Department of Meteorology and Hydrology
The Lao People's Democratic Republic

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES
IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

March 2014

JAPAN INTERNATIONAL COOPERATION AGENCY

JAPAN WEATHER ASSOCIATION
INTERNATIONAL METEOROLOGICAL CONSULTANT INC.
CTI ENGINEERING INTERNATIONAL CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to consist of Japan Weather Association (JWA), International Meteorological Consultant Inc. (IMC) and CTI Engineering International Co., Ltd. (CTII).

The survey team held a series of discussions with the officials concerned of the Government of the Lao People's Democratic Republic, and conducted field investigations. As a result of further studies in Japan, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Lao People's Democratic Republic for their close cooperation extended to the survey team.

March, 2014

Masami Fuwa
Director General, Global Environment Department
Japan International Cooperation Agency

Summary

Summary

Lao P.D.R. is an inland country located in Indochina with about 1,700km of length from north to south. About 80% of the national land is composed of mountains and the Mekong River flows from the northern mountains to the central and southern plains along the border shared with Thailand. The majority of the population lives in the plains or hilly areas stretching from the Mekong River or its tributaries which are directly and greatly damaged by floods or flash floods caused by negative weather phenomena such as heavy rain due to the southwest monsoon or typhoon/tropical depression coming from the South China Sea. On the other hand, there are years when Lao P.D.R. suffers from extreme and serious droughts which have significant adverse impacts on agriculture, water transportation, access to water, etc. Aside from agriculture which engages around 80% of the population, the power, mine tourism and manufacturing industries are also some of the main industries in Lao P.D.R. and all of them can be significantly affected by weather conditions. As a result, it can be said that there is a close relationship between meteorology/hydrology and the socio-economy in Lao P.D.R.

The Greater Mekong Sub-region (GMS) consists of six countries: Lao P.D.R., Myanmar, Thailand, Cambodia, Viet Nam and China. Lao P.D.R. possesses approximately 170 billion m^3 of the total water resources of the Mekong River (approx. 450 billion m^3), the largest among the GMS countries, and the water resource per person in Lao P.D.R. is approximately 34,000 m^3, the largest in the world. However, Lao P.D.R. lacks the funds and the adequate technology to manage these abundant water resources and the country is damaged by floods almost every year, thereby, leading to the significant stagnation of the social and economic development. In particular, during the rainy season from May to September, a great amount of rain water fallen in the mountainous areas flows into each tributary and then into the Mekong River in the downstream areas. As a result, the water discharge of the Mekong River during the rainy season increases to 80%-90% and the water level becomes more than 10m higher than the dry season, causing inundation in the plains and flood in the Mekong delta. Flooding in 2011, which brought about unimaginable catastrophic damages to Lao P.D.R., Thailand, Cambodia, etc., is still a fresh memory. That year, five typhoons hit Lao P.D.R., bringing about massive damages (Killed/Missing in Lao P.D.R.: 42, Affected people: approx.430,000, Total amount of damages: approx. US$220 million).

These natural disasters lead to the loss of human lives and properties, thereby, contributing to the significant set-back of socio-economic activities. Particularly, the damages these disasters bring to the poor people, who are extremely vulnerable to natural disasters, are tremendous, thus, proving to be a major obstacle for Poverty Reduction, one of the development strategies of the Government of Lao P.D.R.. The Government of Lao P.D.R. has set a national goal of "Graduation from a Least Developed Country (LDC) by 2020". In order to stabilize and sustain economic growth as well as to improve the living standards of the majority of poor farmers, it is imperative to mitigate meteorological disasters which have negative impacts on the country's socio-economic activities.

The target rivers of the Project, Xe Bangfai River, Xe Banghiang River, Xe Done River and Xe Kong River, account for about 30 % of the water resources of Lao P.D.R. and play an important role in water resource management including flood management. These four (4) rivers are located in the large southern farming area and the floods occurring every year threaten the lives of farmers made up of 90 % of the regional population.

The typical meteorological phenomena causing floods in Lao P.D.R. are heavy rain caused by the southwest monsoon, monsoon trough and typhoon/tropical depressions approaching the country from the South China Sea during rainy season. Since the water levels of Mekong River and its tributaries are usually higher during the rainy season, a significant amount of rain water brought about by heavy rains is a key trigger for flood and inundation. Thus, in order to effectively mitigate the damages caused by floods, it is essential to know the actual state of the heavy rains (amount or location of the heavy rains, etc.). However, there is no observation network in Lao P.D.R. that could observe the surface meteorological phenomena automatically and transmit the observed data on a real-time basis. In addition, with regards to hydrology, there are only a few observation stations which can observe the water level automatically and transmit the observed data. Thus, the DMH is unable to determine the actual state of the meteorological phenomenon or of the river water level on a timely basis under the current meteorological and hydrological observation systems. This results to a difficulty in the timely provision of highly accurate meteorological and hydrological forecasts/warnings to the public in general, to some specific end-users, and most especially to the population in the target river areas.

Under Japan's Grant Aid, "The Project for Establishment of Disastrous Weather Monitoring System in Vientiane" including the construction of a meteorological radar tower building, the installation of a meteorological radar system at the DMH Head Office as well as the installation of monitoring equipment at the Vientiane International Airport was implemented in 2004-2006. After the completion of this project, the weather data collection system and capability in the central area of Lao P.D.R., the national capital region, have been improved. In addition, the safety of the takeoff and landing of airplanes has been enhanced since air disturbance around the Vientiane International Airport can be observed and the resulting information is transmitted to each airplane on a real-time basis. During 2006-2011, the technical cooperation project "Meteorological and Hydrological Services Improvement Project" was conducted in order to strengthen the DMH's capabilities of meteorological and hydrological information services, organization management, meteorological radar data analysis, etc. When Typhoon "Ketsana" hit Lao P.D.R. in 2009, it was observed that the capability of the DMH greatly improved since the DMH was able to provide the forecasts/warnings promptly. Despite the effective support from Japan, there are still several items which need to be improved or expanded if compared with neighboring ASEAN countries, such as Viet Nam and Thailand, in terms of the effectiveness and efficiency of countermeasures against floods which are the most serious disasters in Lao P.D.R.: 1) density of meteorological and hydrological observation stations for the county; 2) observation frequency and accuracy; 3) delay in transmission of

observed data; and, 4) contents of information and frequency of report/warning to the public. Under these circumstances, in 2010, the Government of Lao P.D.R. has requested the government of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme for the purpose of improving meteorological and hydrological observation capability, implementing wide-area and long-term forecasting, receiving meteorological information and products from developed countries and transmitting observation data from Lao P.D.R. to the rest of the world, etc.

In response to this request, the Japan International Cooperation Agency (hereinafter referred to as "JICA") and the DMH had a discussion about the outline and contents of the Project in August 2012 and reached a common understanding with regards to the requested equipment, the target rivers, etc. The Government of Japan then decided to conduct a Preparatory Survey for Improvement of Equipment and Facilities on Meteorological and Hydrological Services (hereinafter referred to as "Preparatory Survey"). JICA sent the Preparatory Survey Team (1) to Lao P.D.R. in order to conduct the Preparatory Survey (1) from August 7 to 29, 2013. The team conducted several discussions with the officials concerned from the Government of Lao P.D.R. including the DMH and further studies on the required equipment, scale and quantities for the project implementation paying particular attention to the present situation in Lao. P.D.R. from various perspectives such as the operation & maintenance capabilities of the DMH, appropriate equipment arrangement plan, etc.

Subsequently, JICA sent the Preparatory Survey Team for Explanation of Draft Report to Lao P.D.R. from November 27 to December 9, 2013 in order to explain and discuss the outline design & draft survey report prepared in accordance with the results of various considerations in the Analysis made in Japan. In the course of the discussions and field surveys, it was confirmed that the requested items are required for the Project in consideration of the Project's objectives and effects. As a consequence of further studies on the requested items in Japan, it has been decided that the following components indicated in the table attached hereunder are object items of the Preparatory Survey for the Project.

Table1: Object Items of the Preparatory Survey

No.	Component	Places	Quantity
Procurement and Installation of Equipment			
1	GTS Message Switch System and World Meteorological Organization Information System(WIS) (including Power Back-up Apparatus and Lightning Protection)	DMH Head Office (Vientiane)	1
2	High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System	DMH Head Office (Vientiane)	1
3	Automatic Weather Observation System + Meteorological Data Encoding PC (including Evaporation Gauge: 10)	Exiting Synoptic/Climate Observation Station	18
4	Automatic Water Level + Rainfall Observation System	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
5	Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)	DMH Head Office (Vientiane)	1

6	Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools for DMH Maintenance Team to be organized at the DMH Head Office: 1 set)	DMH Head Office (Vientiane)	1
Construction of Ancillary Facilities			
7	Power Back-up Shed	DMH Head Office (Vientiane)	1
8	Equipment Shed	DMH Head Office (Vientiane)	1
9	Concrete Shelter and Water Level Observation Facility	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
10	Soft Component	1	

JICA sent the Preparatory Survey (2) Team again to Lao P.D.R. from December 26, 2013 to January 22, 2014 in order to conduct the Preparatory Survey (2) mainly for the topographic and geotechnical survey of each site.

A key objective of the Project is the effective mitigation of the adverse effects of natural disasters through the improvement of the meteorological and hydrological forecasts/warnings of the DMH. The implementation of personnel training and the installation of Automatic Weather Observation Systems and Automatic Water Level + Rainfall Observation Systems will largely enhance the capability to monitor meteorological and hydrological phenomena as it will increase the density of meteorological and hydrological stations and improve the accuracy and frequency of flood forecasts by using a lead time. In addition, the renewal of the GTS Message Switching System will enable Lao P.D.R. to provide observation data to the rest of the world via GTS for the improvement of global weather forecasts and, in return, receive NWP Products calculated by the global NWP model as well as various meteorological information from developed countries such as the satellite data of Japan. Furthermore, the installation of a High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System will enable the DMH to receive regional meteorological satellite images every 2.5 minutes. To achieve the objective of the Project, the installation and renewal of the equipment indicated above are strongly desired.

As adequately pointed out in careful and comprehensive evaluation of the effects of the Project, considerable and enhanced benefits can be achieved vis-à-vis the improvement of the DMH's capabilities in reducing human loss and the recurrent economic set-back brought about by meteorological disasters such as floods, etc. caused by typhoon and heavy rain. In addition, the climate change mainly due to accelerating global warming has a potential to increase the meteorological disasters and become the greatest threat to the sustainability of the very foundations of human survival and has been a serious global issue which all the countries must deal with through mutually beneficial cooperation. In this situation, the improvement of the DMH's capabilities of monitoring meteorological and hydrological phenomena and the provision of observation data to the rest of world under the Project will surely contribute to the disaster

mitigation in Asia as well as Lao P.D.R. The Project is, therefore, considered to be of great significance in terms of the international cooperation of Japan.

Moreover, in order to reduce the DMH's operational and maintenance costs, the equipment and facilities were designed to minimize spare parts and consumables. As a result, the DMH's budget is expected to be able to cover the Lao portion of the capital and recurrent costs of the Project.

In conclusion, the implementation of the Project is considered to be an appropriately suitable and worthwhile endeavor.

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■ Lao People's Democratic Republic

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ABBREVIATIONS

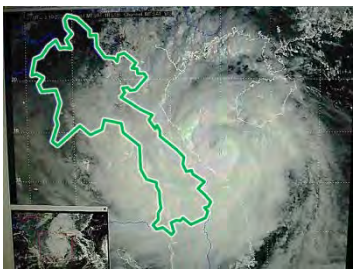
ASEAN : Association of Southeast Asian Nations
AWL+ROS : Automatic Water Level + Rainfall Observation Systems
AWS : Automatic Weather Observation System
DCPC : Data Collection and Processing Centre
DMH : Department of Meteorology and Hydrology
EIA : Environmental Impact Assessment
GISC : Global Information System Centre
GMS : Greater Mekong Sub-region
GTS : Global Telecommunication System
JICA : Japan International Cooperation Agency
LDC : Least Developed Country
LNMCS : Lao National Mekong Committee
MONRE : Ministry of Natural Resources and Environment
MRC : Mekong River Commission
MTSAT : Multi-functional Transport Satellite
NAPA : National Adaptation Program of Action
NC : National Centre
NDMC : National Disaster Management Committee
NDMO : National Disaster Management Office
NWP : Numerical Weather Prediction
OECD : Organization for Economic Co-operation and Development
RTH : Regional Telecommunications Hub
VPN : Virtual Private Network
VUDAA : Vientiane Urban Development and Administration Authority
WIS : WMO Information System
WMO : World Meteorological Organization

Chapter 1
Background of the Project

Chapter 1 Background of the Project

1-1 Background of the Project

Lao P.D.R. is an inland country located in Indochina with about 1,700km of length from north to south. About 80% of the national land is composed of mountains and the Mekong River flows from the northern mountains to the central and southern plains along the border shared with Thailand. The majority of the population lives in the plains or hilly areas stretching from the Mekong River or its tributaries which are directly and greatly damaged by floods or flash floods caused by negative weather phenomena such as heavy rain due to the southwest monsoon or typhoon/tropical depression coming from the South China Sea. On the other hand, there are years when Lao P.D.R. suffers from extreme and serious droughts which have significant adverse impacts on agriculture, water transportation, access to water, etc. Aside from agriculture which engages around 80% of the population, the power, mine tourism and manufacturing industries are also some of the main industries in Lao P.D.R. and all of them can be significantly affected by weather conditions. As a result, it can be said that there is a close relationship between meteorology/hydrology and the socio-economy in Lao P.D.R.



The Greater Mekong Sub-region (GMS) consists of six countries: Lao P.D.R., Myanmar, Thailand, Cambodia, Viet Nam and China. Lao P.D.R. possesses approximately 170 billion m^3 of the total water resources of the Mekong River (approx. 450 billion m^3), the largest among the GMS countries, and the water resource per person in Lao P.D.R. is approximately 34,000 m^3, the largest in the world. However, Lao P.D.R. lacks the funds and the adequate technology to manage these abundant water resources and the country is damaged by floods almost every year, thereby, leading to the significant stagnation of the social and economic development. In particular, during the rainy season from May to September, a great amount of rain water fallen in the mountainous areas flows into each tributary and then into the Mekong River in the downstream areas. As a result, the water discharge of the Mekong River during the rainy season increases to 80%-90% and the water level becomes more than 10m higher than the dry season, causing inundation in the plains and flood in the Mekong delta. Flooding in 2011, which brought about unimaginable catastrophic damages to Lao P.D.R., Thailand, Cambodia, etc., is still a fresh memory. That year, five typhoons hit Lao P.D.R., bringing with them unprecedented heavy rain, which is double the average number of typhoons which hit the country (2.4/year). The following table shows the details of the flooding in 2011.

These natural disasters lead to the loss of human lives and properties, thereby, contributing to the significant set-back of socio-economic activities. Particularly, the damages these disasters bring to the poor people, who are extremely vulnerable to natural disasters, are tremendous, thus, proving to be a major obstacle for Poverty Reduction, one of the development strategies of the Government of Lao P.D.R. The Government of Lao P.D.R. has set a national goal of "Graduation from a Least Developed Country (LDC) by 2020". In order to stabilize and sustain economic growth as well as to improve the living standards of the majority of poor farmers, it is imperative to mitigate meteorological disasters which have negative impacts on the country's socio-economic activities. Since it is also predicted that abnormal weather due to climate change will occur more frequently in the future, the establishment of meteorological and hydrological observation networks and forecasting/warning systems is strongly desired.

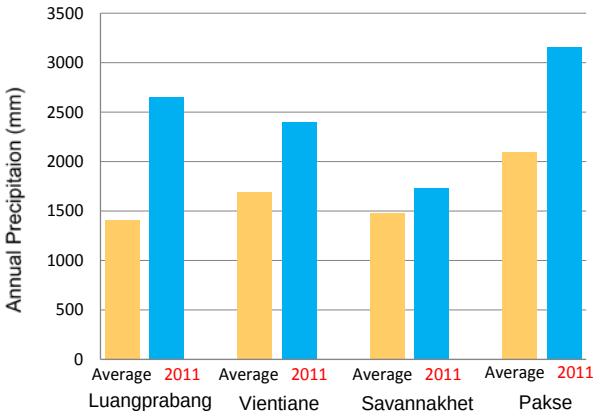
Table2: Details of the Flooding in 2011

Period	Killed/Missing	Affected	Damaged Area	Total Damage Cost
May - October	42	429,954	12	1,764 billion kip (US $220 million)

<Precipitation in 2011>

Observation Station	Precipitation in 2011 (mm)	Comparison with Average (%)
Luangprabang	2,650.5	190
Vientiane	2,395.3	140
Savannakhet	1,730.6	120
Pakse	3,159.6	150

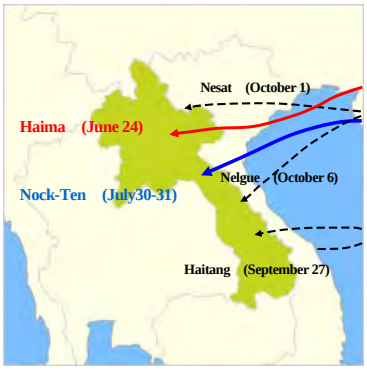
In particular, July had a large amount of rain in 2011. Monthly precipitation of Luangprabang and Vientiane was more than 600mm, and that of Pakse exceeded 1,000mm, 2.6 times greater than the average.



Annual Precipitation (Average & 2011)

<Reason for Heavy Rain>

1. The Southwest Monsoon started earlier and became more active than usual.
2. Five typhoons hit Lao P.D.R.
   Haima (June 24) and Nock-ten (July 30-31) hit the Northern and Central areas causing significant damages.
3. Stagnation of Monsoon Trough
   The amount of precipitation increased mainly in the Southern area during the second half of the monsoon season.



Typhoon Hitting Laos (2011)

<Background>

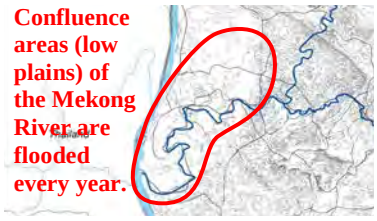
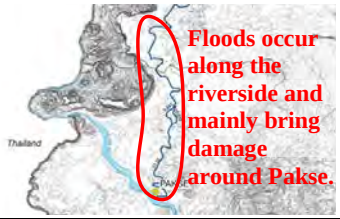
Extreme weather events occurred due to the synergetic effect between the Indian Ocean Dipole Mode and the La Nina phenomenon. (There is a possibility that the frequency of these extreme weather events might increase in the future due to the climate change).

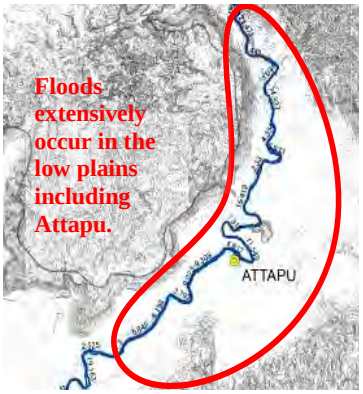
1-2 Current Situations of the Target Rivers of the Project

The Target rivers of the Project are the Xe Bangfai River, the Xe Banghiang River, the Xe Done River and the Xe Kong River, all of which are tributaries of the Mekong River. The Ministry of Natural Resources and Environment (MONRE) has designated them as the target rivers to be developed since they are regarded as the important rivers for water resource management including flood management. These four rivers are located in the southern farming area and about 90% of the population around this area is engaged in agriculture. Floods happening in this area every year bring about repeated damages to the agricultural and livestock industries and transportation. As a result, they have serious and long-term impacts not only on the area but also on the whole country. There are, however, few hydrological observation stations with the capability of observing water level and transmitting the observed data automatically, that is, the Department of Meteorology and Hydrology (hereinafter referred to as the "DMH") head office is not able to obtain the observed water level data on a real-time basis. This makes it impossible for the DMH to fully play its role of preparing more accurate flood forecasts/warnings and issuing them promptly.

Characteristics of the target rivers are indicated in the following table.

Table3: Characteristics of the Floods in the Target River Zone

Name of Rivers	Characteristics of the Floods	
Xe Bangfai	Low plains are spread out downstream of the Xe Bangfai River. These low plains are flooded every year due to the backwater of the Mekong River which floods into the Xe Bangfai River. Fortunately, no loss of human lives has been reported; however, the damage in the agricultural and livestock sectors is significant.	
Xe Banghiang	The Xe Champhon River, which is the right tributary of the Xe Banghiang River, causes flooding approximately once every few years. In most cases, flooding occurs between the Dong Hence and Kengkok zones. Flash flood also occurs in the mountainous section. The causes of these floods are the backwater and internal inundations from the rivers. Fortunately, no loss of human lives has been reported despite the significant property damage caused by the floods.	
Xe Done	A lot of floods occur around Souvannakhet and mainly bring damage along the riverside. Flooding due to typhoons occurs once every few years with a relatively low frequency but affects the agricultural and livestock sectors significantly.	

Xe Kong	The flooding of the Xe Kong River causes floods within the entire area of Attapu with a water depth of more than 2m. This has been reported to have occurred twice. Once was in 1990 due to the heavy rains and the other in 2009 by Typhoon No.16 KETSANA. There was no human loss recorded thanks to the flood information reported and provided by the Vietnamese side as the water which flows into the Xe Kong River originates from the border shared with Viet Nam. In most cases, flooding occurs when a low pressure /typhoon enters Laos from Viet Nam by crossing over the mountainous area and causes heavy rain in the upper river basin of the Xe Kong and Xe Done Rivers.	

1-3 Climate in Lao P.D.R.

- Correlation between El Nino/La Nina and the Climate in Lao P.D.R.

El Nino and La Nina can affect the climate in Lao P.D.R. since there is a tendency for Indochina to have hot and dry weather during El Nino and heavy rain during La Nina due to the activation of southwestern monsoon and the increase in number of the typhoons/tropical depressions landing in Indochina. The following figures show the behavior of Lao's climate during the occurrence of El Nino and La Nina (May-October). It can be observed that there is a high possibility that Lao P.D.R. experiences "drought" in the year of El Nino and "flood" in the year of La Nina.

The table below indicates the correlations between El Nino and droughts and that between La Nina and remarkable floods (total damage cost: over 3 million US dollars). Droughts occur every 5-7 years, most of which are consistent with the occurrence of the year of El Nino. On the other hand, floods occur every 1.4 years on average in Lao P.D.R., and the remarkable ones tend to happen during or right after the occurrence of La Nina. In addition to the flooding in 2011, the other massive flood happened during the rainy season of 2008 causing enormous damages.

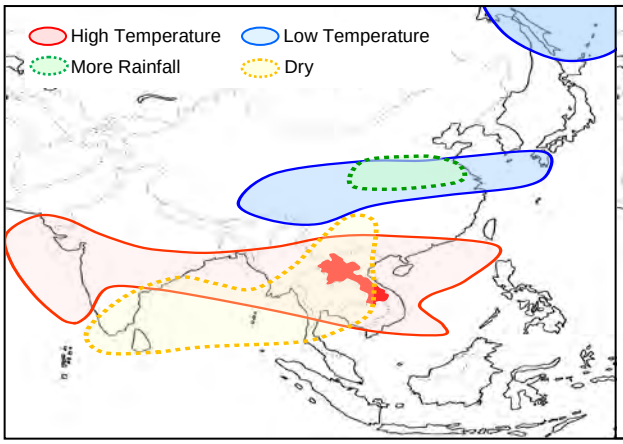


Figure1: Typical Climate Pattern during El Nino (May – October)

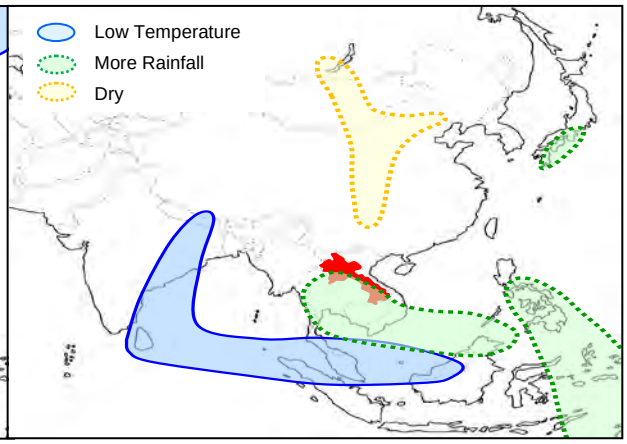


Figure2: Typical Climate Pattern during La Nina (May – October)

Source: JMA

Table4: Drought & El Nino and Major Flood & La Nina in Lao P.D.R. (since 1970)

Year of Drought	Year of El Nino	Year of Major Flood	Year of La Nina
-	1972 Spring-1973 Spring	1971	1970 Spring-1971/1972 Winter
1977	1976 Summer-1977 Spring	1973	1973 Summer-1974 Spring
1983	1982 Spring-1983 Summer	1976	1975 Spring-1976 Spring
1987-1988	1986 Fall-1987/1988 Winter	1978	-
1992	1991 Spring-1992 Summer	1980	-
1997-1998	1997 Spring-1998 Spring	1984	1984 Summer-1985 Fall
2003	2002 Summer-2002/2003 Winter	-	1988 Spring-1989 Spring
2010	2009 Summer-2010 Spring	1995-1996	1995 Summer-1996 Winter
		1998	1998 Summer-2000 Summer
		2000	
		2002	-
		-	2005 Fall-2006 Spring
		2008	2007 Spring-2008 Spring
		2011	2010 Summer-2011 Spring

- Influence of Climate Change in Lao P.D.R.

