APPENDICES

1. Member List of the Study Team

(1) Basic Design Study

Name	Job title	Occupation
Mr. Hiroyuki KINOMOTO	Team Leader	Team Leader, Water Resources Development and Environment Management Team, Project Management Group III, Grant Aid Management Department, JICA
Mr. Yutaka FUKASE	Planning Management	Water Resources Development and Environment Management Team, Project Management Group III, Grant Aid Management Department, JICA
Mr. Masayuki TAGUCHI	Chief/Water Supply Planner	Manager, International Department Kyowa Engineering Consultants Co., Ltd.
Mr. Yoichi HARADA	Water Supply Facilities Design I / Equipment Planning	Manager, International Department Kyowa Engineering Consultants Co., Ltd.
Mr. Hiroyuki HIGUCHI	Water Supply Facilities Design II	Engineer, International Department Kyowa Engineering Consultants Co., Ltd.
Dr. Kenji YOSHIDA	Environment & Social Consideration/ Hydrogeology	Senior Hydro-geologist, Water Resource Dept. International Division, Yachiyo Engineering Co., Ltd.
Ms. Rie KAWAHARA	O&M planning/Sociological Research	Kaihatsu Management Consulting, Inc.
Mr. Susumu HONDA	Construction & Procurement Planning/Cost Estimate	Manager, International Department Kyowa Engineering Consultants Co., Ltd.
Ms. Yukiko OHNO	Coordinator	Kyowa Engineering Consultants Co., Ltd.

(2) Explanation of Draft Summary Report

Name	Job title	Occupation
Mr. Naoki ANDO	Team Leader	Team Leader, Water Resources Development and Environment Management Team, Project Management Group III, Grant Aid Management Department, JICA
Mr. Masayuki TAGUCHI	Chief/Water Supply Planner	Manager, International Department Kyowa Engineering Consultants Co., Ltd.
Mr. Yoichi HARADA	Water Supply Facilities Design I / Equipment Planning	Manager, International Department Kyowa Engineering Consultants Co., Ltd.

2. Study Schedule

(1) Basic Design Study

	Day-date		Official member		Consultant member						
			Kinomoto	Fukase	Taguchi	Harada	Higuchi	Yoshida	Kawahara	Honda	Ohno
1	Jan5	Thu			Haneda→Osaka→						Along with Team
2	Jan6	Fri			→Dubai→Nairobi→Addis Ababa						Along with Team member
3	Jan7	Sat			Collection of quotations from Local Consultants (L/C)						Along with Team member
4	Jan8	Sun		Narita→Frankfurt	Negotiation with Local Consultants, Preparation for Field survey						Along with Team member
5	Jan9	Mon		Frankfurt→Addis Ababa	Visit to JICA, Data Collection, Sign with L/C						Along with Team member
6	Jan10	Tue		Japan Embassy, JICA, MOFED		Preparation for Field survey, Discussion with L/C					Along with Team member
7	Jan11	Wed	Narita→Bangkok		Mobilization (Addis Ababa→Afar)				Discussion with L/C		Along with Team member
8	Jan12	Thu	Bangkok→Addis Ababa		Courtesy call to AWRB, Discussion on Minutes of Discussion (M/D)				Discussion with L/C		Along with Chief
9	Jan13	Fri	Mobilization (Addis Ababa→Afar), Site Survey (Chifra, Derayitu, Kelewan), Team Meeting, Preparation of M/D			Site Survey (Eli Wuha), Mobilization to Bait			Discussion with L/C		Along with Chief
10	Jan14	Sat	Discussion of M/D, Team Meeting			Round trip from Bait to Eli Wuha, Site Survey (Eli Wuha)			Mobilization to Afar		Along with Chief
11	Jan15	Sun	Site Survey (Kumami), Mobilization to Addis Ababa			Site Survey (Chifra)					Along with Chief
12	Jan16	Mon	Discussion of M/D (MoFed, MoI, AWRB)			Site Survey (Chifra)					Along with Chief
13	Jan17	Tue	Signing to M/D			Site Survey (Derayitu)					Along with Chief
14	Jan18	Wed	Report to EoJ, JICA, Addis Ababa→			Site Survey (Kelewan)					Along with Chief
15	Jan19	Thu	→Frankfurt→		Mobilization to Afar	Site Survey (Kelewan)		Site Survey (Gubi Dowra)	Site Survey (Kelewan)		Along with Chief
16	Jan20	Fri	→Narita		Site Survey (Gubi Dowra)				Site Survey (Kelewan)		Along with Chief
17	Jan21	Sat			Site Survey (Gubi Dowra)	Site Survey (Gubi Dowra)		Mobilization to Kemise	Site Survey (Gubi Dowra)		Along with Chief
18	Jan22	Sun			Site Survey (Gubi Dowra, Alamata)	Mobilization to Desse		Mobilization to Wederage			Along with Chief
19	Jan23	Mon			Mobilization to Kombolcha			Site Survey (Wederage)	Mobilization to Kombolcha		Along with Chief
20	Jan24	Tue			Site Survey (Nemelefen)			Site Survey (Wederage)	Site Survey (Nemelefen)		Along with Chief
21	Jan25	Wed			Site Survey (Nemelefen)	Site Survey (Wederage)		Site Survey (Nemelefen)	Site Survey (Nemelefen)		Along with Chief
22	Jan26	Thu			Site Survey (Wederage)	Mobilization to Gawane			Site Survey (Wederage)		Along with Chief
23	Jan27	Fri			Site Survey (Wederage)	Site Survey (Dulecha)			Site Survey (Wederage)		Along with Chief
24	Jan28	Sat			Site Survey (Dulecha)						Along with Chief
25	Jan29	Sun			Site Survey (Dulecha)	Site Survey (Kumami)		Mobilization to Awash	Site Survey (Dulecha)		Afar →Addis Ababa
26	Jan30	Mon			Site Survey (Kumami)			Mobilization to Addis Ababa	Site Survey (Kumami)		Data collection
27	Jan31	Tue			Site Survey (Kumami)	Mobilization to Addis Ababa		Data Collection	Site Survey (Kumami)		Data collection
28	Feb1	Wed			Data Collection in Semera	Data Classification		Data Collection	Site Survey (Eli Wuha)		Data collection
29	Feb2	Thu			Data Collection in Semera	Data Classification		Data Collection	Site Survey (Eli Wuha)		Data collection
30	Feb3	Fri			Data Collection in Semera	Data Collection	Addis Ababa→Dubai	Data Collection	Mobilization to Addis Ababa		Addis Ababa→Dubai
31	Feb4	Sat			Mobilization to Addis Ababa	Data Collection	Dubai→Haneda	Addis Ababa→Dubai	Data Processing	Haneda→Kansai→	Kansai→Haneda
32	Feb5	Sun			Team Meeting			Dubai→Haneda	Addis Ababa→Dubai	Dubai→Addis Ababa	
33	Feb6	Mon			Data Collection in Addis Ababa	Survey of Construction Materials			Dubai→Haneda	Survey of Construction Materials	
34	Feb7	Tue			Data Collection in Addis Ababa	Survey of Construction Materials				Survey of Construction Materials	
35	Feb8	Wed			Data Collection in Addis Ababa	Mobilization to Kombolcha				Mobilization to Kombolcha	
36	Feb9	Thu			Data Collection in Addis Ababa	Site Survey (Gubi Dowra, Kelewan)				Site Survey	
37	Feb10	Fri			Report to EoJ, JICA	Site Survey (Kelewan)				Site Survey	
38	Feb11	Sat			Addis Ababa→Dubai→	Site Survey (Chifra)				Site Survey	
39	Feb12	Sun			→Kansai→Haneda	Mobilization to Debra Brein				Site Survey	
40	Feb13	Mon				Mobilization to Addis Ababa				Mobilization to Addis Ababa	
41	Feb14	Tue				Data Collection				Survey of Construction Materials	
42	Feb15	Wed				Data Collection				Survey of Construction Materials	
43	Feb16	Thu				Data Collection				Survey of Construction Materials	
44	Feb17	Fri				Data Collection				Survey of Construction Materials	
45	Feb18	Sat				Data Collection				Survey of Construction Materials	
46	Feb19	Sun				Data Classification				Survey of Construction Materials	
47	Feb20	Mon				Data Collection				Survey of Construction Materials	
48	Feb21	Tue				Mobilization to Afar				Addis Ababa→Dubai→	
49	Feb22	Wed				Meeting with AWRB				Kansai→Haneda	
50	Feb23	Thu				Mobilization to Kombolcha					
51	Feb24	Fri				Site Survey (Chifra)	Narita→Bangkok				
52	Feb25	Sat				Site Survey (Wederage)	Bangkok→Addis Ababa				
53	Feb26	Sun				Mobilization to Addis Ababa	Preparation for site survey				
54	Feb27	Mon				Courtesy call to Luci Vocational School	Addis Ababa→Afar				
55	Feb28	Tue				Data Collection					
56	Mar1	Wed				Data Collection					
57	Mar2	Thu				Data Collection					
58	Mar3	Fri				Data Collection					
59	Mar4	Sat				Addis Ababa→Dubai→	Preparation for site survey				
60	Mar5	Sun				Kansai→Haneda	Mobilization to Kombolcha				
61	Mar6	Mon					Site Survey				
	-	-									
118	May2	Tue					Site Survey				
119	May3	Wed					Site Survey				
120	May4	Thu					Site Survey				
121	May5	Fri					Site Survey				
122	May6	Sat					Site Survey				
123	May7	Sun					Site Survey				
124	May8	Mon					Site Survey				
125	May9	Tue					Addis Ababa→Bangkok				
126	May10	Wed					Bangkok→Narita				

(2) Explanation on Draft Summary Report

			Official member		
			Ando	Taguchi	Harada
1	Jun4	Sun			
2	Jun5	Mon			
3	Jun6	Tue			
4	Jun7	Wed			
5	Jun8	Thu			
6	Jun9	Fri			
7	Jun10	Sat			
8	Jun11	Sun			
9	Jun12	Mon			
10	Jun13	Tue		→Dubai→	
11	Jun14	Wed			

3. List of the Personnel contacted

⑴ Embassy of Japan in Ethiopia

Mr. Kenjiro Izumi	Ambassador to Ethiopia
Mr. Hiroshi Ishibasi	Secretary

⑵ JICA Ethiopia Office

Mr. Naoki Saitoh	Resident Representative
Mr. Kimiaki Jin	Deputy Resident Representative （Basic Design Study）
Mr. Naoki Ando	Deputy Resident Representative （Explanation on Draft Summary Report）
Mr. Hiroyuki Yakushi	Assistant Resident Representative
Dr. Yuji Maruo	Chief advisor, Ethiopia Water Technology Center Project
Mr. Shigeki Ishigaki	Project Coordinator, Ethiopia Water Technology Center Project

(3) Ministry of Finance and Econimic Development

Mr. Hailemichael Kinfu	Head, Bilateral Cooperation Department
Ms. Asnakech Teferra	Team Leader, Bilateral Cooperation Department

(4) Ministry of Water Resource

Mr. Ketema Wondimagegnehu	Head, Technical & Vocational Training School Coordination Unit

(5) Water Resource Bureau, Afar National Regional State

Mr. Abdulkadir Mohamed	Head, Water Resource Bureau
Mr. Taddesse Melkamu Bollollo	Head, Study & Design Department
Mr. Nuru Yesuf	Head, Water Resource & Contract Administration Department
Mr. Sedik Mohammed	Deputy Head, Water Resource & Contract Administration Department
Mr. Solomon Melake	Leader, Study Team
Mr. Leuseged Zewdie	Leader, Water Quality Control Team
Mr. Osman Mohammed	Geologist, Water Resource Administration & Policy Study Team
Mr. Abdrazak Malmati	Engineer, Water Resource Administration & Policy Study Team

(6) Bureau of Finance and Econimic Development （BoFED）

Mr. Seife Negash	Specialist, Economic and Social Department
Mr. Yakum Negash	Staff, Economic and Social Department
Mr. Sisay Worku	Team Leader, Social Development

⑹ UNICEF

Mr. Hans Spruijt	Chief, Water & Environmental Sanitation
Mr. Haile Gashaw	Staff, Water & Environmental Sanitation

(7) The World Bank

Mr. Yitbarek Tessema	Senior Water and Sanitation Specialist

(8) Water Action (NGO)

Mr. Adane Kassa	Executive Director
Ms. Meselech Seyoum	Service Manager, Fund Rising & Communication

(9) Afar Water Works Construction Enterprise

Mr. Kssahun Lulseged	Head, Water Supply and Sanitation Design Department

4. Minutes of Discussions

(1) Basic Design Study

MINUTES OF DISCUSSIONS
ON THE BASIC DESIGN STUDY
ON THE PROJECT FOR RURAL WATER DEVELOPMENT IN THE AFAR STATE
IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

Based on the results of the Preparatory Study on the project for water supply, which was held on November 2002, the Government of Japan decided to conduct a Basic Design Study on the Project for Rural Water Development in the Afar State (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to the Federal Democratic Republic of ETHIOPIA the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Hiroyuki Kinomoto, Team Director, Water Resources Development and Environment Management Team, Project Management Group III, Grant Aid Management Department, JICA and is scheduled to stay in the country from 6 January to middle of April, 2006.

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

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

Addis Ababa, January [illegible] 2006

Hiroyuki Kinomoto
Leader,
Basic Design Study Team
Japan International Cooperation Agency
Japan

Abdulkadir Mohammed
Bureau Head,
Water Resources Bureau,
Afar National Regional State
Federal Democratic Republic of Ethiopia

Witnessed by

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

ATTACHMENT

1. Objective of the Project

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

2. Project sites

The sites of the Project requested by the Ethiopian side are following

- Kumami (Woreda Town of Semu Robi Woreda)
- Gubi Dowra (Woreda Town of Yalo Woreda)
- Derayitu (Woreda Town of Aura Woreda)
- Nemelefen (Woreda Town of Telalak Woreda)
- Chifra (Woreda Town of Chifra Woreda)
- Wederage (Woreda Town of Dewe Woreda)
- Eli Wuha (Mile Woreda)
- Kelewan (Woreda Town of Gulina Woreda)
- Dulecha (Woreda Town of Dulecha Woreda)

3. Responsible and Implementing Agency

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

3-2. The Implementing Agency is Water Resources Bureau, Afar National Regional State.

4. Items requested by the Government of Ethiopia

After discussions with the Team, the items described in Annex-3 were finally requested by Ethiopian side. JICA will assess the appropriateness of the request and will consider contents of the Project. Among the requested item, the Team explained as to the equipment, that unless necessary data and information on following issues will be submitted, it is difficult to include equipment in the Project.

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

5. Japan's Grant Aid Scheme

Ethiopian side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Ethiopia as explained by the Team and described in Annex-1 and Annex-2.

6. Schedule of the Study

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

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

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

7. Other relevant issues

(1) Arrangements for the Study

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

(2) Prioritization and Selection for the Project

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

a) Urgent needs for water supply facilities
b) Operation and Maintenance Capability of the facilities
c) Water Resource Potential
d) Security Conditions

(3) Operation and Maintenance of facilities and equipments

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

(4) Tax Payment

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

(5) Safety and Security

Ethiopian side agreed to take any necessary measures deemed necessary to secure the safety of the member of the Team

(6) Overlapping with other project

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

(7) Project Title

Both sides agreed that the Project title shall be 'The Project for Water Supply Development in the Afar National Regional State in the Federal Democratic Republic of Ethiopia'.

(8) Counterpart(s) Training

Ethiopian side requested counterpart(s) training in Japan. The team promised to convey the request to JICA Head Quarter, however the Team explained Ethiopian side that they firstly need to consult with JICA Ethiopia office and consultant study team, and that they need to send the formal request through diplomatic channel.

ANNEX-I : JAPAN'S GRANT AID SCHEME

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

1. Grant Aid Procedure

1) Japan's Grant Aid Program is executed through the following procedures.

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

2) Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA to conduct a study on the request. If necessary, JICA send a Preliminary Study Team to the recipient country to confirm the contents of the request.

Secondly, JICA conducts the study (Basic Design Study), using Japanese consulting firms.

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

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

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

2. Basic Design Study

JAPAN INTERNATIONAL COOPERATION AGENCY JICA

OAFAR RAKAKAYA DOLATA Afar National Regional State Water Resources Bureau

1) Contents of the Study

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

a) confirmation of the background, objectives and benefits of the Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation;

b) evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from the technical, social and economic points of view;

c) confirmation of items agreed on by both parties concerning the basic concept of the Project;

d) preparation of a basic design of the Project; and

e) estimation of costs of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

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

2) Selection of Consultants

For the smooth implementation of the Study, JICA uses a consulting firm selected through its own procedure (competitive proposal). The selected firm participates the Study and prepares a report based upon the terms of reference set by JICA.

At the beginning of implementation after the Exchange of Notes, for the services of the Detailed Design and Construction Supervision of the Project, JICA recommends the same consulting firm which participated in the Study to the recipient country, in order to maintain the technical consistency between the Basic Design and Detailed Design as well

as to avoid any undue delay caused by the selection of a new consulting firm.

3. Japan's Grant Aid Scheme

1) Exchange of Notes (E/N)

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

2) "The period of the Grant" means the one fiscal year which the Cabinet approves the project for. Within the fiscal year, all procedure such as exchanging of the Notes, concluding contracts with consulting firms and contractors and final payment to them must be completed.

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

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

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability of Japanese taxpayers.

5) Undertakings required to the Government of the recipient country

a) to secure a lot of land necessary for the construction of the Project and to clear the site;

b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities outside the site;

c) to ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and internal transportation therein of the products purchased under the Grant Aid;

d) to exempt Japanese nationals from customs duties, internal taxes and fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts;

e) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the verified contracts such as facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work;

f) to ensure that the facilities constructed and products purchased under the Grant Aid be maintained and used properly and effectively for the Project; and

g) to bear all the expenses, other than those covered by the Grant Aid, necessary for the Project.

h) to provide necessary permissions, licenses, and other authorization for implementing the Project, if neccessary.

i) "Proper Use"

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

j) "Re-export"

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

k) Banking Arrangement (B/A)

- The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the verified contracts.
- The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of recipient country or its designated authority.

l) Authorization to Pay (A/P)

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

Annex -2

Major Undertakings to be taken by Each Government

NO	Items	To be covered by Grant Aid	To be covered by Recipient side
1	To secure land		•
2	To clear, level and reclaim the site when needed		•
3	To construct gates and fences in and around the site		•
4	To construct the parking lot	•	
5	To construct roads		
	1) Within the site	•	
	2) Outside the site		•
6	To construct the building	•	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
1)Furniture and Equipment			
a.General furniture			•
b.Project equipment		•	
8	To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
	1) Advising commission of A/P		•
	2) Payment commission		•
9	To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
	1) Marine(Air) transportation of the products from Japan to the recipient country	•	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		•
	3) Internal transportation from the port of disembarkation to the project site	•	
10	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		•
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		•
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		•
13	To bear all the expenses, other than those to be borne by the Grant Aid, necessary for construction of the facilities as well as for the transportation and installation of the equipment		•

Note

B/A : Bank Arrangement

A/P : Authorization to Pay

Items requested by the Government of Ethiopia

The Ethiopian side requested following items and explained that Water Supply Facilities have higher priority than Equipment.

1. Requested Water Supply Facilities

Request of Water Supply Facilities include construction works of additional boreholes, distribution reservoirs, extension of distribution lines and some additional public taps etc., as well as rehabilitation of some existing boreholes. Those 9 candidate towns for requested water supply facilities are as follows.

1) Kumami (Woreda Town of Semu Robi Woreda)

2) Gubi Dowra (Woreda town of Yalo Woreda)

3) Derayitu (Woreda Town of Aura Woreda)

4) Nemelefen (Woreda town of Telalak Woreda)

5) Chifra (Woreda Town of Chifra Woreda)

6) Wederage (Woreda Town of Dewe Woreda)

7) Eli Wuha (Mille Woreda)

8) Kelewan (Woreda Town of Gulina Woreda)

9) Dulecha (Woreda Town of Dulecha Woreda)

2. Requested Equipment

In order to build the capacity of Water Resources Development Bureau in terms of effective and efficient maintenance of existing facilities the following equipment are requested.

a) One service Rig with auxiliary tools and pumping test equipment

b) One mobile workshop with necessary tools for water supply facility maintenance

In addition to the above requested items, the Ethiopian side requested the consultant services to raise the capacity of the personnel in terms of operation, maintenance and rehabilitation of water supply facility and equipment.

(2) Explanation on Draft Final Report

MINUTES OF DISCUSSIONS
ON BASIC DESIGN STUDY ON
THE PROJECT FOR WATER SUPPLY DEVELOPMENT IN THE AFAR NATIONAL REGIONAL STATE
IN THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
(EXPLANATION ON DRAFT REPORT)

In January 2006, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on the Project for Water Supply Development in the Afar National Regional State (hereinafter referred to as "the Project") to the Federal Democratic Republic of ETHIOPIA (hereinafter referred to as "ETHIOPIA"), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the Study.

In order to explain and to consult the ETHIOPIA on the components of the draft report, JICA sent to ETHIOPIA the Draft report Explanation Team (hereinafter referred to as " the Team "), which is headed by Mr. Naoki Ando, Deputy Resident Representative, JICA Ethiopia Office, from 5 June to 12 June 2006.

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

Addis Ababa, June 8, 2006

Naoki Ando
Leader,
Basic Design Study Team,
Japan International Cooperation Agency
Japan

Abdulkadir Mohammed
Bureau Head,
Water Resources Bureau,
Afar National Regional Sate
Federal Democratic Republic of Ethiopia

Witnessed by

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

for Mohammed Awol
Head,
Finance and Economic Development Bureau
Afar National Regional State
Federal Democratic Republic of Ethiopia

ATTACHMENT

1.Components of the Project described in the Draft Report

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

2.Japan's Grant Aid scheme

The Ethiopian side understands the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of ETHIOPIA as explained by the Team and described in Annex-1 and Annex-2 of the Minutes of Discussions signed by both parties on January 17, 2006.

3.Schedule of the Study

JICA will complete the final report in accordance with the confirmed item and send it to the Government of ETHIOPIA by the end of August 2006.

4.Other relevant issues

(1) Off-setting

It is confirmed that Finance and Economic Development Coordination Bureau of Afar Region in collaboration with the Water Resource Development Bureau of the Afar Region shall make necessary measures for the arrangement of Offsetting system as regional mandate for ensuring the smooth implementation of Japan's Grant Aid Scheme.

(2) Tax Payment

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

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

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

a) Construction of water supply facilities using groundwater resources in 9 towns of the Afar National Regional State.

b) Procurement of equipment consisting of;

- One (1) set of cargo truck equipped with a 3-ton crane and equipment and accessories for well development.
- One (1) set of cargo truck equipped with a 3-ton crane and equipment and accessories for pumping test.
- One (1) set of water quality analysis kit.

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

- Enhancement for well rehabilitation technique for Water Resources Bureau of Afar State.

- Enhancement for sustainable operation & maintenance capacity of water supply facilities in each target town.

d) Phasing of the implementation of the Project

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

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

e) Other subjects confirmed on the Component of the Project

- The Ethiopian side understood that in respect of water quality of the groundwater in Gubi Dowra town, high contents of Sodium and Fluoride would be in cause of the geological characteristics of the area. And the Ethiopian side agreed the following measures for the proposed facilities in Gubi Dowra town;
  - The test well drilled in the Study should be abandoned for utilizing as a production well due to exceeded contents of these minerals against the Ethiopian Guideline for Drinking Water Quality.
  - A water quality of the existing well tested by the Study was confirmed to clear the Guideline, however, it is difficult to ensure its permanent use because no well structural and drilling data was available.
  - One (1) well shall be drilled near the existing well as the production well by which the same groundwater of the existing well shall be pumped and transmitted to a new ground reservoir.

- In Derayitu, the Ethiopian side requested to drill a new well in the different location instead of re-drilling a well near the existing well in order to keep the existing well for the emergency purposes. The Japanese side will investigate the possibility of the request focusing on construction cost and grandwater potential.

- The Japanese side explained that in Gubi Dowra town, the operational cost would be constantly more than expected revenue by some thousands Birrs monthly even if all users are willing to pay 25 cents for 25 litters of water. Even in other towns, water committees have to set appropriate water fees and maintain high paying rates of users in order to cover operational and maintenance cost. The Ethiopian side has understood the explanation and promised that if the deficit is too large for the individual towns to maintain the operation, the authorities of Afar National Regional State will take necessary measures, such as subsidies, to assure sustainable operation of facilities in the all towns.

(4) Criteria for successful well

Criteria for successful well in implementation stage are as follows.

- Total yield of existing and newly drilled wells in each town shall meet designed water supply volume.
- Water quality shall be basically within the Ethiopian Guideline for Drinking Water Quality.

(5) Undertakings of the Ethiopian side

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

- To carry out the works which are proposed for the Ethiopian side to implement in the draft report.
- To secure access roads to the sites of the proposed facilities, especially in Kumami town a road to the tube well site shall be constructed for drilling and installation of the proposed well. It will be the maintenance road in future.
- To provide lands for temporary site management offices for the Contractor in accordance with requests of it.
- To appoint and deploy counterpart personnel who will participate as trainees to the Soft Component program.
- To bear daily allowance and transportation costs for the counterpart personnel who will participate to each component of the Project.
- To bear all the expenses for consumables such as fuel, oil, others to be necessary for operation and transportation of all the equipment and machinery to be used in the Soft Component program.
- To bear all the expenses for repairing WRB's own equipment and machinery, if necessary, to be used in the Soft Component program.
- To organize water committees in Kumami and Nemelefen, and to facilitate committees in all towns.

5. Other Relevant Data

(1)Cost Estimate of Obligations of Ethiopian Side

1) Grading and Compacting Works for Temporary Road

Road length＝3.03km

Road width＝6.0m

Thickness＝0.3m

Bill of Quantities＝3,030×6.0×0.3＝ 5,454 m^3

Item	BQ	Unit Price (Birr/m^3)	Price (Birr)
Grading and Compacting Works	5,454	228	1,243,512

(16,961,504Yen)

2) Fencing Work for New Wells

Pole：Wood, Fence：Barbed wire

Deimension：L 10.0m×W10.0m×H1.5m

Well Numbers：14 sites

Bill of Quantities＝(10.0×4-5)×12＝ 420 m

Item	BQ	Unit Price (Birr/m)	Price (Birr)
Fencing Work for new Wells	420	86	36,120

(492,677Yen)

3) Fencing Work for New Public Fountains

Specifications is same as New Wells.

Public fountans' number to be constructed：28

Bill of Qunaties per Public fountain＝(5.5+0.5 x 2) x 4-2.5＝ 23.5 m

Total B/Q=23.5 x 28＝ 658 m

Item	BQ	Unit Price (Birr/m)	Price (Birr)
Fencing work for new public fountains	658	86	56,588

(771,861円)

(2) GEOPHYSICAL SURVEY

1.1 GENERAL

The purpose of the geophysical survey was to obtain information on the nature of the subsurface, thereby getting indirect information about the occurrence of groundwater. The main objectives of the survey were

- to estimate the thickness different layers,
- to estimate the depth to water bearing horizons

1.2 INSTRUMENTATION AND FIELD PROCEDURE

- Type of instruments
    - ABEM TERRAMETER SAS 300B
    - ABEM TERRAMETER SAS 300C
- Type of geophysical survey
    - Vertical Electrical Sounding (VES)
        - Type of electrode configuration Schlumberger array
    - 2D survey

1.3 DATA PROCESSING AND PRESENTATION

The field curves were manually interpreted using the two-layer master curves and auxiliary point charts to obtain starting model parameters for the more rigorous inverse modeling using the computer software " RESIST".

The best-fit layer parameters obtained from the inversion process were used to produce the geoelectric interpretation.

1.4 PROJECT TOWN

The project towns are:

No.	Town	Woreda	No. of VES	No. of 2D
1	Gubi Dowra	Yalo	8	
2	Kelwan	Gulina	4	
3	Derayitu	Awra	4	
4	ChfIra	Chifra	7	1
5	Eli Wuha	Mille	8	1
6	Nemelefen	Telalak	7	1
7	Wederage	Dawe	10	
8	Kumami	Simi Robi	2	
9	Dulecha	Dulecha	8	
TOTAL			58	3 (3lineX2Times=6)

2 ELWUHA TOWN

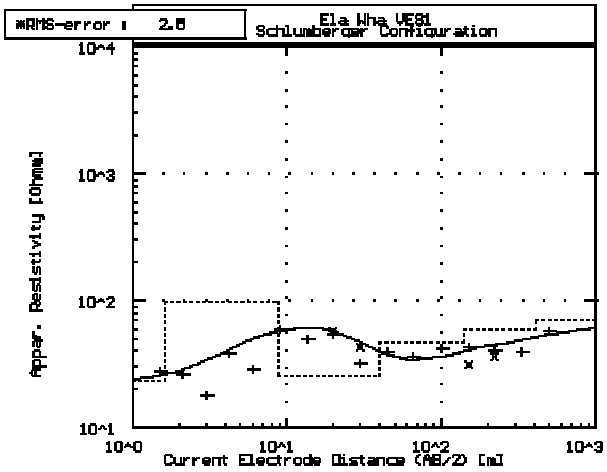
2.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	652611	1242385	
2	651931	1242915	
3	653402	1242123	No.2 Drilling Site
4	650697	1242642	
5	651256	1243282	No.1 Drilling Site – abandoned
6	652367	1243645	
7	651642	1245475	
8	651530	1242973	

2.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

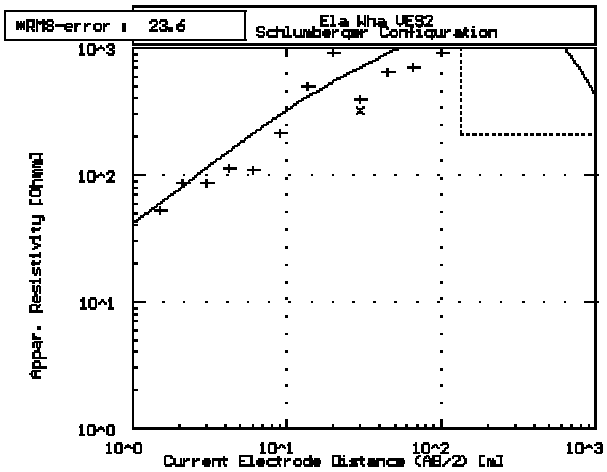
	VES-1	VES-2	VES-3	VES-4	VES-5	VES-6	VES-7	VES-8	VES-9	VES-10
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A
1.5	27.883	52.878	7.22	40.56	8.22	5.42	65.68	9.21		
2.1	26.135	87.25	5.62	29.21	4.76	10.16	66.42	4.45		
3.0	17.958	86.625	5.48	33.27	3.46	22.27	45.80	3.9		
4.2	38.235	113.78	8.19	38.45	59.29	16.52	36.21	5.36		
6.0	28.589	110.175	10.48	41.02	54.58	16.04	24.63	15.82		
9.0	59.944	214.63	16.71	31.75	30.48	13.60	30.98	27.43		
13.5	50.107	497.07	22.19	38.22	31.46	8.00	34.72	58.91		
20.0	54.875	910.00	33.75	51.25	42.5	27.50	40.00	68.75		
20.0	57.752	1183.72	28.00	28.11	35.73	29.54	48.12	55.27		
30.0	42.733	322.62	45.28	96.2	37.92	39.62	74.43	67.92		
30.0	32.14	395.95	30.6	81.81	23.5	39.32	76.16	70.51		
45.0	39.16	638.04	19.35	133.64	22.88	36.40	46.8	109.20		
66.0	36.27	698.34	25.99	128.82	19.21	49.72	25.99	157.07		
100.0	42.182	903.90	31.18	123.14	10.48	102.18	62.09	277.72		
150.0	42.924	2704.80	58.8	352.80	21.22	117.60	170.52	1569.96		
150.0	31.10	2709.85	75.07	129.41	11.29	43.61	143.00	787.21		
220.0	36.54	4359.6	176.00	98.40	17.76	113.40	92.23	945.00		
220.0	40.66	3787.20	45.36	270	21.06	110.16	152.28	1283.00		
330.0	39.38	1470	64.87	375.00	67.50	112.50	150.00	1087.50		
500.0	57.09	1181.6	51.2	553.6	72.66	121.10				
750.0										

2.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



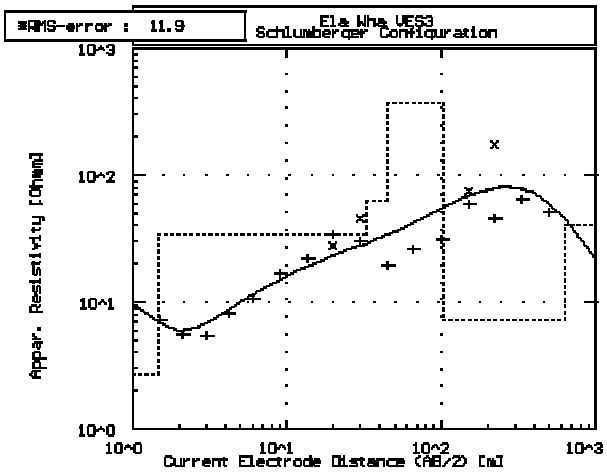
No	Res	Thick	Depth
1	23.1	1.6	1.6
2	97.3	7.1	8.7
3	26.6	31.0	39.7
4	47.3	101.6	141.3
5	58.3	272.5	413.8
6	21.0	-.-	-.-

■ RMS on smoothed data



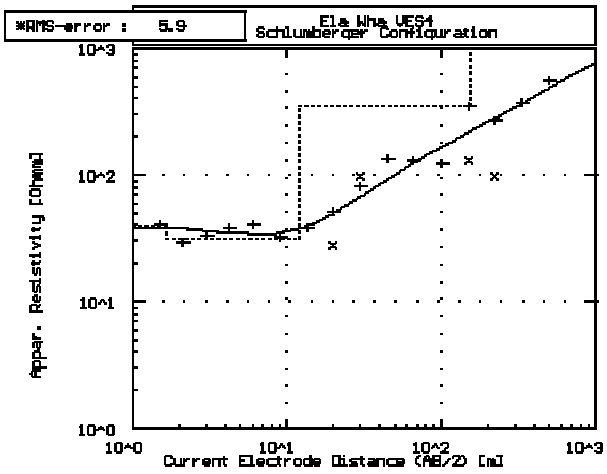
No	Res	Thick	Depth
1	26.7	0.6	0.6
2	1340.6	42.7	43.4
3	8020.1	47.3	90.7
4	2332.7	42.8	133.5
5	207.5	-.-	-.-

■ RMS on smoothed data



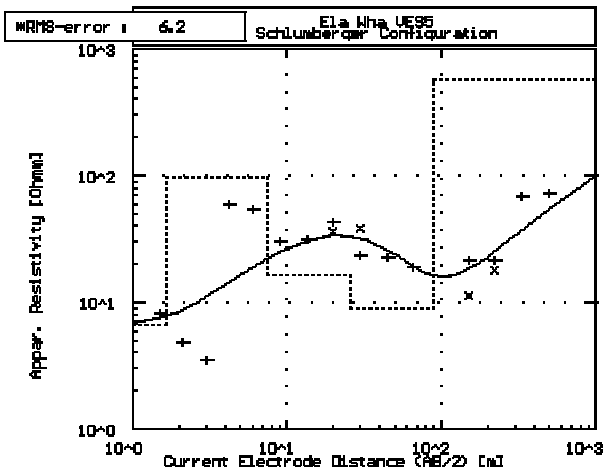
No	Res	Thick	Depth
1	15.3	0.5	0.5
2	5.3	0.8	1.3
3	34.3	31.8	33.0
4	832.0	12.0	45.0
5	373.6	58.1	103.0
6	7.2	525.6	628.6
7	40.2	-.-	-.-

■ RMS on smoothed data



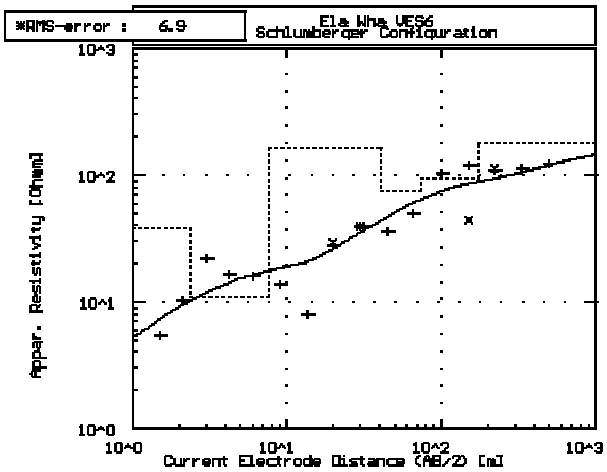
No	Res	Thick	Depth
1	38.8	1.6	1.6
2	37.3	10.5	12.1
3	391.0	141.3	153.4
4	1616.4	-.-	-.-

* RMS on smoothed data



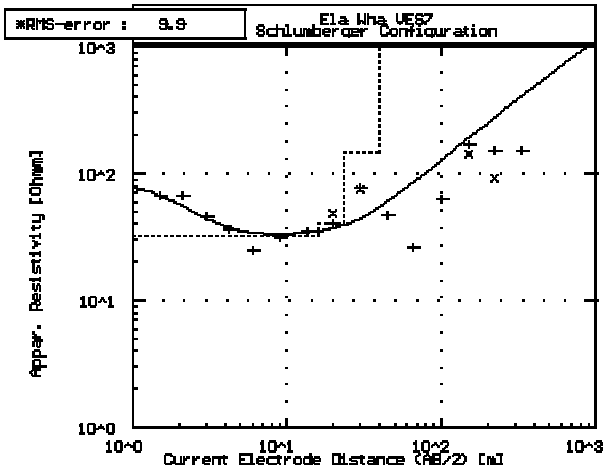
No	Res	Thick	Depth
1	6.6	1.7	1.7
2	98.3	9.7	11.4
3	16.6	16.6	28.0
4	62.9	62.9	88.8
5	578.6	-.-	-.-

* RMS on smoothed data



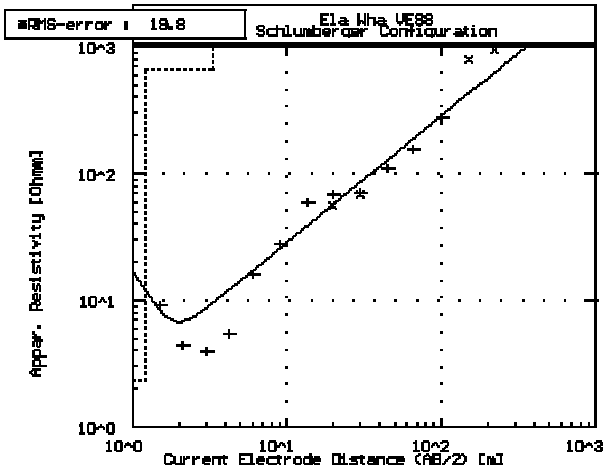
No	Res	Thick	Depth
1	3.1	0.5	0.5
2	27.9	1.9	2.4
3	11.0	5.2	7.6
4	166.3	33.3	40.9
5	34.9	33.1	74.0
6	94.6	98.2	172.2
7	179.0	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	86.8	0.9	0.9
2	39.9	14.9	15.8
3	39.9	7.5	23.3
4	147.3	16.2	39.6
5	7670.7	-.-	-.-

