The Water Resources Bureau
The Afar National Regional State
The Federal Democratic Republic of Ethiopia

THE FOLLOW-UP COOPERATION STUDY ON THE PROJECT FOR WATER SUPPLY IN AFAR REGION IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

FINAL REPORT

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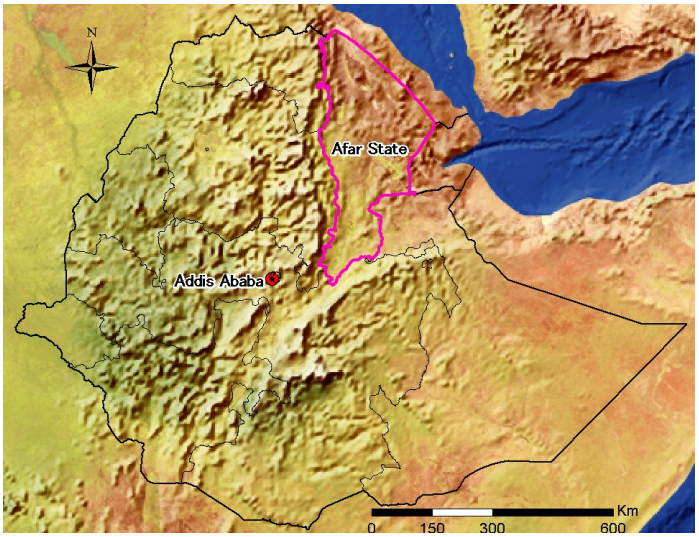

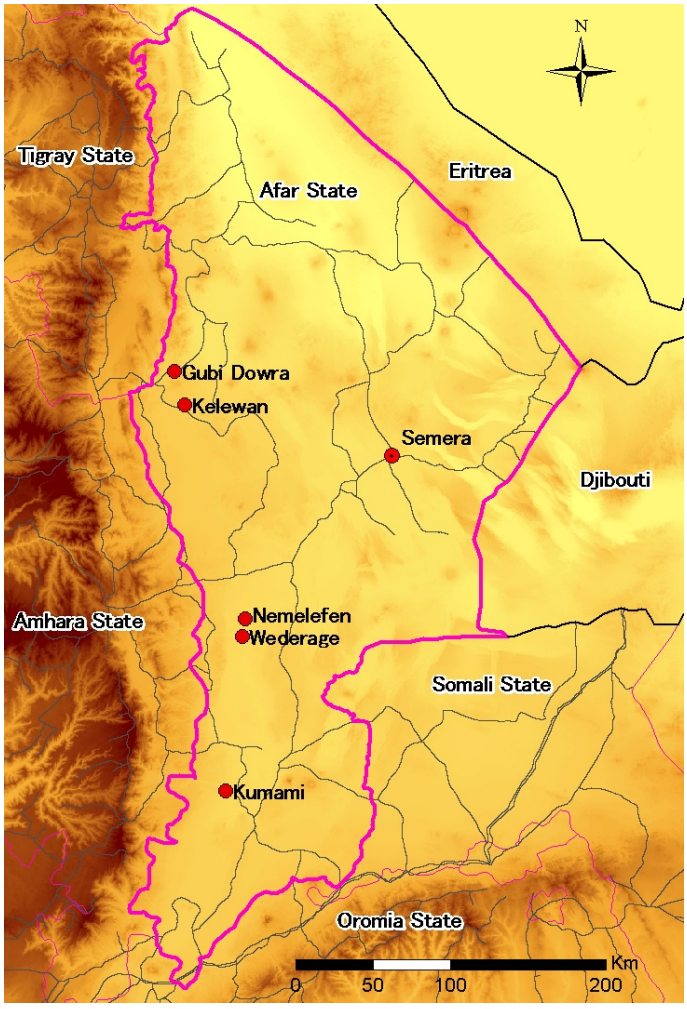

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Abbreviations

ACISDA	: Afar Community Initiative Sustainable Development Association
AWRB	: The Water Resources Bureau, the Afar National Regional State
DN	: Nominal Diameter
DWL	: Dynamic water level
EC	: Electric Conductivity
HDPE	: High density polyethylene
JICA	: Japan International Cooperation Agency
L/C	: Letter of Credit
MOWIE	: Ministry of Water, Irrigation and Energy
O&M	: Operation and Maintenance
PN	: Nominal Pressure
SWL	: Static water level
USAID	: United States Agency for International Development

1. Outline of the Project

1. Background of the Project

1-1 Background

The Federal Democratic Republic of Ethiopia (hereinafter referred to as, "Ethiopia") is a landlocked nation in the heart of what is known as "the Horn of Africa" in eastern Africa, and covers an area of approximately 1,104,000 km^2 with a population of 96.96 million (World Bank, 2014). The GNI economic indicator of Ethiopia is US$ 53.6 billion dollars, US$550 GNI per capita (World Bank, 2014).

The Afar Region, which has a population of about 1.39 million (Central Statistical Agency of Ethiopia, 2007) and is 92,371 km^2 in area, is located in the northeast of Addis Ababa and in the northwest of the Great Rift Valley. The Afar Region is regarded as one of the poorest regions in Ethiopia due to extremely severe natural conditions, and the average water supply coverage in the region was lower than the national level.

Under such circumstances, in 2001, the Government of Ethiopia made a request to the Government of Japan for a grant aid project to improve water supply conditions in the Afar Region. As a result, the Government of Japan decided to conduct the Project for Water Supply in the Afar Region as grant aid to construct water supply facilities in nine towns, which was completed in February 2010.

However, in November 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a commission to conduct the ex-post evaluation of the project mentioned above, and it was found that water supply facilities in three towns, Nemelefen, Wederage and Kumami, were not in working order. Moreover, according to the report of the JICA Ethiopia office in March 2015, there were also some problems with the water supply facilities in the other two towns, Kelewan and Gubi Dowra. Based on this information above, the Ethiopian Government made a request for follow-up cooperation to rehabilitate water supply facilities in these five towns.

In response to the request, JICA dispatched the Study team to conduct the Follow-Up Cooperation Study on the Project for Water Supply in the Afar Region (hereinafter referred to as "the Study") ,which aims to examine the conditions of water supply facilities in the five towns, and to prepare a rehabilitation plan, from November 2015 to January 2016.

1-2 Ouline of the Study

Original target sites, which were requested by the Ethiopian Government for the Follow-Up Cooperation, were based on information of malfunctioning water supply facilities. The five original sites are Gubi Dowra, Kelewan, Nemelefen, Wederage and Kumami. However, it was found in the Study that a broken generator in Gubi Dowra was replaced by the Water Resources Bureau, the Afar National Regional State (hereinafter referred to as "AWRB"), and the entire facility was operated and maintained properly by their efforts. In addition, it was also confirmed that the facility was electrified to suppress operation costs in 2015. Therefore, the Study team and the AWRB agreed that Gubi Dowra would be excluded from the target sites of the Follow-Up Cooperation while the four sites of Kelewan,

Nemelefen, Wederage and Kumami remained as target sites.

The Study aimed to examine conditions of the water supply facilities in the above four sites to decide the scope of the Follow-Up Cooperation. It also aimed to carry out well developments and pumping tests in the three sites of Nemelefen, Wederage and Kumami to rehabilitate wells.

The purpose of the Follow-Up Cooperation is to recover the original function of the facilities in the target sites, which were constructed by the previous grant aid, by supply and installation of equipment and materials on the basis of results of the Study.

1-3 Conditions of the Existing Water Supply Facilities

1-3-1 Kelewan

(1) Existing well

An existing submersible pump and a flow meter of a pump unit were working. An existing generator was not working due to a malfunction in the fuel feed pump, and therefore was not in use at the time of inspection. The facility has been operating with commercial power since 2013.

Figure 1-1 Existing well

Figure 1-2 Existing generator

(2) Production well

The AWRB reported that the pumping discharge of a production well, which was constructed by the previous grant aid, was reduced, and therefore a well development and pumping test were carried out in the Study. A submersible pump installed by the previous grant aid was replaced by the AWRB because it was out of order in 2010. Thereafter, the broken submersible pump was replaced with another pump (18.5 kW). However, the pump was not fulfilling its function due to a failure with the impeller. The flow meter and compound gauge of the pump unit were working. The generator had not been used since the facility was electrified with commercial power in 2013.

Figure 1-3 Production well

Figure 1-4 Existing generator

(3) Existing reservoir

An existing reservoir of 50 m^3 was working properly.

Figure 1-5 Existing reservoir

(4) Reservoir

A reservoir of 100 m^3, which was constructed by the previous grant aid, was working properly.

Figure 1-6 Reservoir

(5) Existing public fountain No.1

Existing public fountain No.1 was working, but the flow meter and a gate valve were not.

Figure 1-7 Existing public fountain No.1

(6) Existing public fountain No.2

Existing public fountain No.2 had not been used since the water supply through private connections was disseminated in the service area.

Figure 1-8 Existing public fountain No.2

(7) Existing public fountain No.3

Existing public fountain No.3 had not been used since the water supply through private connections was disseminated in the service area.

Figure 1-9 Existing public fountain No.3

(8) Existing public fountain No.4

Existing public fountain No.4 was working, but the flow meter and a gate valve were not.

Figure 1-10 Existing public fountain No.4

(9) Public fountain No.1

Public fountain No.1, which was constructed by the previous grant aid, had not been used because the water was not running. That was not considered due to distribution pipelines' problem because water could be supplied by private connections through the distribution pipelines. Therefore, the cause seemed to be a malfunction of a gate valve in the chamber. In addition, the flow meter was removed.

Figure 1-11 Public fountain No.1

(10) Public fountain No.2

Public fountain No.2, which was constructed by the previous grant aid, was working, and the flow meter and a gate valve were working.

Figure 1-12 Public fountain No.2

1-3-2 Nemelefen

(1) Existing well

The existing well had not been used since a submersible pump fell in the well in 2015. However, the well was not required to be rehabilitated because the salt concentration of the groundwater was too high to drink.

Figure 1-13 Existing well

(2) Test well

The AWRB reported that the test well had not been used since 2012 because its pumping yield was reduced. In order to recover the performance, a well development and a pumping test were carried out in the Study.

