THE KINGDOM OF MOROCCO
MINISTRY DELEGATE IN CHARGE OF WATER
TO THE MINISTER OF ENERGY, MINES, WATER
AND ENVIRONMENT

FOLLOW-UP COOPERATION ON THE PROJECT FOR FLOOD FORECASTING AND WARNING SYSTEM IN HIGH ATLAS AREA

FOLLOW-UP COOPERATION REPORT

JULY 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
CTI ENGINEERING INTERNATIONAL CO., LTD.

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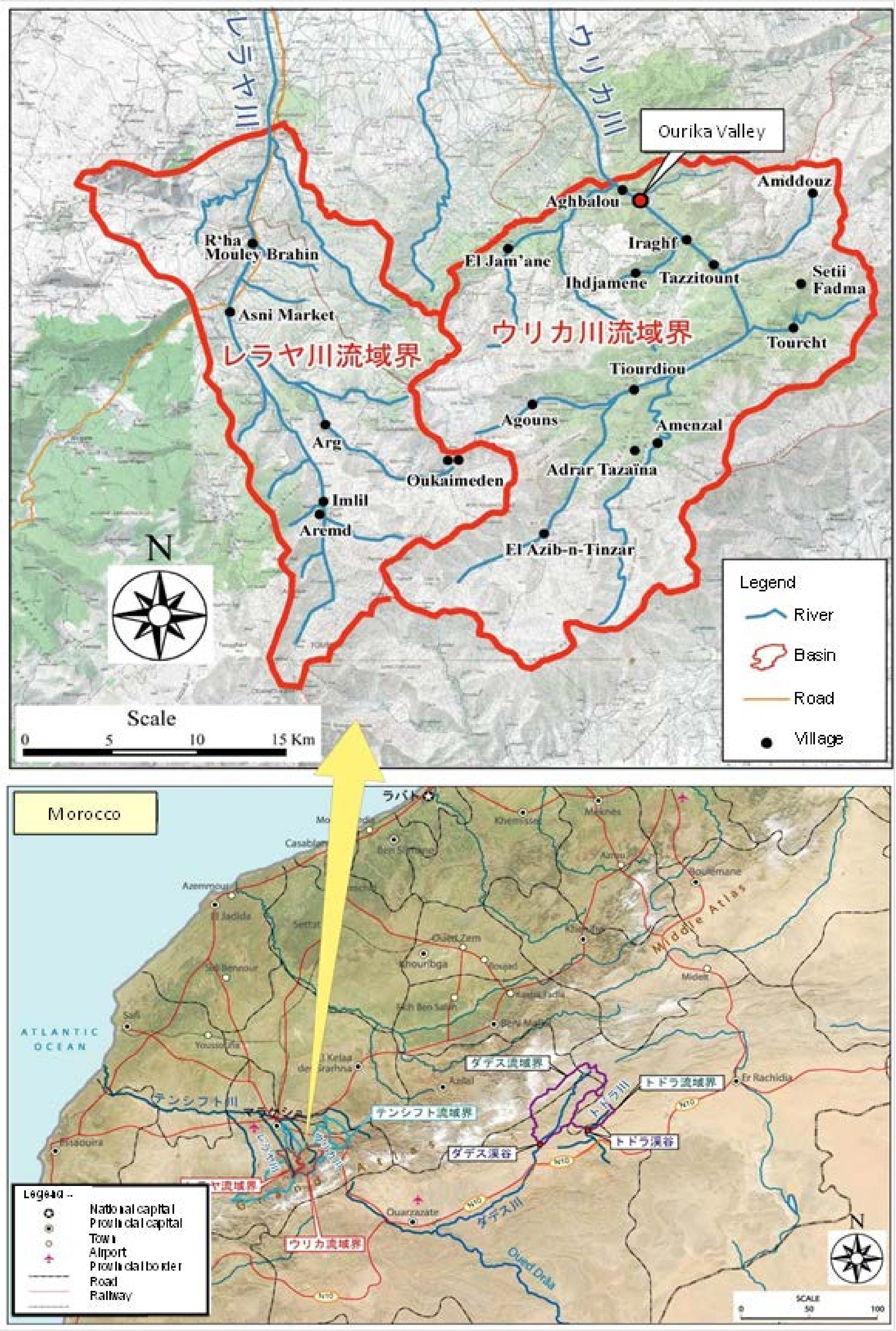

LOCATION MAP

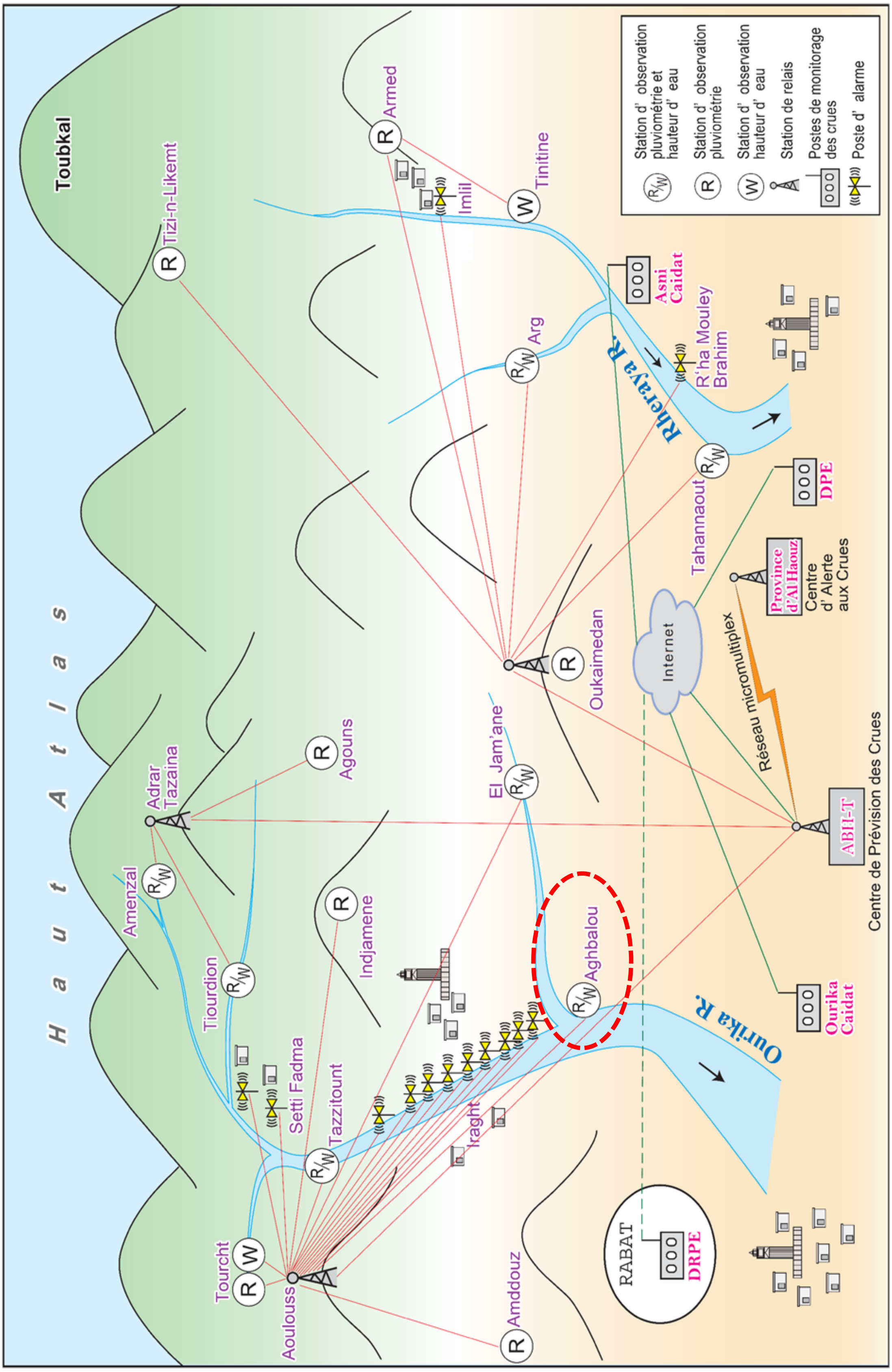

IMAGE OF FLOOD FORECASTING AND WARNING SYSTEM IN HIGH ATLAS AREA

PHOTOGRAPHS (1 /5)

Before Commencement of Work

13th-May Demobilization of Existing Facilities

23rd-May Formwork

25th-May Casting Concrete

2nd-June Casting Concrete

3rd-June Curing

PHOTOGRAPHS (2 /5)

4th-June Removal of Frame (under part)

4th-June Backfilling

9th-June Installation of Gabion

15th-June Installation of arm and pole for water level gauge

26th-June Installation of water level gauge at concrete structure

30th June Final Inspection

PHOTOGRAPHS (3 /5)

Constructed Facility1

Constructed Facility2

14th May Removal of the destroyed steel poles for overhead wiring

6th June Casting Concrete for steel poles for overhead wiring

14th June Installation of steel pole (3m) for overhead wiring

14th June Installation of steel pole (5m) for overhead wiring

PHOTOGRAPHS (4 /5)

9th July Installation of transducer and thermometer transmitter

11th July Completion of installation of transducer and thermometer transmitter

10th July Installation of cable and wire (between arm and 3m pole)

10th July Installation of cable and wire (between 3m pole and 5m pole)

11th July Installation of main body of water level gauge

11th July Completion of installation of main body of water level gauge

PHOTOGRAPHS (5 /5)

panoramic view 1 (before commencement of work)

panoramic view 2 (after completion of work)

Executive Summary

1. Outline of Follow-up Cooperation

1.1 Background

The Japanese grant-aid project, "the Project for Flood Forecasting and Warning System in High Atlas Area" was completed in December 2013. However, a massive flood happened in the southern Morocco in November 2014, and the foundation of the water level gauge of the Aghbalou Station was also scored gradually by the 5-day long-continued flood flow, and was finally fallen on November 24. Since then the water level data supply from the station to the flood forecasting center at ABHT (Agence du Bassin Hydraulique de Tensift) has been stopped, and its urgent restoration is required. This follow-up cooperation has been implemented to confirm damage conditions of the water level gauge and to provide necessary procurement, construction and installation for its restoration.

1.2 Outline of Follow-up Cooperation

The outline of the Follow-up Cooperation is as follows:

Table-1 Outline of the Follow-Up Cooperation

No.	Item	Contents
1	Goal	Water level data at Aghbalou are transmitted to the flood forecasting center at ABHT through the observation station.
2	Expected Outputs	A new water level censor is installed at Aghbalou, and the water level data are transmitted to the Aghbalou Station.
3	Request by Moroccan side	Restoration of the water level gauge in Aghbalou
4	Target Site	Aghbalou, Al Haouz Province, Morocco
5	Related Organizations	Counterpart : ABHT (Agence du Bassin Hydraulique de Tensift) Competent Authorities : DRPE (Direction de la Recherche et de la Planification de l'Eau), Ministry Delegeate in Charge of Water to the Minister of Energy, Mines, Water and the Environment.

2 Confirmation of Contents of Follow-up Cooperation

2.1. Hydrological Study on November 2014 Flood

In November 2014 a large-scale flood hit the southern regions of Morocco, and the water level gauge at the Aghbalou Station that was constructed under the Japanese grant-aid project was totally collapsed by the flood. Based on hydrological analyses, the flood was evaluated to be of a scale of return period of 40 to 50 years with regard to the collapse of the water level gauge.

The life time of equipment of flood forecasting and warning system including water level censors is generally 10 to 20 years. Accordingly, the collapsed water level gauge structure was designed and constructed, supposing a flood of return period of 20 years at the maximum. Taking it into account that the November 2014 flood was as large as the scale of once in 40 to 50 years, it is considered that the collapse of the water level gauge of the Aghbalou Station was caused by Force Majeure.

2.2 Organizational Set-up for Maintenance of Telemetry System

When the telemetering work for equipment procured by JICS (Japan International Cooperation System) under a non-project grant-aid project is completed, ABHT will have as many as 58 stations/posts in total, including 29 stations/posts of the grant-aid project. Now only one technician of the Service of Follow-up and Evaluation of Water Resources of ABHT is narrowly managing the operation and maintenance of the telemetry systems, but these works are likely to be delayed in spite of his devoted efforts. To supplement the insufficient staff, the maintenance work has been outsourced to a local company, SOHIME. This outsourcing system has been basically working, and the equipment have been being barely maintained.

However, it seems necessary to enhance the capacity of ABHT as the owner of the telemetry systems. In addition to flood forecasting and early warning, capacity for initial diagnosis on problems of the equipment should be enhanced/possessed by ABHT to more rapidly respond to the problems. In this context employment of at least an engineer on telecommunication or information technology is recommended.

2.3 Selection of Reconstruction Site and Equipment

At the site of the old and abandoned water level gauge just behind the destroyed gauge was selected as the most appropriate reconstruction site. Since this site needs no land acquisition, construction work could be commenced immediately. Behind the abandoned water level gauge there appears rock, which could support the concrete foundation/substructure of the new gauge to make it durable against even a 100-year flood. However it is necessary to guide river water to the new gauge by excavating the river bed in order to enable continuous water level measurement even at ordinary time. It is also necessary to conduct river cross-section survey for the excavated river bed to modify the pre-alert and alert levels, the water level-discharge conversion table and the cross section coordinates.

As a result of a detail investigation on the collapsed water level gauge equipment that was mainly consisting of a main unit, a transducer with a thermometer transmitter and cable, it was confirmed that it is necessary to newly procure the same transducer and cable for the replacement as the destroyed ones. Regarding the main unit that might have been damaged, it was decided that it would be repaired and adjusted in Japan, and then brought back to Morocco.

2.4 Undertakings of Morocco Side

It was confirmed that the Morocco should undertake 1) Land acquisition for the reconstruction, 2) Arrangement for tax exemption and custom clearance for imported equipment and 3) River bed excavation after the restoration of the water level gauge.

In case that Morocco side does not implement river bed excavation, it is impossible to observe continuous water level. Therefore, it is necessary to guide river water to the new gauge by excavating the river bed in order to enable continuous water level measurement even at ordinary time. Moreover, after completion of river bed excavation, Morocco side is required to conduct river cross section survey again for the excavated river bed. Then the water level - discharge conversion table and the pre-alert and alert water levels were recalculated again based on the new cross section.

2.5 Cost Estimate

The total cost of the restoration works including civil works, and procurement, transportation and installation of equipment was estimated at JPY 8,264,000.

3 Implementation of Follow-up Cooperation

The civil work mainly composed of construction of a concrete foundation/substructure and manufacture and installation of a supporting structure (a pole and an arm) for the water level gauge was commenced in the middle of May and completed at the end of June. The equipment were procured in Japan in the middle of June and shipped by air to Morocco. Immediately after the custom clearance, installation of the equipment was commenced, and completed in the middle of July. The restored water level gauge was successfully delivered to ABHT on July 15, 2015.

4 Recommendation

Following recommendations were made by the Consultant:

- ABHT is required to well maintain the restored water level gauge to ensure sustainable operation of the flood forecasting system. It is recommended that ABHT employ an engineer on telecommunication or information technology to enhance the capacity for the maintenance of the telemetry equipment so as to diagnose and respond rapidly to problems of the system and equipment.

- ABHT should conduct riverbed excavation for guiding water from the main stream of the Ourika River to the restored water level gauge as soon as possible. Consequently ABHT should conduct river cross-section survey for the excavated river bed to modify the pre-alert and alert levels, the water level-discharge conversion table and the cross section coordinates.

Follow-Up Cooperation on
The Project for Flood Forecasting and Warning System in High Atlas Area

Follow-Up Cooperation Report

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CHAPTER 1 OUTLINE OF THE FOLLOW-UP COOPERATION

1.1 Background

The Japanese grant-aid project, "the Project for Flood Forecasting and Warning System in High Atlas Area" which is composed of sixteen (16) observing stations, thirteen (13) warning posts and three (3) relay stations was completed in December 2013 to reduce the flood risk in the Ourika and Rheraya River Basins. Immediately after the completion a variety of troubles began to take place, and the Consultant (CTII) and the Contractor (Marubeni) have responded to them. The system was working normally in principle, although the data acquisition rate was occasionally lowered for some reason or other.