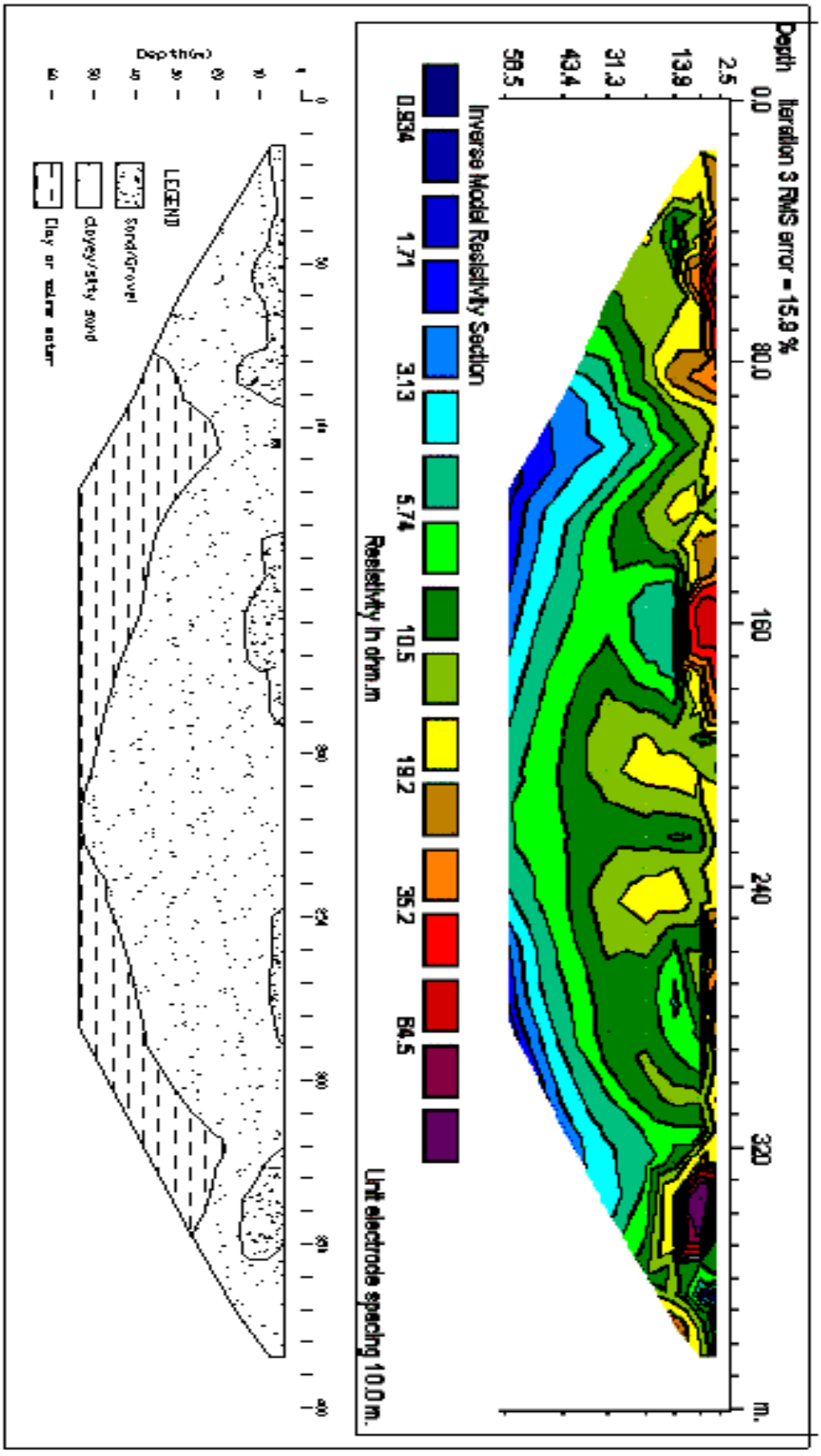
* RMS on smoothed data



No	Res	Thick	Depth
1	46.1	0.4	0.4
2	2.3	0.8	1.2
3	663.1	2.1	3.3
4	16702.8	-.-	-.-

* RMS on smoothed data

2.4 INVERTED MODEL RESISTIVITY AND INTERPRETED GEOELECTRIC SECTION.



3 CHIFRA

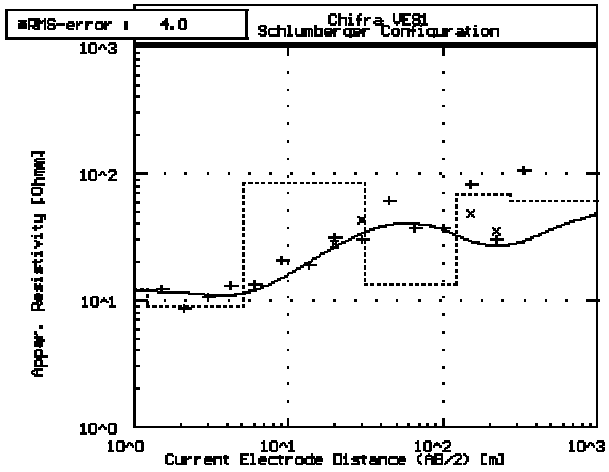
3.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	611463	1283004	
2	611486	1282880	
3	611410	1283298	
4	610328	1283377	Drilling Site
5	610784	1283430	
6	610561	1283729	
7	611270	1282612	

3.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

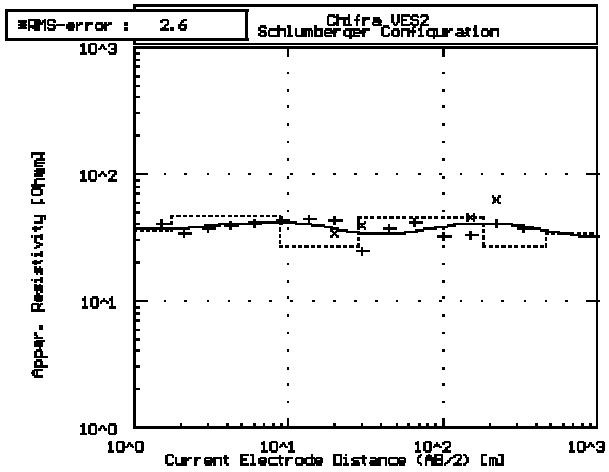
	VES-1	VES-2	VES-3	VES-4	VES-5	VES-6	VES-7	VES-8
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A
1.5	12.27	40.56	18.46	22.92	13.062	52.12	46.53	
2.1	8.59	33.92	17.03	22.75	16.03	36.68	30.65	
3.0	10.58	36.9	18.53	21.5	18.86	34.18	30.36	
4.2	13.07	39.71	21.44	20.35	17.44	35.12	30.79	
6.0	13.44	40	25.99	18.76	18.87	31.3	31.07	
9.0	20.7	42.42	32.00	17.19	17.78	23.87	36.83	
13.5	18.87	44.61	35	24.02	13.09	30.88	46.33	
20.0	30.75	43.50	37.50	33.75	14	81.25	25	
20.0	27.92	34.21	21.34	21.91	18.29	24.96	29.83	
30.0	43.1	39.05	30.28	34.09	12.59	31.69	50.94	
30.0	30.28	24.63	27.12	30.28	15.14	19.21	32.54	
45.0	60.84	36.92	20.8	50.96	26	21.32	37.96	
66.0	37.63	41.81	30.62	66.33	16.95	63.28	33.9	
100.0	36.68	32.48	75.72	74.93	10.48	68.12	34.06	
150.0	82.32	33.51	79.38	53.51	52.92	52.92	32.34	
150.0	48.62	45.04	23.6	38.61	25.74	42.18	25.03	
220.0	34.90	63.00	37.8	34.39	45.36	32.38	27.21	
220.0	30.13	40.5	19.44	29.97	15.47	68.04	22.68	
330.0	105.375	37.5	83.25	93.37	18.56	41.25	20.96	
500.0								
750.0								

3.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



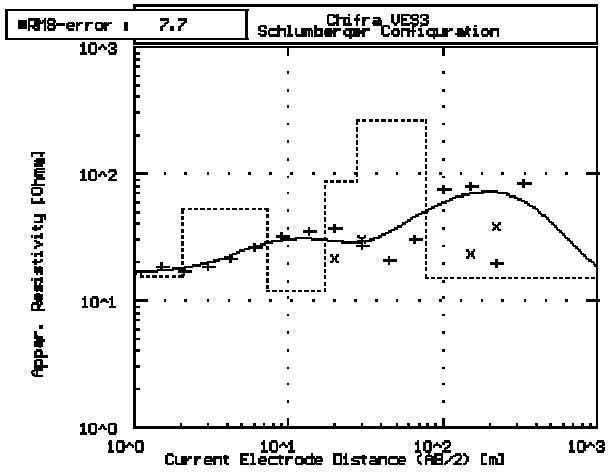
No	Res	Thick	Depth
1	12.2	1.2	1.2
2	9.0	3.9	5.1
3	84.4	26.2	31.3
4	13.4	90.3	121.6
5	69.4	149.9	271.6
6	61.8	-.-	-.-

* RMS on smoothed data



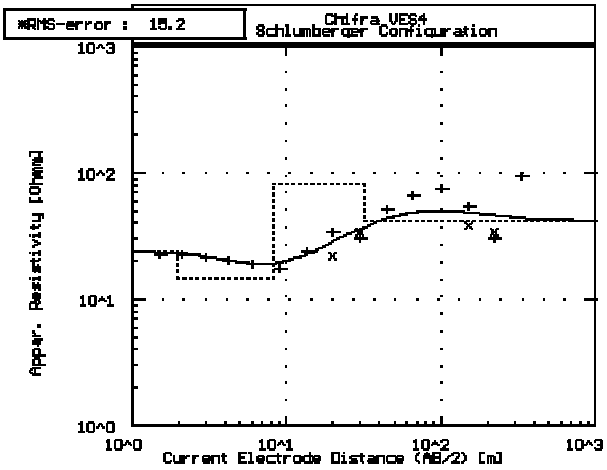
No	Res	Thick	Depth
1	36.1	1.7	1.7
2	19.2	7.2	8.9
3	32.1	19.8	28.7
4	46.1	102.3	131.0
5	26.9	282.6	413.6
6	34.3	-.-	-.-

* RMS on smoothed data



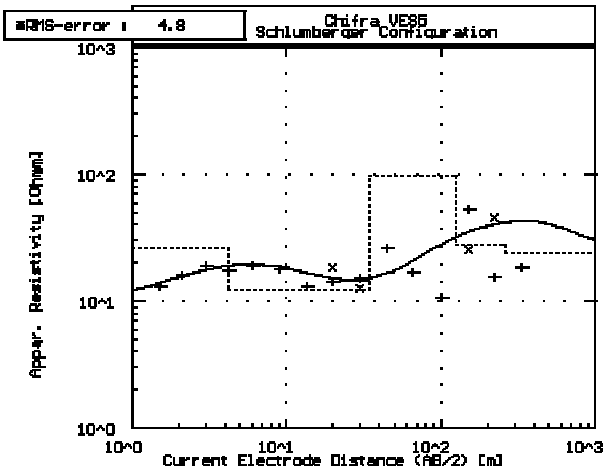
No	Res	Thick	Depth
1	16.6	1.1	1.1
2	19.3	1.0	2.1
3	82.8	5.2	7.3
4	11.0	10.0	17.3
5	86.2	10.2	27.5
6	246.4	50.6	78.1
7	14.8	-.-	-.-

* RMS on smoothed data



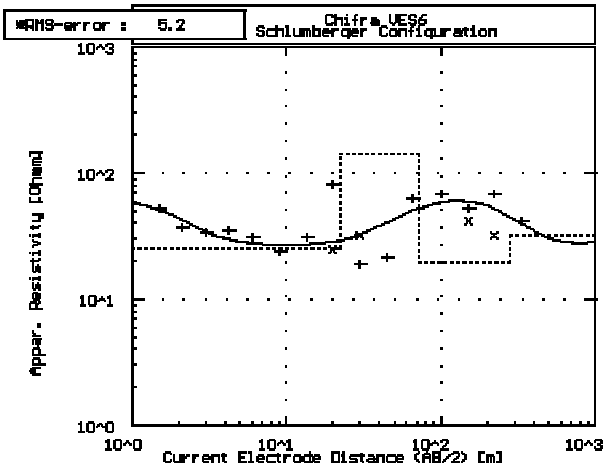
No	Res	Thick	Depth
1	24.1	2.0	2.0
2	14.7	6.2	8.1
3	81.1	24.1	32.2
4	42.0	-.-	-.-

* RMS on smoothed data



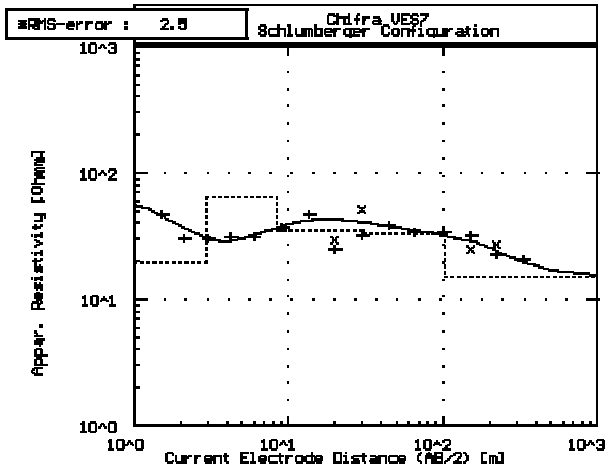
No	Res	Thick	Depth
1	10.9	0.8	0.8
2	25.9	3.4	4.2
3	12.2	29.8	34.0
4	97.0	90.9	125.0
5	27.0	135.7	260.7
6	24.1	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	64.8	0.9	0.9
2	26.7	21.8	22.4
3	141.1	48.1	71.4
4	19.6	212.7	284.2
5	31.8	-.-	-.-

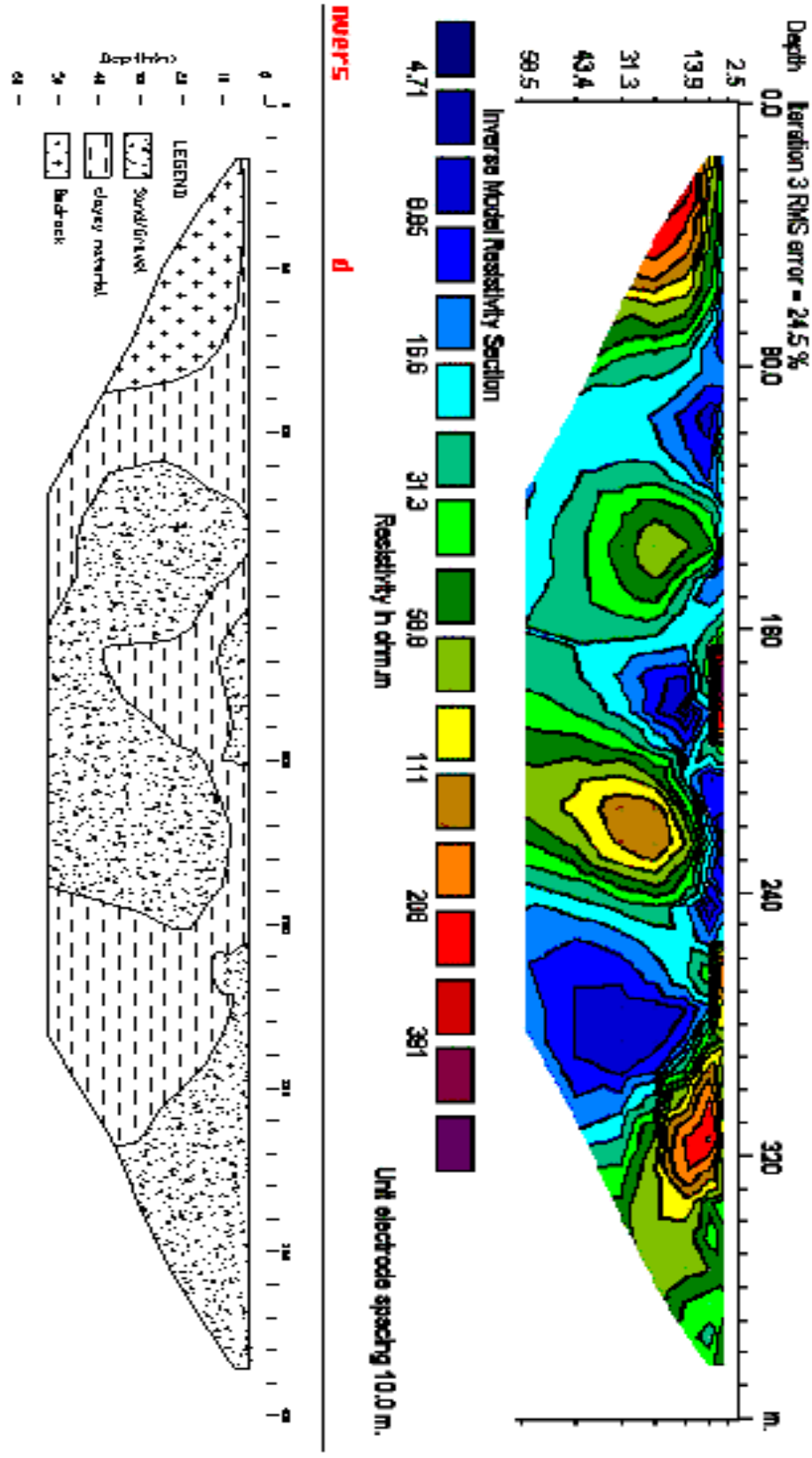
* RMS on smoothed data



No	Res	Thick	Depth
1	66.1	0.8	0.8
2	19.8	2.1	2.9
3	41.8	6.4	9.3
4	34.6	22.1	30.4
5	33.2	71.7	102.1
6	15.2	-.-	-.-

* RMS on smoothed data

3.4 INVERTED MODEL RESISTIVITY AND INTERPRETED GEOELECTRIC SECTION (2D)



4 DERAYITU

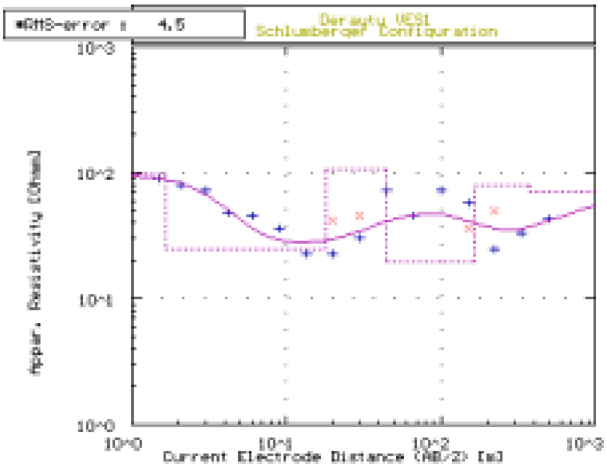
4.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	616686	1334202	
2	616525	1333286	
3	616087	1334043	Drilling Site
4	616406	1334550	

4.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

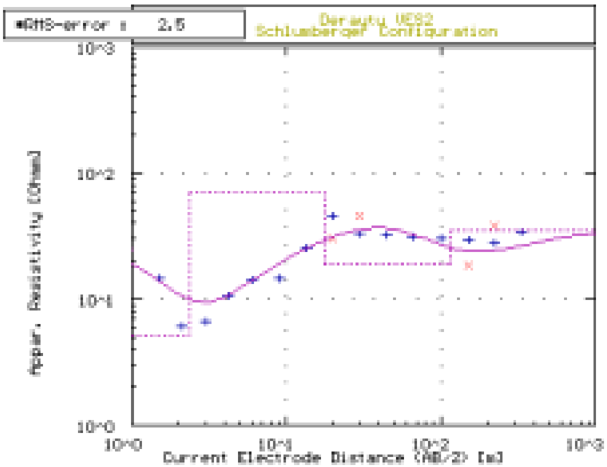
	VES-1	VES-2	VES-3	VES-4
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A
1.5	88.98	14.51	56.83	7.79
2.1	78.34	6.06	61.04	16.28
3.0	72.05	6.65	51.26	22.85
4.2	47.81	10.57	39.44	9.95
6.0	45.31	14.24	22.14	7.79
9.0	35.56	14.73	21.00	7.39
13.5	22.76	25.74	24.71	8.01
20.0	22.5	45.00	31.25	9.25
20.0	42.22	30.49	18.79	14.1
30.0	45.28	45.56	25.27	11.32
30.0	30.51	33.42	41.36	16.04
45.0	72.80	32.24	26.88	18.20
66.0	45.20	30.96	29.38	19.21
100.0	73.36	29.87	52.14	20.96
150.0	57.92	29.69	82.32	25.87
150.0	35.75	18.59	27.88	21.45
220.0	50.02	37.80	83.16	37.80
220.0	24.99	27.54	64.80	22.68
330.0	33.00	33.75	41.25	23.25
500.0	43.25			
750.0				

4.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



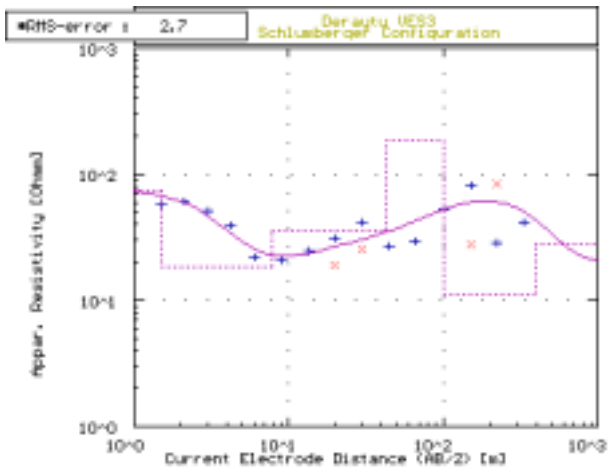
No	Res	Thick	Depth
1	97.4	1.7	1.7
[illegible]	24.3	16.4	18.1
[illegible]	107.1	27.0	45.0
[illegible]	18.4	120.8	166.0
[illegible]	[illegible]	210.7	376.7
[illegible]	70.8	-.-	-.-

* RMS on smoothed data



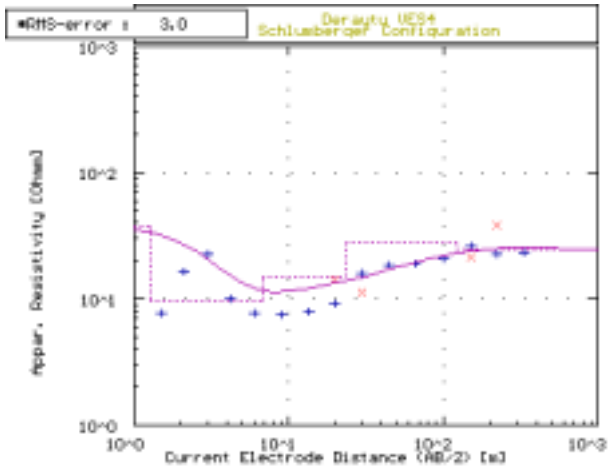
No	Res	Thick	Depth
1	24.4	0.7	0.7
[illegible]	[illegible]	1.7	2.4
[illegible]	70.4	15.0	17.4
[illegible]	18.8	97.8	115.2
[illegible]	34.8	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	75.0	1.5	1.5
2	18.4	5.9	7.4
3	98.7	34.7	42.1
4	164.6	59.0	101.1
5	11.3	288.0	389.1
6	37.6	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	32.5	1.3	1.3
2	9.7	5.4	6.7
3	55.0	16.9	23.6
4	20.7	98.9	122.5
5	24.6	-.-	-.-

* RMS on smoothed data

5 KELEWAN

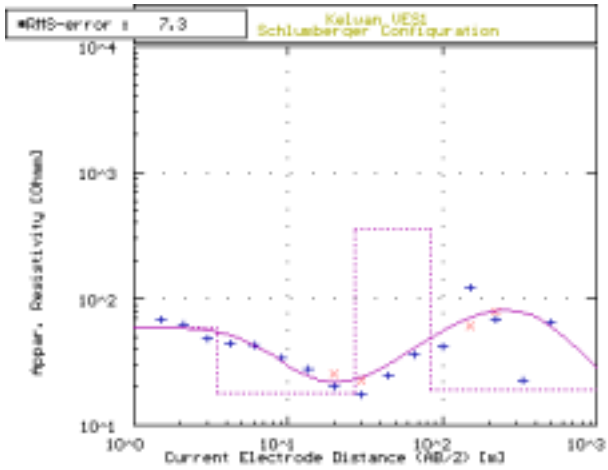
5.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	606029	1342144	Drilling Site
2	606725	1342866	
3	606410	1341976	
4	606413	1342943	

5.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

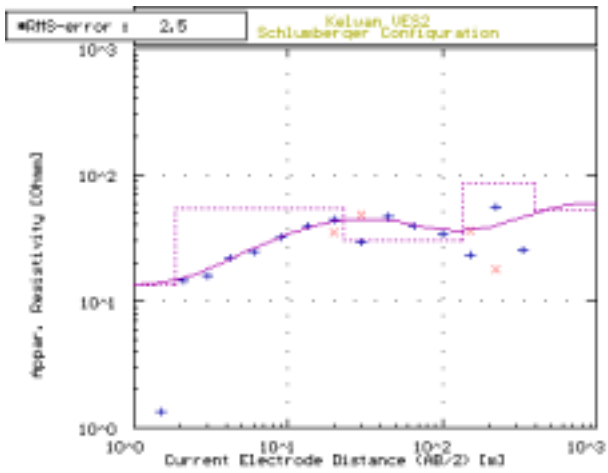
	VES-1	VES-2	VES-3	VES-4
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A
1.5	69.02	135	224.82	14.13
2.1	62.62	14.77	241.56	16.33
3.0	47.68	16.11	254.37	20.79
4.2	44.69	22.09	285.53	29.32
6.0	43.28	24.97	279.11	34.46
9.0	33.78	32	263.65	31.49
13.5	27.34	39.12	285.37	42.9
20.0	20	44.12	179.00	46.25
20.0	25.35	34.68	146.57	27.82
30.0	22.64	48.11	138.67	21.22
30.0	17.4	29.60	84.97	42.94
45.0	24.44	47.32	80.49	33.28
66.0	36.16	39.55	55.93	59.89
100.0	41.92	34.06	41.92	183.40
150.0	123.48	23.52	28.28	170.50
150.0	60.77	35.75	15.51	110.82
220.0	78.75	18.02	26.46	138.6
220.0	68.04	55.08	13.67	120
330.0	22.5	25.31	22.5	956.30
500.0	63.75			
750.0				

5.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



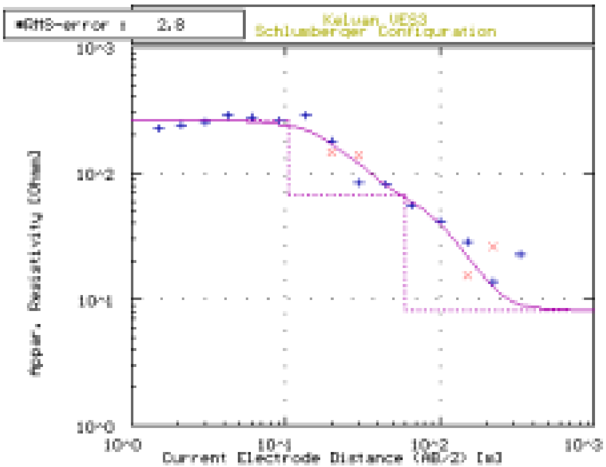
No	Res	Thick	Depth
1	59.9	3.4	3.4
2	17.8	24.7	28.1
3	364.1	66.0	82.2
4	18.9	-.-	-.-

* RMS on smoothed data



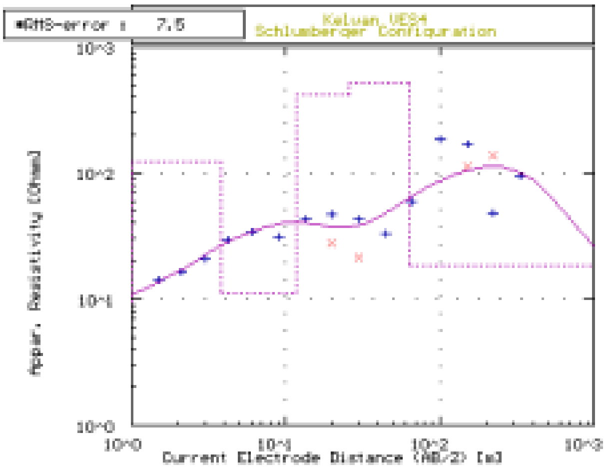
No	Res	Thick	Depth
1	13.2	1.8	1.8
2	35.9	21.2	23.0
3	90.1	109.4	132.5
4	66.0	259.2	391.6
5	82.1	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	263.2	10.5	10.5
2	65.5	49.6	60.0
3	8.1	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	9.3	1.0	1.0
2	123.8	2.8	3.8
3	11.3	8.0	11.8
4	421.3	16.7	28.5
5	612.6	37.8	63.4
6	18.4	-.-	-.-

* RMS on smoothed data

6 GUBI DOWRA

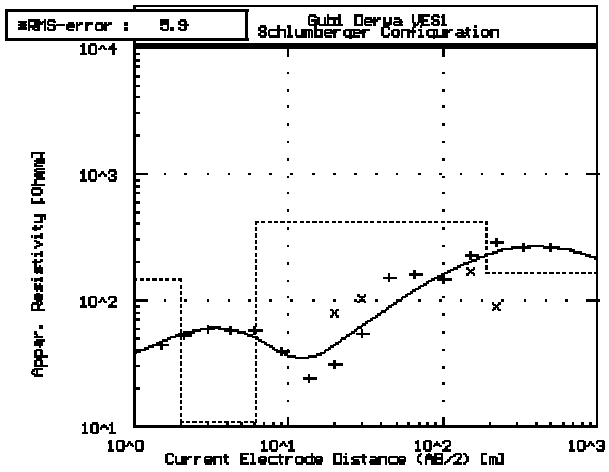
6.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	596365	1366048	
2	596106	1366351	
3	595828	1366765	
4	595555	1367182	
5	596125	1366985	Drilling Site
6	596257	1367209	
7	595061	1366486	
8	596550	1367054	

6.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

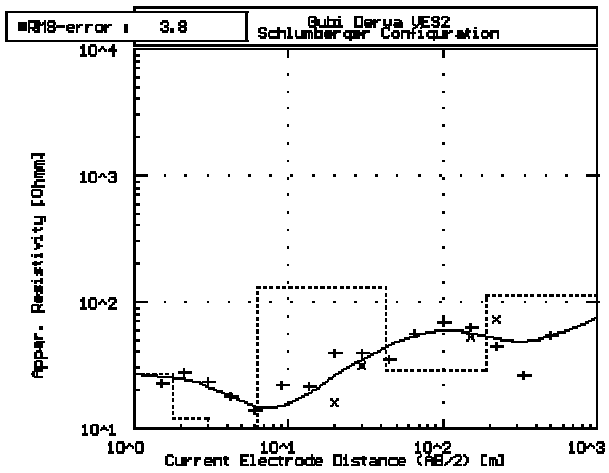
	VES-1	VES-2	VES-3	VES-4	VES-5	VES-6	VES-7	VES-8
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A
1.5	44.46	22.42	28.57	80.00	35.86	28.64	63.74	184.63
2.1	53.05	27.38	27.38	92.48	23.77	28.95	0.40	199.51
3.0	59.12	23.21	31.39	70.68	30.55	33.08	64.90	172.15
4.2	58.09	17.94	33.75	62.85	27.57	43.98	67.61	136.75
6.0	58.31	13.81	35.25	40.45	25.99	52.66	69.043	90.40
9.0	38.86	21.89	44.70	38.35	25.40	60.70	146.30	58.93
13.5	24.19	21.50	57.77	42.33	31.28	82.37	45.07	37.75
20.0	31.25	39.50	82.50	54.12	67.37	93.50	48.75	31.25
20.0	79.19	15.72	32.12	56.22	22.68	72.52	46.22	24.87
30.0	103.86	31.13	67.35	70.18	16.98	74.43	45.28	25.61
30.0	54.46	39.30	98.76	73.22	20.79	72.52	37.52	13.56
45.0	150.80	35.10	113.88	78.00	37.18	46.85	38.58	26.00
66.0	160.00	55.20	109.61	42.71	15.48	55.37	54.8	32.77
100.0	145.93	68.12	141.48	75.72	37.20	107.42	41.92	65.50
150.0	223.44	63.44	163.46	52.80	79.67	94.08	34.4	37.81
150.0	168.74	52.55	95.09	43.82	32.17	26.45	44.33	30.03
220.0	78.49	71.60	59.85	39.18	43.09	84.42	109.62	25.20
220.0	283.50	44.48	101.25	35.32	40.50	74.52	40.50	27.54
330.0	265.12	26.32	39.37	24.26	30.30	37.50	78.75	21.00
500.0	259.50	244.33						
750.0								

6.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



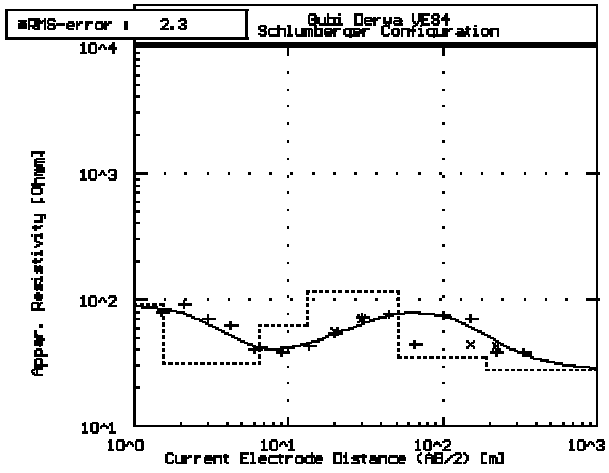
No	Res	Thick	Depth
1	28.6	0.6	0.6
2	145.5	1.3	2.0
3	10.9	4.1	6.1
4	410.8	184.7	190.8
5	162.6	-.-	-.-

* RMS on smoothed data



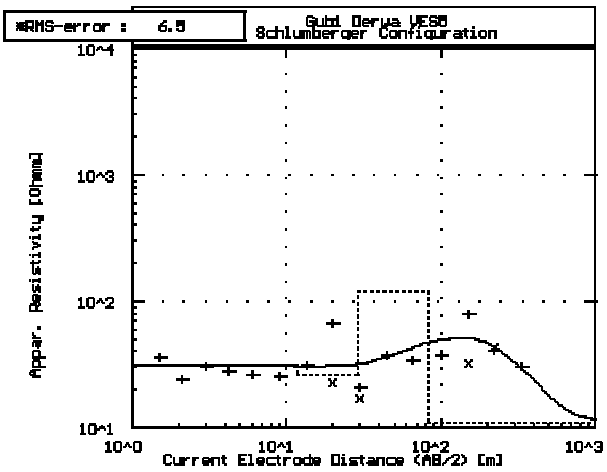
No	Res	Thick	Depth
1	27.2	1.8	1.8
2	12.0	1.2	3.0
3	7.9	9.4	12.4
4	129.0	36.0	48.4
5	28.2	148.6	197.0
6	110.9	-.-	-.-

* RMS on smoothed data



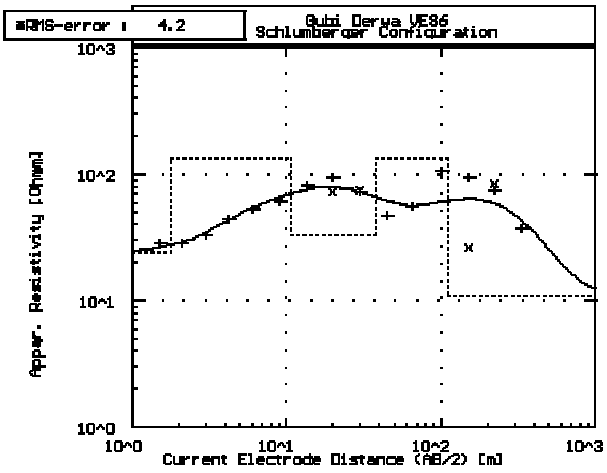
No	Res	Thick	Depth
1	91.3	1.5	1.5
2	31.2	5.0	6.5
3	63.0	6.6	13.1
4	114.8	39.9	53.0
5	34.6	137.6	190.6
6	27.6	-.-	-.-

* RMS on smoothed data



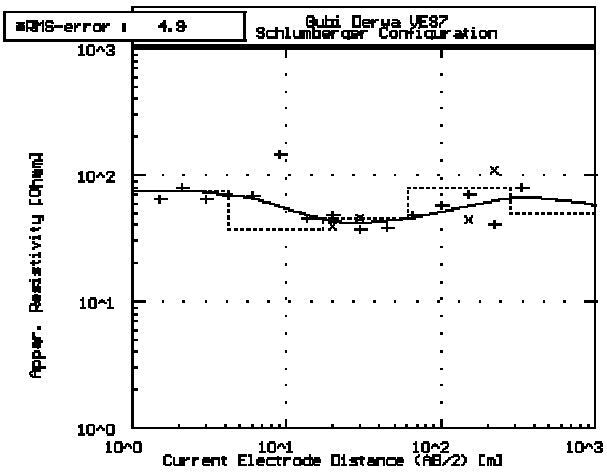
No	Res	Thick	Depth
1	30.9	11.7	11.7
2	125.8	17.1	28.7
3	119.0	53.8	82.6
4	10.9	-.-	-.-

* RMS on smoothed data



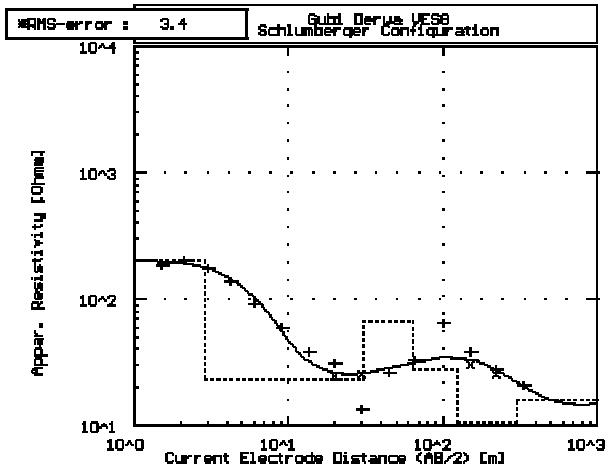
No	Res	Thick	Depth
1	24.1	1.8	1.8
2	136.4	8.8	10.6
3	393.0	27.5	38.0
4	132.1	73.2	111.2
5	11.0	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	79.2	4.2	4.2
2	396.6	12.8	17.0
3	145.5	43.8	60.8
4	291.1	218.4	279.2
5	48.3	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	203.7	2.9	2.9
2	23.2	27.8	30.7
3	68.8	32.5	63.2
4	22.7	61.8	125.1
5	10.6	179.2	304.3
6	16.2	-.-	-.-