A submersible pump installed by the previous grant aid had also not been used and was left in the well since its last use in 2012. The pump was confirmed to not work in the Study. In addition, thread connections of riser pipes were damaged by corrosion. The flow meter and compound gauge of the pump unit were not working. A generator installed by the previous grant aid was not working due to a malfunction in the alternator, and therefore was no longer in use at the time of inspection.

Figure 1-14 Test well

Figure 1-15 Generator

(3) Production well

The submersible pump installed by the previous grant aid was working. A flow meter and a compound gauge of the pump unit were not working. The generator installed by the previous grant aid malfunctioned and was replaced by the AWRB in 2014. The replaced generator was working properly.

Figure 1-16 Production well

Figure 1-17 Generator

(4) Existing reservoir

An exisiting reservoir of 50 m^3 had not been used since the exisitng well ceased to supply water in 2015.

Figure 1-18 Existing reservoir

(5) Reservoir

A reservoir of 50 m^3 , which was constructed by the previous grant aid, was working properly.

Figure 1-19 Reservoir

(6) Existing public fountain No.1

Existing public fountain No.1, located in a school, was working but the flow meter and a gate valve were not.

Figure 1-20 Existing public fountain No.1

(7) Existing public fountain No.2

Existing public fountain No.2, on private land, was working. The flow meter and a gate valve were also working.

Figure 1-21 Existing public fountain No.2

(8) Existing public fountain No.3

Existing public fountain No.3 was working but the flow meter and a gate valve were not.

Figure 1-22 Existing public fountain No.3

(9) Existing public fountain No.4

Existing public fountain No.4 was working. The flow meter was also working but a gate valve was not.

Figure 1-23 Existing public fountain No.4

(10) Public fountain No.1

Public fountain No.1, which was constructed by the previous grant aid, was working. The flow meter and gate valve were also working.

Figure 1-24 Public fountain No.1

(11) Public fountain No.2

Public fountain No.2, which was constructed by the previous grant aid, was working, and the flow meter was also working, but a gate valve was not.

Figure 1-25 Public fountain No.2

(12) Public fountain No.3

Public fountain No.3, which was constructed by the previous grant aid, was working but the flow meter and a gate valve were not.

Figure 1-26 Public fountain No.3

(13) Transmission pipeline

High-density polyethylene (HDPE)transmission pipelines constructed by the previous grant aid were leaking. Two air release valves in a chamber were removed.

Figure 1-27 Transmission pipeline

1-3-3 Wederage

(1) Existing well

The submersible pump installed by the previous grant aid malfunctioned and was replaced by the AWRB. The flow meter of the pump unit had broken down. The facility was electrified with a photovoltaic power plant provided by the Afar community initiative sustainable development association (ACISDA) in 2014, and therefore the existing generator was used as a standby power source.

Figure 1-28 Existing well

Figure 1-29 Existing generator

(2) Test well

The submersible pump installed by the previous grant aid was working. The flow meter and compound gauge of the pump unit were also working. A generator installed by the previous grant aid was not working and was no longer in use at the time of inspection because the control system and an alternator had malfunctioned. The facility has been operating with photovoltaic power since ACISDA electrified it in 2014.

Figure 1-30 Test well

Figure 1-31 Generator

(3) Production well

The production well operating with a diesel generator had not been used since 2014 due to high operating costs compared to other facilities which were electrified with photovoltaic power in 2014. However, operating the production well was required to resolve water shortages in the town, and therefore the AWRB intended to electrify the facility to reduce the operating costs. In this situation, with the electrification as a condition, a well development and a pumping test were carried out to rehabilitate the well in the Study.

A submersible pump installed by the previous grant aid had not been used and was left in the well since 2014 due to the above-described reason. The pump was confirmed to not work in the Study. In addition, thread connections of riser pipes were damaged by corrosion. A flow meter was removed and a compound gauge, a check valve, an air release valve and gate valves of the pump unit failed. A generator installed by the previous grant aid was also out of operation, and had been left unused since 2014.

Figure 1-32 Production well

Figure 1-33 Generator

(4) Existing elevated tank

An existing elevated tank of 50 m^3 was working properly.

Figure 1-34 Existing elevated tank

(5) Existing public fountain No.1

Existing public fountain No.1 was not used because using the fountain caused the lowering of the water supply pressure in the area. The AWRB intended not to use the fountain because frequency of use was low.

Figure 1-35 Existing public fountain No.1

(6) Existing public fountain No.2

Existing public fountain No.2 was working. The flow meter was working but a gate valve was not.

Figure 1-36 Existing public fountain No.2

(7) Existing public fountain No.3

Existing public fountain No.3 was working. The flow meter was also working but the gate valve was not.

Figure 1-37 Existing public fountain No.3

(8) Public fountain No.1

Public fountain No.1, which was constructed by the previous grant aid, was working. The flow meter was also working but the gate valve was not.

Figure 1-38 Public fountain No.1

(9) Public fountain No.2

Public fountain No.2, which was constructed by the previous grant aid, was working. The flow meter was also working but the gate valve was not.

Figure 1-39 Public fountain No.2

1-3-4 Kumami

(1) Production well

A submersible pump installed by the previous grant aid malfunctioned and was replaced by the AWRB in 2011. Thereafter, two submersible pumps continuously malfunctioned and were replaced, and thereby the forth pump was operating. However, according to AWRB, the performance of the pump was not sufficient and the specifications were unknown. The flow meter and the compound gauge of the pump unit failed. The facility was electrified with commercial power by CARE Ethiopia and USAID in 2013, and therefore a generator installed by the previous grant aid was used as a standby power source.

Figure 1-40 Production well

Figure 1-41 Generator

(2) Booster pump station No.1

A booster pump installed by the previous grant aid was operating but was leaking a lot of water from the body. It was also confirmed that a pipeline around the pump was leaking.

Figure 1-42 Booster pump

Figure 1-43 Pipeline around the pump

A generator installed by the previous grant aid has not been used since the facility was electrified with commercial power in 2013.

Figure 1-44 Generator

(3) Booster pump station No.2

A booster pump installed by the previous grant aid malfunctioned and was replaced with a backup pump in 2015. The replaced booster pump was operating and leaking some water from the body. A generator installed by the previous grant aid has not been used since the facility was electrified with commercial power in 2013.

Figure 1-45 Booster pump

Figure 1-46 Generator

(4) Reservoir

A reservoir of 50 m^3 , which was constructed by the previous grant aid, was working properly.

Figure 1-47 Reservoir

(5) Reservoir constructed by other donors

A reservoir of 50 m^3 was constructed by CARE Ethiopia and USAID next to the reservoir constructed by the previous grant aid. Each reservoir was connected by an underground pipe.

Figure 1-48 Reservoir constructed by other donors

(6) Public fountain No.1

Public fountain No.1, which was constructed by the previous grant aid, was working. The flow meter was also working but a gate valve was not.

Figure 1-49 Public fountain No.1

(7) Public fountain No.2

Public fountain No.2 was working. The flow meter was also working but a gate valve was not.

Figure 1-50 Public fountain No.2

(8) Public fountain No.3

Public fountain No.3 was working. The flow meter was also working but a gate valve was not.

Figure 1-51 Public fountain No.3

(9) Public fountains constructed by other donors

Four public fountains were constructed by CARE Ethiopia and USAID. Three of them were connected to distribution pipelines constructed by the previous grant aid and another public fountain was connected to a collection chamber of booster pump station No.1.

Figure 1-52 Public fountains constructed by other donors

(10) Transmission pipeline

According to the AWRB, all air release valves installed by the previous grant aid along transmission pipelines were removed by residents living around the site. Therefore, all chambers of the valves were covered with concrete or cobble to prevent additional damages.

Figure 1-53 Chamber of air release valve

Residents living around the site used leaking water from the transmission pipeline. The leakage shall be repaired for proper management, even though the residents need water. The AWRB intended to take measures against the leakage because it was a regional issue.

Figure 1-54 Leaking water of pipeline

1-3-5 Equipment and materials malfunctions

As a result of the site investigation, water supply facilities in all the sites were operating; however, it was found that some equipment and materials had malfunctions as indicated in the following table.

Table 1-1 Equipment and materials malfunctions

Town	Category of facility	Equipment/material	Specification	Type of malfunction	Remarks
Kelewan	Existing well	Generator	30KVA	Malfunction	Electrified
	Production well	Submersible pump	18.5kW	Lack of performance	
		Generator	42KVA	Not used	Electrified
	Existing public fountain No.1	Flow meter	DN25, PN10	Malfunction	
		Gate valve	DN25, PN10	Malfunction	
	Existing public fountain No.4	Flow meter	DN25, PN10	Malfunction	
		Gate valve	DN25, PN10	Malfunction	
	Public fountain No.1	Flow meter	DN40, PN10	Malfunction	
		Gate valve	DN40, PN10	Malfunction	
Nemelefen	Test well	Submersible pump	3kW	Malfunction	
		Riser pipe	DN50, PN16	Damaged	
		Generator	18KVA	Malfunction	
		Flow meter	DN65, PN16	Malfunction	
		Compound gauge	DN65, PN16	Malfunction	
	Production well	Flow meter	DN65, PN16	Malfunction	
		Compound gauge	DN65, PN16	Malfunction	
	Existing public fountain No.1	Flow meter	DN25, PN10	Malfunction	
		Gate valve	DN40, PN10	Malfunction	
	Existing public fountain No.3	Flow meter	DN25, PN10	Malfunction	
		Gate valve	DN40, PN10	Malfunction	
	Existing public fountain No.4	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.2	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.3	Flow meter	DN40, PN10	Malfunction	
		Gate valve	DN40, PN10	Malfunction	
	Transmission pipeline	Air release valve	DN50, PN16	Malfunction	
		HDPE pipe	DN90, PN16	Water leaking	
Wederage	Existing well	Flow meter	DN50, PN16	Malfunction	
	Test well	Generator	18KVA	Malfunction	Electrified
	Production well	Submersible pump	3kW	Malfunction	
		Riser pipe	DN50, PN16	Damaged	
		Generator	18KVA	Not used	
		Flow meter	DN65, PN16	Malfunction	
		Compound gauge	DN65, PN16	Malfunction	
		Check valve	DN65, PN16	Malfunction	
		Air release valve	DN65, PN16	Malfunction	
		Gate valve	DN65, PN16	Malfunction	
	Existing public fountain No.2	Gate valve	DN25, PN10	Malfunction	
	Existing public fountain No.3	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.1	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.2	Gate valve	DN40, PN10	Malfunction	
Kumami	Production well	Submersible pump	11kW	Lack of performance	
		Flow meter	DN65, PN16	Malfunction	
		Compound gauge	DN65, PN16	Malfunction	
	Booster pump station No.1	Booster pump	11kW	Water leaking	
		Generator	40KVA	Not used	Electrified
		Flow meter	DN65, PN16	Malfunction	
		Gate valve	DN40, PN16	Malfunction	
	Booster pump station No.2	Booster pump	11kW	Water leaking	
		Generator	40KVA	Not used	
	Public fountain No.1	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.2	Gate valve	DN40, PN10	Malfunction	
	Public fountain No.3	Gate valve	DN40, PN10	Malfunction	
	Transmission pipeline	Air release valve	DN50, PN16	Malfunction	
		HDPE pipe	DN110, PN16	Water leaking	