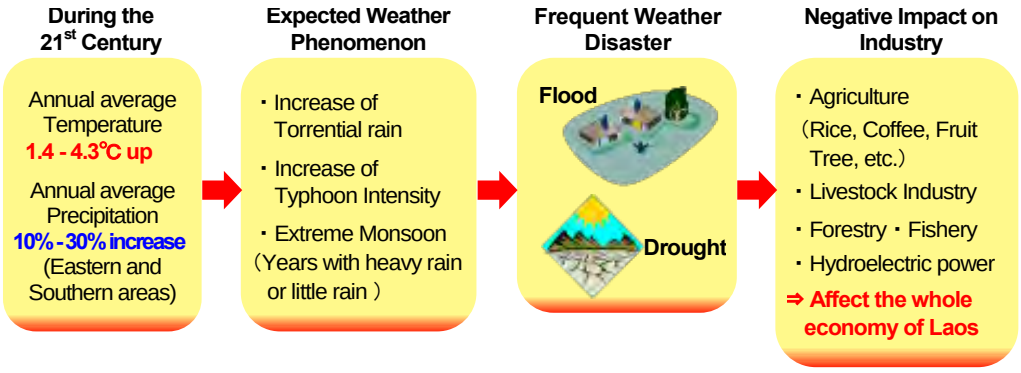
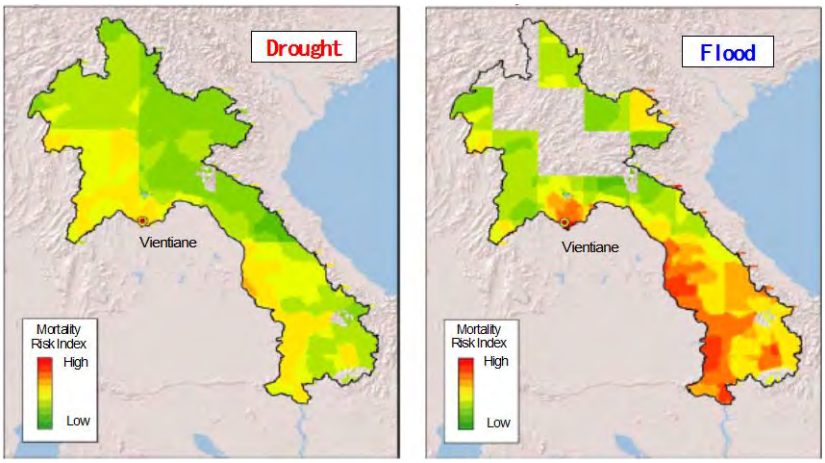


Figure3: Expected Influence of Climate Change due to Global Warming in Laos

In the recent years, the frequency of abnormal weather due to the climate change induced by global warming has increased drastically all over the world. Lao P.D.R. has also experienced such abnormal weather phenomena as heavy rain, extreme high temperature, dry weather, etc.

As shown in the above figure, the average annual temperature is expected to rise by 1.4 ºC and annual precipitation to increase by 10%-30% around the eastern and southern areas in the 21st century. The main factors behind an increase in precipitation are the increase in typhoon intensity and in torrential rain frequency induced by warm moisture air. In most cases, a typhoon coming over Lao P.D.R. becomes weaker by passing through Viet Nam. However, if a typhoon itself becomes more powerful, it could hit Lao P.D.R. without losing strength. In addition, it is predicted that the amount of precipitation during the rainy season will be extreme from one year to another, that is to say, Lao P.D.R. will experience an extensive flood damage due to heavy rain during one year but suffer from drought due to little rain during another year. It is a concern that abnormal weather due to climate change will have an adverse impact on the main industries of Lao P.D.R., such as the agricultural, livestock and power industries, and will become a determining factor for the significant set-back of the socio-economic development of the whole Lao P.D.R.

The figure on the right shows the drought and flood mortality risk distribution due to drought (left) and flood (right). The southern and north-western farming areas will be greatly affected by drought as more and more self-sufficient people are forced to face serious food shortage because of poor harvest. The areas with high risk of flood are the southern and Vientiane areas. Most significantly, the rice-producing areas along the Mekong River and where the population is concentrated have the highest risk of flood and it is predicted that immeasurable casualties will be realized once a massive flood occurs. There is growing concern that global climate change will increase the frequency of large-scale natural disasters in the medium- and long-term. The establishment of meteorological and hydrological early warning system is, therefore, an urgent task and would certainly prove to be a worthwhile endeavor.



Source: Climate Risk and Adaptation Country Profile (The World Bank Group)

Figure4: Drought and Flood Mortality Risk Distribution to be caused by Climate Change

1-4 Brief Summary on the Request for the Project by Lao P.D.R.

Under Japan's Grant Aid, "The Project for Establishment of Disastrous Weather Monitoring System in Vientiane" including the construction of a meteorological radar tower building, the installation of a meteorological radar system at the DMH Head Office as well as the installation of monitoring equipment at the Vientiane International Airport was implemented in 2004-2006. After the completion of this project, the weather data collection system and capability in the central area of Lao P.D.R., the national capital region, have been improved. In addition, the safety of the takeoff and landing of airplanes has been enhanced since air disturbance around the Vientiane International Airport can be observed and the resulting information is transmitted to each airplane on a real-time basis. During 2006-2011, the technical cooperation project "Meteorological and Hydrological Services Improvement Project" was conducted in order to strengthen the DMH's capabilities of meteorological and hydrological information services, organization management, meteorological radar data analysis, etc. When Typhoon "Ketsana" hit Lao P.D.R. in 2009, it was observed that the capability of the DMH greatly improved since the DMH was able to provide the forecasts/warnings promptly. Despite the effective support from Japan, there are still several items which need to be improved or expanded if compared with neighboring ASEAN countries, such as Viet Nam and Thailand, in terms of the effectiveness and efficiency of countermeasures against floods which are the most serious disasters in Lao P.D.R.: 1) density of meteorological and hydrological observation stations for the county; 2) observation frequency and accuracy; 3) delay in transmission of observed data; and, 4) contents of information and frequency of report/warning to the public. Under these circumstances, in 2010, the Government of Lao P.D.R. has requested the government of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme for the purpose of improving meteorological and hydrological observation capability, implementing wide-area and long-term forecasting, receiving meteorological information and products from developed countries and transmitting observation data from Lao P.D.R. to the rest of the world, etc.

In response to this request, the Japan International Cooperation Agency (hereinafter referred to as "JICA") and the DMH had a discussion about the outline and contents of the Project in August 2012 and reached a common understanding with regards to the requested equipment, the target rivers, etc. The Government of Japan then decided to conduct a Preparatory Survey for Improvement of Equipment and Facilities on Meteorological and Hydrological Services (hereinafter referred to as "Preparatory Survey"). JICA sent the Preparatory Survey Team (1) to Lao P.D.R. in order to conduct the Preparatory Survey (1) from August 7 to 29, 2013. The team conducted several discussions with the officials concerned from the Government of Lao P.D.R. including the DMH and further studies on the required equipment, scale and quantities for the project implementation paying particular attention to the present situation in Lao. P.D.R. from various perspectives such as the operation & maintenance capabilities of the DMH, appropriate equipment arrangement plan, etc.

Subsequently, JICA sent the Preparatory Survey Team for Explanation of Draft Report to Lao P.D.R. from November 27 to December 9, 2013 in order to explain and discuss the outline design & draft survey report prepared in accordance with the results of various considerations in the Analysis made in Japan. In the course of the discussions and field surveys, it was confirmed that the requested items are required for the Project in consideration of the Project's objectives and effects. As a consequence of further studies on the requested items in Japan, it has been decided that the following components indicated in the table attached hereunder are object items of the Preparatory Survey for the Project.

Table5: Object Items of the Preparatory Survey

No.	Component	Places	Quantity
Procurement and Installation of Equipment			
1	GTS Message Switch System and World Meteorological Organization Information System(WIS) (including Power Back-up Apparatus and Lightning Protection)	DMH Head Office (Vientiane)	1
2	High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System	DMH Head Office (Vientiane)	1
3	Automatic Weather Observation System + Meteorological Data Encoding PC (including Evaporation Gauge: 10)	Exiting Synoptic/Climate Observation Station	18
4	Automatic Water Level + Rainfall Observation System	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
5	Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)	DMH Head Office (Vientiane)	1
6	Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools for DMH Maintenance Team to be organized at the DMH Head Office: 1 set)	DMH Head Office (Vientiane)	1
Construction of Ancillary Facilities			
7	Power Back-up Shed	DMH Head Office (Vientiane)	1
8	Equipment Shed	DMH Head Office (Vientiane)	1
9	Concrete Shelter and Water Level Observation Facility	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
10	Soft Component	1	
Additional Requests made by the DMH during the Preparatory Survey (1)		Justification	
3 indicated above: Evaporation Gauge (10 sets)		The DMH has already installed the evaporation gauges at 8 out of 18 exiting Synoptic/Climate Observation Stations as the proposed sites for the Automatic Weather Observation Systems and been conducting the evaporation observation which is one of significant observation elements of Agro-meteorology. Inclusion of 10 sets of the evaporation gauges in the Project enables all the 18 exiting Synoptic/Climate Observation Stations to conduct completely the same observations.	
5 indicated above: Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)		In order to secure the required accuracy of the observed data of the Automatic Weather Observation Systems, the annual observed data comparison review using the Automatic Weather Observation Data Management System to be conducted by the DMH Maintenance Team is indispensable.	

6 indicated above: Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools: 1 set)	In order to secure the required accuracy of the observed data of the Automatic Water Level Observation + Rainfall Observation Systems, the annual observed data comparison review using Automatic Water Level + Rainfall Observation Data Management System to be conducted by the DMH Maintenance Team is indispensable.

JICA sent the Preparatory Survey (2) Team again to Lao P.D.R. from December 26, 2013 to January 22, 2014 in order to conduct the Preparatory Survey (2) mainly for the topographic and geotechnical survey of each site.

1-5 Negative Impact on the Development of the Laotian Economy

Approximately 80 % of the population is engaged in the agriculture, forestry and fisheries industry, most of whom are rice farmers. Since rice farming is mainly rain-fed cultivation and is, thus, greatly influenced by weather, production can drastically drop in case of floods or droughts.

The figure on the right shows the cost of damage for each sector caused by the massive flood in 2011. The cost of damage in the agricultural sector was about 978.8 billion kip and accounts for 57 % of the total. More than 64,400 ha of rice-paddy acreage was flooded and it was estimated that the rice harvest for the rainy season that year decreased by about 10 % compared to the normal rainy season.

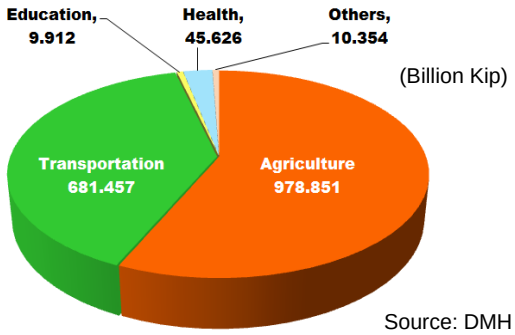


Figure5: Total Damage of Each Sector by the Flood in 2011

Such agricultural damage brought about by natural disasters is expected to expand in the future due to the climate change caused by global warming. According to the "Impact of Climate Change on Poverty in Laos" reported in the "Agricultural & Applied Economics Association, 2011," it is predicted that the GDP Growth Rate of Lao P.D.R. will decrease by 2.8% within 2050 (base line: 2004) because the rice-paddy acreage will reduce and the crop price will escalate due to the climate change. This research specializes in agriculture, the most affected sector, without including other industries. At any rate, however, the steadily rising GDP Growth Rate of Lao P.D.R. is expected to decline in the future as a result of climate change.

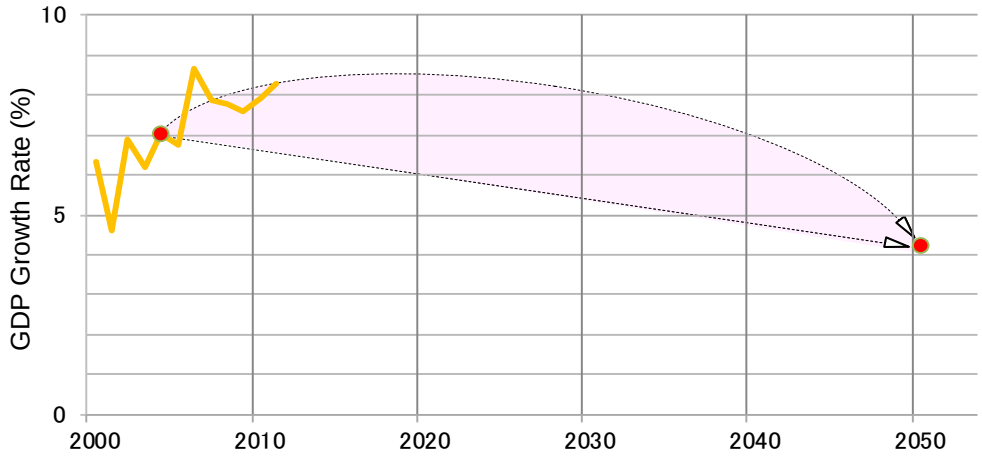


Figure6: GDP Growth Rate Prediction of Lao P.D.R. in consideration of the Impact of Climate Change on Agricultural Sector

Source: Impact of Climate Change on Poverty in Laos

The government of Lao P.D.R. has promoted an agricultural development strategy for the sake of the increase in income of its farmers. The mitigation of agricultural damages caused by meteorological disasters will be a key factor for the socio-economic development of the whole country as well as the improvement in living standards of the Lao people.

1-6 Project Site Infrastructure Information

Table6: Infrastructure of the Proposed Sites for the Equipment Installation

	Proposed Ancillary Facility Construction Site in the premises of the DHM Head Office	Proposed Sites for Automatic Weather Observation System + Meteorological Data Encoding PC (Synoptic/Climate Observation Station)	Proposed Sites for Automatic Water Level + Rainfall Observation System
Site Condition	Enough Space for Ancillary Facility Construction	Enough Space for Equipment Installation	Enough Space for Equipment Installation
Commercial Power (Input Power)	Power Available (380V, 50Hz, 3-phase 4-wire) Power Meter Available	-	-
Telephone	Usable	Usable	Unusable
Internet Connection	Usable (ADSL, IP-phone, GSM/GPRS)	Usable (IP-phone, GSM/GPRS)	Usable (IP-phone, GSM/GPRS)
Mobile Phone	Usable	Usable	Usable
Picture		Picture of each site is attached in Chapter 3.	Picture of each site is attached in Chapter 3.

1-7 Natural Conditions of Lao P.D.R.

The climate of Lao P. D. R. is broadly classified into a rainy season and a dry season with precipitation focused on the period from mid-May to mid-October. The figure on the right shows the monthly average rainfall in Vientiane (2003-2012). Precipitation increases drastically in May and exceeds 300 mm in July and August, the peak period of the rainy season. The precipitation phenomena are mainly brought about by the southwest monsoon and typhoons/tropical depressions.

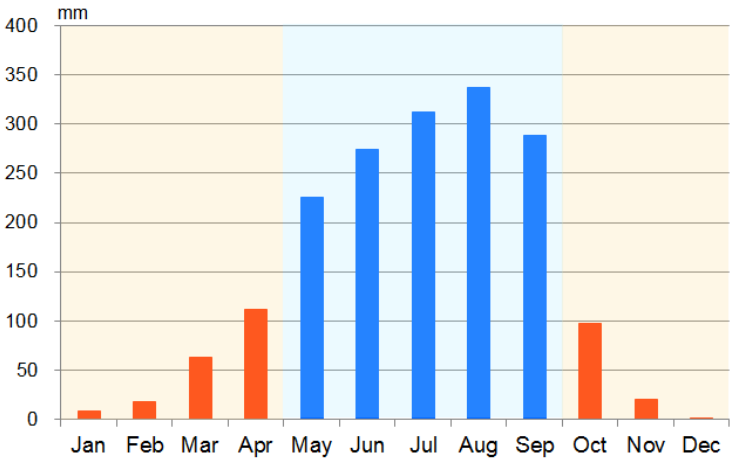


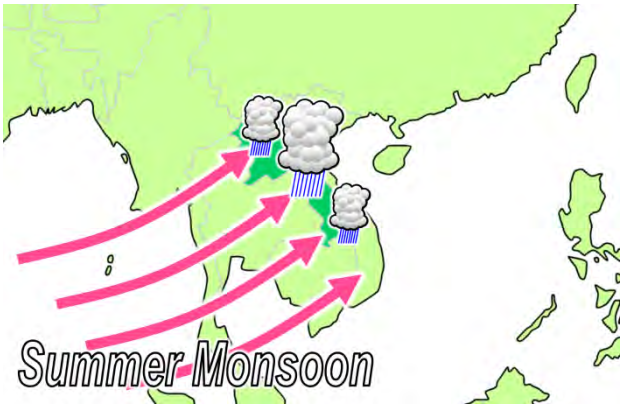
Figure7: Monthly Average Rainfall in Vientiane (2003-2012)

Table7: Calendar of Typical Precipitation Events in Lao P.D.R.

Season of each phenomenon
Peak Season of each phenomenon

Summer Monsoon

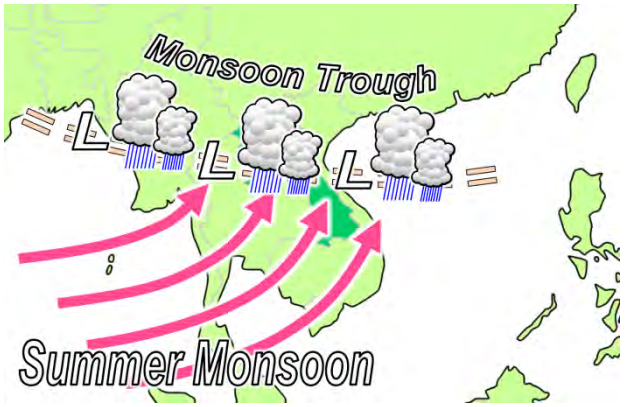
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
				←	—	—	—	—	→		



Mechanism:
From mid-May to mid-October, the summer monsoon is the predominant climate pattern in the whole Indochina. As the seasonal southwest wind brings in a lot of moisture into Lao P.D.R., a wide area of the country receives rainfall much of which is expected to fall in the central provinces such as Bolikhamxai and Khammouan due to the orographic effect. The stronger monsoon wind usually brings heavier rainfall.

Observed Rainfall Event:
1,151mm/month (Thakhek, 19-Jul to 18-Aug-2005)

Heavy Rain Pattern 1 - Monsoon Trough



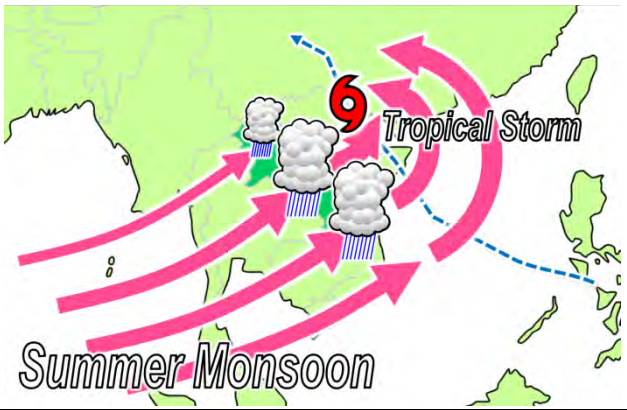
Mechanism:
During a summer monsoon, several low-pressures stretching east to west called a “monsoon trough” are sometimes observed on a weather chart. Along the monsoon trough, rain clouds develop and the intensity of rainfall increases.

The location of the monsoon trough shifts from north to south depending on the season as indicated below.

Northern & Central Lao P.D.R. (July & August)
Central & Southern Lao P.D.R. (September)
Southern Lao P.D.R. (October)

Observed Rainfall Event:
456mm/24h (Phonesay, 20-Aug-2013)
196mm/24h (Thakhek, 3-Jul-2006)

Heavy Rain Pattern 2 - Indirect influence by Tropical Storm

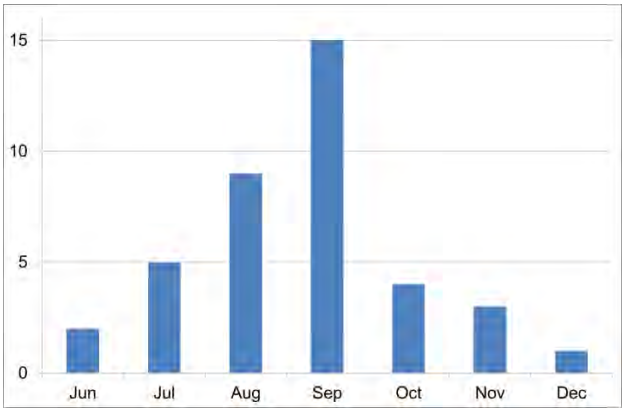


Mechanism:
While a tropical storm (TS) or a tropical depression (TD) is moving northward over the South China Sea or northern Viet Nam and southern China upon landfall, a summer monsoon is activated and intensified in the southern part of the TS/TD which then brings heavy rains in Lao P.D.R..
In case that a strong TS passes by Taiwan, this may result to heavy rains in Lao P.D.R. despite being far from Taiwan or the TS.

Observed Rainfall Event:
382mm/72h (Thakhek, 7 to 9-Aug-2009 when Typhoon Morakot is passing northward over Taiwan)
308mm/72h (Attpeu, 3 to 5-Jul-2007 when TS Toraji is passing northward over the South China Sea)

Tropical Storm / Typhoon

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					←		←	→		→	



The cumulative number of Tropical Storms which hit Lao P.D.R. (1999-2011)

Mechanism:

On average, 25.6 tropical storms (TS) are formed over the northwest Pacific Ocean per year of which 2.4 TSs hit Lao P.D.R. after making landfall in Viet Nam. The number of TSs hitting Lao P.D.R. is greatest in September followed by August and July. The area of the country with a higher risk of being hit by a TS shifts from north to south depending on the season as indicated below.

Northern & Central Lao P.D.R. (June to August)
Central & Southern Lao P.D.R. (September and October)

Even if Lao P.D.R. does not receive much rainfall due to the TS itself, heavy rainfall in Viet Nam can cause severe flooding in Lao P.D.R. as was the case with Typhoon Ketsana back in 2009.