* RMS on smoothed data

7 WEDERAGE

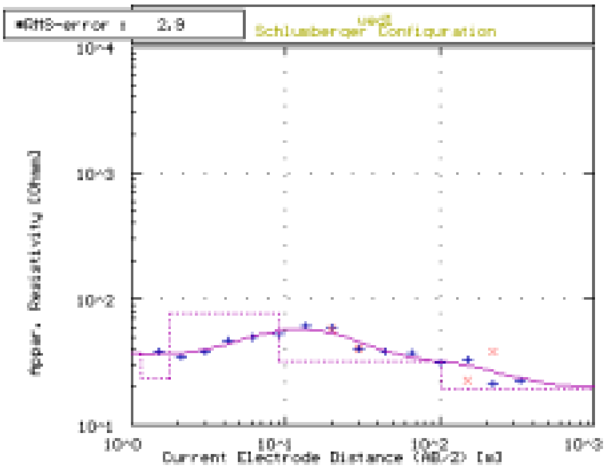
7.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	626341	1195314	
2	629299	1195775	
3	629666	1113198	
4	629944	1196442	
5	629021	1195627	Drilling Site
6	628594	1112445	
7	629202	1113477	
8	628677	1111906	
9	628432	1111788	
10	629100	1112384	

7.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

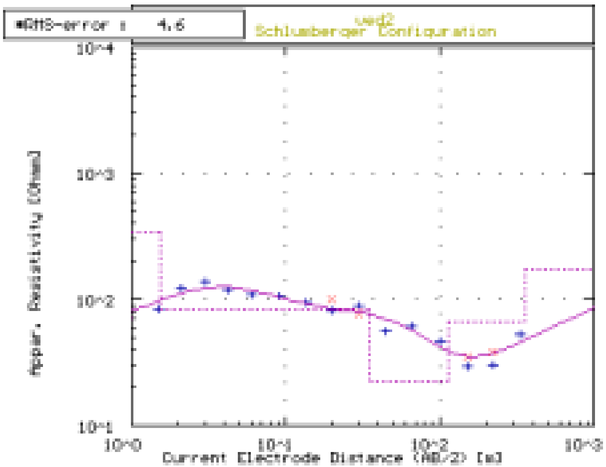
	VES-1	VES-2	VES-3	VES-4	VES-5	VES-6	VES-7	VES-8	VES-9	VES-10
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A
1.5	38.496	84.28	8.59	37.87	91.94	83.90	64.872	6.92	16.58	8.63
2.1	34.977	123.40	6.08	31.571	108.6	96.55	52.40	10.23	14.514	9.353
3.0	38.335	139.15	7.45	32.42	113.57	114.40	59.95	14.41	13.78	12.787
4.2	47.315	117.60	8.37	34.08	109.4	123.075	70.782	12.14	14.00	16.63
6.0	49.268	110.514	10.27	43.84	106.33	120.91	77.744	25.43	14.37	24.29
9.0	52.07	104.65	20.32	43.43	116.58	125.48	84.84	41.15	22.71	38.1
13.5	49.936	94.38	32.60	68.07	113.256	124.12	105.248	61.78	34.89	51.48
20.0	59.625	82.50	45.00	83.75	116.125	123.00	132.50	90.00	30.125	37.5
20.0	57.466	100.54	15.25	41.93	117.41	152.48	95.967	44.41	23.223	68.14
30.0	40.47	77.26	25.47	87.73	96.50	92.54	118.86	101.88	11.66	62.26
30.0	40.00	89.04	18.08	62.83	106.45	115.94	98.536	80.00	64.184	73.45
45.0	19.76	56.16	18.20	90.48	76.23	84.24	98.88	113.36	54.08	52
66.0	37.29	61.02	18.08	103.96	60.34	60.23	180.00	77.97	86	45.20
100.0	31.44	47.16	18.34	86.46	2.48	56.85	235.80	104.07	364.18	28.82
150.0	33.04	29.40	31.75	152.88	64.68	52.16	200.508	105.82	393.96	41.16
150.0	22.88	35.04	16.44	36.46	37.75	34.32	64.07	72.93	240.24	32.175
220.0	37.80	37.8	69.3	63.00	46.87	31.50	113.40	340.20	264.60	32.76
220.0	21.06	30.13	24.3	43.74	24.30	43.74	132.84	127.98	612.3	25.92
330.0	22.50	52.5	48.75	63.75	18.75	22.50		145.00	1113.73	24.375
500.0										
750.0										

7.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



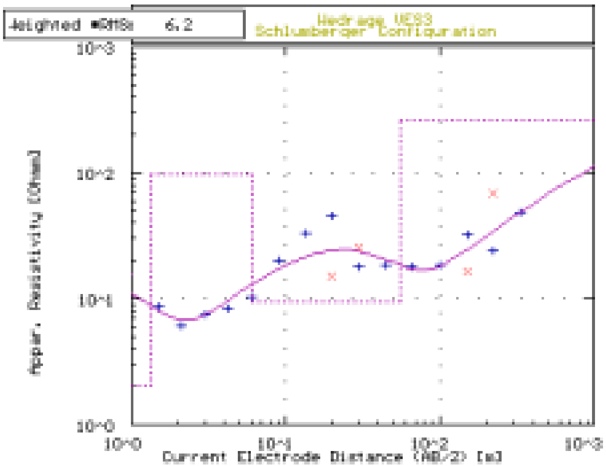
No	Res	Thick	Depth
1	36.9	1.2	1.2
2	33.4	0.6	1.8
3	[illegible]	[illegible]	[illegible]
4	[illegible]	2.3	9.1
5	32.8	94.9	104.0
6	18.8	-.-	-.-

■ RMS on smoothed data



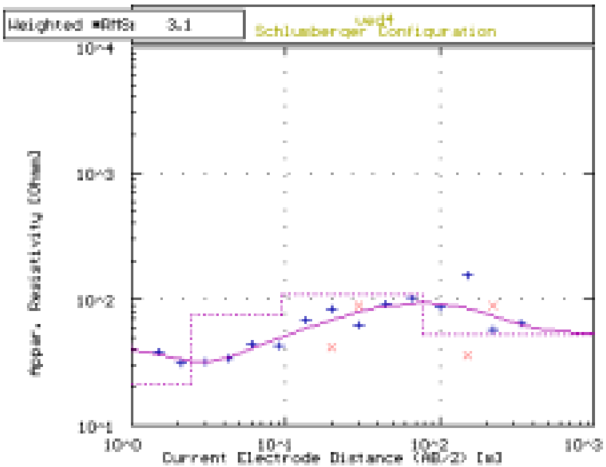
No	Res	Thick	Depth
1	69.9	0.8	0.8
2	344.3	0.7	1.5
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]
6	[illegible]	240.8	[illegible]
7	178.5	-.-	-.-

■ RMS on smoothed data



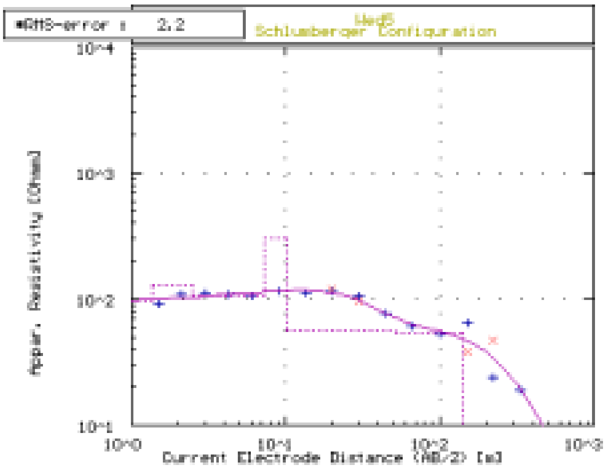
No	Res	Thick	Depth
1	15.3	0.6	0.6
2	5.0	0.7	1.3
3	[illegible]	[illegible]	[illegible]
4	98.3	4.7	6.1
5	5.4	49.4	55.5
6	260.2	-.-	-.-

■ RMS on smoothed data



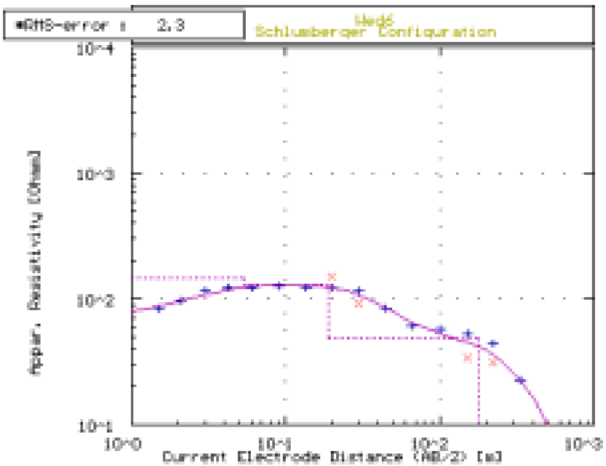
No	Res	Thick	Depth
1	42.7	0.9	0.9
2	21.6	1.5	2.4
3	74.4	6.9	9.4
4	108.2	67.2	76.5
5	52.7	-.-	-.-

* RMS on smoothed data



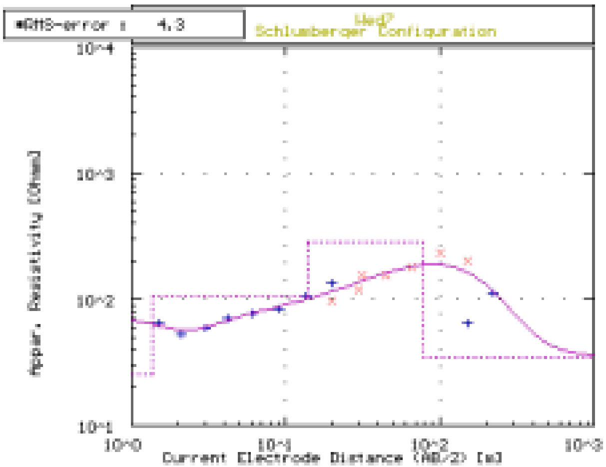
No	Res	Thick	Depth
1	97.0	1.4	1.4
2	128.1	1.1	2.5
3	108.8	4.7	7.2
4	300.2	2.9	10.1
5	55.3	41.6	51.7
6	54.8	88.2	140.0
7	3.7	-.-	-.-

* RMS on smoothed data



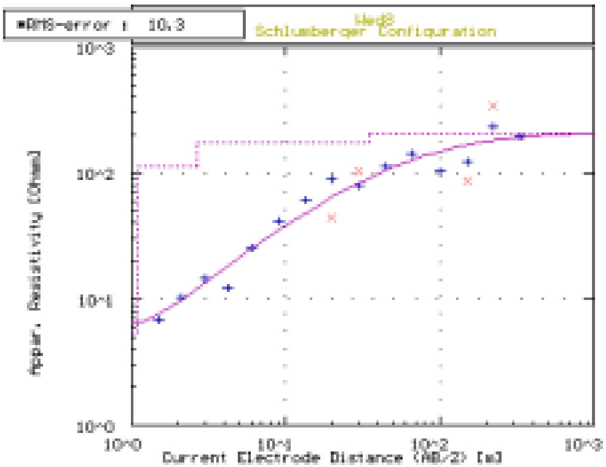
No	Res	Thick	Depth
1	73.0	0.9	0.9
2	145.4	4.5	5.4
3	130.0	13.5	18.8
4	45.2	158.7	177.5
5	1.6	-.-	-.-

* RMS on smoothed data



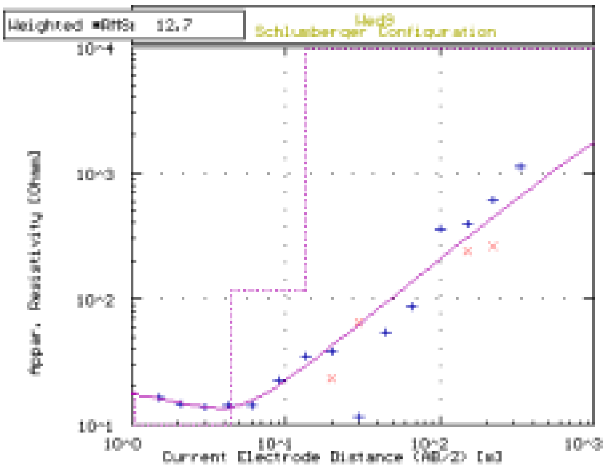
No	Res	Thick	Depth
1	77.3	0.8	0.8
2	28.8	0.6	1.4
3	106.0	12.4	13.8
4	281.8	63.9	77.7
5	[illegible]	-.-	-.-

* RMS on smoothed data



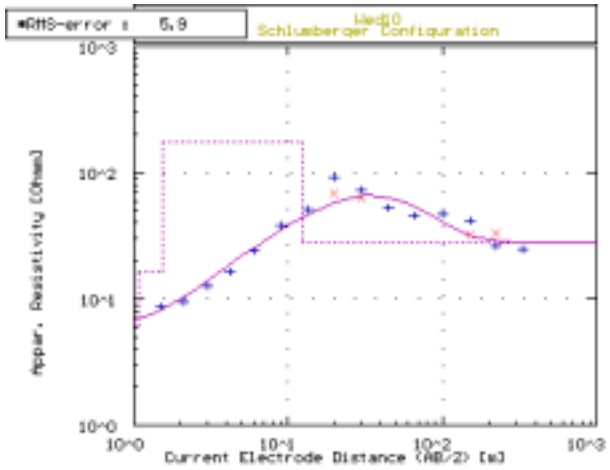
No	Res	Thick	Depth
1	5.4	1.1	1.1
2	111.3	1.6	2.7
3	171.6	32.5	35.2
4	207.5	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	18.2	1.0	1.0
2	16.0	3.4	4.4
3	116.0	9.1	13.5
4	9737.2	-.-	-.-

* RMS on smoothed data



No	Res	Thick	Depth
1	6.1	1.1	1.1
2	16.6	9.5	10.6
3	174.8	10.6	21.2
4	27.4	-.-	-.-

* RMS on smoothed data

8 NEMELEFEN

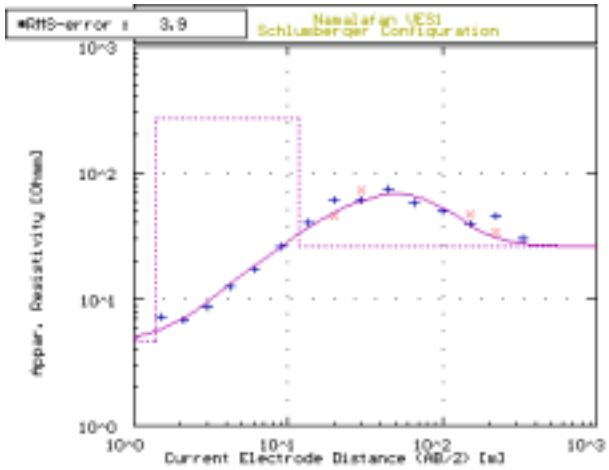
8.1 LOCATION OF VES SITES

VES No	UTM E	UTM N	Remark
1	631821	1207215	
2	632026	1207419	
3	632469	1207916	
4	632224	1207685	
5	632657	1207888	
6	633010	1207833	
7	633286	1207414	Drilling Site

8.2 VERTICAL ELECTRICAL SOUNDING (VES) FIELD DATA

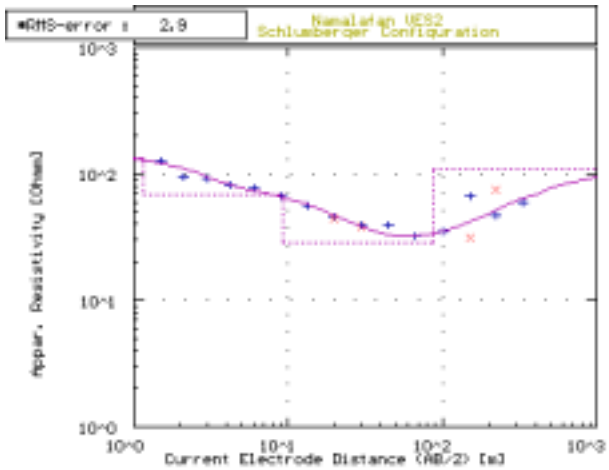
	VES-1	VES-2	VES-3	VES-4	VES-5	VES-6	VES-7
AB/2(m)	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A	RHO-A
1.5	7.329	125.6	4.371	44.46	54.76	47.92	41.01
2.1	6.851	94.058	3.642	46.112	66.02	58.64	46.77
3.0	8.61	92.675	4.045	41.525	67.65	70.4	42.63
4.2	12.64	82.71	4.485	37.47	68.43	77.4	54.7
6.0	17.628	77.066	4.972	36.386	48.43	82.83	43.166
9.0	26.162	67.056	5.84	35.306	29.54	76.45	34.04
13.5	40.212	56.06	6.978	31.689	28.2	81.08	24.02
20.0	60.625	45.00	10.00	28.5	47.5	61.25	22.5
20.0	45.649	44.60	14.43	47.841	25.06	94.73	16.2
30.0	73.58	38.77	8.49	22.923	42.45	65.09	26.06
30.0	61.698	39.78	16.046	42.94	21.696	80.456	13.56
45.0	74.41	39.31	15	35.88	34.37	51.48	19.76
66.0	56.80	31.64	16.95	46.33	36.16	57.97	14.916
100.0	49.78	45.85	18.602	44.54	44.02	75.98	28.82
150.0	38.808	66.44	20.58	41.16	76.44	135.24	41.16
150.0	47.09	31.46	35.75	46.475	42.9	118.69	21.45
220.0	34.02	75.60	20.16	37.8	99.54	88.2	37.80
220.0	32.00	46.98	29.16	35	66.42	72.9	35.00
330.0	30	60	22.5	33.00	90.00	48.88	30.00
500.0							
750.0							

8.3 VERTICAL ELECTRICAL SOUNDING (VES) CURVES AND INTERPRETATION.



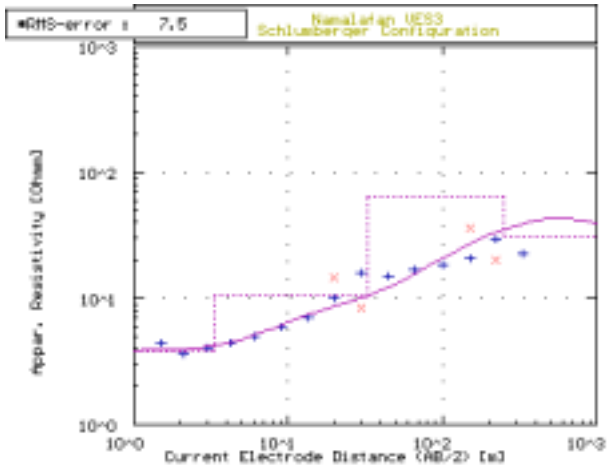
No	Res	Thick	Depth
Layer	4.6	1.4	1.4
	271.4	10.4	11.9
	26.0	-.-	-.-

* RMS on smoothed data



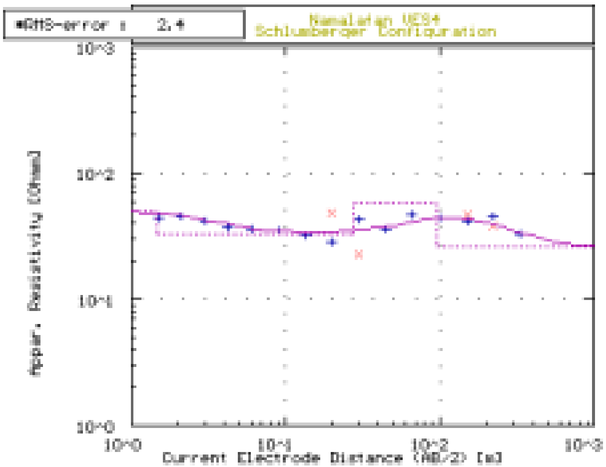
No	Res	Thick	Depth
Layer	135.7	1.2	1.2
	57.9	6.9	8.1
	28.8	77.9	86.3
	110.1	-.-	-.-

* RMS on smoothed data



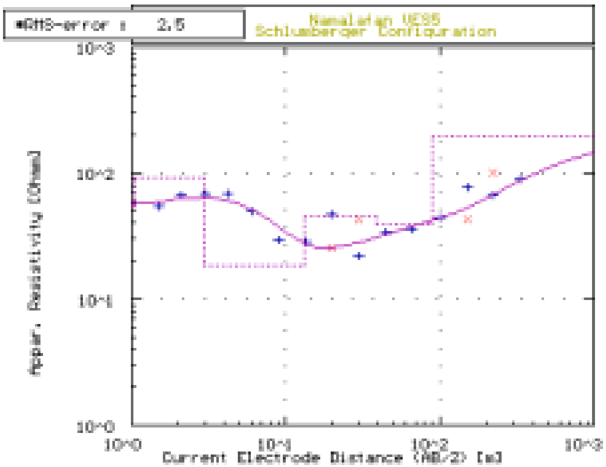
No	Res	Thick	Depth
Layer	153	2.2	2.2
	65.7	243.3	245.5
	31.6	-.-	-.-

* RMS on smoothed data



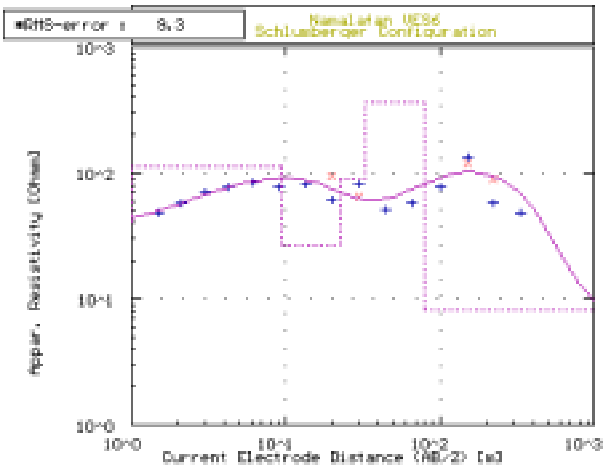
No	Res	Thick	Depth
1	48.7	1.5	1.5
2	[illegible]	26.0	[illegible]
3	[illegible]	67.4	[illegible]
4	26.1	-.-	-.-

* RMS on smoothed data



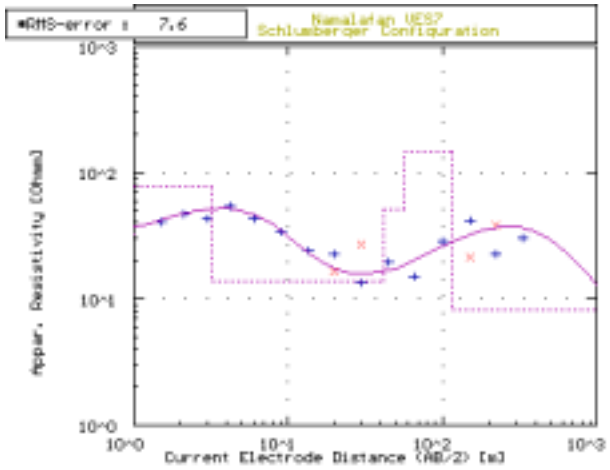
No	Res	Thick	Depth
1	55.0	1.0	1.0
2	91.4	1.9	2.9
3	[illegible]	10.3	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	61.2	[illegible]
6	193.1	-.-	-.-

* RMS on smoothed data



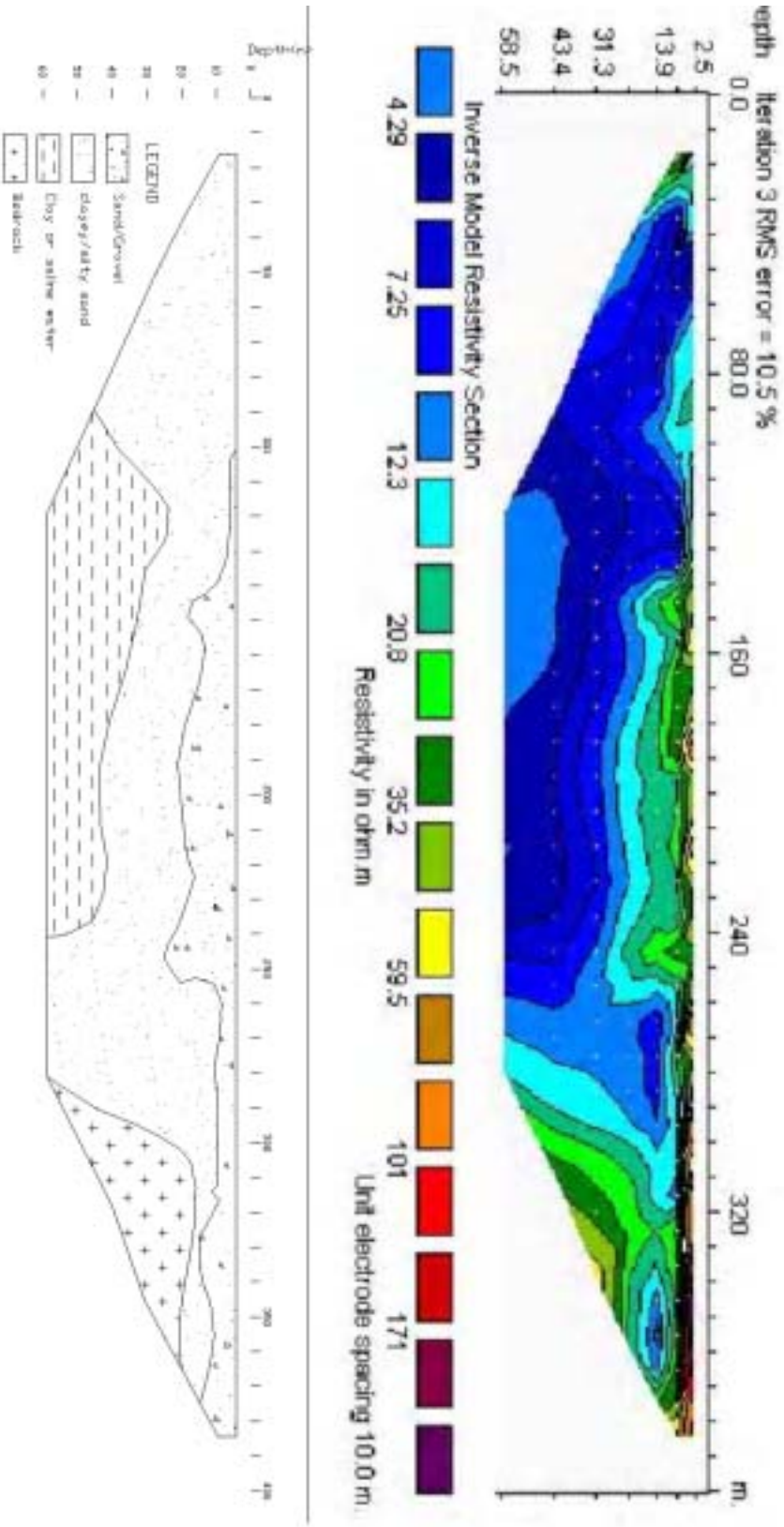
No	Res	Thick	Depth
1	40.6	1.0	1.0
2	[illegible]	[illegible]	[illegible]
3	[illegible]	[illegible]	[illegible]
4	[illegible]	[illegible]	[illegible]
5	[illegible]	46.8	[illegible]
6	[illegible]	-.-	-.-

* RMS on smoothed data


*RMS-error : 7.6
Namalarian UES7
Schlumberger Configuration
10^3
10^2
10^1
10^0
Appar. Resistivity (Ohmm)
10^0
10^1
10^2
10^3
Current Electrode Distance (AB/2) [m]


No
Res
Thick
Depth
* RMS on smoothed data

8.4 INVERTED MODEL RESISTIVITY AND INTERPRETED GEOELECTRIC SECTION.



(3) Result of Test Well

1. Drilling Results
2. Aquifer Testing
3. Water Quality Test Results

(3) Result of Test Well

1. Drilling Results
2. Aquifer Testing
3. Water Quality Test Results

Town Name	Start	End	Drilling Method	Drilling Depth	Casing Depth	Casing Material	Screen Material / Open Rate	Screen Position	Total Screen Length	Screen L / Casing L	Static Water Level	Dynamic Water Level by Constant Test	Maximum Well Yield (Constant test rate)	Transmissivity	Hydraulic conductivity	*Safe Yield*	Plan for Punp Position	Water Qualty	Remark
				m	m			m	m	%	m	m	L/sec	m2/day	cm/sec	L/sec	m		
Gubi Dowra	22-Jan-06	5-Feb-06	Air with T.Bit Air with H.Bit	149	-	No casing	No casing	No Screen	-	-	33.25	106.82	2.0	1.2	-	1.0	138	×	Sodiun, Fluoride are hight level
Kelewan	22-Jan-06	20-Feb-06	Air with T.Bit Air with H.Bit	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Not terminate drilling work due to climate condition
Deraiytu	4-Mar-06	9-Apr-06	Air with T.Bit Mud with T.Bit	62	57.7	PVC	PVC / 8%	32.23 - 40.72 43.55 - 52.04	17.0	29.5%	27.5	30.46	5.0	898	6.94E-01	3.0	52	○	
Chifra	10-Feb-06	26-Feb-06	Air with T.Bit Air with H.Bit	122	99	PVC	PVC / 8%	76.36 - 84.85 87.68 - 93.34	14.2	14.3%	40.1	44.9	> 6.3	1881	1.54E+00	6.7	66	○	
Eli Wuha 1	7-Mar-06	25-Mar-06	Air with T.Bit Air with H.Bit	130	-	No casing	No casing	-	-	-	40	-	-	-	-	-	-	-	Not terminate development work due to few yield
Eli Wuha 2	19-Apr-06	9-May-06	Air with T.Bit Mud with T.Bit	131	131	PVC	PVC / 8%	62.7 - 74 108.46 - 125	27.8	21.2%	33.0	42.3	4.5	35.57	1.57E-02	4.5	55	○	
Nemelefen 1	27-Feb-06	10-Mar-06	Air with T.Bit Air with H.Bit	45	-	No casing	No casing	-	-	-	-	-	-	-	-	-	-	-	Chang site due to corruptions of well
Nemelefen 2	10-Mar-06	5-Apr-06	Air with T.Bit Mud with T.Bit	61	60	PVC	PVC / 8%	33.06 - 41.55 47.28 - 55.70	16.9	28.2%	8.0	38.7	2.0	1.55	1.04E-03	1.5	42	○	
Wederage	20-Feb-06	27-Feb-06	Air with T.Bit Air with H.Bit	110	110	PVC	PVC / 8%	73.21 - 76.04 78.80 - 90.19 95.85 - 104.30	22.7	20.6%	30.5	70.8	2.5	2.5	1.27E-03	2.0	71	○	
Dulecha	22-Feb-06	5-Mar-06	Air with T.Bit Air with H.Bit	78	73	PVC	PVC / 8%	34.0 - 46.0 52.0 - 70.0	30	41.1%	25.9	29.2	> 6.7	153	5.90E-02	4.5	30	○	
TOTAL				*918*	*530.7*				*128.6*	24.2%									

1. Drilling Results

Surmary

No.	Town	Depth(m)	Proposed Pumping Rate(L/s)	Status
1	Dulecha	73.0	4.5	Completed
2	Wderage	110.0	2.0	Completed
3	Nemelefen	60.0	1.5	Completed
4	Chifra	99.0	6.7	Completed
5	Deryitu	57.7	3.0	Completed
6	Gubi Dowra	149.0	1.0	Completed Water quality problem Not Install Casing/Screen
7	El Wuha	130	<1.0	Abandoned
		130	4.5	Completed
8	Kelewan	-	-	Interrupted due to access conditions
9	Kumami	-	-	Did not plan

Gubi Dorwa Test Borehole

Well No.	Location	Coordination		Altitude	Town	Wareda	State	Cuntry
Gobi Dorwa TW1	*Gubi Dorwa*	*596077 E*	*1367056 N*	*856 mamsl*		*Yalo*	*Afar*	*Ethiopia*

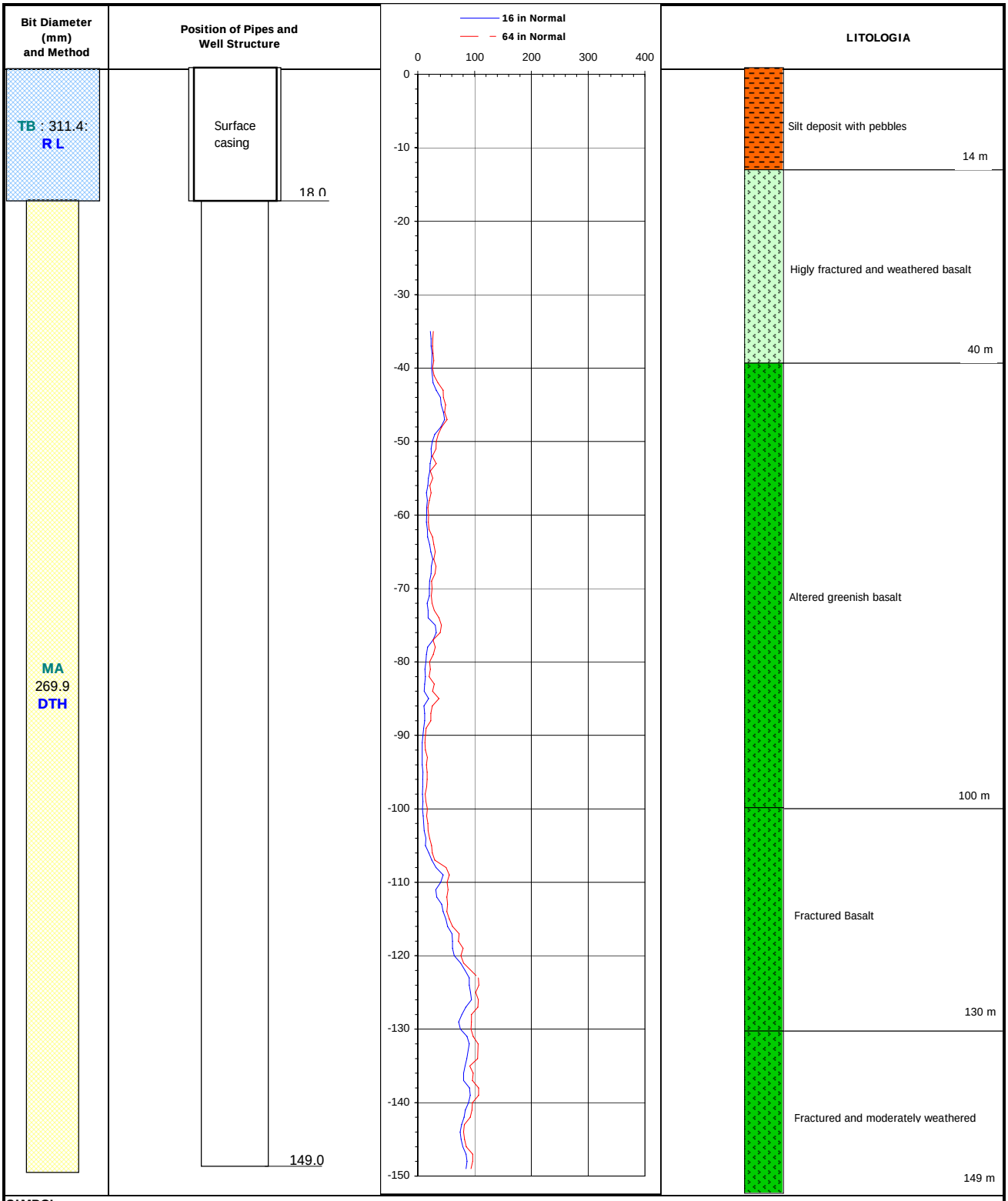
Date: from to	Drilling :	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
			Rotation	*DTH*				*149.0mm*

Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:	Total Length
Steel						

Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:	Total Length
Steel							

Gravel Pakking	Origin	Gravel Size	Location	Volume	Divelopment :	Static Water Leve	Method	Duration	Descharge
					Air lifting	*GL -33.3m*			

Submergible pump : Installation Date :



SIMBOL:

HB = Hammer Bit
TB = Tricon Bit

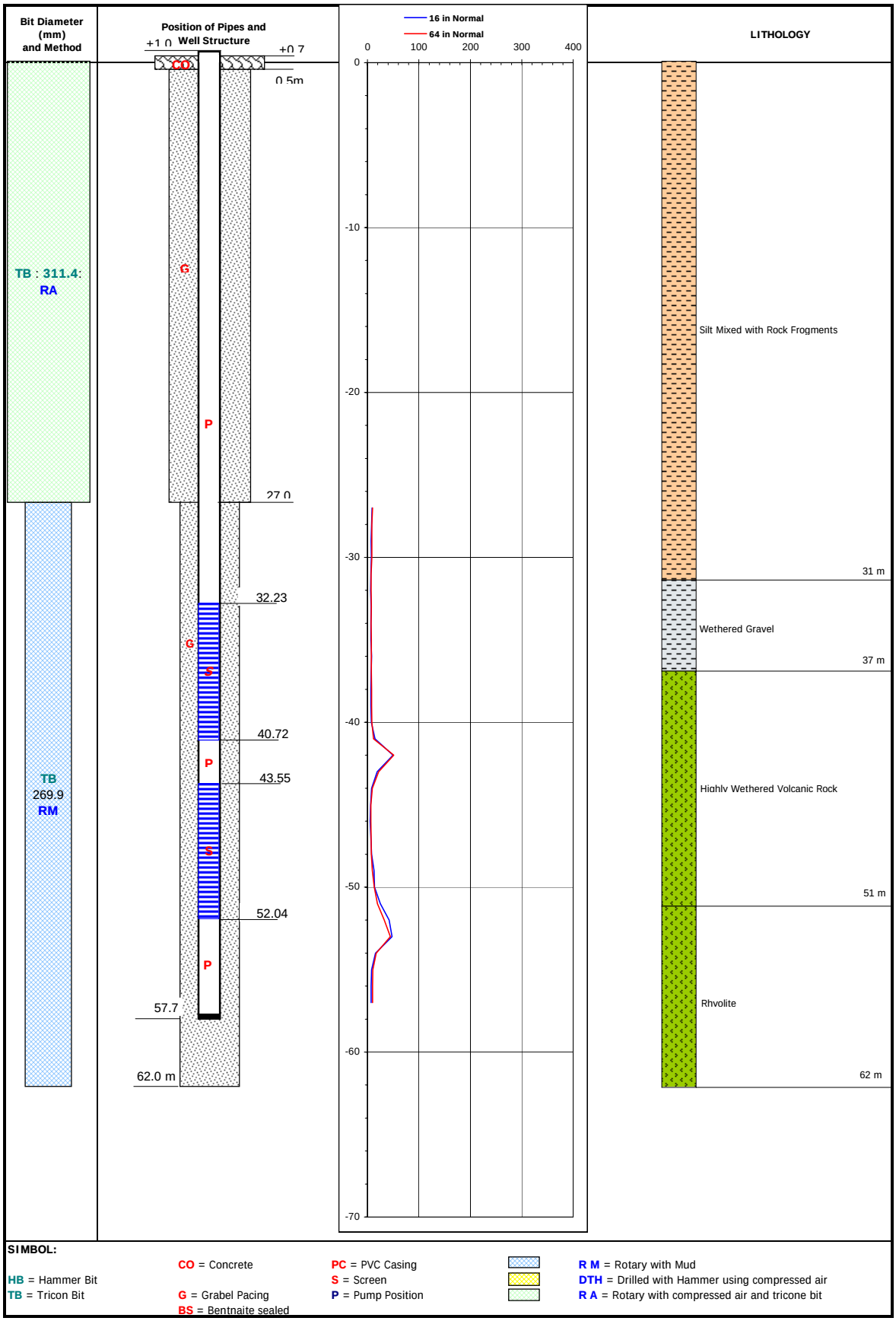
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed

PC = PVC Casing
S = Screen
P = Pump Position

R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

Derayitu Test Borehole

Well No.	Location	Coordination		Altitude	Town	Wareda	State	Cuntry
BZDP/TW1	*Yalo Woreda, Afar*	*616087 E*	*1334043 N*	*816mamsl*	*Derayitu*	*Aura*	*Afar*	*Ethiopia*
Date: from to	**Drilling :**	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
4, mar, 2006 9, apr, 2006			*DTH/Mud*		*mouth : 27.0m*	*depth.: 62.0m*	*Tub.: 57.7m*	*57.7*
Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:			Total Length
PVC	*6"*	*150.0mm*	*165.0mm*	*Screw+welding*	*+1.0-32.23;*	*40-72-43.55;*	*52.04-57.70:*	*41.7m*
Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:		Total Length
PVC		*150.0mm*	*1.0mm*	*10%*	*Screw*	*32.23-40.72;*	*43.55-52.04*	*17.0m*
Gravel Pakking	Origin	Gravel Size	Location	Volume	**Divelopment :**	Static Water Leve	Method	Duration Descharge
		ø 6-9mm				*GL -27.5m*		
Submergible pump :		Installation Date	not installed					

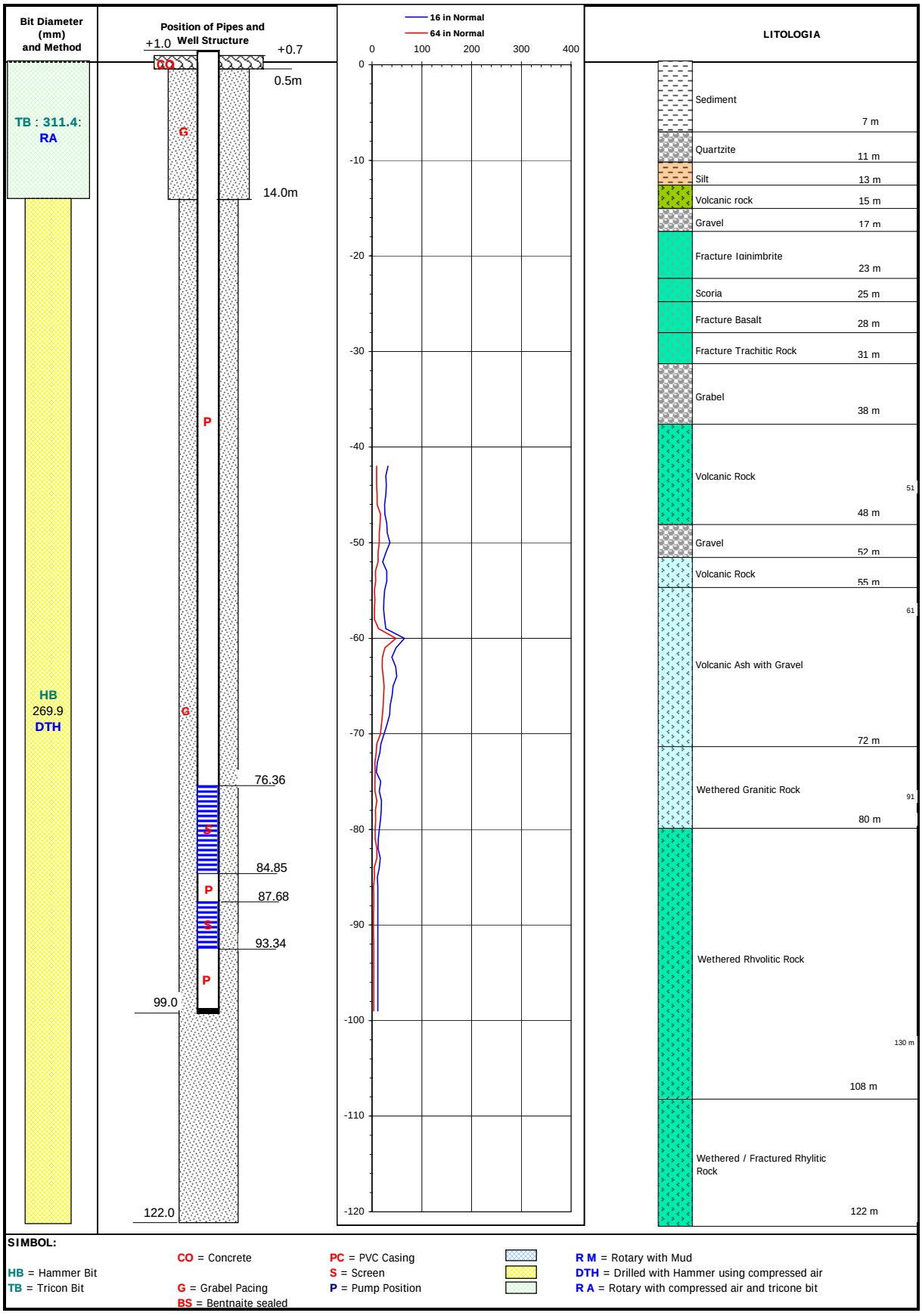


SIMBOL:

HB = Hammer Bit
TB = Tricon Bit
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed
PC = PVC Casing
S = Screen
P = Pump Position
R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

Chifra Test Borehole

Well No.	Location		Coordination		Altitude	Town	Wareda	State	Cuntry
BZDP/TW1	*Chifra Woreda, Afar*		*610328 E*	*1283377 N*	*928mamsl*	*chifra*	*chifra*	*afar*	*Ethiopia*
Date: from to		**Drilling :**	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
10, feb, 2006	*22, feb, 2006*			*DTH*		*mouth : 14.0m*	*depth.: 122.0m*	*Tub.: 99.0m*	*122*
Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:				Total Length
PVC	*6"*	*150.0mm*	*165.0mm*	*Screw+welding*	*+1.0-76.36;*	*84.85-87.68;*	*93.34-99.0:*		*85.9m*
Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:			Total Length
PVC		*150.0mm*	*1.0mm*	*10%*	*Screw*	*76.36-84.85;*	*87.68-93.34*		*14.2m*
Gravel Pakking	Origin	Gravel Size	Location	Volume	**Divelopment :**	Static Water Leve	Method	Duration	Descharge
		ø 6-9mm				*GL -43.0m*			
Submergible pump :		Installation Date	not installed						



SIMBOL:

HB = Hammer Bit
TB = Tricon Bit
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed
PC = PVC Casing
S = Screen
P = Pump Position
R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

Eli Wuha No.2 Test Borehole

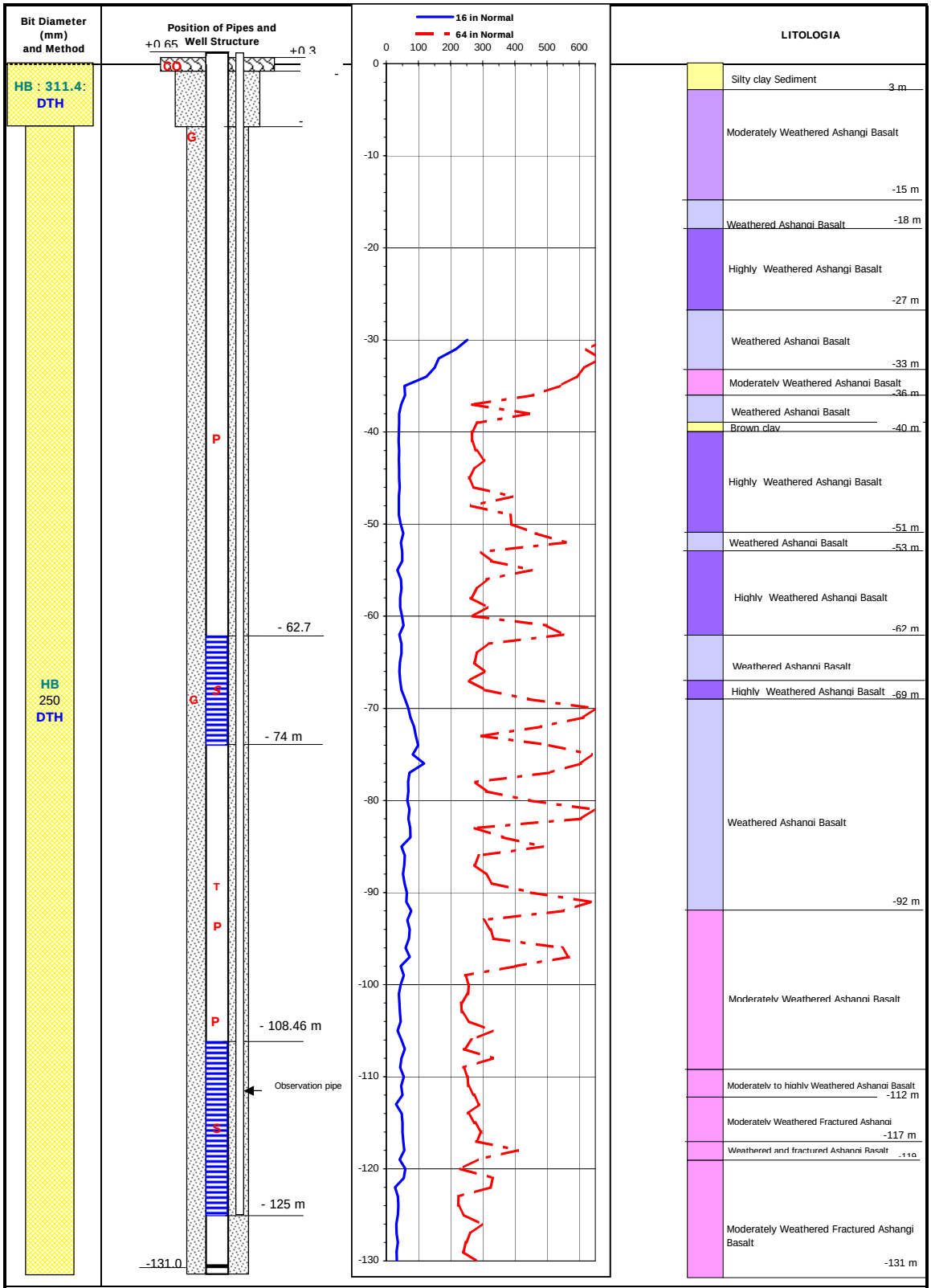
Well No.	Location	Coordination		Altitude	Town	Wareda	State	Cuntry
El Wuha TW2	*Mille Woreda, Afar*	*653402 E*	*1242123 N*	*645 mamsl*	*El Wuha*	*Mille*	*afar*	*Ethiopia*

Date: from	to	Drilling :	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
28, may, 2006	*10, May, 2006*			*Mud circulation*		*mouth : 130.0m*			*-131*

Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:				Total Length
PVC	*6"*	*150.0mm*	*165.0mm*	*Screw+welding*	*+0.65 -62.7;*	*-74.02 - 108.46;*	*-125.5 - 131.0:*		*-102.6m*
Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:			Total Length
PVC		*150.0mm*	*1.0mm*	*10%*	*Screw*	*-62.7- 74.02;*	*-108.46-125.0*		*28.4m*
Observation Pipe:	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:			Total Length
GS Pipe		*19.0mm*			*Screw*	*+0.65 -125.37;*			*28.4m*

Gravel Pakking	Origin	Gravel Size	Location	Volume	Divelopment :	Static Water Level	Method	Duration	Descharge
		ø 6-9mm				*GL -33.0m*			

Submergible pump :	Installation Date	not installed

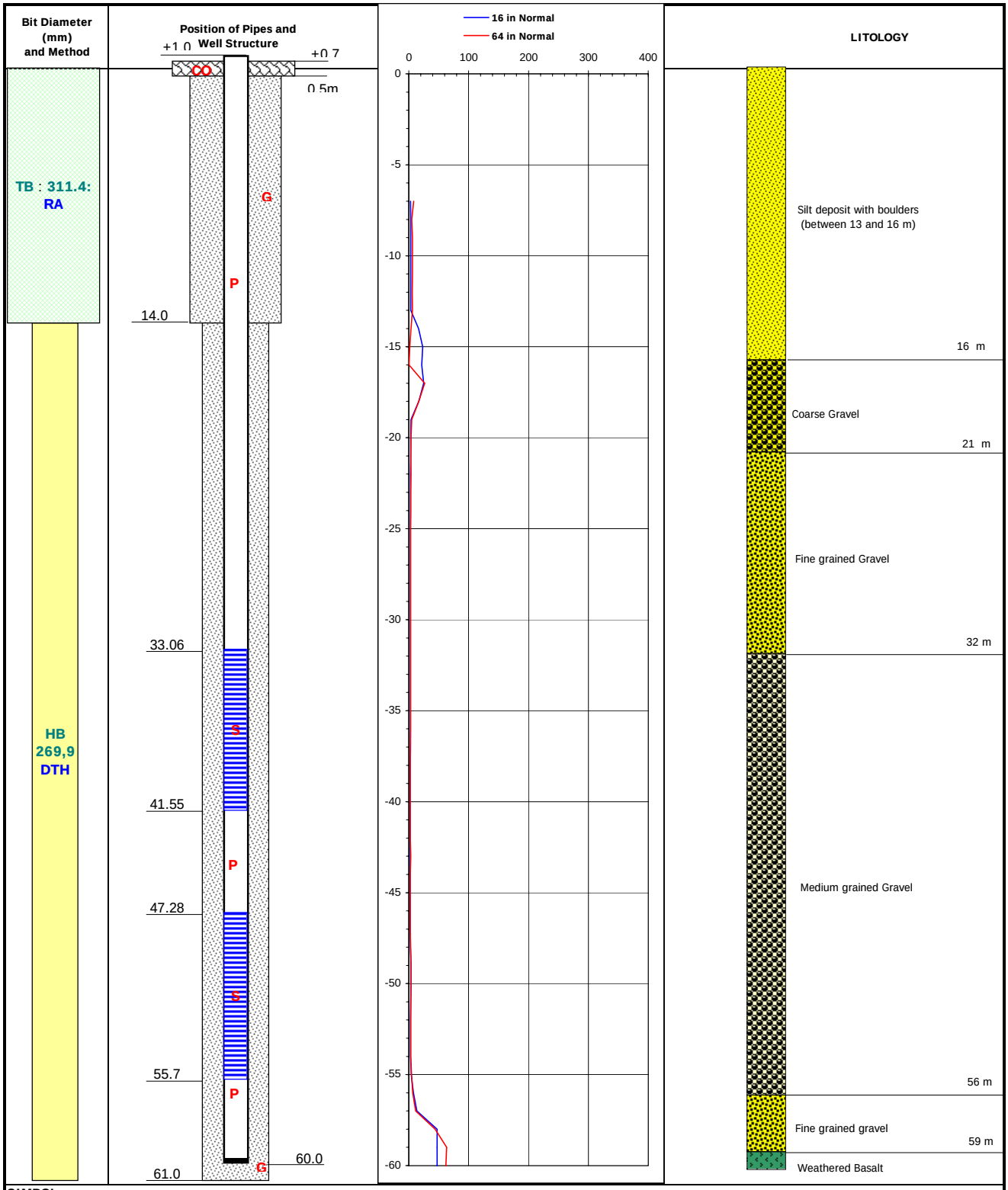


SIMBOL:

HB = Hammer Bit
TB = Tricon Bit
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed
PC = PVC Casing
S = Screen
P = Pump Position
R M = Rotary with mud water
DTH = Percation with air

Nemelefen Test Borehole

Well No.	Location		Coordination		Altitude	Town	Wareda	State	Cuntry	
Nemelefen TW1	*Nemelefen Town*		*633319 E*	*1207437 N*	*858mamsl*	*Nemelefen*	*Telalak*	*Afar*		
Date: from to	**Drilling :**	Equipment Type	Method		Flow	Depth	Depth	Depth	Final Depth	
			Rotation		*Mud*				*168*	*-61.0mm*
Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:					Total Length
PVC	*6" x 6*	*150.0mm*	*165.0mm*	*Screw*	*+1- 33.06;*	*41.55 - 47.28;*	*55.7- 60;*			*43.1m*
Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:				Total Length
Steel		*150.0mm*	*1.0mm*	*10%*	*Screw*	*33.06 -41.55,*	*47.28 - 55.7,*			*16.9m*
Gravel Pakking	Origin	Gravel Size	Location	Volume	**Divelopment :**	Static Water Level	Method	Duration	Descharge	
		ø 2-6mm			*Air lifting*	*GL -8.0m*				
Submergible pump :		Installation Date :								



SIMBOL:

HB = Hammer Bit
TB = Tricon Bit

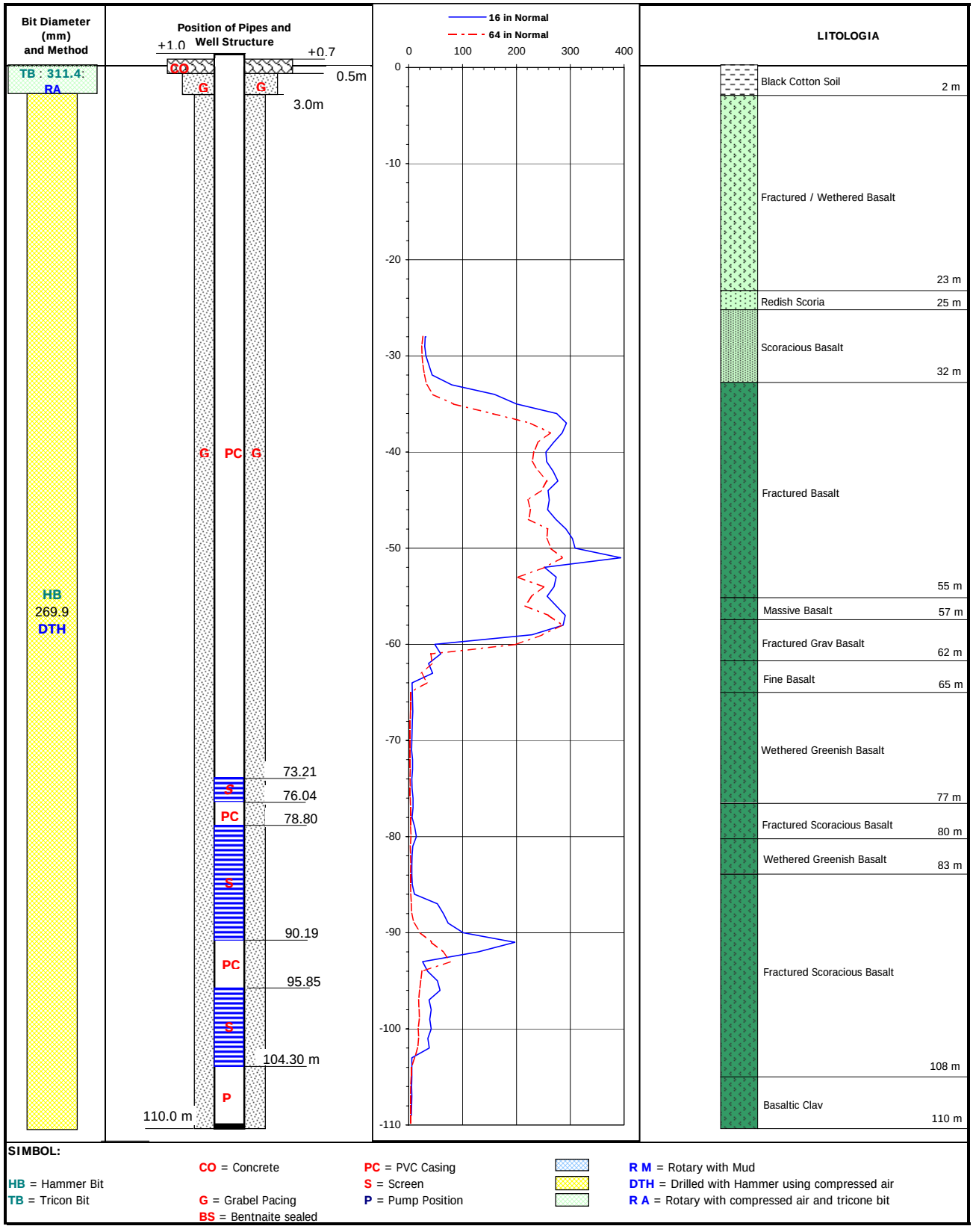
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed

PC = PVC Casing
S = Screen
P = Pump Position

R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

Wederage Test Borehole

Well No.	Location		Coordination		Altitude	Town	Wareda	State	Cuntry
BZDP/TW	*Dewe Woreda, Afar*		*629021 E*	*1195627 N*	*994 mamsl*	*wederage*	*dewa*	*afar*	*Ethiopia*
Date: from	**to**	**Drilling :**	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
20, feb, 2006	*27, feb, 2006*			*DTH*		*mouth : 3.0m*	*depth.: 110.0m*	*Tub.: 110.0m*	*110*
Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:				Total Length
PVC	*6"*	*150.0mm*	*165.0mm*	*Screw+welding*	*+1.0-73.21;*	*76.04-78.8;*	*90.19-95.85;*	*104.3-110.0:*	*88.3m*
Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:			Total Length
PVC		*150.0mm*	*1.0mm*	*10%*	*Screw*	*73.21-76.04;*	*78.8-90.19;*	*95.85-104.3:*	*22.7m*
Gravel Pakking	Origin	Gravel Size	Location	Volume	**Divelopment :**	Static Water Leve	Method	Duration	Descharge
		ø 6-9mm				*GL -28.0m*			
Submergible pump :		Installation Date	not installed						



SIMBOL:

HB = Hammer Bit
TB = Tricon Bit
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed
PC = PVC Casing
S = Screen
P = Pump Position
R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

Dulecha Test Borehole

Well No.	Location	Coordination		Altitude	Town	Wareda	State	Cuntry
Dulecha TW1	*Dulecha Town*	*605196 E*	*1055622 N*	*1021mamsl*	*Dulecha*	*Dulecha*	*Afar*	*Ethiopia*

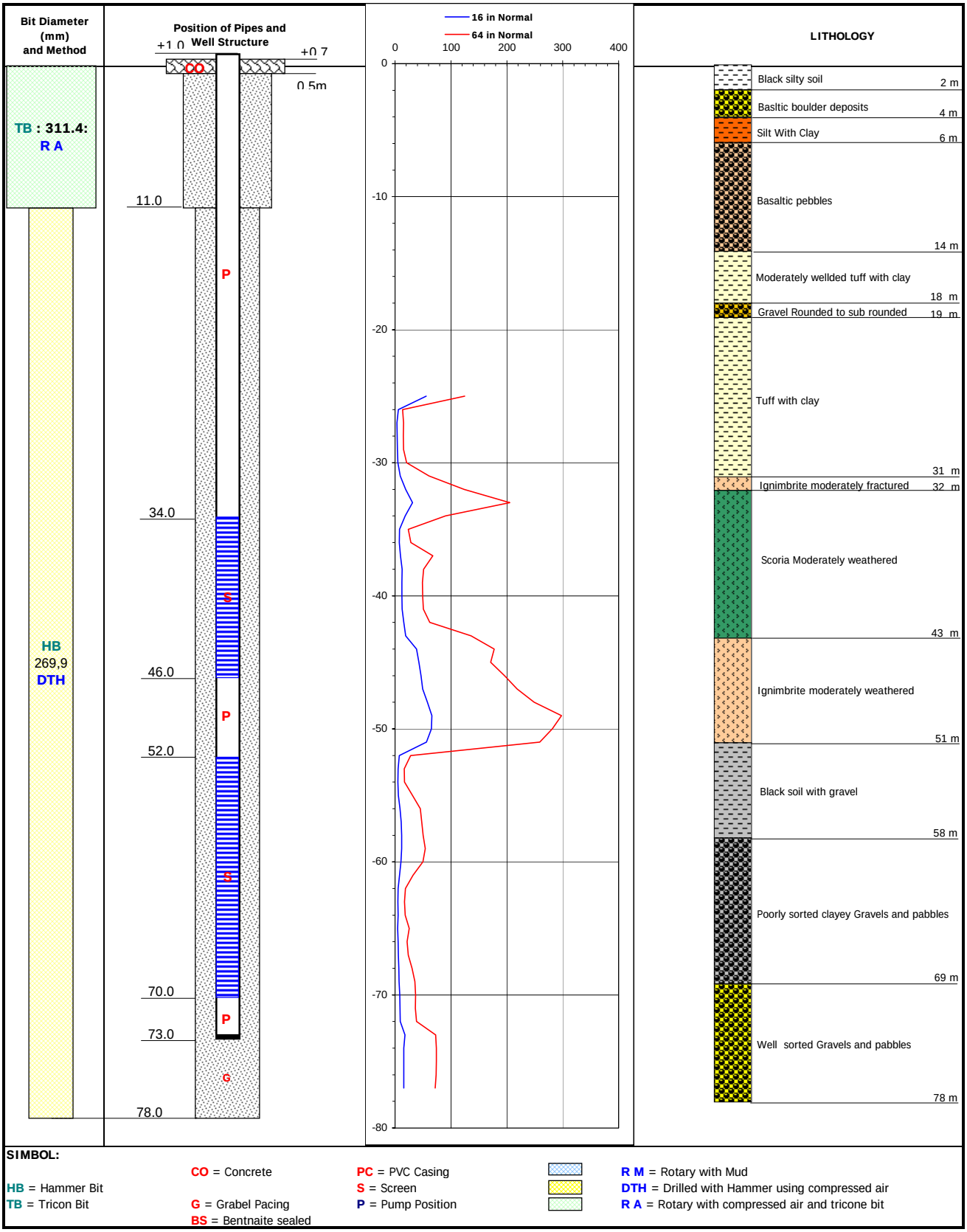
Date: from to	Drilling :	Equipment Type	Method	Flow	Depth	Depth	Depth	Final Depth
			Rotation	*DTH*			*168*	*-149 m*

Casing Type :	Type	Inside Dia.	Outside Dia.	Joint Type	Installation depth:			Total Length
PVC	*6" x 6*	*150.0mm*	*165.0mm*	*Screw*	*+1-34;*	*46 - 52;*		*43.0m*

Screen Pipe :	Material	Diameter	Silot Size	Open Rate	Joint Type	Installation depth:		Total Length
PVC		*150.0mm*	*1.0mm*	*10%*	*Screw*	*34-46,*	*52-70,*	*30.0m*

Gravel Pakking	Origin	Gravel Size	Location	Volume	Divelopment :	Static Water Level	Method	Duration	Descharge
		ø 2-6mm			*Air lifting*	*GL -25.9m*			

Submergible pump : Installation Date :



SIMBOL:

HB = Hammer Bit
TB = Tricon Bit
CO = Concrete
G = Grabel Pacing
BS = Bentnaite sealed
PC = PVC Casing
S = Screen
P = Pump Position
R M = Rotary with Mud
DTH = Drilled with Hammer using compressed air
R A = Rotary with compressed air and tricone bit

2. Aquifer Testing

Summary

Town	Drilled depth (m)	Cased Well depth (m)	Screen length (m)	Constant test (l/s)	Draw down (m)	Aquifer Material	Transmissivity (m2/day)	Potential of aquifer	Proposed Pumping Rate(L/s)
Dulecha	78	73	30	6.7	3.25	Gravel	153	10 to 20 l/s	4.5
Wederage	110	110	22.64	1.5	36.23	Weathered and fractured Volcanic rock	2.5	2 l/s	2.0
Nemelefen	61	60	16.98	1.5	30.69	Gravel	1.55	2 l/s	1.5
Chifra	122	99	14.15	6.3	4.76	Weathered and fractured volcanic rock	1881	10 to 20 l/s	6.7
Derytu	63	57.7	15	5	2.91	Gravel	898	5 to 10 l/s	3.0
Gubi Dorwa	149	No casing		1.5	73.57	Weathered and fractured volcanic rock	1.2	1.5 l/s	1.0
Eli Wuha									

(1) Dulecha

Table - Summary of test pumping result

Ground level (m.a.s.l)	1021
Pumping rate (m3/day)	578.9 (6.7 l/s)
Pumping test length	24 hours
Static Water Level Below ground (m)	25.95
Pumping water level (m)	29.2
Drawdown (m)	3.25
Specific Capacity (M3/day/m)	178.12
Transmissivity from time drawdown plot (m^2/d)	106
Transmissivity from constant rate pumping recovery (m^2/d)	177
Transmissivity from step test recovery (m^2/d)	177
Average transmissivity of aquifer (m^2/d)	153
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	5.1

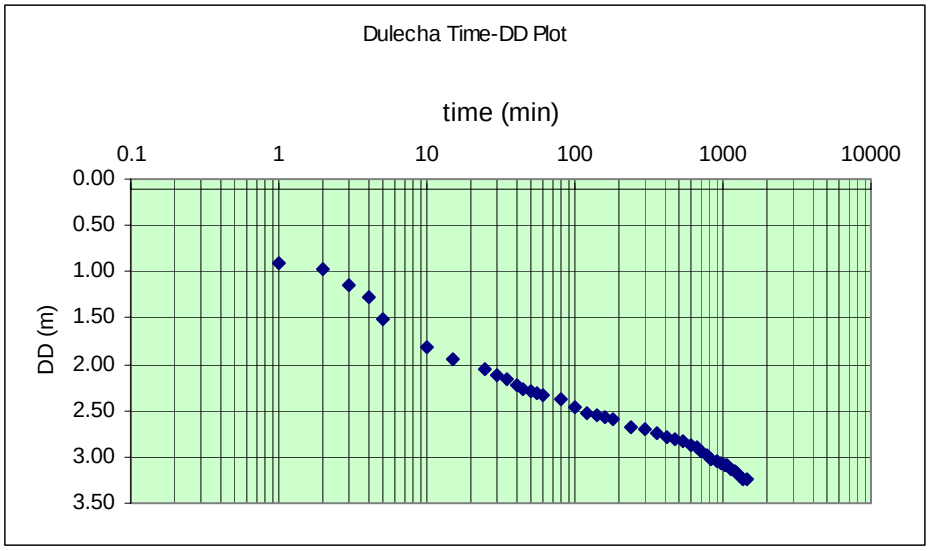


Figure - Dulecha Town Time Drawdown plot

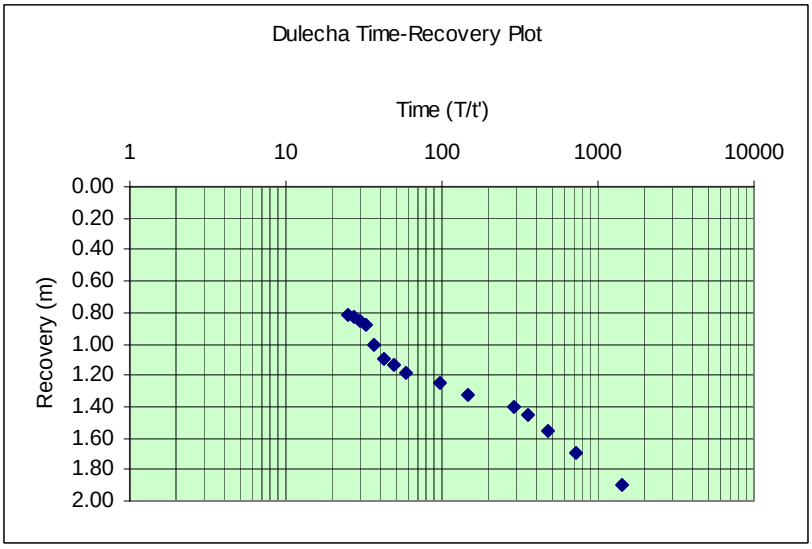


Figure - Dulecha Town Water Level Recovery plot

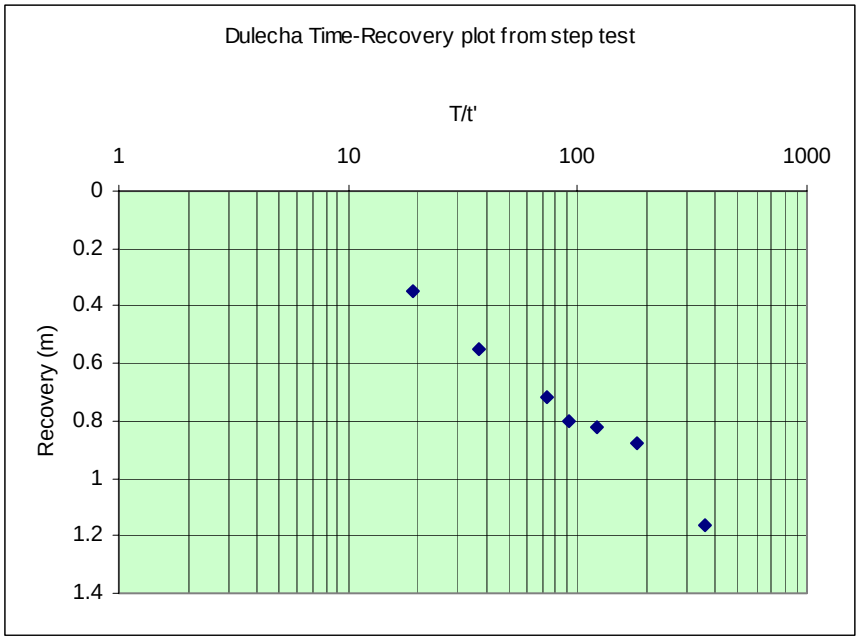


Figure - Dulecha Town Water Level Recovery plot from Step test

Table 3: Result of Step Drawdown test

Step	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	4.5	388.80	1.55	250.84	0.004	0.00385	2.22E-06	1.50	0.34	1.83	82%
2	6.7	578.88	2.55	227.01	0.004			2.23	0.74	2.97	75%
3	5.5	475.20	2.06	230.68	0.004			1.83	0.50	2.33	78%

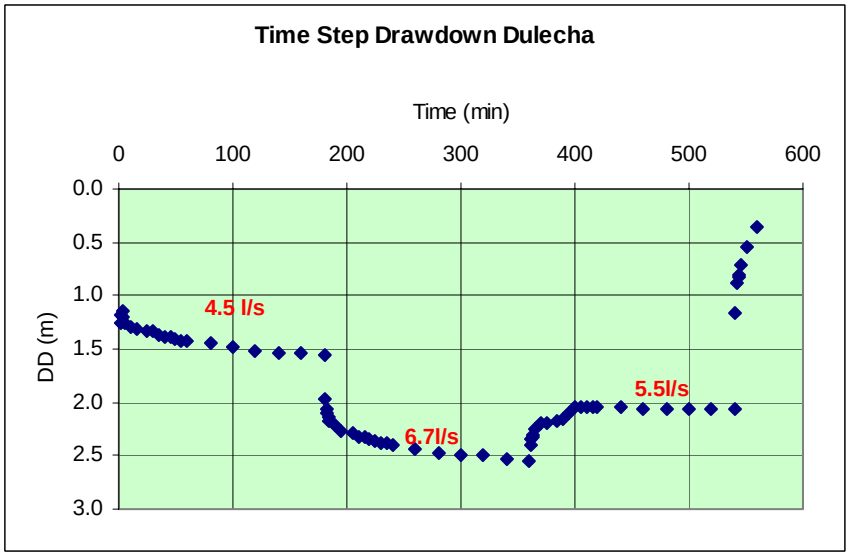


Figure - Dulecha Town, Plot of drawdown vs time of the step test

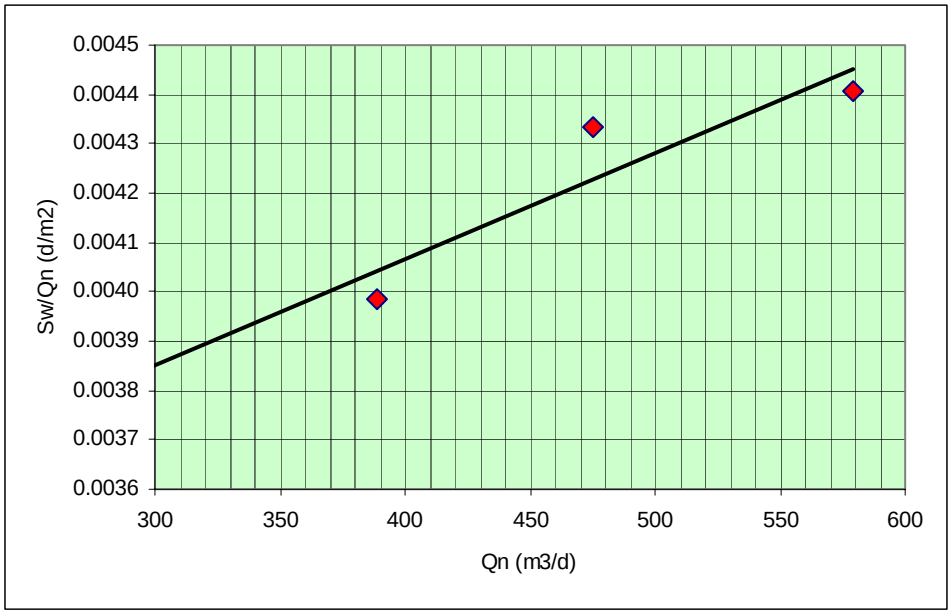


Figure - Dulecha Town, Plot of Specific capacity vs discharge

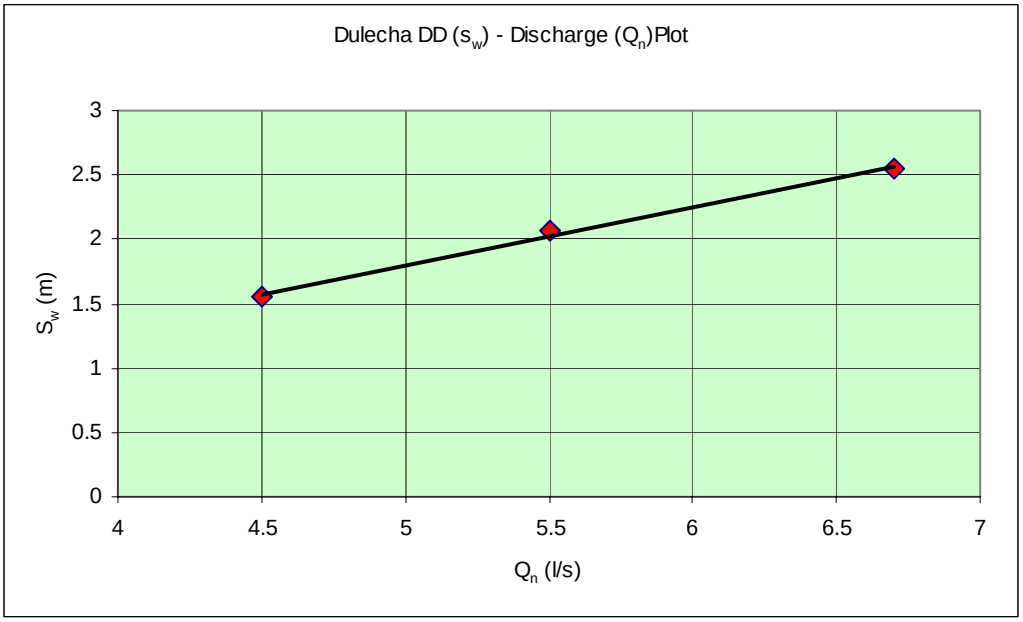


Figure 6. Dulecha Town Plot of Drawdown vs discharge

(2) Wederage

Table - Summary of test pumping result

Ground level (m.a.s.l)	994
Static water Level below ground (m)	30.49
Pumping rate (m3/day)	216 (2.5 l/s)
Pumping test length	24 hours
pumping water level (m)	70.83
Drawdown (m)	40.34
Specific Capacity (M3/day/m)	5.35
Transmissivity from time drawdown plot (m^2/d)	1.75
Transmissivity from constant rate pumping recovery (m^2/d)	2.2
Transmissivity from step test recovery (m^2/d)	3
Average transmissivity of aquifer (m^2/d)	2.5
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	0.11