1-4 Status of operation and maintenance

The Woreda water resource offices in nine towns which were target sites of the previous grant aid were interviewed in the Study. As a result, water committees implemented operation and maintenance (hereinafter referred to as "O&M") by themselves in four towns, and Woreda water resource offices implemented O&M in five towns instead of water committees, which ceased to function properly. The outline of the status of O&M in nine towns is shown in the following table.

Table 1-2 Status of operation and maintenance (O&M)

Town	1. Facility	2. Water committee	3. O&M	4. Finance
Gubi Dowra	Operating	Organized but not performed	Implemented by the Woreda water resource office	Depositing money in bank and keeping financial records
Kelewan	Operating	Not organized	Implemented by the Woreda water resource office	Not depositing money in bank and not keeping financial records
Nemelefen	Operating	Organized but not performed	Implemented by the Woreda water resource office	Not depositing money in bank and not keeping financial records
Wederage	Operating	Organized but not performed	Implemented by the Woreda water resource office	Not depositing money in bank and not keeping financial records
Kumami	Operating	Organized but not performed	Implemented by the Woreda water resource office	Not depositing money in bank and not keeping financial records
Derayitu	Operating	Organized	Implemented by the water committee	Not depositing money in bank and keeping financial records
Chifra	Operating	Organized	Implemented by the water committee	Depositing money in bank and keeping financial record
Eli Wuha	Operating	Organized	Implemented by the water committee	Not depositing money in bank and not keeping financial records
Dulecha	Operating	Organized	Implemented by the water committee	Depositing money in bank and not keeping financial records

1-5 Well Investigation

1-5-1 General

As mentioned in "1-3 Conditions of the Existing Water Supply Facilities", the well investigation including well developments and pumping tests, was carried out in Kelewan, Nemelefen and Wederage in order to recover functions of the wells and determine sustainable yields. Items of the well investigation are indicated in the following table.

Table 1-3 Items of the well investigation

Town	Type of well	Item of investigation			
		Water level measurement	Well development	Pumping test	Water quality analysis
Kelewan	Production well	1 set	1 set	1 set	1 set
Nemelefen	Test well	1 set	1 set	1 set	1 set
Wederage	Production well	1 set	1 set	1 set	1 set

The Study team requested to the AWRB to use the O&M equipment from the AWRB, which was procured by the previous grant aid, in order to effectively use the AWRB's resources. However, at the time of the Study, Ethiopia was facing a devastating drought, sparked by the worst El Niño in a generation. The drought caused a severe food crisis, especially in the Afar Region, an area heavily populated with pastoral people where a large number of livestock died. Under such circumstances, there was an urgent need to improve water supply conditions in the region, and the procured O&M equipment had been used for emergency measures for the drought. Thereby, the Study team changed the policy of the use of O&M equipment and determined to recommission the well investigation to a private company.

1-5-2 Investigation procedure

(1) Water level measurement

The static water level (SWL) was measured to compare the current SWL with the past SWL during the construction prior to the commencement of the well investigation.

(2) Well development

Well development was carried out to recover the original function of the three wells (one each at Kelewan, Nemelefen and Wederage) by the air lifting method. The method used compressed air which can be injected into a well to lift the groundwater to the surface and to remove clogging of screens and around casings. The well development was carried out for about twelve hours for each well.

(3) Pumping test

1) Preliminary pumping test

Preliminary pumping test was carried out to determine the pumping rate to be employed in subsequent tests. The test was continued for at least two hours for each well.

2) Step-drawdown pumping test

Step-drawdown pumping test was carried out to determine a critical yield. The test consisted of five steps and each time was two hours for each well.

3) Continuous pumping test

Continuous pumping test was carried out to obtain the coefficient value to determine the nature of the aquifer. The duration of the test was twenty-four hours for each well.

4) Recovery pumping test

Recovery pumping test was carried out to monitor the recovery of groundwater immediately after the continuous test was completed. The test was continued until the water level recovered or twelve hours had passed for each well.

(4) Water quality analysis

Water quality analysis including electrical conductivity (EC), pH and water temperature was carried out at each site during pumping tests.

1-5-3 Investigation results

(1) Water level measurement

The current SWL measured in the Study and the past SWL during the construction are shown in the following table.

Table 1-4 The current SWL and the past SWL during the construction

Town	SWL (m)		Remarks
	Current	Past	
Kelewan	24.21	26.00	The current SWL and the past SWL during the construction were almost the same.
Nemelefen	7.99	8.00	The current SWL and the past SWL during the construction were almost the same.
Wederage	19.62	25.14	The current SWL was shallower than the past SWL during the construction.

As a result of the water level measurement, all the current SWLs were almost the same as or shallower than the past SWL during the construction. Therefore, it is estimated that the groundwater in the sites has not been reduced much from the time of construction.

(2) Well development

1) Kelewan

Groundwater became free of turbidity within ten minutes after the beginning of the well development. Therefore, the well development was considered to have succeeded.

2) Nemelefen

Groundwater became free of turbidity within ten minutes after the beginning of the well development. Therefore, the well development was considered to have succeeded.

3) Wederage

Groundwater became free of turbidity within ten minutes after the beginning of the well development. Therefore, the well development was considered to have succeeded.

(3) Pumping test

1) Kelewan

As a result of the pumping test, it was estimated that the critical yield was greater than 6.7 L/s and the dynamic water level (DWL) was around 31m. In case that the sustainable yield is 70% of the critical yield, the sustainable yield is estimated to be 4.69L/s and greater than the design yield of 4.65L/s. Thereby, the design yield can be deemed to be pumped stably. In addition, the design pump position of 78m is deep enough for the DWL of 31m and therefore appropriate.

2) Nemelefen

As a result of the pumping test, it was estimated that the critical yield was 2.5 L/s and the DWL was around 28m as a pumping yield of 2.0L/s. In case that the sustainable yield is 70% of the critical yield, the sustainable yield is estimated to be 1.75L/s and greater than the design yield of 1.50L/s. Thereby, the design yield can be deemed to be pumped stably. In addition, the design pump position of 42m is deep enough for the DWL of 28m and therefore appropriate.

3) Wederage

As a result of the pumping test, it was estimated that the critical yield was greater than 1.81 L/s and the DWL was around 57m. In case that the sustainable yield is 70% of the critical yield, the sustainable yield is estimated to be 1.27L/s and greater than the design yield of 1.20 L/s. Thereby, the design yield can be deemed to be pumped stably. In addition, the design pump position of 60m is not deep enough for the DWL of 57m. Thereby, the pump position shall be lowered to 78m to secure enough depth.

(4) Water quality analysis

1) Kelewan

The results of the water quality analysis reveal that the EC was 620μS/cm, the pH was around 7.5 and the water temperature was between 27℃and 28℃. Thereby, the groundwater can be deemed to be suitable for drinking.

2) Nemelefen

The results of the water quality analysis reveal that the EC was between 840μS/cm and 885μS/cm, the pH was around 7.6 and the water temperature was between 27℃and 29℃. Thereby, the groundwater can be deemed to be suitable for drinking.

3) Wederage

The results of the water quality analysis reveal that the EC was between 1,040μS/cm and 1,230 μS/cm, the pH was between 7.2 and 7.5 and the water tempareture was between 31℃and 35℃. Regarding the EC, it showed a high value for drinking water, and therefore the groundwater shall be mixed with other groundwater in accordance with the design.

2. Contents of the Project

2. Contents of the Project

2-1 Basic Concept of the Project

The Follow-Up Cooperation aims to recover the original function of the water supply facilities, which were constructed by the previous grant aid, by procurement of equipment and materials in accordance with results of the Study.

2-2 Outline Design

2-2-1 Design Policy

(1) Basic policy

- The Study team and the AWRB agreed that target sites would be the four towns of Kelewan, Nemelefen, Wederage and Kumami. Gubi Dowra, which had a facility operated and maintained properly by the AWRB's own efforts, was excluded from the target sites. Thereby, the Follow-Up Cooperation will be implemented to recover the original function of the water supply facilities in the four towns by procurement of equipment and materials.
- The AWRB requested to procure an HDPE welding machine to repair transmission pipelines leaking water in Nemelefen and Kumami. Procuring the machine can be justified in order to contribute to achieving sustainable operations and maintenance, and thereby the procurement is included in the Follow-Up Cooperation.

(2) Policy for natural conditions

- The target sites are located in the west part of the low land of the Rift Valley and each site is scattered in a range of about 300km from north to south and at altitudes between 650m and 1,050m above sea level. The target sites are situated in the area with very severe natural conditions. The climate of the area is classed as a tropical dry or semi-arid climate, the annual mean temperature is between 35℃ and 40℃, and the annual rainfall in the area is around 380mm. Severe drought sometimes breaks out in the area. Therefore, careful consideration shall be paid when the technical specifications of generators are decided.
- There are volcanoes in the Rift Valley formed by geological activities of detachment of the African plate and the Indian Ocean plate. Groundwater in the Rift Valley is influenced by volcanic activity. For instance, groundwater in Kumami with a high temperature of around 40℃ was observed. For this reason, careful attention for such characteristics shall be paid to decide the technical specification for pumps.