Example of Tropical Storms which hit Lao P.D.R.:

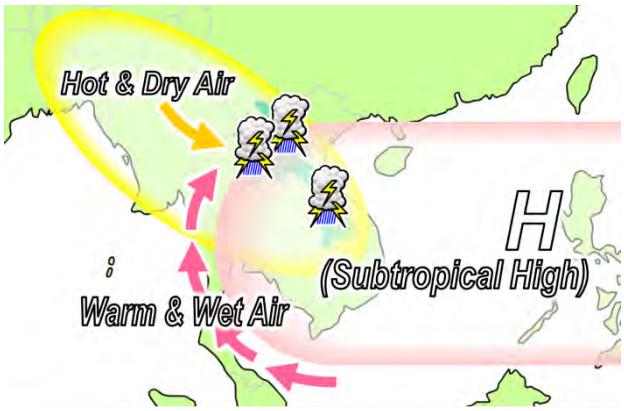
Tropical Storm Haima (June 2011)
Severe Tropical Storm Nock-ten (July 2011)
Typhoon Ketsana (September 2009)

Observed Rainfall Event:

293mm/72h (Luangphabang, 23 to 25-Jun-2011 by TS Haima)
221mm/72h (Vientiane, 30-Jul to 1-Aug-2011 by STS Nock-ten)

Thunderstorm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		←	―	→		←	→				



Mechanism:

In Lao P.D.R., March and April are the hottest months of the year because the east side of the Indochina is covered by the western edge of the Subtropical High and very hot & dry air flows from the northwestern Indochina. Maximum temperature sometimes exceeds 40 ºC. Due to this hot air, atmospheric stability becomes lower in the afternoon and, as a result, cumulonimbus clouds are generated in a short time bringing localized squally weather such as a thunderstorm. In addition, a destructive gusty wind which can break wooden houses as well as hail and lightning also occurs under the cumulonimbus clouds.

Since warm & wet air occasionally flows into the northern part of Lao P.D.R. where the edge of the Subtropical High tends to persist, thunderstorms occur in the wider area of the northern part of Lao P.D.R. compared to the central or southern areas.

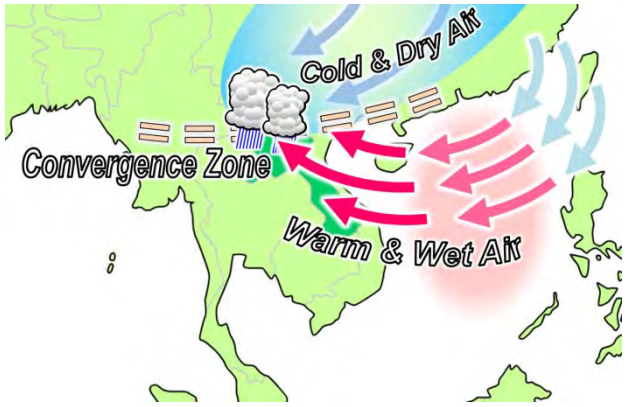
In addition to March and April, thunderstorms are expected to occur during late June to mid-July when the summer monsoon halts temporarily. This is commonly referred to as a "dry spell period."

Observed Rainfall Event:

127mm/24h (Vientiane, 25-Apr-2009)

Winter Monsoon

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
←	→									←	



Mechanism:

Rainfall is observed in Lao P.D.R. even during the dry season from November to February due to cold waves occurring in East Asia. While the cold & dry air mass from the continent is travelling over the western Pacific or the South China Sea, it absorbs heat and moisture from the sea surface resulting in "air mass modification." When the modified air mass flows into Lao P.D.R., rainfall is expected especially in the northern areas due to the orographic effect.

Usually, this type of rainfall is weak. However, heavier rainfall is expected when there is a strong inflow of warm & wet air into Lao P.D.R. or when a convergence zone is formed between the warm & wet inflow and cold & dry air intruding directly from China. In case there is a prolonged cold wave, rainfall in the northern Lao P.D.R. lasts longer.

Observed Rainfall Event:

71mm/24h (Phongsali, 5-Jan-2003)

15-day continuous rain (Phongsali, 8 to 22-Feb-2008)

1-8 Topographic and Geotechnical Surveys

The topographic and geotechnical surveys indicated in the following tables were implemented by a local contractor consigned by the Preparatory Survey Team.

Table8: Elevation Analysis at the Proposed Sites for the Automatic Weather Observation System

Required Works	• Elevation Analysis (Accuracy: ±10cm) • Proposed Sites: Vang Vieng, Phong Saly, Vieng Phukhar, Oudomexai, Viengxai, Luang Prabang, Xieng Khouang, Sai Yaboury, Viengthong, Nongbok, Seno, Samouai, Khongxedon, Thateng, Pakxong, Soukhoumma
Required Products	• Survey Report: MS Word File in CD-ROM

Table9: Elevation Analysis and Topographic Survey at the Proposed Sites for the Automatic Water Level + Rainfall Observation System

Required Works	• Position of the existing building, observation facility, observation field • Calculation of the area planned
	• Plane surveying (0.5m contour line) - Position of the existing facilities (public roads, fences, vegetation, trees: more than 4m height, streetlights, manholes and other features) • Indication of ground level at intervals of 10m • Survey of the true north and magnetic north • Setting bench marks
	• River cross sectional survey (Number of cross section survey at each site: 2, Width of the survey area: left bank+10 m and right bank+10 m to the inner sides, Accuracy of elevation: 2-5 cm, Measurement interval: 5-10 m)
	• Elevation Analysis (Accuracy: ±10cm) - Proposed Sites: Xe Bangfai River (Ban Dong Makfai, Na Teu), Xe Banghiang River (Bang Kengkok, Dong Hence), Xe Done River (Souvannkhily, Phonbok), Xe Kong River (Phon Xai, Nang Yong)
Required Products	• Plane surveying map • River Cross Section • Survey Report: MS Word File in CD-ROM • Drawing: AutoCAD data file in CD-ROM

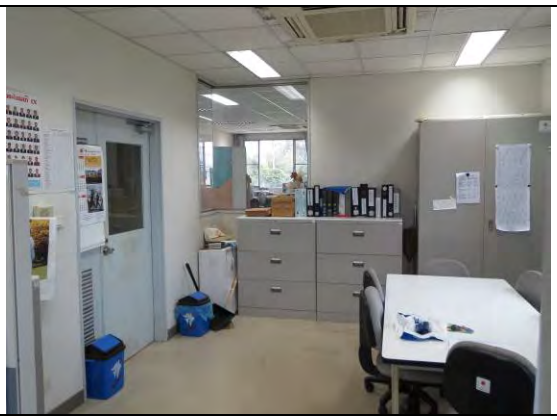
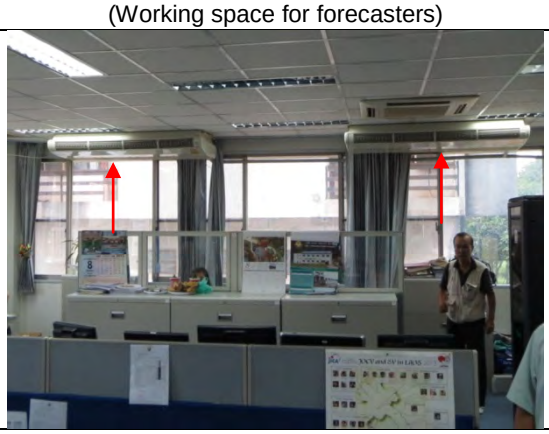
1-9 Existing Facility and Equipment

<Existing Vientiane Radar Tower Building>

Although the external wall paint of the existing Vientiane Radar Tower Building has deteriorated due to aging, the inside has been kept clean as a result of the routine cleaning conducted by the DMH. Through the efforts of the DMH, two (2) air conditioners were installed in the forecasting room and the overhaul of the air conditioning systems in the radar equipment room was implemented at the end of 2011. Furthermore, under the JICA follow-up cooperation from the end of 2011 to March 2012, the renewal of the software and PC relating to the meteorological radar system, water proofing work on the second roof and painting work of the external wall and external stair soffits were implemented. Pictures of the existing Vientiane Radar Tower Building are attached hereunder.

Picture: Current Situation of the Existing Vientiane Meteorological Radar Tower Building

	
Overview of the Existing Vientiane Meteorological Radar Tower Building	1F External wall painted under JICA follow-up cooperation (the end of 2011-March 2012)
	
Electricity room: 1F (Isolation transformer)	Meteorological forecasting room: 1F (MTSAT and Meteorological radar image display system)

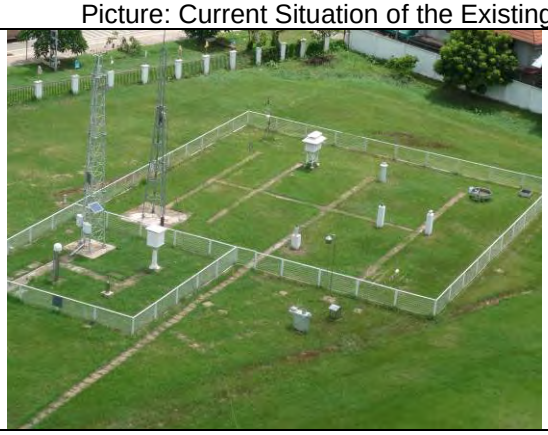
	
Meteorological forecasting room: 1F (Working space for forecasters)	Maintenance room: 1F
	
Air conditioners (2) newly installed at the weather forecasting room by the Ministry of Natural Resources and Environment (the end of 2011)	Exterior unit of air conditioners (2) newly installed at the weather forecasting room by the Ministry of Natural Resources and Environment
	
Water proof seat on 2F roof constructed under JICA follow-up cooperation (the end of 2011-March 2012)	External stair soffits painted under JICA follow-up cooperation (the end of 2011-March 2012)
	
Radar equipment room: 6F (Wave-guide Configuration)	Radar equipment room: 6F (Transmitter, Digital Receiver and Signal Processor and Antenna Controller)

	
Observation deck: 7F (Antenna of Meteorological Data Communication System)	Radome room: 8F (Radar Antenna)

<Existing Vientiane Meteorological Observation Field>

Under the technical cooperation project "Meteorological and Hydrological Services Improvement Project" (2006-2010), the observation fields including the manual observation equipment were improved at the six (6) existing meteorological observation stations (Thakhe, Lak20, Sayabouly, Naphok, Thangone, and Vientiane). The existing Vientiane meteorological observation field is in good condition since the mowing of the field and the cleaning of the equipment are conducted periodically. Pictures of the existing Vientiane meteorological observation field are attached hereunder.

Picture: Current Situation of the Existing Vientiane Meteorological Observation Field

	
Overview of the Existing Vientiane Meteorological Observation Field (China Meteorological Administration installed its own Automatic Meteorological Observation System nearby.)	Sunshine duration sensor

	
Wooden instrument screen	Rain gauge

1-10 Consideration for Environmental Conservation

In order to implement the Project, it was confirmed by the DMH that an Environmental Impact Assessment (EIA) permit is not required.

Chapter 2
Contents of the Project

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

The target rivers of the Project, Xe Bangfai River, Xe Banghiang River, Xe Done River and Xe Kong River, account for about 30 % of the water resources of Lao P.D.R. and play an important role in water resource management including flood management. These four (4) rivers are located in the large southern farming area and the floods occurring every year threaten the lives of farmers made up of 90 % of the regional population. Since extensive flood damage can be a determining factor for the significant set-back of the national economy, the creation of flood countermeasures is an urgent task in Lao P.D.R.

The typical meteorological phenomena causing floods in Lao P.D.R. are heavy rain caused by the southwest monsoon, monsoon trough and typhoon/tropical depressions approaching the country from the South China Sea during rainy season. Since the water levels of Mekong River and its tributaries are usually higher during the rainy season, a significant amount of rain water brought about by heavy rains is a key trigger for flood and inundation. Thus, in order to effectively mitigate the damages caused by floods, it is essential to know the actual state of the heavy rains (amount or location of the heavy rains, etc.). However, there is no observation network in Lao P.D.R. that could observe the surface meteorological phenomena automatically and transmit the observed data on a real-time basis. In addition, with regards to hydrological information, there are only a few observation stations which can observe the water level automatically and transmit the observed data. Thus, the DMH is unable to determine the actual state of the meteorological phenomenon or of the river water level on a timely basis under the current meteorological and hydrological observation systems. This results to a difficulty in the timely provision of highly accurate meteorological and hydrological forecasts/warnings to the public in general, to some specific end-users, and most especially to the population in the target river areas.

Under these circumstances, it is essential for the DMH to (1) obtain the data on a real-time basis such as the rainfall amount all over the country, the specific points of heavy rain and the water level of each river; (2) improve the accuracy of meteorological and hydrological forecasts and (3) issue timely forecasts/warnings for securing sufficient time for evacuation and damage mitigation measures to the inhabitants of the target river region.

In response to these vital needs, the implementation of personnel training and the installation of Automatic Weather Observation Systems and Automatic Water Level + Rainfall Observation Systems are absolutely essential. These will largely enhance the capability to monitor meteorological and hydrological phenomena as it will increase the density of meteorological and hydrological stations and improve the accuracy and frequency of flood forecasts (incl. water level and flood arrival time) by using water level differences between down-streams and up-streams.

In addition, the renewal of the GTS Message Switching System will enable Lao P.D.R. to provide observation data to the rest of the world via GTS for the improvement of global weather forecasts and, in return, receive NWP Products calculated by the global NWP model as well as various meteorological information from developed countries such as the satellite data of Japan. Furthermore, the installation of a High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System will enable the DMH to receive regional meteorological satellite images every 2.5 minutes.

A key objective of the Project is the effective mitigation of the adverse effects of natural disasters through the improvement of the meteorological and hydrological forecasts/warnings of the DMH. To achieve this objective, the installation and renewal of the equipment indicated above are strongly desired.

2-2 Outline Design of the Japanese Assistance

2-2-1 Design Policy

(1) Basic Design Policy of the Project

a) To design a meteorological and hydrological observation system which can contribute to disaster prevention in Lao P.D.R.
b) To enable the DMH to provide the necessary weather information, forecasts, advisories and warnings to ensure the protection of people's lives and properties from natural disasters and the improvement of socio-economic conditions in Lao P.D.R.
c) To enable the DMH to monitor weather conditions and river water levels around-the-clock on a real time basis.
d) To enable the DMH to promptly issue a weather information and/or a warning to the public.
e) To ensure the improvement of the DMH's overall function and capacity in reducing human loss and economic setback brought about by meteorological & hydrological disasters through the upgrading of the DMH's monitoring capabilities of meteorological & hydrological phenomena.
f) To determine and set up the size and components of the Project to match with the technical, operational and maintenance capabilities of the DMH.
g) To design for the reduction of CO_2 emission as much as possible through the utilization of natural solar power to generate electric power for each observation system to be supplied.

[1] Design Policy of the Equipment

a) To ensure that the equipment is compatible with and meets the technical requirements of the World Meteorological Organization (WMO).
b) To ensure that the equipment is suitable for the routine observation and forecasting work of the

DMH.

c) To design the system in such a way that it is within the DMH's capability to operate, maintain and repair.
d) To select equipment for which spare parts and consumables can be easily procured and replaced.
e) To select reliable and durable equipment suitable for the local environment.
f) To minimize the recurrent costs of the DMH for the operation, maintenance and repair of the equipment.
g) To design the equipment in such a way so as to minimize power stoppage.
h) To design the equipment to operate using commercial power (220V, single phase, 2-wire, 50Hz), fluctuation at ±20%.
i) To keep not more than 10Ω grounding resistance to protect the equipment from lightning damage.

[2] Design Policy of the Ancillary Facilities for the Equipment

The plan is to construct ancillary facilities that will ensure appropriate and effective operations and will accommodate the required systems, equipment and personnel. It is a basic policy that the designed ancillary facilities satisfy the following requirements.

a) To have the necessary power supply back-up equipment (diesel generator, uninterruptible power supply system, auto voltage regulator, etc.) for performing around-the-clock meteorological services 24 hours a day, 365 days a year.
b) To be sufficiently robust to allow the performance of uninterrupted routine work and the supply of weather and flood forecasts & warnings even during a natural disaster.
c) To make use of local building materials for easy maintenance of the ancillary facilities by the DMH.
d) To design the equipment so as to minimize power stoppage and lightning damage.

(2) Design Policy on Environmental Conditions

1) Temperature/Humidity

The annual mean maximum and minimum temperatures in Vientiane are approx. 31°C and 23°C respectively. Due to high temperatures in Vientiane, an air-conditioning system is required for each of the operation rooms located in the Ancillary Facilities.

2) Rainfall

To design the equipment in such a way so as to ensure the smooth transmission and receipt of observed data even during heavy rain.

3) Flood

Previous flood disaster records indicate that the maximum flood water level of the Mekong River in Vientiane was about 1.1-1.2m above ground level. In order to avoid serious damages that may result from a bad flood which may occur in the future, the first floor concrete slab of the Ancillary Facilities must be set at 1.5m above ground level.

4) Lightning

Vientiane is located in one of the distribution areas which have 20-40 lightning days in a year (Tokyo is half of it) according to the World Meteorological Organization (WMO). Frequent lightning occurs especially during the rainy season. A lightning protector is, therefore, planned to be installed to prevent damage to the building and to the equipment.

5) Earthquake

Earthquakes have been recorded in the north-western part of Laos bordering Myanmar but no earthquake which has adversely affected building structures has been recorded in Vientiane and its surrounding area. The seismic design standards recently established in Thailand designates the Nong Khai Province, which is adjacent to Vientiane, as an area where it is unnecessary to consider the seismic force. As such, earthquake-proof measures for the Ancillary Facilities are not considered under the Project.

(3) Design Policy for Construction Work for Ancillary Facilities

1) Use of Locally Procurable Materials

Gravel, sand, some secondary concrete products such as blocks, floor materials, reinforced bars, etc. are produced in Lao P.D.R. while other construction materials are imported from Thailand. However, most of all the construction materials are procurable from the local market. For the Project, durable materials will be selected among locally procurable materials.

2) Use of Local Construction Methods and Local Workers

The common local construction method involves RC columns, beams and slabs, concrete block wall with a mortar trowel and paint finish. This method will be applied in the Project. There is currently a shortage of manpower for plastering and other certain parts of the finishing work in Laos and, as such, skilled Thai workers would fill this shortage. While the minimum number of skilled workers is required for plastering and other certain parts of the finishing work, the selection of the local construction method which local workers are familiar with is planned so that local workers can be used as much as possible.

(4) Policy for the Use of Local Construction Companies

1) Construction Work of the Ancillary Facilities

Construction companies in Laos are still small and lack competitive strength because of the fact that the work opportunities for these construction companies are limited to small buildings/facilities. For the construction of the Ancillary Facilities, the local construction methods applied by a local construction company, which would be a local subcontractor, have been selected.

2) Equipment Installation Work

Under the supervision of a Japanese engineer, a local electrical work contractor will be hired during the installation work of the equipment.

(5) Design Considerations to Simplify Operation and Maintenance for the DMH

1) User-friendly equipment

The equipment to be supplied under the Project will be used to support the DMH's routine work as the national meteorological and hydrological agency for natural disaster prevention. A variety of data processing, analysis, display and communications capabilities must be readily available for the DMH, using simple operational procedures.

2) Easy maintenance and affordable recurrent costs of the equipment

The equipment must be designed in such a way so as to minimize the spare parts and consumables required and to simplify regular maintenance. Replacement parts must be quickly and readily available. The expected biggest recurrent cost of the Project is electricity so, therefore, the equipment should be designed in such a way so as to minimize power consumption.

3) Consideration of minimizing operation & maintenance costs

In order for the DMH to meet the increased ongoing costs of the system, such as operation and maintenance costs, after the completion of the Project, the following measures have been included in planning for the equipment.

Table10: Concrete Methods of Minimizing Operation & Maintenance Costs

Key Points	Concrete Method
Fiber Cable	To use fiber cables as much as possible to protect the systems from any damage which can be caused by lightning surges.
Solar Panel and Battery	To use efficient solar panels to supply electricity to the systems as much as technically possible. To use long life batteries as guaranteed by the manufacturer and accommodate them into a battery case with higher heat insulation and install the battery case to accelerate natural heat release since the battery life time is shortened if its temperature is higher than 25ºC.
Remote Diagnosis, Adjustment and Operation	To allow for remote diagnosis, adjustment and operation of the systems through the internet.
PC Monitor	To use liquid crystal display monitors (life time: approx. 30,000 hours) for long time operation, electric power saving and easy replacement
Data Logger for the Observation Systems	To use a data memory (internal RAM) instead of a hard disk which is easily breakable

(6) Design Policy for the Equipment Grade

To allow the supply of uninterrupted forecasts and warnings to the public, even during typhoons, the equipment must be sufficiently robust to withstand floods, local severe storms and lightning strikes and enable the provision of meteorological & hydrological services 24 hours per day.

(7) Design Policy regarding Procurement/ Construction Method and Schedule

The equipment to be installed in the Ancillary Facilities, such as the specialized power backup system and meteorological equipment, is not available in the local market. The equipment for the Project must be durable and reliable. Locally procurable materials and local construction methods must be used in the Ancillary Facility design.

2-2-2 Basic Plan

The equipment to be installed for the Project is as follows.

Table11: Object Equipment of the Preparatory Survey

No.	Component	Places	Quantity
Procurement and Installation of Equipment			
1	GTS Message Switch System and World Meteorological Organization Information System(WIS) (including Power Back-up Apparatus and Lightning Protection)	DMH Head Office (Vientiane)	1
2	High Resolution Meteorological Satellite (“HIMAWARI” to be launched by the Government of Japan) Data Receiving System	DMH Head Office (Vientiane)	1
3	Automatic Weather Observation System + Meteorological Data Encoding PC (including Evaporation Gauge: 10)	Exiting Synoptic/Climate Observation Station	18
4	Automatic Water Level + Rainfall Observation System	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8（2 × 4 Rivers）

5	Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)	DMH Head Office (Vientiane)	1
6	Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools for DMH Maintenance Team to be organized at the DMH Head Office: 1 set)	DMH Head Office (Vientiane)	1

According to the design policies aforementioned, the basic design plan of the Equipment is clarified below.

(1) Equipment Plan

1) GTS Message Switch System and WMO Information System (WIS)

The continuous provision of observed data through the GTS is an extremely important role for Lao P.D.R. to play in order to fulfil its responsibility as a member of the World Meteorological Organization (WMO). Currently the existing GTS Message Switch System in the DMH Head Office is operational. However its function deteriorates day by day and could completely stop in a few years despite the appropriate maintenance done by the engineers of the DMH. Under the Project, an updated GTS Message Switch System will be installed in the DMH as a substitute for the existing system, and which will be connected to the Regional Telecommunications Hub (RTH) in Bangkok over the existing dedicated 128Kbps TCP/IP link. In addition, the new WMO Information System (WIS) servers which will enable the DMH to operate as a National Centre (NC) under the new WMO protocols will be established as Lao P.D.R. was approved to operate a NC by the WMO Executive Council on 22 May 2013. As a member of the WMO Region II, Lao P.D.R. will connect to the WMO world-wide network through the WMO Global Information System Centre (GISC) in Tokyo.

Through the establishment of an improved GTS network in the DMH, the DMH can receive important information from a channel other than the Internet and timely transmit observed data from Lao P.D.R. to the rest of the world. Since recent weather forecasts in the world are prepared through the global data processing and analysis done by the global model of NWP, the transmission of observed data from developing countries, most of which have undeveloped meteorological communication networks, is a very significant key point for the further

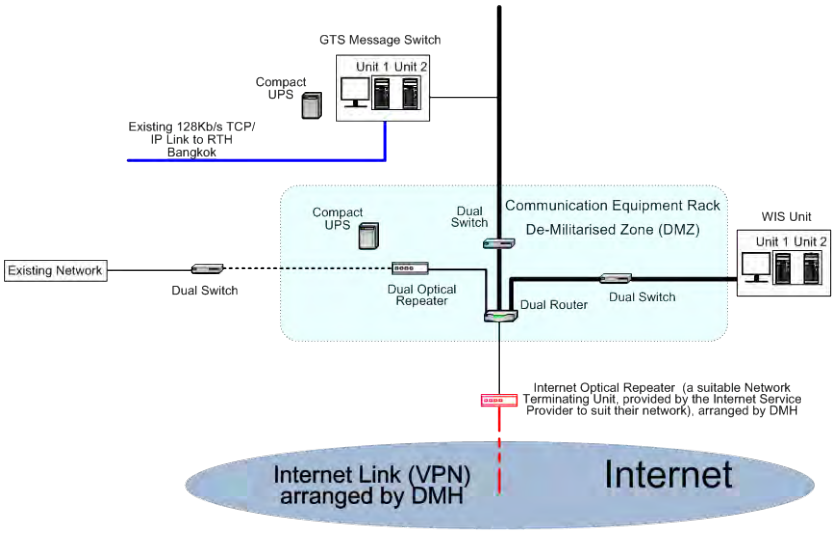


Figure8: GTS Systematic Diagram

improvement of weather forecasts in the world.

