 2005, a more specific program, which takes account of the recipients' circumstances, the Universal Access Programme (UAP) was formulated. The target water supply rate in rural areas is 98%, whereas that of urban areas is 100%, by the year 2012.

The common points of UAP and measures to mitigate effects of climate change are as follows:

- To prevent and eliminate damages caused by drought, by effective and applicable measures of water development and utilization described in water development strategy of the government of Ethiopia;
- And to prevent flooding by sustainable prevention and control measures, and recovery measures after floods.

(2) Outline of the Programme

The outline of this programme is to procure necessary goods and machinery, and to provide the necessary soft-component for operation and maintenance in order to support actions toward goals which were set by superior plans. As a result of these procurements, it is presumed that capacities of the local governments will be strengthened in conducting (adjusting) measures for climate changes, and living environment will be improved. Components to be procured consist of emergency water supply facilities; materials for extending the existing water supply facilities; machinery and goods for groundwater pumping facilities; and flood control measures.

A list in Table 2-1 shows all materials and machinery requested by the Ethiopian government in an official letter on 28th December, 2008.

Table 2-1: Components of the Request

Component			Unit	Priority	Total	Tigray	Oromia	Afar	Amhara	Somali	SNNPR
A	Equipment for well drilling	Drilling rig (200m) and associated tools	set	A	2	1	1	0	0	0	0
				B	1	0	0	0	0	0	1
B	Equipment for emergency water supply	Water purification chemicals	1000 sachet	A	4,800	700	1,100	500	1,000	600	900
				B	4,800	700	1,100	500	1,000	600	900
		Water tank trucks (10 m^3)	unit	A	5	1	1	1	0	1	1
				B	21	0	0	10	0	11	0
		Portable water purification plant (8,000 litre/hr)	set	A	26	2	5	5	5	5	4
				B	12	2	5	0	3	0	2
		Portable water purification plant (12,000 litre/hr)	set	A	26	2	5	5	5	5	4
				B	12	2	5	0	3	0	2
		Plastic tank for water storage (5m^3)	unit	A	120	20	20	30	0	30	20
				B	120	20	20	30	0	30	20
		Plastic tank for water storage (10m^3)	unit	A	120	20	20	30	0	30	20
				B	120	20	20	30	0	30	20
C	Equipment for flood management	Bulldozer	unit	A	2	0	0	1	0	1	0
				B	3	0	0	1	1	1	0
D	Equipment for water supply facilities	Equipment for exploratory well	set	A	3	0	0	0	0	0	3
				B	0	0	0	0	0	0	0

It was confirmed in the Minutes of the Discussion (M/D) that there are no changes to the request; the counterpart agency, the respective regional government, however, requested some corrections through surveys and discussions held by the study team.

Table 2-2: Modifications in the Components (April, 2009)

Classification		Component	Unit	Total	Tigray	Oromia	Afar	Amhara	Somali	SNNPR
A	Equipment for drilling wells	Drilling rig (300m) and associated tools	set	2	1	1	0	0	0	0
		Drilling rig (200m) and associated tools	set	1	0	0	0	1	0	0
B	Equipment for emergency water supply	Water purification chemicals	1000 sachet	3,890	540	1,100	500	250	600	900
		Water tank truck (10 m^3)	set	10	5	2	1	0	1	1
		Plastic tank for water storage (5m^3)	unit	140	20	20	30	20	30	20
		Plastic tank for water storage (10 m^3)	unit	140	20	20	30	20	30	20

Classification		Component	Unit	Total	Tigray	Oromia	Afar	Amhara	Somali	SNNPR
		Portable water purification plant (8,000 litre/hr)	set	51	2	31	5	4	5	4
		Portable water purification plant (12,000 litre/hr))	set	41	2	25	5	0	5	4
C	Equipment for flood management	Bulldozer	unit	2	0	0	1	0	1	0
		Heavy equipment transport vehicle	unit	1	0	0	1	0	0	0
D	Equipment for water supply facilities	Equipment for exploratory well	set	3	0	0	0	0	0	3
E	Equipment for Borehole maintenance	Service rig	set	1	0	0	0	0	1	0
		Mobile workshop	unit	1	0	0	0	0	1	0

* Yellow means change of quantity from original request.

The positioning of this programme is summarized in Project Design Matrix (PDM) as shown in Table 2-3.

Table 2-3: Position of the Programme in Project Design Matrix（PDM）

Name of Programme: Emergency Water Supply for Addressing Climate Change in the Federal Democratic Republic of Ethiopia
Period: October, 2009 - August, 2010 (tentative)
Target areas: Tigray, Oromia, Afar, Amhara, Somali, and S.N.N.P.Regions
Target Group: Inhabitants of the target areas
Date drawn on：June 15th, 2009

Summary of the programme	Indicator	Method of Acquisition	Outside conditions (killer assumptions)
Overall Goal Standard of Hygienic environment will be improved.	Mortality rate of child under 5-years old by acute watery diarrhoea	・ Health statistics	
Programme Goal Safe and stable water is supplied in the target areas during droughts and floods.	Population to receive water during disasters	・ Record of water supply activities ・ Record of the usage of machinery for disaster prevention ・ Record of usage of machinery for operation and maintenance.	There is no big changes in direction of the water supply policy of Ethiopia
Output 1. Safe water is supplied to drought prone areas	1－1 Activities of water tank truck 1－2 Usage of portable water purification plants 1－3 Usage of plastic tank for water storage 1－4 Degree of residents' satisfaction	1－1 Records of water tank truck' activities 1－2 Operation records of portable water purification plant 1－3 Utilization records of plastic tank for water storage 1－4 Questionnaire to the residents	There is no sudden population expansion or decline

Summary of the programme	Indicator	Method of Acquisition	Outside conditions (killer assumptions)
2. Safe water is supplied to AWD prone areas	2－1 Usage of water purification agents 2－2 Usage of portable water purification plants 2－3 Usage of plastic tank for water storage 2－4 Degree of residents' satisfaction	2－1 Distribution records of water purifier agents 2－2 Operation of records of portable water purification plant 2－3 Utilization records of plastic tank for water storage 2－4 Questionnaire to the residents	
3. Safe water is supplied to residents in flood prone areas	3－1 Usage of water purification agents 3－2 Activities of water tank truck 3－3 Usage of plastic tank for water storage 3－4 Degree of residents' satisfaction	3－1 Distribution records of water purifier agents 3－2 Operation records of water tank truck 3－3 Utilization records of plastic tank for water storage 3－4 Questionnaire to the residents	There is no drought or flood which exceed expected scale
4. Frequency of the flooding is decreased by the flood control measure	4－1 Activity of bulldozer 4－2 Activity of heavy machine transporter for 4－3 Frequency of flood occurrence	4－1 Operation records of bulldozers 4－2 Operation records of heavy machinery transporter 4－3 Record of flood disasters	
5. Water supply rate increases at the extensions of the existing water supply facilities	5－1 Utilization of materials and machinery for extension of existing water supply facilities 5－2 Operation and maintenance status	5－1 Operation records of facilities, register of water committee 5－2 Collection record of water tariff	
6. Existing well recover their function; and, safe water will be supplied	6－1 Usage of service rig 6－2 Recovery status of existing wells.	6－1 Operation record of service rig 6－2 Number of wells, records of their status	
Activities	Input		
Japanese Side	(Japanese Side)	(Ethiopian Side)	
1－1 Procurement of water tank truck 1－2 Procurement of portable water purification plants 1－3 Procurement of plastic tank for water storage 2－1 Procurement of water purification chemicals 2－2 Procurement of portable water purification plants 2－3 Procurement of plastic tank for water storage	・ Procurement of the materials and machinery	・ To provide operation and maintenance cost ・ To provide appropriate number of staff ・ To secure storage space for procured materials and machines ・ To secure budget for construction of extension facilities for existing water supply facilities	

Summary of the programme	Indicator	Method of Acquisition	Outside conditions (killer assumptions)
3－1 Procurement of water purification chemicals 3－2 Procurement of water tank truck 3－3 Procurement of plastic tank for water storage 4－1 Procurement of bulldozer 4－2 Procurement of transporter for heavy machinery 5－1 Procurement of materials for extensions for existing water supply facilities. 6－1 Procurement of service rig			
Ethiopian Side			
1－1～6－1 Waiving of tax on procured materials and machinery 1－1、3－2、4－1、4－2、6－1 Drivers / operators for the machinery be secured 2－2 To provide guidance for operators and maintenance of portable water purification plants 1－1～6－1 To conduct monitoring of the usage of the procured materials and machinery 5-1～5-3 Construction of the extension of existing water supply facilities.			

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1) Clarification of the relevance of the equipment and climate change

The equipment to be procured shall be 1) used as equipment for recovery from disasters in the water sector that are presumed to have been caused by climate change and to provide relief for the victims of such disasters, 2) used as equipment to cope with water shortages resulting from drought caused by climate change, and 3) effective as a measure to mitigate climate change. Also, equipment directly relevant to the above-mentioned objectives shall be selected.

(2) Confirmation on quantity, applicability, and sustainability

Appropriateness of the equipment is confirmed in the following manner.

1) Drilling rig and associated tools

Drilling plans and situation of hydrological geology are confirmed at Oromia Regional Government Water resources Department and Tigray Regional Government Water Resources Government. The level of technical skill and system of operation and management are confirmed; and appropriateness of the requested equipment specifications and quantities are confirmed.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Drilling Plan	Water Resource Dept., WWCE	Reference on paper, or hearing	If there is similar procurement plan of rigs from other donors; and, if there is similar drilling plan at present?	There should be a clear drilling plan
Condition of hydrological geology	Water Resource Dept., WWCE	Reference on paper, or hearing	-	
Operation skill	Water Resource Dept., WWCE	Hearing	If there is big difference between their skill and that required for requested rigs?	The user organization must have skill to operate the rigs to be procured.
Operation and maintenance system	Water Resource Dept., WWCE	Hearing	If the regional government can afford operation and maintenance cost of the new rigs.	There should be an operation and maintenance system established in the use organization.
Procurement of spare parts	Water Resource Dept., WWCE	Hearing	If there is any deserted equipment due to lack of the budget for maintenance and/or spare parts.	

2) Water purification chemicals

Water purification chemicals are necessary especially in emergency during outbreak of AWD. A certain amount needs to be stored in each region for health disaster prevention purposes.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Procurement/ Distribution status	Other donors, NGOs, Respective governmental offices	Hearing	If transparency and equality would be maintained during procurement and distribution of the water purification chemicals	The effectiveness and the performances are recognized. There should be storage place for the water purifying agents. The number of machines should be appropriate. There should be established distribution routes.
Past record/ Effectiveness	Other donors, NGOs, Respective governmental offices	Hearing	Effectiveness of the water purification chemicals	
Quantity to be used	Other donors, NGOs, Respective governmental offices	Hearing	Effective duration of the agents is 3 years. Were the agents used up properly in the past?	
Storage place/ distribution routes	Water Resource Dept.	Hearing	Is the storage place suitable for the agents? Are the agents to be distributed at once to the locals, or to distribute them on the demand?	

3) Water tank truck (5-10m^3)

The trucks will be procured for the purpose to supply water to people affected by drought and/or flood.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Target population	Water Resource Dept.	Hearing	Description of past damages during disasters.	User organization should have appropriate skills to operate the water tank truck. There should be an appropriated storage place. There is a clear supply plan and recipients.
Target areas	Water Resource Dept.	Hearing		
Operation skill	Water Resource Dept.	Hearing	If there is big difference between type of machinery in possession and ones requested?	
Operation and maintenance system	Water Resource Dept.	Hearing	Can the user organization cover the cost for operation and maintenance?	
Procurement of spare parts	Water Resource Dept., Dealers	Hearing	If there is any truck deserted by lack of maintenance budget?	

4) Plastic tank for water storage

Plastic tanks for water storage are planned to be used in two ways. One is to set up at the drought/ flood affected villages, and water is to be supplied by water tank truck, from nearby water sources. The other way is to use in combination with portable water purification plants.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Case of combination with water tank truck				
Target Population	Census	Web Site, Reference books, C/P Hearing	Description of the recipients. Are tanks going to water scarce areas at present? How are future predictions made?	Water source should be secured by the recipient agency.
Storage place	Water Resource Dept.	Hearing	It is important to make ways of distribution. If the tanks are distributed to the recipients at once or to transport it on demand.	
Case of combination with portable water purification plants				
Target population	Water Resource Dept.	Hearing	What type of water source the recipients are using?	Amount from water source is enough for the target population and the area. If there is a permanent water supply plan.
Target area	Water Resource Dept.	Hearing	How big is the target area?	
Water source	Water Resource Dept.	Hearing	To find if the quantity to be supplied is enough for the target area/population.	
Future plan	Water Resource Dept.	Hearing	To find if the local government has a permanent water supply plan.	

5) Portable water purification plant

The percentage of the population who receive safe drinking water supply still remains less than half. There are many areas needing the portable water purification machine, other than the drought/ flood affected areas. The water purification machines are to be used temporarily before the regional governments' water supply plans will be implemented. The machinery is also effective for the residents during disaster, especially in disaster prone areas.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
In case of using the machine during emergency				
Target population	Water Resource Dept.	Hearing	What kind of water resource are the residents using?	Is water resource enough for the target population in the area? There should be a plan to
Target area	Water Resource Dept.	Hearing	Size of target area	

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Water source	Water Resource Dept.	Hearing	Is water amount from the source enough for the target population and target area?	supply safe water permanently.
Procurement of spare parts	Water Resource Dept.	Hearing	Where is the source; and How far is the distance and time require?	
In case of using the machine for preparation for drought				
Records of past disasters	Water Resource Dept.	Hearing	Was the damage caused by drought/flood? Could a government official survey the affected area?	There should be disaster experience in which portable water purification plants were required.
Number of affected population	Water Resource Dept.	Hearing	Number of affected people.	
Area affected by disaster	Water Resource Dept.	Hearing	Distribution of the affected people.	
Time needed for recovery	Water Resource Dept.	Hearing	How much time did the recovery work take?	

6) Equipment for flood management

Bulldozers were requested as a flood control measure. How the bulldozers would be used for preventing floods, and in what kind of conditions, was clarified in hearings with the respective government officials. Capability of operation and maintenance, together with preparation of storage places were confirmed. Appropriate types and quantity of the disaster management machinery are examined.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Measures taken for disasters	Respective government official	Hearing	What are the countermeasures for floods? Is it possible to do these with only a bulldozer? How will the bulldozer be transported from the stored place to the affected place?	Usage of the machine is clarified. Organization responsible for the operation and maintenance is clearly defined.
Capability of operation and maintenance	Respective government official	Hearing	Does the local government have sufficient budget for the maintenance of the machinery?	The user organization is capable of maintenance of the machinery.
Storage place	Respective government official	Hearing	Is the storage place safe from the thieves?	Procurement of spare parts is possible in Ethiopia.
Procurement of spare parts	Local dealer	Hearing, acquisition of references	Are there applicable spare parts for machinery procured from third country?	The user organization has appropriate storage place.

7) Equipment for water supply facilities

It is planned to increase water supply rate through provision of construction materials for test boreholes drilled by JICA's technical cooperation project: "Training on Groundwater Development and Water Supply Scheme".

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Results of test pumping	Other JICA Teams	acquisition of references	-	It should be confirmed that operation and maintenance cost for the facility is affordable to the recipients. The recipients have intention to bare the cost of operation and maintenance. The construction can be done by the budget of the local government.
Necessity	Other JICA Teams	acquisition of references	Distribution of the recipients, and concrete requirement of the recipients.	
Financial status of the respective local government	Water Resource Dept.	Hearing, acquisition of references	Does the respective regional government have sufficient budget for the construction? Does the respective local government have similar expertise?	

8) Equipment for borehole maintenance

Somali regional government requested service rigs as an additional request. The appropriate specification and quantity are examined through O&M system and operation skill of the regional government.

Information on	Received from	By means of	Point to be confirmed	Decision factor of appropriateness
Inventory of wells	Water Resource Dept.	acquisition of references/ Hearing	If the abandoned wells in Somali region are repairable ones.	The regional government have present information of wells. The user organization has appropriated level of operation of the procured machinery. The user organization has established an O&M system.
Operation skill	Water Resource Dept.	Hearing	If there is no big difference between what the local government have and what they requested.	
Operation and maintenance system in local government	Water Resource Dept.	Hearing	Does the local government have sufficient budget for O&M?	
Procurement of spare parts	Water Resource Dept.	Hearing	If there is any facilities deserted due to lack of the budget to replace spare parts.	

(3) Confirmation of necessity for technical assistance for the machinery

Whether it is necessary to provide technical assistance for the machinery is decided by hearings at the respective organizations on the past records of the utilization of the same equipment or the materials. The appropriateness off the materials can be judged by their reputation because it may be widely used

in the region, or the user organization may possess, or uses the same materials.

2-2-1-2 Policy on Natural Conditions

Unpaved roads, widely seen in Ethiopia except its trunk roads, could be muddy and slippery during the rainy seasons, hindering water supply activities. The vehicles to be procured should be four-wheel drives.

2-2-1-3 Policy on Equipment Procurement

(1) Selection of machinery with good spare-parts-supply condition

When selecting the machinery, availability of spare parts are confirmed, and selection is to be made according to accessibility of spare parts.

(2) Country of origin of Procured Equipment

Since this programme is 'untied,' there is no restriction of the origin of the products.

2-2-1-4 Policy on Operation and Maintenance

It is a basic idea to procure the equipment to user organizations if they have capability for operation and maintenance; however, if it is crucial for the purpose of preventing floods, individual cases will be determined based on the situation.

2-2-1-5 Policy on Equipment Grade

It is observed that skills of operating equipment and machinery are reaching certain level at respective organizations; however, most of the equipment that they use are old models. Therefore, new equipment should be simple to operate. Machinery with complex electric panels should be avoided as much as possible.

2-2-1-6 Selection Policy of the equipment to be procured

(1) Equipment priority

Since the Exchange of Notes had already been concluded between the ceiling price was already fixed for this programme. Therefore equipment to be procured shall be selected from appropriate equipment. In the event of tender results not reaching the ceiling price, additional equipment shall be selected, from list of backup equipment, and procured.

The appropriate equipment has a variety such as common equipment in the Ethiopia, special made machinery. Equipment priority shall be set based on the following criteria:

1) Equipment that has a high priority based on the hearing investigation to C/P
2) Appropriate minimum quantity is one (1)
3) Appropriate quantities exceed requested quantities.

The summary of priority equipment to be procured is shown below.

Table 2-4: Priority of appropriate equipment to be procured

Priority	Item	Reasons
1	Portable water purification plant, drilling rig with associated tools, Crane cargo truck, Service Rig, equipment for exploratory well	Priority is high at hearing investigation. Minimum quantity for requested equipment.
2	Bulldozer, Heavy equipment transport truck, Water purification chemicals	Minimum Quantity for requested equipment is one set.
3	Water tank truck, Plastic tank for water storage	Quantity for requested equipment is two or more sets

The additional equipment for adjustment of the ceiling price is set to water tank truck and plastic tank for water storage by the above.

(2) The priority by Region

The priority for the water tank truck and plastic tank for water storage in each region is set up in consideration of the following criteria:

1) the quantity procured is low compared to the regional population,
2) the condition in the region needs improving, and target area and coverage population of this equipment are definite, and
3) this equipment is procured for the control of future disasters.

The priority for the water tank truck and plastic tank for water storage in each region is shown in Table 2-5.

Table 2-5: The contents of selection of the priority by region

Target Region	Request situation
Tigray	The condition in the region needs improving, and target area and population are definite. Appropriate quantity: Quantity of procurement to the regional population (4.532 million: year 2009)
Oromia	The condition in the region needs improving, and target area and population are definite. Appropriate quantity Quantity of procurement to the regional population (28.756 million: year 2009)
Afar	This equipment is procured for the control of future disasters. Appropriate quantity: Quantity of procurement to the regional population (1.473 million: year 2009)
Amhara	No request of the water tank truck and plastic tank for water storage
Somali	This equipment is procured for the control of future disasters. Appropriate quantity: Quantity of procurement to the regional population (4.673 million: year 2009)
SNNPR	The condition in the region needs improving, and target area and population are definite.

	Appropriate quantity: Quantity of procurement to the regional population (15.927 million: year 2009)

(3) Selection of additional equipment

In the event the result of the tender does not fulfil the ceiling price, additional equipment shall be selected for additional tender. The additional equipment shall be selected for required amount to fulfil the ceiling price and they will be selected from water tank truck and plastic tank for water storage.

The priority for additional equipment of water tank truck and plastic tank for water storage shall be following the manner stated in Table 2-5.

2-2-2 Basic Plan (Equipment Plan)

2-2-2-1 Drilling rig and associated tools

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-6.

Table 2-6: Examination of Necessity and Appropriateness (Drilling rig and associated tools)

Region	Necessity	Points of Examination on Appropriateness	Study Results
Tigray	Although TWWCE of Tigray regional government possesses 8 rigs, there is only one rig with the ability to dig deeper than 200m; and, such rigs are crucial for the areas with low groundwater level.	• There is a clear plan for well construction.	• There is Tigray regional well construction plan, which is to construct 63 wells in drought affected area, among 1,612 planned new wells until 2015.
		• WWCE has expertise of operation and maintenance of similar machines. • WWCE has established operation and maintenance system.	• Tigray region possesses 8 rigs and 67 staff for operation and maintenance. TWWCE is using the similar machines; and, O&M system has been established. It can be concluded that the procurement is appropriate based on the above reasons.
Oromia	Oromia Regional Government OWRB possesses 150m–class rigs, provided by UNICEF in 2008; however, OWRB has to use private drilling company for digging the deeper boreholes. Procurement of greater rig is crucial for areas with low groundwater level.	• There is a clear plan for well construction.	• There is a clear plan to construct 239 shallow wells in 2009/10, and 162 deep wells.
		• OWRB has expertise of operation and maintenance of similar machines • OWRB has established an operation and maintenance system.	• The Oromia regional government OWRB has a mandate to prioritise well development in drought affected areas. Training system of the drilling staff has been established; and there is an operation and management system within the regional government. A rig was provided to OWRB in 2008; and 90 wells were constructed using this rig. OWRB has the expertise and O&M system. It can be concluded that the procurement is appropriate based on the above reason.

(2) Specifications

1) Typical Cross Section and Drilling Method

Drilling rig and associated tools are requested by Tigray region and Oromia regions. Typical cross sections of each region are studied.

- Tigray Region

Typical cross section of the well for Tigray region is decided as shown in Figure 2-1 according to the region's experience and request from the TWWCE.

Geologic feature of Tigray shows wide varieties, such as alluvium of the quaternary period on one side, and conglomerate stratification of Precambrian period. Therefore, two types of cross sections are chosen: 1) Mud rotary drilling method is chosen for geology of the quaternary and the tertiary period, and soft rocks; 2) Down the Hole Hammer (DTH) is chosen for geology consisted of fine, hard rocks of period from Mesozoic to Precambrian.

- Oromia Region

Expertise of Oromia Water Resources Board (OWRB) and the request from OWRB, typical cross section in Oromia region is designed and shown in Figure 2-2.

Likewise the geologic feature in Oromia is quite similar to that of Tigray, therefore two types of cross sections are chosen: 1) Mud rotary drilling method is chosen for geology of the quaternary and the tertiary period, and soft rocks; 2) Down the Hole Hammer (DTH) is chosen for geology consisted of fine, hard rocks of period from Mesozoic to Precambrian.