(3) Policy for socio-economic conditions

- The Ethiopian government is promoting increasing electric power to achieve the target set by the national development plan. Thereby, promotion of electrification took place in target towns and some water supply facilities were confirmed to be electrified with commercial power and

photovoltaic power. As mentioned in "1-3-3(3) Production well," there was a facility operated with a diesel generator in Wederage and the AWRB intended to electrify the facility to reduce costs. In light of the above national policy, electrification of the facility seems to be realized, and therefore, the Study team decided to include the facility in the Follow-Up Cooperation.

- Residents used leaking water from a transmission pipeline in Kumami. The leakage shall be repaired for proper management, even though the residents needed the water. The AWRB intended to take a measure against the leakage, and thereby the repair is not included in the Follow-Up Cooperation.

(4) Policy for procurement conditions

- Piping materials including valves and meters are available in the Ethiopian market. The AWRB and the Woreda water resource offices can change and install those materials by themselves. Therefore, the Follow-Up Cooperation includes supply of the piping materials but excludes installation works.
- In order to operate and maintain pumps and generators which are essential for water supply systems for a long period, it is necessary to receive proper maintenance services and spare parts whenever circumstances require. Therefore, the equipment's manufacturer or agency shall be in Ethiopia.

(5) Policy for selection of a contractor

- The Follow-Up Cooperation does not include specific equipment, materials and installation works, and therefore it is not necessary to have limits on the nationality of companies bidding for the contract. However, companies who participate in the bidding shall be shortlisted to assure the quality of the work.

(6) Policy for capacity building on O&M

- Principally, water supply facilities shall be operated and maintained by water committees in the towns. However, as a result of the Study, it was confirmed that Woreda water resource offices operated and maintained facilities in some sites. Therefore, the system of O&M shall be reviewed and improved. Under those circumstances, drafts of an O&M manual for water committees and an O&M training plan for the AWRB and the Woreda water resource offices are prepared in the Study.
- It is necessary to acquire specific technical skills to operate the HDPE pipe welding machine. Therefore, the operation training for local operators shall be included in the Follow-Up Cooperation.

(7) Policy for equipment and materials plan

- There was not a manufacturer or an agency for the generators, which were procured by the previous grant aid, in Ethiopia, and thereby the generators have not been operated and maintained properly. In order to improve the situation, the generators shall be replaced with other

generators which have a manufacturer or an agency in Ethiopia. However, generators which were installed in facilities that have since been electrified shall not be replaced due to low necessity.

- The production well in Wederage will be electrified by the Ethiopian side, but it has not been decided when the electrification is to be implemented. Therefore, to avoid having a period without water supply, a generator shall be procured for the site.
- A backup booster pump, which was procured by the past grant aid, had been used to replace a malfunctioning pump. Therefore, additional booster pumps for station No.1 and No.2 shall be procured as a backup.
- Pumps and generators to be procured shall be installed in specific places. Therefore, installation work of the equipment shall be included in the Follow-Up Cooperation.
- Installation work of piping materials, including valves and meters, shall not be included in the Follow-Up Cooperation because the AWRB and the Woreda water resource offices can change and install those materials by themselves.
- Operation training for an HDPE pipe welding machine shall be included in the Follow-Up Cooperation.

(8) Policy for a procurement schedule

- It is expected to take time to issue the letter of credit (L/C) in Ethiopia, and therefore the procurement schedule shall be determined considering it.
- The time of installation work shall be determined considering the rainy season and long vacation around the Ethiopian holidays.

2-2-2 Basic Plan

(1) Equipment plan

Equipment and materials to be procured in the Follow-Up Cooperation are shown in the following table.

Table 2-1 Equipment and materials to be procured

Town	Category of facility	Equipment/material	Specification	Unit	Quantity
Kelewan	Production well	Submersible pump	Q=4.65L/s, H=112m	pc.	1
	Existing public fountain No.1	Flow meter	DN25, PN10	pc.	1
		Gate valve	DN25, PN10	pc.	1
	Existing public fountain No.4	Flow meter	DN25, PN10	pc.	1
		Gate valve	DN25, PN10	pc.	1
	Public fountain No.1	Flow meter	DN40, PN10	pc.	1
		Gate valve	DN40, PN10	pc.	1
Nemelefen	Test well	Submersible pump	Q=1.5L/s, H=112m	pc.	1
		Riser pipe	DN50, PN16	m	42
		Flow meter	DN65, PN16	pc.	1
		Compound gauge	DN65, PN16	pc.	1
		Generator	TBD	pc.	1
	Production well	Flow meter	DN65, PN16	pc.	1
		Compound gauge	DN65, PN16	pc.	1
	Existing public fountain No.1	Flow meter	DN25, PN10	pc.	1
		Gate valve	DN40, PN10	pc.	1
	Existing public fountain No.3	Flow meter	DN25, PN10	pc.	1
		Gate valve	DN40, PN10	pc.	1
	Existing public fountain No.4	Gate valve	DN40, PN10	pc.	1
	Public fountain No.2	Gate valve	DN40, PN10	pc.	1
	Public fountain No.3	Flow meter	DN40, PN10	pc.	1
		Gate valve	DN40, PN10	pc.	1
	Transmission pipeline	Air release valve	DN50, PN16	pcs.	2
Wederage	Existing well	Flow meter	DN50, PN16	pc.	1
	Production well	Submersible pump	Q=1.2L/s, H=126m	pc.	1
		Riser pipe	DN50, PN16	m	78
		Flow meter	DN65, PN16	pc.	1
		Compound gauge	DN65, PN16	pc.	1
		Check valve	DN65, PN16	pc.	1
		Air release valve	DN65, PN16	pc.	1
		Gate valve	DN65, PN16	pcs.	2
		Generator	TBD	pc.	1
	Existing public fountain No.2	Gate valve	DN25, PN10	pc.	1
	Existing public fountain No.3	Gate valve	DN40, PN10	pc.	1
	Public fountain No.1	Gate valve	DN40, PN10	pc.	1
	Public fountain No.2	Gate valve	DN40, PN10	pc.	1
Kumami	Production well	Submersible pump	Q=3.1L/s, H=266m	pc.	1
		Flow meter	DN65, PN16	pc.	1
		Compound gauge	DN65, PN16	pc.	1
	Booster pump station No.1	Booster pump	Q=3.1L/s, H=158m	pc.	1
		Flow meter	DN65, PN16	pc.	1
		Gate valve	DN40, PN16	pc.	1
		Booster pump (backup)	Q=3.1L/s, H=158m	pc.	1
	Booster pump station No.2	Booster pump (backup)	Q=3.1L/s, H=158m	pc.	1
	Public fountain No.1	Gate valve	DN40, PN10	pc.	1
	Public fountain No.2	Gate valve	DN40, PN10	pc.	1
	Public fountain No.3	Gate valve	DN40, PN10	pc.	1
	Transmission pipeline	Air release valve	DN50, PN16	pcs.	10
HDPE pipe welding machine			DN40-160	pc.	1

: The hatched equipment shall iclude an installation work

2-2-3 Procurement Plan

(1) Policy for procurement

- A contractor for the Follow-Up Cooperation shall be selected from shortlisted bidders whose nationalities are irrelevant.
- One contractor can be considered for implementing works including supply and installation of equipment and materials for the following reasons:
  - ✓ HDPE pipe welding machines are available in Ethiopia, even though the machines are not common there.
  - ✓ Pumps and generators are available in the Ethiopian market through agencies.
  - ✓ There are many companies in Ethiopia who can do the installation work of pumps and generators.

  Therefore, the scope of the project does not need to be divided.

(2) Points of concern regarding procurement

- The precondition that a manufacturer or an agency for the pumps and generators shall be in Ethiopia shall be confirmed in the bidding.
- Installing pumps and generators in specific places is important in the project, and therefore the installation work shall be supervised on site.

(3) Scope of responsibility

The scope of responsibility in the Follow-Up Cooperation between the contractor and the AWRB is shown in the following table.

Table 2-2 Scope of responsibility

Item	Contractor	AWRB
1. Procurement of equipment		
Procurement of equipment	✓	
Transportation	✓	
Electrification of facilities		✓
Customs clearance	✓	
Permission procedure to import		✓
2. Installation work		
Permission procedure to work		✓
Preparation for work space		✓
Explanation to local residents	✓	✓
Installation work and supply of water and electricity	✓	
Operation and maintenance		✓
3. Permission procedure of embarkation, disembarkation and stay for persons involved		✓
4. Permission procedure to implement the Follow-Up Cooperation		✓
5. Provision of necessary expenses for the AWRB's staff to participate		✓

Item	Contractor	AWRB
activities for the Follow-Up Cooperation		
6. Implementation of periodical, completion and handover inspection	✓	✓

(4) Supervision plan

As mentioned in "2-2-3 (2) Points of concern regarding procurement", certain processes in the project shall definitely be executed. Therefore, a Japanese consultant shall supervise the above processes to conduct the project smoothly. Work items to be supervised by the consultant are shown in the following table.

Table 2-3 Work items to be supervised by a consultant

Phase	Work item
Bidding	Examination of bidding documents to be submitted by bidders
	Preparation for clarification and amendment of bidding documents
	Assistance of bidding
	Evaluation of bidding documents
Conclusion of contract	Negotiation of contract
	Approval of equipment and materials
	Approval of procurement schedule
Supervision of procurement	Supervision of procurement
	Supervision of installation work
	Inspection of equipment and materials
	Handover inspection

(5) Procurement plan of equipment and materials

1) Submersible pump and booster pump

・ Submersible pumps and booster pumps are available in the Ethiopian market through agencies.

・ Spare parts are not required.

・ Warranty period is one year.

2) Generator

・ Generators are available in the Ethiopian market through agencies.

・ Spare parts for one year are required.

・ Warranty period is one year.

3) Piping materials

・ Piping materials are available in the Ethiopian market.