Under these situations a massive flood happened in the southern Morocco in November 2014. This flood brought heavy damages to the Ourika River Basin, too. Many houses and the Road 2017 along the river were destroyed, and the foundation of the water level gauge of the Aghbalou Station was also scored gradually by the 5-day long-continued flood flow, and was finally fallen on November 24. Since then the water level data supply from the station to the flood forecasting center at ABHT (Agence du Bassin Hydraulique de Tensift) has been stopped, and its urgent restoration is required.

This follow-up cooperation has been implemented to confirm damage conditions of the water level gauge and to provide necessary procurement, construction and installation for its restoration in accordance with the Scope of Work agreed on April 7, 2015 between Japan International Cooperation Agency (JICA) and the Government of the Kingdom of Morocco.

Photo 1.1.1 Water Level Gauge (July 2013)

Photo 1.1.2 Collapsed Water Level Gauge (Nov. 2014)

1.2 Goal, Outputs, Request, Target Site and Related Organization

Goal, Expected Outputs, Request, Target Site, Related Organizations are shown in Table 1.2.1.

Table 1.2.1 Outline of the Follow-Up Cooperation

No.	Item	Contents
1	Goal	Water level data at Aghbalou are transmitted to the flood forecasting center at ABHT through the observation station.
2	Expected Outputs	A new water level censor is installed at Aghbalou, and the water level data are transmitted to the Aghbalou Station.
3	Request by Moroccan side	Restoration of the water level gauge in Aghbalou
4	Target Site	Aghbalou, Al Haouz Province, Morocco
5	Related Organizations	Counterpart : ABHT (Agence du Bassin Hydraulique de Tensift) Competent Authorities : DRPE (Direction de la Recherche et de la Planification de l'Eau), Ministry Delegeate in Charge of Water to the Minister of Energy, Mines, Water and the Environment.

1.3 Objective

The objective of the Follow-Up Cooperation is that design, construction, procurement and installation are conducted for the restoration of the water level gauge of the Aghbalou Station that was developed under the Japanese grant-aid project and destroyed by the flood in November 2014.

1.4 Implementation Flow

A flow chart of the Follow-Up Cooperation is proposed as presented in Figure 1.4.1, so that the collapsed water level gauge could be restored before Ramadan ends on July 18.

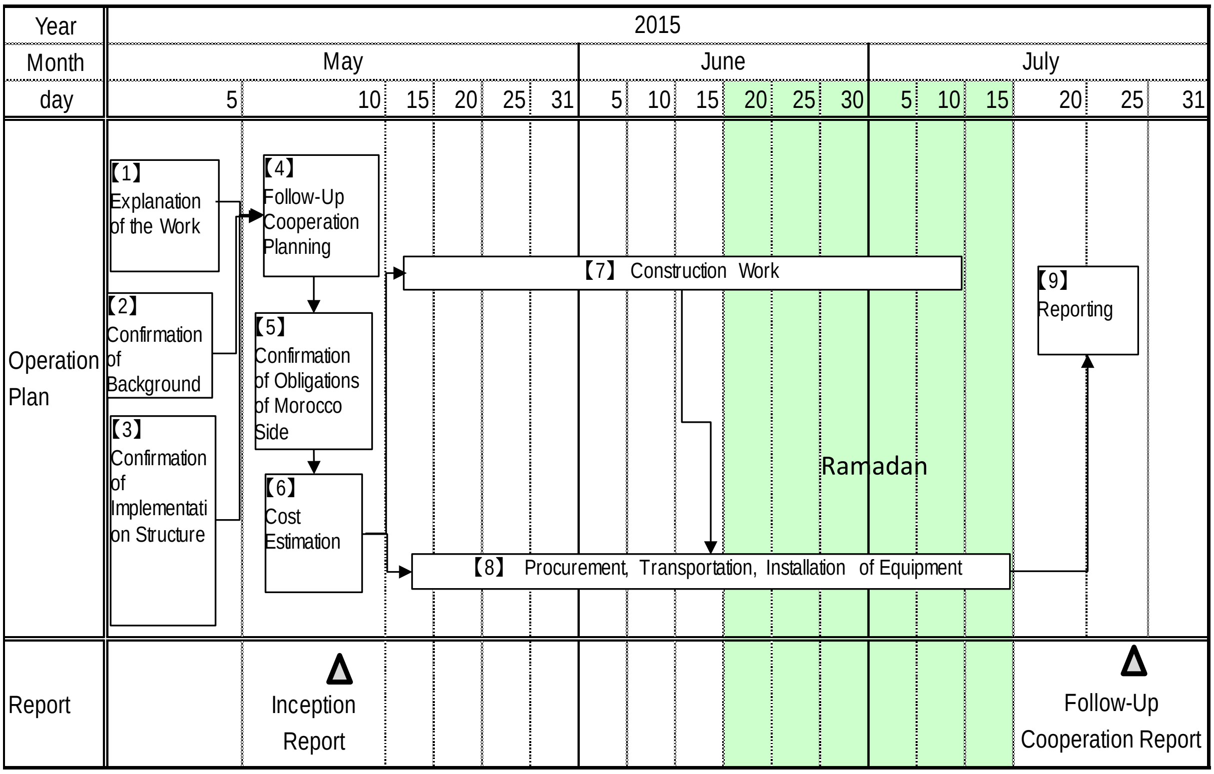


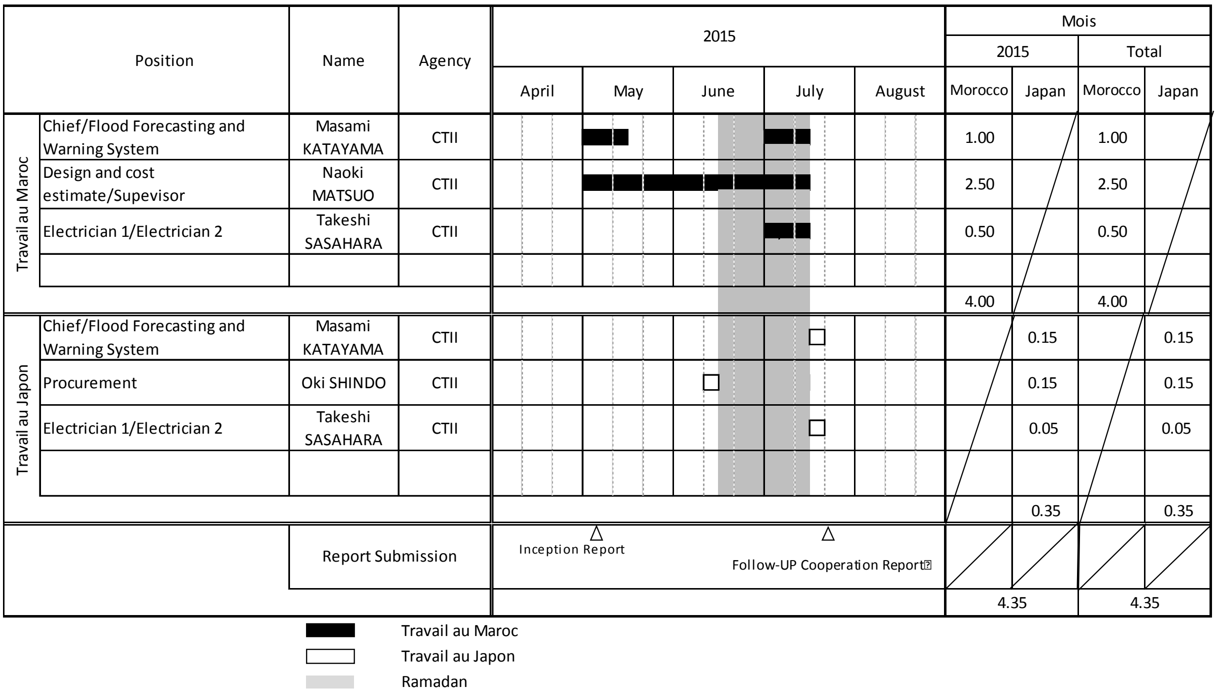
Figure 1.4.1 Flow chart of the Follow-Up Cooperation

1.5 Consultant Team Members and Assignment Schedule

Consultant team members are presented in Table 1.5.1, and their assignment schedule is also presented in Figure 1.5.1.

Table 1.5.1 Members of the Consultant Team

Name	Position	Agency
Masami KATAYAMA	Team Leader / Flood Forecasting and Warning System	CTI Engineering International. Co., LTD.
Naoki MATSUO	Design, Cost Estimation / Supervisor	CTI Engineering International. Co., LTD.
Oki SHINDO	Procurement	CTI Engineering International. Co., LTD.
Takeshi SASAHARA	Electric Engineer 1 / Electric Engineer 2	CTI Engineering International. Co., LTD.



Position		Name	Agency	2015					Mois			
									2015		Total	
				April	May	June	July	August	Morocco	Japan	Morocco	Japan
Travail au Maroc	Chief/Flood Forecasting and Warning System	Masami KATAYAMA	CTII		■		■		1.00		1.00	
	Design and cost estimate/Supevisor	Naoki MATSUO	CTII		■	■	■		2.50		2.50	
	Electrician 1/Electrician 2	Takeshi SASAHARA	CTII				■		0.50		0.50	
									4.00		4.00	
Travail au Japon	Chief/Flood Forecasting and Warning System	Masami KATAYAMA	CTII				□			0.15		0.15
	Procurement	Oki SHINDO	CTII			□				0.15		0.15
	Electrician 1/Electrician 2	Takeshi SASAHARA	CTII				□			0.05		0.05
										0.35		0.35
		Report Submission			△ Inception Report		△ Follow-UP Cooperation Report					
									4.35		4.35	

■ Travail au Maroc
□ Travail au Japon
▨ Ramadan

Figure 1.5.1 Assignment Schedule

CHAPTER 2 CONFIRMATION OF CONTENTS OF THE FOLLOW-UP COOPERATION

2.1 Hydrological Study on November 2014 Flood

2.1.1 Introduction

In November 2014 a large-scale flood hit the southern regions of Morocco and killed over 30 people. In the Ourika River Basin the road and houses along the river were heavily damaged, and the water level gauge at the Aghbalou Station that was constructed under the Japanese grant-aid project was totally collapsed by the flood.

This section describes results of hydrological analyses on the characteristics of the flood, especially focusing on the statistic scale of the flood.

2.1.2 Flood Conditions

The flood conditions are summarized as follows:

- The flood lasted about 11 days from November 20 to 30, and the flood period is exceptionally long in this region. There were two flood waves, namely those between November 20 and 24 and between November 26 and 30, sandwiching a non-rainfall day. The first flood wave was larger.
- The total rainfall at the stations in and around the Ourika River Basin in the flood period ranges from 130 to 520mm. The Tourcht Station recorded 250mm in a day alone on November 21 that corresponds to one-year rainfall of Marrakech.
- The road and many houses on the river bank were destroyed by the flood flow, but no one was dead fortunately.
- The flood peak appeared at Aghbalou early morning, between 2:00 and 5:00 November 22. However, the water level gauge was collapsed two days later, between 9:00 and 13:00 November 24.
- The peak discharge was estimated at 424m^3/s according to the water level-discharge conversion curve constructed based on the river cross section surveyed in July 2013.
- As shown in Photo 2.1.1 where the mainstream is seen flowing near the left bank, namely near the water level gauge during the flood. Therefore, it is deemed that the river bed around the water level gauge was gradually eroded by the flood flow and the water level gauge was finally collapsed on November 24, although it survived the peak discharge on November 22.

Table 2.1.1 Rainfall during the November 2014 Flood

(mm)

Station	Nov-20	Nov-21	Nov-22	Nov-23	Nov-24	Nov-25	Nov-26	Nov-27	Nov-28	Nov-29	Nov-30	Total
Agouns	50.0	80.0	20.0	0.0	0.0	0.0	0.0	7.0	0.0	9.0	5.0	171.0
Tiourdiou	28.5	53.3	23.5	1.8	0.9	0.0	0.0	5.0	22.1	37.0	6.0	178.1
Amenzal	63.7	125.7	62.3	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	260.7
Tourcht	117.1	249.2	42.1	2.3	4.0	0.0	0.0	24.0	26.1	37.3	17.2	519.3
Tazzitount	75.0	57.8	16.0	10.6	1.8	0.0	5.8	16.0	39.0	56.0	12.7	290.7
Aghbalou	22.0	22.1	3.6	19.9	1.5	0.0	9.0	14.6	19.6	51.8	17.5	181.6
Arithmetic basin mean rainfall at Aghbalou	66.9	113.2	32.8	2.9	1.3	0	1.2	12.2	17.4	27.9	8.2	284.0
Tiessen basin mean rainfall at Aghbalou	57.5	94.9	26.2	4.2	1.2	0.0	1.7	11.3	16.6	29.8	8.8	252.2

Note: Manually observed rainfall data (day division time is 7am)

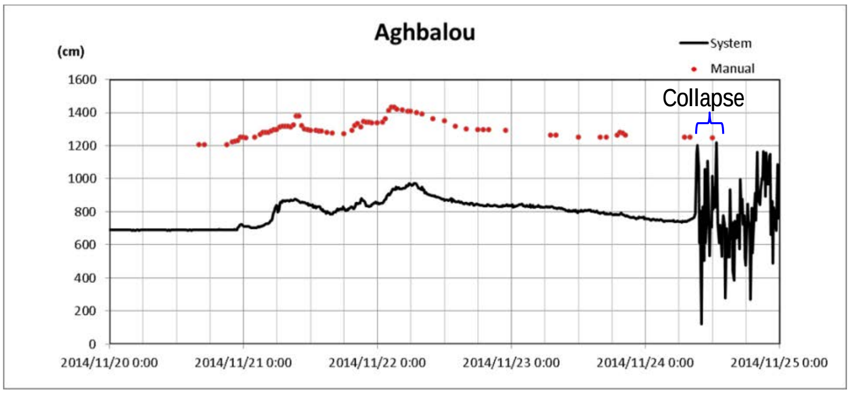


Figure 2.1.1 Hydrograph at Aghbalou Station (November 20 to 24, 2014)

Photo 2.1.1 Photographs taken on November 24, 2014

2.1.3 Scale of Flood

Based on historical rainfall and discharge data collected from ABHT, statistic analyses were conducted to evaluate the scale of the flood in term of return period.

(1) Rainfall

Daily rainfall data of six stations in the Ourika River Basin of past 18 years from 1997/98 to 2014/15 (hydrological year: from September to August) were collected from ABHT. Based on these historical rainfall data, basin mean rainfalls for five durations, 1, 2, 3, 4 and 5 days were estimated by two methods (arithmetic average and Tiessen methods). Then, statistic analyses using several probability distribution models were conducted to estimate return periods of the basin mean rainfalls of the five different durations. Results were summarized in Tables 2.1.2 and 2.1.3, and details of the analyses are presented in ANNEX-4.

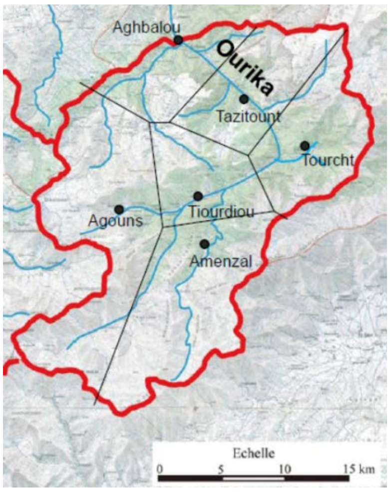


Figure 2.1.2 Location of Stations and Tiessen Division

Observations were made as follows:

- The basin mean rainfalls by the arithmetic average method are all slightly larger than those by the Tiessen method.
- However, the estimated return periods are very similar for both the methods. The return period of 1-day rainfall is about 25 years, those of 2-day and 3-day rainfalls are 30 to 40 years and those of 4-day and 5-day rainfalls are 40 to 50 years respectively.
- Taking it into consideration that the water level gauge was exposed to the flood flow as long as five days from November 20 to 24 until it was collapsed, the flood was of a scale of return period of 40 to 50 years with regard to the collapse of the water level gauge.
- The life time of equipment of flood forecasting and warning system including water level censors is generally 10 to 20 years. Accordingly, the collapsed water level gauge structure was designed and constructed, supposing a flood of return period of 20 years at the maximum. Taking it into account that the November 2014 flood was as large as the scale of once in 40 to 50 years, it is considered that the collapse of the water level gauge of the Aghbalou Station was caused by Force Majeure.