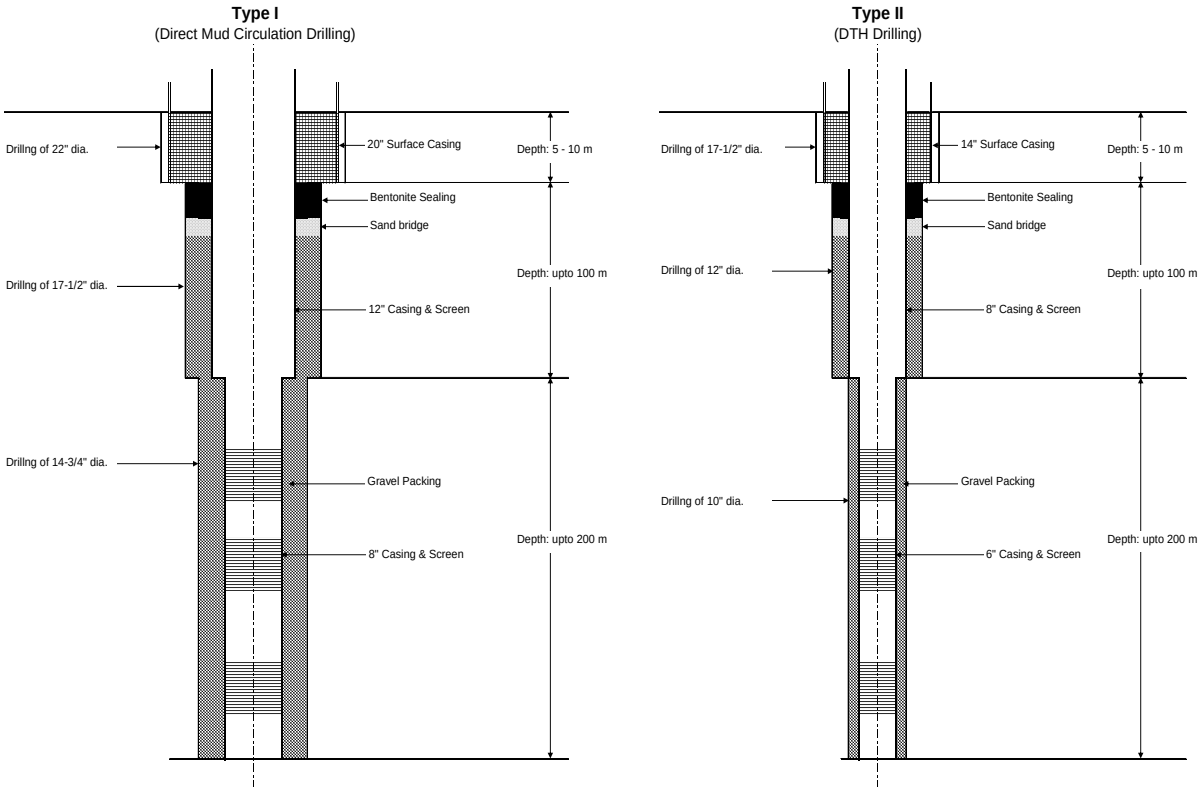


Figure 2-1: Typical Cross Section of Wells in Tigray (2 types)

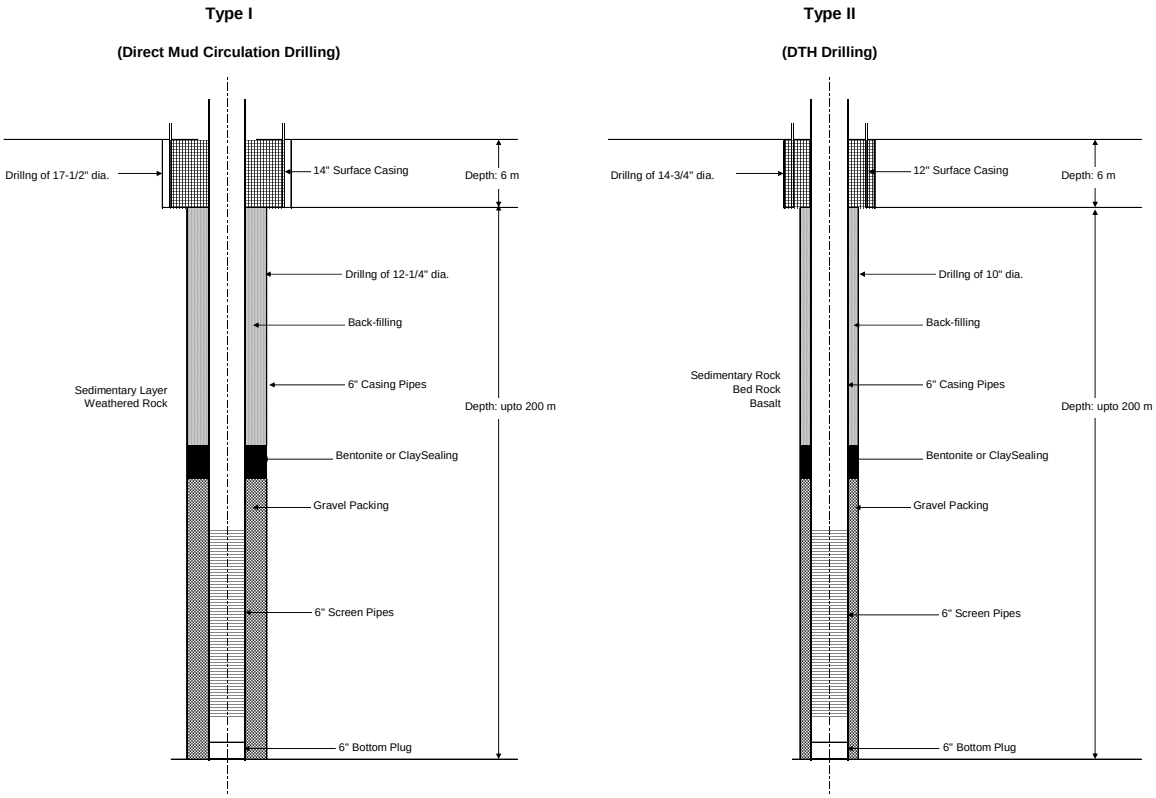


Figure 2-2: Typical Cross Section of Wells in Oromia (2 Types)

2) Selection of Rigs

- Type of Rig

The rig mounted on truck with all wheel driving is selected due to condition of the access roads, and good mobility during carrying in, setting up, and withdrawal.

- Driving Types of Rig (Top drive type and rotary table type)

Type of power train to drill bit is divided into two types. One is a top-drive type, which is powered a by swivel joint, and the other is a rotary table driven by a Kelly rod. Of the two, the top drive type is chosen for its controllability, work efficiency, and the function to use mud rotary/ DTH drilling at the same time.

- Drilling Capacity

Size of drilling machine is determined by lifting weight (weight sum of drive head and mast), mast length, and volume of mud pump; as described in the following.

- Lifting Weight

The total lifting weight when the maximum drilling depth is 200m and diameter 10" would be 10,000 kg (Table 2-7). In addition to the total weight, it also needs to be powerful enough to lift any collapsed sand and rocks. This weight is estimated as 20% of the original weight, and thus makes it more than

12,000 kg in total.

In case of stacking of drill bit, by collapse of the borehole for example, pulling out work will be unavoidable. In this case, load weight on the mast will be twice the original weight at 20,000 kg, or more.

Table 2-7: Weight of Hanging Parts

Tool	Specification	Quantity	Unit Weight (approx. kg)	Total Weight (approx. kg)	Remarks
Drill head		1	1,200	1,200	
Drill pipe	OD: 4-3/4", @6 m	34	160	5,440	200 m/6 m
Drill collar	8", @6 m	2	1,350	2,700	
Stabilizer	For 10", 4-1/2"IF	2	210	420	
Cross over sub	3-1/2"IF(B) x 4-1/2"IF(P)	1	40	40	
Hammer	For 10"	1	210	210	
Button bit	10"	1	60	60	
Total				10,070	

- Mast Length

Normally the drill pipe is either 3m or 6m. This time, drill pipe length of 6 m is chosen for its ease of operation.

- Mud Pump

Although there is no established theory for requirement of mud transportation during rotary mud drilling, rising speed (vm) of mud slime should be more than 10 m/min by empirical knowledge. This rising speed is called annular velocity, calculated by the equation shown below.

$$Qm = A \cdot vm$$

When,
A ：Annula's cross section ([Cross section of borehole] – [cross section of rod] (m^2))
Qm：Capacity of pump (m^3/min)

By utilizing the equation above, given vm=10m/min, necessary capacity of pumps for Tigray and Oromia are calculated as in Table 2-6.

Table 2-8: Necessary Capacity of Pump

Item	Tigray Region	Oromia Region
Diameter of final borehole	14-3/4"	12-1/4"
Annular cross section (m^2)	0.0988	0.0646
Annular velocity (m/min)	10	10
Pump capacity (litre/min)	988	646

From Table 2-8, it is concluded that capacity of mud pump for Tigray region requires 1,000 litre/min, and 650 litre/min for Oromia region.

When,

Pumping pressure is 20kg/cm^2 at depth of 200m, in order to circulate water.

- Others

Priority is given to its mobility; and, the rig is to be mounted on the truck, four-wheel drive by six (4x6), and the power train to be power transmission overdrive type (PTO).

3) Tools and Accessories

Selection of tools and accessories for 300m-class rigs are studied based on typical cross section of the wells: Figure 2-1 and Figure 2-2. Number of bits is two for each diameter for each type, including one spare. Diagram of accessories are shown in Figure 2-3.

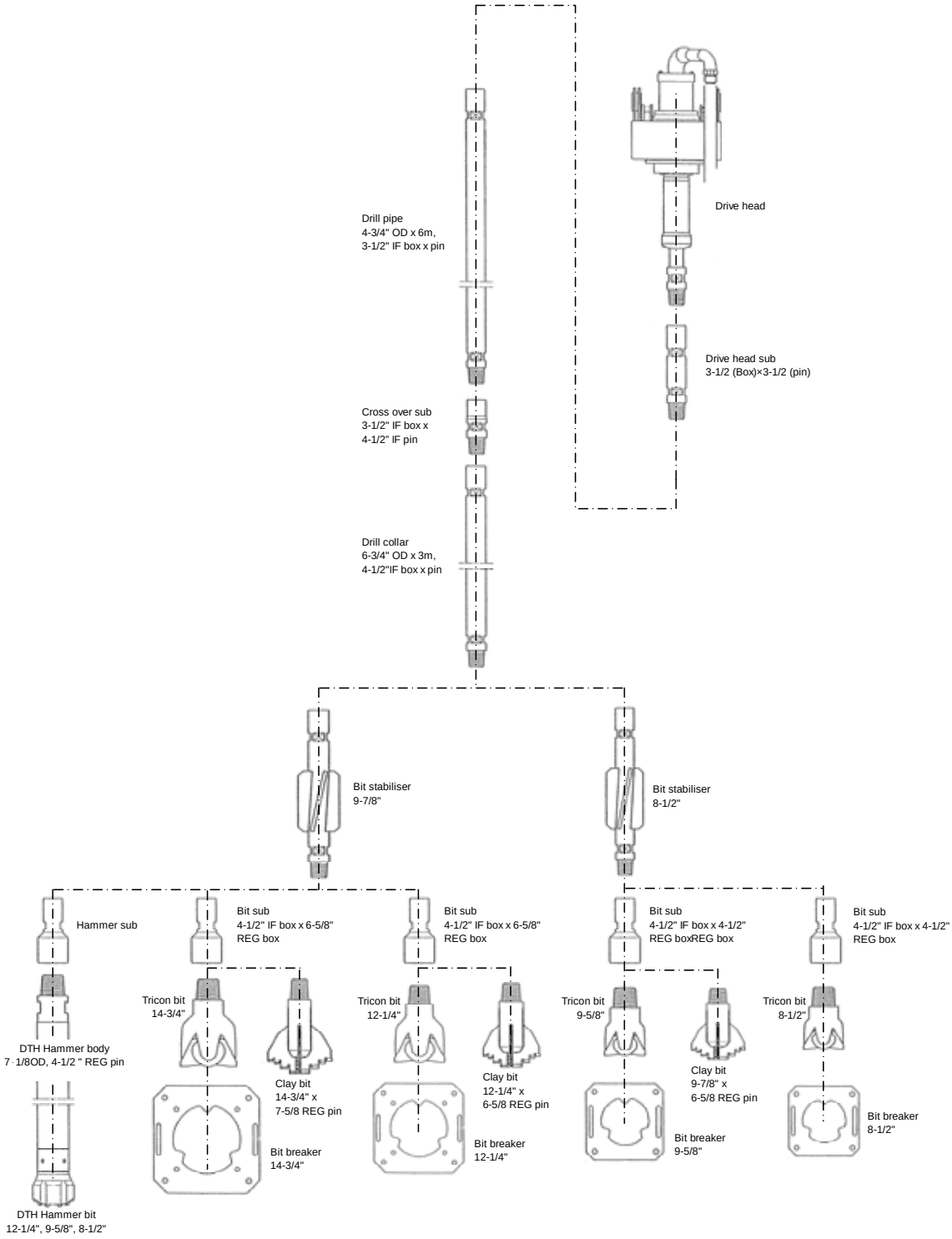
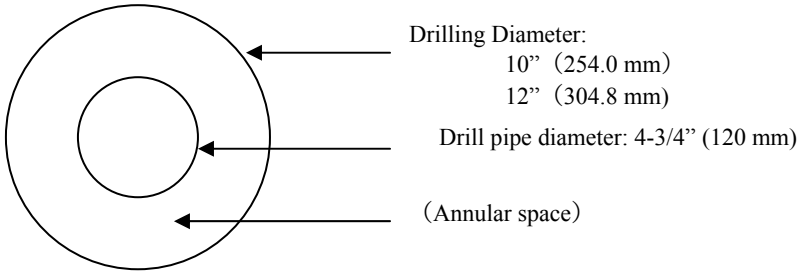


Figure 2-3: Standard Tools

4) High pressure compressor

Required air discharge is calculated by following equation using the DTH method.



A flow rate over 900m/min is required at the annular space (the space between the drill rod and the wall of a borehole) in order to smoothly remove the cutting slime from the well. The flow rate at the annular space is calculated by the following equation:

$V=Q/A$ (1)
$A=\pi (D2 – d2) / 4$ (2)

V = Air flow velocity at the annular space (m/min.),
Q = Necessary air volume (m^3/min.),
A = Annular space area (m^2),
D = Well diameter (m),
d = Rod diameter (m)

The basic condition is assumed as 4-3/4” (0.12 m) rod diameter and D1:10” (0.254 m) borehole diameter or D2:12” (0.305 m) borehole diameter, flow rate 900m/min for DTH drilling method of a C type well in this plan. The necessary air discharge is calculated using the following equations:

Q1 = 3.14 x (0.254 x 0.254 – 0.12 x 0.12) / 4 x 900 = 35.4 m3/min.
Q2 = 3.14 x (0.305 x 0.305 – 0.12 x 0.12) / 4 x 900 = 55.5 m3/min.

Theoretical flow rate is calculated to be approximately 25m^3/min for 10” DTH hammer bit, and 55.3m^3/min or more for a 12” DTH hammer bit. However, a compressor which meets the required flow rate of 35m^3/min is very heavy (more than 7 tons including fuel). These heavy compressors require a large truck for loading and are impractical from a cost-benefit perspective. Further, the fuel consumption rate of a 35m^3/min class compressor is 30% more than that of 25m^3/min class compressor, and it is considered uneconomical. In the case of slime discharge difficulties due to low air volume/flow or water spring, the discharge efficiency of slime can be improved by the addition of a foaming agent into the air during the drilling process.

Based on the above discussion, the specification of a high pressure compressor is determined to be 25m^3/min. (900cfm) or more.

Usually, higher air pressure increases stroke frequency and the rate of drilling, which brings about improvement of operational efficiency. However, too much air pressure might break the hammer itself (acceptable air pressure of hammer is 2.5MPa). Considering the air pressure loss in the water and

possible hammer damage, the compressed air pressure should therefore be around 2.0MPa to 2.41MPa.

5) Truck for Mounting Compressor

A Compressor which satisfies requirement in the preceding clause weighs 6.1 tons to 7.5 tons, and the transporting truck for the compressor is necessary. Table 2-9 shows specification of compressor made by notable manufacturers.

Table 2-9: Specifications of Compressor

Name of Manufacturers	Type	Weight (ton)	Length (m)	With (m)	Height (m)
Atlas Copco	XRVS476CD	6.1	4.9	1.8	2.5
Denyo	DIS-1070XS	7.5	5.2	2.2	2.4
Hokuetsu	PDSK900S	7.1	4.7	2.1	2.3

In order to carry the compressor in Table 2-9, the maximum load of the truck must be more than 8.0 tons; bed length must be longer than 5.5 m for carrying accessories, such as hoses; and the drive train should be 4 x 4 or 6 x 4.

6) Crane Truck

Crane trucks carry standard accessories of the drilling machine: tools, screens, casings, and daily necessities for the drilling team. It is ideal to minimize travel times to increase working efficiency. However, the total weight of the drilling tools alone is more than 10 tons for 300m drilling. Furthermore, the truck will likely spend a large amount of time carrying a great deal of water indispensable for well drilling, but usually difficult to obtain near the site. Furthermore, the truck needs more than twenty 200 litre drums for gasoline, as it is estimated to use between 4,000 and 5,000 litres of fuel for drilling.

Considering these points, the maximum load of the truck should be more than 6 tons. For safety reasons, the truck should be equipped with a crane, since loads are usually heavy machines.

Table 2-10: List of Equipment to Transport and Weight

Name	Load	Quant ity	Unit Weight (kg)	Total Weight (kg)
Drilling tools	Drilling pipe, Drilling collar, Bit, DTH hammer etc.	1 set	ca.10,070	ca.12,026
Airlifting compressor		1	ca.1,900	ca.1,900
Submerged pump and pumping tube		1	ca.1,700	ca.1,700
Generator	60kVA	1	ca.1,400	ca.1,400
Attachments for drawdown test	Pumping tube 2.75m×25, console panel,	1 set	ca.800	ca.800

Name	Load	Quant ity	Unit Weight (kg)	Total Weight (kg)
	triangular-notch weir, valves etc			
Daily use items	Tent, chairs, etc	1 set	ca.50	ca.50
Concrete material	Cement, gravel, sand, reinforcing steel	1 set	ca.1,500	ca.1,500
Steel pipe casing	6 inch	300m	ca.27	ca.8,100
Total				ca.25,520

Considering the drilling tools, casing, screen whose length is more than 6 m, the bed length must be longer than 5.5m and the drive train should be 4 x 4 or 6 x 4.

(3) Number of Rigs

1) Tigray Region

Following equipment will be procured for well drilling and drawdown test.

Table 2-11: Quantity of Drilling Equipment (Tigray Region)

Name	Specification	Quantity
Drilling rig	Drill pipe capacity deeper than 300m, with diameter 4-3/4' Drive head load weight: more than 12 tons Load weight on mast hook: more than 20 tons Drive train: 4 x 4 or 6 x 4	1
Tools		1set
Compressor	Blow capacity over 25m^3/min. (900cfm) Air pressure 2.0MPa - 2.41MPa	1
Truck for compressor mounting	Maximum load : over 8 tons Length of bed: Longer than 5.5m Drive train: 4 x 4, or 6 x 4	1
Crane Truck	Maximum load : over 14 tons Capacity of crane: 3.0 tons@2.5m Length of bed: longer than 5.5m Drive train: 4 x 4, or 6 x 4	1

2) Oromia Region

The following equipment will be procured for well drilling and drawdown tests.

Table 2-12: Quantity of Drilling Equipment (Oromia Region)

Name	Specification	Quantity
Drilling rig	Drill pipe capacity deeper than 300m, with diameter 4-3/4' Drive head load weight: more than 12 tons Load weight on mast hook: more than 20 tons Drive train: 4 x 4 or 6 x 4	1
Tools		1set
Compressor	Blow capacity over 25m^3/min. (900cfm) Air pressure 2.0MPa - 2.41MPa	1
Truck for compressor mounting	Maximum load : over 8 tons Length of bed: Longer than 5.5m	1

Name	Specification	Quantity
	Drive train: 4 x 4, or 6 x 4	
Crane Truck	Maximum load : over 14 tons Capacity of crane: 3.0 tons@2.5m Length of bed: longer than 5.5m Drive train: 4 x 4, or 6 x 4	1

2-2-2-2 Water purification chemicals

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-13.

Table 2-13: Examination of Necessity and Appropriateness (Water purification chemicals)

Region	Necessary	Points of Examination on Appropriateness	Study Results
Tigray, Oromia, Afar, Amhara, Somali, and SNNPR	There was no emergency need of water purification chemicals in targeted 6 regions; however, these regions are inflicted by chronic drought, incurrent flood, and AWD. It is essential to store enough water purification chemicals for securing safe water in case of an AWD outbreak.	• There are storage houses in each regional water resources department.	• 200,000 bags use space about 1.5m^3 only; and, up to 1,000,000 bags don't make any interference with other stored things.
		• There are records of procurement and distribution of water purification chemicals by other donor agency.	• There would be no difficulty because of the past experience of procurement of chemicals at each region by USAID and UNICEF.
		• Distribution routes have been established.	• Distribution routes are about the same for each region: Dept. of Water Resources→Woreda (zone) water board→Village water committee→Users. These distribution routes have been established and supported by other donors, such as UNICEF and USAID. It is considered appropriate to provide water purification chemicals to the target regions.

(2) Specifications

Water sources in chronic drought areas are streams and ponds. These water sources have a heavy load of suspended solids and micro bacteria. Water purification agents should be able to remove suspended solids and sterilize the water.

(3) Quantity

1) All regions

The government of Ethiopia and the supporting agencies published "*Revised Humanitarian Requirements for 2008*" in June of 2008. In the reference, Summary of Water and Environmental Sanitation Requirements by Region, it predicts number of affected people by drought, flood, and AWD in 2008. The extracts are summarized in Table 2-14.

Table 2-14: Prediction of Affected Number of People by Disasters (abridgment)

Region	Flood	AWD	Drought
Afar	30,000	30,000	25,000
Amhara	60,000	48,000	-
Oromia	36,000	60,000	-
SNNPR	48,000	48,000	10,000
Somali	38,000	50,000	20,000
Tigray	20,400	48,000	-
Total	232,400	284,000	55,000

Source：Revised Humanitarian Requirements for 2008

Water purification chemicals are procured for anti-AWD measures. It is reported that AWD morbidity rate decreases as recovery rate of water resources increases. It is also reported that recovery of a flood damaged water source needs 90 days on average. During the 90 days, the water purification chemicals are required; and, thus the quantity of the water purification chemicals is calculated to suffice 90 days usage according to respective areas. The least quantity of water needed for a person during a flood is estimated as 7 litres based on statistics (Handbook for Emergencies Third Edition, (Feb. 2007) UNHCR, and Environmental Health in Emergencies and Disasters; Practical Guide (2003) WHO. In order to determine quantity of the water purification chemicals needed, water usage of one person is set as 7 litres for the above reasons. In addition, since UNICEF and USAID are procuring the same agent, the Japanese side will support 1/3 of total quantity needed.

Table 2-15: Quantity of Water purification chemicals

Region	Target number of people	Quantity required (litre/man/day)	Required quantity of water (litre/day)	Duration (day)	Total water quantity required (litre)	Capacity of water purify agent (litre/bag)	Quantity of the agent required (bag)	Quantity of procurement (bag)
Afar	60,000	7.0	420,000	90	37,800,000	20	1,890,000	630,000
Amhara	108,000	7.0	756,000	90	68,040,000	20	3,402,000	1,134,000
Oromia	96,000	7.0	672,000	90	60,480,000	20	3,024,000	1,008,000
SNNPR	96,000	7.0	672,000	90	60,480,000	20	3,024,000	1,008,000
Somali	88,000	7.0	616,000	90	55,440,000	20	2,772,000	924,000
Tigray	68,400	7.0	478,800	90	43,092,000	20	2,155,000	718,000
Total	516,400		3,614,800		325,332,000		16,267,000	5,422,000

2-2-2-3 Water Supply Truck and Plastic tank for water storage

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-16.