・ Spare parts are not required.

・ Warranty period is not required.

4) HDPE pipe welding machine

・ HDPE pipe welding machines and operation training are available in Ethiopia through an agency.

- Spare parts for one year are required.
- Warranty period is one year.

(6) Operation training

- It is necessary to acquire specific technical skills to operate an HDPE pipe welding machine, and therefore operation training for local operators shall be carried out by a manufacturer or an agency. The operation training shall be carried out for three days or more and include field training on site.

(7) Implementation schedule

Implementation schedule is shown below.

Table 2-4 Implementation schedule

	1	2	3	4	5	6	7
Order	▲						
Transportation	■	■	■	■	■		Total 6.2months
Installation work						■	
Operation training						■	
Inspection & handover							■

(8) Obligations of recipient country

Obligations of the Ethiopian side to be required in the Follow-Up Cooperation are described below. Moreover, the obligations shall be included in the Scope of Work.

- Participation in acceptance inspection of equipment and materials
- Securement of places to keep dismantled equipment
- Establishment of the system to operate and maintain facilities and equipment
- Burden of all the expenses necessary for implementation of the Follow-Up Cooperation including personnel wages, per diem costs and traveling expenses
- Clearance of sites
- Collection and provision of safety information to implement the Follow-Up Cooperation
- Participation in start-up, periodical and completion inspection of installation works

(9) Project operation plan

The AWRB, the Woreda water resource offices and water committees participate in overall management of water supply facilities in the target sites. The respective roles and the activities are summarized below.

1) AWRB

The AWRB, which is the implementation organization of the Follow-Up Cooperation, has a responsibility for implementation of water supply projects over the entire Afar Region. Principally,

facilities to be rehabilitated in the Follow-Up Cooperation shall be operated and maintained by water committees, and the Water Supply Facility Management Sub-Process, which is one department of the AWRB, will supervise the status of the O&M management. In addition, the AWRB is expected to handle problems which are difficult to resolve by the Woreda water resource offices. It is also expected to enhance capacity building of the Woreda water resource offices.

2) Woreda water resource office

The Woreda water resource offices have a responsibility for repair and maintenance of facilities, monitoring of O&M activities by water committees and communication with and reporting to the AWRB. The Woreda water resource offices have technicians who can repair simple mechanical troubles and give improvement guidance for water committees when needed.

3) Water committee

Principally, facilities shall be operated and maintained by water committees who are selected by the town people. Therefore, water committees have a responsibility for operation of facilities and financial management including collecting water tariffs. However, as a result of the Study, it was confirmed that some water committees ceased to function properly due to a lack of ability. In this case, Woreda water resource offices implemented O&M activities instead of the water committees.

Under these circumstances, the current status of O&M was not appropriate, and therefore the O&M system shall be improved.

3. Project Evaluation

3. Project Evaluation

3-1 Preconditions

Preconditions to implement the Follow-Up Cooperation are described below.

① Groundwater will not be reduced significantly due to climate change and/or catastrophic drought.

② Rapid fluctuations in price and exchange, currency crisis and deterioration of the situation of surrounding countries will not happen.

③ Security situation in Ethiopia will not deteriorate and it will not interfere with the Follow-Up Cooperation.

④ To ensure the Ethiopian side shares its burden of the budget, appropriate measures will be carried out on the Ethiopian side to implement the Follow-Up Cooperation.

3-2 Necessary Input by Recipient Country

Necessary inputs by the Ethiopian side to increase and maintain the effect of the Follow-Up Cooperation are described below.

① The production well in Wederage will be electrified.

② Staff of the AWRB and the Woreda water resource offices to participate in activities of the Follow-Up Cooperation will be deployed properly.

③ The O&M system will be improved and perform properly.

④ Water committees in all the towns will be established and O&M activities will be implemented by themselves.

3-3 Relevance

To implement the Follow-Up Cooperation is considered appropriate because of the following.

① The AWRB operates and maintains water supply facilities by its own efforts, although there was equipment and materials that were found to not be in working order.

② The AWRB cannot maintain malfunctioning equipment properly because manufacturers or agencies of the equipment are not in Ethiopia.

③ The AWRB can hardly handle malfunctioning or broken down facilities over the entire Afar Region as necessary due to lack of resources including budget, equipment and manpower. Meanwhile, there exists an urgent need to maintain malfunctioning facilities in the target sites due to a water shortage.

As described above, it is difficult to improve the current status with self-help efforts because of budgetary and system issues. Implementation of the Follow-Up Cooperation can be justified because effective utilization of the water supply facilities constructed by the previous grant aid can be expected.

Appendices

1. Member List of the Study Team

1. Member List of the Study Team

Name	Assignment	Present post
Ryosuke Isobe	Team Leader	Deputy Director, Grant Aid Project Management Division 3, Financial Cooperation Implementation Department, JICA
Toshio Murakami	Rural Water Supply	Visiting Senior Advisor, JICA
Takeshi Abe	Chief Consultant／ Facility Planning／Procurement／ Cost Estimation	Kokusai Kogyo Co., Ltd.
Masatoshi Tanaka	Groundwater Development	Kokusai Kogyo Co., Ltd.

2. Study Schedule

2. Study Schedule

Date		JICA		Consultant	
		Team Leader	Rural Water Supply	Chief Consultant／Facility Planning／Procurement／Cost Estimation	Groundwater Development
		Ryosuke Isobe	Toshio Murakami	Takeshi Abe	Masatoshi Tanaka
29-Nov	S	MOV (Tokyo-Dubai)			
30-Nov	M	MOV (Dubai-AA)			
1-Dec	T	Visit to JICA and MoWIE			
2-Dec	W	MOV (AA-Semera), Visit to AWRB			
3-Dec	T	Field Survey			
4-Dec	F	Field Survey			
5-Dec	S	Field Survey			
6-Dec	S	Field Survey			
7-Dec	M	Discussion of IC/R			Confirmation of Existing Equipment
8-Dec	T	Signing of M/D			Field Survey
9-Dec	W	MOV (Semera-AA), Explanation of Results to JICA, MOV (AA-Dubai)		MOV (Semera-AA), Explanation of Results to JICA	Field Survey
10-Dec	T	MOV (Dubai-Tokyo)		Management of Subcontractor	Field Survey
11-Dec	F			Management of Subcontractor	Field Survey
12-Dec	S			Management of Subcontractor	Field Survey
13-Dec	S			Data Arrangement	Field Survey
14-Dec	M			Marketing Research	Field Survey
15-Dec	T			Marketing Research	Field Survey
16-Dec	W			MOV (AA-Semera)	Data Arrangement
17-Dec	T			Field Survey	Field Survey
18-Dec	F			Field Survey	Field Survey
19-Dec	S			Field Survey	Data Arrangement
20-Dec	S			Field Survey	Well Development & Pumping Test
21-Dec	M			Field Survey	Well Development & Pumping Test
22-Dec	T			Field Survey	Well Development & Pumping Test
23-Dec	W			Field Survey	Well Development & Pumping Test
24-Dec	T			Confirmation for other donors	Well Development & Pumping Test
25-Dec	F			Confirmation of Organization Chart	Well Development & Pumping Test
26-Dec	S			Data Arrangement	Well Development & Pumping Test
27-Dec	S			Data Arrangement	Well Development & Pumping Test
28-Dec	M			Confirmation of O&M system	Well Development & Pumping Test
29-Dec	T			Confirmation of O&M system	Well Development & Pumping Test
30-Dec	W			Confirmation of Technical Capabilities	Well Development & Pumping Test
31-Dec	T			Confirmation of Budget	Well Development & Pumping Test
1-Jan	F			Explanation of Results to AWRB	Well Development & Pumping Test
2-Jan	S			MOV (Semera-AA)	Well Development & Pumping Test
3-Jan	S			Marketing Research	Well Development & Pumping Test
4-Jan	M			Marketing Research	Well Development & Pumping Test
5-Jan	T			Marketing Research	Well Development & Pumping Test
6-Jan	W			Explanation of Results to JICA	Well Development & Pumping Test
7-Jan	T			Marketing Research	Well Development & Pumping Test
8-Jan	F			Marketing Research	Well Development & Pumping Test
9-Jan	S			Data Arrangement	Well Development & Pumping Test
10-Jan	S			Data Arrangement	Well Development & Pumping Test
11-Jan	M			MOV (AA-Dubai)	Well Development & Pumping Test
12-Jan	T			MOV (Dubai-Tokyo)	Well Development & Pumping Test
13-Jan	W				MOV (Kumami-AA)
14-Jan	T				Data Arrangement
15-Jan	F				MOV (AA-Dubai)
16-Jan	S				MOV (Dubai-Tokyo)

3. List of the Parties Concerned in the Recipient Country

3. List of the Parties Concerned in the Recipient Country

(1) The Water Resources Bureau, the Afar National Regional State (AWRB)

Bureau head	Mr. Mohanmmed Lale
Acting bureau head	Mr. Walaq Witikka
Water supply core process owner	Mr. Abdurazok Mohammed
Water resources administrator core process	Mr. Abdulaziz Musa
Acting water supply core process owner	Mr. Sedik Mohammed
Electro-mechanical technician	Mr. Nuru Hussien
Electro-mechanical technician	Mr. Ephrem Beyene

(2) Ministry of Water, Irrigation and Energy (MOWIE)

Water supply and sunitation directorate director	Mr. Nuredin Mohammed
Technical supporter for AWRB	Mr. Kamil Shemsu

(3) Gubi Dowra Woreda Water Resorce Office

Expert	Mr. Amare Arbesa

(4) Kelewan Woreda Water Resorce Office

Office head	Mr. Yasine Ali

(5) Nemelefen Woreda Water Resorce Office

Acting office head	Mr. Said Aliwarii
Mechanic	Mr. Abdu Mohammed

(6) Wederage Woreda Water Resorce Office

Office head	Mr. Ebade Mohammed
Mechanic	Mr. Hassan Abdula

(7) Kumami Woreda Water Resorce Office

Office head	Mr. Hussen Ferura

(8) UNICEF Afar

WASH officer	Mr. Fikadu Tadesse

(9) JICA Etiopia Office

Senior representative	Mr. Hiroyuki Tanaka
Project formulation advisor (Water and sanitation)	Mr. Itsuro Takahashi
Program Officer	Mr. Ephrem Fufa Leta

4. Minutes of Discussions

MINUTES OF DISCUSSIONS

ON

THE FOLLOW-UP COOPERATION STUDY

ON

THE PROJECT FOR WATER SUPPLY IN AFAR REGION

IN FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

In response to a request from the Government of Federal Democratic of Ethiopia (hereinafter referred to as "Ethiopia"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to conduct a Follow-up Cooperation Study (hereinafter referred to as "the Study") on "The Project for Water Supply in Afar Region (hereinafter referred to as "the Original Project")."