Currently, the WMO strongly promotes the WIS as a communication infrastructure for effective international data exchange. The WIS has been designed as a response to the new requests or needs coming from the increase in data products received and the rapid diffusion of the Internet. It consists of the GISC, the Data Collection and Processing Centre (DCPC) and the NC. The GTS Message Switch System to be installed under the Project will satisfy the following points:

- To connect the GTS Message Switch System to the Internet by Virtual Private Network (VPN)
- To connect with the GISC
- To maintain an improved connection to RTH Bangkok.
- To compose of dual systems against any operation stoppage

A VPN link makes it possible to have stable data-exchange and release/dissemination of information and forecast/warning even if the DMH website is experiencing heavy traffic and/or during heavy rains and flooding. The recurrent cost of a VPN link is cheaper than that of a dedicated link and the VPN security level has been enhanced by improvement in cryptographic technology.

2) High Resolution Meteorological Satellite ("HIMAWARI 8/9" to be launched by the Government of Japan) Data Receiving System

In order to monitor cloud movements and determine the distribution and movement of rain clouds and tropical depressions approaching Laos, the DMH has been receiving high resolution meteorological satellite data from the Multi-functional Transport Satellite (MTSAT) of Japan through the meteorological satellite data receiving system for the MTSAT which was installed at the Forecasting Center of the Radar Tower building under Japan's Grant Aid, "the Project for Establishment of Disastrous Weather Monitoring System in Vientiane." The data received through the system is also effectively utilized during the routine works conducted by the DMH. Since the designed lifetime of the current MTSAT (Himawari-7) is expected to expire by 2016, the Japan Meteorological Agency (JMA) has plans to launch the Himawari-8 satellite in 2015 and the Himawari-9 satellite in 2017 to replace the current MTSAT (Himawari-7). The Himawari-8/9 will not carry a system intended for the direct dissemination of satellite imagery, rather, the HRIT (High Rate Information Transmission) and LRIT (Low Rate Information Transmission) imageries (similar to the case of the MTSAT) derived from the satellites will be distributed via a commercial telecommunication satellite using a C band. As a result, the existing meteorological satellite data receiving system for these new MTSATs will be unable to receive the satellite imageries of the current MTSAT (Himawari-7) which uses an L band. Thus, it is indispensable to replace the existing meteorological satellite data receiving system with a High Resolution Meteorological Satellite Data Receiving System.

Antenna of Existing Meteorological Satellite Data Receiving System

The existing antenna foundation, which appears in the picture attached on the right side, will be used for a new antenna.

Spatial resolutions, observation intervals and observation types of the Himawari-8/9 horizontal resolutions will be very much improved and the expected data volume will be more than 100 times larger than the current MTSAT. Since there is a limitation with regards to the reception of the imageries from the HIMAWARI 8/9 via a commercial telecommunication satellite, the other imageries can be received by the DMH via an Internet connection as the need arises.

During the time gaps of more than a few months between the replacement of the current MTSAT (Himawari-7) with the Himawari-8 &9 satellites by the JMA and the installation of the High Resolution Meteorological Satellite Data Receiving System, the DMH is not able to receive high resolution meteorological satellite data. Therefore, the DMH has a plan to patiently take the time to receive high resolution meteorological satellite data through the Internet.

Table12: Comparison of the Observation Contents of the Meteorological Satellites

Item		Himawari 6/7 (MTSAT)	Himawari 8/9
Spatial Resolutions	Visible	1.0 km	0.5 km/1.0 km
	Infrared	4.0 km	2.0 km
Observation Interval		Full Disk: every 60 min. Half Disk: every 30 min.	Full Disk: every 10 min. Specified Region: every 2.5 min.
Observation Type (Wave Length: μm)	Visible	1ch (0.55-0.90)	3ch (0.46, 0.51, 0.64)*
	Near Infrared	-	3ch (0.86, 1.60, 2.30)*
	Infrared	4ch (3.5-4.0, 6.5-7.0, 10.3-11.3, 11.5-12.5)	10ch (3.9, 6.2, 7.0, 7.3, 8.6, 9.6, 10.4, 11.2, 12.3, 13.3)*
Data File Size (Original Data)		Approx. 3.9 GB/day	Approx. 430 GB/day

*Mark: Central Wavelength

3) Automatic Weather Observation System (Operating Electric Power: Solar Energy (Solar Panel))

As indicated in the following table, observed data transmission methods and routes for the Automatic Weather Observation System (AWS) are as follows.

Table13: Observed Data Transmission Method and Route for the AWS

Surface Observation		Data Transmission Method		DMH Head Office
Automatic Weather Observation System (AWS)	⇒	GSM/GPRS quad band Modem (Mobile Telecommunication Network)	⇒	Weather Observation Data Collection Unit

As indicated in the following table, the required observation sensors and the outputs of the AWS are as follows.

Table14: Observation Elements and Outputs of the AWS

Observation Element	Output		Picture
Wind Speed & Direction	Wind Speed and Direction Sensor	• Instantaneous value (1 minute average as per WMO) • 2 minute speed and direction average • 10 minute speed and direction average • Minimum and maximum daily wind speed instantaneous values	
Temperature	Temperature Sensor	• Instantaneous value (1 minute average as per WMO) • Dew point (calculated from most recent "instantaneous" value for temperature and humidity) • Minimum and maximum daily instantaneous values	
Humidity	Humidity Sensor	• Instantaneous humidity value (1 minute average as per WMO) • Minimum and maximum daily instantaneous values	
Pressure	Barometer	• Instantaneous averaged value (1 minute average as per WMO) • Pressure adjusted for mean sea level • Minimum and maximum daily instantaneous values	
Precipitation	Rain Gauge (Sensitivity: 0.5mm)	• Latest measured value (Typically total for the last hour) • Daily total	
Sunshine Duration	Sunshine Duration Sensor	• Latest measured value (total minutes of sunshine since last measurement) • Daily total	
Sunshine Radiation	Sunshine Radiation Sensor	• Latest measured value since the last measurement • Daily total	
Soil Temperature (5cm, 10cm, 20cm, 50cm, 100cm)	Soil Temperature Sensor	• Latest measured value • Daily minimum and maximum values	

Note:

- According to the WMO the Instantaneous value should actually be a short term average as per *Manual 8: Guide to Meteorological Instruments and Methods of Observation.*
- Instantaneous: in order to exclude natural small-scale variability and noise, an average value over a period of 1 min is considered as a minimum and is most suitable.

Table15: Proposed Sites for Automatic Weather Observation System Installation

No.	Station Name	Province	Category
1	Vientiane	Vientiane Capital	Synoptic
2	Vang Vieng	Vientiane	Climate
3	Phong Saly	Phong Saly	Synoptic
4	Vieng Phoukha	Luangnamtha	Climate
5	Oudomxai	Oudomxai	Synoptic
6	Viengxai	Houa Phanh	Synoptic
7	Luang Prabang	Luang Prabang	Synoptic
8	Xieng Khouang	Xieng Khouang	Synoptic
9	Sayabouly	Sayabouly	Synoptic
10	Viengthong	Bolikhamxai	Climate
11	Pakxan	Bolikhamxai	Synoptic
12	Thakhek	Khammouane	Synoptic
13	Seno	Savannakhet	Synoptic
14	Samouai	Salavanh	Climate
15	Khongxedon	Salavanh	Climate
16	Xepon	Savannakhet	Climate
17	Pakxong	Champasack	Climate
18	Soukhoumma	Champasack	Climate

: Proposed Sites for Evaporation Gauge

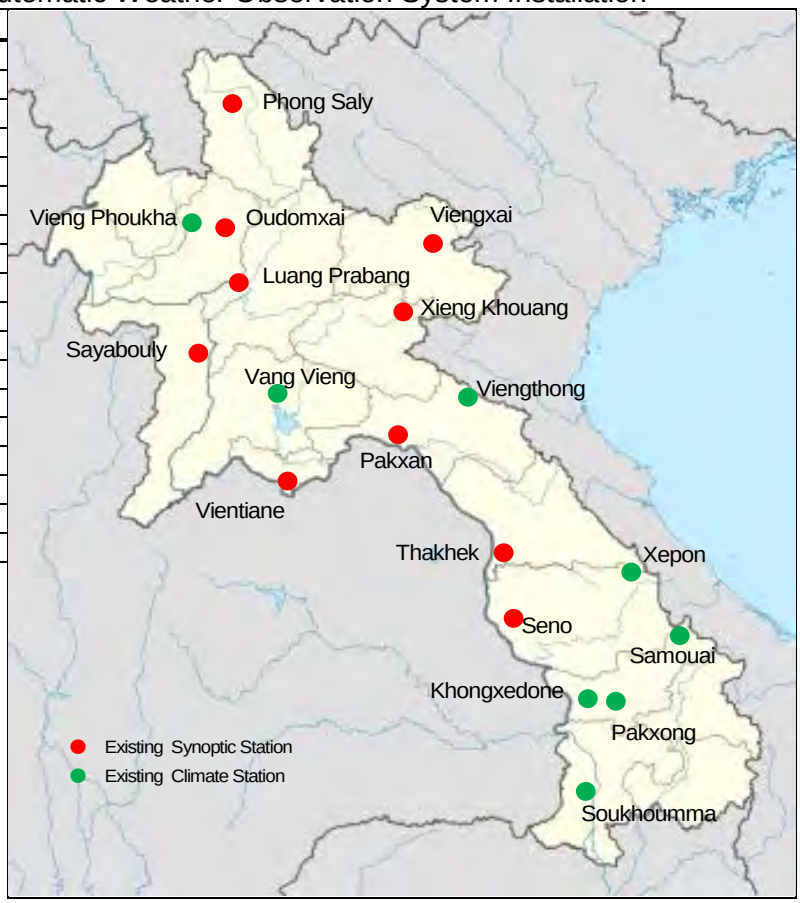
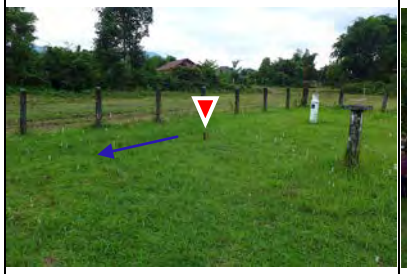
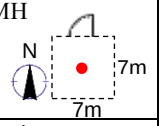
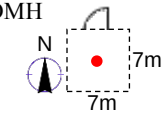
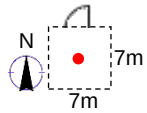
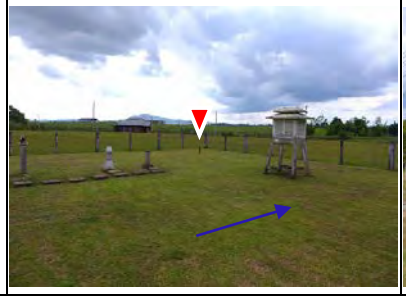
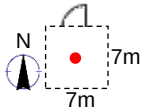
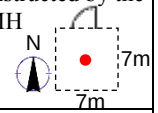
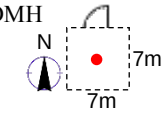
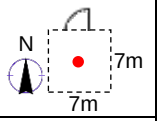
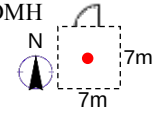


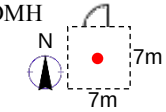
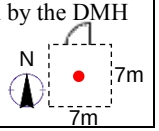
Table16: Automatic Weather Observation System (AWS) Site Information

No.	Site Name	Code	Location	Address	GSM Signal Level	Site Picture		Remarks
1	Vientiane	48940	Lat: N 17º 58’ 12.9” Long: E 102º 34’ 14.0” Altitude: 170.88m indicated on the existing benchmark in the DMH Head Office	Souphanouvong Avenue, Barn Akart, Vientiane Capital	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: available in the observation building Existing 1 PC: in operation Operation Hour: 24 hrs.
2	Vang Vieng	48939	Lat: N 18º 56’ 44.4” Long: E 102º 26’ 55.7” Altitude: 241.92m	Huay Sanguow, Vang Vieng	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Time: 07:00-16:00 Fence: to be constructed by the DMH 
3	Phong Saly	48042	Lat: N 21º 40’ 34.3” Long: E 102º 05’ 31.9” Altitude: 1,376.25m	Ban Phongkeo, PhongSaly	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Time: 07:00-19:00 Fence: to be constructed by the DMH 
4	Vieng Phoukha	48062	Lat: N 20º 41’ 17.0” Long: E 101º 03’ 53.9” Altitude: 712.71m	Ban Vieng Savang, Vieng Phoukha	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation New Observation building, Observation field and Fence: to be constructed by the DMH 

No.	Site Name	Code	Location	Address	GSM Signal Level	Site Picture	Remarks
5	Oudomxai	48925	Lat: N 20º 41’ 22.3” Long: E 102º 00’ 07.8” Altitude: 660.59m	Ban Donkeo, Muoangxai	LTC ETL SMS Text : OK	 	Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 07:00-19:00
6	Viengxai	48927	Lat: N 20º 25’ 02.0” Long: E 104º 13’ 50.4” Altitude: 915.57m	Ban Nakai, Viengxai	LTC ETL SMS Text : OK	 	Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 06:30-19:00
7	Luang Prabang	48930	Lat: N 19º 54’ 32.4” Long: E 102º 10’ 42.0” Altitude: 303.40m	Ban Phousangkhan, Luang Prabang	LTC ETL SMS Text : OK	 	Surrounding Environment: no problem for Observation Movement of the observation station to the new site: 2014
8	Xieng Khouang	48935	Lat: N 19º 26’ 38.8” Long: E 103º 10’ 15.3” Altitude: 1,093.39m confirmed by the National Geographic Department	Ban Phonthong, Pek	LTC ETL SMS Text : OK	 	Surrounding Environment: no problem for Observation A/C: not available in the observation building Existing 4 PCs: in operation Operation Hour: 07:00-19:00

No.	Site Name	Code	Location	Address	GSM Signal Level	Site Picture		Remarks
9	Sayabouly	48938	Lat: N 19º 14’ 37.4” Long: E 101º 42’ 36.9” Altitude: 289.95m	Ban Keng, Sayaboury	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Existing 1 PC: in operation Internet Connection: available Operation Hour: 24 hrs.
10	Viengthong	-	Lat: N 18º 30’40.2" Long: E 104º 26'29.2" Altitude: 306.66m	Ban Nam Ngom, Viengthong	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation New Observation building, Observation field and Fence: to be constructed by the DMH in 2014 
11	Pakxan	48945	Lat: N 18º 23’ 28.5” Long: E 103º 39’ 55.8” Altitude: 156.38m	Ban Phosy, Pakxan	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: available in the observation building Existing 2 PCs: in operation Operation Hour: 07:00-19:00 Fence: to be constructed by the DMH 
12	Thakhek	48946	Lat: N 17º 24’ 16.7” Long: E 104º 48’ 29.8” Altitude: 151.14m	Chomphet, Thakhek	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: available in the observation building Existing 1 PC: in operation Operation Hour: 07:00-19:00

No.	Site Name	Code	Location	Address	GSM Signal Level	Site Picture		Remarks
13	Seno	48948	Lat: N 16º 40’ 33.9” Long: E 104º 59’ 40.4” Altitude: 196.53m	Ban Chaleum Souk, Seno	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 07:00-16:00 Fence: to be constructed by the DMH 
14	Samouai	-	Lat: N 16º 17’ 30.3” Long: E 106º 53’ 36.2” Altitude: 569.26m	Ban Samouai, Samouai	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Observation field and fence: to be constructed by the DMH 
15	Khongxedon	48951	Lat: N 15º 36’ 48.1” Long: E 105º 48’ 37.4” Altitude: 141.59m	Ban Honglueymixai, Khongsedon	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 07:00-19:00 Fence: to be constructed by the DMH 
16	Xepon	-	Lat: N 16º 41’ 53.7” Long: E 106º 12’ 23.4” Altitude: 202.41m	Ban Vongvilay, Xepon	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 07:00-16:00

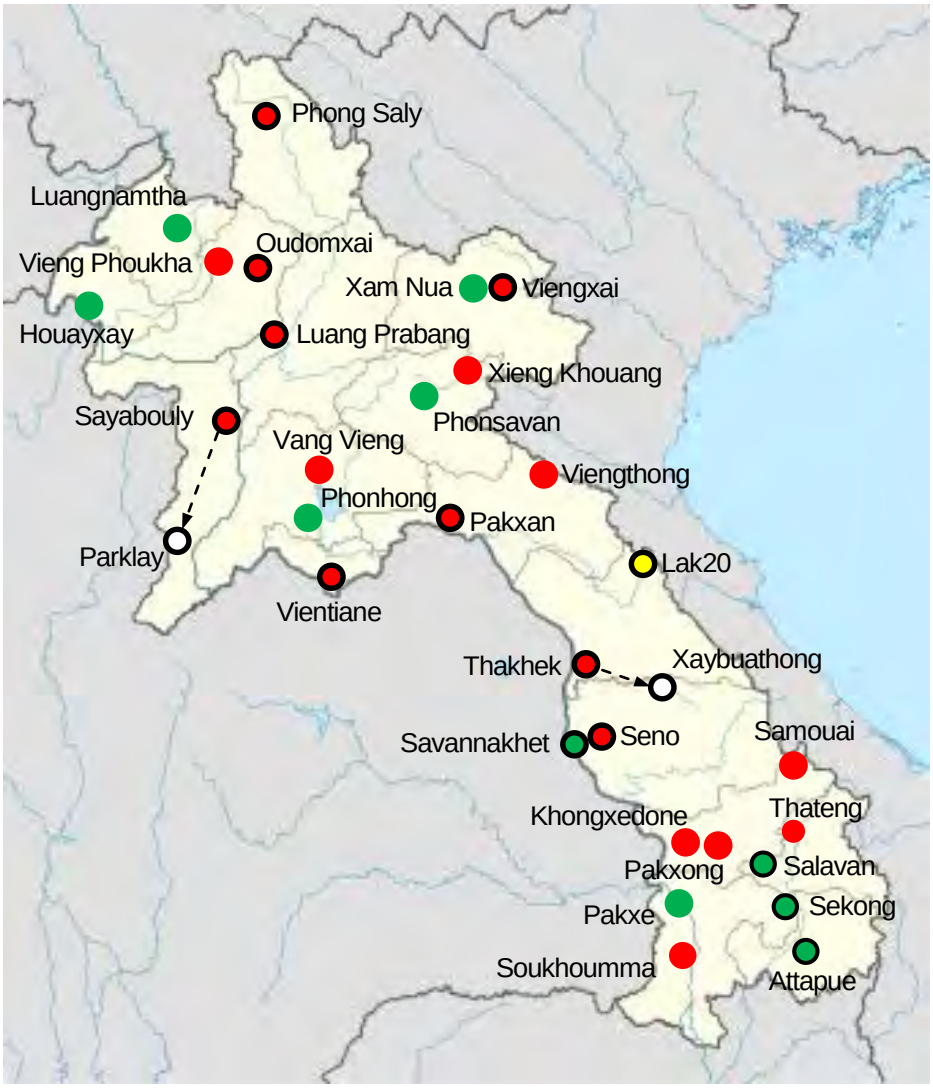
No.	Site Name	Code	Location	Address	GSM Signal Level	Site Picture		Remarks
17	Pakxong	48956	Lat: N 15º 10’ 45.0” Long: E 106º 13’ 38.4” Altitude: 1,279.82m confirmed by the National Geographic Department	Ban Pakxong, Pakxong	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the observation building Operation Hour: 07:00-19:00 Fence: to be constructed by the DMH 
18	Soukhoumma	48958	Lat: N 14º 39’ 16.3” Long: E 105º 47’ 43.4” Altitude: 97.22m	Ban Soukhouma, Soukhouma	LTC ETL SMS Text : OK			Surrounding Environment: no problem for Observation A/C: not available in the MONRE building under construction Observation field and fence: to be constructed by the DMH 

Proposed Location of AWS Installation

Azimuth Direction (North)

After the completion of the Project, the DMH currently has a future improvement plan to increase the number of synoptic stations from 19 to 31 as indicated in the Figure attached hereunder and disseminate observed data through the GTS and WIS to the global meteorological community. In order to materialize its plan, it is quite important that reviews of the observed data must be conducted at each synoptic station through a comparison between the Portable Data Comparison & Maintenance Tools to be procured under the Project and the AWS sensors or the existing observation instruments and that the sequential transition in the utilization and application of observed data generated by the automatic weather observation from the manual observation currently conducted must be done at the synoptic stations wherein the AWS is already installed.

In order to conduct the annual observed data comparison review between each AWS and the Portable Data Comparison & Maintenance Tools by the Automatic Weather Observation Systems maintenance team 1 and 2, 2 sets of the Portable Data Comparison & Maintenance Tools at the DMH Head Office are required. In addition, prior to commencement of the annual observed data comparison review, the observed data comparison review between the Portable Data Comparison & Maintenance Tools and the Data Comparison & Maintenance Tools as the standard devices (1 set at the DMH Head Office) is indispensable.



AWS to be installed under the Project at the Existing Synoptic Station

AWS to be installed under the Project at the Existing Climate Station (to be registered as "Synoptic" to WMO)

AWS to be installed by the World Bank Project at the Existing Synoptic Station

Existing Synoptic Station

Manual Observation Instruments procured under TCP at the Existing Climate Station (to be registered as "Synoptic" to WMO)

Manual Observation Instruments procured under TCP to be shifted to the Existing Climate Station (Sayabouly⇒Parklay, Thakhek⇒Xaybuathong) (to be registered as "Synoptic" to WMO)

AWS: Automatic Weather Observation System
WMO: World Meteorological Organization
TCP: Technical Cooperation Project of Japan

Figure9: Future Synoptic Observation Network Plan of DMH

4) Automatic Water Level + Rainfall Observation System (Operating Electric Power: Solar Energy)

As indicated in the following table, the transmission method and operating electric power for the Automatic Water Level + Rainfall Observation System are as follows.