Table 2-16: Examination of Necessity and Appropriateness (Water Supply Truck and Plastic tank for water storage)

Region	Necessity	Points of Examination on Appropriateness	Study Results
Tigray	For drought affected area in Tigray, trucks are rented from a private company; however, this is always insufficient because there is only one truck available. The regional government needs their own water tank truck for sufficient water supply activities during disasters.	(Water tank truck) • The user organization has to have skills to operate the truck.	(Water tank truck) • The government is operating water supply activities with a rented water supply truck from a private company. It can be concluded that the regional government has O&M skills for trucks.
		• Is there an O&M system established for truck in the organization?	• There is a specialized organization for water supply in the regional government, namely, TWWCE; and it is conducting O&M.
		• Is there an appropriate storage place?	• TWWCE has storage place with good security level.
		• Is there a clear water supply plan with target area?	• The regional government intends to supply water during disasters for drought prone areas. Their purpose is considered clear enough. For the reasons above, the procurement is considered appropriate.
			(Plastic tank for water storage) It is inefficient to supply water to the recipients directly by water tank truck because it is time consuming. A better alternative is to supply to large plastic tank for water storage from the water tank truck, then to the recipients while the truck is moving to the next location. So it is considered appropriate to supply plastic tanks for water storage.
Oromia	The regional government requested these water supply facilities for drought affected people in the region. The water resources department does not own any water supply trucks at present; and, the regional government rents trucks from private companies every time disasters occur. The necessity of water supply truck is high in the region.	(Water tank truck) • The user organization has to have skills to operate the truck.	(Water supply truck) • The regional government is conducting water supply activities with 11 water tank trucks rented from private companies as of May 2009. There is sufficient number of skilled operators in the region.
		• Is there an O&M system established for trucks in the organization? •	• Oromia region has variety of machinery such as rigs, pick up trucks, etc.; and is maintaining them. It is considered that there is an appropriate system of O&M.
		• Is there an appropriate storage place? •	• There are storage places at the Water Resources Dept. and Woreda offices.
		• Is there a clear water supply plan with target area? •	• The regional government has clear target zone and the population. Based on the above observations, the procurement is considered appropriate.
			(Plastic tank for water storage: same as the results of Tigray region)
Afar	The regional government requested these water supply facilities for drought affected people in the region. The water resources department have	(Water tank truck) • The user organization has to have skills to operate the truck.	(water supply truck) • The regional government owns one water supply truck. It is considered that the operation of the truck is not a problem in the region.
		• Is there an O&M system established for trucks in the organization?	• The regional government-owned water facility construction company is conducting O&M if the machinery; and, there is no problem of O&M of the machinery in the region.

Region	Necessity	Points of Examination on Appropriateness	Study Results
	only one water tank truck at present; and, the regional government rents trucks from private companies every time disasters occur. The necessity of water supply truck is high in the region.	• Is there an appropriate storage place?	• There is an appropriate storage place at water resources dept. and woreda offices.
		• Is there a clear water supply plan with target area?	• It is possible to estimate the future number of affected people in the region since there is sufficient statistics of past droughts, flood areas, and the number of affected people. Based on the above observations, the procurement is considered appropriate.
			(Plastic tank for water storage: same as the results of Tigray region)
Amhara	Plastic tank for water storage are necessary for the people evacuated from, at the villages whose water supply facilities are still working. Plastic tank for water storage will be used for temporary extensions from the existing facilities for evacuated people.	(Plastic tank for water storage) • Is there an appropriate storage place?	(Plastic tank for water storage) • There is an appropriate storage place of plastic tank for water storage in the regional water resources dept.
		• Is there a clear target in the user organization's plan?	• The request is made for disaster preparedness measures. The regional government has been conducting similar measures for concurrent disasters; and, the target is clear for water tanks. Based on above observations, the procurement is considered appropriate.
Somali	The regional government has requested water supply tanks and plastic tank for water storage as water supply facilities for drought affected people in the region. The water resources department does not own any water supply truck at present; and, the regional government rents a truck from private company every time the disaster occurs. The necessity of water supply truck is high in the region.	(Water tank truck) • The user organization has to have skills to operate the truck.	• The regional government has experience of water supply activities with rented water tank trucks from private sector: the regional government has sufficient skill of operating the trucks.
		• Is there an O&M system established for truck in the organization? •	• The water resources, mine and energy development Dept. owns machinery such as crane truck; and, it is responsible for the O&M. There is no problem of O&M of the trucks.
		• Is there an appropriate storage place? •	• There are appropriate storage spaces at the water resources dept. and woreda offices.
		• Is there a clear water supply plan with target area?	• There is a clear record of past droughts, food disasters; and, it is possible for future uses of the trucks. Based on the above observations, the procurement is considered appropriate.
			(Plastic tank for water storage: same as the results of Tigray region)
SNNPR	The regional government requested water tank truck and water supply tanks for drought affected people in the region. The	(Water tank truck) • The user organization has to have skills to operate the truck.	(Water supply truck) • The regional government has experience of water supply activities with rented water tank trucks from private sector: the regional government has sufficient skill of operating the trucks.

Region	Necessity	Points of Examination on Appropriateness	Study Results
	regional government rents trucks from private companies every time disasters occur. The necessity of water supply truck is high in the region.	• Is there an O&M system established for truck in the organization?	• There is O&M division for machinery, such as rigs, trucks, and other machinery owned by the region. Therefore there is no problem of O&M for the trucks
		• Is there an appropriate storage place?	• There are appropriate storage spaces at the water resources dept. and woreda offices.
		• Is there a clear water supply plan with target area?	• There is clear database of target woredas and the populations. Based on the above observations, the procurement is considered appropriate.
			(Plastic tank for water storage: same as the results of Tigray region)

(2) Specification

1) Water Supply Truck

It is considered that medium size vehicle is most suitable for narrow, unpaved roads; however, if there is water supply record with large-sized vehicle, a vehicle with a 15,000 litre tank is chosen. Other areas, and for areas with no previous water supply activities, a vehicle with 6,000 litre tank with 4 x 4 drive train will be chosen for difficult conditioned roads, and for the areas with good road condition, 15,000 tanker with 6 x 4 drive train type is chosen.

2) Plastic tank for water storage

Common practice in Ethiopia is to supply water to individual recipients directly from water tank truck; however, in order to save time in emergency, a water is going to be stored once in a plastic tank for water storage from a water supply truck, and then to the individuals. There are some kinds of water storage tanks, such as plastic tank for water storage, panel type tank. This time, plastic type is chosen for its lesser cost. The water tank should de equipped with water taps. The sizes should be two common types: 5,000 litre and 10,000 litre type.

(3) Appropriate quantity

1) Tigray Region

■ Water Supply Truck

♦ For the present circumstances

Water supply activities of Tigray Water Resource Department is to distribute 10,000 litre of water to 9 areas by 3 round trips for each district, using 2 days to cover all the districts, according to hearing done by the Study team. Population of each area is shown in Table 2-15. Since the safe water supply rate is 51.2% in Tigray region, population has to be covered by water supply is 48.8%.

Table 2-17: Target Population (Tigray)

Woredas	Areas	Population	Population with water supply facility	Target population
Raya Azebo	Gira Wosen	3,780	2,117	1,847
	Adi Methan	2,630	1,473	1,285
	Adi Tinbil	1,788	1,001	873
	Hade Alga	2,436	1,364	1,190
	Keyih Tekli	5,500	3,080	2,687
	Fondel	2,794	1,565	1,365
	Horda	5,000	2,800	2,443
	Dualga	3,800	2,128	1,856
	Adi Shambel	1,794	1,005	876
Total		29,522	16,533	14,422

Table 2-18: Water Supply Rate in Ethiopian Regions (2006)

Region	2007		
	Rural (%)	Urban (%)	Total (%)
Amhara	42.45	82.00	48.00
Oromiya	45.00	90.40	50.90
SNNPR	58.00	66.00	59.00
Tigray	51.15	60.00	52.80
Afar	51.00	73.00	52.98
Somali	23.26	60.00	29.44
Benishangul-Gumuz	48.72	85.56	52.33
Harar	29.24	21.00	24.13
Gambella	49.43	72.90	53.71
Dire Dawa	65.07	72.00	70.21
Addis Ababa	-	94.42	94.42
Average	42.12	70.66	53.45

Source: MoWR Year Report (2007)

One water supply truck (15,000 litres) will be procured for the water supply areas with insufficient distribution capacity.

- Other Areas

Amount of water necessary for other areas are calculated and shown in Table 2-19, using minimum unit of water required.

Table 2-19: Required Water Quantity of Other Areas (Tigray)

Woreda	District	Population	Population with water supply facilities	Target population	Unit water quantity (litre/man/day)	Total amount of water requested (m^3)
Raya Azebo	Tima	2,645	1,481	1,292	7.00	9,044
	Koban	1,240	694	606	7.00	4,242
	Hadush kigni	4,730	2,649	2,311	7.00	16,177
	Bandera	3,415	1,912	1,668	7.00	11,676
	Seleka	1,780	997	870	7.00	6,090

Woreda	District	Population	Population with water supply facilities	Target population	Unit water quantity (litre/man/day)	Total amount of water requested (m^3)
	Adi Wejerat	2,340	1,310	1,143	7.00	8,001
	Methun	1,933	1,082	944	7.00	6,608
	Keyih Tekli	1,425	798	696	7.00	4,872
	Mechare	3,340	1,870	1,632	7.00	11,424
	Sereka	2,116	1,185	1,034	7.00	7,238
	Grawosen	2,714	1,520	1,326	7.00	9,282
	Eabo	1,931	1,081	943	7.00	6,601
	Emba chara	2,145	1,201	1,048	7.00	7,336
	Tsiga'a	3,027	1,695	1,479	7.00	10,353
	Woinalem	1,817	1,018	888	7.00	6,216
	Maru	1,923	1,077	939	7.00	6,573
Sub Total		38,521	21,570	18,819		131,733
Atsbi-Wonberta	Eset Village 4 sites	8,430	4,721	4,118	7.00	28,826
		8,430	4,721	4,118		20,590
Tanqua Aberele	Siye Village	7,593	4,252	3,709	7.00	25,963
	Felege Hiwot	5,466	3,061	2,670	7.00	18,690
Sub Total		13,059	7,313	6,379		44,653
Total		60,010	33,604	29,316		205,212

Note: 9 District, shown in Table 2-15, is not included

Number of water tank truck necessary is calculated as follows.

Provided that:

Deliver the water to the target areas: 3 round trips /day.

Capacity of truck used is 6,000 litre and 15,000 litres.

15,000 litres/vehicle/times×3 times/day×3 vehicles = 135,000 litres
6,000 litres/vehicle/times×3 times/day×4 vehicles = 72,000 litres
Total 207,000 litres
(Amount needed for other areas: 205,212 litres)

Quantity for other areas: 3 vehicles (capacity: 15,000litres)
4 vehicles (capacity: 6,000litres)

Thus the total appropriate quantities are: 4 units (capacity: 15,000 litres: 1+3)
4 units (capacity: 6,000 litres: 0+4).

- Plastic tank for water storage

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litre requirement.

Total quantity is calculated as follows.

(205,212 litres/day) / (5,000 tank + 10,000 tank) =13.68, rounded up to14 tanks.

Table 2-20: Quantity of Water tank truck and Plastic tank for water storage (Tigray Region)

Name	Specification	Quantity
Water Supply Truck	Tank Capacity 15,000 litre Drive train 4 x 4, or 6 x 4	4
	Tank Capacity 6,000 litre Drive train 4 x 4	4
Plastic tank for water storage	5,000 litre	14
	10,000 litre	14

2) Oromia Region

- Water Supply Truck

Oromia Regional government is conducting water supply activities with 11 water tank trucks rented from private companies (as of May 2009). The target areas are namely, Borona, Guji, West Arsi, and East Hararge Woredas. The capacity of water tanks of the trucks are two types: 10,000 litres and 15,000 litres, according to the hearing of the Study team.

Table 2-19 shows target populations of the area. The regional government is requesting portable water purification plants, instead of water supplied by trucks, for five villages which are heavily affected by AWD, and roads to the areas are inaccessible in the rainy seasons. For this reason, these five villages are excluded from the target areas supplied by truck.

Table 2-21: Target Population of Water Supply Activities (Oromia)

Zone	Woreda	Village	Target Population	Remarks	Target population of water supply activities
Arsi	Digalu-Tijo		6,000	Concurrent outbreak of AWD	–
Borana/Guji	Dawa	Dawa village	6,000		6,000
E/Shawa	Adama	Bosat	1,200		1,200
E/Shawa	Fantalle/Adama		3,200		3,200
E/Shawa	Lume	Ejersa	5,000		5,000
Guji	Goro Dola	Gannale Donta	2,200		2,200
Guji	Goro Dola	Jiddoola	2,500		2,500
Guji	Anasora	Dame	4,000		4,000
Guji	Adola	Chambe	4,000		4,000
Guji	Adola	Michichaa	3,000		3,000
Guji	Adola	Oda Buttaa	2,500		2,500
Guji	Adola	Anfarara	3,500		3,500
Guji	Adola	Zanbaba	3,000		3,000
Guji	Shakkiso	Magaddo	4,500		4,500
Guji	Shakkiso	Hayadima	4,000		4,000
I/A/Boora	Mattu		15,000		15,000
Q/Welega	Sayo		3,000		3,000
W/Arsi	Arsi Negelle	Goljota	12,000	Concurrent outbreak of AWD	–
W/Arsi	Shashemene town		11,100	Concurrent outbreak of AWD	–
W/Arsi	Shashemene		12,000	Concurrent outbreak of	–

Zone	Woreda	Village	Target Population	Remarks	Target population of water supply activities
				AWD	
W/Arsi	Kofale		5,000	Concurrent outbreak of AWD	–
W/Arsi	Dodola		4,500		4,500
W/Arsi	Asaasa		6,000		6,000
W/Welega	Gimbi		6,000		6,000
W/Welega	Dirmegii	Karkaro	4,300		4,300
Total			133,500		87,400

Necessary amount of the water for the target population described above is 611,800 litres (population 87,400× 7 litres/man/day). At present activities (10,000 litres×5 vehicles + 15,000 litre × 6 vehicles) × 2.5 round trip/day = 350,000 litres/ day): 261,800 litres/ day is insufficient.

A large type, 15,000 litres capacity vehicle is to be procured because there is record of the activities with the size of the vehicle. The appropriate quantity is calculated as below.

261,800 litres / (15,000 litre /2.5 times of round trip) = 6.98 rounded up to 7 units

- Plastic tank for water storage

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litre requirement.

Total quantity is calculated as follows.

(261,800 litres/day) / (5,000 litres tank+10,000 litres tank) =17.45, rounded up to18 tanks

Table 2-22: Quantity of Water Supply Tank and Plastic tank for water storage (Oromia)

Name	Specification	Quantity
Water Supply Truck	Tank capacity 15,000 litre Drive train 4 x 4, or 6 x 4	7
Plastic tank for water storage	5,000 litre	18
	10,000 litre	18

3) Afar Region

- Water Supply Truck

Quantity of vehicles is calculated based on the numbers of affected people in drought and flood disasters after 2006. Target population will be 100% of the flood affected population, and 44% (water supply rate in rural areas) is multiplied by the population. Target population of Afar is summarized in Table 2-23.

Table 2-23: Target Population for Water Supply Activities during Flood (Afar)

Year	Place	Disaster type	Affected population	Target population
2006	Woredas in the region	Drought	420,000	*
2008	Woredas in the region	Drought	61,000	26,840
2008	Asayta Woreda	Flood	935	935
2009	Woredas in the region	Drought	86,000	37,840
Average				21,872

* The figure of 2006 is disregarded as the scale of disaster is too big for average.

Necessary amount of the water for the target population described above is 153,104 litres (population 21,872× 7 litres/man/day). There is a past experience of 4 round trips, necessary number of vehicles are calculated as follows.

15,000 litres × 2 vehicles × 4times = 120,000 litres
6,000 litres × 2 vehicles × 4times = 48,000 litres
Total 168,000 litres
153,104 litres 168,000 litres

The number of affected people shown in Table 2-23 is a sum of several disasters, and it is not likely that the number of population will be affected at same time in future. The target population adjusted by multiplied by 70% of total number of population affected.

The appropriate quantities are calculated as follows.

15,000 litres water supply truck: 1 unit

6,000 litres water supply truck: 1 unit

- Plastic tank for water storage

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litre requirement.

Total quantity is calculated as follows.

(153,104 litres/day) / (5,000 tank+10,000 tank) ×70% = 7.14, rounded up to 8 tanks

Table 2-24: Quantity of Water Supply Tank and Plastic tank for water storage (Afar)

Name	Specification	Quantity
Water Supply Truck	Tank capacity 15,000 litre Drive train 6 x 4	1
	Tank capacity 6,000 litre Drive train 4 x 46	1
Plastic tank for water storage	5,000 litre	8
	10,000 litre	8

4) Somali Region

■ Water tank truck

Quantity of vehicles is calculated based on the numbers of affected people in drought and flood disasters after 2007. Target population will take an average of flood affected people in Table 2-25.

Table 2-25: Natural Disasters after 2007 (Somali Region)

(in sequence of occurrence)

	Zone	Woreda	Population affected		Zone	Woreda	Population Affected
1	Gode	Adadle	14,850	10	Gode	Gode	37,350
2	Jijiga	Aware	12,510			Gunagoda	7,178
		Bare	42,173			Gursum	4,935
3	Warder	Boh	8,500			Hamero	14,600
		Chereti	38,726			Hargele	24,666
		Danot	6,500			Hudet	9,500
4	Kebridehar	Bedeweyni	15,630			Jijiga	21,406
		Degahabur	18,278	11	Kebridehar	Kebridehar	29,708
		Degahamedo	16,848	12	Gode	Kelafo	71,280
		Dembel	13,504			Legehida	7,650
		Denan	29,250			Meyumuluka	4,650
5	Fik	Dihun	9,450	13	Shinile	Meiso	6,789
6	Gode	Dolo Odo	18,000	14	Gode	Mustahil	43,740
		East Imi	54,960	15	Fik	Segeg	12,842
7	Shinile	Erer	15,268			Selahad	8,750
		Ferfer	23,650	16	Kebridehar	Shekosh	8,987
8	Fik	Fik	25,355			Shilabo	14,069
9	Liben	Filtu	6,750	17	Shinile	Shinile	5,117
		Geladin	12,000	18	Gode	West Imi	37,300
		Gerbo	9,000	Total			761,719

Source: Hearings by the Study Team

Average disaster affected population 42,318 (people/ disaster) = 761,719 / 18 times

Water requirement for person is set as 7.0 litres/ person, same for other districts; and, round trip number are set 4 times / day based on the hearing by the Study team. Quantity of the procurement is calculated as follows.

Necessary amount of the water for the target population described above is 296,226 litres (population 421,318× 7.0 litres/person/day).

15,000 litres × 4 vehicles × 4times = 240,000 litres
6,000 litres × 4 vehicles × 3times = 72,000 litres
Total 312,000 litres
296,226 litres

The number of affected people is the sum of several disasters, and it is not likely that the number of population will be affected at same time in future. The target population adjusted by multiplied by 70% of total number of population affected.

Therefore, the appropriate quantities are calculated as follows.

15,000 litres water supply truck: 3 units

6,000 litres water supply truck: 2 units

- Plastic tank for water storage

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litre requirement.

Total quantity is calculated as follows.

(296,226 litres/day) / (5,000 tank+10,000 tank) ×70% = 13.82, rounded up to 14 tanks

Table 2-26: Quantity of Water Supply Tank and Plastic tank for water storage (Somali)

Name	Specification	Quantity
Water Supply Truck	Tank capacity 15,000 litre Drive train 6 x 4	2
	Tank capacity 6,000 litre Drive train 4 x 4	1
Plastic tank for water storage	5,000 litre	14
	10,000 litre	14

5) S.N.N.P.Region

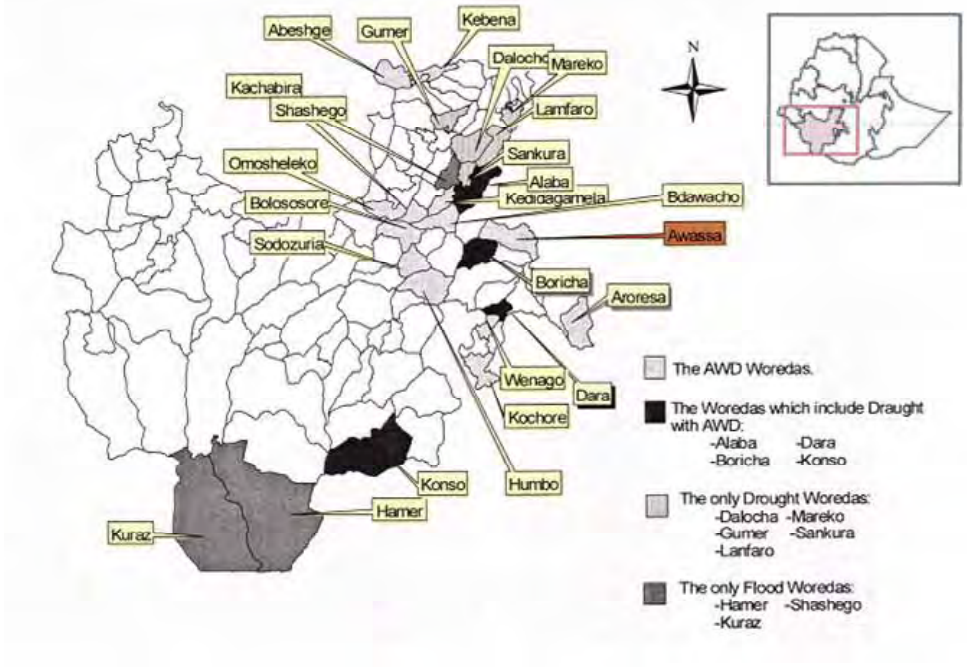
- Water Supply Truck

Target area of the SNNPR is large, and the target population is more than 100,000, which makes water supply by trucks not efficient in the part of the Region. For this reason, quantity of water tank trucks is calculated based on Alaba Special Woreda of SNNPR, which has been affected by disasters (drought and AWD) periodically. Table 2-27 shows the summary.

Table 2-27: Estimated Affected Population in Requested Area for Equipment (SNNPR)

Zone	Woreda	Rural Population (2009)	Water supply rate (rural area)	Population inaccessible to safe water	Remarks
Alaba Special	Alaba	217,476	41%	128,311	High occurrence rate of drought and AWD observed
Gurage	Gumer	81,785	42%	47,435	
Gurage	Mareko	59,907	42%	34,746	
Silti	Lanforo	109,750	32%	74,630	
Silti	Delocha	55,815	40%	33,489	
Silti	Sankura	85,820	30%	60,074	
Wolayita	Dugnafango	98,544	7%	91,646	
Total		1,556,954		1,030,830	

Population of 2009： Estimated by population of 2007 multiplied by increasing rate
Water supply rate： Proposal for Water Supply Intervention in Prolonged Dry Season Areas of SNNPR (March, 2008) Regional water resources department



Source: SNNPWRDB

Figure 2-4: Disaster Prone Areas of SNNPR

About 30% of population without safe water need urgent safe water supply, according to the Study team's hearing from the Water Resources Department of SNNPR. Based on the above written information, the appropriate quantity of the vehicles are as follows.

Necessary amount of the water for the target population described above is 2696,453 litres (population 128,311× 30% × 7.0 litres/person/day).

15,000 litres × 4 vehicles × 3 times = 180,000 litres
6,000 litres × 4 vehicles × 4 times = 96,000 litres
Total 276,000 litres
296,453 litres

The number of affected people is the sum of several disasters, and it is not likely that the number of population will be affected at same time in future. The target population is adjusted by multiplying by 70% the total number of population affected.

Therefore, the appropriate quantities are calculated as follows.

15,000 litres water supply truck: 2 units

6,000 litres water supply truck: 3 units

- Plastic tank for water storage

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litres requirement.

Total quantity is calculated as follows.

(296,453 litres/day) / (5,000 tank+10,000 tank) ×70% = 12.57, rounded up to 13 tanks

Table 2-28: Quantity of Water tank truck and Plastic tank for water storage (SNNPR)

Name	Specification	Quantity
Water Supply Truck	Tank capacity 15,000 litre Drive train 6 x 4	3
	Tank capacity 6,000 litre Drive train 4 x 4	4
Plastic tank for water storage	5,000 litre	9
	10,000 litre	9

(4) Quantity to be procured

E/N total amount has already been decided for this programme, and the adjustment of the quantity to be procured is required to an E/N limit. The selection policy of quantity to be procured was determined based on the "2-2-1-6 Selection Policy of the equipment to be procured". Quantity to be procured for water tank truck and plastic tank for water storage in each region is shown below.