Table 2.1.2 Statistic Analysis (Arithmetic Average)

Rainfall		1-day	2-day	3-day	4-day	5-day
Probability Distribution Model		LogP3	LogP3	LogP3	LogP3	Exp
Standard Least Squares Criterion		0.045	0.037	0.027	0.046	0.075
Probable Rainfall by Return period (mm)	2	31.2	43.5	52.6	58.9	67.9
	3	40.1	55.1	66.0	73.1	86.3
	5	53.0	72.0	85.3	92.6	109.4
	10	75.2	100.8	117.9	123.5	140.9
	20	104.6	138.6	160.4	161.1	172.3
	30	126.1	166.1	191.2	187.0	190.7
	50	159.0	208.0	237.8	224.4	213.9
	80	196.3	255.2	290.1	264.4	235.2
	100	216.7	281.0	318.5	285.5	245.3
November 2015 Rainfall (mm)		113.2	180.1	212.9	215.8	217.1
Estimated Return Period (years)		24	37	39	45	55

LogP3:Log Pearson type Ⅲ distribution
Exp: Exponential distribution

Table 2.1.3 Statistic Analysis (Tiessen)

Rainfall		1-day	2-day	3-day	4-day	5-day
Probability Distribution Model		Exp	LogP3	LogP3	Exp	SqrtEt
Standard Least Squares Criterion		0.048	0.040	0.031	0.048	0.053
Probable Rainfall by Return period (mm)	2	30.7	43.1	52.5	57.5	64.9
	3	41.5	54.4	66.6	73.3	80.2
	5	55.0	70.2	85.5	93.1	98.9
	10	73.3	95.7	114.8	120.0	124.8
	20	91.6	127.4	149.6	146.9	152.1
	30	102.3	149.7	173.1	162.6	168.9
	50	115.8	182.3	206.6	182.5	191.0
	80	128.2	217.6	241.7	200.7	212.3
	100	134.1	236.4	260.0	209.4	222.7
November 2015 Rainfall (mm)		94.9	152.4	178.6	182.8	184.0
Estimated Return Period (years)		23	32	33	50	44

LogP3: log Pearson type Ⅲ distribution
SqrtEt: SQRT-wxponential type maximum distribution

(2) Discharge

Discharge data of the Aghbalou Station of the past 45 years from 1969/70 to 2014/15 (hydrological year: from September to August) were collected from ABHT. Based on these historical discharge data, statistic analysis was conducted as shown in ANNEX-4, and the peak discharge of 424 m^3/s of the November 2014 flood evaluated at a return period of 8 years. ABHT also estimated the flood discharge scale at a return period of 10 years, which is almost same as the result of the Consultant Team.

However, a steep slope river like the Ourika River flows with high current velocity during floods, eroding its river bed with strong tractive force. It could be suggested that the river bed was lower during the peak discharge than ordinary time and the actual peak discharge was larger than 424m^3/s, although the cross section during the flood peak is unknown unfortunately. After all it seems unreasonable to discuss the scale of a flood, focusing on its peak discharges that are calculated based on cross sections surveyed before or after the flood, not during the flood, especially for the steep Ourika River of which cross section must have been dynamically changing during floods.

Figure 2.1.3 compares cross sections before and after the flood at the Aghbalou and Tazzitount Stations. At Tazzitount, which is some 10 km upstream of Aghbalou, the river channel is narrow and straight, and the river bed was only lowered slightly but did not changed horizontally at all. As for Aghbalou, the change of the river bed was more dynamic, and the mainstream was flowing near the left bank while the flood was high as shown in Photo 2.1.1, but moved toward the middle of the wide river channel due to sedimentation as the flood receded.

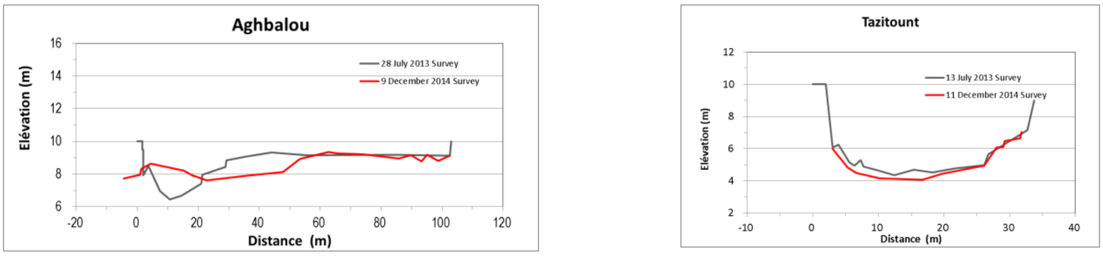


Figure 2.1.3 Comparison of Cross Sections before and after the Flood

2.2 Organizational Set-up for Maintenance of Telemetry System

ABHT is now operating two telemetry systems related to flood early warning in its jurisdiction area, the Tensift River Basin. They are “The Flood Forecasting and Warning System in High Atlas Area” developed under the Japanese grant-aid that is dedicated to only the Ourika and Rheraya Sub-basins, and the Telemetry System by ABHT that covers the other areas except the Ourika and Rheraya Sub-basins in the Tensift River Basin. As shown in Table 2.2.1, there are existing 48 stations/posts in total. In addition, 10 stations, which were equipped with water level/rainfall gauges procured by JICS (Japan International Cooperation System) under a non-project grant-aid project, were recently constructed and are now being telemetered and integrated to the existing ABHT telemetry system. When this telemetering work is completed, ABHT will have as many as 58 stations/posts in total soon. This number seems not small if the present capacity of ABHT in terms of operation and maintenance of the telemetry systems is concerned.

Table 2.2.1 Number of Stations/Posts of ABHT

System	Target Area	Number of Stations/Posts			Remarks
		Hydrological Station	Warning Posts	Total	
Flood Forecasting and Warning System in High Atlas Area	Ourika and Rheraya Sub- basins	16	13	29	Japanese grant-aid
ABHT Telemetry System	Other Areas except Ourika and Rheraya Sub-basins in Tensift River Basin	19 (29)	0	19 (29)	
Total		35 (45)	13	48 (58)	

Note: Number in parenthesis is the number of stations/posts after the completion of the present telemetering work for the JICS equipment.

The operation and maintenance of the telemetry systems is one of the tasks of the Service (group) of Follow-up and Evaluation of Water Resources that is under the Division of Evaluation and Planning of Water Resources. There are four staff in the Service. However, only one technician alone is actually in charge of the operation and maintenance, although the other three staff sometimes help him. Therefore, the operation and maintenance works are likely to be delayed in spite of his devoted efforts. The present staff of the service is definitely insufficient. According to the Minutes of Meetings dated January 28, 2012 on the grant aid project between DRPE and JICA, an engineer on telecommunication or information technology who can diagnose problems of equipment was agreed to be recruited, but the agreement has not been realized yet.

To supplement the insufficient staff, the maintenance work has been outsourced to a local company, SOHIME. SOHIME has been long participating in the development and maintenance of the telemetry systems including the on-going telemetering work since SOHIME was employed in the installation work for the pilot project under the JICA master plan study. This outsourcing system has been basically working, and the equipment have been being barely maintained. However, it seems necessary to enhance the capacity of ABHT as the owner of the telemetry systems. In addition to flood forecasting and early warning, capacity for initial diagnosis on problems of the equipment should be enhanced/possessed by ABHT to more rapidly respond to the problems. In this context employment of at least an engineer on telecommunication or information technology is recommended.

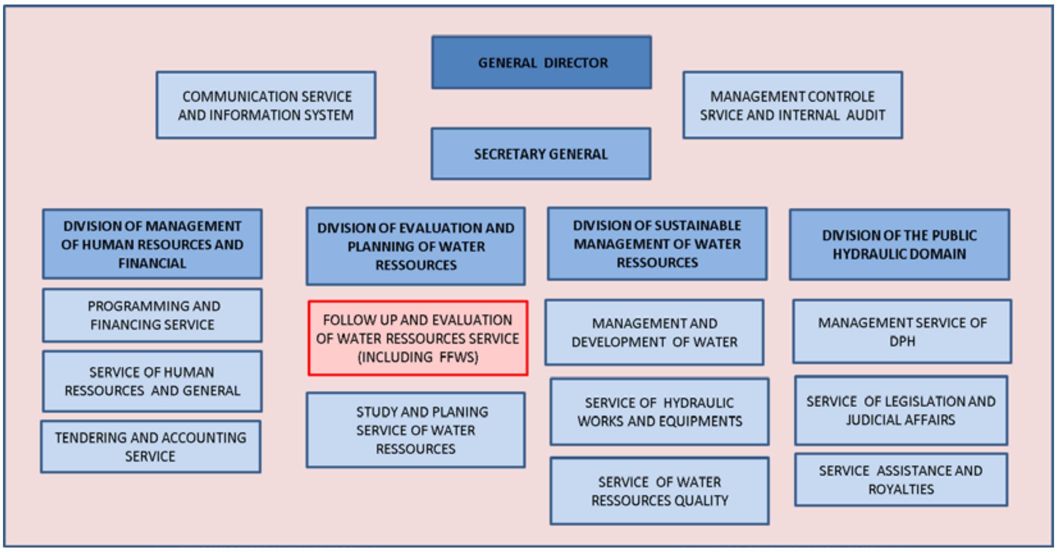


Figure 2.2.1 Organization Chart of ABHT

2.3 Contents of the Follow-up Cooperation

2.3.1 Selection of Reconstruction Site

As a prerequisite for the Follow-Up Cooperation, it is necessary to secure a land for the restoration of the water level gauge as soon as possible in order to restore it by the summer tourist season that will start after Ramadan ends on July 18. It is of course that the restored water level gauge should be safe and strong against floods. Regarding the data transmission method from the gauge to the station, wiring is preferred to radio because the radio method needs more equipment and costly.

The Consultant (CTII) conducted a preliminary survey in March 2015 and found four candidate sites near the Aghbalou Station. Table 2.3.1 compares the four sites. The Consultant proposed the site of old and abandoned water level gauge just behind the destroyed gauge as the most appropriate site (refer to Photos 2.3.1 and 2.3.2). The old gauge have been broken and left unused for more than 10 years. Since this site needs no land acquisition, construction work could be commenced immediately. Behind the abandoned water level gauge there appears rock, which could support the concrete foundation/substructure of the new gauge to make it durable against even a 100-year flood.

The abandoned structure would be dismantled and removed, and the new foundation/substructure would be constructed at the same site. The Consultant proposed this plan to ABHT, and then it was approved as final plan. Cable wiring is also possible by following the same route as the destroyed one.

As seen in Photos 2.3.1 and 2.3.2, the site is far from the main stream and there is no water at ordinary time. Therefore, it is necessary to guide river water to the water level gauge by excavating the river bed. This river excavation work is supposed to be implemented by the Moroccan side in accordance with the S/W (Scope of Work) dated April 7, 2015 and the Minutes of Meetings on the Inception Report dated May 12, 2015.

Draft drawings of the new foundation/substructure and the new supporting structure of the water level gauge (pole and arm) are presented in Figures 2.3.1 and 2.3.2.

Table 2.3.1 Comparison Result of Proposed Sites for Restoration Water Level Gauge

Site Condition	Site1: Abandoned water level gauge		Site2: Left abutment of suspension bridge		Site3: Upper left bank		Site4: Right bank (opposite shore)	
	Condition	Evaluation	Condition	Evaluation	Condition	Evaluation	Condition	Evaluation
Topography	River bank and river bed	Good	River bank and river bed	Good	River bank and river bed	Good	sand and gravel	Good○
Geology	sand and gravel	Good	sand and gravel	Good	soil	Fair	5m	Good
Distance from river flow	3m from small stream but 20m form main stream	Fair	40m	Bad	5m	good	private land	Bad
Land/Facility owner	ABHT	Very good	Local Association	Good	private land	Bad	Radio 150m	Bad
Data transmission	wired 100m	Good	Wired 300m	Fair	Wired 250m	Fair	Necessary	Bad
House	unnecessary	Good	unnecessary	Good	unnecessary	Good	New construction	Good
Substructure/ Foundation	Removal of old gauge and construction of new one	Fair	Strengthening of existing abutment	Fair	New construction	Good	Ultrasonic water level gauge, supporting structure (pole and arm), power equipment, radio transmitter and receiver	Bad
Equipment	Ultrasonic water level gauge, supporting structure (pole and arm) and short wiring	Good	Ultrasonic water level gauge, supporting structure (pole and arm) and short wiring	Good	Ultrasonic water level gauge, supporting structure (pole and arm) and short wiring	Good	Need of land expropriation and complicated equipment	Bad
General Evaluation	Easier construction and installation	Good	Far from river flow, no space for installation	Fair	Need of land expropriation and long wiring	Bad	Steep river bank	Fair
Remarks	• No land expropriation is necessary. • To measure the water level of the main stream, river bed has to be excavated. • The rock behind the abandoned gauge is useful to support the concrete foundation/substructure of the new water level gauge..		• During the strengthening work, the bridge will be impassable. • Careful structural designing is necessary for use of the existing abutment.		-		• Very costly due to the complicated equipment configuration and necessity of a hut for the equipment.	