Table17: Observed Data Transmission Method and Route for the Automatic Water Level + Rainfall Observation System

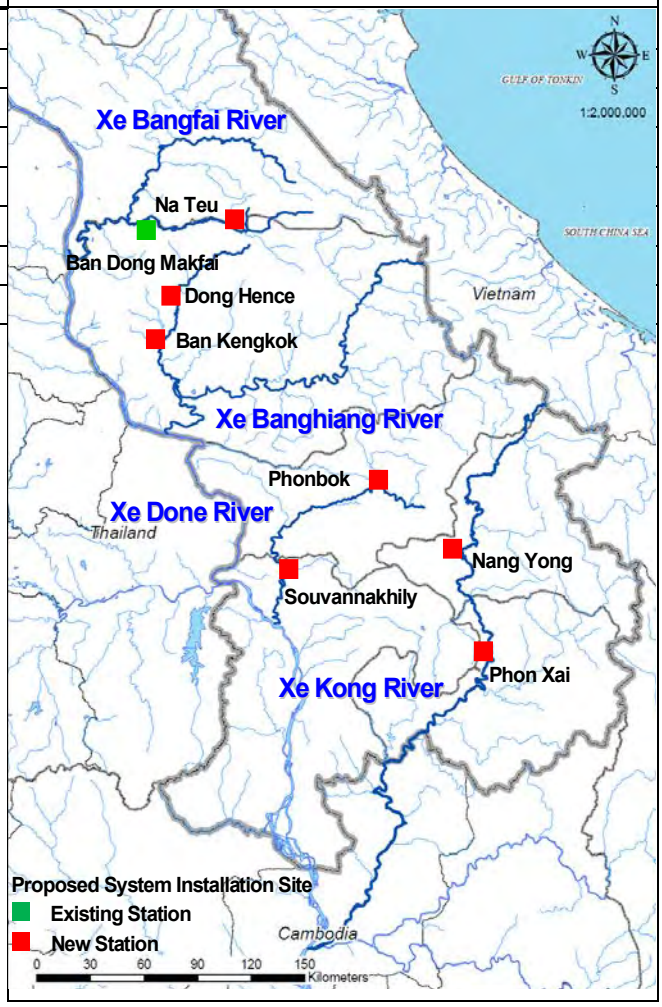
Observation	⇒	Data Transmission Method	⇒	DMH Head Office
Automatic Water Level + Rainfall Observation System		GSM/GPRS quad band Modem (Mobile Telecommunication Network)		Automatic Water Level + Rainfall Observation System

Table18: Observation Elements and Outputs of the Automatic Water Level + Rainfall Observation System

Observation Element	Output		Picture
Water Level	Water Level Sensor	• Latest measured value	 
Precipitation	Rain Gauge (Sensitivity: 0.5mm)	• Latest measured value (Typically total for the last hour) • Daily total	

Table19: Proposed Sites for Water Level + Rainfall Observation System Installation

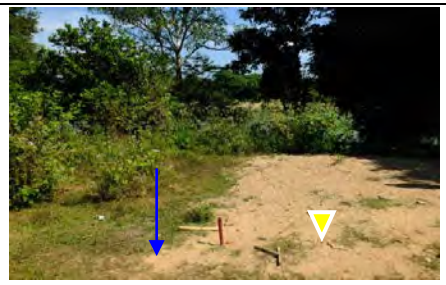
No.	River Name	Observation Site	District	Province
1	Xe Bangfai	Ban Dong Makfai	Xaybonly	Savannakhet
		Na Teu	Vilabouly	Savannakhet
2	Xe Banghiang	Ban Kengkok	Champhone	Savannakhet
		Dong Hence	Atsaphangthong	Savannakhet
3	Xe Done	Souvannakhily	Sanasomboon	Champasack
		Phonbok	Salavan	Salavan
4	Xe Kong	Phon Xai	Samakyxay	Attapeu
		Nang Yong	Lamarm	Xe Kong



The DMH has a plan to conduct the annual observed data comparison review between the Portable Data Comparison & Maintenance Tools to be procured under the Project and the Automatic Water Level Observation + Rainfall Observation Systems.

Table20: Automatic Water Level + Rainfall Observation System Site Information

No.	Site Name	Location	Address	GSM Signal Level	Site Picture		Remarks
1	Ban Dong Makfai	Lat: N 17º 04’ 29.8” Long: E 105º 02’ 44.2” Altitude: 146.64m	Ban Dong Makfai, Xaybonly	LTC ETL SMS Text : OK (Only LTC)			Surrounding Environment: tree branch trimming required for solar power supply system
2	Na Teu	Lat: N 17º 04’ 02.4” Long: E 105º 45’ 35.3” Altitude: 189.18m	Na Teu, Vilabouly	LTC ETL SMS Text : OK			Surrounding Environment: tree branch trimming required for solar power supply system
3	Ban Kengkok	Lat: N 16º 26’ 44.9” Long: E 105º 12’ 01.3” Altitude: 139.19m	Ban Kengkok, Champhone	LTC ETL SMS Text : OK			Surrounding Environment: no problem
4	Dong Hence	Lat: N 16º 42’ 36.9” Long: E 105º 16’ 55.9” Altitude: 148.89m	Dong Hence, Atsaphangthong	LTC ETL SMS Text : OK			Surrounding Environment: no problem

No.	Site Name	Location	Address	GSM Signal Level	Site Picture		Remarks
5	Souvannkhily	Lat: N 15º 23’ 45.2” Long: E 105º 49’ 26.3” Altitude: 128.56m	Souvannakhily, Sanasomboon	LTC ETL SMS Text : OK			Surrounding Environment: no problem
6	Phonbok	Lat: N 15º 42’ 42.0” Long: E 106º 25’ 48.5” Altitude: 178.15m	Phonbok, Salavan	LTC ETL SMS Text : OK			Surrounding Environment: no problem
7	Phon Xai	Lat: N 15º 01’ 59.6” Long: E 106º 51’ 29.7” Altitude: 109.75m	Phon Xai, Salavan	LTC ETL SMS Text : OK (Only LTC)			Surrounding Environment: tree branch trimming required for solar power supply system
8	Nang Yong	Lat: N 15º 28’ 10.1” Long: E 106º 43’ 35.4” Altitude: 150.32m	Nang Yong, Lamam	LTC ETL SMS Text : OK			Surrounding Environment: tree branch trimming required for solar power supply system

▼ Proposed Location of AWL Installation

▼ Proposed Location of ROS + Concrete Shelter Installation

← Azimuth Direction (North)

The “Schematic Diagram of Equipment and Facilities on Meteorological and Hydrological System in Lao P.D.R.” is attached hereto.

Schematic Diagram of Equipment and Facilities on Meteorological and Hydrological Services in Lao P. D. R.

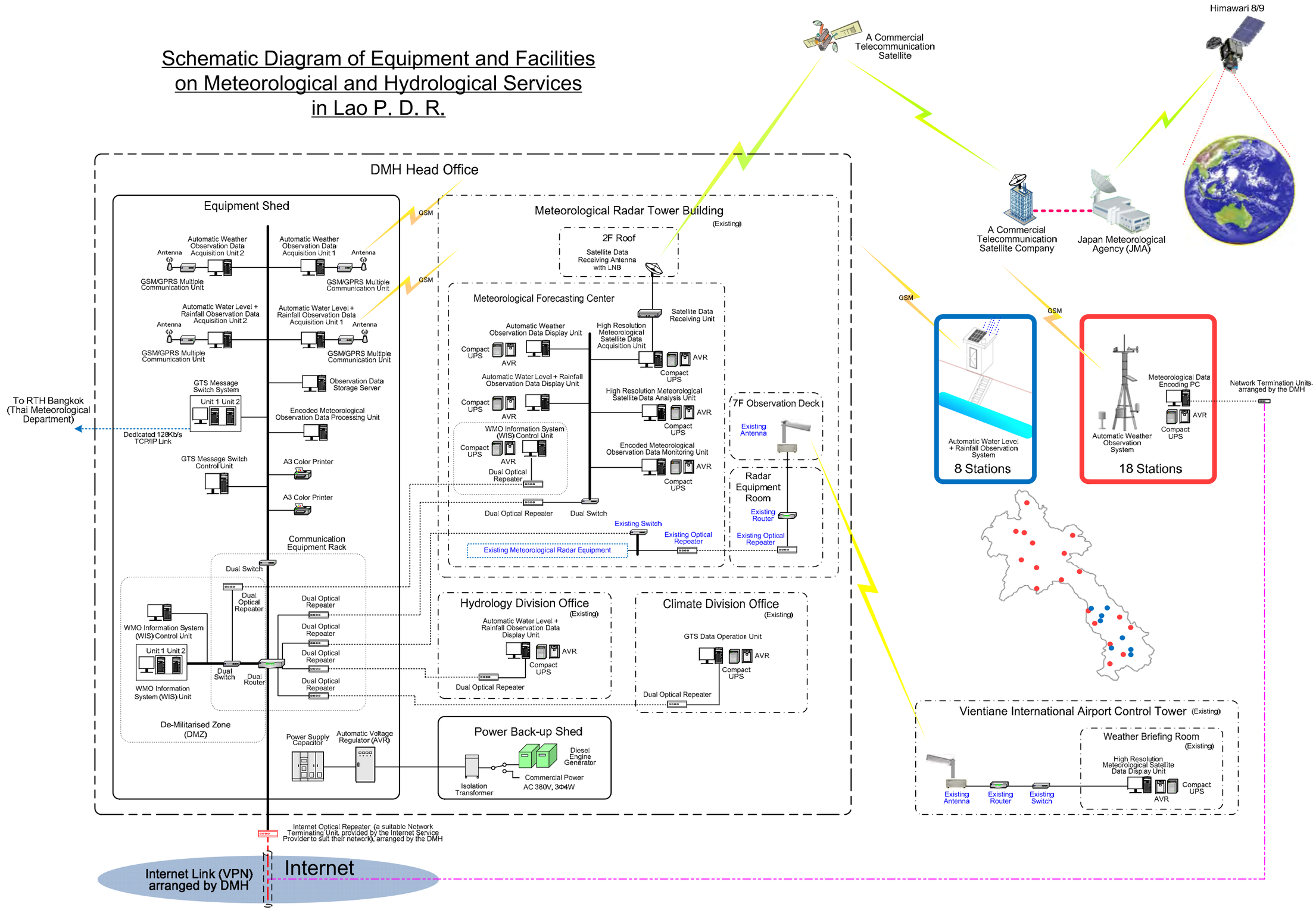


Figure10: Schematic Diagram of Equipment and Facilities on Meteorological and Hydrological Services in Lao P.D.R.

(2) Major Equipment List

As a consequence of the basic design study, the major components of the Project are described below.

Table21: Main Equipment Components

Component	Places	Quantity
Procurement and Installation of Equipment		
GTS Message Switch System and World Meteorological Organization Information System (WIS) (including Power Back-up Apparatus and Lightning Protection)	DMH Head Office (Vientiane)	1
High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System	DMH Head Office (Vientiane)	1
Automatic Weather Observation System + Meteorological Data Encoding PC (including Evaporation Gauge: 10)	Exiting Synoptic/Climate Observation Stations	18
Automatic Water Level + Rainfall Observation System	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)	DMH Head Office (Vientiane)	1
Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools for DMH Maintenance Team to be organized at the DMH Head Office: 1 set)	DMH Head Office (Vientiane)	1

Major Equipment List

GTS Message Switch System and World Meteorological Organization Information System (WIS)

Name of Site: DMH Head Office (Equipment Shed and Power Back-up Shed)			
Equipment		Quantity	Purpose
Equipment Shed			
GTS Message Switch		1 set	To transmit and receive observed data globally through the GTS network
GTS Message Switch Control Unit		1 set	To operate and control GTS Message Switch
WMO Information System (WIS) Unit		1 set	To provide and collect meteorological data to and from the WMO Information System (WIS)
WMO Information System (WIS) Control Unit		1 set	To operate and control WMO Information System (WIS) Unit
Dual Router		1 set	To forward data packets between computer networks
Dual Switch-1		1 set	To connect all the computer equipment to LAN
Dual Switch-2		1 set	To connect all the computer equipment to LAN
Dual Optical Repeater		5 sets	To convert electrical and optical signal on LAN for protection against surges
Color Printer		2 sets	To print observation data
Communication Equipment Rack		1 set	To install communication equipment
Power Supply Capacitor		1 set	To supply uninterrupted power by the Electric Dual Layer Capacitor energy to the radar system when power failure occurs
Automatic Voltage Regulator (AVR)-1		1 set	To supply constant or regulated voltage to the system
Power Back-up Shed			
Isolation Transformer		1 set	To protect each equipment from surges in main power
Diesel Engine Generator		2 sets	To generate stable electric power by diesel engine
Spare Parts	LAN Arrester	6 sets	For maintenance of the system
	Air Filter for Diesel Engine Generator	2 sets	For maintenance of the system

	Oil Filter for Diesel Engine Generator	2 sets	For maintenance of the system
Service Manuals		2 sets	For maintenance of the system

GTS Message Switch System and World Meteorological Organization Information System (WIS)

Name of Site: DMH Head Office (Meteorological Radar Tower Building)		
Equipment	Quantity	Purpose
WMO Information System (WIS) Control Unit	1 set	To operate and control WMO Information System (WIS) Unit
Dual Optical Repeater	1 set	To convert electrical and optical signal on LAN for protection against surges
Automatic Voltage Regulator (AVR) -2	1 set	To supply constant or regulated voltage to the system
Compact UPS	1 set	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	1 set	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

GTS Message Switch System and World Meteorological Organization Information System (WIS)

Name of Site: DMH Head Office (Climate Division Office)		
Equipment	Quantity	Purpose
GTS Data Operation Unit	1 set	To operate GTS Data to be collected by GTS Message Switch
Dual Optical Repeater	1 set	To convert electrical and optical signal on LAN for protection against surges
Automatic Voltage Regulator (AVR) -2	1 set	To supply constant or regulated voltage to the system
Compact UPS	1 set	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	1 set	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

High Resolution Meteorological Satellite Data Receiving System

Name of Site: DMH Head Office (Meteorological Radar Tower Building)		
Equipment	Quantity	Purpose
Satellite Data Receiving Antenna	1 set	To receive Meteorological Satellite Data via a commercial Telecommunication Satellite
Low Noise Block Downconverter (LNB)	1 set	
Satellite Data Receiving Unit	1 set	To demodulate Meteorological Satellite Data
High Resolution Meteorological Satellite Data Acquisition Unit	1 set	To process raw data for Satellite Data Analysis Unit and monitoring the system operation
High Resolution Meteorological Satellite Data Analysis Unit	1 set	To analyze the formatted data and processing high level meteorological output suitable for weather forecasting, event evaluation and research
Dual Switch-2	1 set	To connect all the computer equipment to LAN
Dual Optical Repeater	2 sets	To convert electrical and optical signal on LAN for protection against surges
Automatic Voltage Regulator (AVR)	2 sets	To supply constant or regulated voltage to the system
Compact UPS	2 sets	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	2 sets	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

High Resolution Meteorological Satellite Data Receiving System

Name of Site: Vientiane International Airport (Control Tower)		
Equipment	Quantity	Purpose
High Resolution Meteorological Satellite Data Display Unit	1 set	To display Meteorological Satellite Data
Automatic Voltage Regulator (AVR) -2	1 set	To supply constant or regulated voltage to the system
Compact UPS	1 set	To supply back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	1 set	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

Automatic Weather Observation System + Meteorological Data Encoding PC

Name of Site: 18 Automatic Weather Observation Stations			
Equipment		Quantity	Purpose
Wind Speed and Direction Sensor		18 sets	To observe wind speed and direction
Temperature and Humidity Sensor		18 sets	To observe temperature and humidity
Barometer		18 sets	To observe air pressure
Rain Gauge		18 sets	To observe precipitation
Pedestal for Rain Gauge		18 sets	To set-up rain gauge
Sunshine Duration Sensor		18 sets	To observe sunshine duration
Sunshine Radiation Sensor		18 sets	To observe sunshine radiation
Soil Temperature Sensor (5cm, 10cm, 20cm, 50cm and 100cm)		18 sets	To observe soil temperature
Evaporation Gauge		10 sets	To observe evaporation
AWS Data Logger Module		18 sets	To collect weather observation data from each sensors and transmit such data to the Data Acquisition Unit at the DMH Head Office
Observation Data Display		18 sets	To display observed data
GSM/GPRS Modem		18 sets	To transmit observation data over a cell phone network
AWS Enclosure		18 sets	To accommodate Data Logger Module and GSM/GPRS Modem
Solar Power System Enclosure		18 sets	To accommodate Solar Power System
Solar Power Supply System		18 sets	To generate and supply electric power to the System
10m Freestanding Tower		18 sets	To mount the observation equipment and other related devices
Meteorological Data Encoding PC		18 sets	To encode observation data
Automatic Voltage Regulator (AVR) -2		18 sets	To supplying constant or regulated voltage to the system
Compact UPS		18 sets	To supplying back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts	Wind Speed and Direction Sensor	4 sets	To maintenance of the system
	Built-in Bearing Replacement Kit	18 sets	
	Temperature and Humidity Sensor Base	4 sets	
	Temperature Sensor Module and Humidity Sensor Module	4 sets	
	Barometer	4 sets	
	Rain Gauge	4 sets	
	Sunshine Duration Sensor	4 sets	
	Sunshine Radiation Sensor	4 sets	
	Soil Temperature Sensor (5cm, 10cm, 20cm, 50cm and 100cm)	4 sets	
	Evaporation Gauge	4 sets	
	AWS Data Logger Module	4 sets	
	Observation Data Display	4 sets	
	GSM/GPRS Modem	4 sets	
	AWS Enclosure	4 sets	
	Solar Power System Enclosure	4 sets	
	Meteorological Data Encoding PC	4 sets	
	Solar Power Supply System	4 sets	
	LAN Arrester	18 sets	
Service Manuals		21 sets	To maintenance of the system

Automatic Water Level + Rainfall Observation System

Name of Site: 8 Automatic Water Level + Rainfall Observation Stations			
Equipment		Quantity	Purpose
Water Level Sensor		8 sets	To observe water level
Rain Gauge		8 sets	To observe precipitation
Water Level + Rainfall Data Logger Module		8 sets	To collect water level + rainfall observation data from each sensors and transmit such data to the Data Acquisition Unit at the DMH Head Office
GSM/GPRS Modem		8 sets	To transmit observation data over a cell phone network
Water Level + Rainfall Observation System Enclosure		8 sets	To accommodate Data Logger Module and GSM/GPRS Modem
Solar Power System Enclosure		8 sets	To accommodate Solar Power System
Solar Power Supply System		8 sets	To generate and supply electric power to the System
Aluminum Step Ladder		8 sets	To maintenance of the system
Spare Parts	Water Level Sensor	2 sets	To maintenance of the system
	Rain Gauge	2 sets	

	Water Level + Rainfall Data Logger Module	2 sets	
	GSM/GPRS Modem	2 sets	
	Water Level + Rainfall Observation System Enclosure	1 set	
	Solar Power System Enclosure	1 set	
	Solar Power Supply System	2 sets	
Service Manuals		2 sets	To maintenance of the system

Automatic Weather Observation Data Management System

Name of Site: DMH Head Office (Equipment Shed)		
Equipment	Quantity	Purpose
Automatic Weather Observation Data Acquisition Unit	2 sets	To collect and process observed data from each observation point for recording.
GSM/GPRS Multiple Communication Unit	2 sets	To receive observation data to be sent over cell phone network.
Observation Data Storage Server	1 set	To store observation data and information
Encoded Meteorological Observation Data Processing Unit	1 set	To process encoded meteorological observation data
Portable Data Comparison & Maintenance Tools	2 sets	For maintenance of the system
Data Comparison & Maintenance Tools (Standard Devices)	1 set	For maintenance of the system
Spare Parts LAN Arrester	4 sets	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

Automatic Weather Observation Data Management System

Name of Site: DMH Head Office (Meteorological Radar Tower Building)		
Equipment	Quantity	Purpose
Automatic Weather Observation Data Display Unit	1 set	To display weather observation data and information
Encoded Meteorological Observation Data Monitoring Unit	1 set	To monitor encoded meteorological observation data
Automatic Voltage Regulator (AVR) -2	2 sets	To supplying constant or regulated voltage to the system
Compact UPS	2 sets	To supplying back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	2 sets	For maintenance of the system
Service Manuals	2 sets	2 sets

Automatic Water Level + Rainfall Observation Data Management System

Name of Site: DMH Head Office (Equipment Shed)		
Equipment	Quantity	Purpose
Automatic Water Level + Rainfall Observation Data Acquisition Unit	2 sets	To collect and process observed data from each observation point for recording
GSM/GPRS Multiple Communication Unit	2 sets	To receive observation data to be sent over cell phone network
Portable Maintenance Tools	1 set	For maintenance of the system
Spare Parts LAN Arrester	2 sets	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

Automatic Water Level + Rainfall Observation Data Management System

Name of Site: DMH Head Office (Meteorological Radar Tower Building)		
Equipment	Quantity	Purpose
Automatic Water Level + Rainfall Observation Data Display Unit	1 set	To display water level and rainfall observation data and information
Automatic Voltage Regulator (AVR) -2	1 set	To supplying constant or regulated voltage to the system
Compact UPS	1 set	To supplying back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Spare Parts LAN Arrester	1 set	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

Automatic Water Level + Rainfall Observation Data Management System

Name of Site: DMH Head Office (Hydrology Division Office)		
Equipment	Quantity	Purpose
Automatic Water Level + Rainfall Observation Data Display Unit	1 set	To display water level and rainfall observation data and information
Automatic Voltage Regulator (AVR) -2	1 set	To supplying constant or regulated voltage to the system
Compact UPS	1 set	To supplying back-up AC power to the computer equipment in order to enable the proper shutdown of the system in case of power failure
Dual Optical Repeater	1 set	To convert electrical and optical signal on LAN for protection against surges
Spare Parts LAN Arrester	1 set	For maintenance of the system
Service Manuals	2 sets	For maintenance of the system

(3) Basic Plan of the Ancillary Facility

The Ancillary Facilities to be constructed under the Project are indicated in the following table.

Table22: Ancillary Facilities

Component	Places	Quantity
Power Back-up Shed	DMH Head Office (Vientiane)	1
Equipment Shed	DMH Head Office (Vientiane)	1
Concrete Shelter and Water Level Observation Facility	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)

1) Site and Ancillary Facility Layout Plan

The site for the construction of the Ancillary Facilities is located in the premises of the DMH Head Office. The premises of the DMH Head Office are sufficiently large enough to accommodate the Ancillary Facilities and are adjacent to residential areas. Its main entrance is located in the northern side facing the national road route 1 while another entrance is in the southern side facing the Mekong River.

Regarding the infrastructure, power supply, water supply and telephone lines are available; however, there is no drainage and sewerage facilities.

<Site Conditions>

Construction Site : sufficient and flat
Power Supply : AC 380V, 3 phases and 4 wires, 50Hz is available
Water Supply : available
Sewerage : not available
Telephone : the existing or new lines are usable

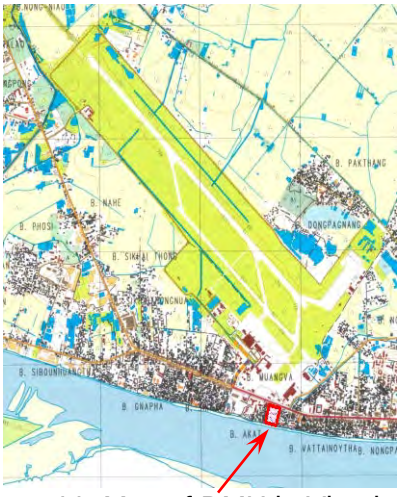


Figure11: Map of DMH in Vientiane

In addition, each site for the installation of the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS) has enough space.

2) Architectural Design

[1] Floor Plan

Construction methods and materials follow local practice and the buildings are of standard grade in Lao P.D.R. The floor area of each room, the room's function and the method of calculation of the size of each room are shown in the following tables.

Table23: Calculation Base of Each Ancillary Facility

Name of Room	Floor Area (m^2)	Room Function	Calculation Base
Power Back-up Shed	26.73	For installation of 2 engine generators, 1,000 litter service tank, battery, isolation transformer, automatic change-over switch , etc.	Operation and maintenance space for engine generators (2)
Equipment Shed	38.85	For installation of Automatic Weather Observation Data Management System, Automatic Water Level + Rainfall Observation Data Management System, GTS Message Switch System and World Meteorological Organization Information System (WIS), AVR, UPS, Shelves of Maintenance Instruments and Air-conditioners.	Operation and maintenance space for the equipment
Concrete Shelter	3.24	For installation of battery, battery controller and ladder for Automatic Water Level + Rainfall Observation System	Operation and maintenance space for the equipment

[2] Internal and External Finishing Plan

Materials specified for both the exterior and interior finishing, which are all available locally, have been selected with a view to ease maintenance for the DMH and are as follows.

Table24: Finishing Materials of Each Ancillary Facility

Finishing Materials of Power Back-up Shed		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base spray tile finish
Interior Finishing	Floors	Cement sand mortal base, Epoxy resin paint finish
	Skirting	Cement sand mortar base, Epoxy resin paint finish
	Wall	Cement sand mortal base, Vinyl paint finish
	Ceiling	Fare-faced Concrete Cement sand mortar base Emulsion paint finish
Window and Door	Exterior	Glass block, Aluminum window, Aluminum grille, Aluminum door, Stainless steel door
	Interior	Aluminum door
Finishing Materials of Equipment Shed		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base spray tile finish
Interior Finishing	Floors	Vinyl tile finish
	Skirting	Wooden Skirting, Vinyl paint finish
	Wall	Cement Sand mortal base, Vinyl paint finish
	Ceiling	Fare-faced Concrete, Acoustic panels
Window and Door	Exterior	Glass block, Aluminum window, Stainless steel door

Finishing Materials of Concrete Shelter		
Exterior Finishing	Roof Floor	Fare-faced Concrete
	Wall	Concrete blocks Fare-faced Concrete Cement sand mortar base vinyl paint finish
Interior Finishing	Floors	Cement sand mortal base
	Skirting	Cement sand mortar base
	Wall	Cement Sand mortal base
	Ceiling	Fare-faced Concrete Cement sand mortar base
Window and Door	Exterior	Stainless steel door

[3] Structural Plan

I. Structural Design Standard

Based on the UBC (United Building Code) which is commonly used in Asian countries, the structural design of the Ancillary Facilities is implemented in conformity with Thai and Japanese standards.