Table 2-29: Priority for procurement of the water tank truck and plastic tank for water storage

Target Region	Request situation	Priority
Tigray	The condition in the region needs improving, and target area and population are definite. Appropriate quantity: 4 sets (6m3), 4 sets (15m3) Quantity of procurement to the Regional population (4.532 million: year 2009): 176.52 x 10-8	3
Oromia	The condition in the region needs improving, and target area and population are definite. Appropriate quantity: 7 sets (15m3) Quantity of procurement to the Regional population (28.756 million: year 2009): 24.34 x 10-8	1
Afar	This equipment is procured for the control of future disasters. Appropriate quantity: 1 set (6m3), 1 set (15m3) Quantity of procurement to the Regional population (1.473 million: year 2009): 135.77 x 10-8	5
Amhara	No request of the water tank truck and plastic tank for water storage	-
Somali	This equipment is procured for the control of future disasters. Appropriate quantity: 2 sets (6m3), 3 sets (15m3) Quantity of procurement to the Regional population (4.673 million: year 2009): 107.00 x 10-8	4
SNNPR	The condition in the region needs improving, and target area and population are definite. Appropriate quantity: 2 sets (6m3), 3 sets (15m3) Quantity of procurement to the Regional population (15.927 million: year 2009): 31.39 x 10-8	2

Table 2-30: Appropriate quantity for water tank truck and plastic tank for water storage

	Component/Specification		Unit	Tigray	Oromia	Afar	Somali	SNNPR
Appropriate quantity	Water tank truck	6m3	set	4	0	1	2	3
		15m3	set	4	7	1	3	2
	Plastic tank for water storage	5m3	tank	14	18	8	14	13
		10m3	tank	14	18	8	14	13
Quantity to be procured	Water tank truck	6m3	set	3	0	1	1	1
		15m3	set	3	5	1	1	1
	Plastic tank for water storage	5m3	tank	11	13	8	6	5
		10m3	tank	11	13	8	6	5

(5) Backup quantity to be procured

Additional equipment to be procured in accordance with Table 2-29 and maximum quantities are shown as below.

Table 2-31: Maximum quantity to be procured for backup equipment

	Component/Specification		Unit	Tigray	Oromia	Afar	Somali	SNNPR
Backup equipment	Water tank truck	6m3	Unit	1	0	0	1	2
		15m3	Unit	1	2	0	2	1
	Plastic tank for water storage	5m3	Unit	3	5	0	8	8
		10m3	Unit	3	5	0	8	8

Additional equipment shall be procured with a combination of water tank trucks and plastic tanks for water storage the combination is as follows;

Table 2-32: Combination of additional equipment to be procured

Region	Water tank truck		Plastic tank	
			5m3 (unit)	10m3 (unit)
Tigray	6m3	1 unit	1.0	1.0
	15m3	1 unit	2.3	2.3
Oromia	15m3	1 unit	2.5	2.5
Somali	6m3	1 unit	1.0	1.0
	15m3	1 unit	3.5	3.5
SNNP	6m3	1 unit	2.0	2.0
	15m3	1 unit	4.0	4.0

2-2-2-4 Portable water purification plant and Plastic tank for water storage

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-33.

Table 2-33: Examination of Necessity and Appropriateness (Portable Water Purification Plant and Plastic tank for water storage)

Region	Necessity	Points of Examination on Appropriateness	Study Results
Tigray	Installation will be done in 4 areas which are severely affected by drought and AWD, as an emergency measure.	(Portable water purification plant) • If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		• If the organization has established O&M system.	• There is a branch office in the region. The branch office offers trainings of the O&M, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has appropriate place for storage of the machine.	• The destination of the machine is already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in Tigray Water Resources Dept. and Woreda offices.
		• If there is a clear plan which defines target population and the area.	• There is a clear plan of target Woredas, and the regional government has a record of disasters in the past. It is highly possible to estimate future disasters. The procurement is considered appropriate for the above reasons.
			(Plastic tank for water storage) A storage tank is necessary for receiving purified water from the water purifying machine. Water purification machine is equipped with only 4-6 taps. Amount of treated water supply is much greater than the usage. It is appropriate to procure water tanks for temporary storage device attached on water purifying machine.
Oromia	The machines are procured as emergency purpose for 5 areas which have water supply plans, but are not able to implement the plans due to budgetary problems.	(Portable water purification plant) • If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		• If the organization has established O&M system. •	• There is a branch office in the region. The branch office offers training of the O&M, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has appropriate place for storage of the machine. •	• Places of installation of the machines are already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in Oromiya Water Resources Dept. and Woreda offices.

Region	Necessity	Points of Examination on Appropriateness	Study Results
		• If there is a clear plan which defines target population and the area.	• The machines are planned to be provided for 5 areas with high occurrence ratio of drought and/or flood. Target area and the population are in the plan. The procurement is considered appropriate for the above reasons.
			(Plastic tank for water storage) It is the same as Tigray region.
Afar	The machines are procured as emergency purpose for 7 areas which have water supply plans, but are not able to implement the plans due to budgetary problem.	(Portable water purification plant) If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		•	• There is a branch office in the region. The branch office offers O&M training, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has established O&M system. •	• Places of installation of the machines are already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in Afar Water Resources Dept. and Woreda offices.
		• If the organization has appropriate place for storage of the machine. •	• The machines are planned to be provided for 5 areas with high occurrence ratio of drought and/or flood. Target area and the population are in the plan. The procurement is considered appropriate for the above reasons.
			(Plastic tank for water storage) It is the same as Tigray region.
Amhara	The machines are procured as emergency purpose for 7 areas which have water supply plans, but are not able to implement the plans due to budgetary problem.	(Portable water purification plant) • If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		• If the organization has established O&M system. •	• There is a branch office in the region. The branch office offers trainings of the O&M, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has appropriate place for storage of the machine. •	• Places of installation of the machines are already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in Amhara Water Resources Dept. and Woreda offices.

Region	Necessity	Points of Examination on Appropriateness	Study Results
		• If there is a clear plan which defines target population and the area.	• The machines are planned to be provided for the areas with high occurrence ratio of drought and/or flood. Target area and the population are in the plan. The procurement is considered appropriate for the above reasons.
			(Plastic tank for water storage) It is the same as Tigray region.
Somali	The machines are procured as emergency purpose for 5 areas which have water supply plans, but are not able to implement the plans due to budgetary problems.	(Portable water purification plant) • If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		• If the organization has established O&M system. •	• There is a branch office in the region. The branch office offers trainings of the O&M, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has appropriate place for storage of the machine. •	• Places of installation of the machines are already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in Somali Water Resources Dept. and Woreda offices.
		• If there is a clear plan which defines target population and the area.	• The machines are planned to be provided for the areas with high occurrence ratio of drought and/or flood. Target area and the population are in the plan. The procurement is considered appropriate for the above reasons.
			(Plastic tank for water storage) It is the same as Tigray region.
SNNPR	The machines are procured as emergency purpose for 7 areas which have water supply plans, but are not able to implement the plans due to budgetary problem.	(Portable water purification plant) • If user organization has appropriate skill to operate the machine.	(Portable water purification plant) • The machine has been provided by UNICEF, and has been used up to present. There should be no problem operating the machine.
		• If the organization has established O&M system. •	• There is a branch office in the region. The branch office offers trainings of the O&M, and also gives guidance on spare parts and expendable supplies. Staff of Water Resources Dept. also commute to the villages for guidance of the maintenance. O&M system has been established and functioning.
		• If the organization has appropriate place for storage of the machine. •	• Places of installation of the machines are already planned; and, there is no need for a storage place in the Dept. of Water Resources. The machine requires only 10m (length) × 5m (width) at the outside. There are also storage spaces in SNNPR Water Resources Dept. and Woreda offices.

Region	Necessity	Points of Examination on Appropriateness	Study Results
		• If there is a clear plan which defines target population and the area.	• The machines are planned to be provided for the areas with high occurrence ratio of drought and/or flood. Target area and the population are in the plan. The procurement is considered appropriate for above reason.
			(Plastic tank for water storage) It is the same as Tigray region.

(2) Specifications

1) Portable water purification plant

The water purification plant should be movable because it is only a temporary water supply measure until a permanent facility is installed.

There are two kinds of water purification machines in Ethiopia. One is made in Norway, and the other is of domestic company. Their mechanism is the same in principle. The purification process is illustrated in the Figure 2-5.

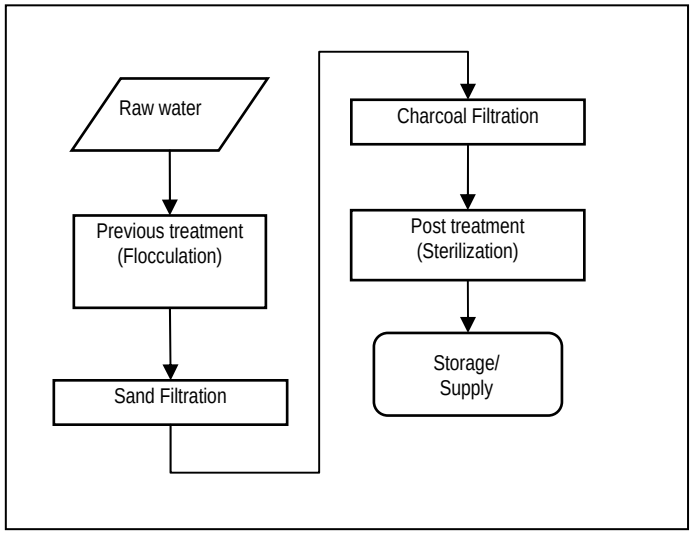


Figure 2-5: Water Purification Flow

Basic components of the machine are as follows.

Engine pump : Drawing water, water supply for filtration, backwash, water supply to storage tank

Previous treatment tank : Flocculation, settling

Filtration module : Main part of the machine. It is consisted of sand filtration and charcoal filtration.

Assembly-type purification tank : Sterilization is done in this temporary storage tank

Water supply module : 4-6 taps

To operate water purification machine, two kinds of chemicals are needed. One is pre-treatment chemical (*alumina*, or others) for flocculation, and the other is chloride chemicals for sterilization. Both are expendable supplies that have to be added continuously. Production abilities of the machines used in Ethiopia are from 8,000 to 12,000 litres/hour. It is difficult to decide at this point, whether many small machines, or less number of large machines are better than the other. This time, smaller machine (8,000 litres/ hour) and large machine (12,000 litres/ hour) are combined for required water supply amount 20,000 litres. Duration of operation is set at 8 hours for each machine.

2) Plastic tank for water storage

A storage tank is necessary for receiving purified water from the water purifying machine. Water purification machine is equipped with only 4-6 taps. Production of treated water volume by the purification machine is much greater than the water usage by the people. It is appropriate to procure water tanks for temporary storage device attached on water purifying machine.

A set of a 10,000 litre and a 5,000 litre plastic tank for water storage, total 2 tanks are used for the 15,000 litre requirement. The quantity of tanks is determined by production capacity of the machine.

(3) Quantity of Procurement

1) Tigray

- Portable water purification plant

Amount of water necessary based on disaster affected numbers in target areas, shown in Table 2-28. The calculation is based on a minimum unit, 7.0 (litre/man/day), which is applied in other regions. Target population is 48.15% of in-serviced population of the Woredas (Table 2-18).

Table 2-34: Required Amount of Purified Water (Tigray)

Woreda	Affected Population	Target Population	Unit quantity of water to be supplied (litre/man/day)	Necessary water quantity (litre/day)
Raya Azebo	109,575	53,527	7.00	374,689
Enderta	128,651	62,846	7.00	439,922
Atsibi Womberta	110,349	53,905	7.00	377,335
Tahtay Koraro	79,134	38,657	7.00	270,599
Total	427,709	208,935		1,462,545

Quantity of portable water purification plants, based on the specifications above, is described in Table 2-35.

Table 2-35: Number of Portable water purification plants (Tigray)

Woreda	Necessary amount of water supply (litre/day)	Hours of operation (hours/day)	Necessary amount of water (litre/hour)	Number of machine necessary ($8m^3$/hr)	Number of machine necessary ($12m^3$/hr)
Raya Azebo	374,689	8	46,836	3	2
Enderta	439,922	8	54,990	3	3
Atsibi Womberta	377,335	8	47,167	3	2
Tahtay Koraro	270,599	8	33,825	3	1
Total	1,462,545		182,818	12	8

- Plastic tank for water storage

Quantity of plastic tank for water storage is determined by the following equation.

182,818 (litre/hour)/15,000=12.19 13 tanks (5,000 litres), and 13 tanks (10,000 litres)

2) Oromia Region

- Portable water purification plant

Amount of water necessary for disaster affected area which estimated based on population in the areas are shown in Table 2-36.

Table 2-36: Target villages of portable water purification plants (Oromia Region)

No	Zone	Woreda	District	Population	Remark
1	Guji	Goro Dola	Gannale Donta	2,200	
2		Goro Dola	Jiddoola	2,500	
3		Anasora	Darme	4,000	
4		Adola	Chambe	4,000	
5		Adola	Michichaa	3,000	
6		Adola	Oda Buttaa	2,500	
7		Adola	Anfarara	3,500	
8		Adola	Zanbaba	3,000	
9		Shakkiso	Magaddo	4,500	
10		Shakkiso	Hayadima	4,000	
11	Borana/Guji	Dawa	Dawa Village	6,000	
12	E/Shawa	Adama	Bosat	1,200	
13		Fantalle/Adama	Villages along river	3,200	
14		Lume	Ejersa	5,000	
15	W/Arsi	Arsi Negelle	Goljota	12,000	Areas of concurrent occurrence of AWD
16		Digalu-Tijo	Villages along river	6,000	Areas of concurrent occurrence of AWD
17		Shashemene	Residents who live within 15km radius from town centre	11,100	Areas of concurrent occurrence of AWD
18		Shashemene		12,000	Areas of concurrent occurrence of AWD
19		Kofale	Areas around Kofale town	5,000	Areas of concurrent occurrence of AWD
20		Dodola	Areas along Wabe River	4,500	
21		Asaasa	Areas along Asaasa Spring	6,000	
22	I/A/Boora	Mattu	Areas around Mattu	15,000	

No	Zone	Woreda	District	Population	Remark
23	W/Welega	Gimbi	Areas north & west of the town	6,000	
24	Q/Welega	Sayo	Areas north & south west of the town	3,000	
25	W/Welega	Dirmegii	Karkaro	4,300	
26		Elementary school prone to AWD			
27		Local dispensaries			
				133,500	

Resource: OWRB

Table 2-37: Required Amount of Purified Water (Oromia)

Zone	Woreda	Target population	Unit water supply quantity(litre/man/day)	Necessary quantity of water supply (litre/day)
West Arsi	Arsi Negelle	12,000	7.0	84,000
West Arsi	Digalu-Tijo	6,000	7.0	42,000
West Arsi	Shashemene	11,100	7.0	77,700
West Arsi	Shashemene	12,000	7.0	84,000
West Arsi	Kofale	5,000	7.0	35,000
Total		46,100		322,700

Quantity for procurement of portable water purification plants with specification described above is shown in Table 2-32.

Table 2-38: Number of portable water purification plants (Oromia)

Zone	Woreda	Necessary amount of supplied water (litre/day)	Operation hours (hours/day)	Necessary amount of water (litre/hour)	Necessary number of water purification machines	
					$8m^3/hr$	
West Arsi	Arsi Negelle	84,000	8	10,500	0	West Arsi
West Arsi	Digalu-Tijo	42,000	8	5,250	1	West Arsi
West Arsi	Shashemene	77,700	8	9,713	0	West Arsi
West Arsi	Shashemene	84,000	8	10,500	0	West Arsi
West Arsi	Kofale	35,000	8	4,375	1	West Arsi
Total		322,700		40,338	2	0

- Plastic tank for water storage

Quantity for procurement of plastic tank for water storage is calculated by an equation below.

40,338 (litre/hour)/ 15,000 litre =2.69 3 tanks (5,000 litres), and 3 tanks (10,000 litres)

3) Afar Region

- Portable water purification plants

Amount of water necessary for target area, based on the areas' population. 7.0 litres is utilized as a unit for amount of water to be supplied for a man per day. Target population is 49.00% of woreda

population, for water supply rate for rural areas of Afar Region is 51.00% (2007)

Table 2-39: Required Amount of Purified Water (Afar)

Zone/Woreda	Population	Target population of water supply	Unit amount of water supply (litre/man/day)	Required amount of water (litre/day)
Zone 1				
Afambo	24,367	11,940	7.0	83,579
Asayita	32,548	15,949	7.0	111,640
Dubti	33,841	16,582	7.0	116,075
Sub total	90,756	44,470		311,293
Zone 3				
Amibara	32,582	15,965	7.0	111,756
Bure Mudayitu	33,200	16,268	7.0	113,876
Gewane	26,458	12,964	7.0	90,751
Sub total	92,240	45,198		316,383
Zone 5				
Dalifage	32,561	15,955	7.0	111,684
Sub total	32,561	15,955		111,684
Total	215,557	105,623		739,361

Quantity of procurement of portable water purification plants with specification above is shown in Table 2-40.

Table 2-40: Number of portable water purification plants (Afar)

Zone/Woreda	Necessary amount of supplied water (litre/day)	Operation hours (hours/day)	Necessary amount of water (litre/hour)	Necessary number of water purification machines	
				$8m^3/hr$	
Zone 1					Zone 1
Afambo	83,579	8	10,447		Afambo
Asayita	111,640	8	13,955	2	Asayita
Dubti	116,075	8	14,509	2	Dubti
Sub total	311,293		38,912	4	Sub total
Zone 3					Zone 3
Amibara	111,756	8	13,970	2	Amibara
Bure Mudayitu	113,876	8	14,235	2	Bure Mudayitu
Gewane	90,751	8	11,344		Gewane
Sub total	316,383		39,548	4	Sub total
Zone 5					Zone 5
Dalifage	111,684	8	13,961	2	Dalifage
Sub total	111,684		13,961	2	Sub total
Total	739,361		92,420	10	Total

Likewise the water tank truck, possibility of occurring above described disasters at once is very low; hence, the procurement quantity is reduced by 70%. The numbers of machines to be procured will be 7 smaller machines (8,000 litre/hour), and 1 larger machine (12,000 litre/hour).

- Plastic tank for water storage

Quantity for procurement of plastic tanks for water storage is calculated by an equation below.

92,420 (litre/hour) /15,000 litres × 70% =6.16　　7 tanks (5,000 litres), and 7 tanks (10,000 litres)

4) Amhara Region

- Portable water purification plant

Amhara regional government has requested portable water purification plants for 4 woredas listed below; however, the population is much larger than the production capacity of the machines, which are intended for temporary use. It is also difficult to operate and maintain them properly due to the large target area. Target population was narrowed down only to area with urgent necessity. The target population of the area was calculated based on need survey done by the Study team, and determined as shown in Table 2-41.

Table 2-41: Population in Area of Intensive Requirement of Water (Amhara)

Zone	Woreda	Target population of water supply	Intensity	Water supply target population (2)
South Gondar	Libokemkem	105,498	20%	21,100
South Gondar	Fogera	140,888	20%	28,178
North Gondar	Dembia	277,356	20%	55,471
North Gondar	Metema	59,056	20%	11,811
Total		582,798		116,560

Quantity of procurement of portable water purification plant with specification above is summarized in Table 2-42.

Table 2-42: Number of Portable water purification plants (Amhara)

Zone	Woreda	Water supply target population (2)	Unit amount of water supply (litre/day)	Necessary amount of supplied water (litre/day)	Duration of operation (hour)	Required amount of water (litre/hour)	Required water purification machines	
							8m3/hr	
South Gondar	Libokemkem	21,100	7.0	147,700	8	18,463	1	South Gondar
South Gondar	Fogera	28,178	7.0	197,243	8	24,655	2	South Gondar
North Gondar	Dembia	55,471	7.0	388,298	8	48,537	2	North Gondar
North Gondar	Metema	11,811	7.0	82,678	8	10,335	0	North Gondar
Total		116,560		815,919		101,990	5	0

- Plastic tank for water storage

Quantity for procurement of plastic tank for water storage is calculated by an equation below.

101,990 (litre/hour) /15,000 litres = 6.80 7 tanks (5,000 litres), and 7 tanks (10,000 litres)

Table 2-43: Flood Prone Woredas and the population (Amhara)

No.	Zone	Woreda	Population	Water Supply Rate (%)	Target population
1	West gojjam	Bahir dar zuria	259,960	27%	189,771
2		North Achefer	121,464	14%	104,459
3		Mecha	320,024	10%	288,022
4		Jabitihnan	241,241	24%	183,343
5		Sekella	180,114	26%	133,284
6	Awi	Fageta lecoma	155,876	18%	127,818
7	South Gondar	Dera	281,130	30%	196,791
8		Libokemkem	181,893	42%	105,498
9		Fogera	213,466	34%	140,888
10	North Gondar	Dembia	298,232	7%	277,356
11		Gondar zuria	193,561	9%	176,141
12		Alefa	167,378	4%	160,683
13		Metema	78,741	25%	59,056
14	Nortjh Shoa	Antsokia	86,259	63%	31,916
15	Oromia	Artuma fursi	111,789	39%	68,191
16		Gilie Tumuga	95,114	32%	64,678
17	South wollo	wogedi	135,345	35%	87,974
18		Kallu	198,069	31%	136,668
19	North wollo	Kobo	207,599	58%	87,192
20	Wag himra	Dahina	104,799	42%	60,783
Total			3,632,054		2,680,510

Source: AWRDB

It is common practice in Amhara region that the government relocates disaster affected people to adjacent villages temporarily, and supply water by extension facilities (with 1-1/2" GI pile) from the existing water sources. The water is provided to evacuated people by extension facilities and storage tanks at the end of facility. Plastic tank for water storage (20 sets of $5m^3$ and $10m^3$ tanks) will be procured for 20 Woredas.

The sum is 27 tanks (5,000 litres), and 27 tanks (10,000 litres)

5) Somali Region

- Portable water purification plant

Amount of water to supply for one person is set as 7.0 litres per day, the same figure with other regions. The target population is decided as 76.74% of the respective Woredas' population, because the water supply rate in rural area of Somali Region is 23.76% (as of 2007).

Table 2-44: Required Amount of Purified Water (Somali)

Zone	Woreda	Population	Target population	Unit amount of supplied water (litre/man/day)	Required amount of supplied water (litre/day)
Gode	Kelafo	66,000	50,648	7.0	354,539

Zone	Woreda	Population	Target population	Unit amount of supplied water (litre/man/day)	Required amount of supplied water (litre/day)
	Mustahil	43,103	33,077	7.0	231,541
	Burukur	77,625	59,569	7.0	416,986
	West Emi	33,244	25,511	7.0	178,580
	Doloodo	17,620	13,522	7.0	94,651
Total		237,592	182,327		1,276,297

Quantity of procurement of portable water purification plants, with specification described above is shown in Table 2-45.

Table 2-45: Number of Portable water purification plants (Somali)

Zone	Woreda	Required amount of water (litre/day)	Duration of operation (hour)	Required amount of supplied water (litre/day)	Number of Water Purification Machines	
					$8m^3/hr$	
Gode	Kelafo	354,539	8	44,317	3	Gode
	Mustahil	231,541	8	28,943	2	
	Burukur	416,986	8	52,123	2	
	West Emi	178,580	8	22,323	3	
	Doloodo	94,651	8	11,831	0	
Total		1,276,297		159,537	10	0

Likewise the water tank truck, possibility of occurring above described disasters at once is very low; hence, the procurement quantity is reduced by 70%. The number of the machines to be procured will be 7 smaller machine (8,000 litre/hour), and 5 larger machine (12,000 litre/hour).

- Plastic tank for water storage

Quantity for procurement of plastic tank for water storage is calculated by an equation below.

159,537 (litre/hour) /15,000 litres × 70% = 7.44 8 tanks (5,000 litres), and 8 tanks (10,000 litres)

6) S.N.N.P.Region

- Portable water purification plant

Necessary water amount to be supplied is shown in Table 2-40, based on the population of the target Woredas.