Photo 2.3.1 Location of Reconstruction Site

Photo 2.3.2 Abandoned Water Level Gauge

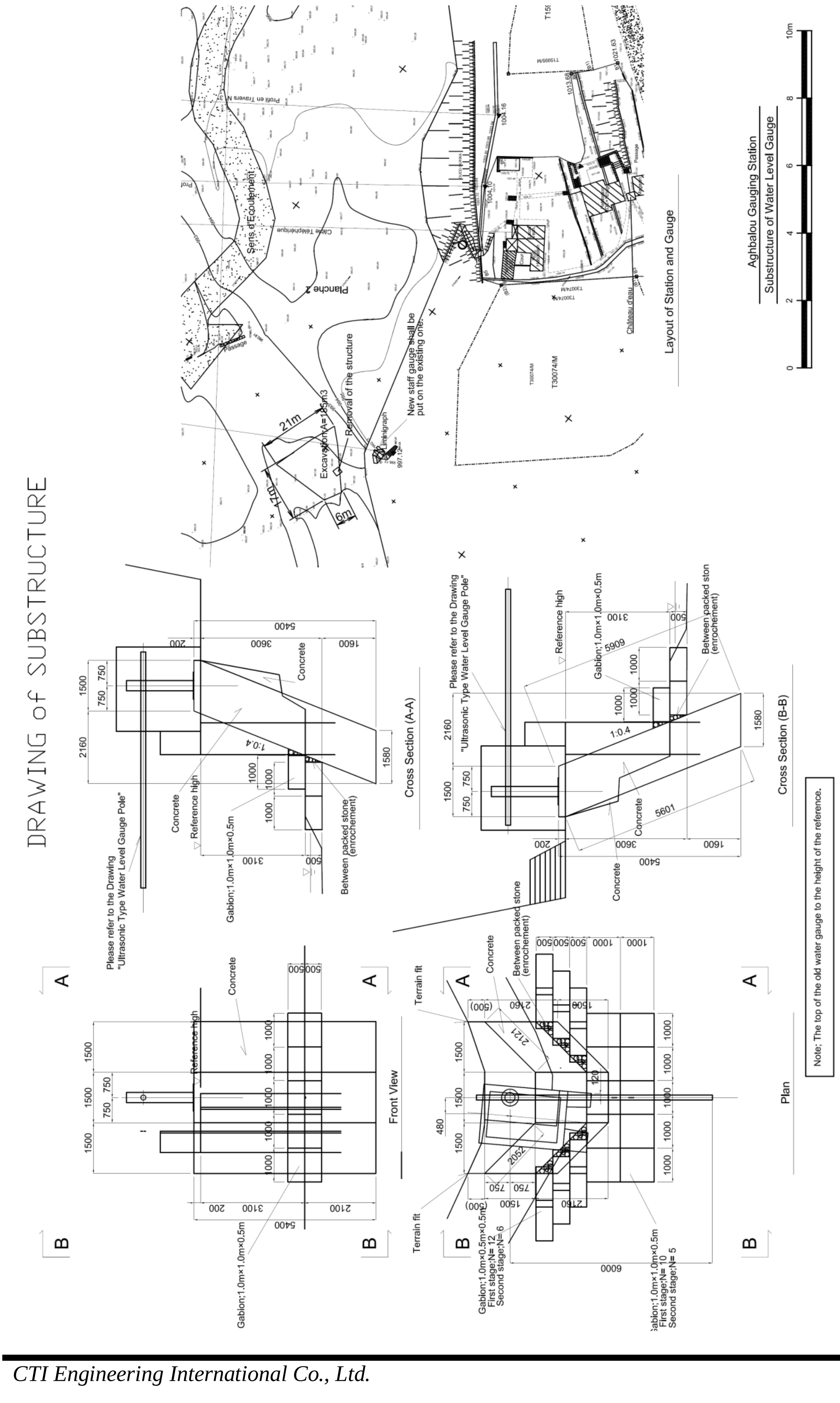


Figure 2.3.1 Design of foundation/substructure

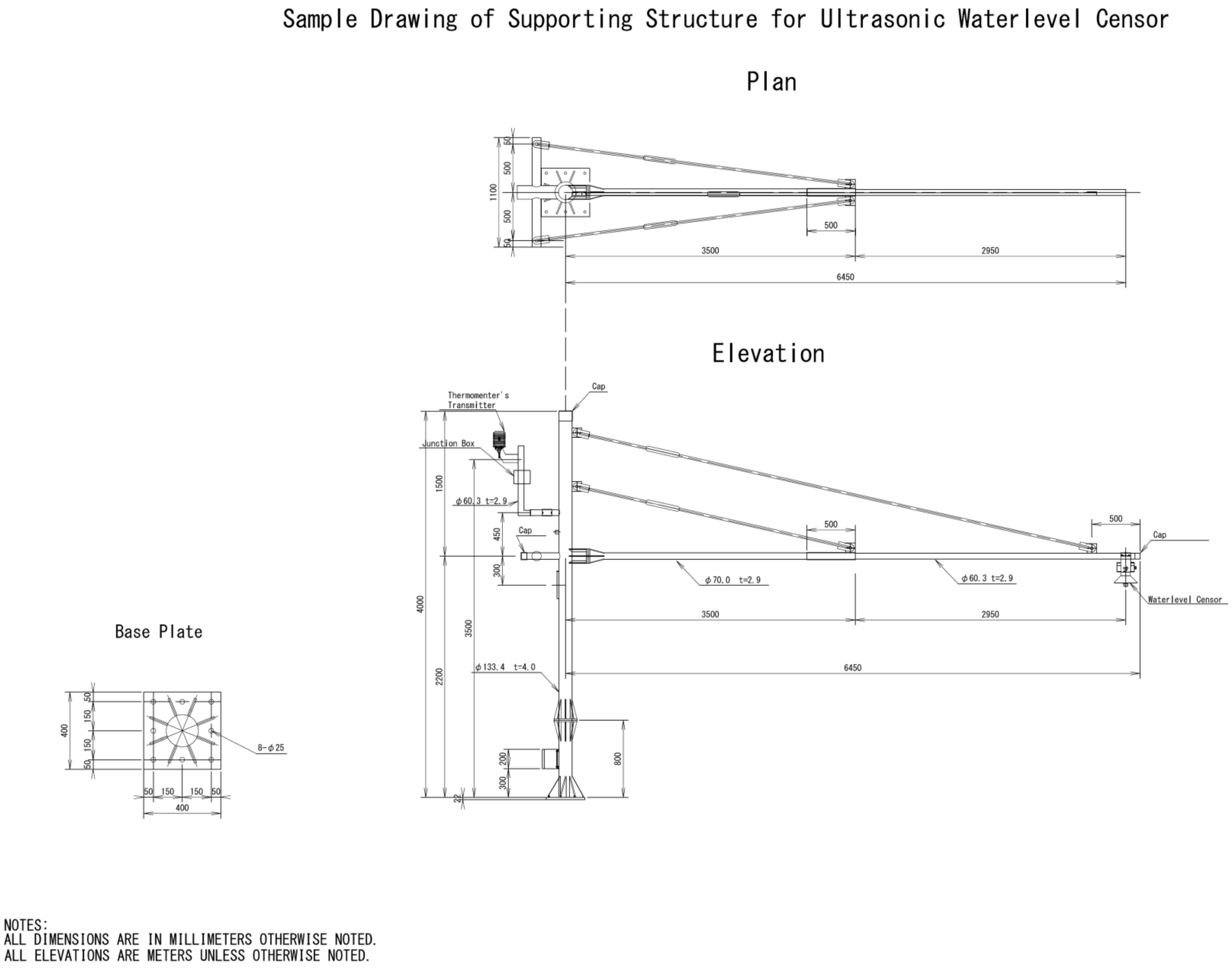


Figure 2.3.2 Design of supporting structure (pole and arm)

2.3.2 Selection of Equipment for Replacement and Repair/Adjustment

Interface among equipment is very important in such a telemetry system as the flood forecasting and warning system established under the Japanese grant-aid project. Since the water level gauge equipment has to be consistent with the existing telemetry system, the same model equipment should be procured and installed in the follow-up cooperation to avoid the risk of mismatching between the newly procured water level gauge equipment and the existing telemetry system.

The configuration of the existing equipment at the Aghbalou Station is shown in Figure 2.3.3. The water level gauge is mainly composed of a transducer with a thermometer transmitter (TS-200) and its main unit (US-500). According to the preliminary survey by the Consultant in March 2015, the transducer and connection cable between the transducer and the main unit were totally damaged by the flood.

It is necessary to newly procure the same transducer and cable for the restoration. Regarding the main unit that might have been damaged, the Consultant got approval from DRPE and took it to Japan for checking and adjustment in March 2015. The main unit would be brought back to Morocco after the repair/adjustment in Japan and installed again where it was before, in the follow-up cooperation.

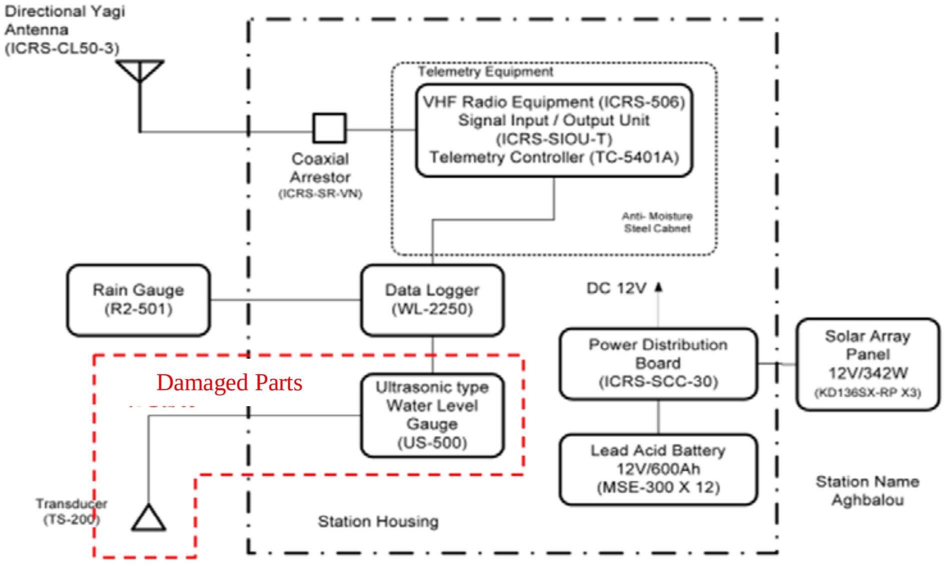


Figure 2.3.3 Component of Existing Equipment in Aghbalou Station

2.4 Undertakings of Moroccan Side

As confirmed in the Minutes of Meetings on the Inception Report dated May 12, 2015, undertakings of the Moroccan side for the implementation of the follow-up cooperation are as follows:

- To secure land for reconstruction of the water level gauge structure
- To make necessary arrangement of tax exemption and custom clearance for imported equipment from Japan.
- To conduct river bed excavation to guide river water to the restored water level gauge.

In case that Morocco side does not implement river bed excavation, it is impossible to observe continuous water level. Therefore, it is necessary to guide river water to the new gauge by excavating the river bed in order to enable continuous water level measurement even at ordinary time. Moreover, after completion of river bed excavation, Morocco side is required to conduct river cross section survey again for the excavated river bed. Then the water level - discharge conversion table and the pre-alert and alert water levels were recalculated again based on the new cross section.

2.5 Cost Estimate

Construction cost, Equipment cost, Transportation cost and Installation cost were estimated for the implementation of the follow-up cooperation. Summary of cost estimation and its detailed breakdown are presented in Tables 2.5.1 and 2.5.2.

Table 2.5.1 Summary of Cost Estimation

<table>
<tr><td colspan="2">The Kingdom of Morocco</td><td>Follow-Up Cooperation for the Project for Flood Forecasting and Warning System in High Atlas Area</td></tr>
<tr><td colspan="2">Consultant</td><td>CTI Engineering International Co., LTD.</td></tr>
<tr><td colspan="2">Item</td><td>Process and Result</td></tr>
<tr><td colspan="2">Basic Design</td><td>1) Reconstruction site: The old abandoned water level gauge
2) Foundation/Substructure: Non-reinforced concrete, Gabion
3) Supporting structure of water level gauge: A pole and an arm
4) Equipment : The same transducer and cable as the grant-aid project are newly purchased and the main unit is repaired and adjusted in Japan.</td></tr>
<tr><td colspan="2">Plan for Construction, Schedule and Procurement</td><td>1) Construction plan
In order to ensure the smooth and timely implementation, Moroccan side is required to secure the land immediately and to secure tax exemption for equipment and prompt customs clearance. The Consultant has to confirm occasionally their progresses.
2) Schedule plan
The Follow-Up Cooperation aims to complete the restoration of the water level gauge by the end of Ramadan (middle of July) when many tourists begin to visit the Ourika Valley. The construction schedule was planned from beginning of May to middle of July for the reasons described above.
3) Procurement plan
Interface between equipment is very important in such a telemetry system as the flood forecasting and warning system established under the Japanese grant-aid project. Since the water level gauge equipment have to be consistent with the existing telemetry system, the same model equipment are procured and installed in the follow-up cooperation to avoid the risk of mismatching between the water level gauge equipment and the existing telemetry system.</td></tr>
<tr><td rowspan="2">Outline of Cost Estimation</td><td>Basic Policy</td><td>1) Targets for cost estimation
- Construction cost
- Equipment cost
- Transportation cost
- Installation cost
2) Currency: MAD (Morocco dirham), Japanese Yen(JPY100-=MAD12.256)
3) Point in time for cost estimation: May 2015</td></tr>
<tr><td>Contents</td><td><u>Cost of Construction and Procurement</u>
1) Construction cost (construction of foundation/substructure of water level gauge, manufacturing and installation of water level gauge)
The construction work is subcontracted to a local construction company. After decision of work item and design drawings (Figures 2.3.1and 2.3.2), quotations were collected from three local construction companies, and then the lowest price was determined as the construction cost.
2) Equipment cost (water level gauge and its accessaries and installation materials)
The same model equipment as the Japanese grant-aid project are procured as described in procurement plan. The water level gauge is mainly composed of a transducer with a thermometer transmitter (TS-200) and its main unit (US-500). The transducer, composite 6-conductor cable and installation materials, etc. are purchased in Japan. The existing main unit is repaired and adjusted in Japan. The quotation was collected from the same supplier as the grant-aid project.
3) Transportation cost (airfreight)
The transportation of the procured equipment is outsourced to an air courier company to ensure rapid transportation. A quotation was collected from an international courier company.
4) Installation cost
The installation of the equipment is made by local technicians and laborers hired by the Consultant. The installation cost was estimated by assuming 11 persondays of technicians and 10 persondays of laborers. The unit costs are determined to be those of similar past projects.</td></tr>
<tr><td colspan="2">Total Cost</td><td>JPY 8,264,000- (round down to the JPY1,000-)</td></tr>
<tr><td colspan="2">Remarks</td><td></td></tr>
</table>

Table 2.5.2 Detailed Statement

Items	Detail	Specification	Unit	Quantity	MAD (1MAD=JPY12.256)		US$ (1$=JPY118.96)		Japanese Yen		Total Cost (JPY)
					Unit price	Cost	Unit price	Cost	Unit price	Cost	
Total Construction Cost (A+B) (Aghbalou Station)						439,900		0		2,872,938	8,264,352
A. Cost of Construction Work						398,400		0		0	4,882,790
Construction											
	Preparation of Access Road for Heavy Construction Machines	300m	lot	1	24,000	24,000	0.00	0.00	0	0	294,144
	Demolition and Removal of the substructure with a supporting post and arm of water level gauge destroyed during the flood in November 2014.		lot	1	72,000	72,000	0.00	0.00	0	0	882,432
	Demolition and Removal of the old structure and hut for water level gauging		lot	1	24,000	24,000	0.00	0.00	0	0	294,144
	Demolition and Removal of the two destroyed steel poles for overhead wiring		lot	2	3,600	7,200	0.00	0.00	0	0	88,243
	Construction of a foundation/substructure of water level gauge at the old structure.		lot	1	108,000	108,000	0.00	0.00	0	0	1,323,648
	Construction of two steel poles for overhead wiring at the same places as No. 4.	Height = 3 and 5m	lot	2	21,600	43,200	0.00	0.00	0	0	529,459
	Manufacturing of a supporting structure (pole and arm) of water level gauge.		lot	1	96,000	96,000	0.00	0.00	0	0	1,176,576
	Installation of the supporting structure (pole and arm) on the foundation/substructure.		lot	1	12,000	12,000	0.00	0.00	0	0	147,072
	Manufacturing and installation of staff gauge on the slope of the concrete foundation/substructure and the gabions. (maximum length: 5m)	W=20cm, L=4.5m	lot	1	12,000	12,000	0.00	0.00	0	0	147,072
B. Cost of Procurement and Installation of Equipment						41,500		0.00		2,872,938	3,381,562
Equipment											
	Repair and adjustment of Main Body of Water Level Gauge	US-500	Set	1	0	0	0.00	0.00	330,000	330,000	330,000
	Purchase of transducer	TS-200	Set	1					500,000	500,000	500,000
	Purchase of thermometer transmitter	ST-51	Set	1					222,000	222,000	222,000
	Purchase of connecting terminal box	JS-10A	Set	1					55,000	55,000	55,000
	Purchase of composite 6-conductor cable	120m	Set	1					293,000	293,000	293,000
	Purchase of installation materials		lot	1					150,000	150,000	150,000
	Expense for preparation of inspection at factory		lot	1					50,000	50,000	50,000
	Expense for procurement management		lot	1					500,000	500,000	500,000
Transportation											
	airfreight	250kg	Set	1	0	0	0.00	0.00	772,938	772,938	772,938
Installation											
	Installation work	Local technician	personday	11	3,500	38,500	0.00	0.00	0	0	471,856
	Installation work	Local laborer	personday	10	300	3,000	0.00	0.00	0	0	36,768

CHAPTER 3 IMPLEMENTATION OF THE FOLLOW-UP COOPERATION

3.1 Civil Work

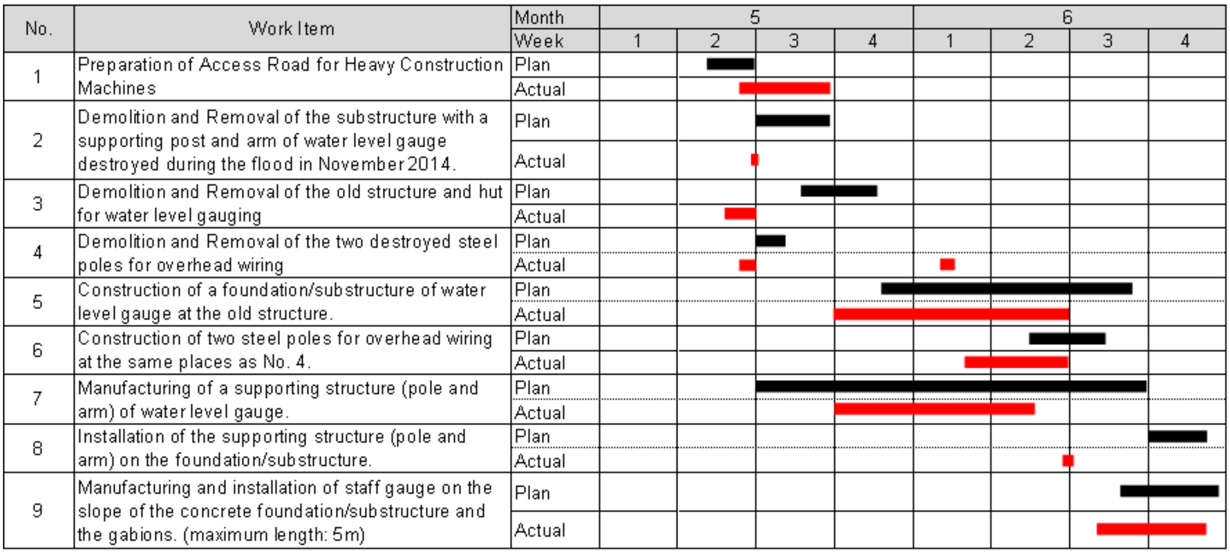
The civil work mainly consisting of construction of a concrete foundation/substructure, and manufacture and installation of a supporting structure of the new water level gauge was implemented by a local subcontractor under the supervision of the Consultant. The outline of the subcontract is presented as follows:

Table 3.1.1 Outline of Subcontract

Item	Contents
Contractor	Sté TIGUIRNA sarl
Contact person of Contractor	Mr. Youssef BEN BOURCH Tel. (+212)-661-44-55-21 Email: tiguirna@hotmail.fr Address: Ksar tiguirna BP 56 Alnif TINGHIR, Morocco
Selection Method	Estimate Competition by Nominated Tenderers
Contract Amount	MAD398,400 （JPY 4,882,000）
Contents of Contract	● Removal of the water level gauge structure and poles foe wiring collapsed during the 2014 Flood. ● Removal of the abandoned water level gauge structure ● Construction of a concrete foundation/substructure ● Manufacture and installation of a supporting structure for the new gauge.
Date of Contract	May 8, 2015
Date of Commencement	May 11, 2015
Date of Final Inspection	June 30, 2015
Date of Completion	June 30, 2015

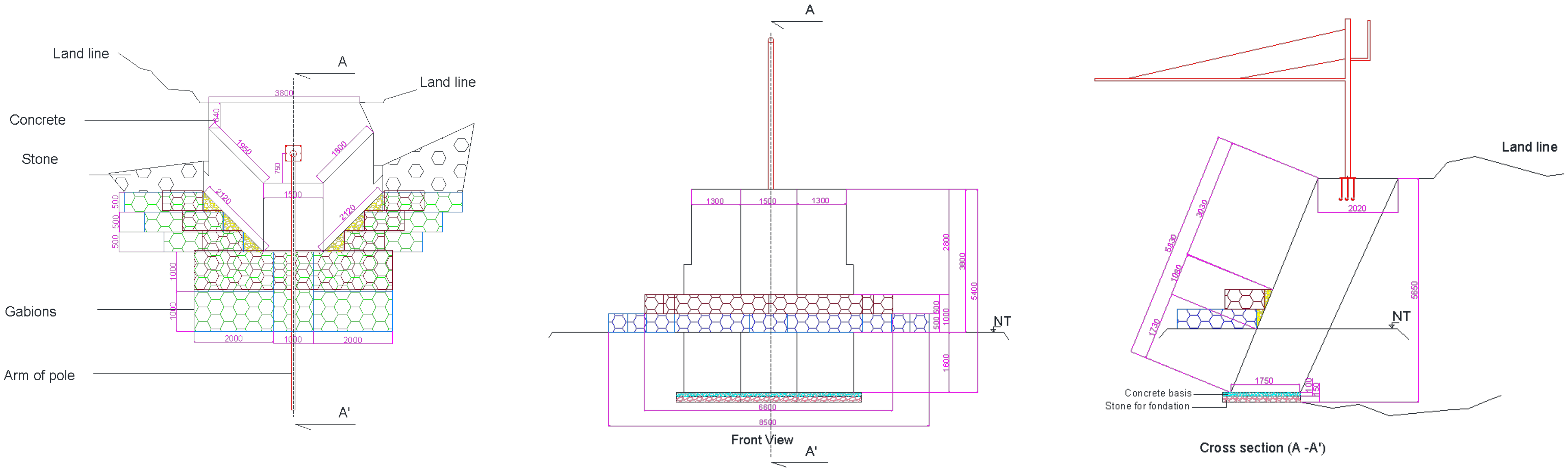
The work was commenced in the middle of May and completed at the end of June as shown in Figure 3.1.1. The inspection on the civil work was conducted with the presence of ABHT staff on June 30. The reconstructed structures were satisfactorily accepted by ABHT.

Photographs of the civil work are presented in the front pages of this report. As-built drawings also presented in Figures 3.1.2 and 3.1.3.



No.	Work Item	Month	5				6			
		Week	1	2	3	4	1	2	3	4
1	Preparation of Access Road for Heavy Construction Machines	Plan		■						
		Actual		🟥	🟥					
2	Demolition and Removal of the substructure with a supporting post and arm of water level gauge destroyed during the flood in November 2014.	Plan			■					
		Actual		🟥						
3	Demolition and Removal of the old structure and hut for water level gauging	Plan			■	■				
		Actual		🟥						
4	Demolition and Removal of the two destroyed steel poles for overhead wiring	Plan			■					
		Actual		🟥			🟥			
5	Construction of a foundation/substructure of water level gauge at the old structure.	Plan				■	■	■	■	
		Actual				🟥	🟥	🟥		
6	Construction of two steel poles for overhead wiring at the same places as No. 4.	Plan						■	■	
		Actual					🟥	🟥		
7	Manufacturing of a supporting structure (pole and arm) of water level gauge.	Plan			■	■	■	■	■	
		Actual				🟥	🟥	🟥		
8	Installation of the supporting structure (pole and arm) on the foundation/substructure.	Plan								■
		Actual						🟥		
9	Manufacturing and installation of staff gauge on the slope of the concrete foundation/substructure and the gabions. (maximum length: 5m)	Plan							■	■
		Actual							🟥	🟥

Figure 3.1.1 Implementation Schedule of Civil Work



a) Cubic Diagram

b) Front View

c) Cross Section

Figure 3.1.2 As-built Drawing of Foundation/Sub-structure

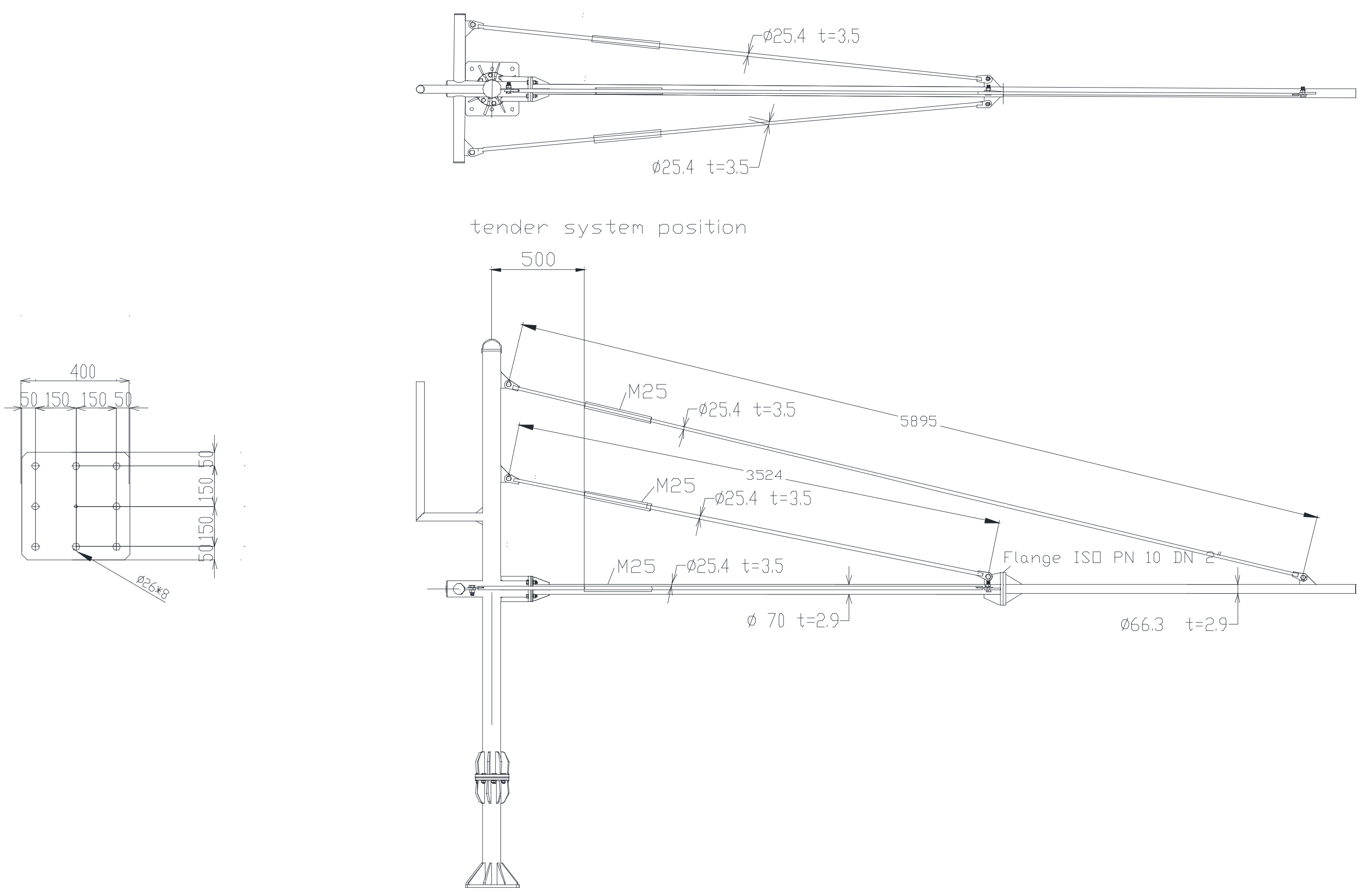


Figure 3.1.3 **As-built Drawing of Supporting Structure (Pole and Arm)**

3.2 Procurement and Installation of Equipment

3.2.1 Procurement of Equipment

In accordance with the selection of equipment in Subsection 2.3.2, equipment in Table 3.2.1 were procured from the same supplier as the grant-aid project. Prior to the shipment of the equipment, the transducer was once connected to the repaired and adjusted main unit at the supplier's factory to check the measurement accuracy and the consistency between the transducer and the main unit. Immediately after passing the factory test, the equipment was shipped by air in the middle of June.

Table 3.2.1 Procured Equipment

Item	Model type	Quantity	Remarks
Main Unit of Water Level Gauge	US-500	1 pc	Repaired and adjusted
Transducer	TS-200	1 pc	Newly purchased
Thermometer transmitter	ST-51	1 pc	Newly purchased
Connecting terminal box	JS-10A	1 pc	Newly purchased
Specialized 6-conductor cable	-	120 m	Newly purchased
Installation Materials			
・ Messenger wire	-	150 m	Newly purchased
・ Grip	-	15 pcs	Newly purchased
・ Thimble	-	15 pcs	Newly purchased
・ Band (φ139mm)	-	10 pcs	Newly purchased
・ Cable Clamper (for 120 ~	-	1 lot	Newly purchased
・ PVC pipe (φ40mm)	-	5 m	Newly purchased
・ Stainless Band	-	5 pc	Newly purchased
・ Turn Buckle	-	10 pcs	Newly purchased

Table 3.2.2 Outline of Procurement Contract

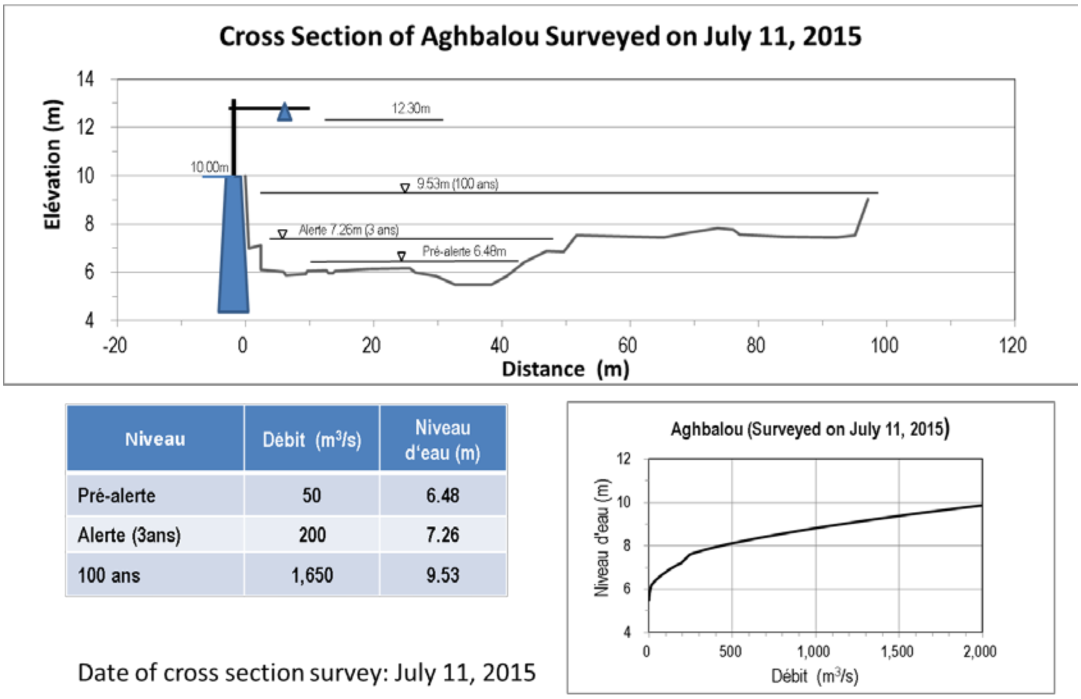
Item	Contents
Supplier	Marubeni Protechs Corporation
Contact person of Supplier	Mr. Daisuke WATANABE Tel. (+81) 3 5261 1666, Fax (+81) 3 5261 2040 Email: watanabe-d@mpc.marubeni.co.jp Address: Iidabashi Masumoto Building, 1-21 Agebacho, Shinjuku-ku, Tokyo 162-0824
Selection Method	Direct Appointment
Contents of Contract	● Procurement of equipment in Table 3.2.1 ● Preparation of inspection at factory
Contract AmountJPY	JPY 2,100,000
Date of Contract	May 1, 2015
Date of inspection at factory	June 15, 2015
Date of delivery	June 17, 2015
Manufacturer of water level gauge	Sonic Corporation
Contact person of Manufacturer	Dr. Yoshiki ITO TEL: (+81) 42 568 3206, FAX: (+81) 42 568 3305 Email: yoshiki-ito@u-sonic.co.jp Address: 1-18-2 Akebono-cho Tachikawa-shi Tokyo,JAPAN 190-0012

3.2.2 Installation

Thanks to appropriate and prompt arrangements by DRPE and ABHT, the equipment cleared the custom and were transported to ABHT in Marrakech on July 7. Immediately, the installation work of the equipment was commenced by local technicians hired by the Consultant. The installation work was made very smoothly and completed on July 11. Transmission of water level data from the Aghbalou Station to the Flood Forecasting Center in ABHT through the telemetry system was also resumed at the same time. Photographs of the installation work are presented in the front pages of this report.

River cross section survey was conducted across the cross section line on the restored water level on July 11. Based on the survey result, the water level - discharge conversion table and the pre-alert and alert water levels were recalculated as shown in Figure 3.2.1. These values were also reset in the system server in ABHT on July 13. However, this reset is provisional. Since ABHT is supposed to implement river bed excavation as explained in Subsection 2.3.1, ABHT is required to conduct river cross section survey again for the excavated river bed. Then the water level - discharge conversion table and the pre-alert and alert water levels were recalculated again based on the new cross section.

The final inspection on the installation work was conducted at the Aghbalou Station and the Flood Forecasting Center in ABHT with the presence of ABHT staff on July 15. The installation work was accepted by ABHT, and finally the restored water level gauge was successfully delivered to ABHT on July 15 upon signing of the Minutes of Meetings agreed between ABHT and the Consultant Team as presented in ANNEX-3.