II. Structure Type

Reinforced concrete has been selected as the construction material for the proposed ancillary facilities as reinforced concrete construction is the most typical structural type in Lao P.D.R. The floor slabs are to be reinforced concrete while the exterior walls and partition walls are to be locally made of concrete blocks.

[4] Electrical Facility Design

I. Power intake facility

Power Back-up Shed: 380V, 3-phase, 4-wire
Equipment Shed: 380V, 3-phase, 4-wire

II. Lighting and power outlet

All lighting fixtures will be LED for their low power consumption. The lighting levels in the various rooms will be approximately as shown below.

Power Back-up Shed: 200 Lx
Equipment Shed: 300 Lx

General-purpose power outlets will be equipped with switches. Dedicated power outlets are required in the Equipment Shed for the computing equipment.

III. Grounding system

All the equipment to be installed in the Power Back-up Shed and the equipment Shed will be connected to a terminal box grounded by erecting a grounding electrode and running a wire from there to the terminal box.

IV. Fire extinguisher

Fire extinguishers will be supplied in the following rooms.

Power Back-up Shed: ABC Type × 2
Equipment Shed: CO_2 Type × 2

[5] Air-conditioning and Ventilation System Design

Air-conditioning systems will be installed in the Equipment Shed. It is essential to have a good operating environment, especially for the equipment. Therefore, 2 air-conditioning systems are indispensable. Package type air-conditioning systems have been selected to minimize any impact to the operation in the event that an air-conditioning system fails.

2-2-3 Outline Design Drawing

The following design drawings for the Project are attached hereunder.

<Equipment Shed and Power Back-up Shed>

- Floor Plan and Section : EQS-01
- Elevation : EQS-02
- Equipment Layout Plan : ELP-01

<Automatic Weather Observation System>

- 10m Free-standing Tower and Foundation : AWS-01

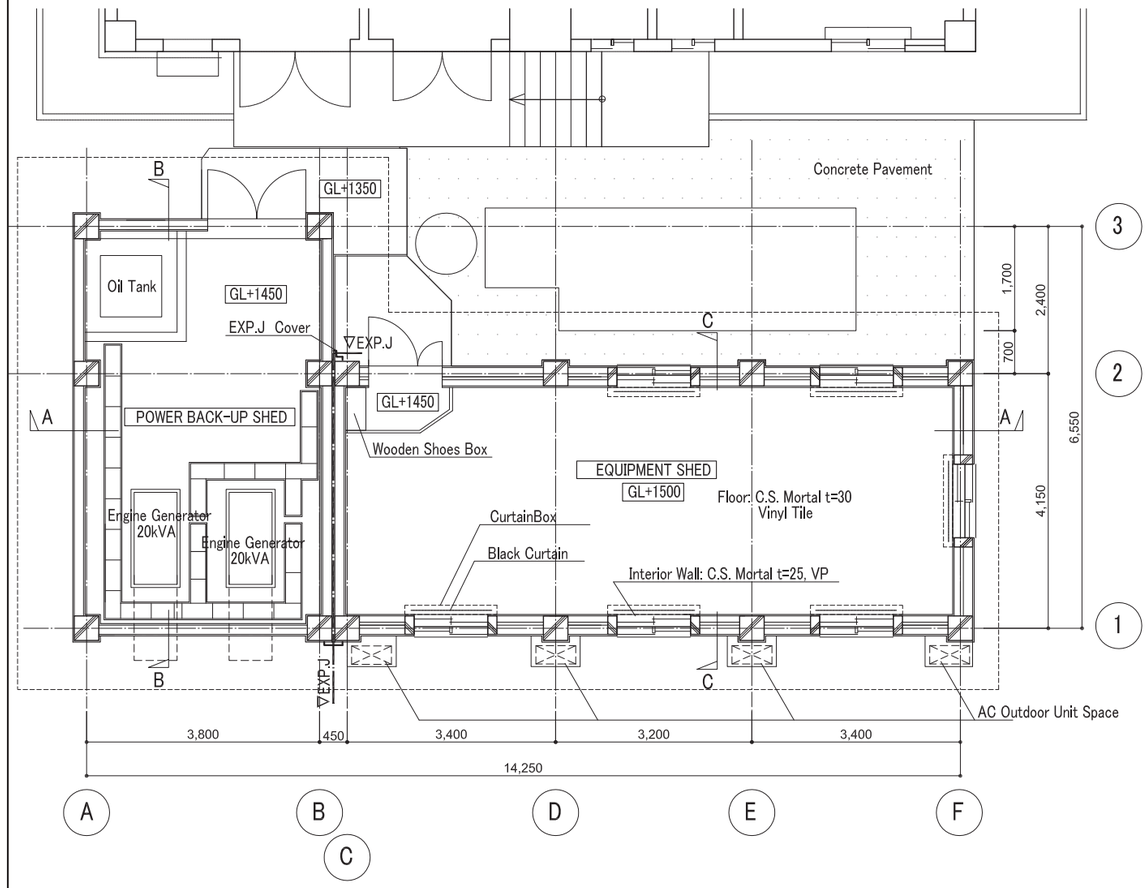
<Automatic Water Level + Rainfall Observation System>

- Ban Dong Makfai : AWL-01
- Na Teu : AWL-02
- Ban Kengkok : AWL-03
- Dong Hence : AWL-04
- Souvannakhily : AWL-05
- Phonbok : AWL-06

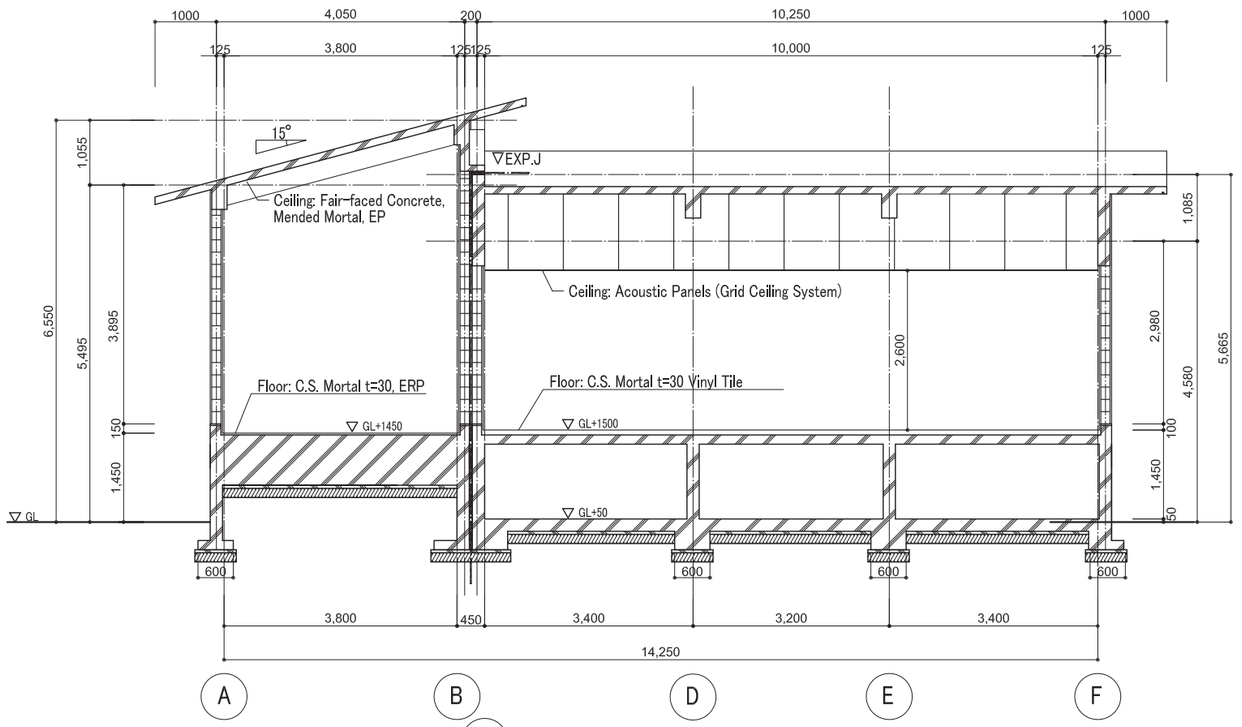
- Phon Xai : AWL-07
- Nang Yong : AWL-08

<Concrete Shelter>

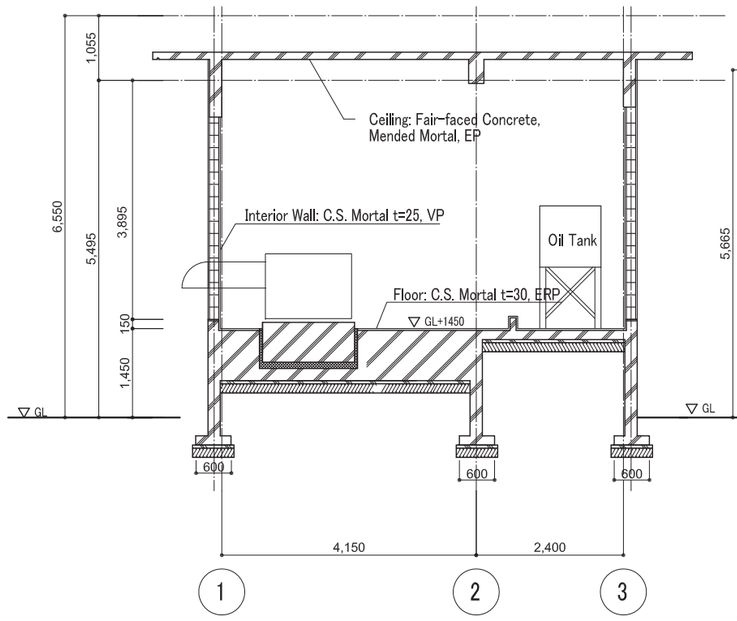
- Floor Plan, Section and Elevation : CS-01



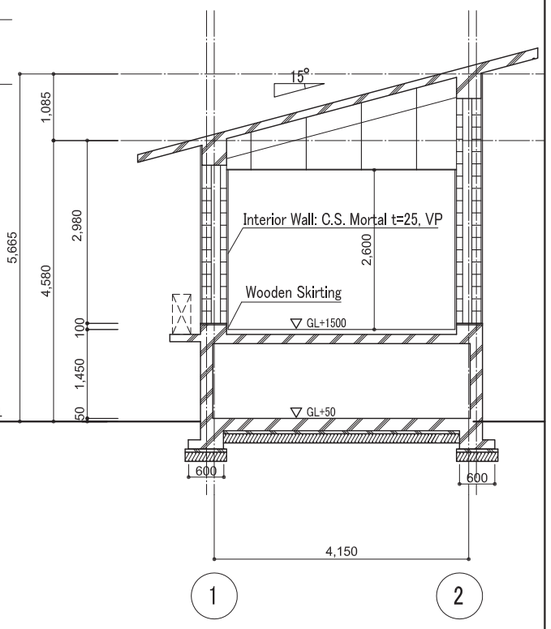
FLOOR PLAN



SECTION A-A



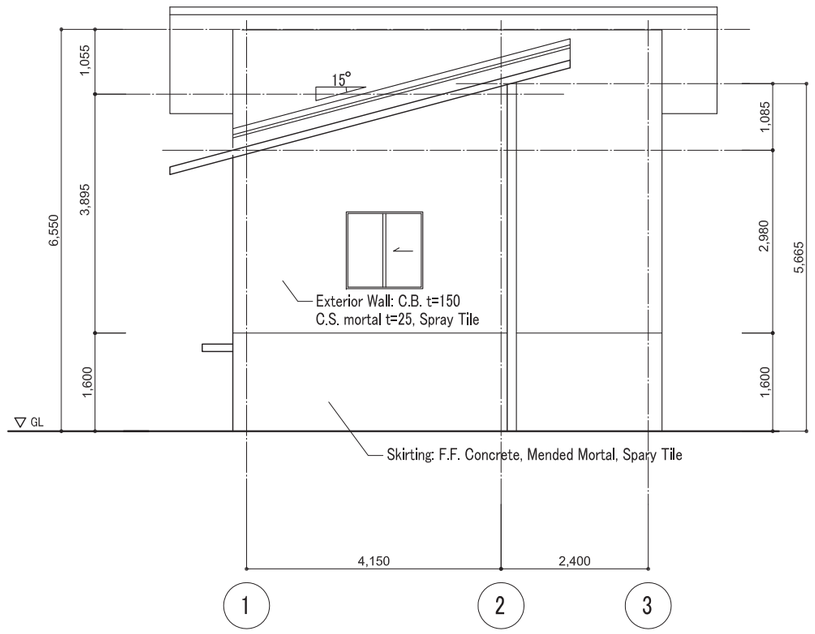
SECTION B-B



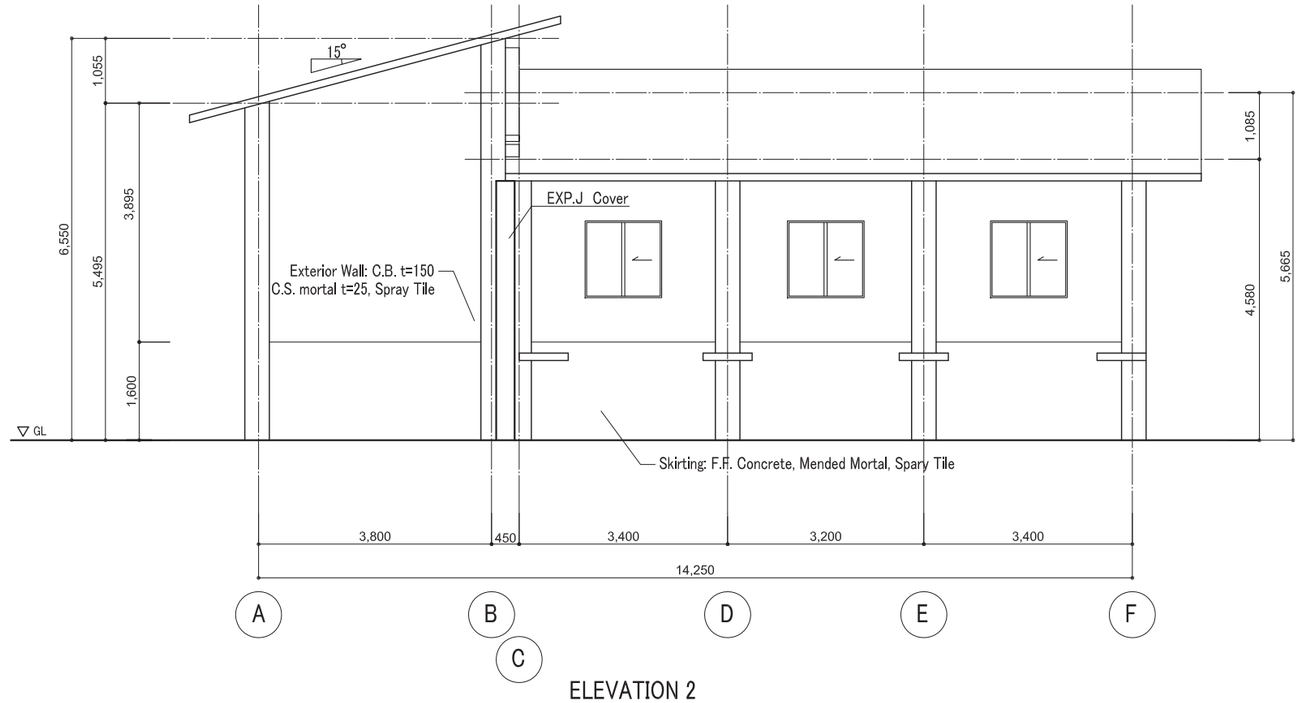
SECTION C-C

ABBREVIATIONS
- C.S. Mortal: Cement sand mortal
- EP: Emulsion Paint
- VP: Vinyl Paint
- ERP: Epoxy resin paint
- F.F. Concrete: Fair-faced concrete

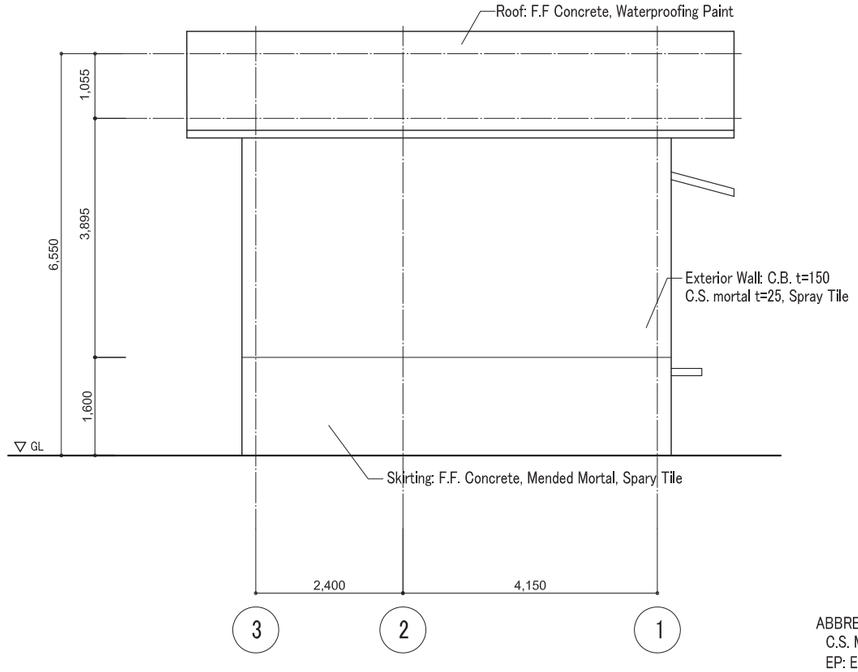
CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE EQUIPMENT SHED & POWER BACK-UP SHED FLOOR PLAN AND SECTION	SCALE 1:100	DRAWING No. EQS - 01



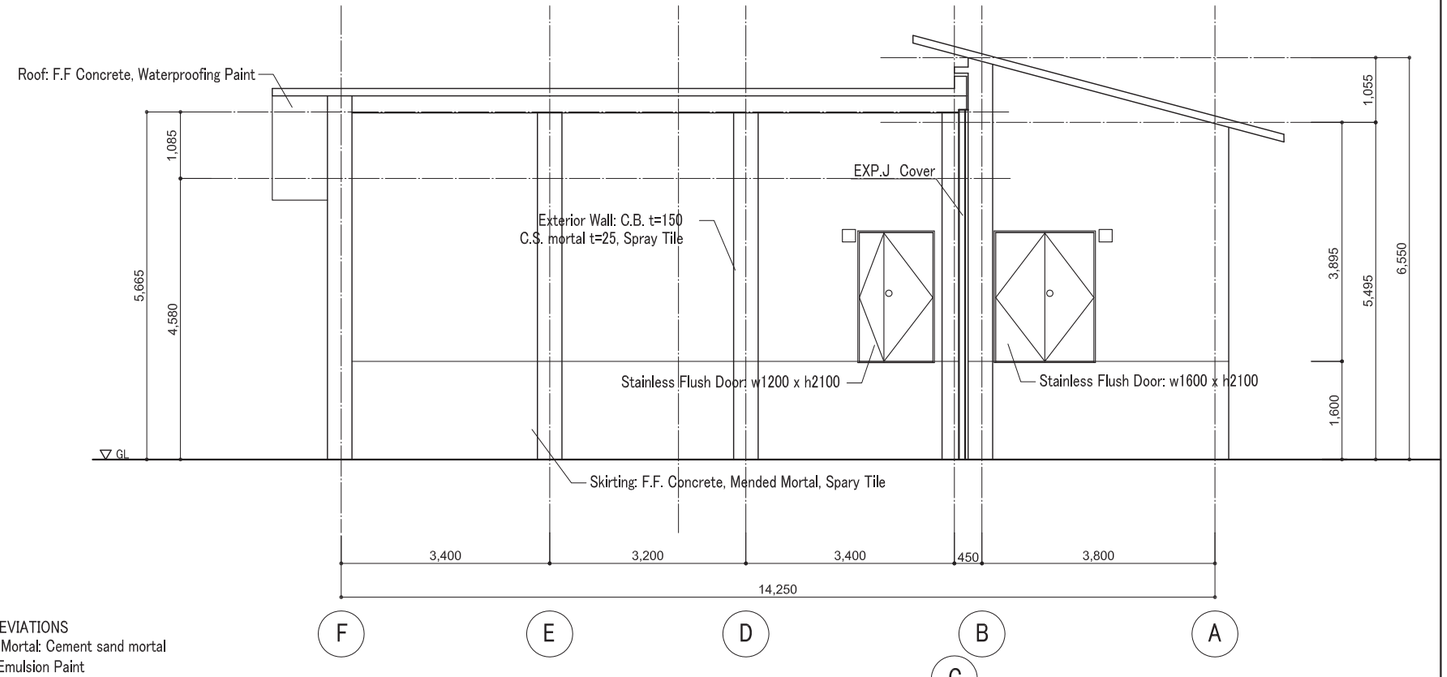
ELEVATION 1



ELEVATION 2



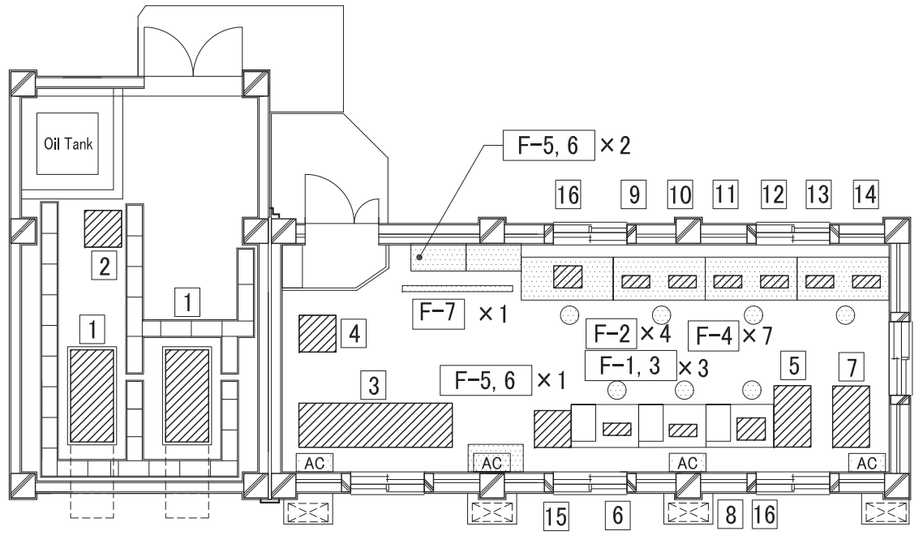
ELEVATION 3



ELEVATION 4

ABBREVIATIONS
- C.S. Mortal: Cement sand mortal
- EP: Emulsion Paint
- VP: Vinyl Paint
- ERP: Epoxy resin paint
- F.F. Concrete: Fair-faced concrete

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE EQUIPMENT SHED & POWER BACK-UP SHED ELEVATION	SCALE 1:100	DRAWING No. EQS - 02