JICA dispatched the Follow-up Cooperation Study Team (hereinafter referred to as "the Team") headed by Mr. Ryosuke Isobe, Deputy Director, Grant Aid Project Management Division 3, Financial Cooperation Implementation Department from November 30th to December 9th, 2015.

The Team held a series of discussions with the officials concerned of Ethiopia and both the Team and Ethiopia side confirmed the main items described on the attached sheets.

The Team will proceed to further works/study and prepare the Follow-up Study Report.

Semera, December 8th, 2015

磯辺良介

Mr. Ryosuke Isobe
Team Leader
Follow-up Cooperation Study Team
Japan International Cooperation Agency
Japan

Mr. Walaq Witikka
Acting Bureau Head
Irrigation and Drainage Department
The Water Resources Bureau
The Afar National Regional State

ATTACHMENT

1. Objectives of the Follow-up Cooperation

1-1. The objective of the Follow-Up Cooperation is to repair damaged water supply facilities in order to restore originally expected function under the Original Project.

1-2. The viability of the implementation of the Follow-up Cooperation will be determined after further studies in Japan.

1-3. The Study aims to have meetings with officials concerned in Ethiopia, in order to review the current situation of water supply facilities and to collect information necessary for JICA's decision-making on the Follow-up Cooperation.

2. Responsible and Implementing Agencies

2-1. The responsible and Implementing agency is the Water Resources Bureau in the Afar National Regional State. (hereinafter referred to as "the Bureau")

3. JICA's Follow-up Cooperation Scheme

3-1. The Ethiopian side understood JICA's Follow-up Cooperation Scheme as explained by the Team.

3-2. The Ethiopian side shall take the necessary measures, as described in the Article 7, for the smooth implementation of the Follw-up Cooperation, as a condition for the JICA's Follow-up Scheme to be implemented.

4. Components of the Study

4-1. Target sites of the Study were five towns; Kelewan, Nemelefen, Wederage, Kumami and Gubi Dowra.

4-2. During the Study, Gubi Dowra was excluded from the Study where its borehole had been already repaired by Ethiopian side.

4-3. Cleaning of borehole and pumping test will be carried out in Kelewan, Nemelefen and Wederage for further examination of components of the Follow-up Cooperation.In Kumami capacity of the yield of the borehole was found sufficient. Therefore cleaning of the borehole and pumping test won't be carried out in the Study.

5. Components of the Follow-up Cooperation

5-1. JICA has explained that new borehole drilling would not be implemented in the Follow-up Cooperation. Instead cleaning of borehole and pumping test will be conducted. This is because of the budgetary limitation of the Follow-up Cooperation.

5-2. The Ethiopian side understood that a final decision of the implementation of the Follow-up Cooperation would be made by JICA after further studies in Japan. Such decision may also be subject to budgetary allocation by JICA.

Afar National Regional State Water Resources Bureau

5-3. JICA will examine the Scope of Work and feasibility of the Follow-up Cooperation. The scope of work may be finalized based on available budget as well as technical affordability. Draft of Scope of Work is attached in Annex 2.

5-4. Some of expected rehabilitation works on water supply facilities are;

(a) Flushing and cleaning of borehole for Kelewan, Nemelefen and Wederage.

(b) Replacement of generator for Nemelefen, Wederage and Kumami.

(c) Replacement of submersible water pump for Kelewan, Nemelefen, Wederage and Kumami.

6. Schedule

Based on the Minutes of Discussions and technical examination of the Study, JICA will inform the Ethiopian side of the final decision of components of the Follow-up Cooperation through JICA Ethiopia Office by April 2016. Tentative schedule for the Follow-up Cooperation is attached in Annex-1.

7. Undertakings by Ethiopian side

7-1. To accord the entry and stay permit to Japanese nationals whose services may be required in connection with the supply of the services under the contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work, when necessary.

7-2. To assign counterpart personnel during the period of the Follow-up Cooperation.

7-3. To bear all the expenses, other than those to be borne by the Follow-up Cooperation, necessary for the transportation and installation of the facility, when necessary.

7-4. To take necessary actions for completion of the Follow-up Cooperation, upon the request of JICA and the consultant under the contract, including being witness of the inspections done by the consultant in each stage in the Follow-up Cooperation.

7-5. To properly and effectively utilize/maintain the repaired and/or renewed facility under the Follow-up Cooperation, including purchasing all necessary consumables for continuous utilization of the facility.

7-6. To provide JICA with necessary information on the Follow-up Cooperation upon the request of JICA.

7-7. To support the consultant teams in order to conduct field surveys efficiently and effectively.

7-8. To regularly monitor the progress of the Study by the consultant teams through Zonal Water Offices and Woreda Water Offices (WWOs).

7-9. To observe the inside situation of the boreholes utilizing borehole camera.

8. Findings by the Team

8-1. The Team asked the Bureau to submit the regional groundwater development plan to the

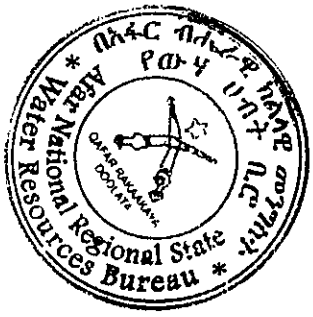
mission. The Bureau shall provide the plan to the the Team during the Study.

8-2. Currently severe drought occurs in Ethiopia especially in Afar Region. As a whole about Eight (8) million people suffers from the drought in Ethiopia. In Afar Region most of the part has influence of the severe drought and crops and plants died and the groundwater level reduced.

8-3. The service rigs procured in the Original Project are being utilized for the countermeasures to the drought as mentioned in 8-2. Therefore those equipment cannot be utilized for the Follow-up Cooperation. On the other hand the Bureau offered the Team to utilize the borehole camera which is owned by the Bureau as mentioned in 7-9.

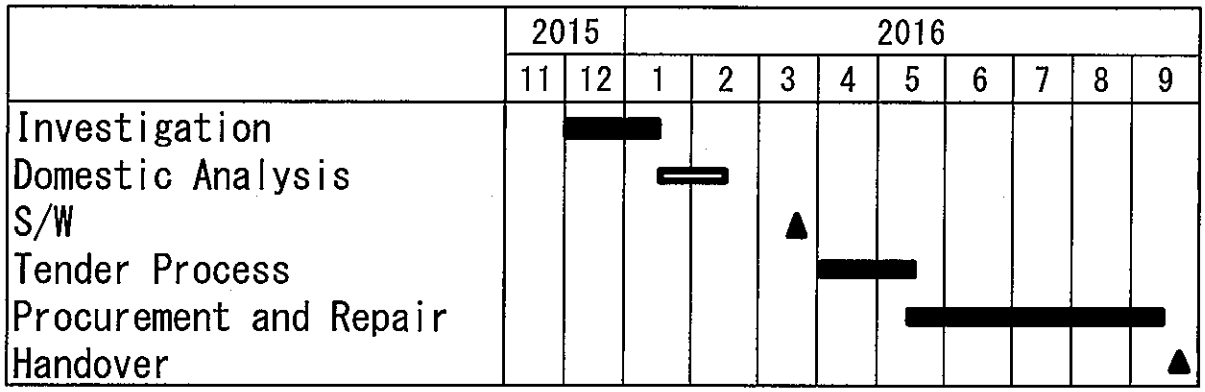
Annex-1. Tentative schedule

Annex-2. Scope of Work (Draft)



Annex 1

Tentative Schedule



Annex2: Scope of Work (Draft)

(Draft)

SCOPE OF WORK
FOR THE FOLLOW-UP COOPERATION
ON
THE PROJECT FOR WATER SUPPLY IN AFAR REGION IN FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
AGREED BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE GOVERNMENT OF FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

In response to a request from the Government of Federal Democratic of Ethiopia (hereinafter referred to as "Ethiopia"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to implement Follow-up Cooperation for the Project for Water Supply in Afar Region.

Based on the discussions between the Government of Ethiopia and JICA, this document sets forth the Scope of Work for the Follow-up Cooperation and the undertakings to be taken by the authorities concerned.

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1. Introduction

According to the survey conducted JICA Ethiopia Office in March Ethiopia, Water supply facilities in 4 towns (Nemelefen, Kelewan, Wederage and Kumami) were not working properly. In response to the request of the Government of Ethiopia, JICA decided to implement the Follow-up Cooperation for the Project for Water Supply in Afar Region.

Accordingly, JICA will undertake necessary work for the Follow-up Cooperation (hereinafter referred to as the "the Work") in cooperation with the Ethiopian authorities concerned. This document sets forth the Scope of Work for the Work and the undertakings to be taken by the Ethiopian authorities concerned.

2. Scope of Work

The Work shall be to restore function of the malfunctioned Water Supply facility in Nemelefen, Kelewan, Wederage and Kumami established under the Project for Water Supply in Afar Region in 2010. Having said that, the work doesn't contain new borehole drilling.

3. Tentative Work Schedule

The Follow-up Cooperation will be carried out in accordance with the tentative schedule indicated in Appendix 1.

4. Major Undertakings that shall be taken by the Government of Ehiopia and JICA

The Government of Ethiopia and JICA confirmed that, for the smooth implementation of the Follow-up Cooperation, Government of Ethiopia and JICA should particularly implement major undertakings described in Appendix 2 as scheduled and secure the necessary budget.

5. Mutual Consultation

The Government of Ethiopia and JICA shall consult with each other on any matters that may arise from or connected with the Follow-up cooperation prior to actual responses.