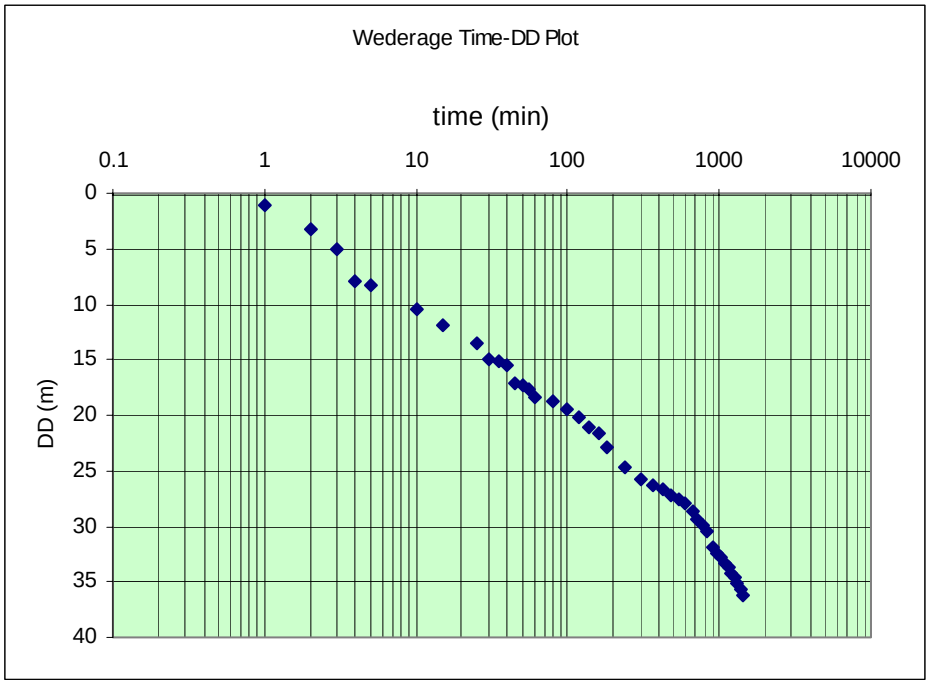


Figure - Wederage Town Time Drawdown plot

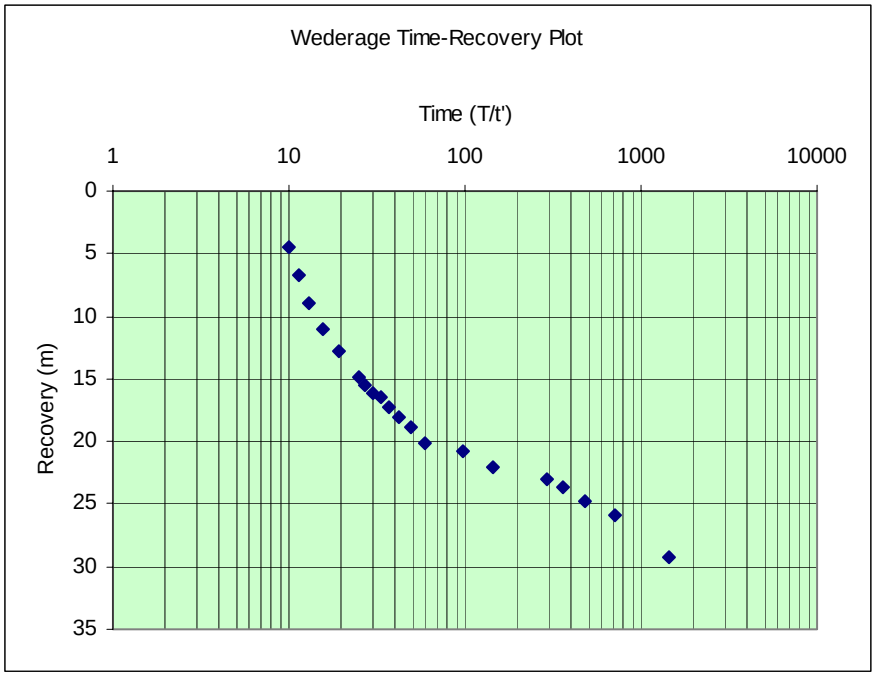


Figure - Wederage Town Water Level Recovery plot

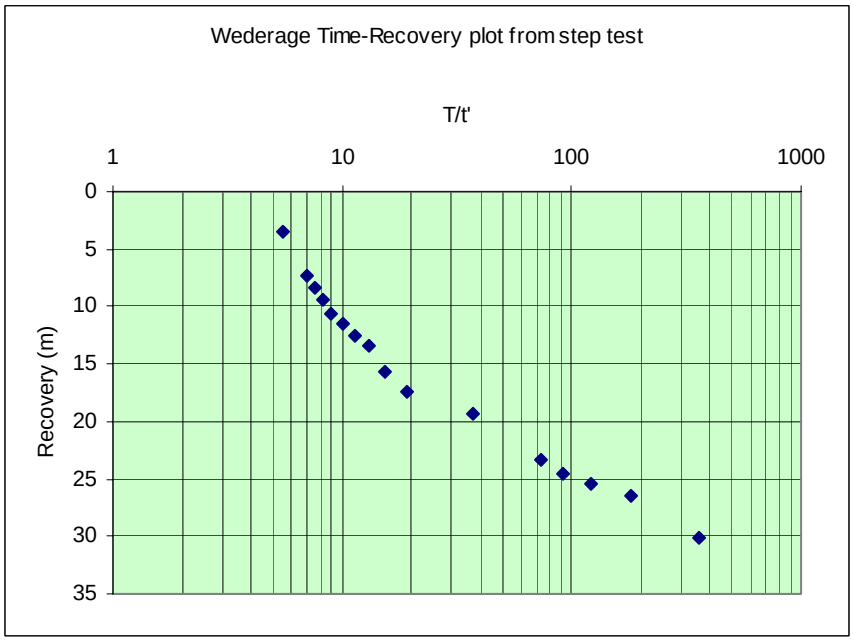


Figure - Wederage Town Water Level Recovery plot from Step test

Table - Result of Step Drawdown test

Steps	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	1.5	129.60	9.6	13.50	0.07	0.032	0.000333	4.15	5.60	9.75	43%
2	2.5	216.00	22.25	9.71	0.10			6.91	15.55	22.46	31%
3	3.5	302.40	39.38	7.68	0.13			9.68	30.48	40.16	24%

Figure - Wederage Town, Plot of drawdown vs time of the step test

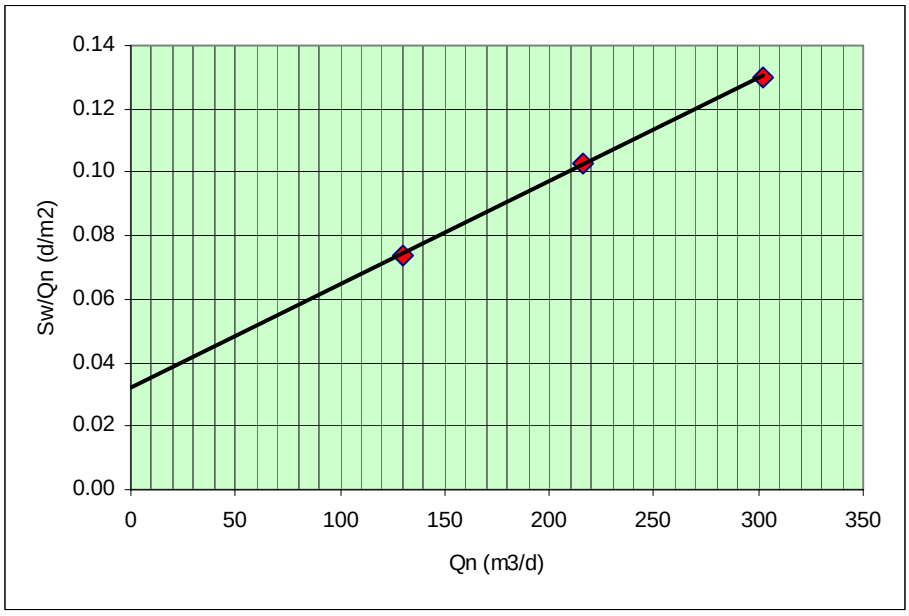


Figure - Wederage Town, Plot of Specific capacity vs discharge

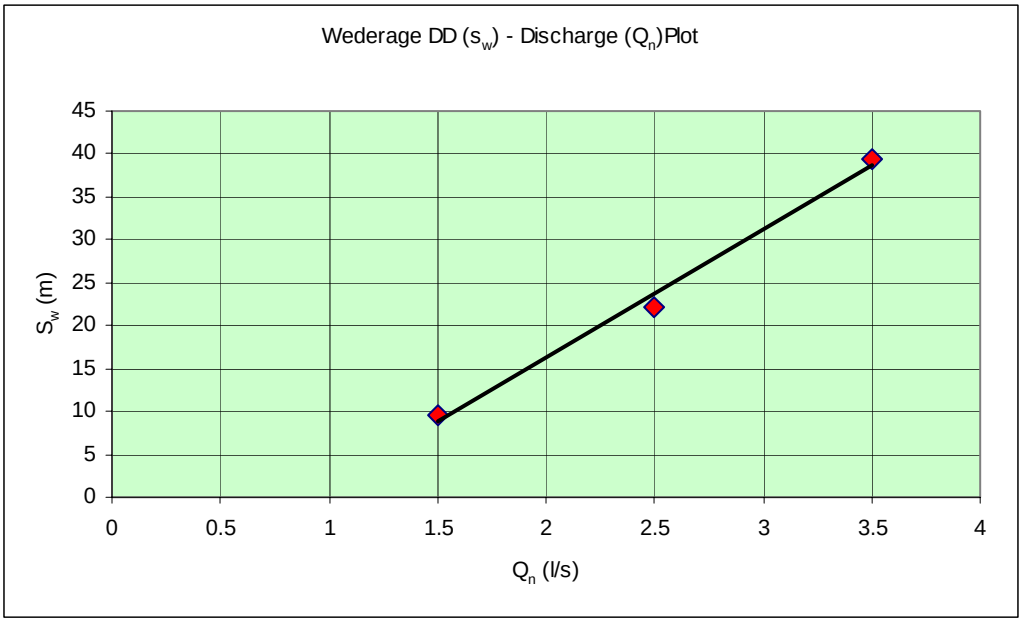


Figure - Wederage Town Plot of Drawdown vs discharge

(3) Nemelefen

Table - Summary of test pumping result

Ground level (m.a.s.l)	858
Static water Level below ground (m)	8
Pumping rate (m3/day)	129.6 (1.5 l/s)
Pumping test length	24 hours
Pumping water level (m)	38.69
Drawdown (m)	30.69
Specific Capacity (M3/day/m)	4.22
Transmissivity from time drawdown plot (m^2/d)	1.59
Transmissivity from constant rate pumping recovery (m^2/d)	1.48
Transmissivity from step test recovery (m^2/d)	1.58
Average transmissivity of aquifer (m^2/d)	1.55
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	0.09

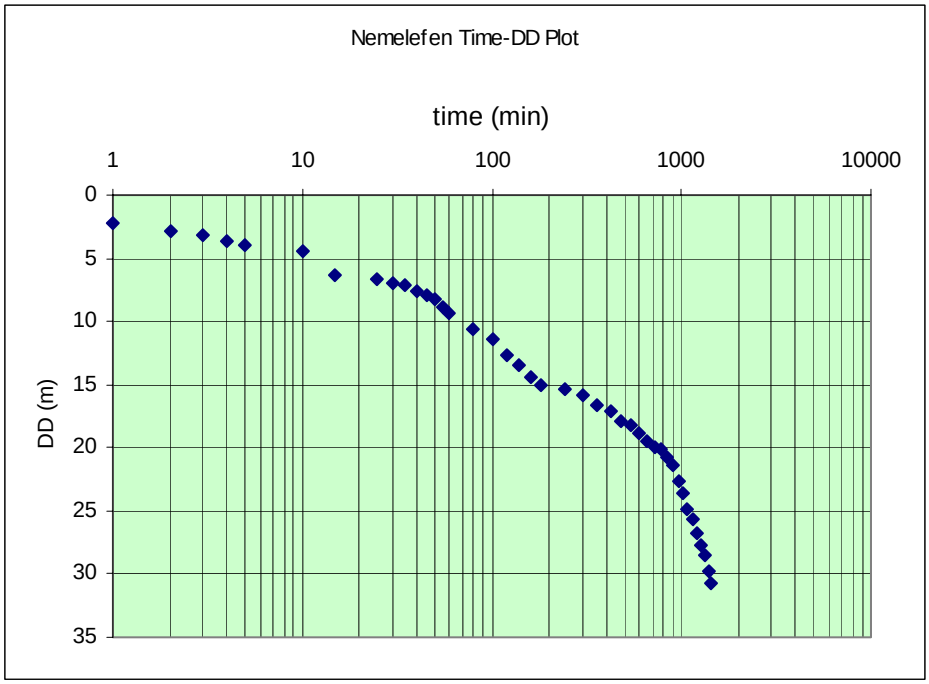


Figure 13 Nemelefen Town Time Drawdown plot

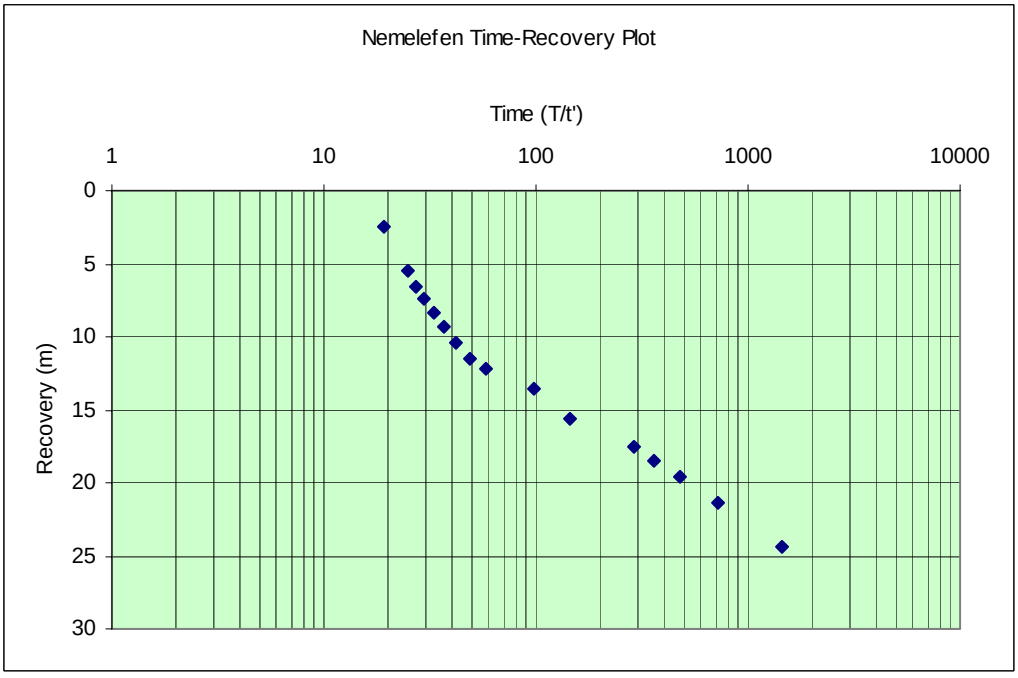


Figure 14 Nemelefen Town Water Level Recovery plot

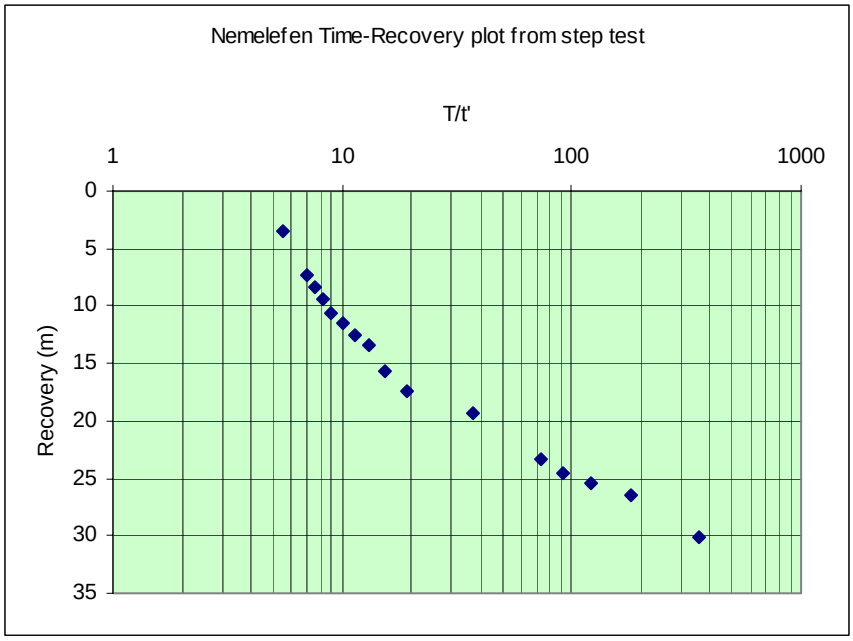


Figure - Nemelefen Town Water Level Recovery plot from Step test

Table - Result of Step Drawdown test

Steps	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	1.04	89.86	11.45	7.85	0.13	0.065	0.001	5.84	8.07	13.91	42%
2	1.5	129.60	29.53	4.39	0.23			8.42	16.80	25.22	33%
3	2	172.80	35.56	4.86	0.21			11.23	29.86	41.09	27%

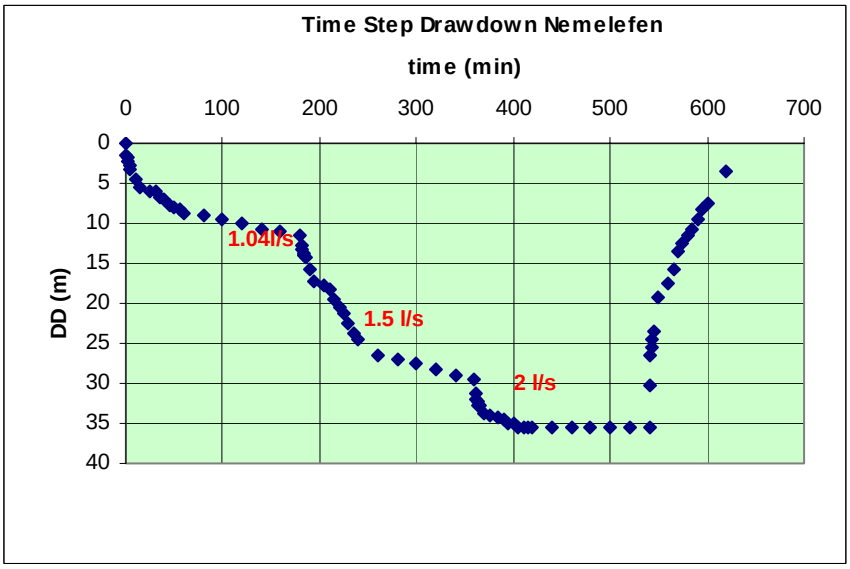


Figure - Nemelefen Town, Plot of drawdown vs time of the step test

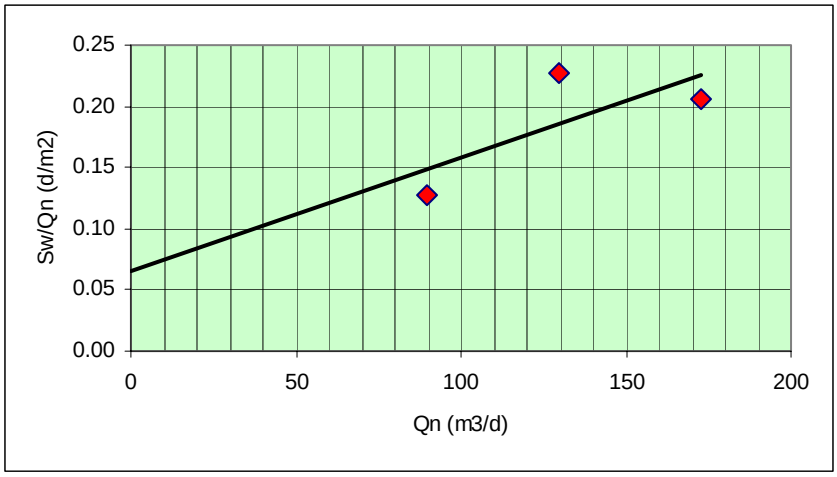


Figure - Nemelefen Town, Plot of Specific capacity vs discharge

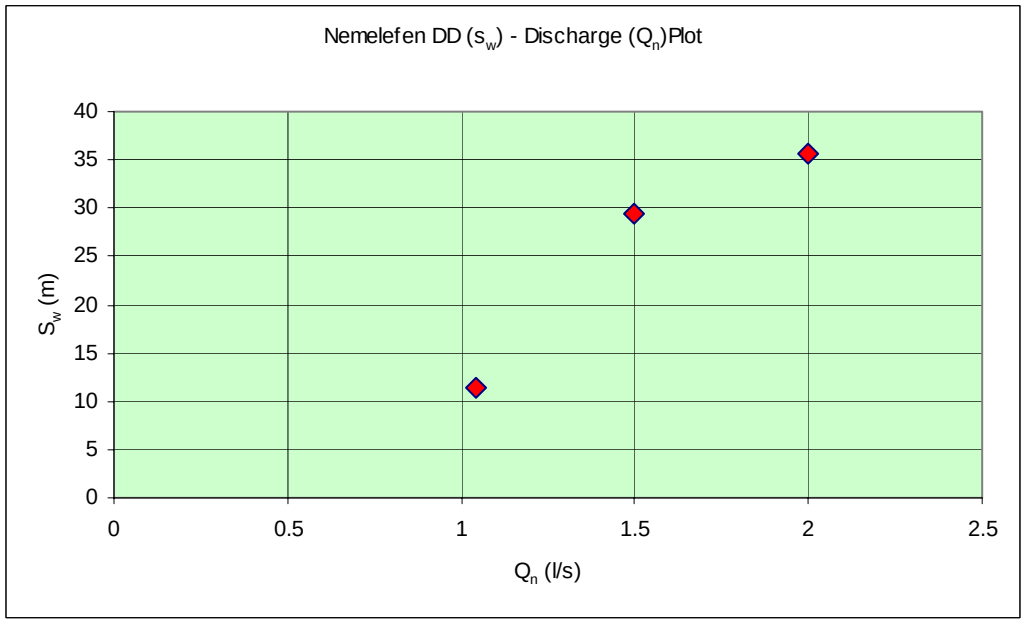


Figure - Nemelefen Town Plot of Drawdown vs discharge

(4) Chifra

Table - Summary of test pumping result

Ground level (m.a.s.l)	928
Static water Level below ground (m)	40.1
Pumping rate (m3/day)	544.32 (6.3 l/s)
Pumping test length	24 hours
Pumping water level (m)	44.86
Drawdown (m)	4.76
Specific Capacity (M3/day/m)	114.35
Transmissivity from time drawdown plot (m^2/d)	1660
Transmissivity from constant rate pumping recovery (m^2/d)	1992
Transmissivity from step test recovery (m^2/d)	1992
Average transmissivity of aquifer (m^2/d)	1881
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	133

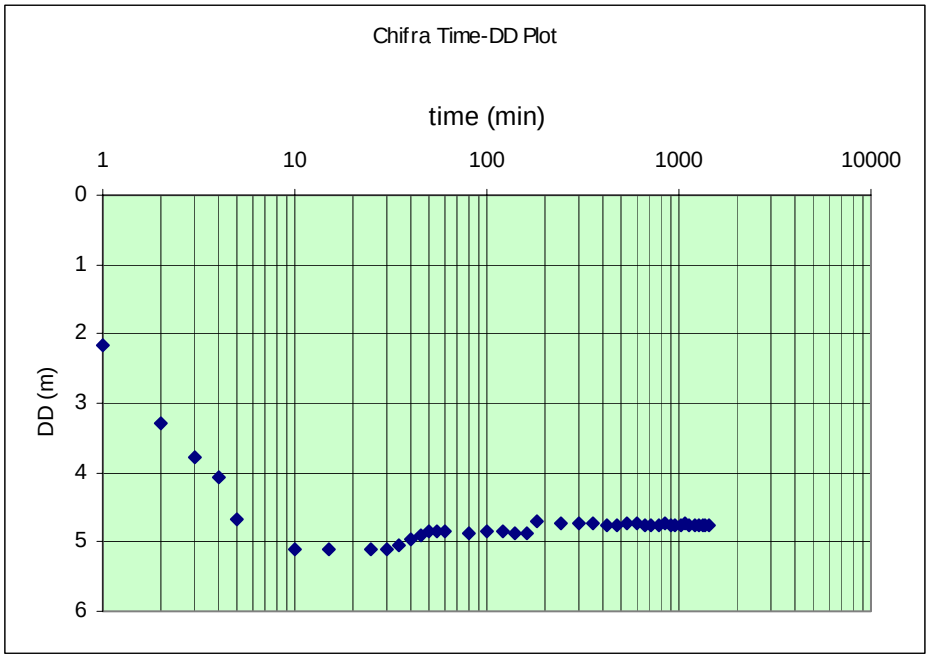


Figure - Chifra Town Time Drawdown plot

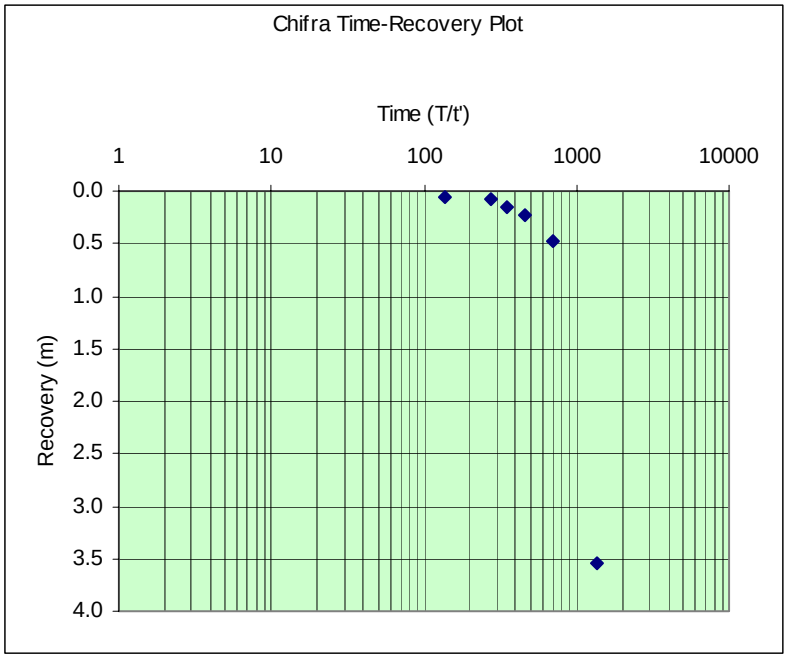


Figure - Chifra Town Water Level Recovery plot

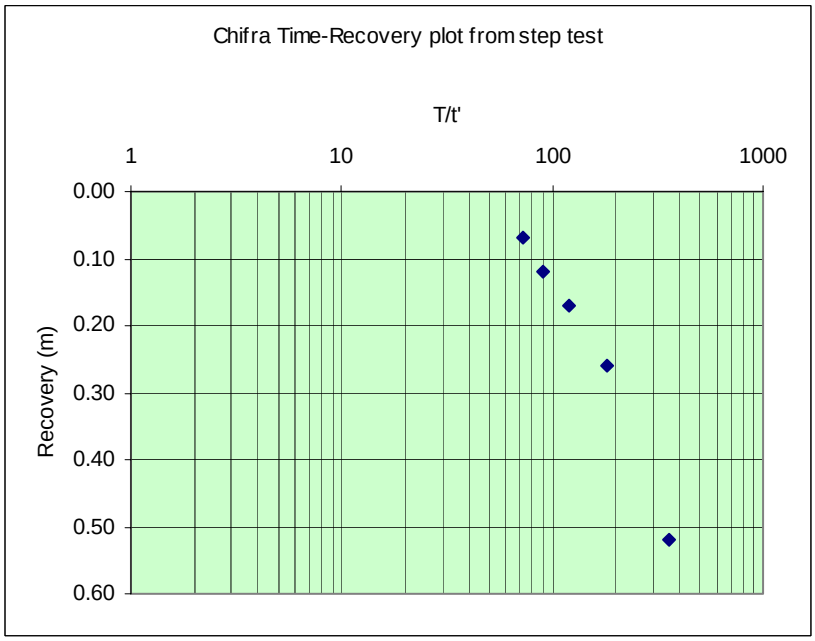


Figure - Chifra Town Water Level Recovery plot from Step test

Table - Result of Step Drawdown test

Steps	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	4	345.60	3.54	97.63	0.01						
2	6.3	544.32	5.57	97.72	0.01						
3	5	432.00	2.52	171.43	0.01						

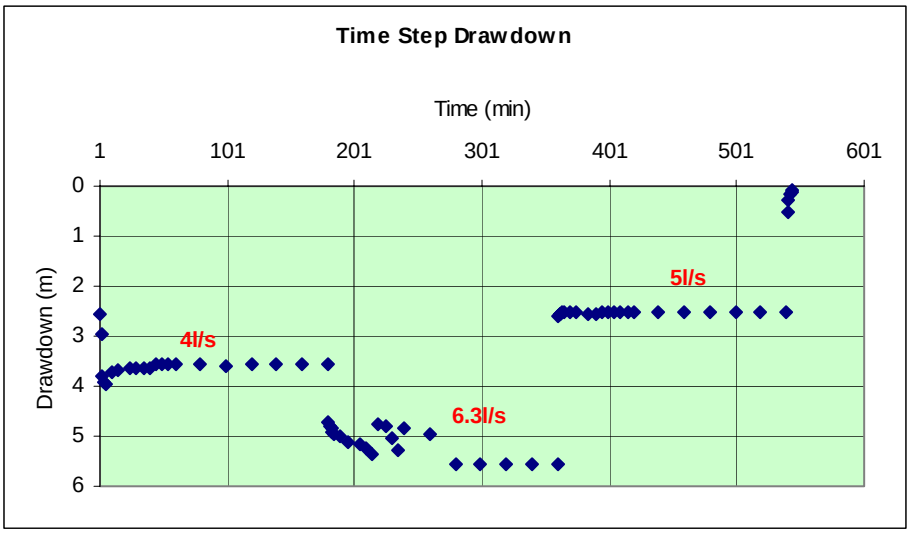


Figure - Chifra Town, Plot of drawdown vs time of the step test

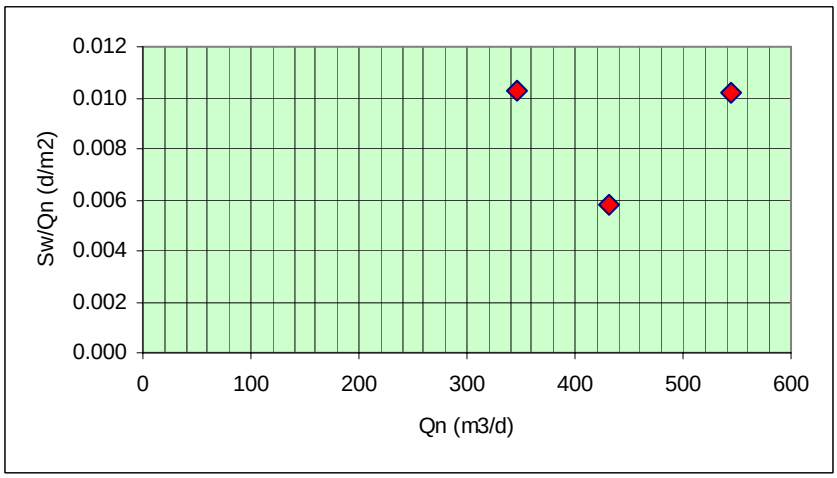


Figure - Chifra Town, Plot of Specific capacity vs discharge

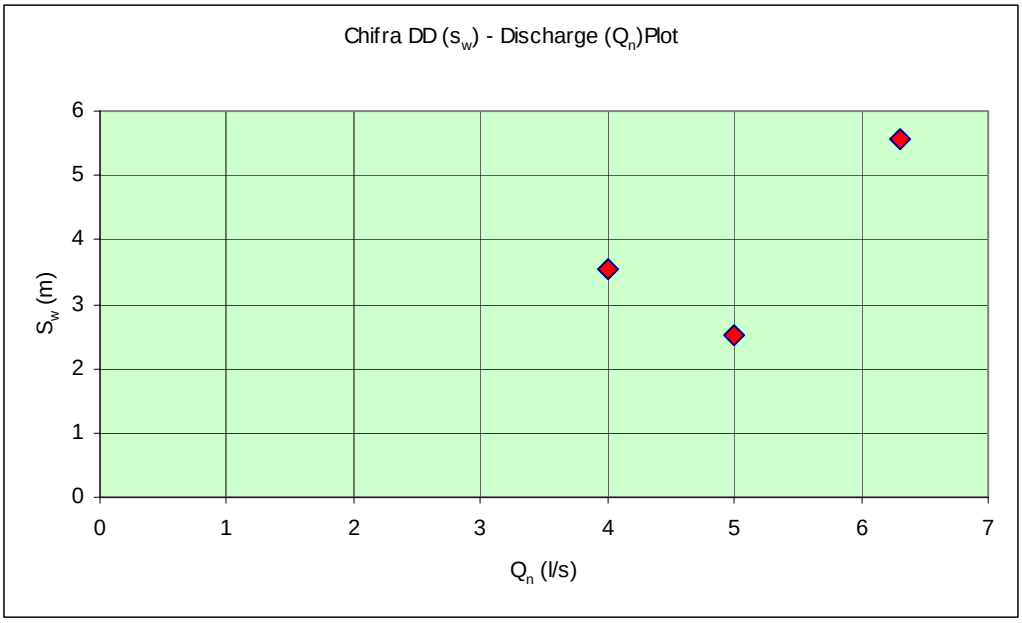


Figure - Chifra Town Plot of Drawdown vs discharge

(5) Derayitu

Table - Summary of test pumping result

Ground level (m.a.s.l)	816
Pumping rate (m3/day)	432 (5 l/s)
Pumping test length	24 hours
Static water level below ground (m)	27.55
Pumping water level (m)	30.46
Drawdown (m)	2.91
Specific Capacity (M3/day/m)	148.45
Transmissivity from time drawdown plot (m^2/d)	1317
Transmissivity from constant rate pumping recovery (m^2/d)	718
Transmissivity from step test recovery (m^2/d)	659
Average transmissivity of aquifer (m^2/d)	898
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	60

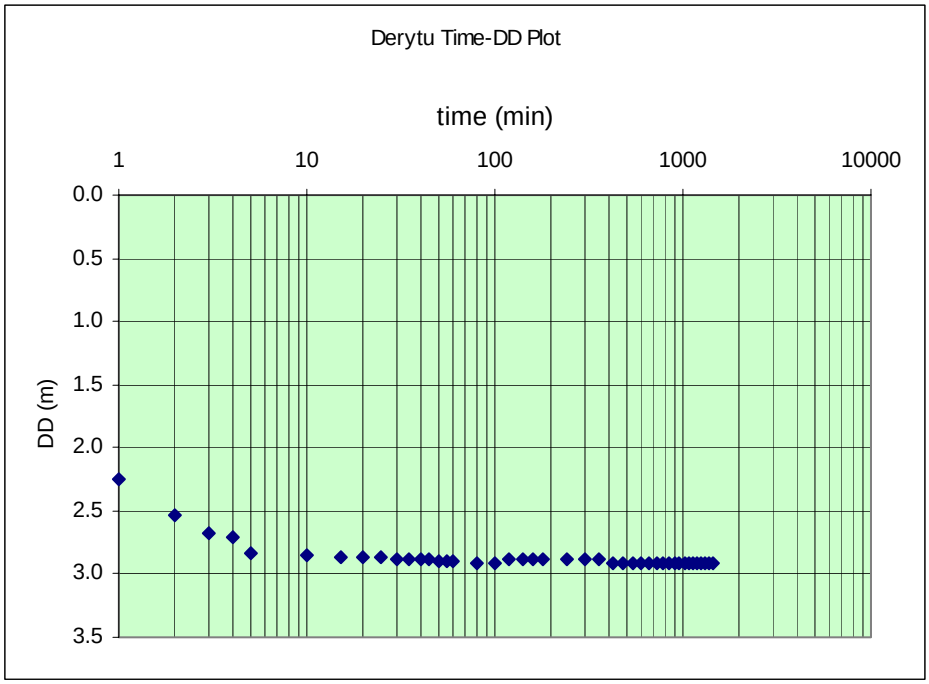


Figure - Derytu Town Test Well Time Drawdown plot

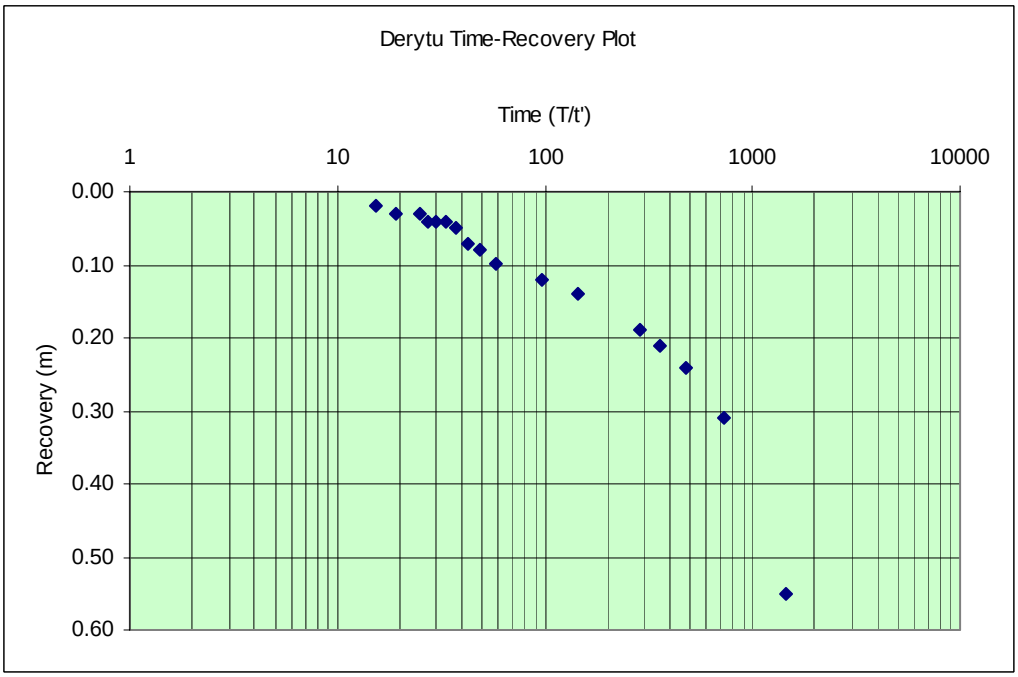


Figure - Deraytu Town Test Well Water Level Recovery plot

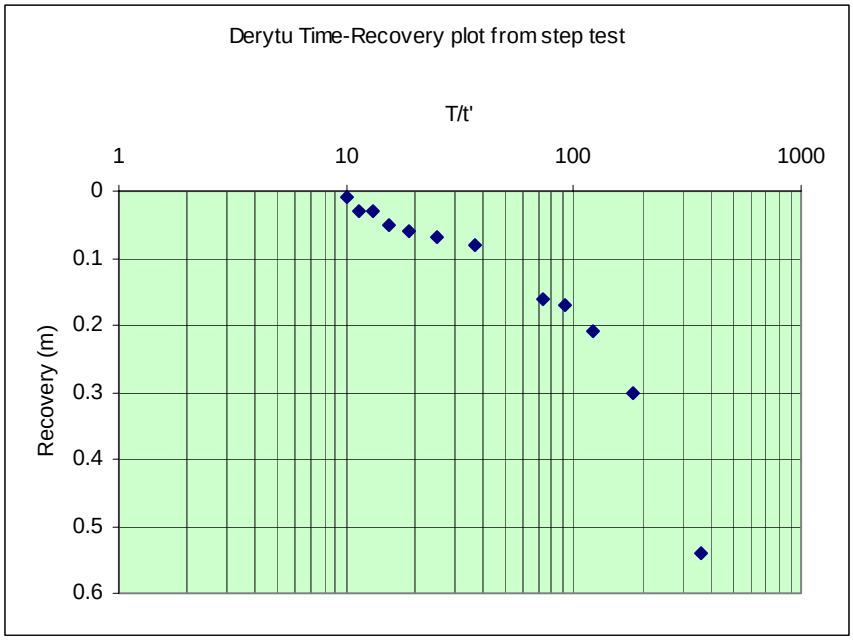


Figure - Derytu Town Test Well Water Level Recovery plot from Step test

Table- Result of Step Drawdown test

Steps	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	3	259.20	1.57	165.10	0.01	0.0049	4.55E-06	1.27	0.31	1.58	81%
2	4	345.60	2.14	161.50	0.01			1.69	0.54	2.24	76%
3	5	432.00	2.94	146.94	0.01			2.12	0.85	2.97	71%