Niveau	Débit (m³/s)	Niveau d'eau (m)
Pré-alerte	50	6.48
Alerte (3ans)	200	7.26
100 ans	1,650	9.53

Date of cross section survey: July 11, 2015

Figure 3.2.1 Cross Section, Pre-alert and Alert Levels and Water Level-Discharge Rating Curve

CHAPTER 4 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The follow-up cooperation was implemented to confirm damage conditions of the water level gauge and to provide necessary procurement, construction and installation for its restoration in accordance with the Scope of Work agreed on April 7, 2015 between Japan International Cooperation Agency (JICA) and the Government of the Kingdom of Morocco.

Thanks to appropriate and prompt arrangements by DRPE and ABHT especially for the tax exemption and the custom clearance, the follow-up cooperation was implemented very smoothly. The water level gauge at the Aghbalou Station was successfully restored, and accordingly data transmission was also resumed. The restored water level gauge was delivered to ABHT on July 15, 2015.

4.2 Recommendations

- ABHT is required to well maintain the restored water level gauge to ensure sustainable operation of the flood forecasting system. It is recommended that ABHT employ an engineer on telecommunication or information technology to enhance the capacity for the maintenance of the telemetry equipment so as to diagnose and respond rapidly to problems of the system and equipment.
- ABHT should conduct riverbed excavation for guiding water from the main stream of the Ourika River to the restored water level gauge as soon as possible. In addition, ABHT will conduct river cross-section survey for the excavated river bed and modify, based on the survey result, the pre-alert and alert levels, the water level-discharge conversion table and the cross section coordinates that have been tentatively set in the server by the Consultant Team.

ANNEX

ANNEX-1

SCOPE OF WORK
FOR THE FOLLOW-UP COOPERATION
ON
THE PROJECT FOR FLOOD FORECASTING AND WARNING SYSTEM
IN HIGH ATLAS AREA
AGREED BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
THE GOVERNMENT OF THE KINGDOM OF MOROCCO

In response to a request from the Government of the Kingdome of Morocco (hereinafter referred to as "Morocco"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to conduct follow-up cooperation for the Project for Flood Forecasting and Warning System in High Atlas Area.

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

Rabat, 07 April, 2015

Koichi SHOJI
Chief Representative
JICA Morocco Office

Maroc

Abdelmajid NAIMI
Director
ABHT

Le Directeur de L'Agence
du Bassin Hydraulique du Tensift
NAIMI Abdelmajid

Mr. Abdeslam Ziad
Director
Water Research and Planning
Ministry of Energy, Mines, Water and Environment

Directeur de la Recherche
et de la Planification de l'Eau
Signé : Abdeslam ZIYAD

1. Introduction

A water-level gage station in Aghbalou, which was installed under the Project for Flood Forecasting and Warning System in High Atlas Area, was collapsed as a result of large-scale flood in November 2014. In response to the request of the Government of the Kingdome of Morocco, JICA decided to implement the Follow-up Cooperation on the Project for Flood Forecasting and Warning System in High Atlas Area (hereinafter referred to as "the Work").

Accordingly, JICA will undertake the Work in cooperation with the authorities concerned. This document sets forth the Scope of Work for the Work and the undertakings to be taken by the authorities concerned.

2. Scope of Work

The Work shall be to replace the damaged Aghbalou water-level gage station except river channel improvement.

3. Tentative Work Schedule

The Project will be carried out in accordance with the tentative schedule indicated in Annex 1.

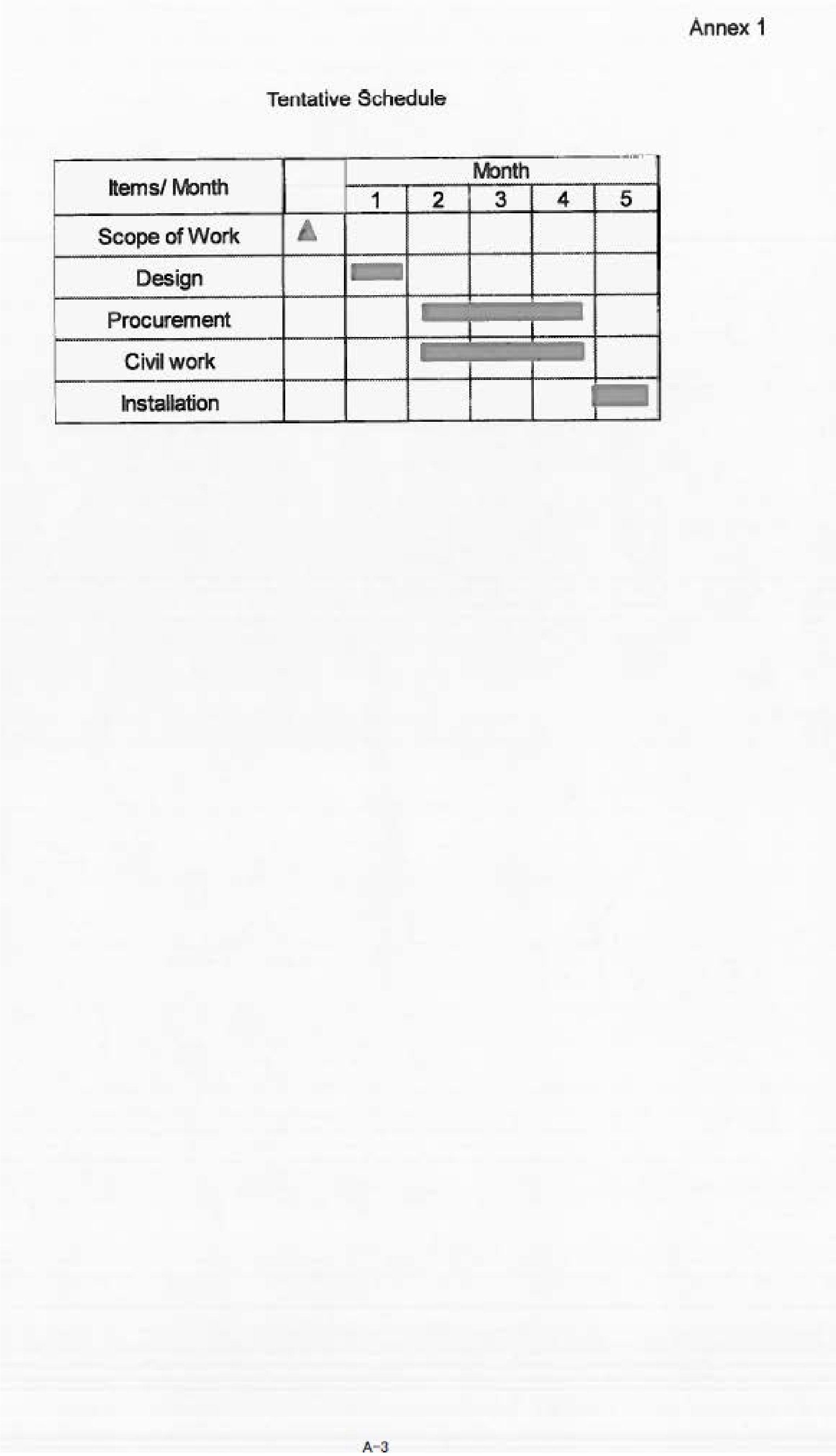
4. Major Undertakings to be taken by the Government of Morocco and JICA

Both parties confirmed that, for the smooth implementation of the Project, Government of Morocco and JICA should particularly implement major undertakings described in Annex 2 as scheduled and secure the necessary budget.

5. Mutual Consultation

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

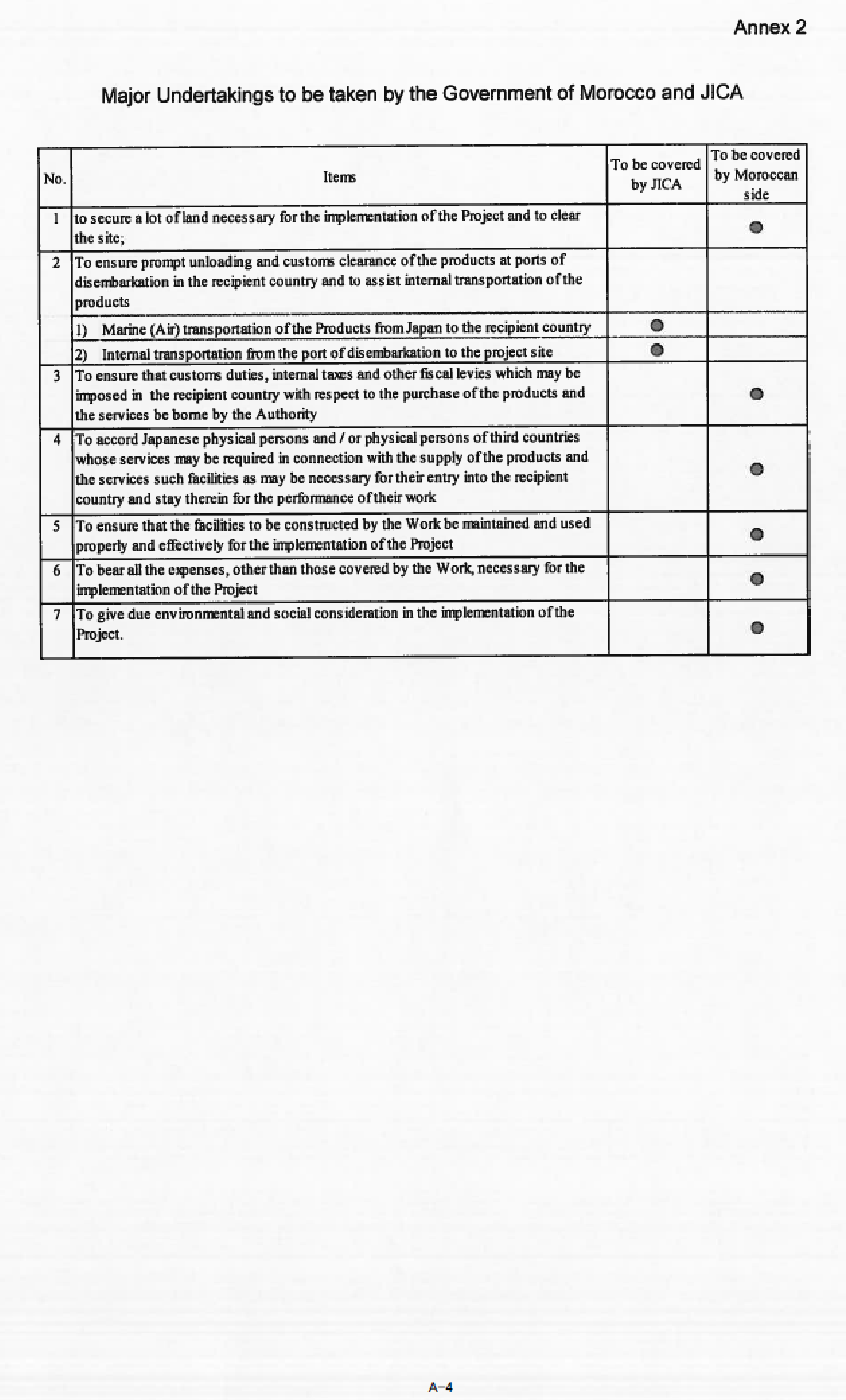
Annex 1: Tentative schedule
Annex 2: Major Undertakings to be taken by the Government of Morocco and JICA



Annex 1

Tentative Schedule

Items/ Month		Month				
		1	2	3	4	5
Scope of Work	▲					
Design		▬				
Procurement			▬	▬	▬	
Civil work			▬	▬	▬	
Installation						▬



Annex 2

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

No.	Items	To be covered by JICA	To be covered by Moroccan side
1	to secure a lot of land necessary for the implementation of the Project and to clear the site;		●
2	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Internal transportation from the port of disembarkation to the project site	●	
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be borne by the Authority		●
4	To accord Japanese physical persons and / or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
5	To ensure that the facilities to be constructed by the Work be maintained and used properly and effectively for the implementation of the Project		●
6	To bear all the expenses, other than those covered by the Work, necessary for the implementation of the Project		●
7	To give due environmental and social consideration in the implementation of the Project.		●

ANNEX-2

MINUTES OF MEETINGS
ON
INCEPTION REPORT
FOR
FOLLOW-UP COOPERATION
ON
ATLAS AREA

AGREED BETWEEN

MINISTRY DELEGATE IN CHARGE OF WATER TO THE MINISTER OF ENERGY, MINES, WATER AND ENVIRONMENT

AND

CONSULTANT TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

Marrakech, 11 May 2015

Abdelmajid NAIMI
Director
Tensift River Basin Agency (ABHT)

Le Directeur de L'Agence
du Bassin [illegible] du Tensift
NAIMI Abdelmajid

Masami KATAYAMA
Leader
JICA Consultant Team

Witnessed
Abdeslam Ziyad
Director
Water Research and Planning
Ministry Delegate in Charge of Water to the Minister of Energy, Mines, Water and Environment

Directeur de la Recherche
et de la Planification de l'Eau
Signé : Abdeslam ZIYAD

Witnessed
P.O Koichi SHOJI
Chief Representative
JICA Morocco Office

1. Introduction

In accordance with the Scope of Work agreed on April 7, 2015 between the Government of the Kingdom of Morocco and Japan International Cooperation Agency (hereinafter referred to as "JICA"), JICA dispatched the Consultant Team headed by Mr. Masami KATAYAMA to Morocco in the beginning of May 2015 to commence the Follow-up Cooperation on the Project for Flood Forecasting and Warning System in High Atlas Area.

A series of meetings were held in Rabat and Marrakech between the Moroccan side represented by Direction of Water Research and Planning (hereinafter referred to as "DRPE") and Tensift River Basin Agency (herein after referred to as "ABHT") and the Consultant Team to discuss the Inception Report.

The Inception Report was generally accepted by the Moroccan side, and results of the discussions are summarized as follows:

2. Discussions

The both sides confirmed followings:

- The Consultant Team will make efforts to complete the restoration of the water level gauge at the Aghbalou Station by the middle of July 2015; and
- The Moroccan side will undertake followings to facilitate the restoration work;
  - Arrangement for securing lands for the reconstruction of the water level gauge;
  - Arrangement for tax exemption on equipment that will be imported from Japan for the restoration work; and
  - Riverbed excavation for guiding water from the main stream of Ourika River to the water level gauge that will be reconstructed under the Follow-up Cooperation.

ANNEX-3

MINUTES OF MEETINGS
ON
FOLLOW-UP COOPERATION
ON
THE PROJECT FOR FLOOD FORECASTING AND WARNING SYSTEM IN HIGH ATLAS AREA
AGREED BETWEEN
MINISTRY DELEGATE IN CHARGE OF WATER TO THE MINISTER OF ENERGY, MINES, WATER AND ENVIRONMENT
AND
CONSULTANT TEAM OF
JAPAN INTERNATIONAL COOPERATION AGENCY

Marrakech, 15 July 2015

Le Directeur de L'Agence
du Bassin Hydraulique du Tensift
NAIMI Abdelmajid

Abdelmajid NAIMI
Director
Tensift River Basin Agency (ABHT)

Masami KATAYAMA
Leader
JICA Consultant Team

Directeur de la Recherche
et de la Planification de l'Eau
Signé : Abdeslam ZIYAD

Witnessed
Abdeslam Ziyad
Director
Water Research and Planning
Ministry Delegate in Charge of Water to the Minister of Energy, Mines, Water and Environment

Witnessed
p. o Koichi SHOJI
Chief Representative
JICA Morocco Office

1. Introduction

   In accordance with the Minutes of Meeting agreed on May 11, 2015 between the Tensift River Basin Agency (herein after referred to as "ABHT") and the Consultant Team, the Follow-Up Cooperation has been implemented. Upon the completion of the Follow-up Cooperation the both sides have confirmed followings:

2. Confirmation

   - The water level gauge of the Aghbalou Station has been successfully restored and the data transmission from the station to the Flood Forecasting Center of ABHT has been also normally resumed.as before the destruction of the water level gauge in November 2014.
   - Upon signing of this Minutes of Meetings the restored water level gauge will be delivered to ABHT. ABHT will well maintain the restored water level gauge to ensure sustainable operation of the restored water level gauge.
   - ABHT will proceed to conduct riverbed excavation for guiding water from the main stream of the Ourika River to the restored water level gauge. In addition, ABHT will conduct river cross-section survey for the excavated river bed and modify, based on the survey result, the pre-alert and alert levels, the water level-discharge conversion table and the cross section coordinates that have been tentatively set in the server by the Consultant Team.