Table 2-46: Required Amount of Supplied Water (SNNPR)

Zone	Woreda	Target population	Unit amount of water supply (litre/man/day)	Required amount of supplied water (litre/day)
Wolayita	Humbo	26,231	7.0	183,614
Gurage	Abeshege	28,853	7.0	201,972
Hadia	East Badewaco	23,324	7.0	163,268
Hadia	West Badewacho	30,996	7.0	216,969
Konso	Konso	64,490	7.0	451,427
Gurage	Kebena	59,959	7.0	419,715
Sidama	Wondogenet	53,506	7.0	374,540
Total		287,359		2,011,505

Quantity of procurement of portable water purification plants, with specification described above is shown in Table 2-47.

Table 2-47: Number of Requested Portable water purification plants (SNNPR)

Zone	Woreda	Required amount of water (litre/day)	Duration of operation (hour)	Required Amount of Supplied Water (litre/hour)	Number of Water Purification Machines	
					$8m^3/hr$	
Wolayita	Humbo	183,614	8	22,952	3	Gurage
Gurage	Abeshege	201,972	8	25,247	2	Gurage
Hadia	East Badewaco	163,268	8	20,409	1	Hadia
Hadia	West Badewacho	216,969	8	27,121	2	Hadia
Konso	Konso	451,427	8	56,428	3	Konso
Gurage	Kebena	419,715	8	52,464	2	Sidama
Sidama	Wondogenet	374,540	8	46,817	3	Wolayita
合計		2,011,505		251,438	16	0

Likewise the water tank truck, possibility of occurring above described disasters at once is very low; hence, the procurement quantity is reduced by 70%. The numbers of the machines to be procured will be 13 smaller machines (8,000 litre/hour), and 8 larger machines (12,000 litre/hour).

- Plastic tank for water storage

Quantity for procurement of plastic tank for water storage is calculated by an equation below.

251,438 (litre/hour) /15,000 litres × 70% = 11.73　　12 tanks (5,000 litres), and 12 tanks (10,000 litres)

2-2-2-5 Bulldozer and Heavy Equipment Transport Vehicle

(1) Examination of Appropriateness

The results of the Study show necessity and appropriateness of procurement of bulldozer and related equipment as shown in Table 2-48.

Table 2-48: Examination of Necessity and Appropriateness（Bulldozer and Heavy Equipment Transport Vehicle）

Region	Necessity	Points of Examination on Appropriateness	Study Results
Afar	Although most of the region is covered by Danakili desert, flooding occurs concurrently along side of Awash river. Bulldozer is necessary for river bed excavation, and dike reinforcement and repair. Heavy machine transporting vehicle is also necessary because there is no private company that offer the transportation of bulldozers.	• If user organization has appropriate skill to operate the machine.	• Bulldozer will be used for excavation of riverbed and reinforcement and maintenance of river embankment.
		• If the organization has established O&M system.	• Water Resource Dept. will be the responsible agency.
		• The user organization is able to operate and maintain the machinery.	• The regional government owns other heavy machinery, such as rigs, water supply vehicles, etc., and there is no problem of O&M.
		• If there is an appropriate storage place.	• The regional govt. possess appropriated storage place. The procurement is considered appropriate for the above reasons.
Somali	Bulldozer is necessary for excavation of riverbed, and reinforcement of embankment of rivers, such as Wabi shabere, in the Region that flood frequently.	• If user organization has appropriate skill to operate the machine.	• Bulldozer will be used for excavation of river bed and reinforcement and maintenance of river embankment.
		• If the organization has an established O&M system.	• Water Resource, Mine, Energy development Dept. of Somali regional government will be the responsible agency.
		• The user organization is able to operate and maintain the machinery.	• The regional government owns other heavy machinery, such as rigs, water supply vehicle, etc., and there is no problem of O&M.
		• If there is an appropriate storage place.	• The regional govt. possess appropriate storage place.
			The regional government has requested maintenance machinery for wells, for it gives priority on water supply activities rather than flood control. Flood control can be conducted by private company or water supply facility construction company. Therefore bulldozer is to be excluded from the procurement list.

(2) Specifications

Zone 1 and Zone 3 of Afar region are flood prone areas in which floods occurr concurrently. The Awash River, which penetrate centre of Afar region, has created gigantic alluvial fan in the region by changing its river course frequently. The gradient of the Awash River is especially flat in the circled areas in Figure 2-6, and floods along side of the land in every rainy season.

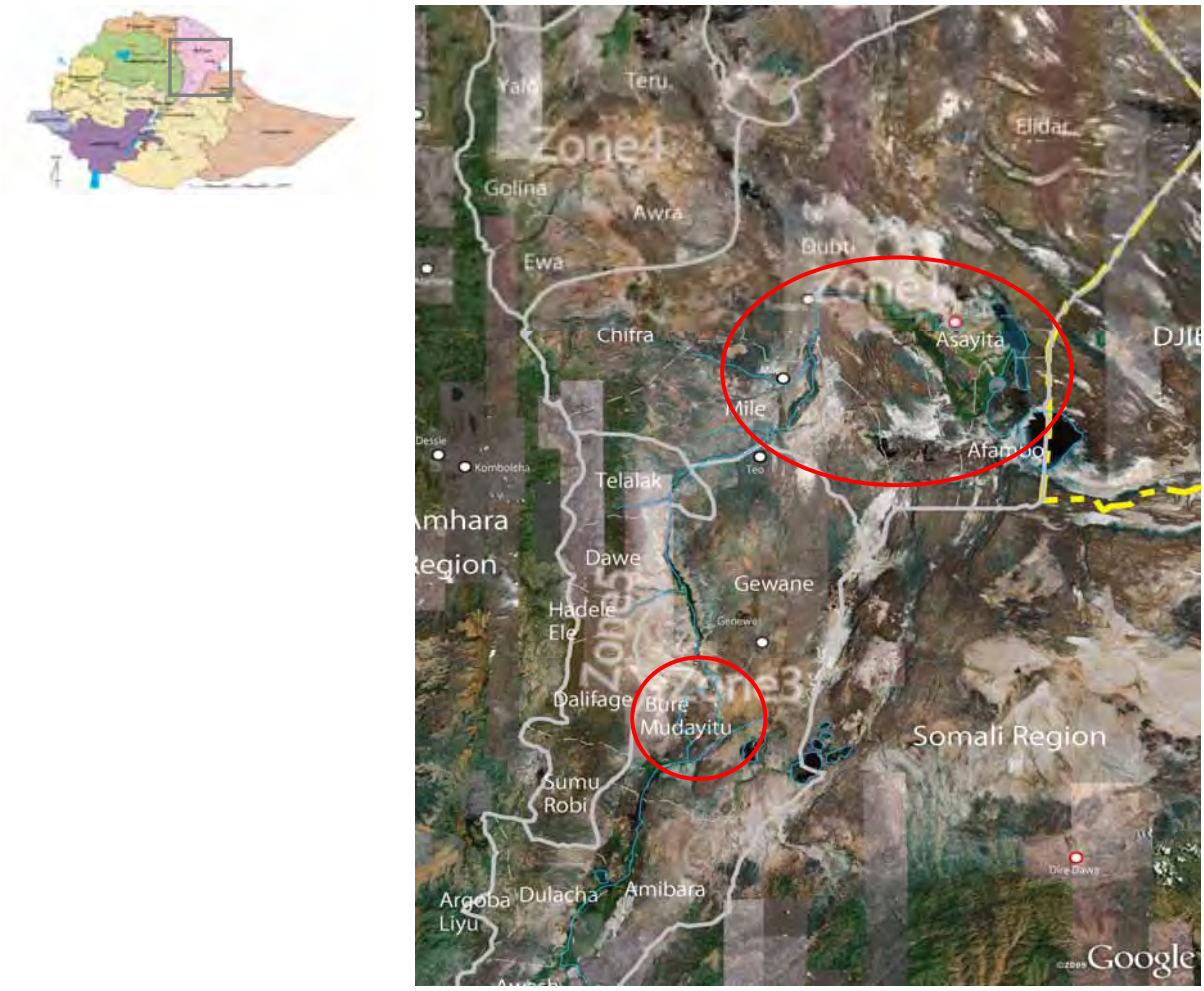


Figure 2-6: Flood Prone Areas in Afar Region

Most of the residents historically in this area are nomads; and, flooding is normal and periodic natural phenomenon, which fertilizes their land. However, in recent years, dike is frequently busted caused by ever-rising level of Awash River, due to the deposits at change-points of river gradient; and excessive development in the upstream areas. Frequency of flood disaster occurrence is higher since 2005. In 2007, there were 9 floods and the disaster forced 20,000 people to be relocated, and affected 100,000 people in southern Ethiopia. The floods also cause decreasing of cross section of the Awash River, and eventually flooding. The Water Resources Department of Afar Region required 10-ton class bulldozer for flood control and the recovery works; however, it is conceived that 10-ton class bulldozer is ineffective and inappropriate machine for excavating vast amount of deposits in the river course. A bulldozer of 20-tonnes class will be procured for the reason that 20-tons class, or larger, bulldozer is recommended for this type of works in the cost estimation standard, Ministry of Land Transportation and Construction Japan.

(3) Quantity for Procurement

1) Afar Region

Quantity of bulldozer is one, at least. The Water Resources Department of Afar Regional government does not possess a transporter truck, one heavy machinery transportation truck of size 20-tons or over will be procured.

2-2-2-6 Equipment for Exploratory Well

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-49.

Table 2-49: Examination of Necessity and Appropriateness (Equipment for exploratory well)

Region	Necessity	Points of Examination on Appropriateness	Study Results
SNNPR (Shemen Shershera)	The expansion of the facility is necessary for supplying water for the people in the area, who has to use unsanitary water. Existing extension facility has been out of service for a long time.	• If water users can afford paying the maintenance fee.	• There is a test borehole constructed by the Programme for the Improvement of the Equipment for Groundwater Development, and ready to be used. • There also is commercial electric supply line of EEPCo, along Butajira-Ziway road. The distance between the village and the power line is only 400m; and, if the power line is extended, great deal of operation cost will be saved.
		• If the water users have intention to operate and maintain the facility	• The local organization have O&M expertise, and the beneficiaries have strong intention for conducting O&M.
		• If construction fee can be paid by the Ethiopian side.	• It is confirmed that budget for the construction cost of the facility is secured by the Bureau of Finance and Economic Development of SNNPR. It is considered that procurement of the materials is appropriate for the above reasons.

Region	Necessity	Points of Examination on Appropriateness	Study Results
SNNPR (Inceno Town)	Component of existing facility is as follows. Deep well with powered pump (depth 48m, capacity 4.98 litre/sec), Elevated tank (capacity 20 m^3: 10m^3 Roto tank ×2), Generator house, water taps (×6), aqueduct (430m), distribution pipe (2,300m). The existing facility has been operating; but, the capacity is much smaller than the amount required by the target population: 15,000. Urgent needs for safe water is very high.	• If water users can afford paying the maintenance fee.	• There is a test borehole constructed by the Programme for the Improvement of the Equipment for Groundwater Development, and ready to use. • There also is commercial electric supply line of EEPCo, in Inceno town. The distance between the village and the power line is only 400m; and, if the power line is extended, great deal of operation cost will be saved.
		• If the water users have intention to operate and maintain the facility	• The local organization have O&M expertise, and the beneficiaries have strong intention for conducting O&M.
		• If construction fee can be paid by the Ethiopian side.	• It is confirmed that budget for the construction cost of the facility is secured by the Bureau of Finance and Economic Development of SNNPR. It is considered that procurement of the materials is appropriate for the above reasons.
SNNPR (Kuno Kertafa)	Locations of water sources are concentrated in the village, and some villagers need to consume greater time than others for safe water.	• If water users can afford paying the maintenance fee. • If the water users have intention to operate and maintain the facility • If construction fee can be paid by the Ethiopian side.	• There are 7 hand pump wells, 6 hand dug wells, total 13 wells in the village. Locations of water sources are concentrated in the village. Although some villagers need to consume greater time than others for safe water, the urgency of construction of the extension is low. Water supply rate exceeds the national target rate. The priority of the extension work is low: construction materials for this facility are excluded from the procurement list.

Region	Necessity	Points of Examination on Appropriateness	Study Results
SNNPR (Bidera Faka)	The residents in 7 out of 26 villages in this woreda lack access to safe water, while the other 10 villages have water supply facilities (including Kuno Kertafa). Occurrence of AWD is high in the 7 villages.	• If water users can afford paying the maintenance fee. • If the water users have intention to operate and maintain the facility • If construction fee can be paid by the Ethiopian side.	• The component of the existing water supply facility is as follows. Borehole, Power house, elevated tank (capacity: 8 tons), water tap (1). The residents have difficulty in procuring safe water due to the small production capacity, and the far distance from the residential area. The urgency of the procurement for this area is high. However, geo-hydrological information for this area is insufficient, and makes it difficult for development of new wells, which suffice all the population by one well. For this reason, materials for this area are excluded from the procurement list.

(2) Specifications

Procurement plan and basic design will be drawn up for Semen Shershera and Inceno Town, which are selected by the previous discussion.

1) Target Year

The year 2015 is set as target year for this programme, considering this is an urgent water supply programme as it addresses climate change.

2) Water Demand

■ Target Population

Social survey was conducted in order to acquire necessary data, including population, for design capacity of the facility. Existing data (2007 Census) carries only up to population in Woreda level. Population increase ratio, 2.9%, is applied. The figure is an average of population increase rate between 1994 and 2007, in SNNPR (2007 Census).

Table 2-50: Estimated Population

Year	Increase Ratio (%)	Meskan Province		Remarks
		Semene Shershera	Inceno Town	
2007	2.9	2,926	–	2007
2008	2.9	3,011	15,000	2008
2009	2.9	3,098	15,435	2009
2010	2.9	3,188	15,883	2010
2011	2.9	3,280	16,344	2011
2012	2.9	3,375	16,818	2012
2013	2.9	3,473	17,306	2013
2014	2.9	3,574	17,808	2014
2015	2.9	3,678	18,324	2015

- Per Capita Daily Water Demand

Per Capita Daily Water Demand is set as 15 (litre/capita/day), which is a minimal figure indicated in Rural Water Supply and Sanitation Design Criteria (MoWR, April 2005); and, considering balance of the urgency and the maintenance capacity of the user (local people) of the facility.

- Planned Daily Average Supply

Planned Daily Average Supply is product of the target population multiplied by Per Capita Daily Water Demand.

- Average Daily Water Demand

Average Daily Water Demand is a figure deducted Planned Daily Average Supply by water loss (leaked water). Water loss ratio is 20%, according to Rural Water Supply and Sanitation Design Criteria (MoWR, April 2005).

- Maximum Daily Demand Factor

Maximum Daily Demand Factor is adapted 1.2, which is application of the figure from Rural Water Supply and Sanitation Design Criteria (MoWR, April 2005).

- Peak Hour Water Demand Factor

Maximum Hourly Water Demand Factor is adapted 1.5, which is application of the figure from Rural Water Supply and Sanitation Design Criteria (MoWR, April 2005).

- Maximum Daily Water Demand

Maximum Daily Water Demand is product of Average Daily Water Demand multiplied by Maximum Daily Demand Factor. Design water demand for respective villages is shown in Table 2-51.

Table 2-51: Design water demand

Zone	Woreda	Village/town	Target Population (2015)	Planned Daily Average Supply (m^3/day)	Average Daily Water Demand (m^3/day)	Maximum Daily Water Demand (m^3/day)	Peak Hour Water Demand (l/s)
Grage	Meskan	Semen Shershera	3,678	56	67	80	1.38
		Inceno Town	18,324	275	330	396	6.87

3) Water Source

- Water Quality of Water Source (Well)

Results of water quality analysis of the Semen Shershera and Inceno Town are shown in Table 2-52, done by the local government. All results of each parameter are within the water quality standard; and,

it is confirmed to be safer for drinking purposes.

Table 2-52: Result of Water Quality Analysis

Parameters		Water Quality Standard of Ethiopia		Semene shershera *1	Inceno *2
		Standard on substances harmful to health (mg/l)	Complaint level (mg/l)		
Total Dissolved Solids	TDS	-	1776.00	238.00	126.00
pH	pH	-	6.5-8.5	6.82	7.76
Ammonia	NH3	-	2.00	0.13	0.17
Sodium	Na	-	358.00	25.00	34.50
potassium	K	-	-	10.10	6.40
Total Hardness	Total Hardness as CaCo3	-	-	149.60	126.00
Calcium	Ca	-	-	41.40	42.00
Magnesium	Mg	-	-	11.30	5.10
Total iron	Fe	-	0.40	Trace	0.02
Manganese	Mn	0.80	0.13	0.02	0.10
Fluoride	F	3.00	-	0.32	0.21
Chloride	Cl	-	533.00	4.80	4.12
Nitrate	NO3	50.00	-	4.60	0.40
Alkalinity	Alkalinity as CaCo3	-	-	194.70	203.70
Carbonate	CO3	-	-	Trace	Nil
Bicarbonate	HCO3	-	-	237.50	248.50
Sulphate	SO4	-	483.00	3.30	0.19
Phosphate	PO4	-	-	0.37	0.56

*1: Butajira-Ziway Areas Development Study Drilling and Pumping Test (January 2008)
*2: Laboratory test results of the Study team

- Quantity of Water Source (well)

Specification of the existing Test well is shown in Table 2-53.

Table 2-53: Specification of Existing Test Wells

Parameters		Semen Shershera	Inceno Town		Remarks
		Test Well *1	Test Well *2	Existing Well *3	
Specification	Depth (m)	86.00	113.70	48.00	
	Production (m^3/day)	345.60	630.72	430.72	
	Static level (m)	48.55	14.90	N.A.	
	Dynamic level (m)	70.15	19.85	N.A.	
	Screen	6"PVC	6"PVC	6"PVC	
	Casing	6"PVC	6"PVC	6"PVC	
	Year constructed	Feb. 2006	Jul.2007	2004	
	Production Capacity (litre/sec)	3.20	5.84	3.99	Production capacity×80%
Judgement of appropriate production	Design Maximum Production Amount (m^3/day)	80.00	316.80	79.20	*4
	Duration of operation of submerged pump (hr)	8.0	15.50	8.0	
	Pump capacity (litre/sec)	2.78	5.68	2.75	
	Judgement	OK	OK	OK	

*1: Butajira Ziway Awasa Development Study Drilling and Pumping Test (Jan 2008) AG consultant
*2: EWTEC Drawdown data
*3: Hearings of Social survey in this Study

*4: Distribution of design maximum production amount (8:2) was decided by tank capacity

4) Outline of Facility Planning

An outline of the water supply facility is shown in Table 2-54.

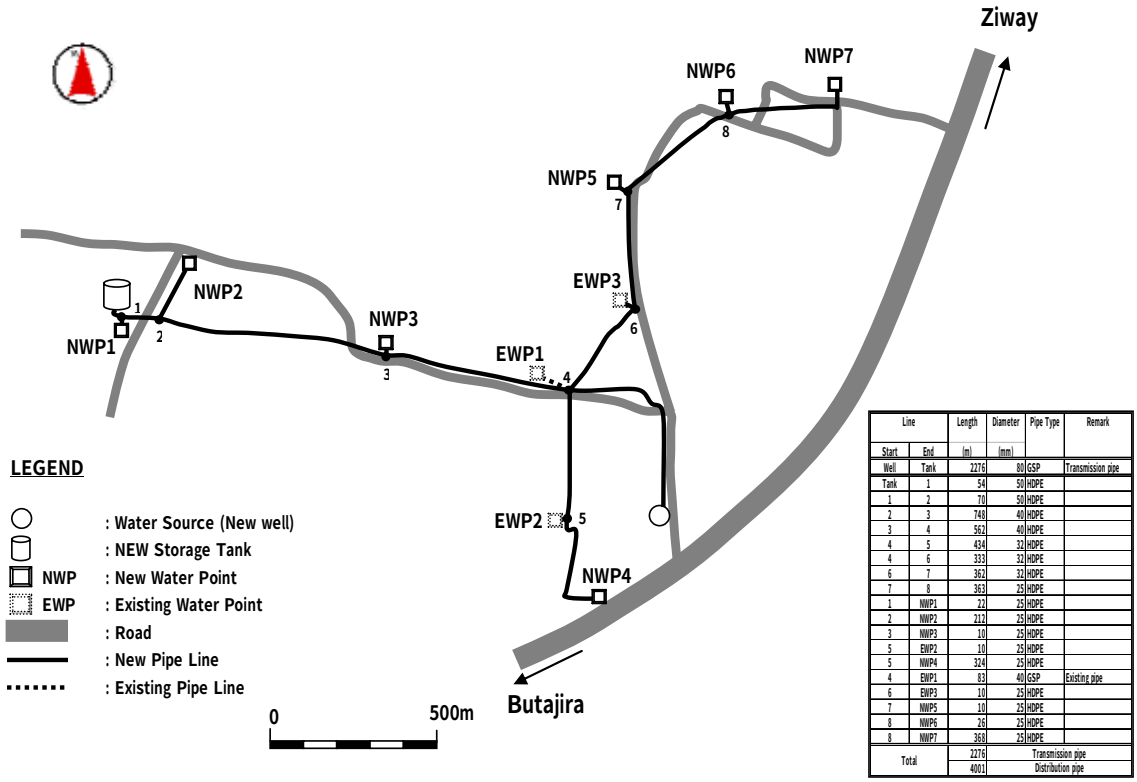
Table 2-54: Facility Plan (SNNPR)

Facility			Semen Shershera	Inceno Town	Remark
Intake	Intake Well	Existing well (EB1)	-	1	
		Observation borehole（RB1)	1	1	
	Submerged Pump	Existing（EB1）	-	Q=250-308 (litre/min) 1	
		New（RB1）	Q=167 (litre/min) 1	Q=341(litre/min) 1	
	Generator	Existing（EB1）	-	22 kVA:1	For emergency use
		New（RB1）	45 kVA:1	30 kVA:1	For emergency use
	Electric supply (purchasing)	Existing（EB1）	-	In use	Responsibility of Ethiopian side
		New（RB1）	In use	In use	Responsibility of Ethiopian side
	Machine room	Existing	1	1	
		New	-	1	
Transfer Facility	Water pipe (new construction)	GI Pipe	2,276m	339m	
	Air valve		1	-	
	Mud discharge valve		2	-	
Distribution Facility	Distribution pond	Ground level type $50m^3$	1	-	
		Elevated type $100m^3$	-	1	
	Distribution water pipe (existing)	GI Pipe	83m	1,211**m**	
	Distribution water pipe (new construction)	HDPE Pipe	3,918m-	6,705m	
	Water tap	Existing	3	6	
		New	7	13	
	Valve chamber	Divergence	12	30	

(3) Quantity to be procured

Layout plan and the quantity of the procurement are shown below.