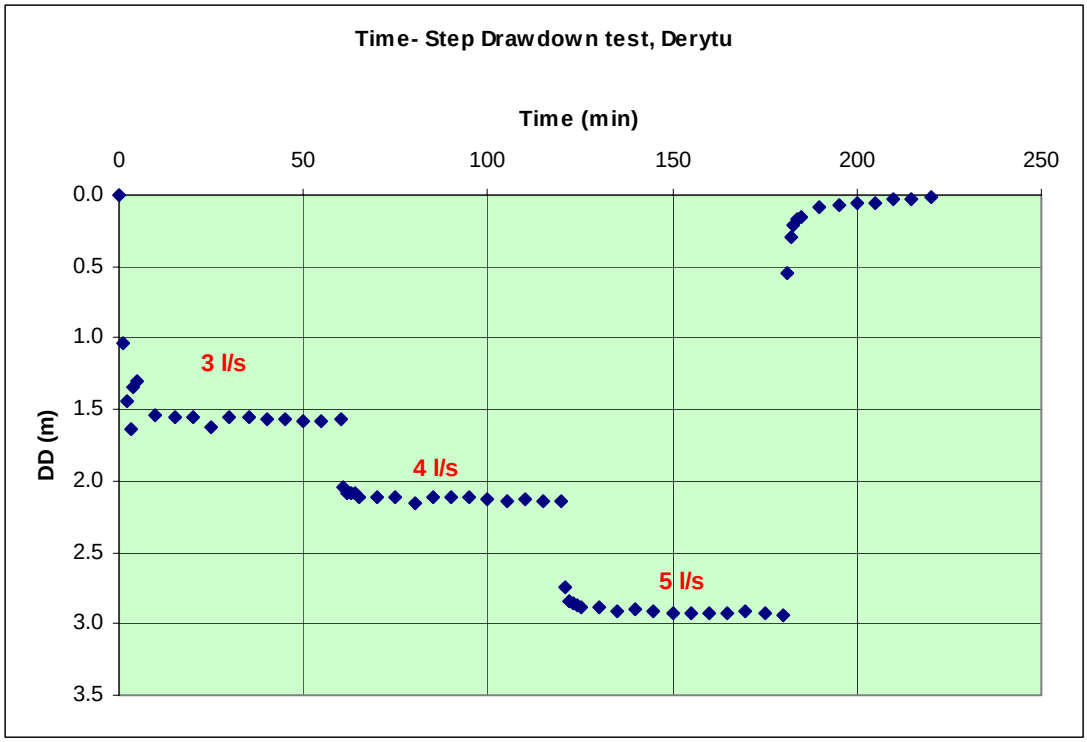


Figure - Drytu Town, Plot of drawdown vs time of the step test

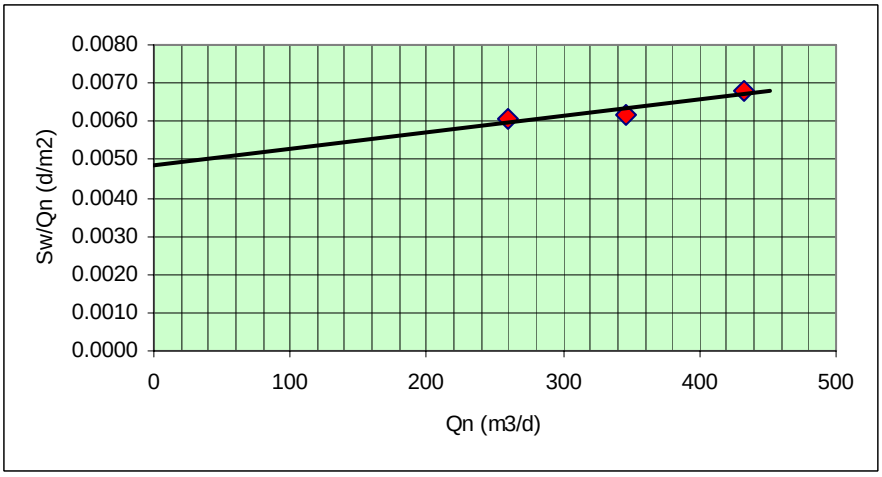


Figure - Derayitu Town Test well, Plot of Specific capacity vs discharge

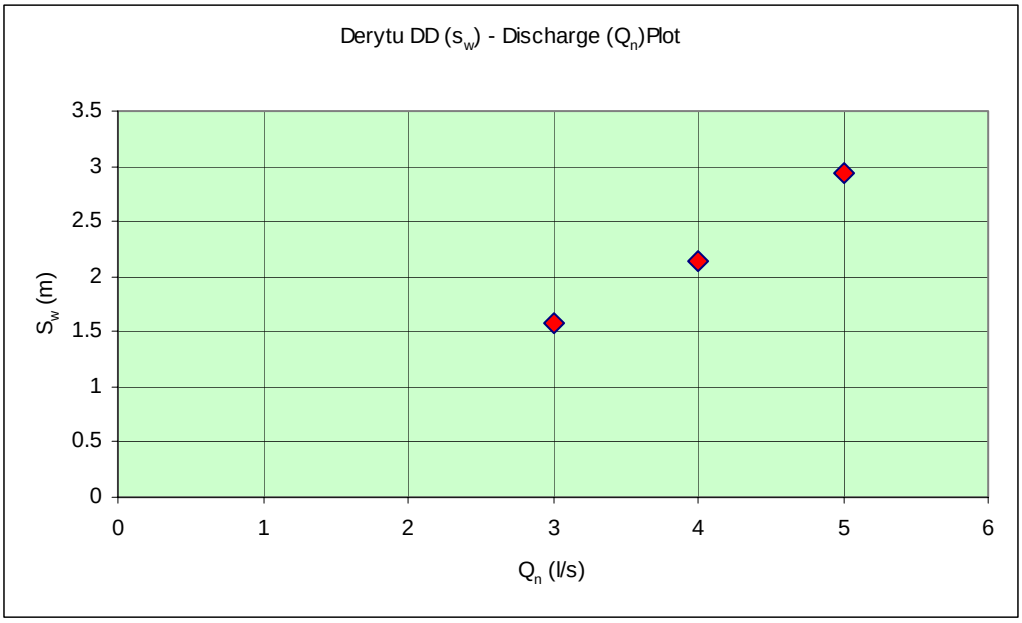


Figure - Derytu Town Test well Plot of Drawdown vs discharge

(6) Gubi Dowra

Table - Summary of test pumping result

Ground level (m.a.s.l)	1021
Static Water level below ground (m)	33.25
Pumping rate (m3/day)	129.6 (1.5 l/s)
Pumping test length	24 hours
Pumping water level (m)	106.82
Drawdown (m)	73.57
Specific Capacity (M3/day/m)	1.76
Transmissivity from time drawdown plot (m^2/d)	0.8
Transmissivity from constant rate pumping recovery (m^2/d)	1.6
Transmissivity from step test recovery (m^2/d)	1.2
Average transmissivity of aquifer (m^2/d)	1.2
Hydraulic Conductivity m/d (Transmissivity divided by screen length)	No screen

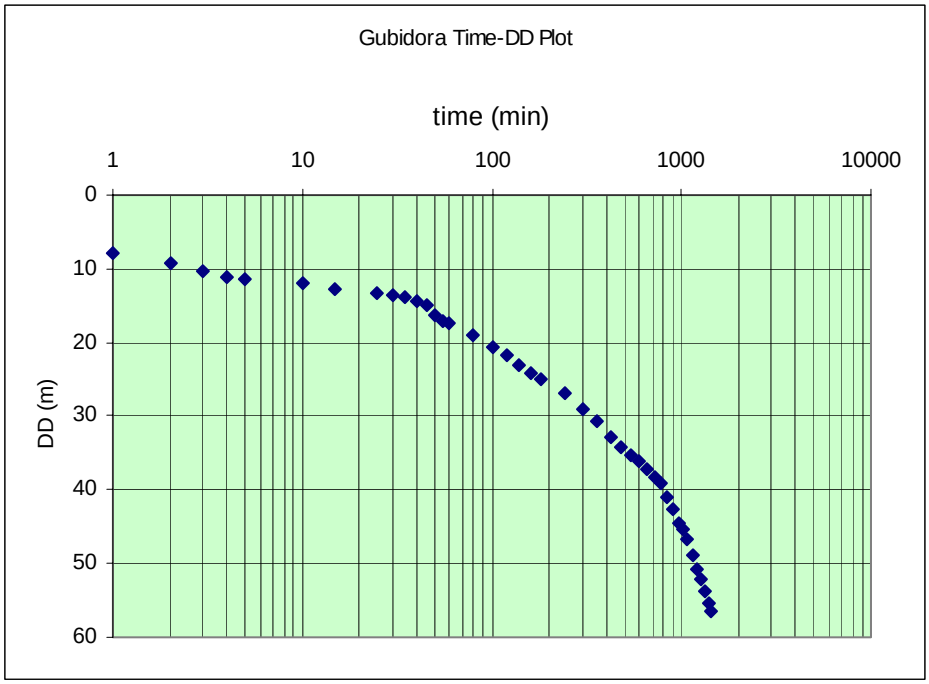


Figure - Gubi Dorwa Town test borehole Time Drawdown plot

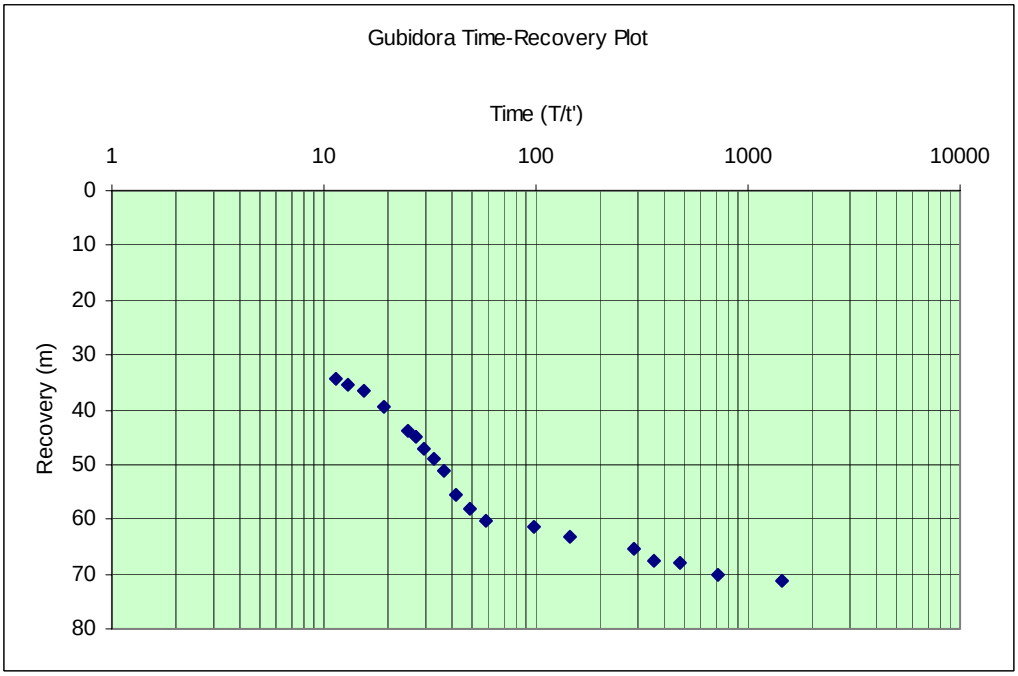


Figure - Gubi Dorwa Town test borehole Water Level Recovery plot

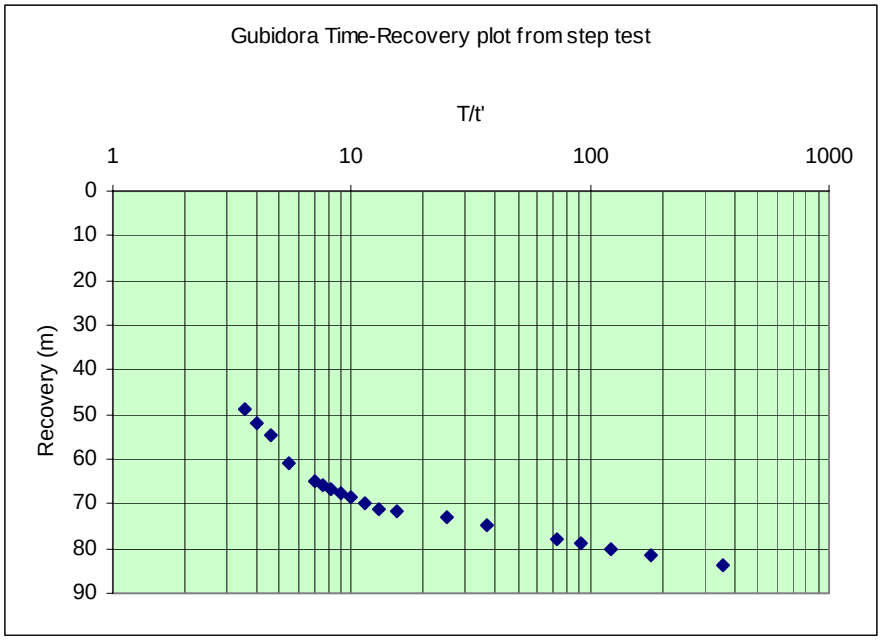


Figure - Gubi Dorwa Town test borehole Water Level Recovery plot from Step test

Table - Result of Step Drawdown test

Steps	Q_n (l/s)	Q_n (m^3/d)	DD, S_w (m)	Specific Capacity (m^2/d)	S_w/Q_n (d/m^2)	B (d/m^2)	C	B*Qn	CQn^2	$S_{wn} = B*Qn + CQn^2$	100*BQn / (BQ+CQn2)
1	1.05	90.72	44.28	2.05	0.49	0.48	0.000125	43.55	1.03	44.57	98%
2	1.5	129.60	68.84	1.88	0.53			62.21	2.10	64.31	97%
3	2	172.80	86.75	1.99	0.50			82.94	3.73	86.68	96%

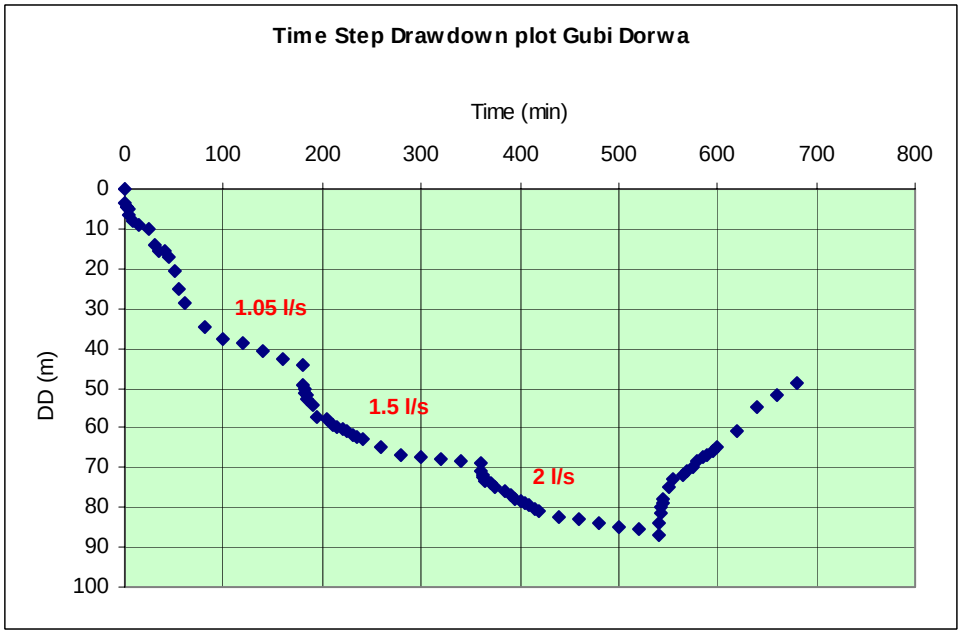


Figure - Gubi Dorwa Town, Plot of drawdown vs time of the step test

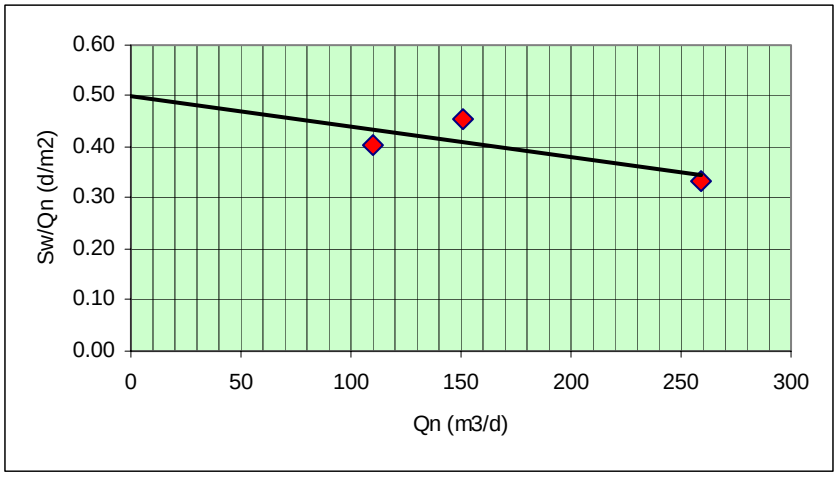


Figure - Gubi Dorwa Town test borehole, Plot of Specific capacity vs discharge

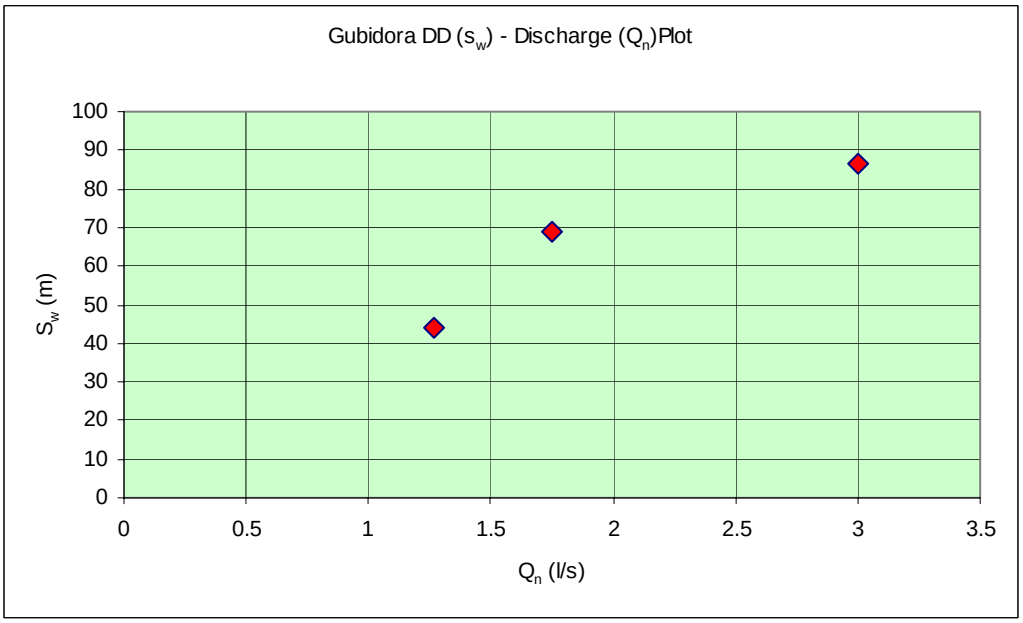


Figure - Gubi Dorwa Town test borehole Plot of Drawdown vs discharge

(4) Results of Socio-economic Surveys

Objective of the Socio-economic Surveys was as follows:

1) Objective

i) Understanding of present conditions and problems on socio-cultural and economic status of the 9 towns

ii) Understanding of present conditions and problems on water use and water supply facility management in the 9 towns

iii) Understanding of needs for improvement of water supply facility, which could be reflected to design of the Project

2) Survey methodologies and Survey Items

i) Socio-economic Profile Interview Survey in the 9 Towns

The Socio-economic Profile survey at 9 candidate towns was implemented by the JICA basic Study Team member (in charge of Operation and Maintenance Plan and Socio-economic Survey) in order to know general social and economic conditions. Methodology of the survey was an interview to key informants of the Town such as the Woreda Council Administrators (Woreda Administrative Head, if available, and key department heads[1] such as Pastoralist Development Coordination Department Head, Finance Department Head, Capacity Building Department Head, Justice Department Head, Information Department Head and Education Officer etc.) and the community leaders (Water Committee members, key members of women groups and other Community Based Organization: CBOs). Main questions and information obtained by the interview survey were summarized in Table5 (Major findings and Analysis from the Results of Socio-economic Profile Surveys and Socio-economic Surveys) attached. Preliminary findings and analysis are described in 2.1 and 2.2.

ii) Stakeholder Meetings in the 9 Towns

In the 9 towns stakeholder meetings were organized in order to draw problems of water supply conditions, the reasons for the problems and measure to be taken for meeting objectives (improvement) from town inhabitants. Through the participatory type meetings, it was also expected to identify needs for the water supply facility improvement project, and to confirm the will of the town inhabitants for new facility construction and payment of the water fee through discussions. At each towns, about 4-6 hours were spent to complete the stakeholder meetings. The stakeholder meeting was implemented following the style of Project Cycle Management (PCM) workshop, and ①Stakeholder analysis, ②Problem analysis, ③Objective analysis. During the meetings, tress and summaries were made for respective analysis in both Amharic and English in order to make participants understood the procedures and result of

[1] Woreda Sector Department Heads: those department heads are political appointees.

discussions well. After the stakeholder meetings, documents in Amharic were left to water committee or woreda administration in each town so as to the documents could be utilized later.

Participants of the Meetings were about 20-30 inhabitants of the respective towns paying attention on gender balance (at least 10 women representation is must), and an arrangement to call key members of the Water Committee, community based groups (CBGs: such as women group, traditional chief group, elder group, youth group) were made through the Woreda Council administrator (mostly by the Pastoralists Development Coordination Department head) in the previous day. Besides, key Woreda Council administrators were also requested to sit the Meeting as observers. Translators from the Amharic to local languages are prepared by the Woreda Council administration. Venues of the Meetings were in general at the meeting spaces at Pastoralists Development Coordination Department, where about 20-30 people could fit well. Records (as seen in the stakeholder analysis and trees on problems and objective analysis) of the Stakeholder Meetings were described in both Amharic and English to be understood visually, and the Amharic records were left to the Pastoralists Development Coordination Department head or the Water Committee for their later reference. In all 9 towns, it is observed that participants are familiar with the participatory types of the meetings since they have experienced similar workshops organized by other donors and NGOs.

All the stakeholders meetings held in 9 candidate towns were successful in terms of drawing and extracting the inhabitants facing problems, opinions, needs and issues of water supply situations. At the end of the meetings, wills to new facility development by the town inhabitants were also asked. On contrary to worry that women might not to be active for participation and opinion exchanges in the meetings in the Islamic culture background, women participants were in fact expressive and interested in arguing the water supply problems and the associated problem on water supply. [2] At all 9 towns women and children are identified as the most affected group in their communities by the current water supply situations as seen in the Problem Analysis described later.

Facilitation of the stakeholder meeting was carried out by the Japanese consultants (in charge of Socio-economic Survey/Operation and Maintenance Plan) with Ethiopian consultant who speak/write English and Amharic. Translators from/to Amharic to/from Afar were assigned by respective Woreda or town administration in order to all participants understood and coach the agenda and issues of analysis fully. Major findings identified and analyzed through the stakeholder meetings were presented in Figures and Tables.

[2] In most of the towns, women mentioned that water problems are their own everyday problems, therefore they participated the discussions eagerly. On the other hand, in the meeting at the most towns, it was expressed that

(1) Stakeholders

As shown in the Tables1.1 to 1.4 Stake Holder Analysis on Stakeholder identification, Community People (Women, Men and Children), Water Committee and water supply service offices (Pastoralist Development Coordination Department, Water Desk, regional water office) are identified as main stakeholders for water supply in general. It was generally observed that the inhabitants often pointed out Pastoralist Development Coordination Department as a main office for water supply rather a Water Desk with which the functions of the Water Desk have not well developed yet at this moment.

(2) Problems Identification through Problem Analysis

By carrying out the Problem Analysis, it was expected to identify and reveal the core problems on water supply with which people in the 9 towns are affected currently. The main problems on water supply vary depending on the towns as seen in the problem trees (Figures 1.1 to 1.9). In some towns, volume of water sources were primarily concerned such as insufficient water as the key problem while women's heavy work-load for fetching water was identified in some places.

(3) Objectives and the Needs Identification through Objective Analysis

Due to constraints of time, objective analysis with which needs identification could be withdrawn were omitted in some towns. However, the needs identification will be inferred from problem analysis by seeing the key problems and its development as trees.

As seen in Figures 2.1 to 2.4, the inhabitants of towns for ideal situations on and related to water supply problems vary. In some towns shorting waiting time to take water is identified their ideal situation while decrease of women's burden to fetch water is discussed as the necessary improvement.

men's duties on water were limited to watering animal and to finding traditional water sources.

＜Stake Holder Analysis＞

1) Who are stakeholders for water supply ? Who are actors being involved in water supply activities ?

2) And what are their interests ?

Table 1.1 Stake Holder Analysis of (Chifra, Derayitu, Kelewan)

Actors		Interest
CHIFRA (Chifra Woreda)		
1)	Community people (such as women, pastoralists, agriculturalists)	• To get water for drinking & agriculture (i.e., for everyday life) • To get water water for animals in close distance
2)	Water Committee (Chairperson, Secretary, Treasurer)	• To secure water/generating water • To collect water fee (finance) • To facilitate repair& maintenance (technical)
3)	Pastoralist Coordination Department (Woreda Council Administration)	• To provide clean water to people • To provide water for agricultural purposes
4)	NGOs/Donors	• To provide clean & safe water to people
DERAYITU (Aura Woreda)		
1)	Women	• To obtain quality of water for domestic uses (As tradition/culture of the area, men does not take water)
2)	Water Committee (pump operator, care taker)	• To administer public water supply for town inhabitants
3)	Water Desk	• To give technical/mechanical advice to the water committee to run all the time to whole woreda
KELEWAN (Gulina Woreda)		
1)	Public (① Women, ② Men, ③ Water Committee)	① As a main care taker of household, fetching water for family to support life, for agricultural uses and for livestock To secure water for family for domestic purposes, gardening etc. ② Digging traditional wells and guard them ③ Administrating water for timely supply & supplying water in adequate volume
2)	Water Desk (Woreda Administrative Council)	• To provide clean water • To strengthening capacity of water providers • Capacity building for community on ownerships and supply
3)	Health Centre/HC staff	• To verify water provided clean • To provide guideline of health education

* NGOs: There is a project by “Lutheran Church” (national NGO) since 2005 in rural woredas

Table 1.2 Stake Holder Analysis (GubiDowra, Nemelefen, Wederage)

Actors		Interest
GUBI DOWRA (Yalo Woreda)		
1)	Local people ① Women and Children ② Men ③ Water Committee	• To get water for drinking, cooking & cleaning • To water animals, to find traditional wells • To distribute water in equal and timely manners
2)	Water Desk (Woreda Administrative Council)/ Water Technician	• To provide clean and adequate water to public • To estimate and study water supply needs and potentials • To provide equipment for water supply • To report water supply problem to regional bureau
NEMELEFEN (Talalak Woreda)		
1)	Women	• To take/secure water for domestic uses such as drinking, cooking preparation, washing, bathing and washing before praying
2)	Children	• Health concerns
3)	Men	• To secure water for livestock • To find water sources for family needs
4)	Woreda Council (Pastoralist Development Coordination Office/ Water Desk)	• To supply clean and sufficient water to public • To maintain water facilities in good conditions
WEDERAGE (Dewe Woreda)		
1)	Water Committee	• To supply water to people
2)	Women & children	• To fulfill primary roles on water at households • To fetch water and keep water for domestic purposes • Need of clean water in good timing
3)	Men	• Need of water for livestock • To find traditional water source and to dig them
4)	Health clinic	• To provide health education • To provide treatment for water borne diseases
5)	Woreda Administration (Pastoralist Development Coordination Office)	• To report water problem and to find the solutions

Table 1.3 Stake Holder Analysis (Dulecha, Kumami)

Actors		Interest
DULECHA (Dulecha Woreda)		
1)	Women	• To secure clean and safe water for families in order to sustain everyday life • Play greater roles for water supply and most of works are done by women (men's role is not significant and secondary role)
2)	Women Groups (as agent for governing water supply instead of Water Committee)	• To distribute water in town • To collect water fee to sustain water supply to public • To save money from the fee collected for replacement and repair of water supply facilities
3)	Regional Water Bureau, Woreda Pastoralist Development Coordination Office/ Water Desk	• To provide clean and safe water to public uses • To strengthen water supply capacity by technical support • To find water source/explore potential
KUMAMI (Semu Robi Woreda)		
1)	Federal Governement/Woreda Administration/Pastoralist Development Coordination Office/Water Desk	• To provide clean water in good timing
2)	Water vendor from Showa Robi Town	• To make business (by selling water for people in Kumami) • Can be supporter for new water source development (not potential opponent)
3)	Women	• To secure water for all domestic uses • To give water young animals at home • Playing dominant roles in water preparation (controller of water at home)
4)	Men	• To secure water for livestock such as camels
5)	Water Committee (currently it is not active: in 2005 water was distributed from tankers free of charge by the state government subsidy and it stopped now)	• To manage water for equal distribution

Table 1.4 Stake Holder Analysis (EliWuha)

Actors		Interest
ELI WUHA (Mille Woreda)		
1)	Women	• To bring water for domestic uses and for children (sufficient and clean water) • Play greater roles for water supply and most of works are done by women (men's role is not significant and secondary role)
2)	Water Committee	• To response to people's needs on water supply • To report Kabala council • Equal and fair distribution of water • To hire necessary staff for water supply • To manage water supply in secured ways
3)	Regional Water Bureau, Woreda Pastoralist Development Coordination Office/ Water Desk	• To provide technical and material support to Kabales

＜Problem Analysis＞

CHIFRA (Chifra Woreda

The most affected group is women at the current water supply condition

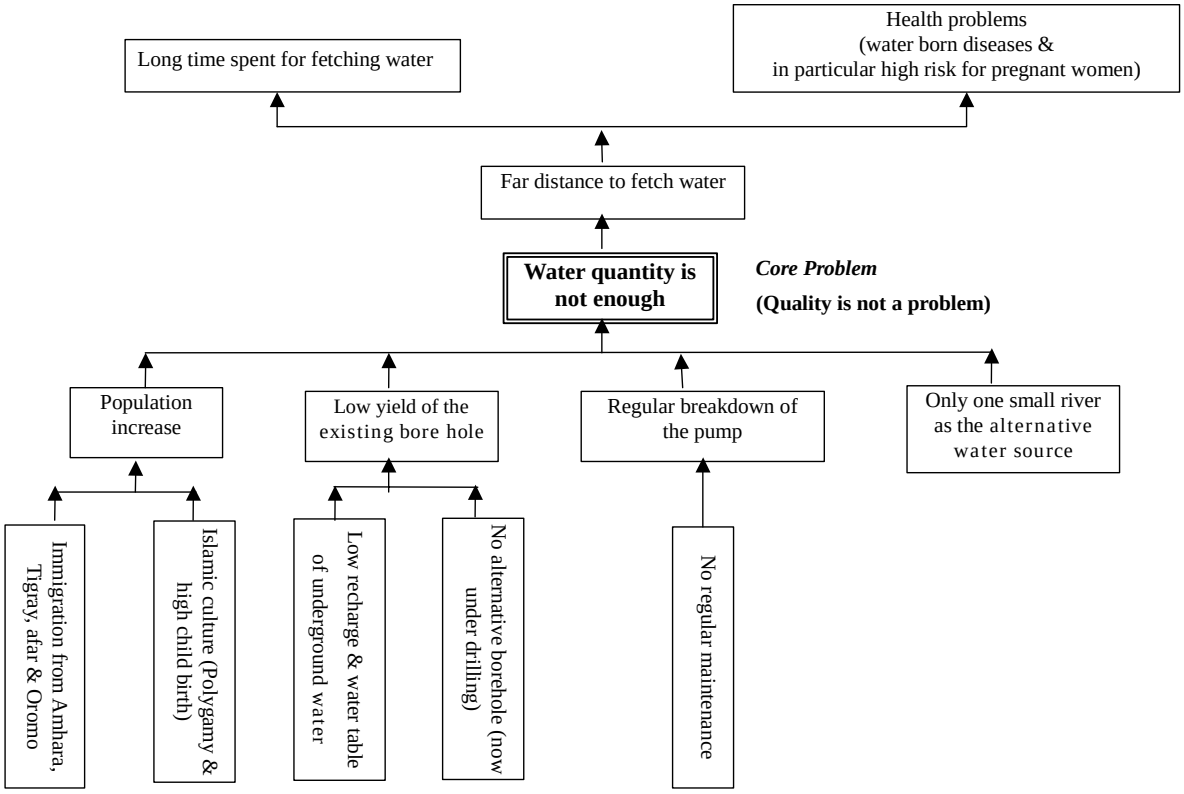


Figure 1.1 Problem Analysis of Chifra town

DERAYITU (Aura Woreda)

The most affected group is women at the current water supply condition

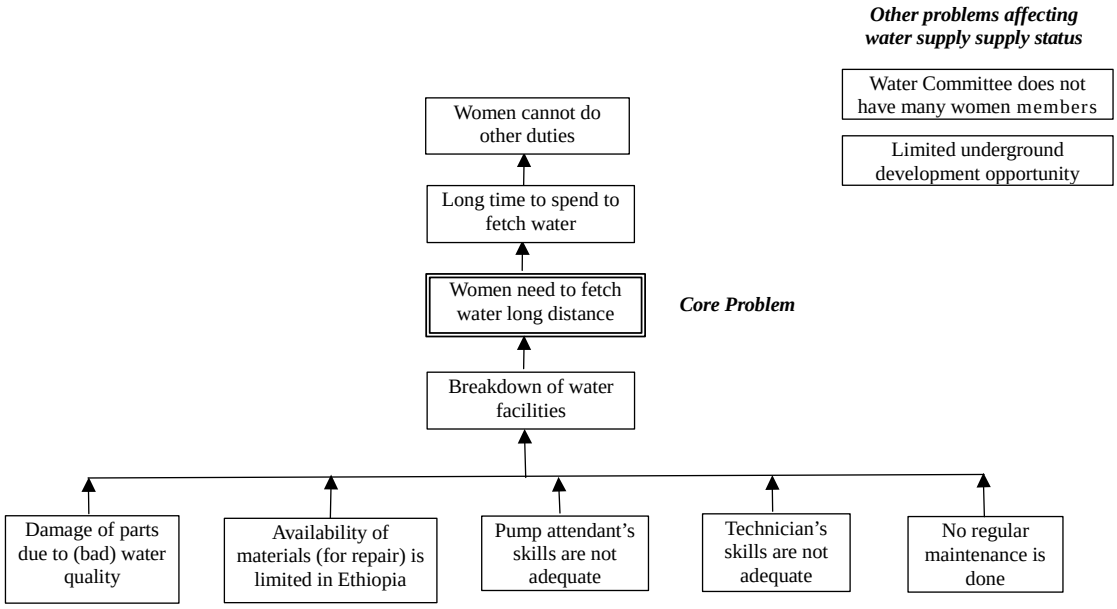


Figure 1.2 Problem Analysis of Derayitu town

KELEWAN (Gulina Woreda)