Appendix 1: Tentative schedule of the Follow-up Cooperation

Appendix 2: Major Undertakings to be taken by the Government of Ethiopia and JICA

Afar National Regional State Water Resources Bureau

Appendix 1

Tentative Schedule of the Follow-up Cooperation

	2016						
	3	4	5	6	7	8	9
Signing of S/W	▲						
Tender Process		■	■				
Procurement and Repair			■	■	■	■	■
Handover							▲

Appendix 2

Major Undertakings to be taken by the Government of Ethiopia and JICA

1. The Government of Ethiopia

1-1. To accord the entry and stay permit to Japanese nationals whose services may be required in connection with the supply of the services under the contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work, when necessary.

1-2. To assign counterpart personnel during the period of the Follow-up Cooperation.

1-3. To bear all the expenses, other than those to be borne by the Follow-up Cooperation, necessary for the transportation and installation of the facility, when necessary.

1-4. To take necessary actions for completion of the Follow-up Cooperation, upon the request of JICA and the consultant under the contract, including being witness of the inspections done by the consultant in each stage in the Follow-up Cooperation.

1-5. To properly and effectively utilize/maintain the repaired and/or renewed facility under the Follow-up Cooperation, including purchasing all necessary consumables for continuous utilization of the facility.

1-6. To provide JICA with necessary information on the Follow-up Cooperation upon the request of JICA.

1-7. To observe the inside situation of borehole utilizing borehole camera

2. JICA

2-1. JICA shall undertake the Work under contracts with appropriate consultant firm and construction firm.

5. Pumping Test Results

1. Kelewan

1.1. Step-Drawdown Test

- The minimum yield was set at 3.0 L/s and the maximum yield was set at 6.7 L/s for the step-drawdown test.
- The static water level (SWL) was 25.69 m[1], and the dynamic water level (DWL) was 31.73 m.
- As can be seen from the following figure, it was estimated that the critical yield was greater than 6.7 L/s.

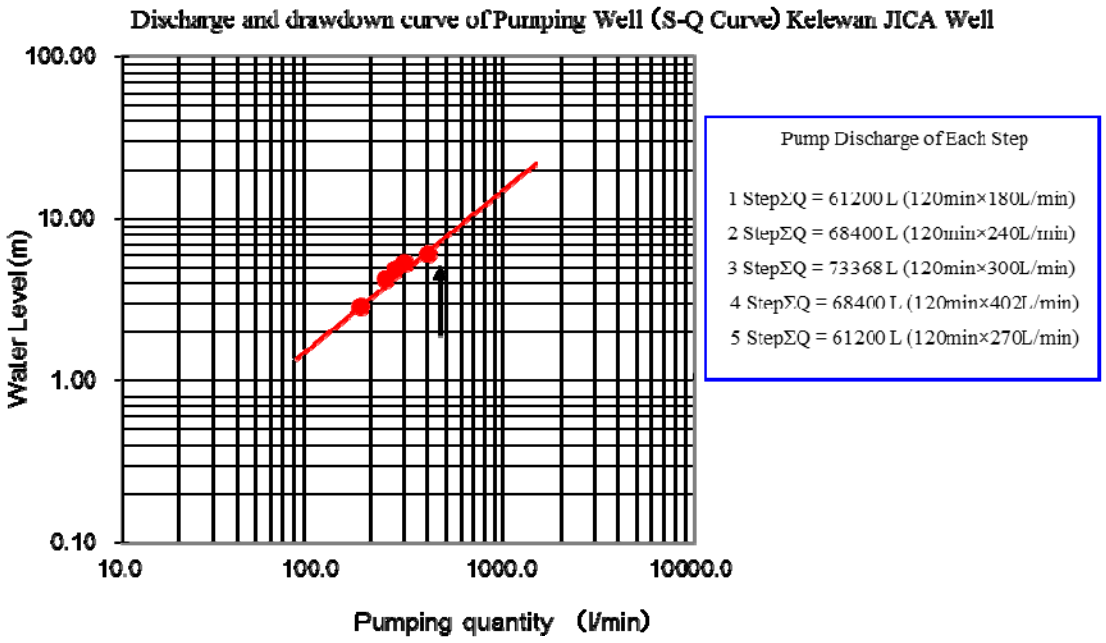

Figure 1 S-Q curve diagram

1.2. Continuous Pumping Test

- The maximum yield was set at 6.7 L/s for the continuous pumping test.
- The static water level (SWL) was 25.65 m, and the dynamic water level (DWL) was between 31.94 m and 31.98 m.

[1] Water levels described in this document are measured from a riser pipe head above the ground.

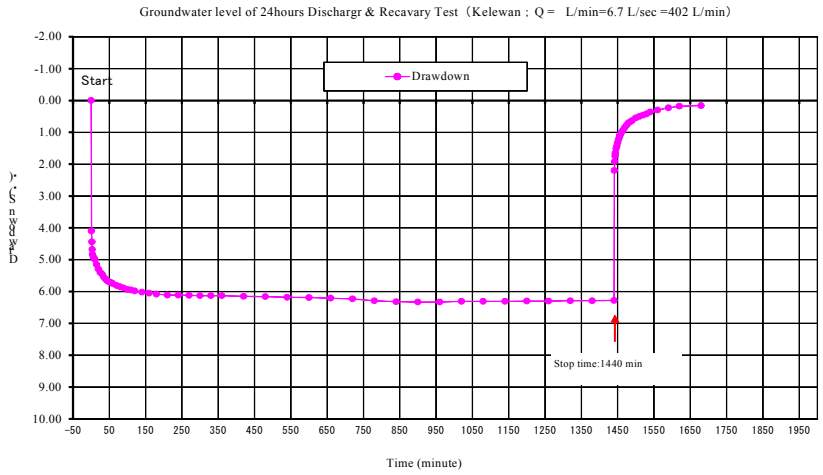

Figure 2 Fluctuation of groundwater level of the continuous pumping test (24 hours)

1.3. Recovery Test

- The groundwater level recovered up to 97.9 %, 60 minutes after stopping the pumping.

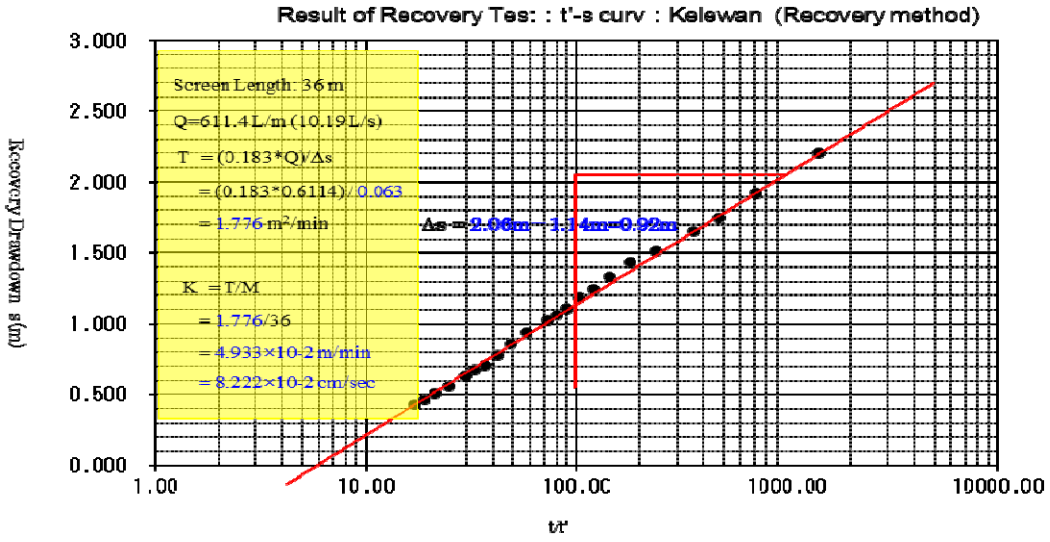

Figure 3 Graphical analysis of the recovery test

1.4. Hydrologic Constant of Aquifer

- Specific capacity: 44.38 m3/day/m
- Permeability: 3.442 E-3 cm/s

2. Nemelefen

2.1. Step-Drawdown Test

- The minimum yield was set at 1.01 L/s and the maximum yield was set at 2.5 L/s for the step-drawdown test.
- The static water level (SWL) was 9.50 m, and the dynamic water level (DWL) was 24.39 m (2.0 L/s) and 41.70 m (2.5 L/s).
- As it can be seen from the following figure, it was estimated that the critical yield was greater than 2.5 L/s.

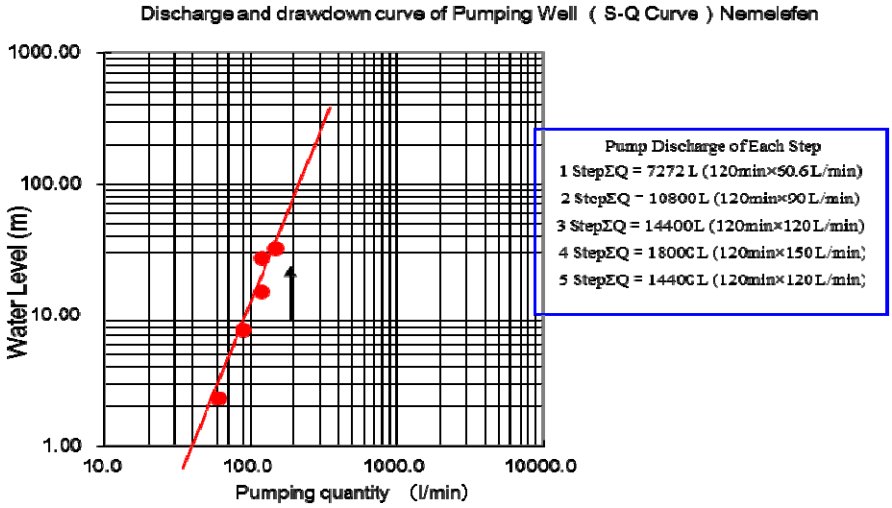

Figure 4 S-Q curve diagram

2.2. Continuous Pumping Test

- The maximum yield was set at 2.0 L/s for the continuous pumping test.
- The static water level (SWL) was 9.10 m and the dynamic water level (DWL) was between 28.33 m and 28.72 m.