1) SemenShershera



Line		Length	Diameter	Pipe Type	Remark
Start	End	(m)	(mm)		
Well	Tank	2276	80	GSP	Transmission pipe
Tank	1	54	50	HDPE	
1	2	70	50	HDPE	
2	3	748	40	HDPE	
3	4	562	40	HDPE	
4	5	434	32	HDPE	
4	6	333	32	HDPE	
6	7	362	32	HDPE	
7	8	363	25	HDPE	
1	NWP1	22	25	HDPE	
2	NWP2	212	25	HDPE	
3	NWP3	10	25	HDPE	
5	EWP2	10	25	HDPE	
5	NWP4	324	25	HDPE	
4	EWP1	83	40	GSP	Existing pipe
6	EWP3	10	25	HDPE	
7	NWP5	10	25	HDPE	
8	NWP6	26	25	HDPE	
8	NWP7	368	25	HDPE	
Total		2276	Transmission pipe		
		4001	Distribution pipe		

Figure 2-7: Layout Plan（Semen Shershera）

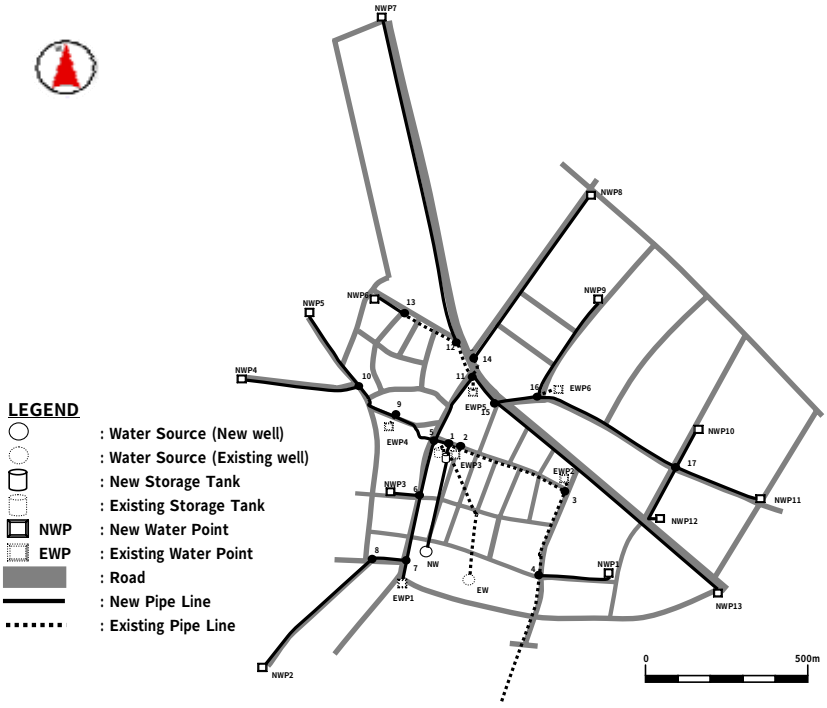
Table 2-55: Materials for Construction of Facility Extensions（Semen Shershera）

Name of material / equipment	Specification		Q'ty	Unit
Cement	Ordinary Portland Cement (50kg/bag)		678	bag
Fine aggregate	For concrete		180	m3
Course aggregate			56	m3
Rabble Stone			105	m3
Crusher stone	0-25mm		15	m3
Lime powder			0.000	ton
Round reinforced bar	D6mm		0.027	ton
Deformed reinforced bar	D8mm		0.000	ton
	D10mm		0.787	ton
	D12mm		0.876	ton
	D16mm		0.679	ton
Galvanised Wire mesh	3.2mm×50mm		49	m2
Binding wire	#21 (0.8mm)		15	Kg
Steel plate	3mm		0.025	ton
Vinyl chloride water stop	150mm×5mm		23	m
Submersible pump	6 inch, H=250m,Q=167L/min		1	unit
Generator	45KVA		1	unit
GI short pipe (flanged edges)	PN16, L=500mm	DN 2－1/2"	2	no
GI pipe (short) screwed in type	PN10, L=500mm	DN 4"	1	no
	PN10, L=1000mm	DN 2"	3	no
GI straight pipe (with socket)	Class B, L=3m	DN 2－1/2"	33	no
		DN 3"	2	no
	Class B, L=6m	DN 1-1/2"	14	no

Name of material / equipment	Specification		Q'ty	Unit
		DN 2"	10	no
		DN 2-1/2"	4	no
		DN 3"	384	no
		DN 3/4"	4	no
HDPE straight pipe	PE80,PN10	OD 25mm	1,355	m
		OD 32mm	1,129	m
		OD 40mm	1,310	m
		OD 50mm	124	m
HDPE 90° T-shaped pipe with reducer	Compression fitting	OD 32mm x 25mm x 32mm	3	no
		OD 40mm x 25mm x 40mm	2	no
		OD 50mm x 25mm x 50mm	2	no
HDPE 90° T-shaped pipe	Compression fitting	OD 25mm x 25mm x 25mm	2	no
		OD 40mm x 40mm x 40mm	1	no
HDPE Connector 90°	Compression fitting	OD 25mm	3	no
		OD 40mm	1	no
		OD 50mm	1	no
HDPE coupling	Compression fitting	OD 25mm	28	no
		OD 32mm	23	no
		OD 40mm	27	no
		OD 50mm	3	no
HDPE ball valve	Compression fitting	OD 32mm	2	no
HDPE x shape	Compression fitting	OD 40mm	1	no
HDPE reducer	Compression fitting	OD 40mm x 32mm	2	no
HDPE end plug		OD 25mm	1	no
		OD 40mm	1	no
T shape	PN10	DN 1-1/2"	20	no
		DN 2"	1	no
		DN 3"	2	no
		DN 4"	1	no
	PN16	DN 1"	1	no
		DN 2-1/2"	1	no
		DN 3"	1	no
Adopter (Female)	Compression fitting	40mm x 1-1/2"	11	no
Adopter (Male)	Compression fitting	40mm x 1-1/2"	11	no
Elbow 45°	PN10	DN 3"	2	no
Elbow 90°	PN10	DN 1-1/2"	50	no
		DN 2"	4	no
		DN 3"	3	no
		DN 4"	2	no
	PN16	DN 2-1/2"	3	no
Gate valve	PN10, with frange	DN 2"	1	no
	PN16, with frange	DN 2"	1	no
		DN 2-1/2"	1	no
	PN10, with thread	DN 1-1/2"	10	no
		DN 2"	2	no
Socket	PN10	DN 3/4"	60	no
Nipple	PN10	DN 1-1/2"	33	no
		DN 2"	10	no
		DN 3"	4	no
	PN16	DN 1"	4	no
		DN 1/2"	1	no
		DN 1-1/2"	1	no
		DN 2"	2	no
		DN 2-1/2"	8	no
		DN 3"	2	no
Flange with thread (with bolt and nut)	PN10	DN 2"	2	no
	PN16	DN 2"	2	no
		DN 2-1/2"	2	no
Ball valve	PN10	DN 1"	1	no
	PN16	DN 1"	1	no

Name of material / equipment	Specification		Q'ty	Unit
		DN 1/2"	1	no
Union	PN10	DN 1-1/2"	10	no
		DN 2"	2	no
		DN 3"	2	no
	PN16	DN 2"	2	no
		DN 2-1/2"	3	no
		DN 3"	1	no
Check valve (abnormal pressure release device attached)	PN16, flange	DN 2-1/2"	1	no
Air valve	PN10	24mm	1	no
	PN16	25mm	1	no
Water tap		DN 3/4"	60	no
Cross pipe	PN10	DN 1-1/2"	20	no
Water meter	PN16, flange, maximum flow 10m3/hr	DN 2-1/2"	1	no
	PN10, with thread	DN 1-1/2"	10	no
		DN 2"	1	no
Reducer	PN10	DN 1-1/2" x 1"	1	no
		DN 1-1/2" x 3/4"	50	no
		DN 3x 1-1/2"	1	no
		DN 3x 1-2"	1	no
	PN16	DN 1"x 1/2"	1	no
		DN 1-1/2"x 1"	1	no
		DN 2-1/2"x 1-1/2"	1	no
		DN 3"x 2"	1	no
		DN 3"x 2-1/2"	1	no
Compound pressure gauge	Max pressure 20bar	DN 1/2"	1	no

2) Inceno Town



Line		Length	Diameter	Pipe Type	Remark
Start	End	(m)	(mm)		
Well	Tank	339	80	GSP	Transmission pipe
Tank	1	19	90	HDPE	
1	2	9	90	HDPE	
2	3	367	50	GSP	Existing pipe
3	4	305	40	GSP	Existing pipe
1	5	54	90	HDPE	
5	6	200	63	HDPE	
6	7	226	50	HDPE	
7	8	106	40	HDPE	
5	9	161	50	HDPE	
5	11	242	90	HDPE	
9	10	154	50	HDPE	
11	12	64	40	GSP	Existing pipe
12	13	187	40	GSP	Existing pipe
11	14	75	50	GSP	Existing pipe
11	15	123	63	HDPE	
15	16	128	63	HDPE	
16	17	481	63	HDPE	
7	EWP1	77	25	GSP	Existing pipe
3	EWP2	32	25	GSP	Existing pipe
2	EWP3	27	25	GSP	Existing pipe
9	EWP4	5	25	GSP	Existing pipe
11	EWP5	16	25	GSP	Existing pipe
16	EWP6	47	25	GSP	Existing pipe
4	NWP1	231	32	HDPE	
8	NWP2	478	40	HDPE	
6	NWP3	89	32	HDPE	
10	NWP4	339	40	HDPE	
10	NWP5	282	40	HDPE	
13	NWP6	97	40	HDPE	
12	NWP7	1089	50	HDPE	
13	NWP8	660	40	HDPE	
16	NWP9	356	40	HDPE	
17	NWP10	128	40	HDPE	
17	NWP11	269	40	HDPE	
17	NWP12	214	40	HDPE	
15	NWP13	579	40	HDPE	
Total		339	Transmission pipe		
		7916	Distribution pipe		

Figure 2-8: Layout Plan (Inceno Town)

Table 2-56: Materials for Construction of Facility Extensions（Inceno Town）

Name of material / equipment	Specification		Q'ty	Unit
Cement	Ordinary Portland cement (50kg/bag)		1,248	Bag
Fine aggregate	For concrete		226	m3
Course aggregate			98	m3
Rubble stone			126	m3
Concrete block	400×200×200mm		750	no
Crushed stone	0-25mm		39	m3
Lime powder			0.204	ton
Round reinforced bar	D6mm		0.047	ton
Deformed reinforced bar	D8mm		0.063	ton
	D10mm		1.030	ton
	D12mm		1.017	ton
Binding wire	#21 (0.8mm)		67	Kg
Timber	φ100mm×6m		0.236	m3
Timber	75mm×50mm×4m		0.300	m3
Timber	2.5cm×25cm		0.015	m3
Scalloped metal sheet	G30		20	m2
Door	steel sheet: height 2.1m, width 1.5m		1	no
	steel sheet: height 2.1m, width 0.8m		1	no
Window	steel sheet: height 1.2m, width 1.2m		1	no
Oil paint			3	litre
Mixed paint			9	litre
Submersible pump	6 inches, H=80m,Q=341L/min		1	unit
Generator	30KVA		1	unit
GI short pipe (flanged edges)	PN16, L=500mm	DN 3"	2	no
GI pipe (short) screwed in type	PN10, L=500mm	DN 4"	15	no
GI straight pipe (with socket)	Class B, L=3m	DN 3"	11	no
	Class B, L=6m	DN 1-1/2"	18	no
		DN 3"	63	no
		DN 3/4"	5	no
		DN 4"	13	no
HDPE straight pipe	PE80,PN10	OD 32mm	320	m
		OD 40mm	3,508	m
		OD 50mm	1,630	m
		OD 63mm	932	m
		OD 90mm	315	m
HDPE 90° T-shaped pipe with reducer	Compression fitting	OD 50mm x 40mm x 50mm	2	no
		OD 63mm x 40mm x 63mm	2	no
		OD 63mm x 50mm x 63mm	1	no
HDPE 90° T-shaped pipe	Compression fitting	OD 40mm x 40mm x 40mm	1	no
		OD 50mm x 50mm x 50mm	3	no
		OD 63mm x 63mm x 63mm	2	no
		OD 90mm x 90mm x 90mm	1	no
HDPE Connector 90°	Compression fitting	OD 25mm	3	no
		OD 32mm	3	no
		OD 40mm	14	no
		OD 50mm	1	no
		OD 63mm	1	no
HDPE coupling	Compression fitting	OD 32mm	7	no
		OD 40mm	71	no
		OD 50mm	33	no
		OD 63mm	19	no
		OD 90mm	13	no
HDPE ball valve	Compression fitting	OD 32mm	2	no
		OD 40mm	10	no
		OD 50mm	3	no

Name of material / equipment	Specification		Q'ty	Unit
		OD 63mm	3	no
		OD 90mm	1	no
HDPE cross pipe	Compression fitting	OD 40mm	1	no
		OD 90mm	2	no
HDPE reducer	Compression fitting	OD 32mm x 25mm	2	no
		OD 40mm x 25mm	3	no
		OD 40mm x 32mm	3	no
		OD 50mm x 25mm	1	no
		OD 50mm x 40mm	3	no
		OD 63mm x 32mm	1	no
		OD 63mm x 40mm	3	no
		OD 63mm x 50mm	2	no
		OD 75mm x 50mm	1	no
		OD 90mm x 63mm	5	no
		OD 90mm x 75mm	1	no
PVC straight pipe	Thread、L=3m	DN 1"	1	no
T shape pipe	PN10	DN 1-1/2"	27	no
		DN 4"	1	no
	PN16	DN 1"	1	no
		DN 3"	1	no
Adapter (with internal thread)	Compression fitting	25mm x 1"	2	no
		32mm x 1-1/2"	1	no
		40mm x 1-1/2"	17	no
		50mm x 2"	1	no
Adapter (with internal thread)	Compression fitting	25mm x 1"	1	no
		40mm x 1-1/2"	17	no
		50mm x 2"	2	no
		90mm x 4"	1	no
Elbow	PN10	DN 1-1/2"	65	no
		DN 4"	8	no
		DN 3"	3	no
	PN16	DN 3"	4	no
Gate valve	PN10, flange	DN 4"	2	no
	PN16, flange	DN 3"	1	no
	PN10, thread	DN 1-1/2"	14	no
Socket	PN10	DN 3/4"	78	no
Nipple	PN10	DN 1-1/2"	40	no
		DN 2"	1	no
		DN 4"	4	no
	PN16	DN 1"	4	no
		DN 1/2"	1	no
		DN 1-1/2"	1	no
		DN 3"	9	no
Flange with external thread	PN10	DN 4"	4	no
	PN16	DN 3"	2	no
Ball valve	PN16	DN 1"	1	no
		DN 1/2"	1	no
Union	PN10	DN 1-1/2"	13	no
		DN 2"	1	no
		DN 4"	2	no
	PN16	DN 3"	4	no
Check valve（abnormal pressure release device attached）	PN16, flange	DN 3"	1	no
Air valve	PN16	25mm	1	no
	PVC、1" connection	DN1"	6	no
Water tap		DN 3/4"	78	no

Name of material / equipment	Specification		Q'ty	Unit
Cross pipe	PN10	DN 1-1/2"	26	no
Water meter	PN10, flange	DN 4"	1	no
	PN16, flange, Maxflow 10m3/hr	DN 3"	1	no
	PN10, thread	DN 1-1/2"	13	no
Reducer pipe	PN10	DN 1-1/2" x 3/4"	65	no
	PN16	DN 1"x 1/2"	1	no
		DN 1-1/2"x 1"	1	no
		DN 3"x 1-1/2"	1	no
Compound pressure gauze	Max pressure 20bar	DN 1/2"	1	no
Elevated tank	H shape	UB-161.8x154.4x8.1×11.5	3.744	t
		UB-259.6x147.3x7.3×12.7	3.294	t
		UB-467.4x192.8x11.4×19.6	2.382	t
	Bolt	φ12	36	no
	Steel plate	t=10mm	5.202	t
		t=12mm	0.104	t
	Checker plate	t=2.3mm	0.355	t
	Water tank	100 ㎥	1	no
	L shape	L-120x120x15	9.432	t
		L-40x40x3	0.458	t
		L-50x50x3	0.079	t
		L-70x70x10	3.381	t
		L-90x90x12	0.849	t
	Flat bar	30mm×3mm	0.071	t
	Channel	[-152.4x76.2×6.4×9	0.386	t
		[-304.8x101.6×10.2×14.8	1.050	t

3) Other Facilities

Other layouts of the facilities are shown below.