The most affected group is women at the current water supply condition

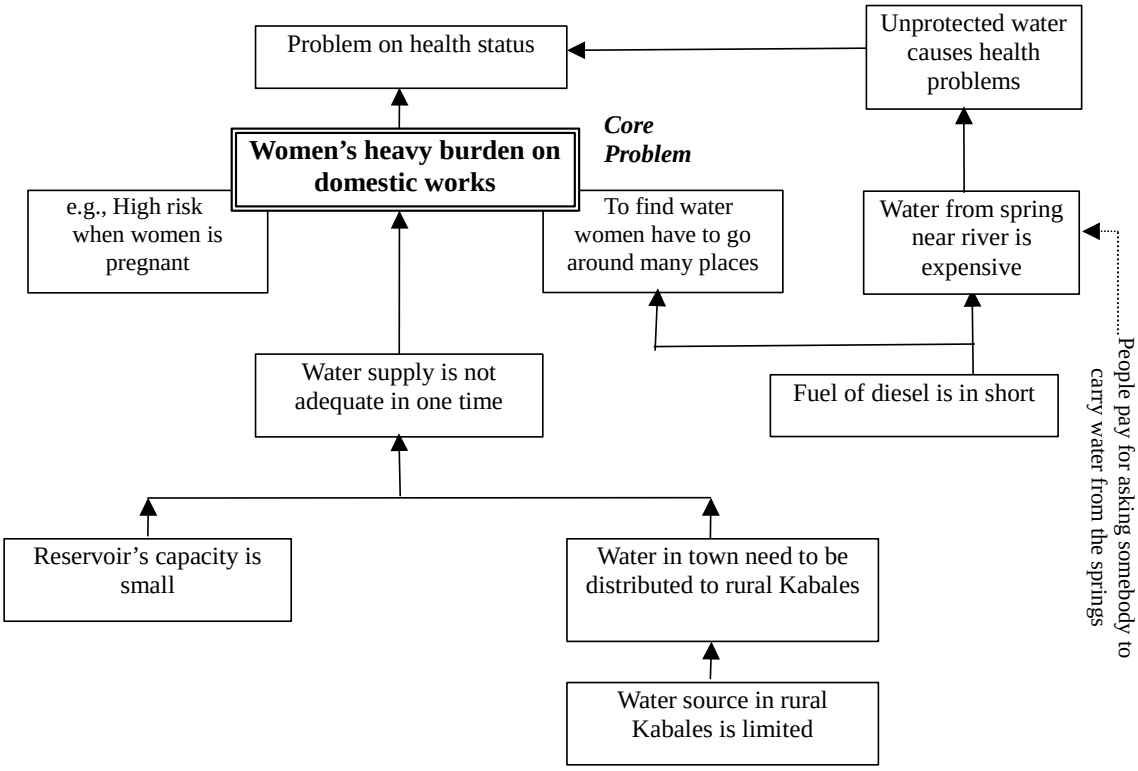


Figure 1.3 Problem Analysis of Kelewan town

GUBI DOWRA (Yalo Woreda)

The most affected group is women and children at the current water supply condition

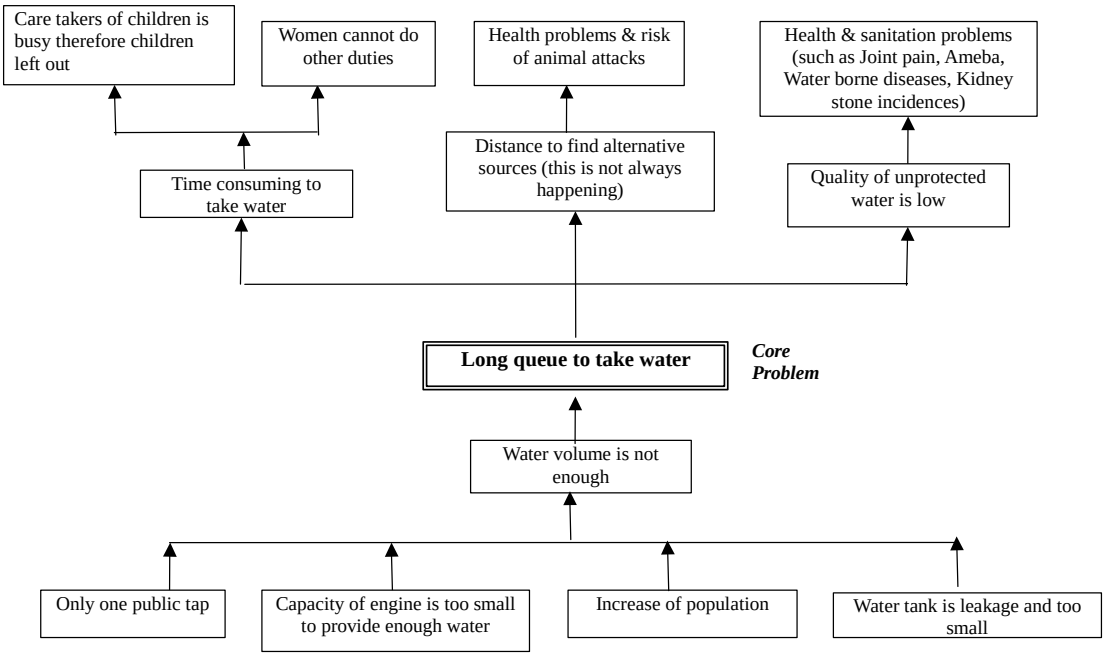


Figure 1.4 Problem Analysis of GubiDowra town

NEMELEFEN (Talalak Woreda)

The most affected group is women at the current water supply condition

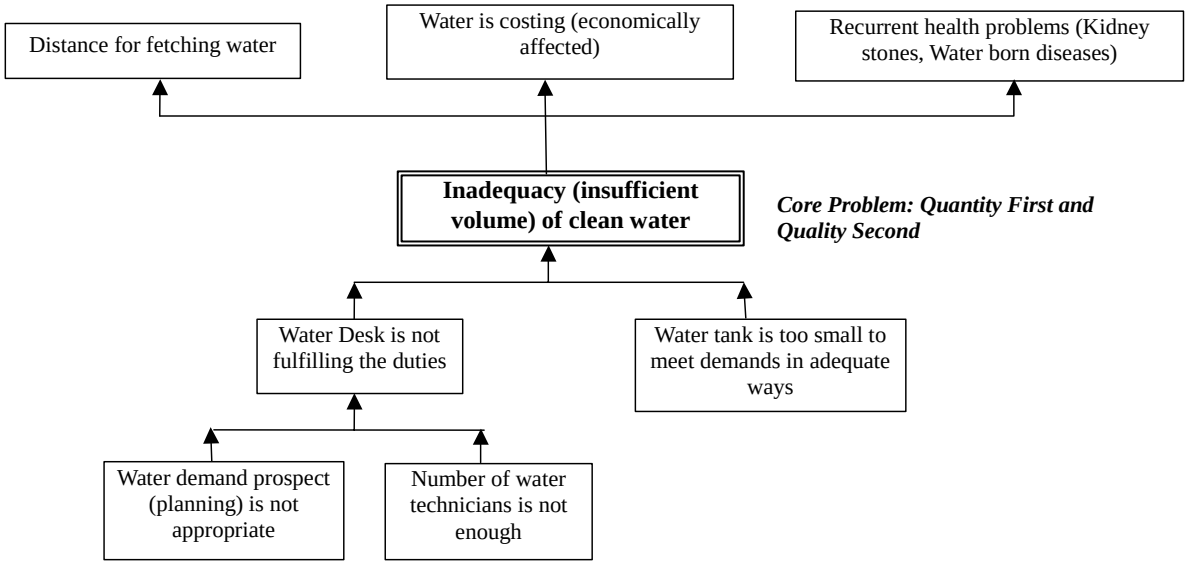


Figure 1.5 Problem Analysis of Nemelefen town

WEDERAGE (Dewe Woreda)

The most affected group is women & children at the current water supply condition

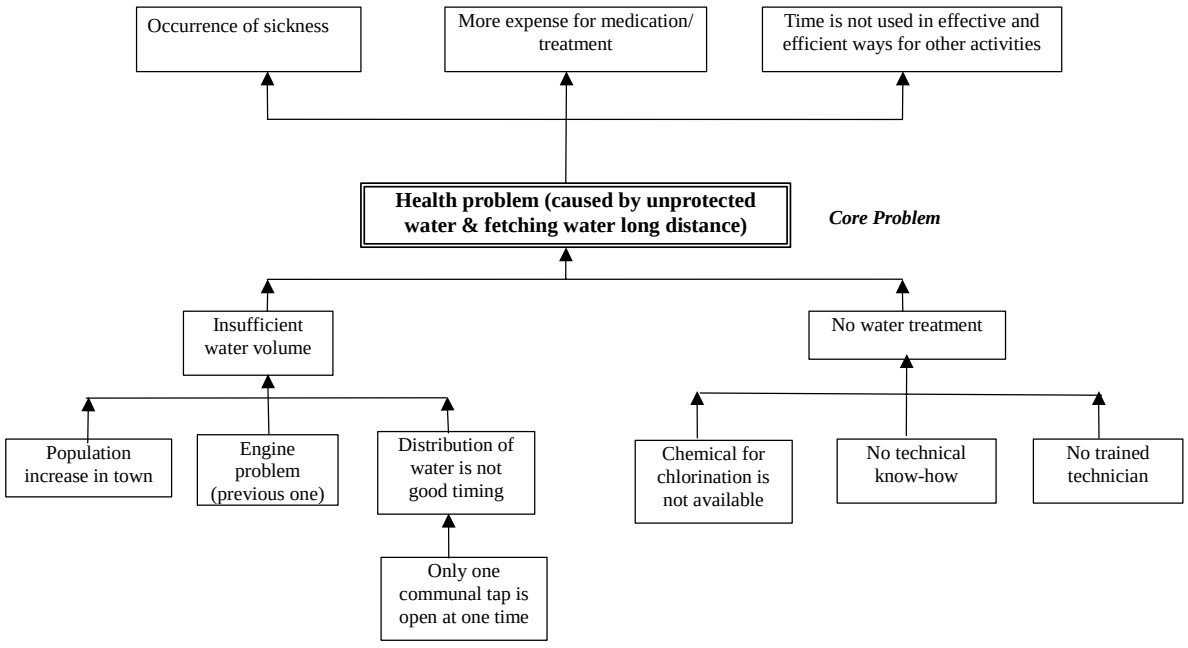


Figure 1.6 Problem Analysis of Wederage town

DULECHA (Dulecha Woreda)

The most affected group is women at the current water supply condition

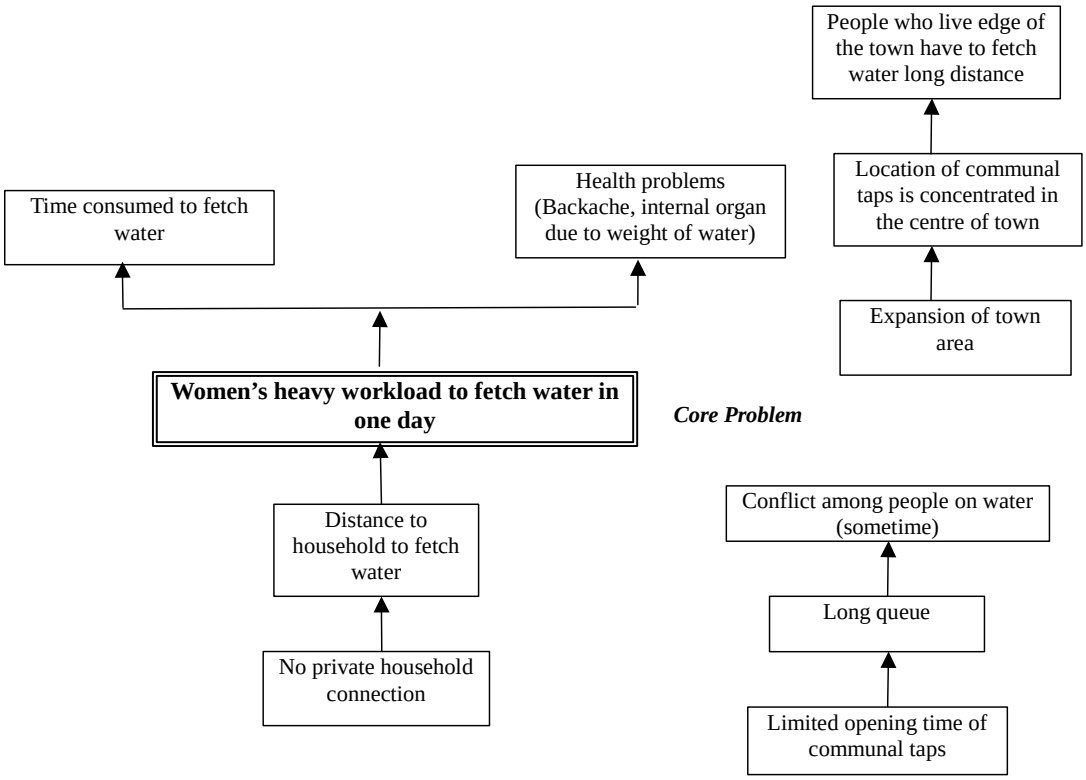


Figure 1.7 Problem Analysis of Dulecha town

KUMAMI (Semu Robi Woreda)

The most affected group is women at the current water supply condition

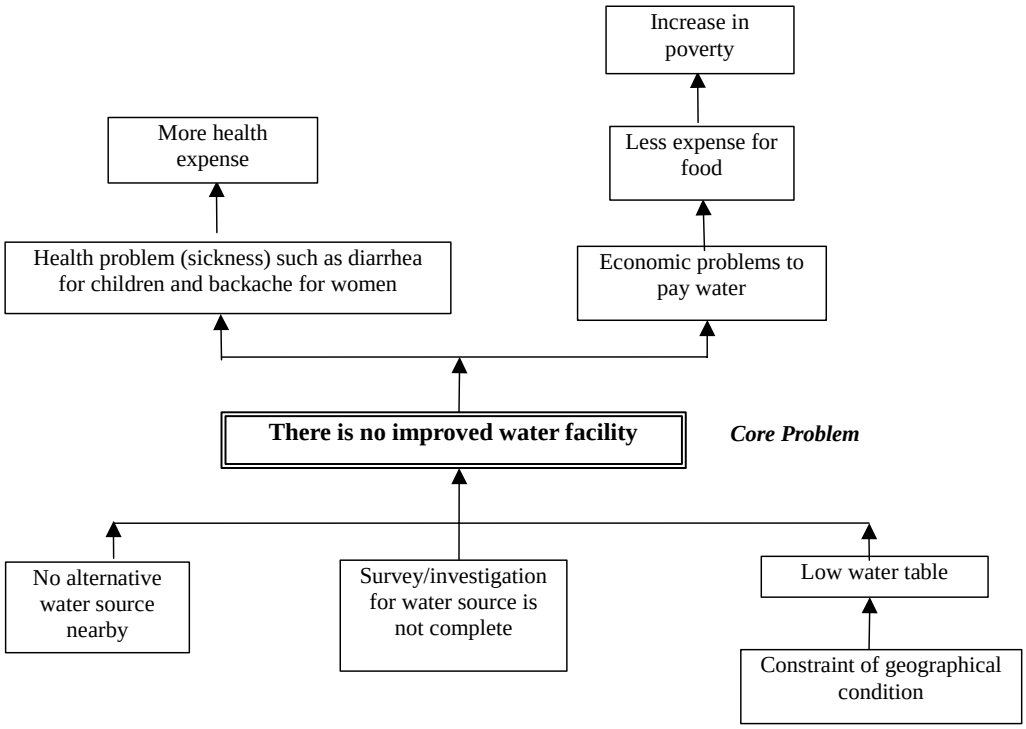


Figure 1.8 Problem Analysis of Kumami town

ELI WUHA (Mille Woreda)

The most affected group is women and children at the current water supply condition

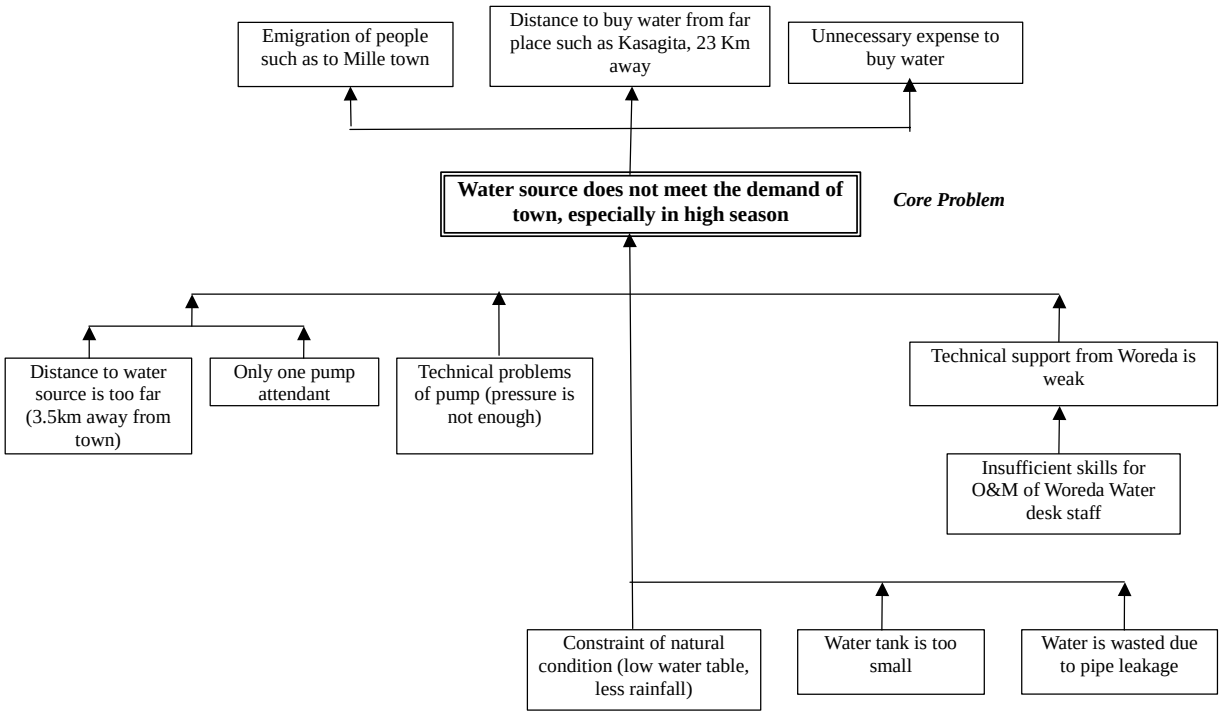


Figure 1.9 Problem Analysis of Eli Wuha town

＜Objective Analysis＞

CHIFRA (Chifra Woreda)

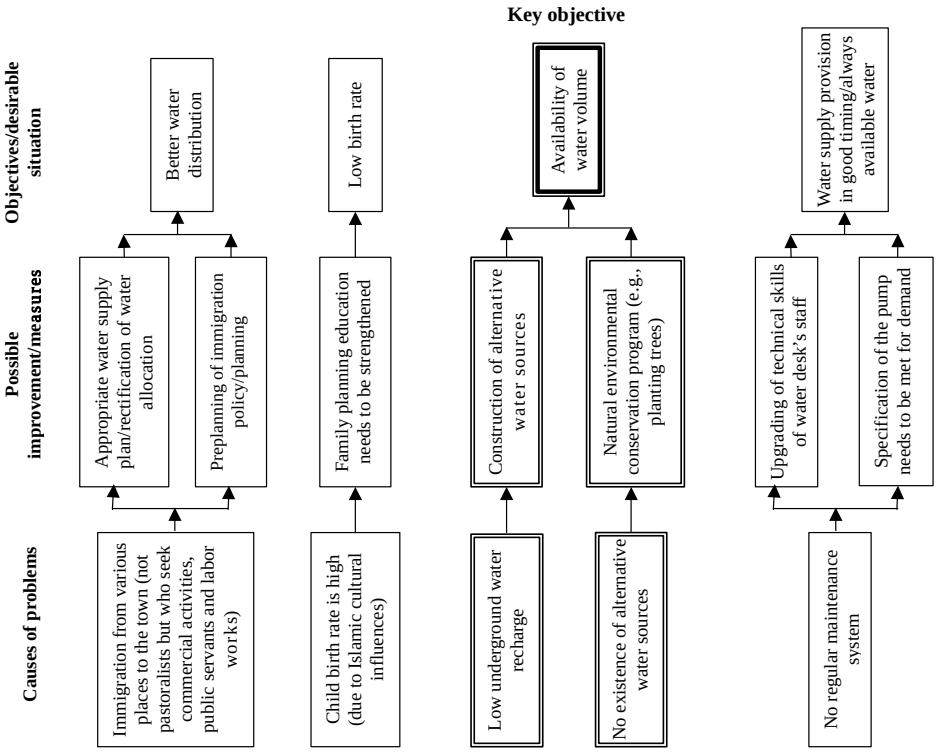


Figure 2.1 Objective Analysis of Chifra town

DERAYITU (Aura Woreda)

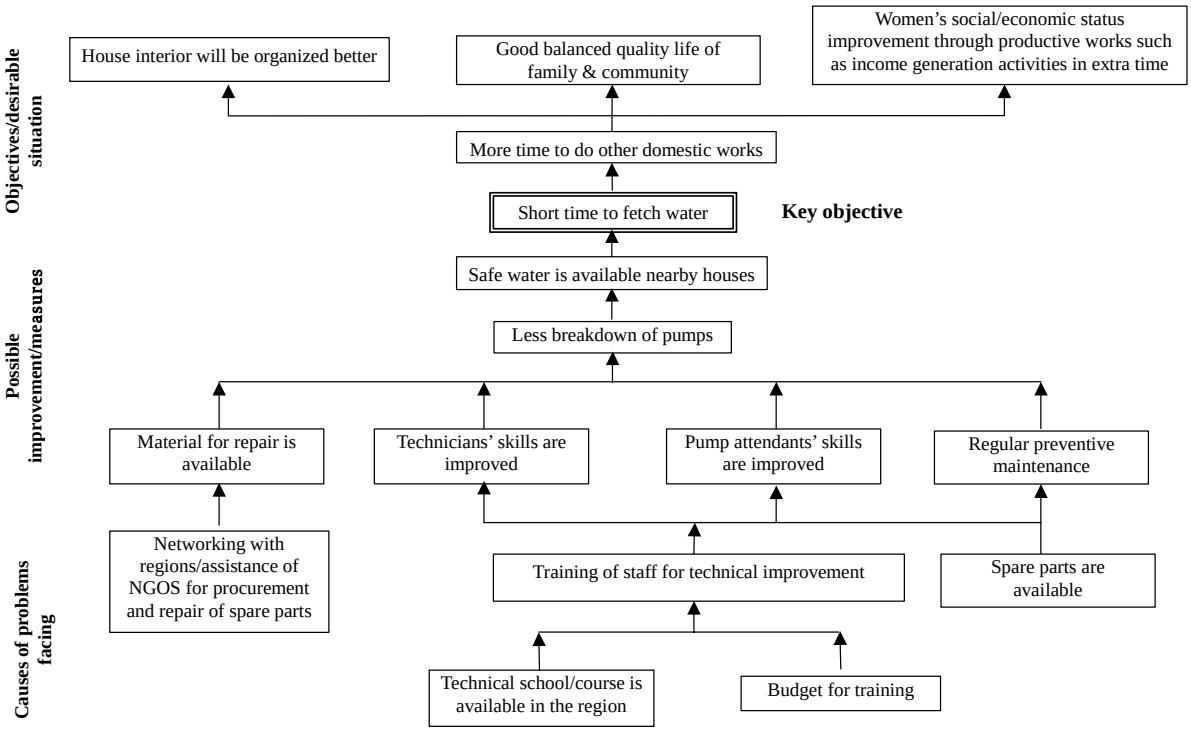


Figure 2.2 Objective Analysis of Derayitu town

KELEWAN (Gulina Woreda)

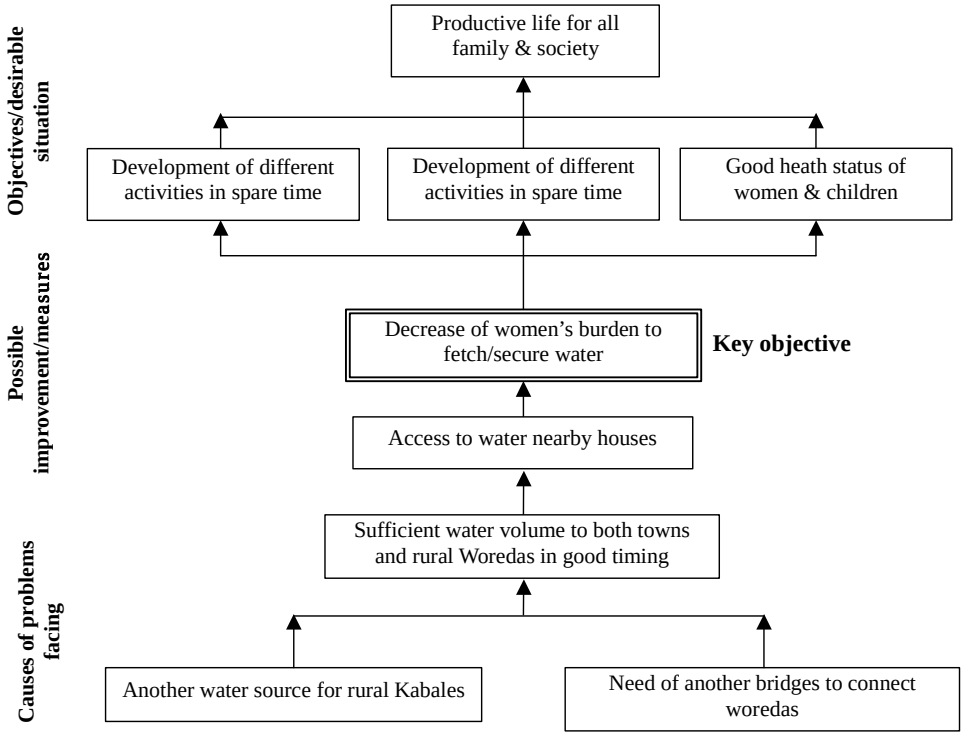


Figure 2.3 Objective Analysis of Kelewan town

GUBI DOWRA (YaloWoreda)

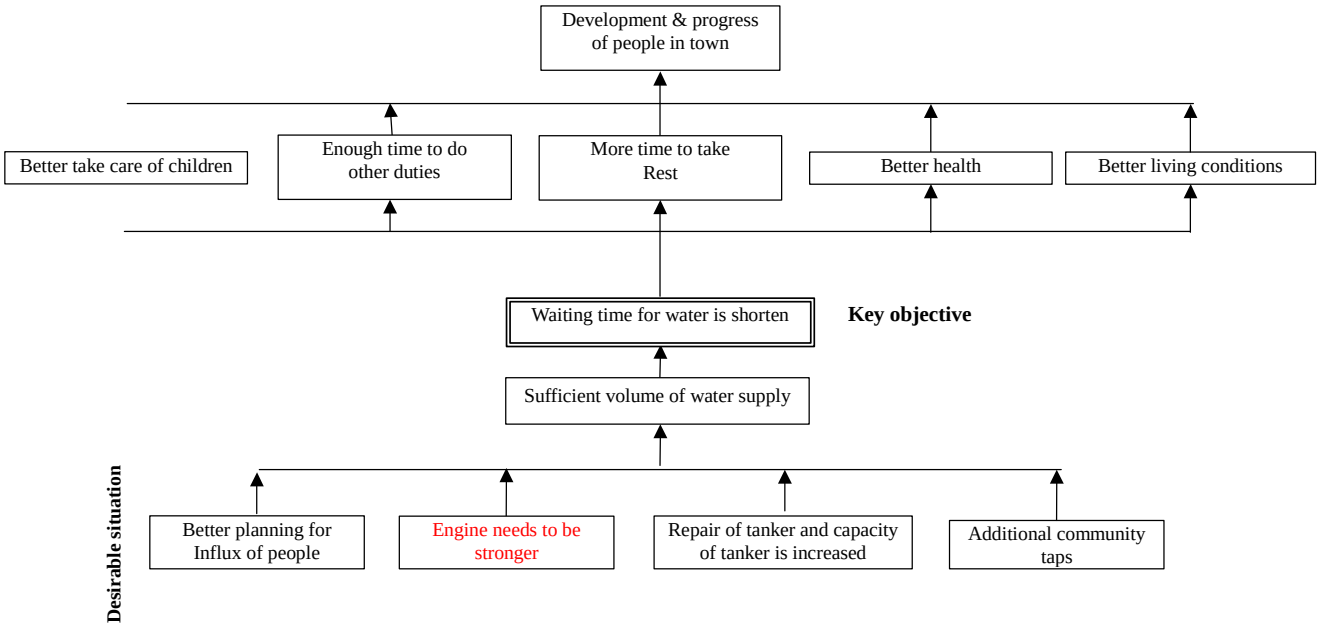


Figure 2.4 Objective Analysis of Gubi Dowra town

iii) Sample Household Survey

(1) Methodologies and Questions

Sample household surveys are sub-contracted to the Ethiopian local consultants and the field survey by the Ethiopian sub-contractor was completed within January 2006. Ten households were selected from each geographical block of the town and structured interview using the questionnaire were carried out to the sampled households. Expected respondents of the household survey were housewives who are primal care takers of domestic water and consumptions of it at the household level. Major questions interviewed to the 90 households in the 9 towns are the following 4 items:

① General information of the respondents (name, age, school attendance, literacy, language and religion)
② General information of the households (family size, occupation and income sources, schooling status/literacy of the family members, income/expenditure, physical conditions of the houses, availability of the local credit, community group activities)
③ Water use and water related information (main water sources by seasons and by purposes, satisfaction to the existing water sources, time to fetch water, frequency to fetch water, participation and satisfaction to the water committee, water fee, mode of payment for water fee, possible payment after water facility improvement, possible changes of water usage after water facility improvement)
④ Health related information (major diseases, availability of latrines/bath facility, practice of boiling water, needs for health/sanitation improvement)

(2) Result of Sample Household Survey:

Major finding of the sample household survey are summarized as follows:

① Demography and General Information

As shown in Table 2, population of each town is 2,040 to 5,803. In some towns there are 2-3 sub towns or hamlets, and these sub-units comprise the one town. Number of households of each town vary from 130 to 1,600, and women headed households are considered about one-third (31%) of the total households in the town. This relatively large percentage of women headed household is due to Islamic influence, such as practice of polygamy, in the Afar region.

② Ethnic Group and Religion

As previously stated, the Afar occupies predominant percentage as 70% to 99% in general. However, as seen in Chifra, there are towns where Amharic population is counted as 20% of the total population. Because the9 towns are designated as centre of the woreda, there are many non-Afar population in the

towns. According to the result of the sample household survey, average ethnic composition of the sample household are Afar 57%, Amharic 37% while 95% of the total sample household taken in the 9 towns in the is Muslim.

Table 2 Characteristics of Demographic Situations and General Information

Towns / Characteristics		Chifra	Derayitu	Kelewan	Gubi Dorwa	Nemele-fen	Wederage	Dulecha	Kumami	Eli Wuha	Average or General Picture
Year of Establishment		1995	2005 (as Town)	1996	2000	1994	1996	1953	1999	1930 (the oldest town in Afar Region)	1930～2005
No of (Traditional) Sub-division within the Town		6	no info.	no info.	3	none	no info.	5	no info.	5	3～6
Population		2,850	4,136	3,026	2,040	4,900	4,099	4,773	5,803	5,000	4,069
No of Total HH		570	410	1,611?	130	980	700	955	1,160	800 (assumed)	130～1,611?
Female headed HH (%)		no info.	115 (28%)	813? (50%)	45%	20%	no info.	11%	no info.	no info.	31%
Ethnic Groups (%)	Afar	75%	85%	80%	92%	97%	99%	70%	98%	80%	70%～99%
	Amhara	20%	8%	20%	5%	Amharic + Oromo 3%	0.5%	10%	Amharic + Oromo 2%	15%	0.5%～20%
	Tigrian		5%		3%		0.5%				
	Omoro	Oromo + Gurage 5%	2%							5%	
	Argoba							15%			
	Others							Kenbata + Walita etc. 5%			
Religion (%)	Muslim	99%	99%	99%	98%	99%	More than 99%	95%	More than 99%	More than 99%	95%～99%
	Ethiopian Orthodox	1%	1%	1%	2%	1%	Less than 1%	5%		Less than 1%	Less than 1%～5%
No of Kabales in the Same Woreda	Urban Kabales	1	1	1	1	1	1	1	1	1	1
	Rural Kabales	18	11	7	no info.	11	9	11	11	no info.	7～18

*) the oldest town in Afar Region

Table 3 Socio-economic Conditions of Sampled Household in the 9 Towns

Characteristics	Towns	Chifra	Derayitu	Kelewan	Gubi Dorwa	Nemelefen	Wederage	Dulecha	Kumami	Eli Wuha	Average or General
Average Family Size (Persons)		5.4	11	7.6	7.4	8.4	5	7.7	4	6	6.9
Ethnic Group	Afar	18%	58%	80%	58%	90%	50%	58%	50%	54%	57%
	Amhara	82%	42%	20%	34%	10%	33%	17%	50%	38%	36%
	Others				8% (Tigrian)		17% (Oromo)	25% (Argobe and others)		8% (Oromo)	7%
Literacy Rate of the Respondents		64%	42%	10%	17%	10%	33%	0%	39%	38%	28%
School Completion of the Respondents: Among the illiterate respondents:		Completion of Grade 1-4: 43% Completion of Grade 5-6: 43% Completion of Grade 9-12: 14%	no info.	(Lower literacy since school did not exit before 1996)	Completion of Grade 1-6: 50%	Completion of Grade 1-6: 100%	Completion of Grade 1-4: 50% Completion of Grade 5-6: 25% Completion of Grade 9-12: 25%	no info.	no info.	None: 20% Completion of Grade 1-6: 40% Completion of Grade 1-7 or 8: 40%	
School Attendance Rate of Their Children	General	no. info.	30%	77% (higher literacy because of promotion by PCDP)	59%	no. info.	62%	56%	78%	no. info.	60%
	Boy		32%	31%	59%		31%	8%	17%		30%
	Girl		29%	46%	58%		31%	11%	67%		40%
Livelihood	Government Employment	46%	50%	20%	17%	20%	25%	8%	25%	8%	24%
	Animal Husbandry	22%	37%	40%	58%	60%	52%	42%	8%	15%	37%
	(Small Scale) Commerce/Business	10%	17%	30%	33%	20%	42%	42%	50%	46%	32%
	Daily Labor	9%		10%			17%	8%	17%	31%	15%
Average Income/annual	HH	Birr 3,558 (USD396)	Birr 5,030 (USD560)	Birr 3,814 (USD424)	Birr 5,000 (USD556)	Birr 5,000 (USD556)	Birr 4,559 (USD507)	Birr 5,000 (USD556)	Birr 4,167 (USD464)	Birr 3,772 (USD420)	Birr 4,433 (USD493)
	Per Capita	Birr 659 (USD73)	Birr 457 (USD51)	Birr 502 (USD56)	Birr 676 (USD75)	Birr 595 (USD66)	Birr 912 (USD101)	Birr 649 (USD72)	Birr 1,041 (USD117)	Birr 620 (USD70)	Birr 642 (USD71)
5% of HH Income (Average): Estimated Water Fee		Birr 33	Birr 23	Birr 25	Birr 34	Birr 30	Birr 46	Birr 32	Birr 52	Birr 31	Birr 32
Rate Depending on Food Aid		13% (solely depending on food aid)	70%	50%	90%	no info.	78%	no info.	50%	63%	59%

Note: Literacy Rate of the Respondents: Can read and write at least 1 language

*) Attendance for girls is highh althogh drop out of girl is more to help domestic works

As shown in Table 3, average household size of the sample household is 6.9 persons. Means of livelihood are ①Animal raising 37%, ②small commercial and business 32%, ③ government employment 24%. Average annual income per household is 4,433birr（＝USD493）[3] and this amount is beyond the national average. On the other hand, it is found that dependent rate for food aid is high as 59%. This is because land is arid and not suitable for agricultural cropping.

3） Water Use and Related Information (Frequency of Fetching Water, Satisfaction to the Existing Water Supply Facilities, Modes of Payment and Amount of Payment, Capacity to Pay, Satisfaction to the Water Committee, Needs for Water Supply Facility Improvement)

As shown in Table 4.1and 4.2 (Water Use and Related Information), frequency to fetch water is higher and time consuming in dry season compared with that of rain season. Water scarcity is generally more problematic in the dry season. Many women go farer in search of water in traditional or alternative source, and waiting time to take water at source becomes longer.