ANNEX-4

Hydrological Statistic Analyses

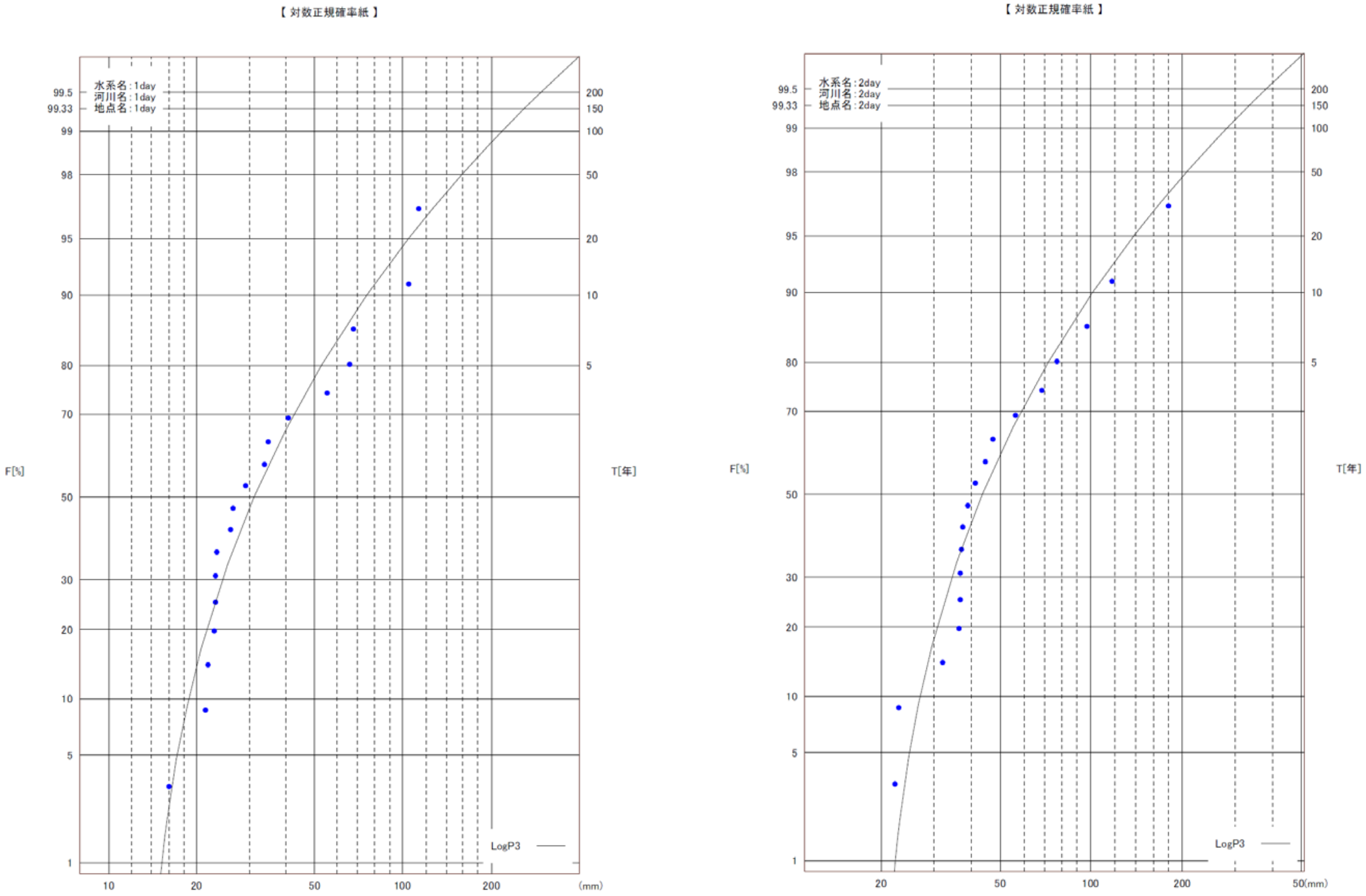
１）Rainfall

Table　Annual Maximum Basin Mean Rainfall at Aghbalou (Arithmetic Average)

year	1- day rain		2- day rain		3- day rain		4- day rain		5- day rain	
	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)
1997/98	28-Mar	55.3	28-Mar	68.6	27-Mar	75.9	26-Mar	76.0	25-Mar	77.1
1998/99	27-Aug	26.1	26-Aug	41.2	26-Feb	57.6	25-Feb	65.0	24-Feb	65.0
1999/00	28-Oct	65.7	27-Oct	76.6	26-Oct	96.1	25-Oct	96.1	24-Oct	96.9
2000/01	26-Dec	16.0	25-Dec	22.4	25-Dec	28.3	24-Dec	28.3	22-Dec	32.5
2001/02	11-Apr	21.8	31-Mar	39.1	31-Mar	53.6	31-Mar	56.2	30-Mar	56.2
2002/03	4-Aug	34.8	3-Aug	36.4	4-Aug	37.4	14-Nov	41.5	13-Nov	41.5
2003/04	16-Nov	23.4	16-Nov	37.2	15-Nov	50.5	14-Nov	50.5	29-Apr	56.8
2004/05	28-Feb	23.1	28-Feb	36.8	28-Feb	43.5	28-Feb	50.7	28-Feb	62.7
2005/06	24-Apr	68.0	24-Apr	96.8	23-Apr	111.5	22-Apr	112.2	21-Apr	112.2
2006/07	28-Oct	105.1	27-Oct	116.8	27-Oct	128.2	25-Oct	132.8	25-Oct	144.2
2007/08	4-Jan	29.1	4-Jan	47.3	3-Jan	64.0	3-Jan	65.2	21-Nov	66.8
2008/09	18-Sep	33.7	22-Jun	37.6	22-Jun	42.7	17-Jan	55.8	17-Jan	63.8
2009/10	17-Feb	26.6	17-Feb	44.5	17-Feb	52.6	17-Feb	58.8	17-Feb	60.6
2010/11	29-Apr	21.3	1-May	32.1	3-Apr	41.1	29-Apr	59.4	28-Apr	60.2
2011/12	23-Mar	22.9	23-Mar	36.8	19-Nov	41.5	20-Nov	53.3	19-Nov	62.7
2012/13	30-Oct	40.7	30-Oct	56.1	29-Oct	58.4	29-Oct	58.8	24-Sep	66.0
2013/14	21-Apr	23.0	21-Apr	23.0	29-Jan	29.6	29-Jan	29.6	29-Jan	29.6
2014/15	21-Nov	113.2	20-Nov	180.1	20-Nov	212.9	20-Nov	215.8	20-Nov	217.1

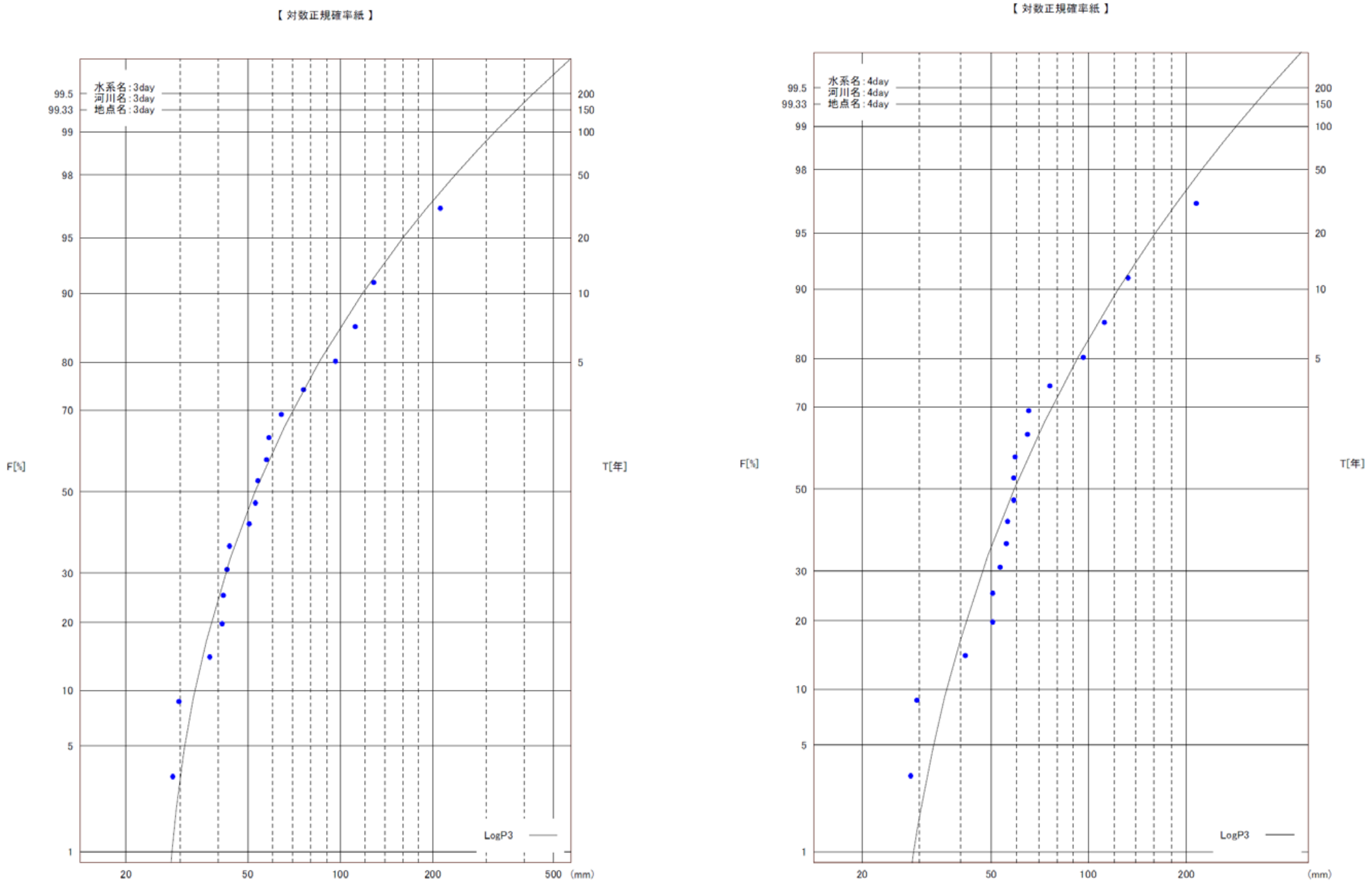
Table　Annual Maximum Basin Mean Rainfall at Aghbalou (Tiessen)

Year	1- day rain		2- day rain		3- day rain		4- day rain		5- day rain	
	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)	Date	(mm)
1997/98	28-Mar	45.9	28-Mar	61.0	27-Mar	66.7	26-Mar	66.8	25-Mar	67.9
1998/99	27-Aug	26.7	26-Aug	45.6	25-Aug	59.2	25-Feb	69.8	24-Feb	69.8
1999/00	28-Oct	60.9	27-Oct	71.9	26-Oct	90.8	25-Oct	90.8	24-Oct	92.1
2000/01	12-Oct	14.0	26-Dec	21.5	25-Dec	26.2	24-Dec	26.3	23-Dec	28.1
2001/02	11-Apr	20.7	31-Mar	38.2	31-Mar	52.8	31-Mar	56.7	30-Mar	56.7
2002/03	4-Aug	29.3	14-Nov	31.3	14-Nov	34.6	14-Nov	43.6	13-Nov	43.6
2003/04	2-May	22.1	16-Nov	39.4	15-Nov	52.4	14-Nov	52.4	29-Apr	57.3
2004/05	29-Oct	24.2	28-Feb	37.4	28-Feb	46.0	28-Feb	53.0	28-Feb	65.8
2005/06	24-Apr	62.6	24-Apr	96.7	23-Apr	108.9	22-Apr	110.2	21-Apr	110.2
2006/07	28-Oct	103.6	28-Oct	116.4	27-Oct	127.3	25-Oct	132.0	25-Oct	144.8
2007/08	21-Nov	25.6	4-Jan	45.2	3-Jan	60.5	2-Jan	61.1	21-Nov	69.1
2008/09	18-Sep	31.5	3-Mar	36.7	2-Mar	39.7	17-Jan	52.9	17-Jan	59.8
2009/10	17-Feb	23.2	17-Feb	38.2	17-Feb	47.7	6-Jan	55.4	6-Jan	60.6
2010/11	29-Apr	23.5	3-Apr	33.7	3-Apr	46.4	29-Apr	62.7	28-Apr	64.2
2011/12	23-Mar	22.3	23-Mar	37.4	23-Mar	41.2	20-Nov	49.8	19-Nov	58.1
2012/13	30-Oct	47.3	30-Oct	57.3	29-Oct	60.0	29-Oct	60.4	24-Sep	69.3
2013/14	27-Oct	21.1	26-Oct	21.3	29-Jan	23.2	29-Jan	23.2	29-Jan	23.2
2014/15	21-Nov	94.9	20-Nov	152.4	20-Nov	178.6	20-Nov	182.8	20-Nov	184.0



a) 1-day rainfall b) 2-day rainfall

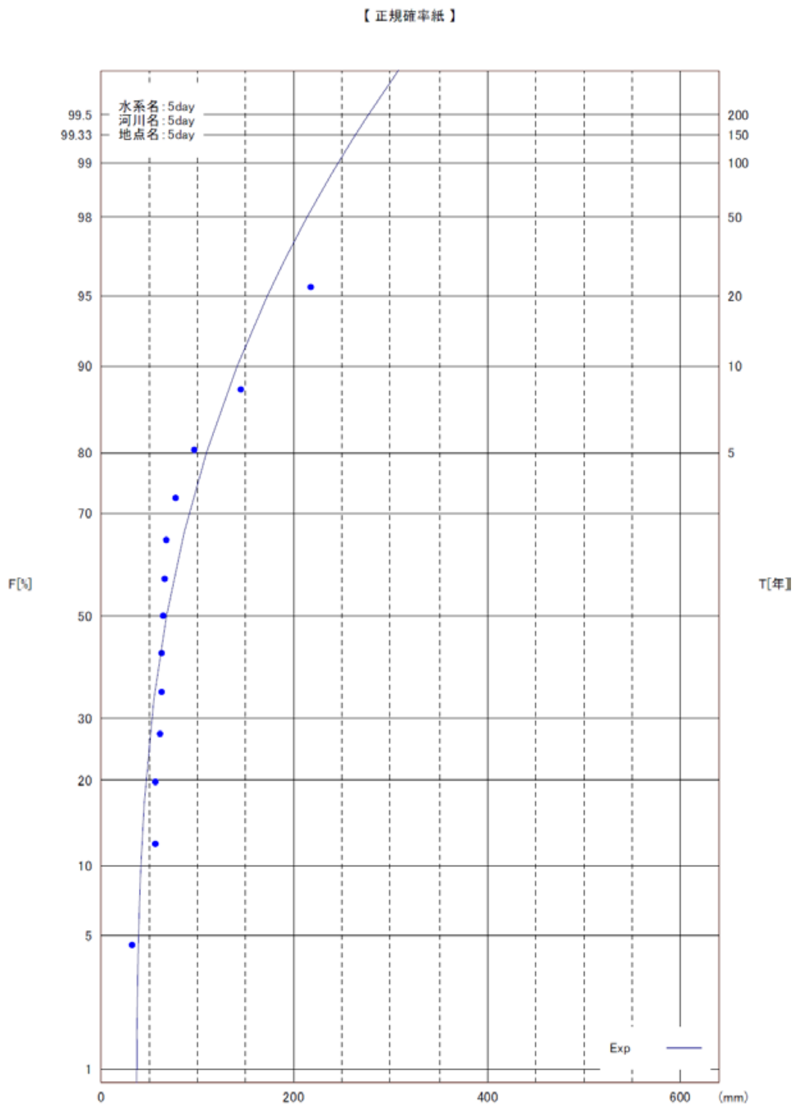
Figure Probability Distribution of Bain Mean Rainfall at Aghbalou (Arithmetic Average)