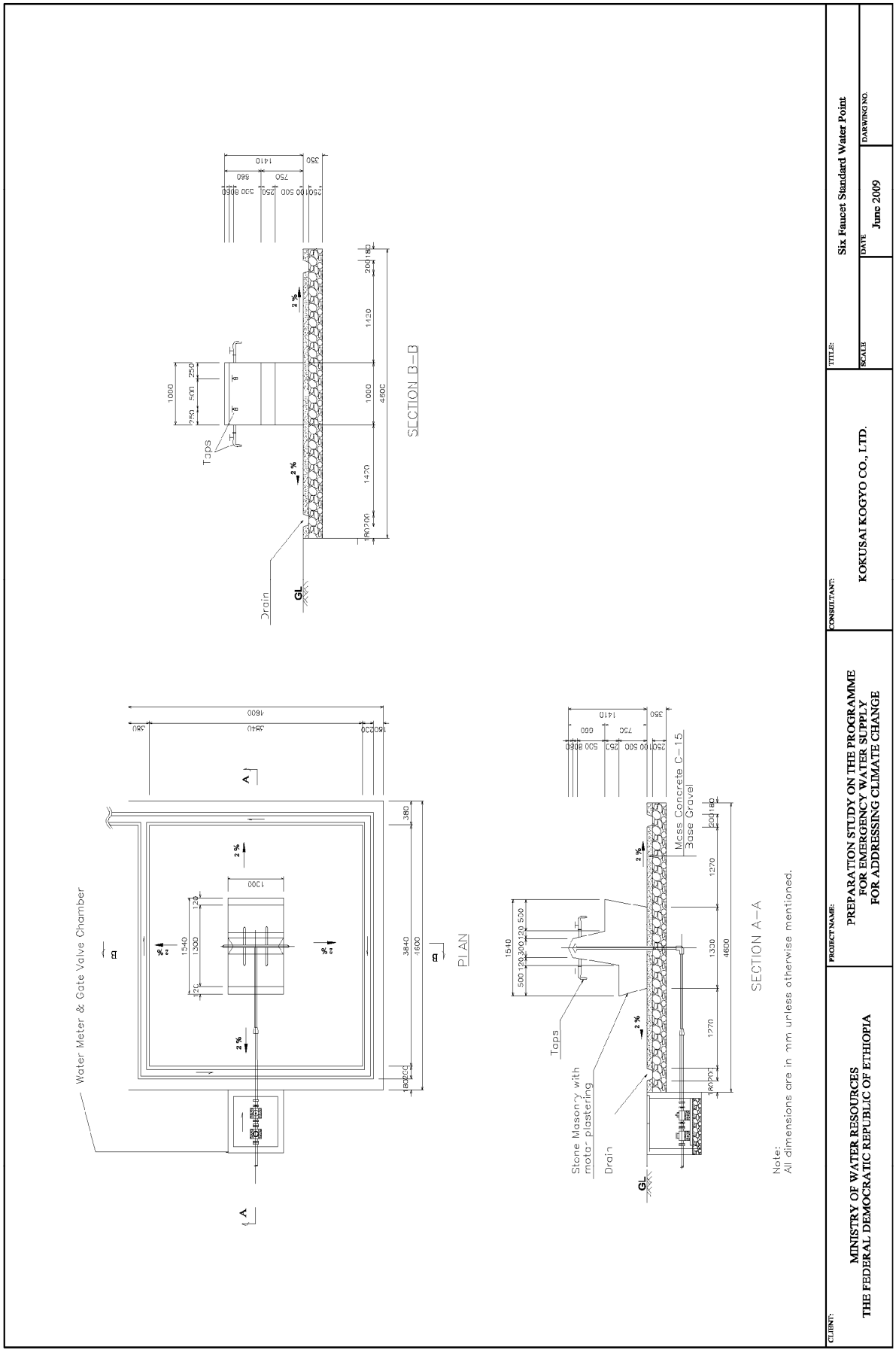


Figure 2-9: Six Faucet Standard Water Point

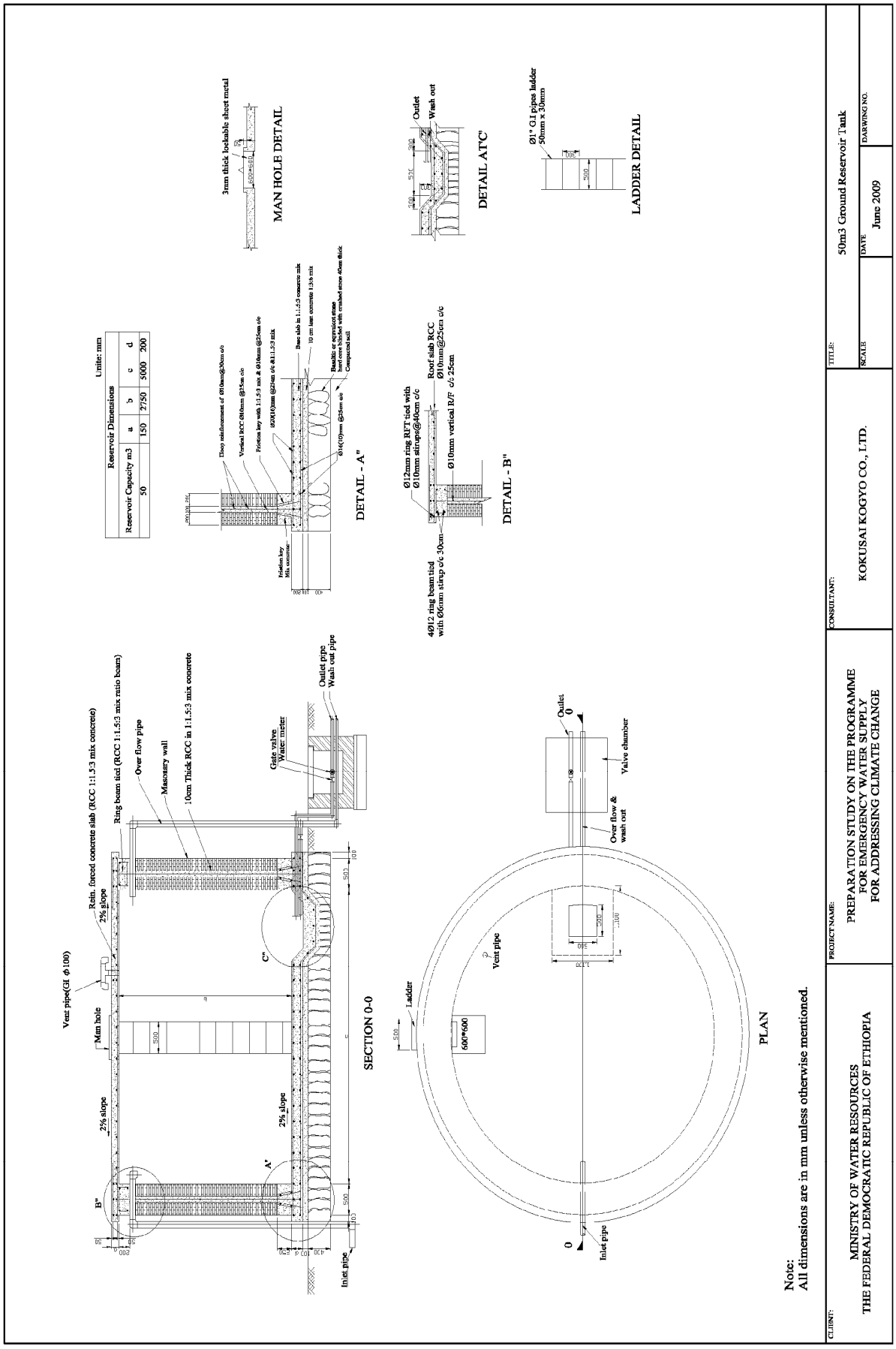


Figure 2-10: $50m^3$ Ground Reservoir Tank

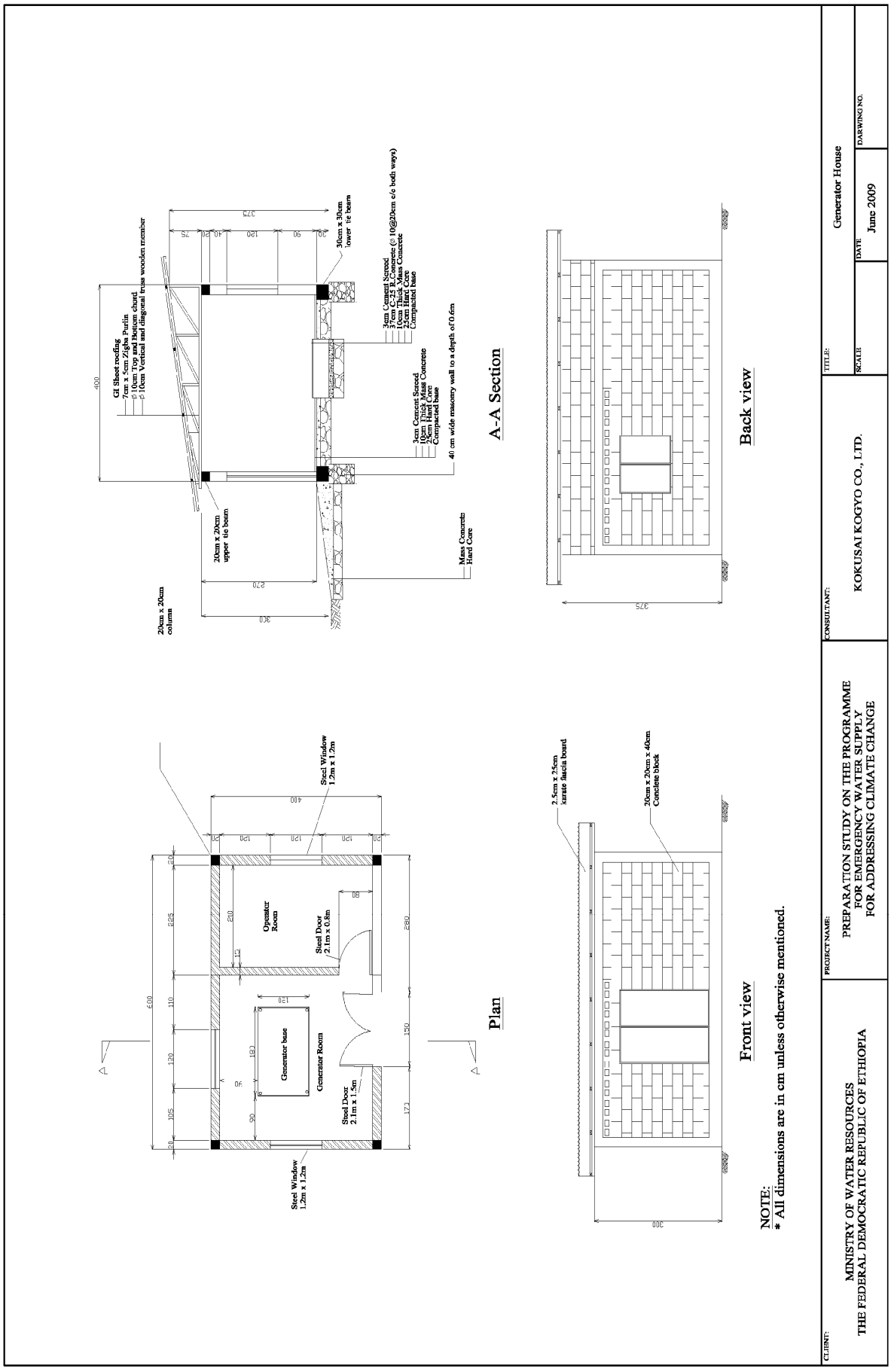


Figure 2-11: Generator House

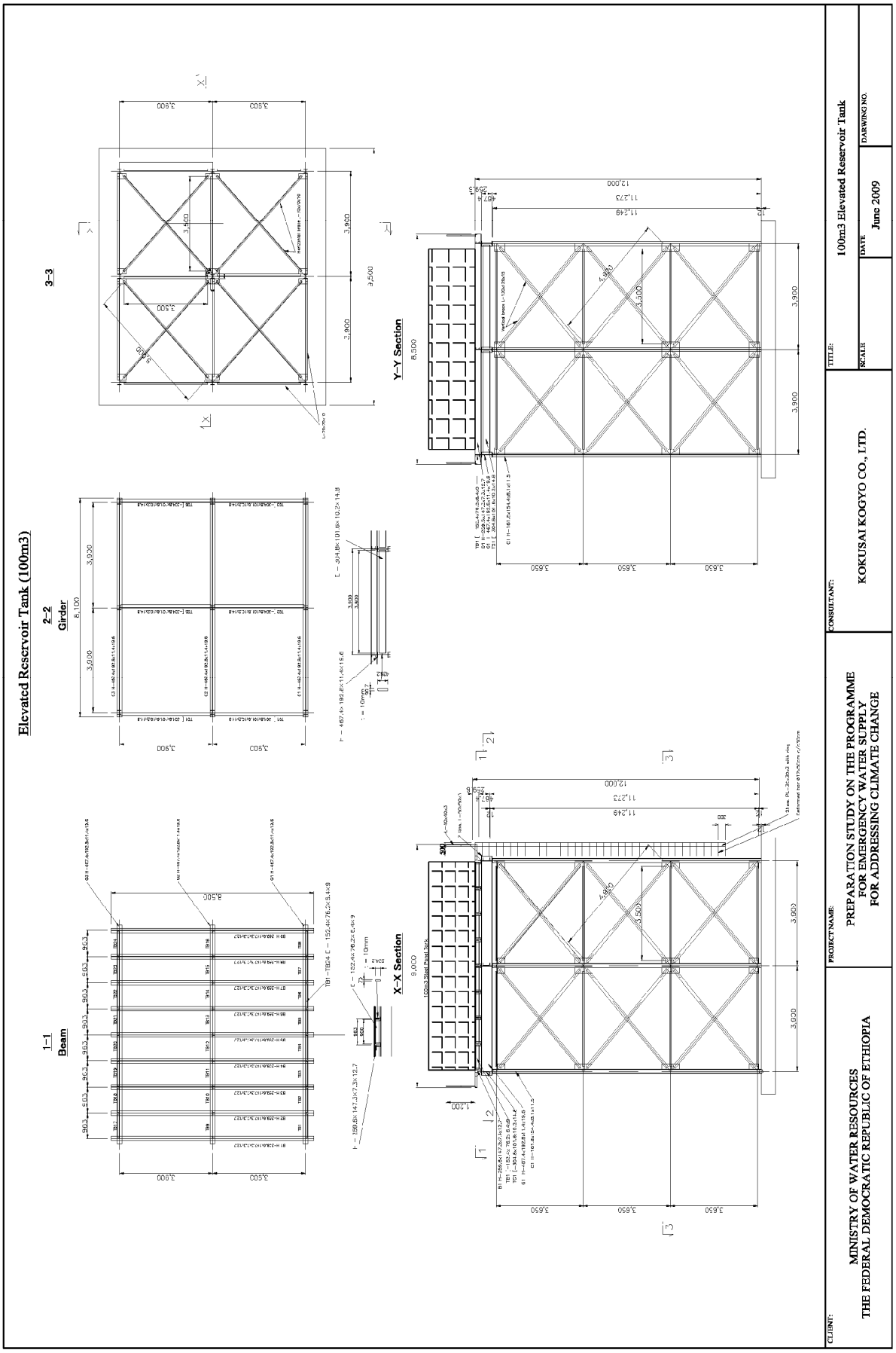


Figure 2-12: 100m^3 elevated Reservoir Tank

2-2-2-7 Equipment for Borehole Maintenance

(1) Examination of Appropriateness

Study results of necessity and appropriateness are described in Table 2-57.

Table 2-57: Examination of Necessity and Appropriateness (Equipment for borehole maintenance)

Region	Necessity	Points of Examination on Appropriateness	Study Results
Somali (Service rig)	There are many wells in the Somali Region, with support from DFID and others. However, half of the wells are not used. Excluding salt water wells and dry wells, 23% of deep wells could be changed to production wells. For this reason, the Somali regional government requested a service rig. Repairing of wells could well be less costly and has shorter working period.	• If the present status of all the well is known to the regional government	• There is an inventory list of all wells in Somali Region. According to the list, 169 wells among 393 wells are not functioning due to the depletion of water, decreasing of water level, etc. The regional government has clear target wells and knowledge on present status of the wells.
		• If the organization (operator) has sufficient skill for the operation	• There is well construction going on in the region, and the government has the expertise.
		• If there is a system of operation and maintenance established	• Water Resources, Mine, and Energy Development Dept. of Somali Regional Government own machinery besides rigs. There is an O&M system established within the Regional Government. It is considered that the procurement is appropriate.
Somali (Mobile workshop)	There is a necessity for a mobile workshop, which is a specialized truck equipped with maintenance tools for operation and maintenance works in remote areas.	• If there is clear purpose or plans of its utilization	• There is no clear idea of necessary tools and the quantity, and target wells in the regional government.
		• If the organization (operator) has sufficient skill for the operation	• It is not directly related to measures for disasters caused by climate change.
		• If there is a system of operation and maintenance established	• Water Resources, Mine, and Energy Development Dept. of Somali Regional Government own machinery besides rigs. There is an O&M system established within the Regional Government. This item is excluded from the procurement list because it is not directly related to the purpose of this programme.

(2) Specifications

1) Service Rig and Tools

Service rig is used for rehabilitation of the existing wells. Necessity of rehabilitation of the existing

wells is becoming important in recent years; in the Somali Region, there is a rehabilitation plan of unusable wells. Depth of most existing wells in Somali Region are less than 200 m; and there are large diameter casing, too. A service rig, to be procured, is given its maximum capacity, 200 m; the maximum diameter, 8 inches.

2) Specification of the Vehicle

Since the service rig needs to be effective and efficient, the following components are to be equipped: Main drum winch, sand reel, mast, air compressor, generator, water pump, an oil pressure jack, etc. The engine is highland type (maximum at EL. 2,500m), and the drive train is either 6 x 4, or 4 x 4.

3) Equipment for Well Rehabilitation

Equipment of the service rig should correspond to the Ethiopian rehabilitation method. The common practices done in Ethiopia for rehabilitation of the well are: air lifting, bailing, brushing, and jetting. The service is to be able to fit for following diameters: 4, 6, and 8 inches.

4) Compressor for Air Lifting

Capacity of the compressor is determined by Compressor Utilization Diagram (Figure 2-10), shown in *Development of Hot Spring and Management* (1996) Chijinshoikan, since the principle of compressor is the same.

Lifting distance (H) and submerged depth of air pipe (Hs) can be read from Figure 2-14 as follows.

H =80 m
Hs=80 m

When,

Average static water level : GL – 30 m
Lifting distance : 80 m
Minimum submergence ratio : 50 %

Necessary volume of air is shown Qa=8 (m^3/min.) in the diagram, by a drawing a line straight up from the crossing point of a line, H: 80m, and a downward curve of submergence rate, 50%.

Provided: Necessary air volume, Qa, is pumping up of groundwater at rate of 1 (m^3/min)。

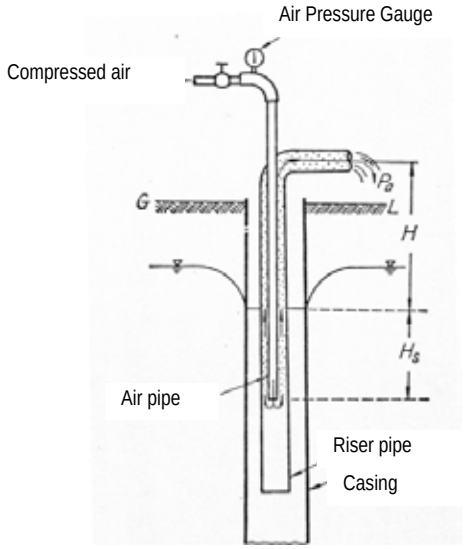


Figure 2-13: Mechanism of Central Air Pipe

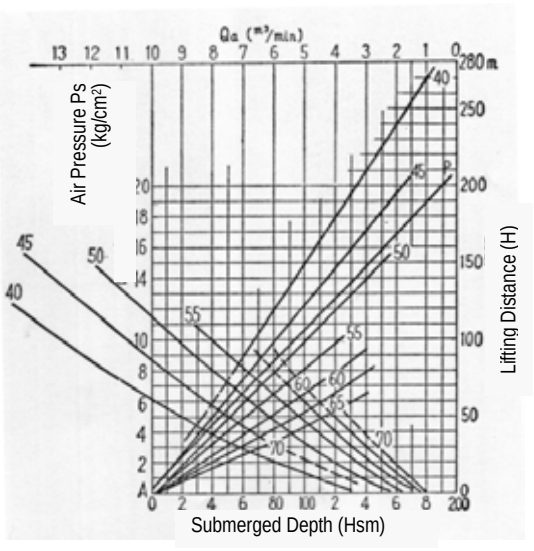


Figure 2-14: Air Compressor Utilization Diagram

Air pressure necessary for withdrawing water of amount Qa is calculated by the equation below.

$P = (Hs/10) + (0.2 - 0.5)$

When P: Air pressure necessary (kg/cm^2)
Hs: submerged depth of an air pipe (m)

Air pressure necessary (P) is 8.2 – 8.5 kg/cm^2, since the submerged depth (Hs) is 80m.

5) High Pressure Pump for Jetting

Capacity for high pressure pump, commonly used for jet wash, is 2.0 MP, and the flow rate is 200 litres/min. It is mounted on a truck for mobility.

6) Support Vehicle of Service Rig

Support vehicles for rehabilitation works will be the vehicle with a crane owned by the water resources department. There is no plan of procurement of a support vehicle for the service rig.

(3) Quantity of Procured Equipment

Quantity of procurement is summarized in Table 2-58.

Table 2-58: Well Maintenance Equipment (Somali)

Name	Specification	Quantity
Service Rig	(1)Truck Steering: position : Left side Drive train : 4×4 or 6×4 Engine type: Liquid cooled diesel Total weight: over 20 tons Engine: capable of operation at EL. 2,500 m (2) Power source	1 set

Name	Specification	Quantity
	Truck engine (Power train Operations: PTO) via fluid system (3) Mast The work space : more than 9m Hook : Maximum Load over 49 kN (5000 kg) (4) Machine parts 1) Hoisting reel 2) Sand reel 3) Tool box (2) 4) Jack 5) Anchor	
Tools	Air lifting tools (well diameter 4", 6", and 8") Brushing tools (well diameter 6" and 8") Jetting tools(well diameter 6" and 8") High pressure pump Accessories	1 set
High pressure compressor	Power train: Diesel generator Blow air volume capacity: more than 8.5 m^3/min Blow pressure capacity: more than 1.0 Mpa (10 kgf/cm^2)	1

2-2-2-8 Summary of Procurement Equipment List

Equipment to be procured in this programme is shown in Table 2-59.

Table 2-59: List of priority equipment to be procured

No	Equipment Name	Unit	Total		Tigray		Oromia		Afar		Amhara		Somali		SNNP	
			Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result
A. Deep well drilling equipment																
A.1-1	Drilling rig (300m)	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.1-2	Accessaries for the above Rig	Ls	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.1-3	High pressure Air compressor with Truck	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
A.2	Cargo truck with crane (3t rifting)	Unit	2	2	1	1	1	1	-	-	-	-	-	-	-	-
B. Emargency water supply equipment																
B.1	Water purification chemicals (per 1,000 pcs)	Box	4,800	5,422	700	718	1,100	1,008	500	630	1,000	1,134	600	924	900	1,008
B.2	Water tank truck (6m3)	Unit	-	4	-	1	-	-	-	1	-	-	-	1	-	1
B.3	Water tank truck (15m3)	Unit	10	9	5	1	2	5	1	1	-	-	1	1	1	1
B.4	Movable Water Purifier（8,000 litre/hr）	Unit	26	46	2	12	5	2	5	7	5	5	5	7	4	13
B.5	Movable Water Purifier（12,000 litre/hr）	Unit	26	31	2	8	5	3	5	1	5	6	5	5	4	8
B.6	Plastic tank (5m3)	Unit	120	106	20	17	20	16	30	15		27	30	14	20	17
	For water tank truck	Unit		36		4		13		8		0		6		5
	For movable water pulifier	Unit		70		13		3		7		27		8		12
B.7	Plastic tank (10m3)	Unit	120	106	20	17	20	16	30	15		27	30	14	20	17
	For water tank truck	Unit		36		4		13		8		0		6		5
	For movable water pulifier	Unit		70		13		3		7		27		8		12
C. Disaster control equipment																
C.1	Bulldozer (10t)	Unit	2	0	-	-	-	-	1	-	-	-	1	-	-	-
C.2	Bulldozer (20t)	Unit	-	1	-	-	-	-	-	1	-	-	-	-	-	-
C.3	Heavy equipment transport vehicle	Unit	-	1	-	-	-	-	1	1	-	-	-	-	-	-
D. Equipment and materials to expand the facility for practical application of production wells in drought-affected areas																
D.1	Material for water supply facility construction A	Ls	1	1	-	-	-	-	-	-	-	-	-	-	1	1
D.2	Material for water supply facility construction B	Ls	1	1	-	-	-	-	-	-	-	-	-	-	1	1
D.3	Material for water supply facility construction C	Ls	1	0	-	-	-	-	-	-	-	-	-	-	1	-
E. Service rig																
E.1-1	Service Rig	Unit	-	1	-	-	-	-	-	-	-	-	1	1	-	-
E.1-2	Tools the above service rig	Ls	-	1	-	-	-	-	-	-	-	-	1	1	-	-
E.2	Mobil work shop	Unit	-	0	-	-	-	-	-	-	-	-	1	-	-	-

Table 2-60: List of Backup equipment to be procured

No	Equipment Name	Unit	Total		Tigray		Oromia		Afar		Amhara		Somali		SNNP	
			Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result	Request	Result
B. Emargency water supply equipment																
B.2	Water tank truck (6m3)	Unit		6		3		0		0		0		1		2
B.3	Water tank truck (15m3)	Unit		8		3		2		0		0		2		1
B.6	Plastic tank (5m3)	Unit		31		10		5		0		0		8		8
	For water tank truck	Unit		31		10		5		0		0		8		8
B.7	Plastic tank (10m3)	Unit		31		10		5		0		0		8		8
	For water tank truck	Unit		31		10		5		0		0		8		8

2-2-3 Implementation Plan

2-2-3-1 Implementing Policy

(1) Basic Items

Exchange of notes (E/N) on Japan's Programme: Grant Aid for Environment and Climate Change is concluded by agreement of the Japanese government and the Ethiopian government through the Cabinet decision in Japan on April 23, 2009.

Based on the E/N, the programme enters into an implementation phase. The Ministry of Finance and Economic Development, which manage implementation organization of Ethiopia side, enters into contract with the proxy organization for procurement by the Japanese government, on procurement management and tender management on April 24, 2009.

(2) Equipment Procurement

The procurement agent will prepare tender documents, which include specifications of the machinery, based the information provided by the preparatory survey report, specifications for machinery (draft), and tender document (draft). The procurement agent will submit list of the procurement equipment and the tender documents to the Ethiopian Committee, chaired by Ministry of Finance and Economic Development; and obtain approval.

(3) Tender

- The tender is preceded in accordance with the Procurement Guidelines of Japan's Programme Grant Aid for Environment and Climate Change (hereinafter referred to as "the guideline").
- The qualifications of bidders for machinery procurement tender are given to all companies which comply with the guidelines, and not restricted by their nationalities: they will be open competitive bidding.
- The procurement agent will make public announcements, conduct tenders, and evaluate quotations on be half of the implementation agency of the Ethiopian government.
- The procurement agent will make a contract with a bidder with the lowest price, with the approval of JICA upon the approval of the committee, by making a tender evaluation report on the results of the bidding and evaluation of the quotations.
- In case remainder occurs as a result of the bidding, additional procurement will be made. The procurement agent will make selection from the procurement list based on this report; and will receive approval from the committee.
- The additional procurement will be continued until the remainder reaches less than 3% of the E/N amount.
- The proxy agency shall return the remainder if it becomes less than 3% of the E/N amount.

2-2-3-2 Implementation Conditions

(1) Securing Budget of Construction Fee

Division of the Japanese government and the Ethiopian government on procurement and installation works are shown in Table 2-61. The Ethiopian government must secure budget for construction of the extension facilities before the construction materials are procured.

(2) Acceptance of the Equipment

Equipment is delivered to the respective water resources department of the regions; however, if public security deteriorates in the proximity of the water resources department, or along the course of delivery, the equipment is delivered to another appropriate location. At present, deliveries are made to the water resources department.

2-2-3-3 Scope of Works

Division of the Japanese government and the Ethiopian government on procurement and installation works are shown in Table 2-61.

Table 2-61: Division of Responsibility on Procurement and Installation

Type of Responsibility	The Japanese side	The Ethiopian side
Procurement of Equipment		
Procurement of the equipment	○	
Construction works		
Construction works of water facilities (laying distribution pipes, distribution pond, machine house building)		○
Technical Cooperation		
Initial operation training, technical support	○	
Others		
Securing of storage space and building of procured equipment		○
Delivery of the equipment to users, implementation agency from the ministry		○
Prompt processing of customs clearance and other procedures		○
Waiver of tariffs on the procured equipment (budgetary measure)		○
Appropriate operation and maintenance of the equipment		○

2-2-3-4 Procurement Agency Supervision

This programme is conducted in accordance with Japan's Programme: Grant Aid for Environment and Climate Change. The Ministry of Water Resources of Ethiopia enters into contract with the proxy organization, which the Ministry of Foreign Affairs of Japan recommends, for procurement by the Japanese government, on procurement management and tender management.

Procurement of the machinery is conducted by the procurement agent. The procurement agent and dealers of the equipment will dispatch management staff shown in Table 2-62.

Table 2-62: Tender Management/ Control of Procurement Management

Division	Control and Management staff	Number	Responsible Work	Dispatched period
*Tendering management／ *Procurement management (procurement proxy agency)	Manager	1	Overall management of the programme (procurement and tendering)	Spot
	Tender procedure management	1	Management of tendering process	Spot
	Tender documents making	1	Making of tender documents and reports	―
	Procurement management	1	Management of procurements	Spot
	Budgetary management	1	Financial management	Spot
Management of procurement (dealers of procured equipment)	Management of procurement	1	Delivery, initial training	Spot
	Inspection engineer	1	Inspections of the equipment	―

2-2-3-5 Quality Control Plan

The procurement proxy agent shall confirm design drawings for assembly materials, before procuring the equipment if necessary. For machinery requires manufacturing, inspections shall be done at the factory before delivery. For equipment procured in Japan, the third organization inspections will be conducted proper to shipping. The procurement agent shall attend inspections done by the government of Ethiopia, when they are carried in to Ethiopia.

2-2-3-6 Procurement Plan

(1) Method of Procurement

All the equipment selected by this programme shall be able to receive after services. Procurement agents shall be limited to the company, who is cooperated with dealers of manufacturers or its local agency; however, expendable materials are not limited to the above clause.

(2) Procurement plan for spare parts and consumables

Spare parts of the trucks and other widely used equipment are not necessary, and shall not be procured because the parts are available from the agent or contract dealers of the manufacturers. Quantities for one year of spare parts are procured for special equipment; and, amount of one year consumption of chemical additives for portable water purification plant shall be procured. Spare parts to be used in and after the second year shall be procured by the Ethiopian side.

Table 2-63: Procurement plan of spare parts and consumables

Division	Name of Equipment	Spare Parts	Consumables
Groundwater development equipment	Drilling Rig (300m class)	○	
Emergency water supply equipment	Portable water purification plant		○
Disaster prevention machine	Bulldozer (20 ton class)	○	
Maintenance Equipment	Service Rig	○	

(3) Transportation and Packaging Plan

In order to keep transportation costs down, delivery method from third countries and Japan is to be by ship, in principle.

1) Equipment Procured from Japan or Third Country

The procured equipment is delivered by land to the water resources department of each region after the cargo was disembarked. Equipment procured in third countries and in Japan is loaded on regular cargo ships at the respective international ports and disembarked at Port of Djibouti. The equipment is then transported by land from Djibouti to the water resources departments of respective regions via Addis Ababa.

It takes 4 to 9 weeks for shipping, one week to disembark and loading on to the trucks at Djibouti, and one day for land transportation to Addis Ababa. The equipment is then sent to each region by truck. The total duration required for transportation from a third country or from Japan is 6 to 11 weeks approximately.

2) Equipment procured in Ethiopia

The equipment procured from the local factories is delivered to the water resources department of respective regions. The time required for the delivery is one to 5 days at the maximum.

2-2-3-7 Operational and initial guidance plan

(1) Installation Work Plan

There is no installation work needed for this programme.

(2) Initial Adjustment and Commissioning

Equipment that requires initial adjustment and commissioning are drilling rig, high pressure compressor, crane cargo truck, water supply truck, portable water purification plant, bulldozer, heavy machine transporter, and service rig. The necessary duration of initial adjustment for each machine is ranging from a few hours to a half day.