[3] Exchange Rate: 1USD=Ethiopian Birr 8.99 (April, 2006)

Table 4.1　Water Use and Related Information (i)

Characteristics			Towns: Chifra	Derayitu	Kelewan	Gubi Dorwa	Nemelefen	Wederage
Water Use and Water Supply Facilities	Water Fetching (day/average)	Rainy Season	2～4 times	1～2 times	2～3 times	2～4 times	More than 3～4 times	2～4 times
		Dry Season	2～4 times	2～3 times	4 times	3～4 times	More than 4 times	4 times
	Satisfaction to Existing Water Facilities		Not satisfied：73%	Not satisfied：Out of order as of January 2006 (pump to be replaced)	Not satisfied：70%（rainy season）～80%（dry season）	Satisfied	Not satisfied：Out of 4 communal taps, 3 are out of order (functioning one is only for school）	Not satisfied：waiting time is long due to shortage and limited supply time
	Current Mode of Payment: Communal/Public Taps		Per jelly can, paid to collectors	Per jelly can, paid to collectors	Per jelly can, paid to collectors	Per jelly can, paid to collectors	Communal traps are not functioning （the inhabitants buy water from neighbors' private tap ：25 cents/25L ）。	Per jelly can, paid to collectors
	Amount of Payment: Communal/Public Taps		30 cents/25L	25 cents/25L	15 cents/20L or 20 cents/25L	25 cents/25L		15 cents/20L or 20 cents/25L
	Amount of Payment: Private Connection (Household)		_	4 Birrs/m3	More than 10 Birrs/monthly (average/household)	_	4 Birrs/m3	10 Birrs/monthly (average/household)
	Daily Expenditure for Water (average) in Rain Season/Household		Water source is borehole: 0.6 to 1.00 Birr/family: 55%, more than 2.00 Birr/family: 27%	Water source is borehole: 0.5 to 1.0 Birr/family (average)	Water source is borehole: 0.6 to 1.0 Birr/family: 56%, 1.10 to 1.50 Birr/family: 22%, more than 1.60 Birr/family: 22%	Water source is borehole: 0.75 to 1.25 Birr/family (average)	Water source is borehole: 0.6 to 1.00 Birr/family: 60%	Water source is borehole: 0.6 to 1.20 Birr/family: 83%, 1.10 to 1.50 Birr/family: 17%
	Satisfaction to Existing Water Committee		Not satisfied: 82%（Supply time, financial management, physical management）	Not satisfied：100%（Leadership, supply time and financial management）	Not satisfied: 60%（Supply time, physical management）, Satisfied: 40%（financial management）	Satisfied: 100%	Water Committee is not functioning （under control of the Woreda Water Desk). Dissatisfied with the past committee（Leadership, financial management）	Not satisfies: 83%（Supply time, financial/physical management）, Satisfied：17%（Leadership）
	Request for Facility Improvement		①Private tap: 80%, ②Communal tap	①Private tap: 75%, ②Communal tap: 25%	①Communal tap: 56%, ②Private tap: 46%	①Private tap: 91%, ②Communal tap: 9%	①Private tap: 100%	①Private tap: 75%, ②Communal tap: 25%
	Capacity to Pay	Communal/Public Taps	More than 15 Birr/month: 63%, 3.0-5.0 Birr/month: 18%, 20-25cents/bucket: 37%, 30-50 cents/bucket: 36%	More than 26 Birr/month: 42%, 16-20 Birr/month: 25%, more than 15 cents/bucket: 83%	More than 21-26 Birr/month: 60%, 6-15Birr/month: 20%, more than 15 cents/25L bucket: 70%	More than 20 Birr/month: 40%, 5-10 Birr/month: 20%, more than 25 cents/25L bucket: 55%	_	More than 15 Birr/month: 84%, more than 20 cents/25L bucket: 42%
Health/Sanitation	Major Water Related Diseases (Sample HHs)		Diarrheas, Parasite, Malaria, Skin disease, Typhoid	Malaria, Diarrheas, Typhoid, Skin diseases, Eye Diseases	Diarrheas, Malaria, Parasites, Skin disease, Eye disease	Malaria, Diarrheas, Typhoid, Parasite, Skin disease	Malaria, Parasite, Typhoid, Skin disease, Eye disease	Diarrheas, Malaria, Skin disease, Typhoid, Parasite
	Availability of Sanitary Facilities（Sample HHs）		No toilet: more than 90%, Bathing facility: none	Toilet & Bathing facility: none	Toilet & Bathing facility: none	Toilet & Bathing facility: none	No toilet: more than 90%, Bathing facility: none	No toilet: more than 90%, Bathing facility: none
	Awareness to Hygiene/Sanitation Status (Sample HHs）		Women: answered as problematic.	Fair: 75%	Answered as problematic.	Problematic: 73%	Fair: 100%	Fair: 75%
	Expectation for Facilities	Improvement for Sanitary Standard	①	①	①	①	①	①
		Improvement for Economic Standard	②	②	②	②	①	②
		Improvement of Food Intake	③	③	③	③	②	③
		Improvement of Animal Husbandry		④	④	④		

Table 4.2　Water Use and Related Information (ii)

Characteristics			Towns: Dulecha	Kumami	Eli Wuha	General Situations
Water Use and Water Supply Facilities	Water Fetching (day/average)	Rainy Season	1～3 times	Purchase from Vendor (more than 90%) (3 Birr/25L)。	2～4 times	In dry season, it takes more time to fetch water (due to shortage of water, dependency to unprotected water is higher. Therefore it takes more to search and wait for water).
		Dry Season	2～3 times		3～4 times	
	Satisfaction to Existing Water Facilities		Satisfied: 75%、Not satisfied：25%	No existing water facility	Not satisfied：85%（shortage, long waiting time, quality, taste, turbidity）	The inhabitants are not satisfied with shortage and long waiting line. Some community conflicts/quarrels happen sometimes due to long lines and water quality sometimes.
	Current Mode of Payment: Communal/Public Taps		Per jelly can, paid to collectors		Per jelly can, paid to collectors	Mode of collection is per jelly can and the fee is paied to collectors at water points. In general water tap attendants collect the fee. The inhabitants are not satisfied with limited supply time because the tap attendants attend the water points only short time a day.
	Amount of Payment: Communal/Public Taps		25 cents/25L		10 cents/25L	15 cents/20L or 20～25 cents/25L There are some households who cannot afford tap water due to poverty, and some in habitants raise concerns on the issues.
	Amount of Payment: Private Connection (Household)		–	–	–	4 Birr/m3 for household connection. In the rainy season, most households pay about 10 Birrs/month (depending the family size).
	Daily Expenditure for Water (average) in Rain Season/Household		Water source is borehole: 0.25 to 0.75 Birr/family (average)	2.10 to 3.00 Birr/family: 83%, more than 3 Birr/family: 17%	Water source is borehole: 0.6 to 1.0 Birr/family: 54%, 1.1 to 2.0 Birr/family: 31%	Daily expenditure for water per household is 0.6-1.0 Birr/average.
	Satisfaction to Existing Water Committee		A Women Group is entrusted to manage water supply. Satisfied：75%、Not satisfied：25%（Supply time, physical/financial management）	Activities of the Water Committee is stopped.	Not satisfied: more than 90%（Financial/physical management, supply time）、Satisfied：17%（Leadership）	In general, reasons for dissatisfaction are: ①short supply time, ②poor financial management, ③poor physical management, poor enforcement of regulations, and ⑥poor leadership. There are 2 main issues: leadership of the communities and capacities to manage physical maintenance.
	Request for Facility Improvement		①Private tap: 92%, ②Communal tap	①Private tap: 75%, ②Communal tap: 25%	①Private tap: 77%, ②Communal tap: 23%	Most inhabitants request for private taps. The inhabitants, who live in the towns where the existing water supply facilities are broken, spend a large amount of money for water. However, it is necessary to note that all the inhabitants who need private taps can not afford the construction costs of the private connection.
	Capacity to Pay	Communal/Public Taps	–	More than 20 Birr/month: 92%, 15-20 Birr/month: 8%, 25 cents/25L bucket: 67%	25 cents/25L bucket: 73%, 30-50 cents/25L bucket: 18%,	Excepting for Chifra, repondents answered they could pay more than 20 Birrs/month/HH.
Health/Sanitation	Major Water Related Diseases (Sample HHs)		Malaria, Diarrheas, Typhoid, Parasite	Malaria, Diarrheas, Typhoid, Parasite	Diarrheas, Parasite, Malaria	①Diarrheas, ①Malaria, ③Parasite and ④Typhoid are common diseases. In particular, diarrheas is answered as very common to all people.
	Availability of Sanitary Facilities（Sample HHs）		No toilet: more than 90%, Bathing facility: none	No toilet: more than 90%, Bathing facility: none	No toilet: more than 90%, Bathing facility: none	Household without toilet is more than 90%, and with bathing facility is almost none. Sanitary environment is very poor as the inhabitants answered the sanitation is beyond their reaches.
	Awareness to Hygiene/Sanitation Status (Sample HHs）		Fair: 83%. Problem of water quality: 53%	No information	Fair: 85%	In general awareness for sanitation and changes of sanitary practices is low.
	Expectation for Facilities	Improvement for Sanitary Standard	①	①	①	Needs for water facility improvement and associated health improvement is high. Economic advantages through water facility improvement is also requested (the inhabitants could allocated higher costs of buying water from vendor for something else.).
		Improvement for Economic Standard	②	②	②	
		Improvement of Food Intake	③	③	③	
		Improvement of Animal Husbandry			④	

Satisfaction of the existing water supply facility is related to adequacy of water volume, waiting time and water quality according to the results. Users have dissatisfaction due to the 3 main reasons. Some respondents pointed out there are argument happening among the users when waiting line is long. It is often pointed out that time schedule for water provision is not kept well in most towns, and users tend to have dissatisfaction to it because it not convenient for users. It is necessary to review not only modes of payment/collection and water fee but manners of the use and provision of water at domestic points along with promotion of community based water supply facility management.

Dominant mode of payment from the communal/public taps is per container (20 or 25 L of jelly can) in the 9 towns, and users pay the water fee to care taker of domestic point. It is observed that most common amount of fee is 15 cents/20L or 20～25 cents/25L currently. Some participants of the stakeholder meeting pointed out that some clusters of people in the town could not afford the water fee currently collected.

It is found that range of capacity to pay from the respondent are 20 Birr per household/month. Considering the income level, estimation of the 5 % of the income is about 15-21 Birr in the 9 towns. It could be said in case water fee is set about 20 birr per month per household, it could be payable for majority of the habitants. Many respondents hope that they would like to have household connection because of convenience. However, not all respondents answer they may be able to afford the construction cost of the household connection.

Frequently happening water borne diseases in the 9 towns are: diarrhea, malaria intestinal parasite and typhoid. In particular diarrhea is pointed out as commonly disease in all the respondents. It is generally observed that awareness on hygiene/sanitary practices is low, and facility for environmental sanitation is not prevalent as 90% household do not have toilet and 100% do not have bath facilities in the 9 towns.

Table 5 Major Findings on Socio-Economic Status in the 9 Candidates Towns (Answers Obtained by the Socio-economic Profile Interviews): as of January 2006

Name of the Town / Socio-economic Characteristics		Chifra	Derayitu	Kelewan	Gubi Dorwa	Nemelefen	Wederage	Dulecha	Kumami	Eli Wuha
Year of Establishment of the Town (formal)		1995	2005 (settlement started in 1995)	1996	2000	1994	1996	-	1999	1930 (After the Italian Occupation. Around the time, the village was a camp for the road construction) :the oldest twon in the Afar region
Population		2,850	4,136	3,026	2,040	4,900 (2006) by Health Office	4,099 (2005) by the Health Statistics	4,773	5,803	5,000 (Assumed)
No. of Household		570	410	1,611(Assumed)	130	980	700 (Assumed)	955	1,160	800 (Assumed)
Observed Recent Demographic Changes		Increasing (1,660 in 1995)	Since 2005 it has been increasing (182 new comers after 2004)	Commercials have been decreasing after the zonal functions were diminished.	Since 5 years ago, population has been increasing	N.A.	After 1995, Oromo, Amharic and Tigray moved into the Town.	About 25% increase in the last 10 years due to increase of govt employees and private commercials	Not significant. Pastoralists go to better pasture land and where water is more available. (no continuous food aid program here.)	Natural increase due to high birth rate and immigration from the highland area and other part of Afar. In the last 10 years many pastoralist family (about 1,000 people?) settled in the peripheries of the Town (at the beginning) and moved into to the town
Influx/settlement of Pastoralists During the Dry Season		Not significant	Not significant: few in dry season (visit the town only for receiving food aid)	1,000-2,000 increase in dry season (mainly come to town for food aid)	Population becomes about 2 times since pastoralists come to near the Town for seeking water (no alternative source)	Pastoralists do not come to the Town since no good pasture land in dry season, and no food aid. They go to Oromia and near river areas.	Not very significant. Pastoralists come to the Town only to get food aid and for commerce/transaction at market. They go to other regions for water and pasture land.	Not significant. Pastoralists come to the Town only temporarily for water, then move to better pasture land.		
Months of Rainy Season		July to August small rain in February	July to September	July, August small rain in September	July, August few shower in Septermber&October	July, August	July, August	July, August	July, August	July to August
Driest Months		May, June	May, June	May, June	March to July	April to June	December to May	May, June	January, February & April, May	April to June
Infrastructure Development Status		No electricity, but the line is installed.	No electricity, but the line is installed in 1.5 year ago.	No electricity, but the line is installed.	No electricity, but the line is installed (within January the bidding would be held)	No electricity, but the line is installed (within February electric would come)	No electricity. Office have generators.	No electricity, but the line is installed (within February electric would come)	No electricity, but the line installation is planned. Office have generators.	Electric
Main Economic Activities		Agro-pastoralist, Commerce, Govt employment, NGO employment	Commerce, Animal husbandry, Govt employment	Animal husbandry, Small commerce	Animal husbandry, Small commerce	Animal husbandry, Small commerce, Small cropping	Animal husbandry, Commerce	Commerce, Govt employment	Animal husbandry, Small commerce	Small commerce, Animal husbandry
Donor Support Programmes		Food Aid (WFP) , Rural Development by Lutheran Church Federation only for rural Kabales (2005-)	Food Aid (WFP: most of the town habitant depend on food aid), PCDP (World Bank)	Food Aid (WFP: All the town habitant depend on food aid), PCDP (World Bank)	Food/Oil Provision Aid (WFP & Catholic Relief NGO) : All the town habitant depend on food aid)	UNICEF for WS (1HP well in 2005), PCDP (World Bank)	Water Group Support, Bridge, Garden Demonstration (UNDP: 2005-)	Afar Animal Health Program (FAO /Norway:2005-), Food Aid by the Ethiopian Govt	Plan: Not identified programe by Goal Ethiopia (NGO), Animal Health Programe by FAO & Rural Community Cooperative & Dry-land Farming by Fam Africa (NGO)	_
Community Based Organizations (CBOs)		IGAs & Awareness: Women Groups & Youth Groups, Religion Groups	Youth group, Women group (idea)	IGAs: Women groups, Youth Group	IGAs: Women groups, Youth group	IGAs: Women groups	no informaton	IGAs: Women groups	IGAs: Women group, Youth group (both: not really started)	IGAs: Women group, Youth group, Local credit association (in particular for funeral, marriage and child birth to cover the costs)
Number of Water Supply Facility Outlets	Institutions	All offices have	30 offices + health clinic	19	N.A. ?	5 offices	4	Have lines but not supplied	0	N.A.
	Households	65 including offices	2	103	0	19	12	0	0	77
	Communal Taps	2 (each 4 faucets)	3	4 (each 4 faucets)	1 (10 faucets)	4 (Among them, 1 is exclusively for a school)	2	3	0	4
Function Status of Water Supply Facilities		Out of 6 public taps, 2 taps are cuurently operational while 4 tasp are out of order.	All private and communal taps had not been functioning since September 2005 due to the broken pump (→ just to be installed a new pump in January 2006)	All functioning: Since numbers of private taps are large, one communal tap is closed. There is no significant problem on water supply currently in the Town.	Functioning	Out of 4 communal taps, 2 were are not functioning since the beginning (due to misconnection? or lines are not throughout). 1 communal taps had been used for several years and currently it is out of order. Only 1 tap for a school has been used but this i	2 communal taps are function but users are decreasing since people prefer buy water from the neighbors' private taps.	All 3 are functioning, but only one tap is open 1 time since only 1 collector hired by the WC. Many inhabitant complain the limited opening time.	No protected water source. Most villagers buy water from the vendor from Shoa Rob Town.	Out of 4 communal taps, 1 has been broken since 2005.
Timing of Water Supply (at WS outlet)		AM 9:00-12:00 or AM 9:00-PM1:00 (3hrs/4hrs)	No water supply currently (due to a broken pump)	AM: 8:00-11:00 (3 hrs) + PM 4:00-6:00 (2 hrs	Not regularly (Pump operation: AM: 6:00-11:00 + PM 4:00-6:00)	AM: 6:00-PM:6:00 (11 hrs)	AM: 8:00-12:00 (4 hrs) + PM: 4:00-6:00 (2 hrs): 2 outlests are not opining at the same time since only 1 collector for water fee collection is hired.	AM:7:00-9:00 (2 hrs) + PM: 5:00-7:00 (2 hrs)	_	AM: 7:00-11:00 (4 hrs) only
Alternative Water Sources		River (throughout the year)	River (2 hrs/round), traditional wells in rainy seasons	1 Shallow well (UNCEF) for an emergency case, River	Traditional wells, pond, spring	1 hand pump well by UNICEF (200-300m) , River (300m) , Spring along river	River	River	River	None
Status of Water Committee		2 WCs, hiring pump operator, tap supervisors, mechanic	1 WC, hiring 1 pump operator & 1 tap attendant	1 WC but not active, therefore Woreda Water Office directly controls water supply management at this moment. In the near future, Water service office will be a main body for WS management.	1 WC	Not functioning	1 WC, hiring tap attendant/collector. Not active since the Town inhabitant does not support the WC.	1 active WC operated by the Women Group. There were the WC but it was not active. Then District asked the WG to administer the water facilities. The WG does good financial management.	Not active. The Water Committee was supervising the fair distribution of the free-distributed water in 2005. After ceasing the free distributing, the WC became inactive.	1 WC hiring pump operator, collector. The WC and the Kabale Govt request for technical assistance to repair broken outlet, but no response from the Woreda Water Desk.
Water Fee Collected		30 cents/25L (raised in 2005), for piped fee is scheduled	25 cents/25L	15 cents/20L and 20 cents/25L	25 cents/25L (There are many who cannot afford)/600 Birr/month	Not functioning	15 cents/20L, 20 cents/25L,	25 cents/25L	No protected water source	10 cents/25L
Availability of Water Vendors		Yes, 50 cents/25L from private connection	Yes, 50 cents/25L from river	None	50 cents/L (for market day) form spring	25 cents/25L (houses with private connection)	15 cents/20L, 20 cents/25L (houses with private connection)	No	Yes, Water brought from Shoa Robi Town (3 Birr/25L)	Yes, 25 cents/25L (some houses with household connection): Many town inhabitants buy water from neighbors since they do not like to be in queue and to wait
Priority for Water Improvement		1 Quantity, 2 Quality, 3 Convenience	Men: 1 Quality, 2 Quantity, 3 Convenience while Women: 1 Quantity, 2 Quality, 3	Men: 1 Quality, 2 Quantity, 3 Convenience while Women: 1 Quantity, 2 Convenience, 3	1 Quantity, 2 Quality, 3 Convenience	1 Quality, 2 Convenience (distance), 3 Quantity	1 Quality, 2 Quantity, 3 Convenience	1 Quality, 2 Convenience, 3 Quantity	1 Quality, 2 Convenience, 3 Quantity	Men: 1 Quality, 2 Quantity, 3 Convenience while Women: 1 Quantity, 2 Quality, 3
Volume of Water Uses/per Households for Drinking, Cooking, Washing & Bathing (Excluding for Animal Watering)		Average: 52L/person/day	Average: 39.5L/person/day	Average 31.5L/person/day	Range: 25L to 43L/person/day	Range: Drinking & Cooking 16-25L/person/day (water from river), Washing and Bathing by river water	Range: 10-17L/person/day	Range: 38-66L/person/day (Washing done at river)	Range: 20-38L/person/day (Washing and Bathing at river)	Range: 22-27L/person/day
Availability of Health Facilities and Private Latrines		Health centre (2005), private pit latrine: some have	Health clinic, private latrine: 0	Health centre, private latrine: 0	Health centre, private latrine: almost none	Dispensary, private latrine: 0	Dispensary, private latrine: 10	Health centre, private latrine: 2-3	Dispensary, private latrine: 0	Dispensary, private latrine: some commercial families
Major Diseases		Malaria, Diarrheas, Dysentery, Eye disease, Respiratory,	Malaria, Pneumonia, Respiratory, Typhoid, Ameba	Malaria, Diarrheas, Dysentery, Respiratory, Pneumonia, Parasites	Malaria, Ameba, Diarrheas, Respiratory	Malaria, TB, Water borne diseases for children, kidney stones above age 30,	Malaria, TB, Meningitis, Diarrheas, Measles	Malaria, Pneumonia, Typhoid, Eye disease, Diarrheas	Diarrheas, TB, Pneumonia, Typhoid (Malaria is not significant)	Malaria, TB, Eye disease, Diarrheas

Source: Socio-economic Profile Survey Interviewed by the JICA Basic Design Study Team

(5) Power Requirements of the Submersible Motor Pump and Hydraulic Calculation on the Transmission Pipelines

Towns	Pumpage		Dynamic Water Level H_3 (GL-m)	Ground Level H_1 (m)	HWL of Reservoirs H_2 (m)	Actual Head $=(H_2-H_1)+H_3+3.0$ (m)	Riser Pipes				Transmission Pipeline				Total Loss of Head $H+H_3+H_4$ (m)	Power requirement of the submersible motor pumps (kW)
	L/min.	L/sec.					Dia. (mm)	Length (m)	Velocity (m/sec.)	Loss of Head H_3(m)	Dia. (mm)	Length (m)	Velocity (m/sec)	Loss of Head H_4 (m)		
Gubi Dowra (EW)	60	1.0	107.0	0.0	43.80	153.8	65	138.0	0.30	0.50	63	1,170.0	0.32	4.14	158.44	2.86
Kelewan (EW1)	246	4.1	50.0	100.0	124.80	77.8	65	62.0	1.24	3.06	63	1,000.0	1.32	48.13	128.99	9.55
Kelewan (W1)	279	4.7	50.0	102.6	124.80	75.2	65	62.0	1.40	3.86	75	1,280.0	1.05	33.27	112.33	9.43
Derayitu (W2)	210	3.5	31.0	0.0	17.00	51.0	65	52.0	1.05	1.91	75	25.0	0.79	0.38	53.30	3.37
Derayitu (W1)	168	2.8	31.0	0.6	17.00	50.4	65	52.0	0.85	1.27	75	1,170.0	0.64	11.94	63.61	3.22
Chifra (EW1)	186	3.1	50.0	0.0	38.60	91.6	65	66.0	0.93	1.94	75	1,190.0	0.70	14.61	108.15	6.05
Chifra (W1)	402	6.7	50.0	7.1	38.60	84.5	65	66.0	2.02	8.07	100	650.0	0.85	8.18	100.75	12.19
Eli Wuha (EW1)	216	3.6	43.0	0.0	62.90	108.9	65	60.0	1.08	2.33	75	4,270.0	0.81	69.12	180.35	11.72
Eli Wuha (W2)	270	4.5	43.0	0.0	62.90	108.9	65	60.0	1.36	3.51	100	5,100.0	0.57	30.73	143.15	11.63
Nemelefen (EW1)	90	1.5	34.0	113.1	158.30	82.2	65	42.0	0.45	0.32	63	610.0	0.48	4.57	87.09	2.36
Nemelefen (W1)	90	1.5	34.0	100.0	158.30	95.3	65	42.0	0.45	0.32	63	2,080.0	0.48	15.58	111.20	3.01
Nemelefen (W2)	90	1.5	34.0	100.5	158.30	94.8	65	42.0	0.45	0.32	63	2,550.0	0.48	19.10	114.23	3.09
Wederage (EW1)	90	1.5	71.0	100.0	135.00	109.0	65	83.0	0.45	0.64	63	890.0	0.48	6.67	116.30	3.15
Wederage (W1)	72	1.2	71.0	111.7	135.00	97.3	65	71.0	0.36	0.36	50	690.0	0.61	10.54	108.20	2.34
Wederage (W2)	72	1.2	71.0	105.0	135.00	104.0	65	83.0	0.36	0.42	50	1,160.0	0.61	17.72	122.14	2.65
Kumami (W1)	186	3.1	20.0	0.0	185.50	208.5	65	32.0	0.93	0.94	75	3,030.0	0.70	37.20	246.64	13.80
Dulecha (EW1)	108	1.8	30.0	18.3	68.50	83.2	65	42.0	0.54	0.45	50	380.0	0.92	12.29	95.94	3.12
Dulecha (W1)	77	1.3	30.0	0.0	68.50	101.5	65	30.0	0.39	0.17	50	1,210.0	0.66	21.14	122.82	2.86
Pumping test 1	138	2.3	100.0	0.0	1.00	104.0	50	112.0	1.17	6.80	50	15.0	1.17	0.76	111.56	4.63
Pumping test 2	318	5.3	100.0	0.0	1.00	104.0	50	112.0	2.70	31.86	50	15.0	2.70	3.58	139.44	13.34

Legend) Test Well Existing Well with the replacement of the submersible pumps

Remarks) 1) The dynamic water level of the test well is applied for the other wells. In case of the existing well, the dyanamic water level is assumed on the basis of the existing data.

2) In case of the existing well without the replacement of the submewrsible pump, the technical requirement is assumed on the basis of the available data.

(6)Required Output Rating of the Diesel Generator and Fuel Consumption

Towns	Submersible Motor Pump		Generator								
			Required Output Rating (KVA)		Applied Generator		Fuel Consumption ④=(①×②×③)				
	Applied Power (kW)	Starting Method	Normal Operation	Startup	①Output Rating (kVA)	kW	Hourly consumption rate ②	Operation Duration ③	Daily Fuel Consumption ④ (L)	Monthly Fuel Consumption ④× 30days (L)	Total Fuel Consumption (L)
Gubi Dowra (EW)	4.0	DOL	5.5	14.1	17.0	13.6	0.17	8	24	720	720
Kelewan (EW1)	11.0	S/D	15.2	26.0	30.0	24.0	0.17	7.5	39	1,170	
Kelewan (W1)	9.2	S/D	12.7	21.7	28.0	22.4	0.17	7.5	36	1,080	2,250
Derayitu (W2)	4.0	DOL	5.5	14.1	17.0	13.6	0.17	7.5	22	660	
Derayitu (W1)	4.0	DOL	5.5	14.1	17.0	13.6	0.17	7.5	22	660	1,320
Chifra (EW1)	7.5	DOL	10.4	26.5	30.0	24.0	0.17	7.5	39	1,170	
Chifra (W1)	11.0	S/D	15.2	26.0	28.0	22.4	0.17	7.5	36	1,080	2,250
Eli Wuha (EW1)	15.0	S/D	20.8	35.5	40.0	32.0	0.17	7.5	51	1,530	
Eli Wuha (W2)	13.0	S/D	18.0	30.7	37.0	29.6	0.17	7.5	48	1,440	2,970
Nemelefen (EW1)	5.5	DOL	7.6	19.4	15.0	12.0	0.17	7.9	21	630	
Nemelefen (W1)	4.0	DOL	5.5	14.1	17.0	13.6	0.17	7.9	23	690	
Nemelefen (W2)	5.5	DOL	7.6	19.4	23.0	18.4	0.17	7.9	31	930	2,250
Wederage (EW1)	5.5	DOL	7.6	19.4	15.0	12.0	0.17	7.5	20	600	
Wederage (W1)	3.0	DOL	4.2	10.6	17.0	13.6	0.17	7.5	22	660	
Wederage (W2)	3.0	DOL	4.2	10.6	17.0	13.6	0.17	7.5	22	660	1,920
Kumami (W1)	15.0	S/D	20.8	35.5	37.0	29.6	0.17	6.1	39	1,170	1,170
Dulecha (EW1)	5.5	DOL	7.6	19.4	17.0	13.6	0.17	6	18	540	
Dulecha (W1)	3.0	DOL	4.2	10.6	17.0	13.6	0.17	6	18	540	1,080
Pumping test 1	13.0	S/D	18.0	30.7	37.0	29.6	0.17	96	604		

Legend) Test Well The existing well without the replacement of the submersible motor pump

Remarks) 1)Hourly consumption rate is based on " The Rent on Heavy Duty Machines by the Juristic Corporation Japan Heavy Duty Mechanization Association".

2)Fuel consumption is estimated at the normal operation.

⑺ Hydraulic Calculation on the Distribution Pipeline in the Project Sites

Hydraulic calculation is made with Hazen-Williams' formla. Galvanized steel is applied for the pipe materila, and velocity cc 110 is applied.

①Gubi Dowra

Pipeline (Reservoir①- School④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.063					40.30	40.60	
①-②		170.00	170.00	SP	0.063	0.002685	0.02199	3.74	0.86	6.10	36.86	30.76
②-③	③-⑤	290.00	460.00	SP	0.063	0.002685	0.02199	6.38	0.86	4.00	30.49	26.49
③-④		450.00	910.00	SP	0.050	0.001101	0.01302	5.86	0.56	15.00	24.62	9.62

LWL of the reservoir is assumed at the elevation of GL+0.3m.

Pipeline (③-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.050					4.00	30.49	
③-⑤		100.00	100.00	SP	0.050	0.000752	0.00643	0.64	0.38	2.80	29.84	27.04

②Kelewan

Pipeline (Reservoir①-C6)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.150					121.30	121.60	
①-②		480.00	480.00	SP	0.150	0.014568	0.00735	3.53	0.82	93.90	118.07	24.17
②-③	③-⑦	110.00	590.00	SP	0.150	0.014568	0.00735	0.81	0.82	98.80	117.26	18.46
③-④	④-⑧	290.00	880.00	SP	0.125	0.008595	0.00673	1.95	0.70	100.70	115.31	14.61
④-⑤	⑤-⑨	80.00	960.00	SP	0.100	0.004224	0.00536	0.43	0.54	100.00	114.89	14.89
⑤-⑥		320.00	1,280.00	SP	0.075	0.002622	0.00900	2.88	0.59	98.30	112.00	13.70

LWL of the reservoir is assumed at the elevation of GL+0.3m.

Pipeline (④-⑧)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					100.70	115.31	
④-⑧		300.00	300.00	SP	0.075	0.002040	0.00566	1.70	0.46	104.20	113.62	9.42

Pipeline (⑤-⑨)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.050					100.00	114.89	
⑤-⑨		70.00	70.00	SP	0.050	0.001165	0.01446	1.01	0.59	99.40	113.87	14.47

Pipeline (③ -⑦)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					98.80	117.26	
③-⑦		240.00	240.00	SP	0.075	0.003351	0.01417	3.40	0.76	98.20	113.86	15.66

③Derayitu

Pipeline (Elevated tank①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.150					9.32	15.42	
①-②		360.00	360.00	SP	0.150	0.010486	0.00400	1.44	0.59	8.89	13.98	5.09
②-③		400.00	760.00	SP	0.150	0.010486	0.00400	1.60	0.59	6.35	12.38	6.03
③-④		330.00	1,090.00	SP	0.100	0.005243	0.00799	2.64	0.67	4.65	9.74	5.09

LWL of the elevated tank is assumed at the elevation of はGL+6.1m.

④Chifra

Pipeline (Reservoir①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.125					35.60	35.90	
①-②	②-⑤	90.00	90.00	SP	0.125	0.016317	0.02202	1.98	1.33	18.60	33.92	15.32
②-③	③-⑥	480.00	570.00	SP	0.125	0.014196	0.01702	8.17	1.16	17.20	25.75	8.55
③-④		980.00	1,550.00	SP	0.100	0.005221	0.00793	7.77	0.66	3.50	17.98	14.48

LWL of the reservoir is assumed at the elevation of GL＋0.3m.

Pipeline (②-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					18.60	33.92	
②-⑤		390.00	390.00	SP	0.075	0.002121	0.00608	2.37	0.48	13.40	31.55	18.15

Pipeline③-⑥)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					17.20	25.75	
③-⑥		600.00	600.00	SP	0.075	0.001469	0.00308	1.85	0.33	19.00	23.90	4.90

⑤Eli Wuha

Pipeline (Reservoir①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.150	0.013534				59.90	60.20	
①-②	②-⑥	690.00	690.00	SP	0.150	0.013534	0.00641	4.42	0.77	31.80	55.78	23.98
②-③	③-⑤	70.00	760.00	SP	0.100	0.010286	0.02780	1.95	1.31	30.30	53.83	23.53
③-④		670.00	1,430.00	SP	0.100	0.005143	0.00771	5.17	0.65	29.70	48.66	18.96

LWL of the reservoir is assumed at the elevation of GL＋0.3m.

Pipeline (②-⑥)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					31.80	55.78	
②-⑥		419.00	419.00	SP	0.075	0.003248	0.01338	5.61	0.74	32.30	50.17	17.87

Pipeline (③-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.075					30.30	53.83	
③-⑤		310.00	310.00	SP	0.075	0.005143	0.03131	9.70	1.16	32.00	44.12	12.12

⑥Nemelefen

Pipeline (Reservoir①-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.100					155.60	155.90	
①-②	②-⑥	150.00	150.00	SP	0.100	0.007917	0.01713	2.57	1.01	142.60	153.33	10.73
②-③	③-⑦	130.00	280.00	SP	0.100	0.005621	0.00909	1.18	0.72	143.00	152.15	9.15
③-④		250.00	530.00	SP	0.075	0.002692	0.00945	2.36	0.61	136.50	149.79	13.29
④-⑤		310.00	840.00	SP	0.050	0.001346	0.01889	5.86	0.69	126.70	143.93	17.23

LWL of the reservoir is assumed at the elevation of GL＋0.3m.

Pipeline (③ -⑦)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.050					143.00	152.15	
③-⑦		330.00	330.00	SP	0.050	0.001346	0.01889	6.23	0.69	136.00	145.92	9.92

Pipeline (②-⑥)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.063					142.60	153.33	
②-⑥		350.00	350.00	SP	0.063	0.002296	0.01646	5.76	0.74	136.90	147.57	10.67

⑦Wederage

Pipeline (Elevated tank①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.125					125.70	131.70	
①-②		400.00	400.00	SP	0.125	0.006484	0.00399	1.60	0.53	121.60	130.10	8.50
②-③		80.00	480.00	SP	0.100	0.005836	0.00974	0.78	0.74	119.40	129.32	9.92
③-④		120.00	600.00	SP	0.100	0.005836	0.00974	1.17	0.74	115.00	128.15	13.15
④-⑤		390.00	990.00	SP	0.063	0.003307	0.03233	12.61	1.06	99.40	115.55	16.15

LWL of the elevated tank is assumed at the elevation of はGL+6.0m.

⑧kumami

Pipeline (Reservoir①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.125					182.00	182.30	
①-P4		1,313.00	1,313.00	SP	0.125	0.004052	0.00167	2.20	0.33	158.40	180.10	21.70
P4-②		1,417.00	2,730.00	SP	0.125	0.004052	0.00167	2.37	0.33	167.10	177.73	10.63
②-P9		2,789.00	5,519.00	SP	0.100	0.004052	0.00496	13.84	0.52	130.80	163.89	33.09
P9-P10		366.00	5,885.00	SP	0.100	0.004052	0.00496	1.82	0.52	104.80	162.08	57.28
P10-③	③-⑤	1,140.00	7,025.00	SP	0.100	0.004052	0.00496	5.66	0.52	132.90	156.42	23.52
③-A3		225.00	7,250.00	SP	0.063	0.002026	0.01306	2.94	0.65	134.20	153.48	19.28
A3-④		94.00	7,344.00	SP	0.063	0.002026	0.01306	1.23	0.65	133.50	152.26	18.76

LWL of the reservoir is assumed at the elevation of GL＋0.3m.

Pipeline (③-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP						132.90	156.42	
③-B1		80.00	80.00	SP	0.063	0.002026	0.01306	1.04	0.65	131.90	155.38	23.48
B1-⑤		60.00	140.00	SP	0.063	0.002026	0.01306	0.78	0.65	129.90	154.59	24.69

⑨Dulecha

Pipeline (Elevated tank①-④)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.125					59.00	65.50	
①-②	②-⑤	110.00	110.00	SP	0.125	0.004138	0.00174	0.19	0.34	58.00	65.31	7.31
②-③	③-⑥	170.00	280.00	SP	0.125	0.001862	0.00040	0.07	0.15	56.50	65.24	8.74
③-④		420.00	700.00	SP	0.050	0.001034	0.01160	4.87	0.53	33.30	60.37	27.07

LWL of the elevated tank is assumed at the elevation of はGL+6.5m.

Pipeline (②-⑤)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.100					58.00	65.31	
②-⑤		180.00	180.00	SP	0.100	0.001655	0.00095	0.17	0.21	63.30	65.14	1.84

Pipeline (③-⑥)

Pipeline	Branched pipeline	Length (m)	Accumulative length (m)	Pipeline data						Ground level (m)	Dynamic water level (m)	Pressure (m)
				Pipe Material	Dia. (m)	Flow (m^3/sec.)	Hydraulic gradient (I)	Loss of head h_2(m)	Velocity (m/sec.)			
		0.00	0.00	SP	0.063					56.50	65.24	
③-⑥		160.00	160.00	SP	0.063	0.000828	0.00249	0.40	0.27	54.00	64.84	10.84

⑻ O&M Cost

O&M cost consists of energy cost, personnel cost, material cost, replacement cost, and others. Energy (Fuel) cost includes in the transportation fare for the purchase in neiboring town. Personnel cost is based on the necessary personnel for the operation of the water supply facilities to be constructed. Material cost is for the implellar of the submersible pump, filter of generator, etc. The consumable for submersible pump is estimated at 10% of local price, and 15 % for generator. Replacement cost is to save money monthly for 15 years for the purchase of new submersible pump and generator. The other cost is for office supply and transportation fare necessary for the activities of Water Committee.

Item	Unit	Unit Price (Birr)	Q'ty	Cost (Birr)
Fuel	L	4.6	1,000	4,600
Tranportation fare (50Birr× 10times/month)	Lot	500	1	500
Total				5,100

			Gubi Dorwa			Kelewan			Derayitu			Chifra			Eli Wuha			Nemelefen			Wederage			Kumami			Dulecha		
	Item	Unit	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost
①Energy cost	(a) Fuel	L	6	720	4,320	6	2,250	13,500	6	1,320	7,920	6	2,250	13,500	6	2,970	17,820	6	2,250	13,500	6	1,920	11,520	6	1,170	7,020	6	1,080	6,480
	(b) Lubricant (20% of (a))	Lot	864	1	864	2,700	1	2,700	1,584	1	1,584	2,700	1	2,700	3,564	1	3,564	2,700	1	2,700	2,304	1	2,304	1,404	1	1,404	1,296	1	1,296
	Sub-total				5,184			16,200			9,504			16,200			21,384			16,200			13,824			8,424			7,776
					5,190Birr			16,200Birr			9,510Birr			16,200Birr			21,390Birr			16,200Birr			13,830Birr			8,430Birr			7,780Birr
②Personnel cost	Item	Unit	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost
	Operator	人	720	1	720	720	2	1,440	720	2	1,440	720	2	1,440	720	2	1,440	720	2	1,440	720	2	1,440	720	1	720	720	2	1,440
	Bill collector	人	720	2	1,440	720	3	2,160	720	2	1,440	720	3	2,160	720	3	2,160	720	3	2,160	720	3	2,160	720	2	1,440	720	2	1,440
	Meter reader	人	360	1	360	360	2	720	360	1	360	360	2	720	360	2	720	360	2	720	360	2	720	360	1	360	360	1	360
	Accountant	人	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290	1,290	1	1,290
	Sub-total				3,810			5,610			4,530			5,610			5,610			5,610			5,610			3,810			4,530
					3,810Birr			5,610Birr			4,530Birr			5,610Birr			5,610Birr			5,610Birr			5,610Birr			3,810Birr			4,530Birr
③Material cost	Item	Unit	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost
	Submersible pump (local price ×10% × 1/24)	Lot	5	1	5	13	2	26	7	2	14	16	2	33	21	2	42	5	3	14	5	3	14	18	1	18	5	2	9
	Generator (local price ×15% × 1/24)	Lot	50	1	50	60	2	120	54	2	108	60	2	120	63	2	126	54	3	162	50	3	150	72	1	72	50	2	100
	Sub-total				55			146			122			153			168			176			164			90			109
	1$= 9.08Birr				500Birr			1,330Birr			1,100Birr			1,390Birr			1,520Birr			1,590Birr			1,500Birr			820Birr			1,000Birr
			Local price	1,100($)	8,000($)	Local price	3,100($)	9,500($)	Local price	1,550($)	8,500($)	Local price	3,900($)	9,500($)	Local price	5,000($)	10,000($)	Local price	1,100($)	8,500($)	Local price	1,100($)	8,000($)	Local price	4,100($)	11,500($)	Local price	1,100($)	8,000($)
④Replecement cost	Item	Unit	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost	Unit Price ($)	Q'ty	Cost
	Submersible pump (Local price×1/15 × 1/12)	Lot	6	1	6	17	2	34	9	2	17	22	2	43	28	2	56	6	3	18	6	3	18	23	1	23	6	2	12
	Generator (Local price×1/15 × 1/12)	Lot	44	1	44	53	2	106	47	2	94	53	2	106	56	2	111	47	3	142	44	3	133	64	1	64	44	2	89
	Sub-total				51			140			112			149			167			160			152			87			101
	1$= 9.08Birr				460Birr			1,280Birr			1,020Birr			1,360Birr			1,520Birr			1,460Birr			1,380Birr			790Birr			920Birr
⑤Others	Item	Unit	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost	Unit Price (Birr)	Q'ty	Cost
	Office supply (notebook, pencils, etc.)	Lot	60	1	60	60	1	60	60	1	60	60	1	60	60	1	60	60	1	60	60	1	60	60	1	60	60	1	60
	Transportation fare (twice a month to neighoring town)	Lot	100	1	100	100	1	100	100	1	100	100	1	100	100	1	100	100	1	100	100	1	100	100	1	100	100	1	100
	Sub-total				160			160			160			160			160			160			160			160			160
					160Birr			160Birr			160Birr			160Birr			160Birr			160Birr			160Birr			160Birr			160Birr
Total (①+②+③+④+⑤)					10,120Birr			24,580Birr			16,320Birr			24,720Birr			30,200Birr			25,020Birr			22,480Birr			14,010Birr			14,390Birr


jICA