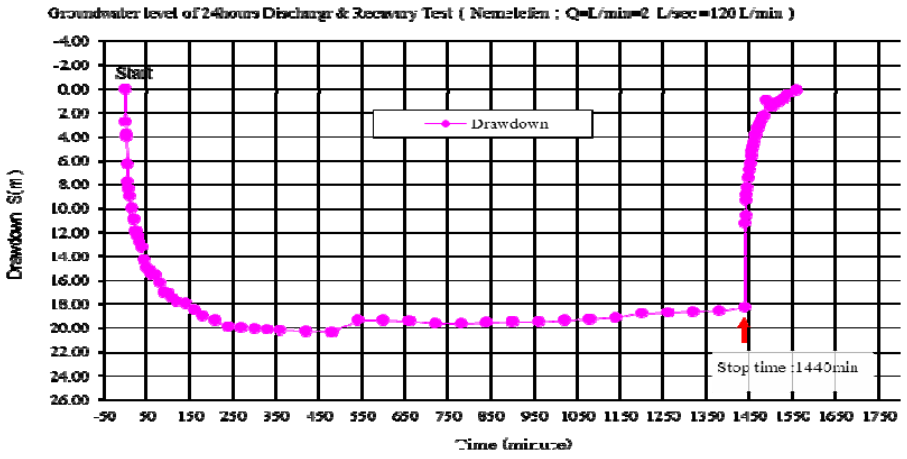

Figure 5 Fluctuation of groundwater level of the continuous pumping test (24 hours)

2.3. Recovery Test

- The groundwater level recovered up to 99.2 %, 120 minutes after stopping the pumping.

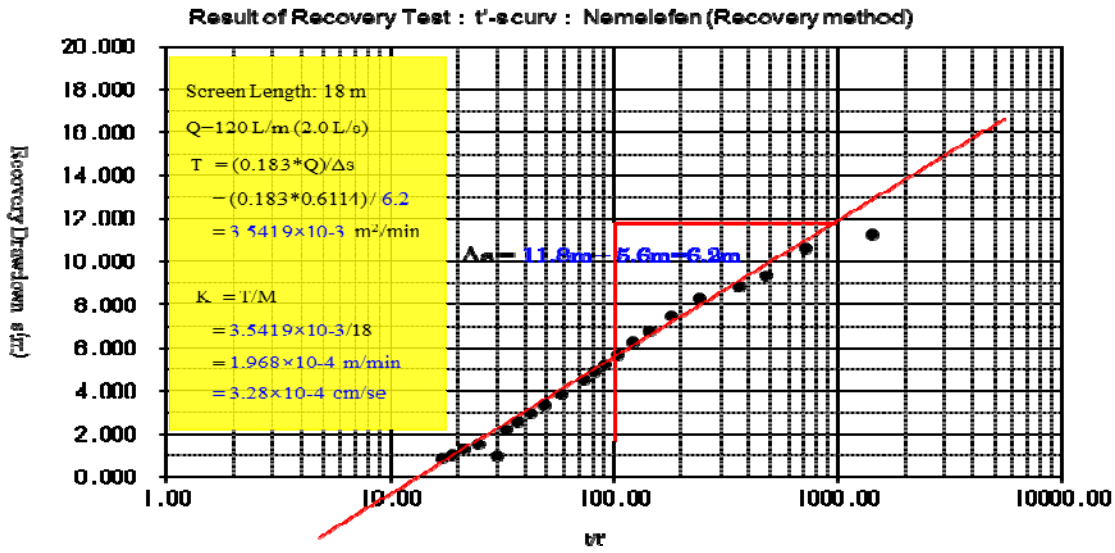

Figure 6 Graphical analysis of the recovery test

2.4. Hydrologic Constant of Aquifer

- Specific capacity: 4.49 m3/day/m
- Permeability: 2.618 E-4 cm/s

3. Wederage

3.1. Step-Drawdown Test

- The minimum yield was set at 0.38 L/s and the maximum yield was set at 1.81 L/s for the step-drawdown test.
- The static water level (SWL) was 20.95 m, and the dynamic water level (DWL) was 58.52 m.
- As it can be seen from the following figure, it was estimated that the critical yield was greater than 1.81 L/s.

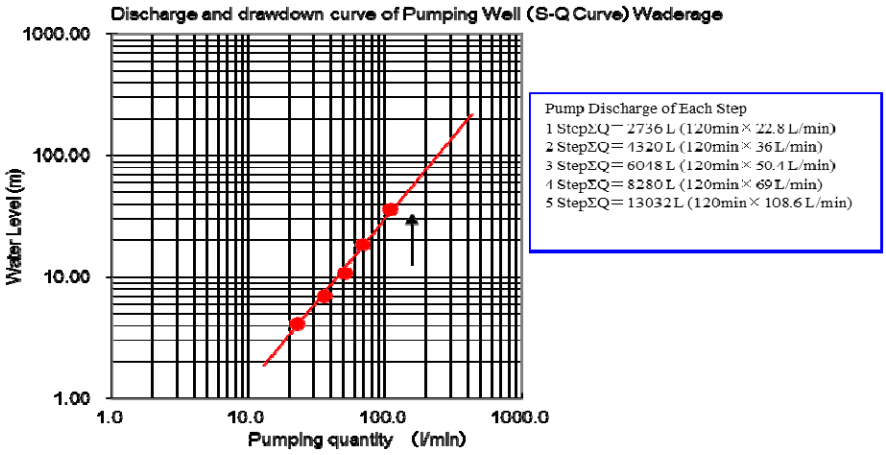

Figure 7 S-Q curve diagram

3.2. Continuous Pumping Test

- The maximum yield was set at 1.81 L/s for the continuous pumping test.
- The static water level (SWL) was 20.95 m, and the dynamic water level (DWL) was between 57.31 m and 58.52 m.

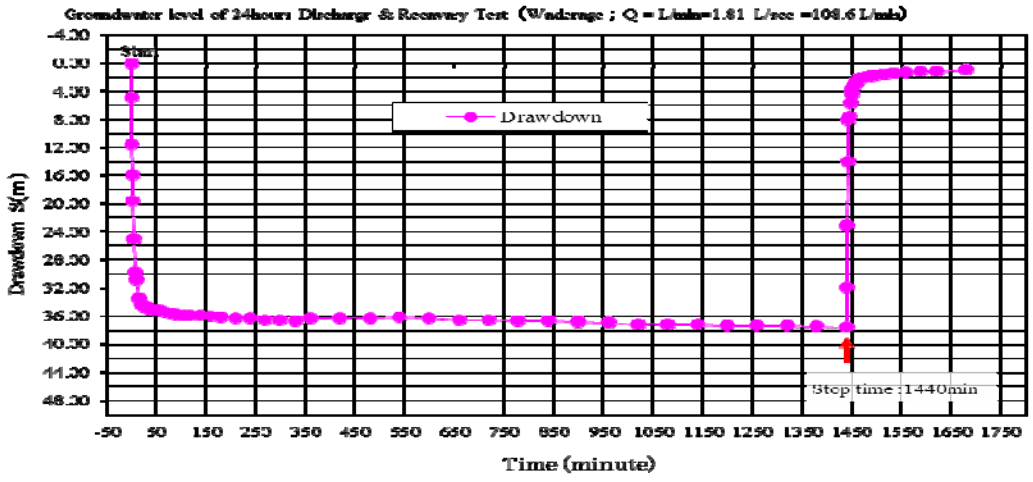

Figure 8 Fluctuation of groundwater level of the continuous pumping test (24 hours)

3.3. Recovery Test

- The groundwater level recovered up to 94.0 %, 360 minutes after stopping the pumping.

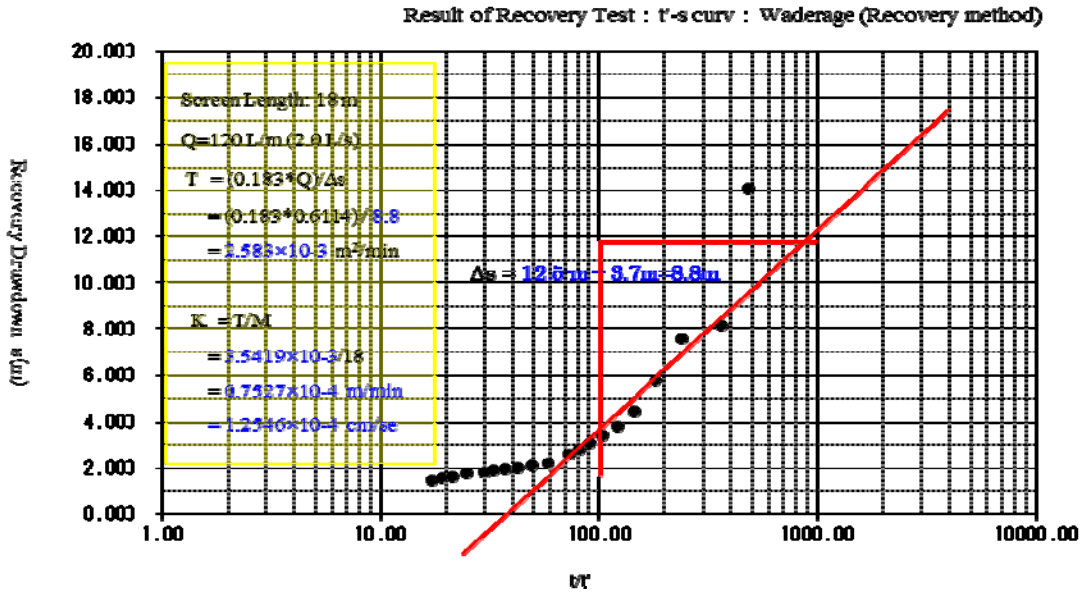

Figure 9 Graphical analysis for the recovery test

3.4. Hydrologic Constant of Aquifer

- Specific capacity: 2.01 m3/day/m
- Permeability: 1.383 E-4 cm/s