Initial training shall be conducted for each machine, and hours for initial adjustment and operation shall be included in the training session.

(3) Training for Initial Operation and General Operation Plan

Procurement agency will conduct initial operation training for the procured machinery. The participants to the training sessions are operators for the respective machinery, at water resource department in each region, in principle. If security is not confirmed, other venue will be chosen through discussion with the user organizations.

Table 2-64 is a list of the machinery with training sessions planned.

Table 2-64: Equipment Requiring Operation Guidance and Initial Practices

Name of Equipment		Tigray	Oromia	Afar	Amhara	Somali	SNNPR
A.1	Well drilling rig + tools	○	○				
A.2	Crane mounted truck	○	○				
B.2	Water tank truck ($6m^3$)	○		○		○	○
B.3	Water tank truck ($10m^3$)	○	○	○		○	○
B.4	Portable water purification plant (8,000 litre/hr.)		○	○	○	○	○
B.5	Portable water purification plant (12,000 litre/hr.)	○			○	○	○
C.2	Bulldozer (20 ton-class)			○			
C.3	Heavy machine transporter			○			
E.1	Service rig					○	

(4) Operation Guidance and Practice Plan

There is no machinery that requires try out or tune up.

(5) Inspection and Receiving Plan

Since there are number of modified vehicles, verification is important. The following inspections shall be conducted: drawing, factory, before delivery, and before loading. Inspection by the user organization will also be conducted.

2-2-3-8 Soft Component (Technical Assistance) Plan

1) Technical Cooperation and Difficulty of Training

Basically, technical assistance is necessary for all the equipment for their long term and effective usage. Table 2-65 shows subject, difficulty of the training, time required, and necessity of attendance of an expert.

Table 2-65: Subject and Difficulty of Trainings

	Equipment		Difficulty	Items and components
A	Equipment for drilling	Drilling rig, crane truck, compressor (set), (100-300m)	High	Instruction for O&M of the rig (Training on operation and maintenance by the agent of procured rig at the site is necessary)
B	Equipment for emergency water supply	Water purification chemicals (1,000Bags/box)	Low	Instruction for how to use the machines (Explanation by the dealer of procured chemical can meet the need)
		Plastic tank for water storage (5-10m^3)	Low	Instruction for O&M of the machines (Explanation frequency of the clean up by the agent of procured machine can meet the need)
		Water tank truck (5-15m^3)	Relatively high	Instruction for O&M of the trucks (Explanation on operation and maintenance by the agent or contract agency of procured truck can meet the need)
		Portable water purification plant	Relatively high	Instruction for O&M of the water purifying machine (Explanation on operation and maintenance by the agent of procured water purifying machine can meet the need)
C	Equipment for Flood Management	Bulldozer (20 tons)	Relatively high	Instruction for O&M of the bulldozer (Explanation on operation and maintenance by the agent or contract agency of procured bulldozer can meet the need)
		Heavy equipment transport vehicle	Relatively high	Instruction for O&M of the heavy equipment transport vehicles (Explanation on operation and maintenance by the agent or contract agency of procured heavy equipment transport vehicle can meet the need)
D	Equipment for Water Supply Facilities	For utilization of wells by extension them in drought affected area	–	Since only construction materials are procured for this programme; and, the technical training is not necessary.
E	Equipment for Borehole Maintenance	Service rig and associated tools	High	Instruction for O&M of the rig (Training on operation and maintenance by the agent of procured service rig at the site is necessary)

2) Relativity of Technical Cooperation

Relativity of technical cooperation, described above, is summarized in Table 2-66, by their difficulty and nature of the component.

Table 2-66: Component of Technical Cooperation (tentative)

	Difficulty Low → High
Soft Component Activities	Beginners Training, Maintenance etc.
Technical Cooperation	On the job training

3) Technical Cooperation in this Programme

Although it is necessary to provide guidance on operation for water supply trucks and movable water purification trucks, respective provinces have the expertise of procurements of similar machines, and explanation on initial operation by the dealer agents are sufficient.

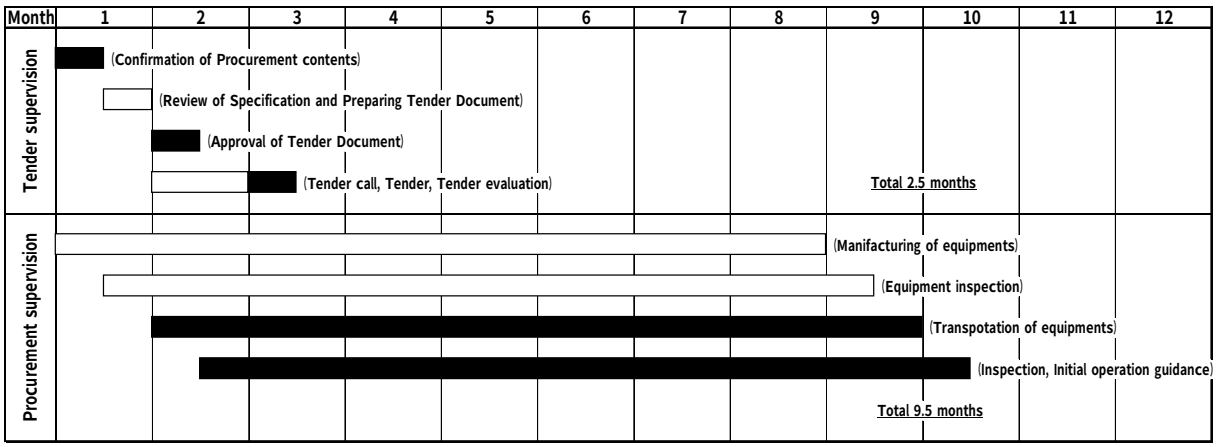
There is a training centre in the Road Department, which is built by technical cooperation project, for bulldozer operation. The bulldozer operation staff can be trained in the training centre.

Operation training on drilling rig and the accessories can be provided in the curriculum of EWTEC and instructions by dealer agents; therefore, training programs and technical cooperation programmes shall not be planned in relation with this programme.

2-2-3-9 Implementation Schedule

The implementation schedule is given below.

Table 2-67: Implementation Schedule



2-3 Obligations of Recipient County

2-3-1 Specific Items for this Programme

The following special items are required to be undertaken by the Ethiopian side when carrying out the Japanese Grant Aid scheme.

1) To secure salary for personnel who will be assigned to the Programme

2) To attend equipment inspection

3) To strengthen the monitoring system for operation and maintenance

2-3-2 General Items

In the implementation of Japan's Programme Grant Aid Scheme, the recipient country is required to undertake certain measures, as follows:

1) To ensure prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.

2) To exempt from customs duties, internal taxes and other fiscal levies, this will be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.

3) To accord agent whose services may be required in connection with the supply of the products and services under the verified contracts, such facilities that may be necessary for their entry into the recipient country and stay therein for the performance of the work.

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

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

2-4 Programme Operation Plan

(1) Basic Concept

The Ministry of Water Resources holds the ownership for the procured equipment, and users of procured equipment are each regional water bureau. Moreover, each regional water bureau has agreed to bear operation and maintenance cost for procured equipment.

Since equipment with low frequency of daily usage, such as disaster control, is also contained in procured equipment, a monitoring system shall be established in order to grasp how it is utilised and maintained, and to prevent its utilisation for other purposes.

(2) Operation and Maintenance Structure

Since the management section for the equipment already exists in each regional water bureau, water works and construction enterprises under the regional water bureau which are end users of the procured equipment and they have experience in management of similar equipment related to water supply. Therefore it is not necessary to newly build or re-organize a management system for proper operation and maintenance.

(3) Monitoring System

As mentioned in the basic policy, since equipment with low frequency of usage in daily are contained in procured equipment. Therefore in order to understand the situation of usage and management, the monitoring system shall be established.

The monitoring system is made based on the monitoring sheet in Table 2-68, and each regional water bureau shall submit it to the Ministry of Water Resources once a year, which shall then submit these monitoring sheet to the JICA Ethiopia office once a year. Monitoring will be carried out for a period of five (5) years after handover of the equipment. A monitoring flow is shown in Figure 2-15.

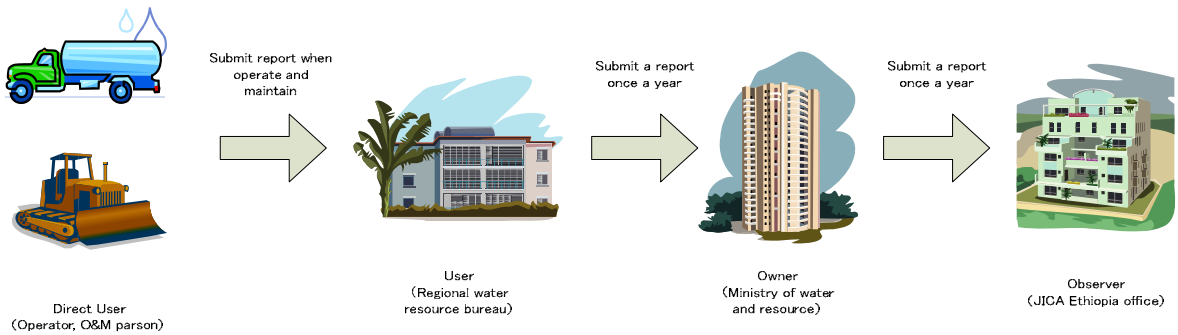


Figure 2-15: Monitoring flow

Table 2-68: Monitoring sheet (Draft)

EQUIPMENT OPERATION AND MAINTENANCE RECORD

Organization Name _____ **Type of equipment** _____

Year: _____

Jan. / Feb. / Mar. / Apr. / May / Jun. / Jul. / Aug. /Sept. /Oct. / Nov. / Dec.

Operated Record

End hour meter (hrs)	Total hour meter month (hrs)	

Date from to	Project name	Location	Type and Depth of Borehole	Numbers
-				
-				
-				
-				
-				
-				
-				
-				
-				
-				
-				
-				
-				
-				

Maintenance record

Type of Maintenance	Date	Remarks
Regular · Repair		
Regular · Repair		
Regular · Repair		
Regular · Repair		
Regular · Repair		
Regular · Repair		
Regular · Repair		

	Date	Name	Signature
Recorded by driver			
Checked by head of office			
Authorized by organization principl			
Authorized by MoWR			

2-5 Programme Cost Estimation

2-5-1 Initial Cost Estimation

(1) Obligation of Ethiopian side

The following cost shall be born by the Ethiopian side.

15,501,500 Birr （Approximately 136.41million JPY）

Description	Amount (Birr)
Bank commission (Transfer from Ethiopian account to Agent account)	45,500
Internal Tax (VAT)	13,636,000
Construction fee for Water Supply Scheme (SNNPR)	1,820,000
Total	15,501,500

Note: VAT amount is estimated 15% of procurement cost. If VAT will exempt, the cost shall not be required.

(2) Condition of Cost Estimation

1) Time of Cost Estimation

Programme cost was estimated in May 2009 when the field survey of the Preparatory Survey was completed.

2) Exchange Rate

Programme cost was calculated using average rate in six months from November 1, 2008 to April 30, 2009.

$1US＝95.78Yen, 1Birr＝9.00Yen

3) Schedule for equipment procurement

Schedule for equipment procurement is shown in 2-2-3-9 Implementation Schedule.

4) Others

Programme cost was estimated according to the Guideline of Japanese Grant Aid.

2-5-2 Operation and Maintenance Cost

2-5-2-1 Operation and Maintenance Cost

(1) Drilling rig and associated tools

Required maintenance cost for the equipment should be included in the well construction cost (Ethiopian own project budget). Therefore maintenance cost shall not be required by the each regional

water resource bureau.

(2) Water tank truck

Operational cost for water tank truck is shown as below. Cost estimation was carried out based on the conditions below.

- Travelling distance per day 100 km (average from the hearings)
- Km per hour 20 km/hr (6,000 litre truck), 15km/hr (15,000 litre truck）
- Fuel consumption ratio 0.05 litre/kwhr
- Engine power 154kw (6,000 litre truck), 272kw（15,000 litre truck）
- Working day per year 1 year×70%＝250 days
- Maintenance repair rate, Basic values for the equipment 45%÷11year＝4.1%、4.53 million Japanese yen (6,000 litre), 12.1 million Japanese yen (15,000 litre)

※ Fuel consumption ratio, maintenance repair rate and basic values for the equipment is based on the rent tables, such as construction machinery in the 2009 fiscal year by Japan Construction Mechanization Association.

Fuel consumption of the water tank truck (6,000 litre) per day is calculated

100 km/ day/ 20km/ hr × 154kw× 0.05 litre/ kwhr=38.5 litre /day

and operation costs per day is calculated

38.5 litre /day×7.00Birr/ litre＝269.5Birr/day,

and operation costs per year is calculated

269.5Birr/day×250days＝67,375Birr 0.59million Japanese yen.

Moreover, repair and consumable supplies costs are estimated

4.35 million Japanese yen×4.10% 0.18 million Japanese yen,

and maintenance cost per year is estimated

0.59 million Japanese yen＋0.18 million Japanese yen 0.77 million Japanese yen /truck,

in case that purchase expense of repair and consumable supplies is assumed 4.1% of the main body price.

In the same way, operation cost for the water tank truck (15,000 litre) is estimated

100km/15km/hr×272kw×0.05 litre /kwhr×7.00Birr/ liter×180days＝114,240Birr 1 million Japanese yen,

and repair and consumable supplies costs is estimated

12.1 million Japanese yen ×4.10% 0.50 million Japanese yen,

and maintenance cost per year is estimated 1.6 million Japanese yen/truck.

(3) Portable water purification plants

The maintenance cost offered by the equipment maker is as follows.

Operation cost for purification of 30,000 litre raw water is estimated,

Fuel cost of suction pump（gasoline）	2.74 litre	25.00 Birr
Squeeze pump	3.90 litre	35.10 Birr
Medicine of sedimentation processing （Sulphate acid aluminium）	2.5kg	14.50 Birr
Medicine for sterilization（chlorine）	0.075kg	7.00 Birr
Total		81.60 Birr

Quantity per set which can be annually purified is estimated

10,000 litre /hour/one truck × 8hours ×300days/year＝24,000,000 litre /year/one truck

in case that operating hours are 8 hours, annual operating days are 300 days, and an average of 10,000 litre per hour is purified. Therefore total operation cost per set is estimated

81.60Birr÷30,000×24,000,000＝65,280Birr/year/set.

In addition, two kinds of filters (sand, activated carbon) will be replaced about once a year, and the replacement expense of a sand filter and an activated carbon filter is 400Birr and 2,000Birr respectively.

Therefore, annual maintenance cost of portable water purification plant is estimated

65,280＋400＋2,000＝67,680Birr　0.60 million Japanese yen/set.

(4) Bulldozer

Operational cost for a bulldozer is shown below. Cost estimation was carried out based on the conditions as below.

- Fuel consumption ratio　0.175 litre /kwhr
- Maintenance repair rate　60.0%÷10years＝6.0%/year
- Machine output　152kw
- Daily operating time　7 hours/day
- Annual activity days　1 year×30%　100 days（maintenance and activity of an emergency plan）

※ Fuel consumption ratio, maintenance repair rate and basic values for the equipment is based on the rent tables, such as construction machinery in the 2009 fiscal year by Japan Construction Mechanization Association.

Annual operating cost is estimated,

0.175 litre /kwhr×152kw×7hr/day×100days×7.00Birr/ litre ＝ 130,340Birr　1.2 million Japanese yen,

and also repair and consumable supplies costs is,

19 million Japanese yen×6.0%＝1.14 million Japanese yen,

therefore, annual maintenance cost is estimated 1.20＋1.14=2.34 million Japanese yen/bulldozer.

(5) Service Rig

Required maintenance cost for the equipment shall be included in the well rehabilitation cost (Ethiopian own project budget) as the same as the maintenance cost for the drilling rig. Therefore maintenance cost shall not be bared by each regional water resource bureau.

2-5-2-2 Operation and maintenance cost in each region

Operation and maintenance cost for procured equipment in each region are shown as below.

Table 2-69: Operation and maintenance cost for procured equipment

Unit: Thousand Birr

No	Equipment name	O&M fee per year	Tigray	Oromia	Afar	Amhara	Somali	SNNP
B. Equipment for Emergency water supply								
B.2	Water tank truck (6,000 litre)	77	308	-	77	-	77	231
B.3	Water tank truck (15,000 litre)	160	640	1,120	160	-	320	320
B.4	Portable water purification plant (8,000 litre/hour)	60	720	120	420	300	420	780
B.5	Portable water purification plant (12,000 litre/hour)	60	480	-	-	360	300	480
C. Equipment for Flood Management								
C.2	Bulldozer (20t class)	234	-	-	234	-	-	-
Total (x 10 thousand yen)			2,148	1,240	891	660	1,117	1,811
Total (thousand Birr)			2,441	1,409	1,013	750	1,269	2,058

The annual revenue of each regional water bureau is classified into four items such as federal revenue, regional revenue, Grant Aid and Loan. Among the annual revenue in each regional water bureau, Grand Aid and Loan are appropriated for the implementation of the identified project, and it is not clearly defined whether these funds can be credited to this programme. Therefore, maintenance cost for procured equipment is secured by the sum total of federal revenue and Regional revenue. The annual revenue of each regional water bureau is shown below.

Table 2-70: Annual revenue of each Regional Water Bureau

unit：Thousand Birr

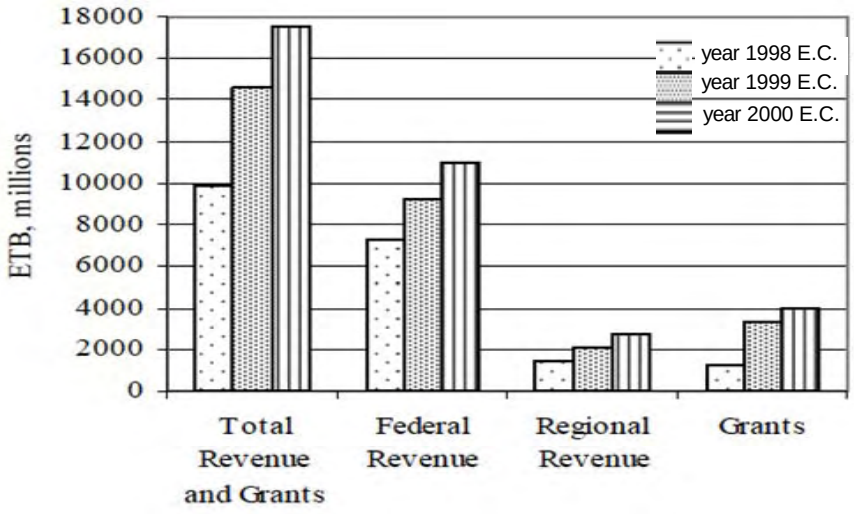
	Tigray	Oromia	Afar	Amhara	Somali	SNNP
Annual revenue	86,840	192,108	181,373	41,000	74,330	79,543
Fiscal year	2008/09	2008/09	2006/07	2007/08	2008/09	2008/09

Source：hearing survey by study team

Table 2-71: Maintained cost for the procurement of the equipment in each Regional Water Bureau to Annual revenue

Unit: Thousand Birr

	Tigray	Oromia	Afar	Amhara	Somali	SNNP
Annual revenue	86,840	192,108	181,373	41,000	74,330	79,543
O&M cost	2,441	1,409	1,013	750	1,269	2,058
O&M ratio	2.81%	0.73%	0.56%	1.83%	1.71%	2.59%



Source: Joint Budget and Aid Review Analytical Report (April 2008)

Figure 2-16: Breakdown for annual revenue (fiscal year 1998-2000 in Ethiopian calendar (E.C))

Maintenance cost for the procured equipment in each regional water bureau has become 0.56 to 2.81% of the federal revenue and regional revenue shown in Table 2-71. Moreover, federal revenue and regional revenue in each region is shown to have grown 10% or more in recent years, therefore, O&M cost for the procured equipment is judged to be sufficiently securable in each target region.

2-6 Considerations for implementing the Programme

(1) Customs clearance, tax exemption and approval of entrance into a country and stay

Although the equipment procured under the Programme Grants Aid scheme is exempted from taxation, which is borne by the recipient country, a procurement schedule may be substantially delayed due to the custom clearance or tax exemption procedure. It is necessary to take care so that these procedures may be carried out promptly and implementation schedule may not be affected.

(2) To secure construction cost for water supply facilities in SNNPR

Although equipment and materials for water supply facilities of 2 schemes in SNNPR is procured by this programme and Bureau of Finance and economic Development, SNNPR has agreed to secure the construction costs (about 16 million Japanese yen) in the next annual budget (July 2009 – June, 2010),

it is necessary to confirm a budgetary allocation before the bid for the equipment procured by this programme.

(3) Adjustment of each Regional Water Bureau by implementing agency

Although Ministry of Water Resources instead of each regional water bureau has agreed to carry out the monitoring of the procurement of the equipment and to secure the maintenance cost at the time of the field survey, this is a mandatory condition for procurement of equipment, Ministry of Water and Resources has to obtain agreement from individual regional water bureau regarding the condition of procurement of the equipment. Therefore, it is necessary to confirm the contents before the implementation stage.

Chapter 3 *Programme Evaluation and Recommendations*

Chapter 3 Programme Evaluation and Recommendations

3-1 Programme Effect

When implementing of the Programme, Programme effect is as below.

Table 3-1: Programme Effect

Current condition and problems	Programme actions / countermeasures	Direct effects and degree of improvement	Indirect effects and degree of improvement
・Difficult to secure suitable safe water for drinking in drought affected regions.	・Procurement of water tank truck ・Procurement of portable water purification plant ・Procurement of plastic tank for water storage	・The drinking water to residents can be provided to drought areas by procurement of water tank truck.	・Provided safe water for the drought damage area residence.
・AWD is widely spread due to bad water quality of drinking water source	・Procurement of water purification chemical ・Procurement of portable water purification plant ・Procurement of plastic tank for water storage	・The pond and river water can be used as a drinking water source using water purification chemicals. ・The pond and river water can be used as a drinking water source using portable water purification plant.	・Provided safe water for the AWD damage area.
・Difficult to secure of the safe drinking water for residents due to flooding.	・Procurement of water purification chemical ・Procurement of water tank truck ・Procurement of plastic tank for water storage	・The pond and river water can be used as a drinking water source using water purification chemicals. ・Provided safe water to disaster affected people	・Provided safe water for residents of flooding affected area.
・Damage has been caused frequently due to river flooding.	・Procurement of Bulldozer ・Procurement of heavy equipment transport vehicle for Bulldozer	・Dredging rivers and river bank maintenance can be managed.	・The countermeasure against flood damage can be implemented and flood damage can be reduced.
・The drinking water for residents is insufficient due to increase of population and the impact of climate change.	・Procurement of the equipment for exploratory well	・Provides safe water to an increasing population.	・The water supply rate in target area can be improved by expansion of the existing water supply facilities.
・Wells, a source of drinking water for residents, have stopped functioning due to the impact of floods and droughts.	・Procurement of Service Rig	・The function of existing wells can be recovered and safe water for residents can be provided.	・The function of existing wells can be recovered and safe water for residents can be provided.

3-2 Recommendations

3-2-1 Issues to be solved by the recipient country and recommendations

(1) To secure the budget and staff by Ethiopian side

In order to sustainably utilize procured equipment, it is very important to engage sufficient staff, and it is recommended to secure adequate staff assignment and a budget allocation.

(2) To secure safe water

Most of the equipment procured in this programme is related to the provision of safe water. This result may arise from droughts and/or floods; it is also connected with the increasing scale of disasters that decrease the water supply coverage, especially in rural areas. Therefore, it is recommended to improve water supply coverage in rural areas.

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

Currently, water supply programs are implemented based on the "Universal Access Plan" (UAP).

The WASH Project, funded by WB and AfDB, is currently being implemented. Also, international aid agencies such as UNICEF and USAID are offering assistance of disaster recovery or relief activities for disaster victims. The common feature of these assistance activities is to provide safe water to residents. It is necessary to promote cooperation between other donors in the congestion of assistance activities.