C) 3-day Rainfall

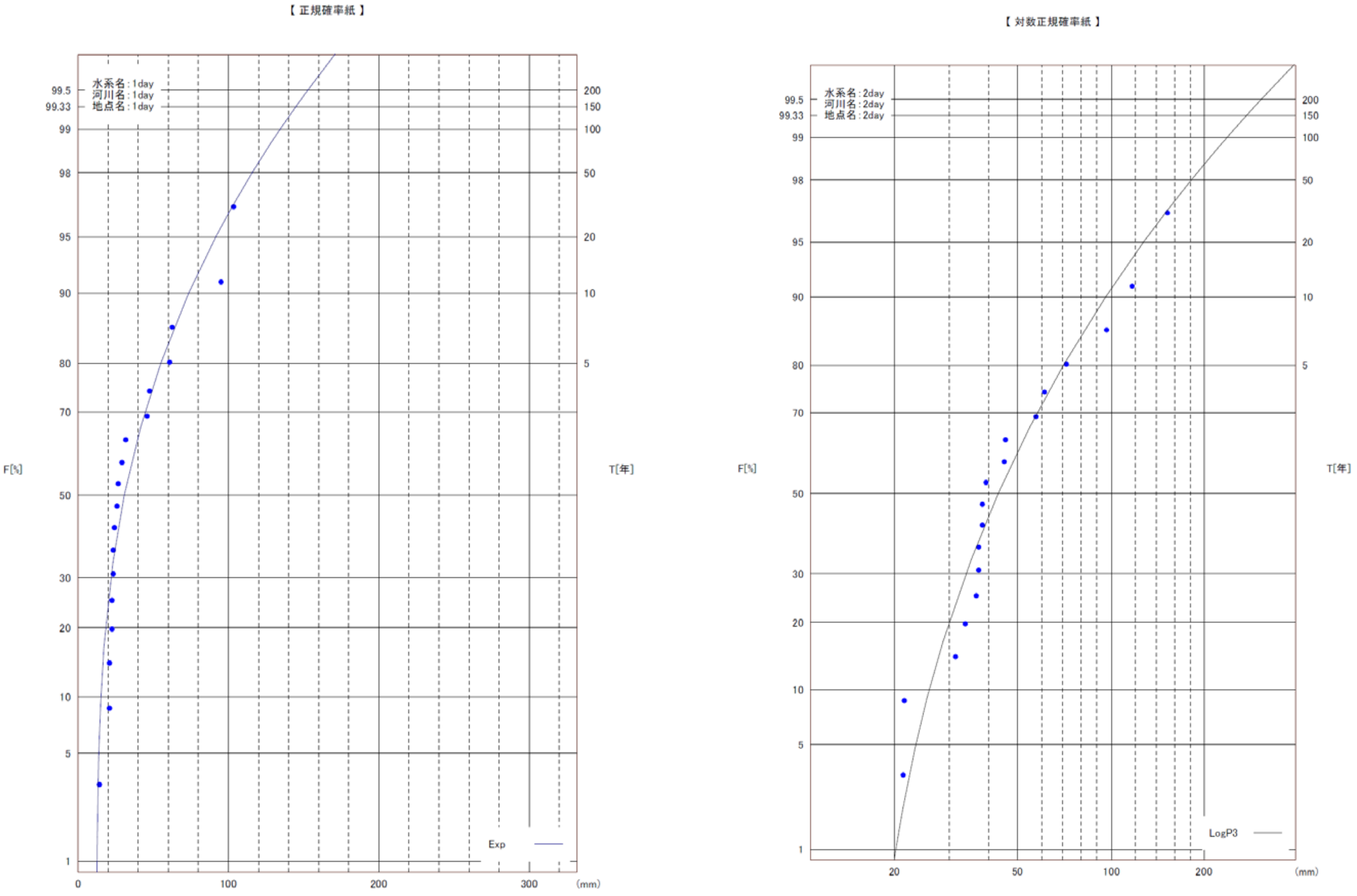
d) 4-day Rainfall

Figure Probability Distribution of Bain Mean Rainfall at Aghbalou (Arithmetic Average)



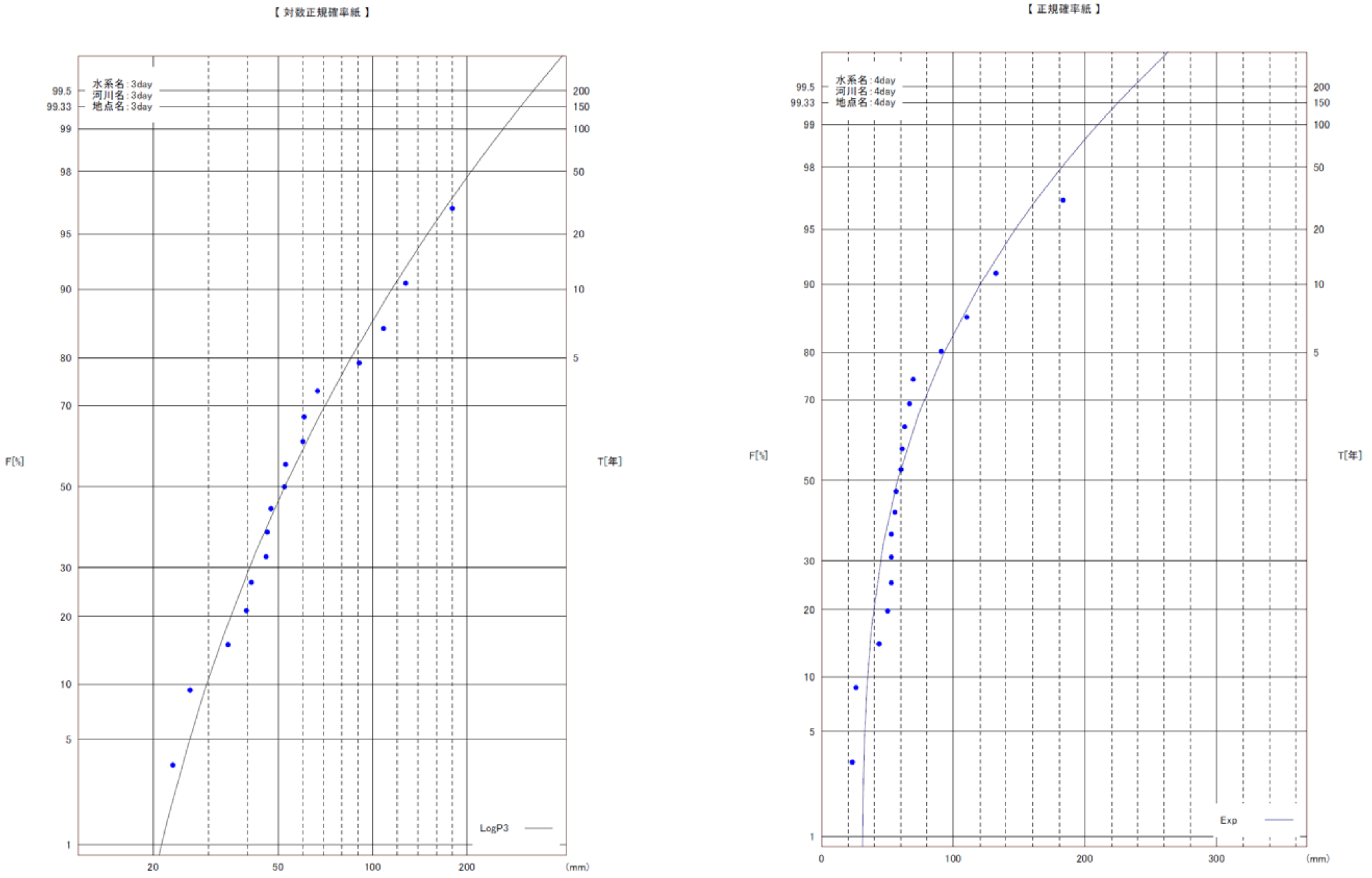
e) 5-day Rainfall

Figure Probability Distribution of Bain Mean Rainfall at Aghbalou (Arithmetic Average)



a) 1-day Rainfall b) 2-day Rainfall

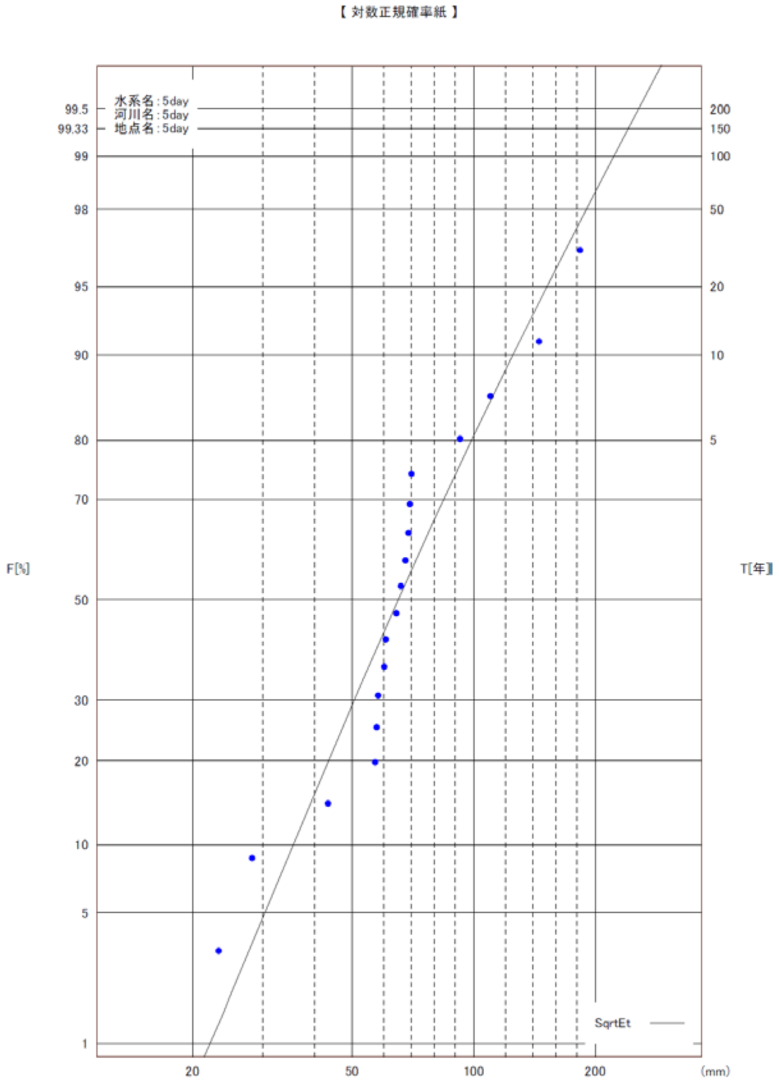
Figure Probability Distribution of Bain Mean Rainfall at Aghbalou (Tiessen)



D)　3-day Rainfall

d)　4-day Rainfall

Figure　　Probability Distribution of Bain Mean Rainfall at Aghbalou (Tiessen)



e) 5-day Rainfall

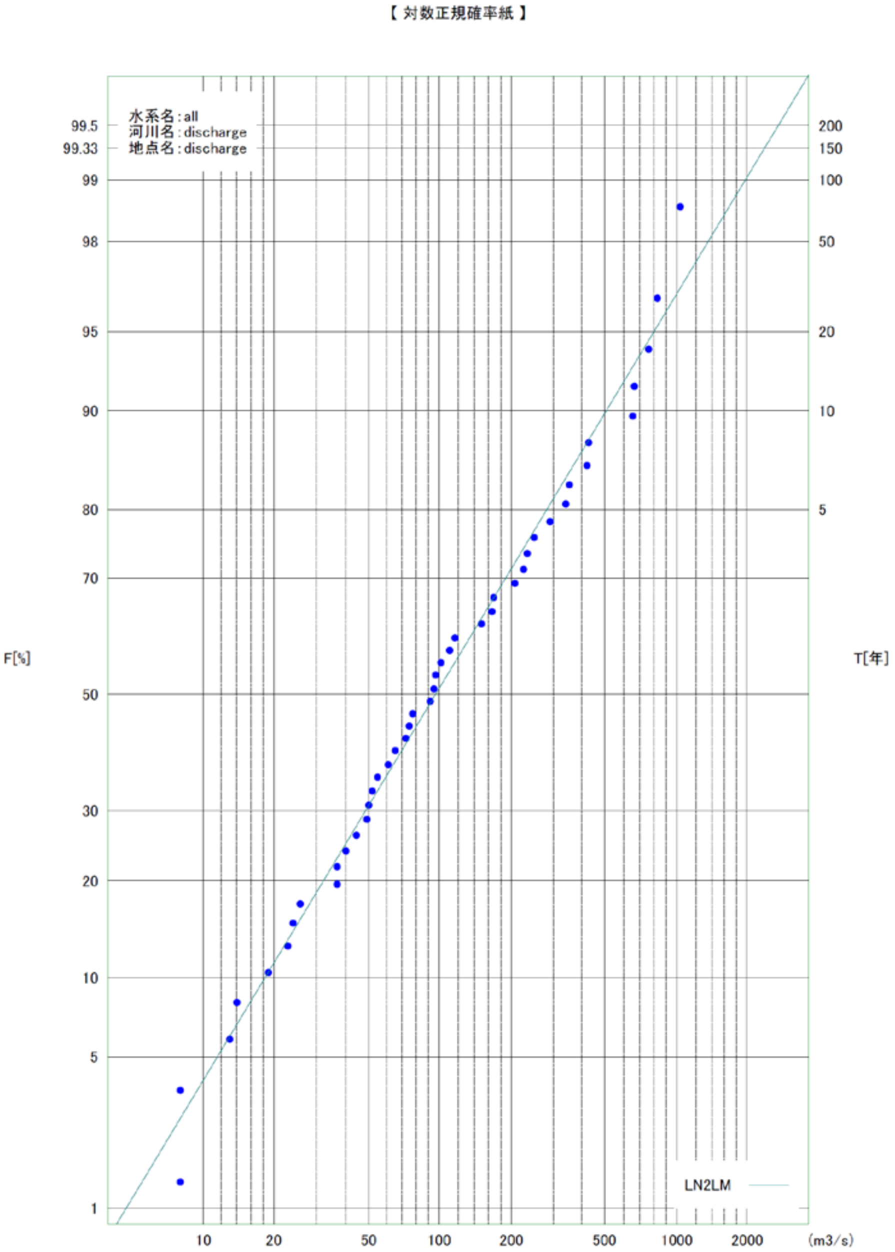
Figure Probability Distribution of Bain Mean Rainfall at Aghbalou (Tiessen)

２)Discharge

Annual Maximum Discharge at Aghbalou

year	Date	Discharge (m³/s)
1969/70	2-Mar	96.0
1970/71	18-May	116.0
1971/72	10-May	55.0
1972/73	24-Oct	72.0
1973/74	9-Apr	77.0
1974/75	5-May	23.0
1975/76	17-May	101.0
1976/77	21-Jan	52.0
1977/78	9-Sep	95.0
1978/79	25-Oct	49.0
1979/80	10-Sep	350.0
1980/81	6-Oct	8.0
1981/82	27-Apr	91.0
1982/83	10-May	24.0
1983/84	8-May	37.0
1984/85	25-Jul	40.0
1985/86	31-Jul	50.0
1986/87	11-Feb	249.0
1987/88	2-Nov	650.0
1988/89	14-Jul	823.0
1989/90	10-Mar	265.0
1990/91	14-Sep	207.0
1991/92	1-Aug	290.0
1992/93	22-Mar	74.0
1993/94	7-Mar	226.0
1994/95	17-Aug	1029.0
1995/96	25-Mar	165.0
1996/97	20-Apr	65.0
1997/98	5-Sep	168.0
1998/99	27-Aug	61.0
1999/00	28-Oct	762.0
2000/01	12-Aug	26.0
2001/02	11-Apr	150.0
2002/03	14-Jun	110.0
2003/04	20-Oct	37.0
2004/05	30-Sep	8.0
2005/06	26-Apr	13.0
2006/07	9-Aug	19.0
2007/08	29-May	14.0
2008/09	19-Sep	667.0
2009/10	16-Aug	234.4
2010/11	15-Sep	339.1
2011/12	23-Mar	44.2
2012/13	31-Oct	420.2
2014/15	22-Nov	424.3

Data Source: ABHT



LN2LM: 2-parameter log normal distribution (Slade I, L-Moment Method)

Probability Distribution of Annual Maximum Discharge at Aghbalou