FLOOR PLAN

FURNITURE

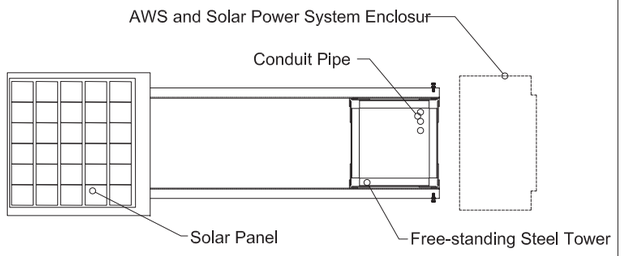
F-1	Pedestal Desk (W1,100 × D700)
F-2	Pedestal Desk (W1,500 × D700)
F-3	Drawer Unit with Casters
F-4	Chair
F-5	Lateral Filling Cabinet H1,100
F-6	Cabinet (Double Hinged Doors) H1,000
F-7	White Board (W1,800 × H900)

EQUIPMENT

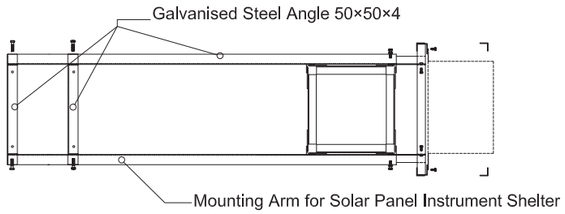
1	Diesel Engine Generator
2	Isolation Transformer
3	Power Supply Capacitor
4	Automatic Voltage Regulator
5	GTS Message Switch System
6	GTS Message Switch Control Unit
7	WMO Information System (WIS) Unit
8	WMO Information System (WIS) Control Unit
9	Automatic Weather Observation Data Acquisition Unit 1
10	Automatic Weather Observation Data Acquisition Unit 2
11	Observation Data Storage Server
12	Encoded Meteorological Observation Data Processing Unit
13	Automatic Water Level + Rainfall Observation Data Acquisition Unit 1
14	Automatic Water Level + Rainfall Observation Data Acquisition Unit 2
15	Communication Equipment Rack
16	Colour Printer
AC	Air-Conditioning Indoor Unit

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE EQUIPMENT SHED & POWER BACK-UP SHED EQUIPMENT LAYOUT PLAN	SCALE 1:100	DRAWING No. ELP - 01

Mouting Arm for Solar Panel and Instrument Shelter

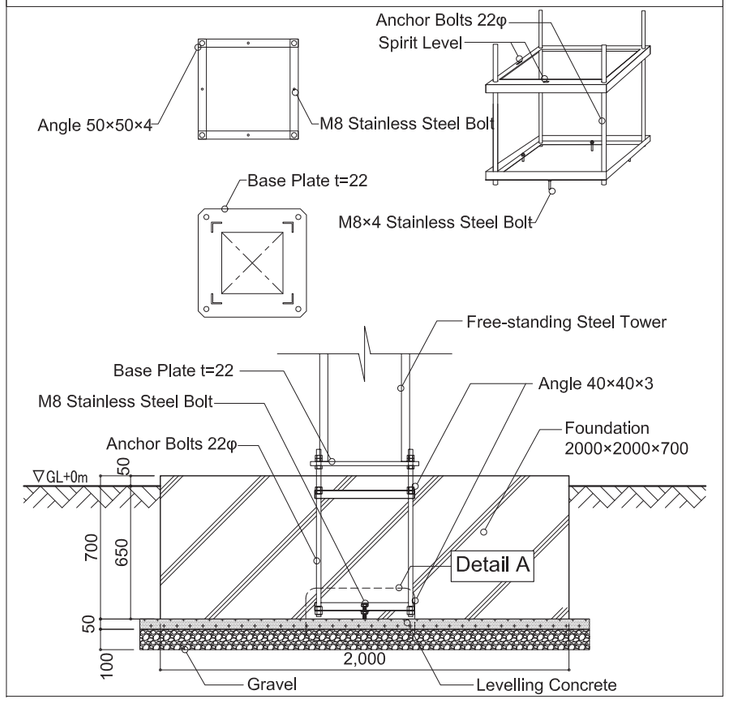


Overhead View

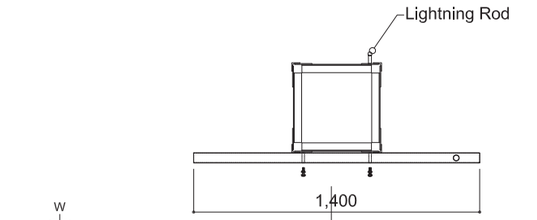


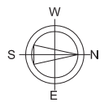
Frame Plan

Detail for Tower Base

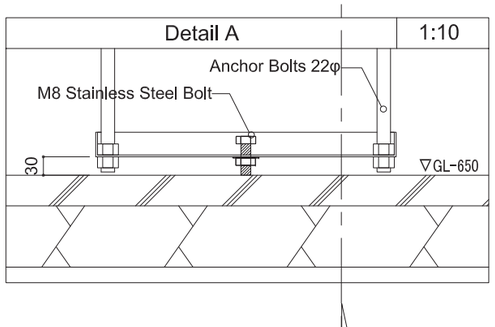


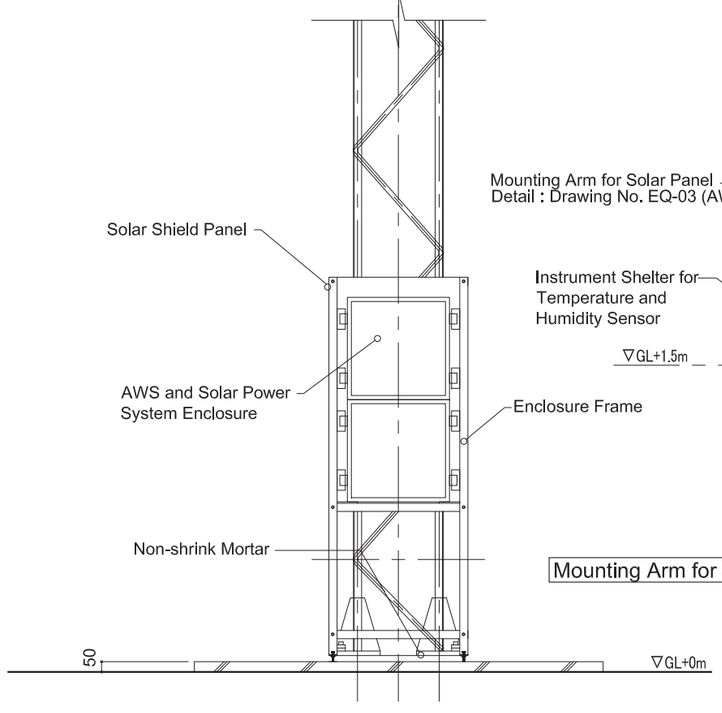
Detail : Drawing No. EQ-04 (AWS)



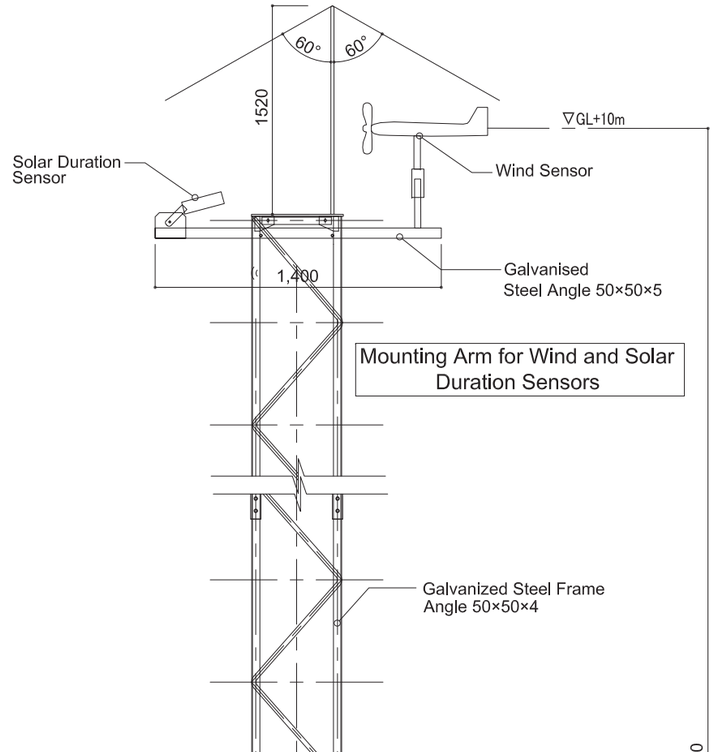


Overhead View of Mounting Arm for Wind and Solar Duration Sensors





North Elevation



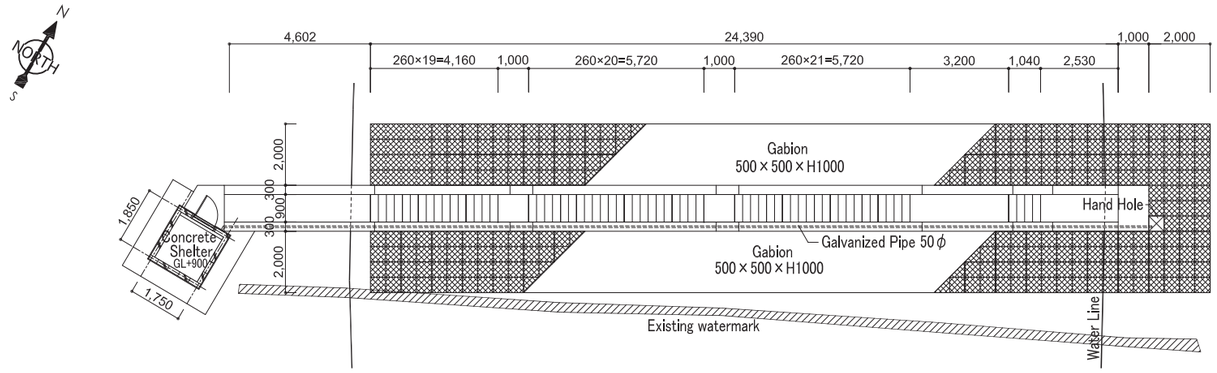
Mounting Arm for Wind and Solar Duration Sensors

Mounting Arm for Solar Panel and Instrument Shelter

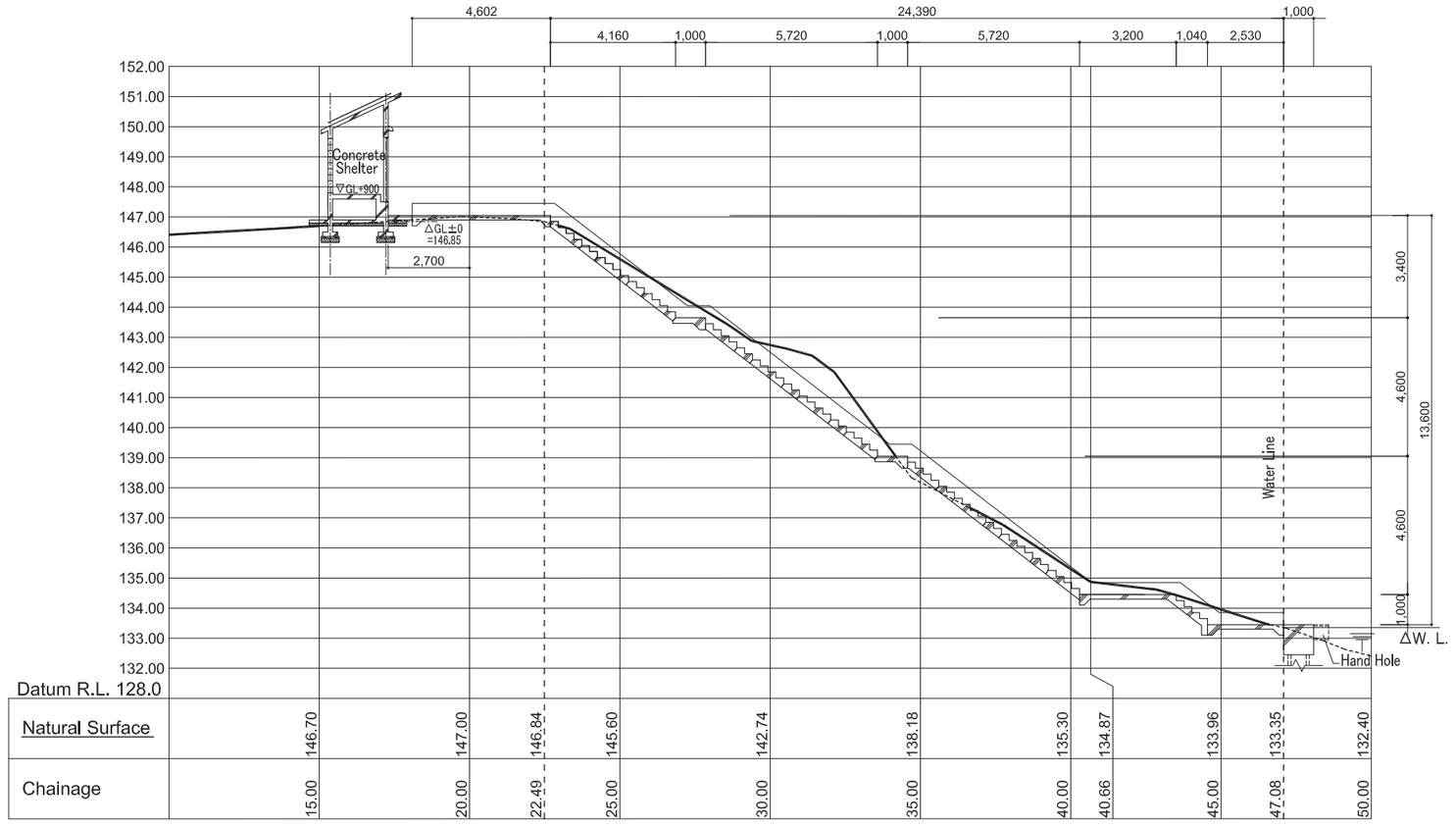
East Elevation

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WEATHER OBSERVATION SYSTEM 10m FREE-STANDING TOWER AND FOUNDATION	SCALE 1:30	DRAWING No. AWS - 01

PLAN

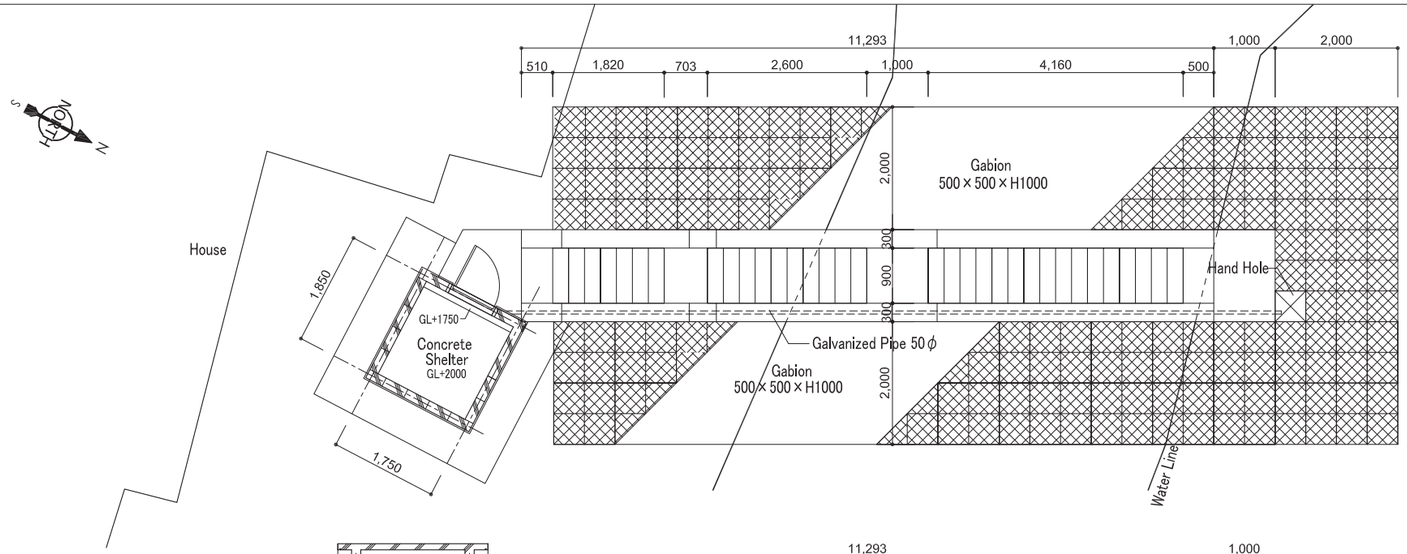


SECTION



CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Ban Dong Makfai	SCALE 1:200	DRAWING No. AWL - 01

PLAN



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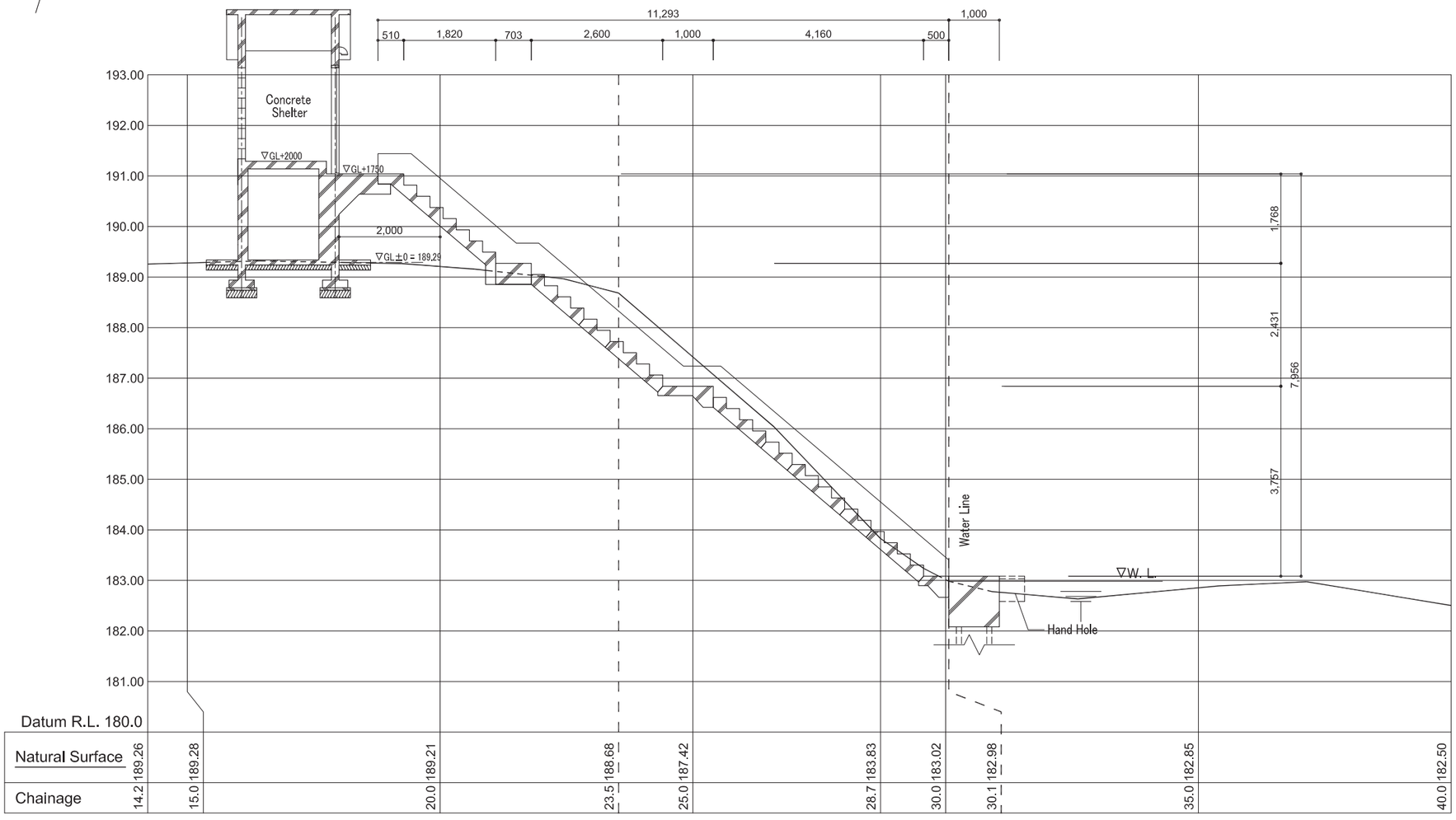
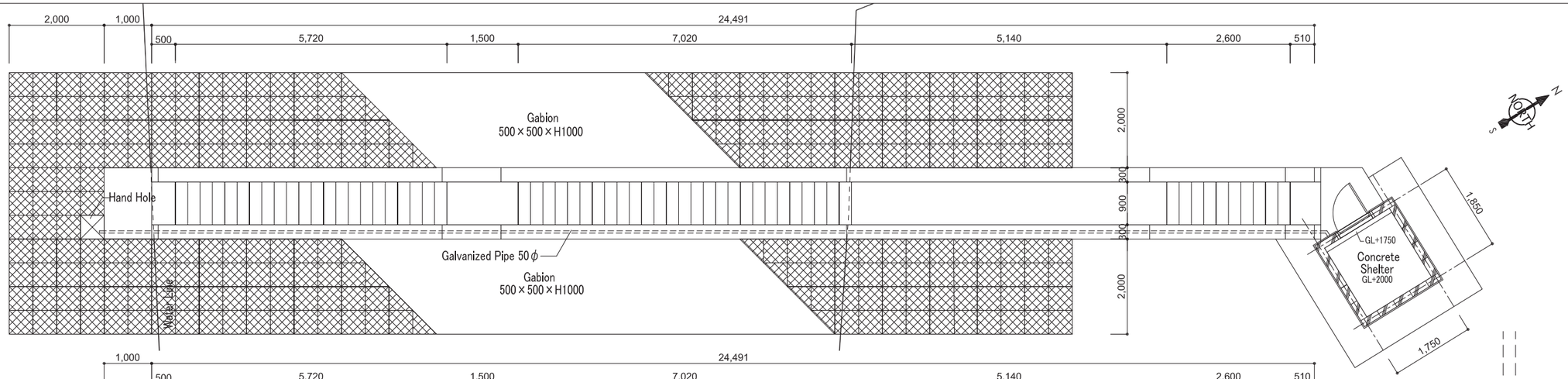
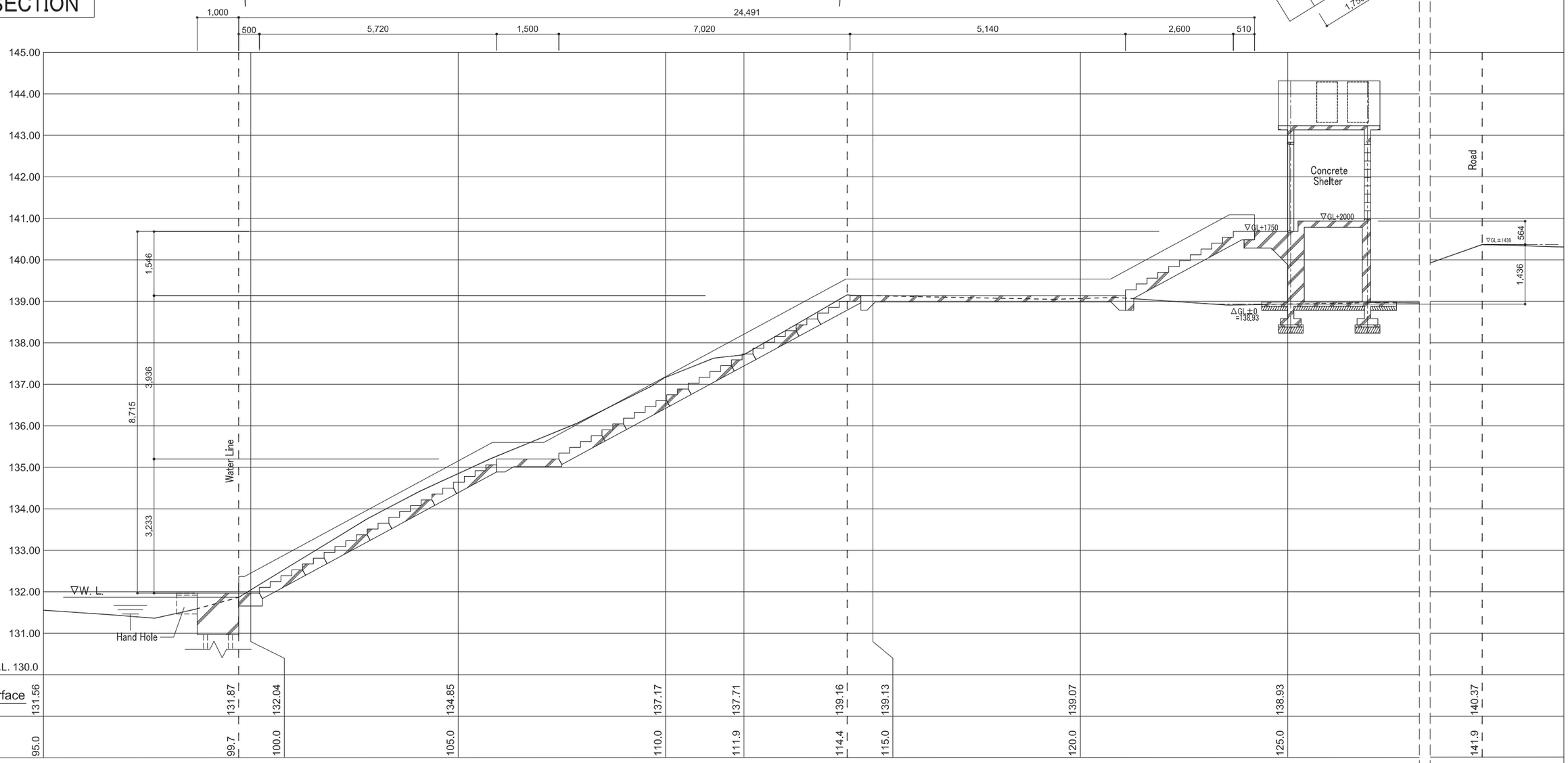


CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Na Teu	SCALE 1:100	DRAWING No. AWL - 02

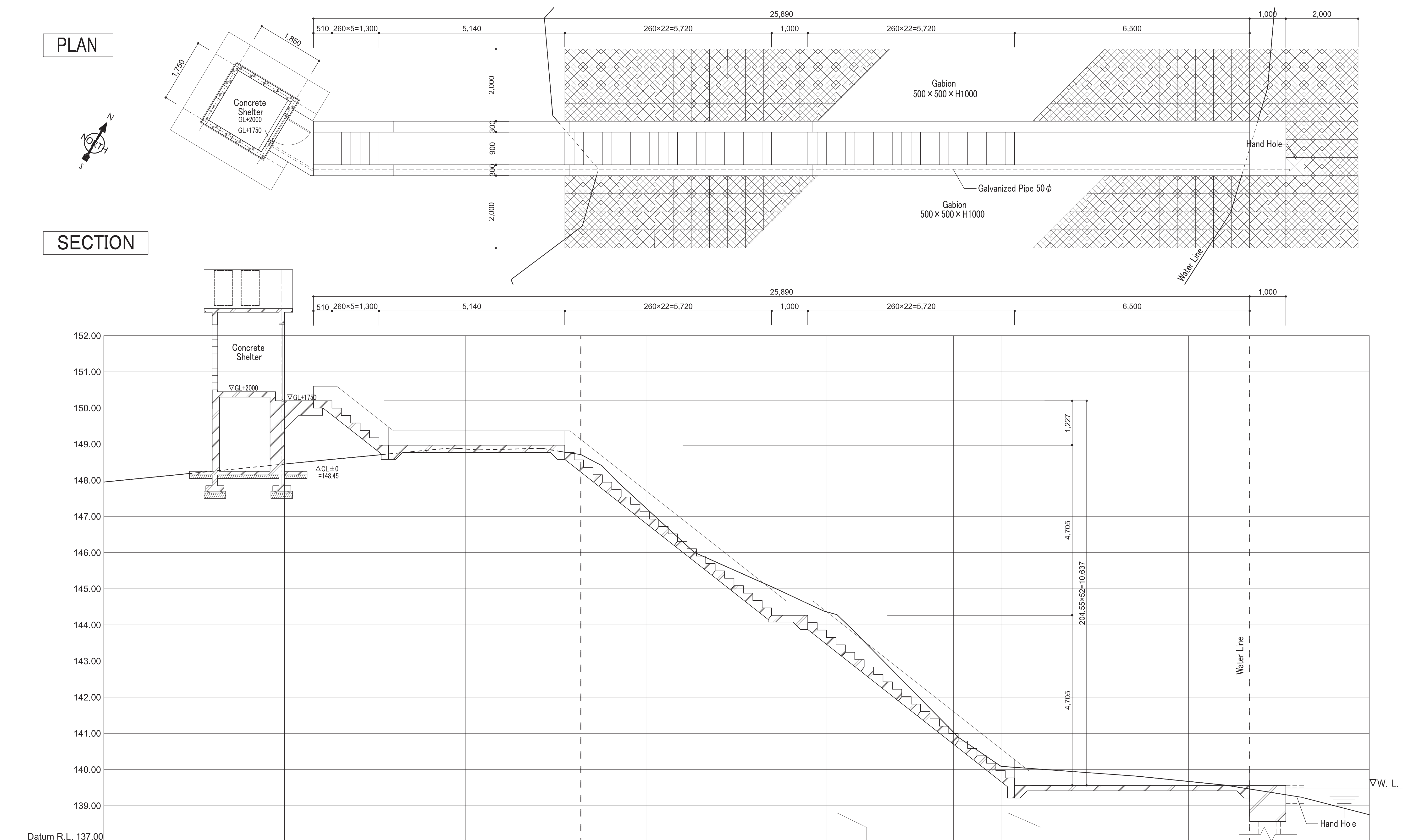
PLAN



SECTION



CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Ban Kengkok	SCALE 1:100	DRAWING No. AWL - 03



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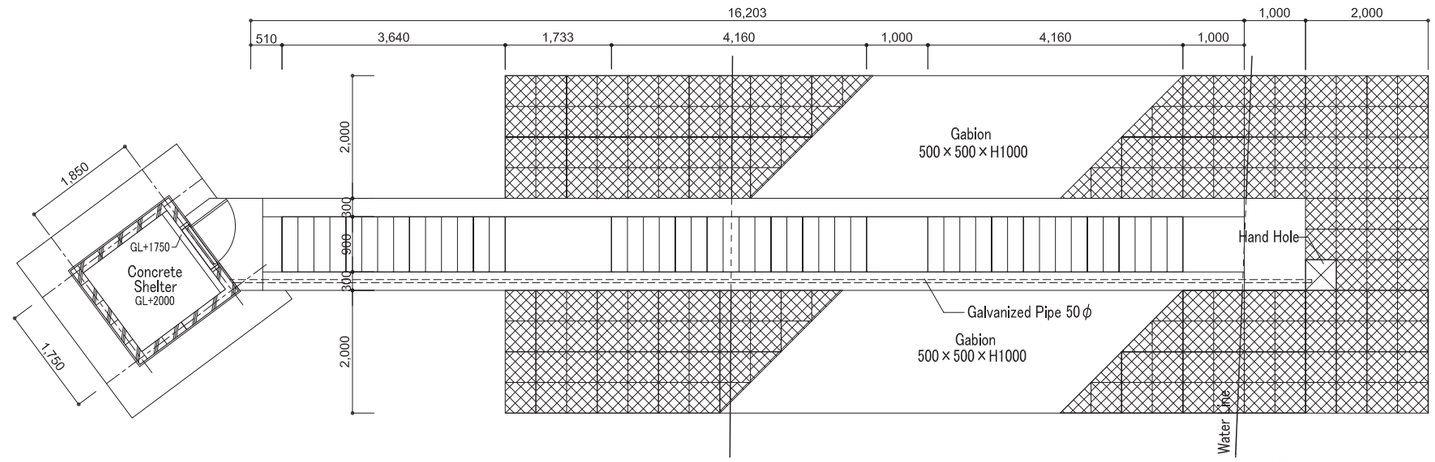
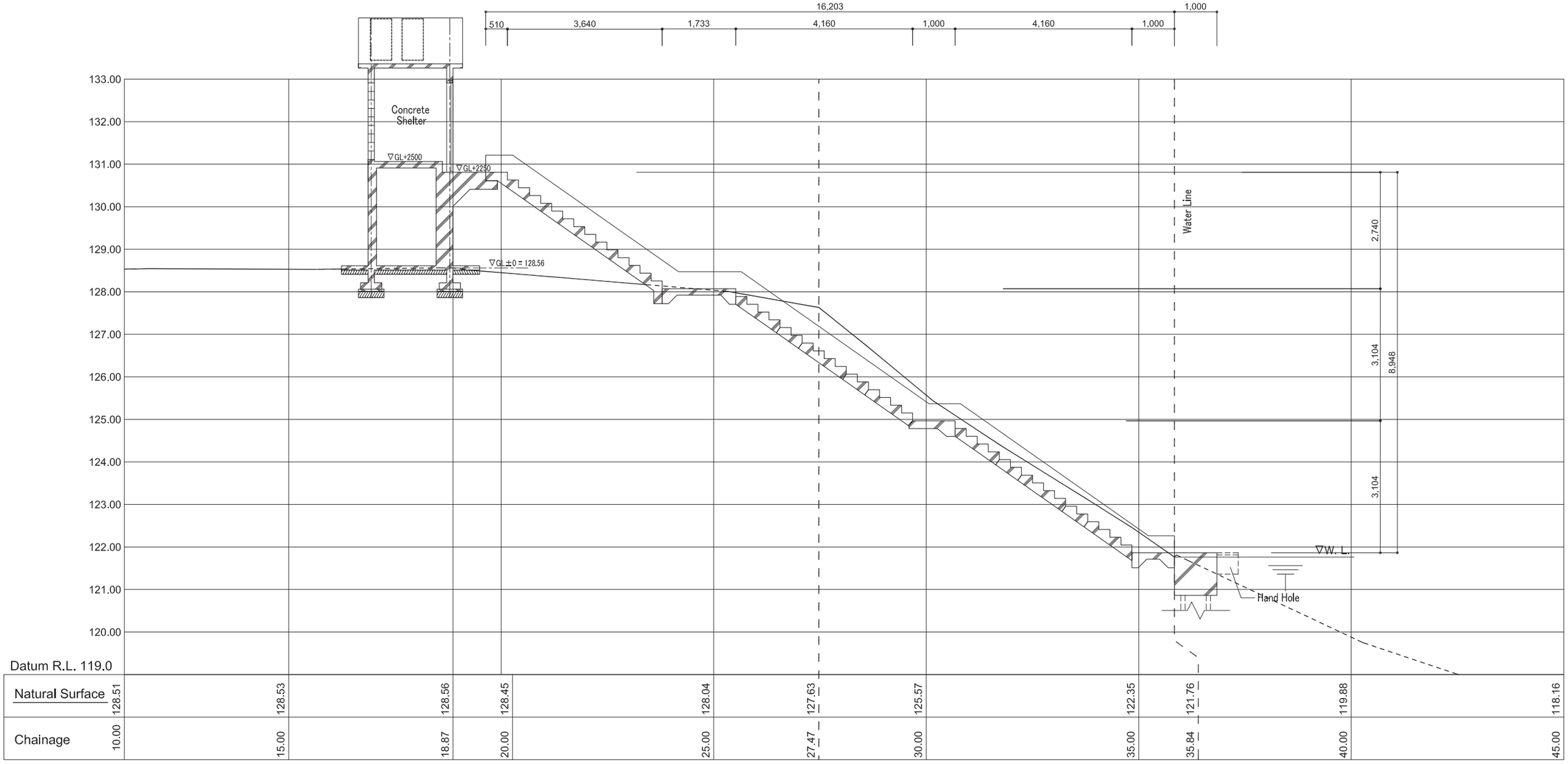
Chainage	5.0	10.0	15.0	18.2	20.0	25.0	25.3	28.5	29.8	30.0	35.0	36.7	40.0

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Dong Hence	SCALE 1:100	DRAWING No. AWL - 04

PLAN

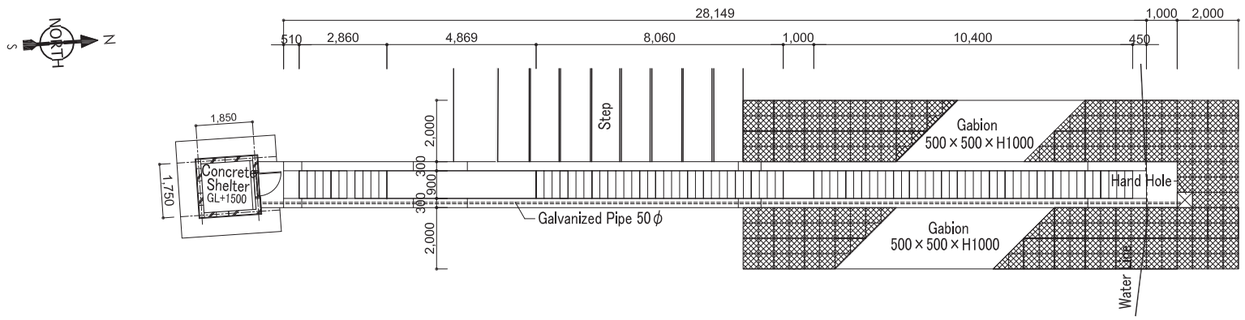


SECTION



CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Souvannakhily	SCALE 1:100	DRAWING No. AWL - 05

PLAN



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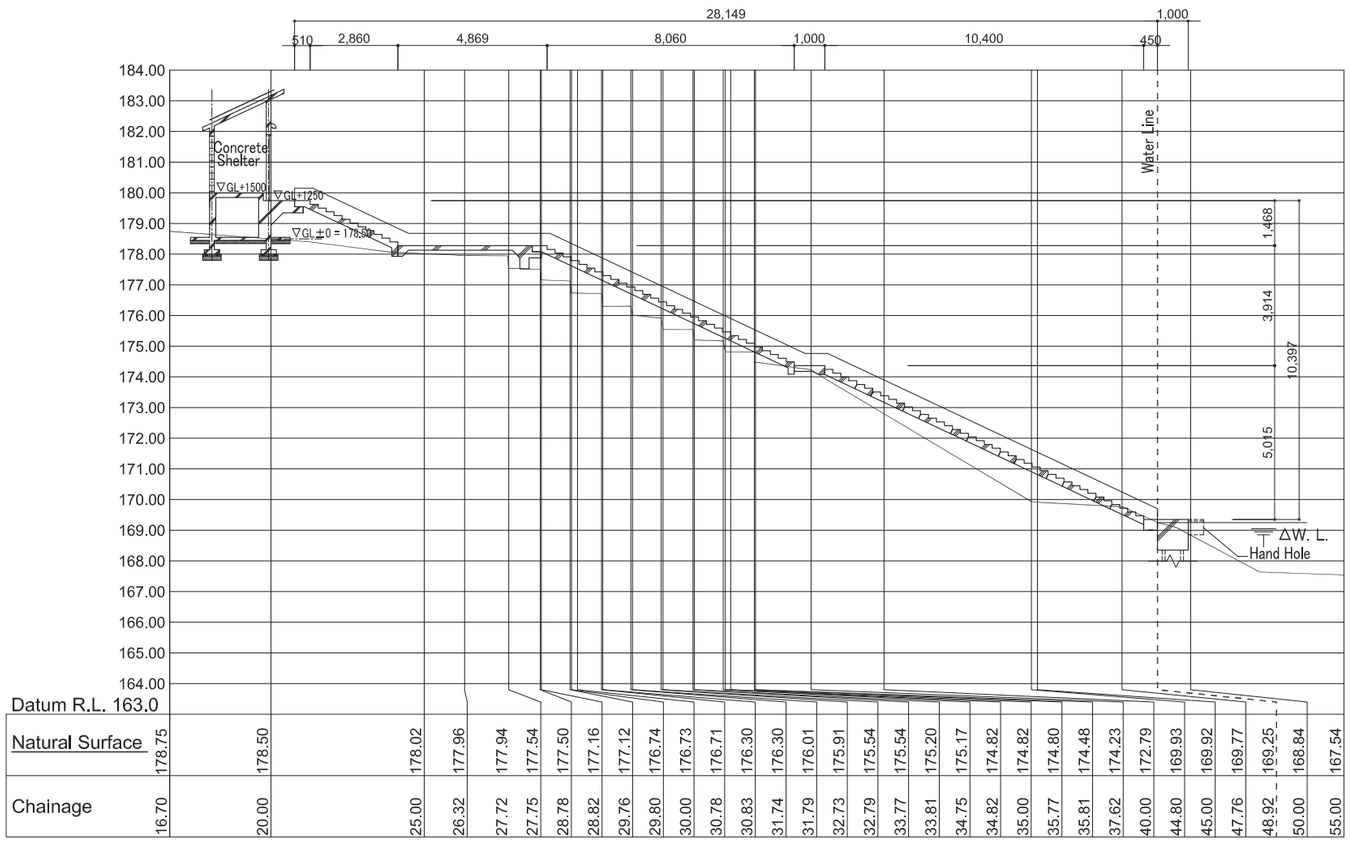
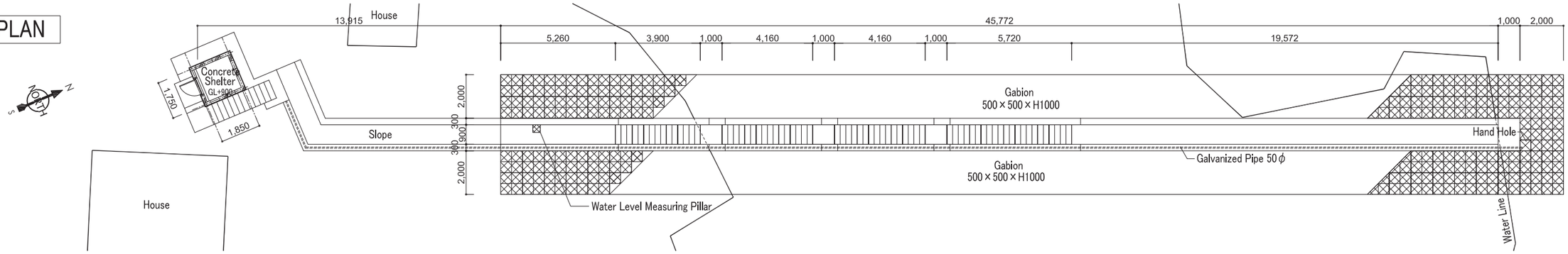


CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Phonbok	SCALE 1:200	DRAWING No. AWL - 06

PLAN



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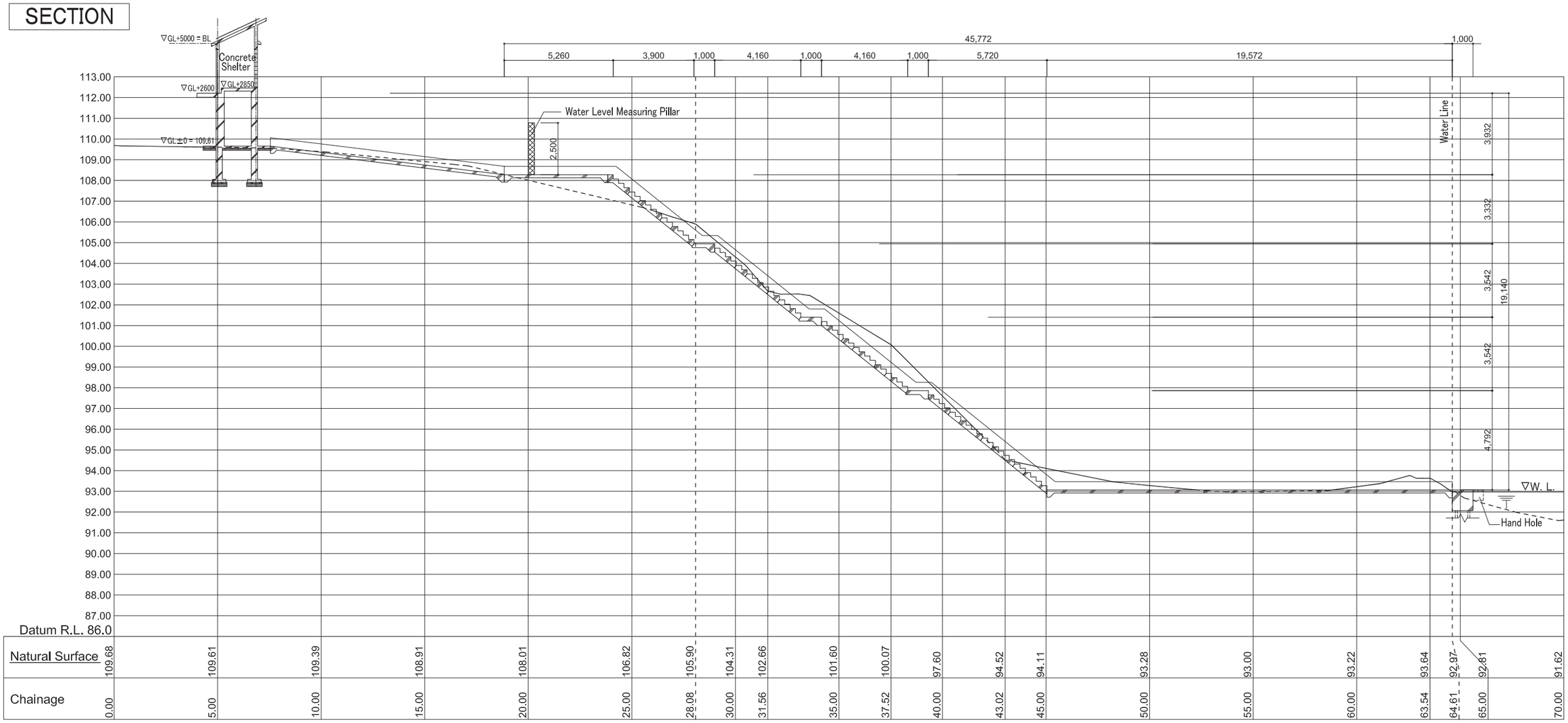

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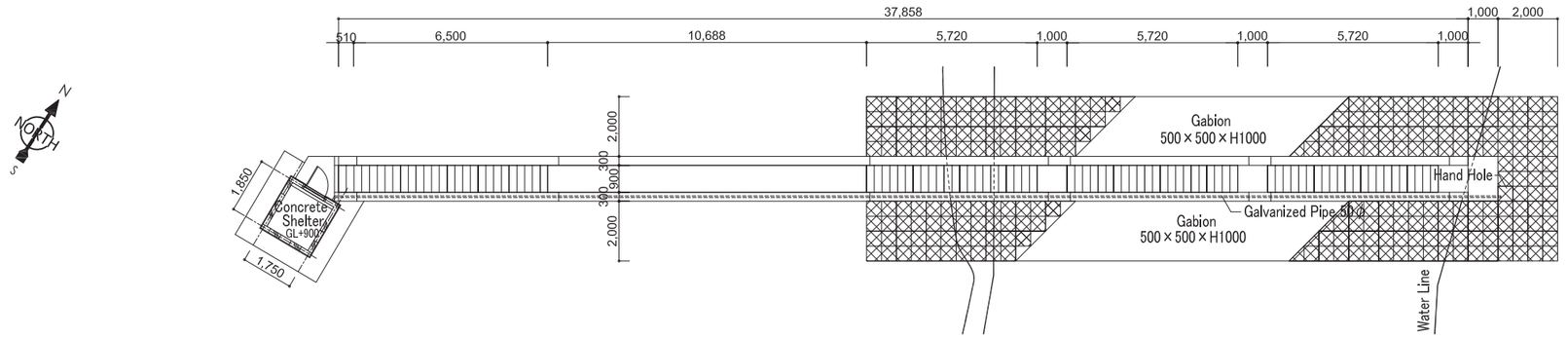
Chainage	0.00	5.00	10.00	15.00	20.00	25.00	28.08	30.00	31.56	35.00	37.52	40.00	43.02	45.00	50.00	55.00	60.00	63.54	64.61	65.00	70.00

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Phon Xai	SCALE 1:200	DRAWING No. AWL - 07

PLAN



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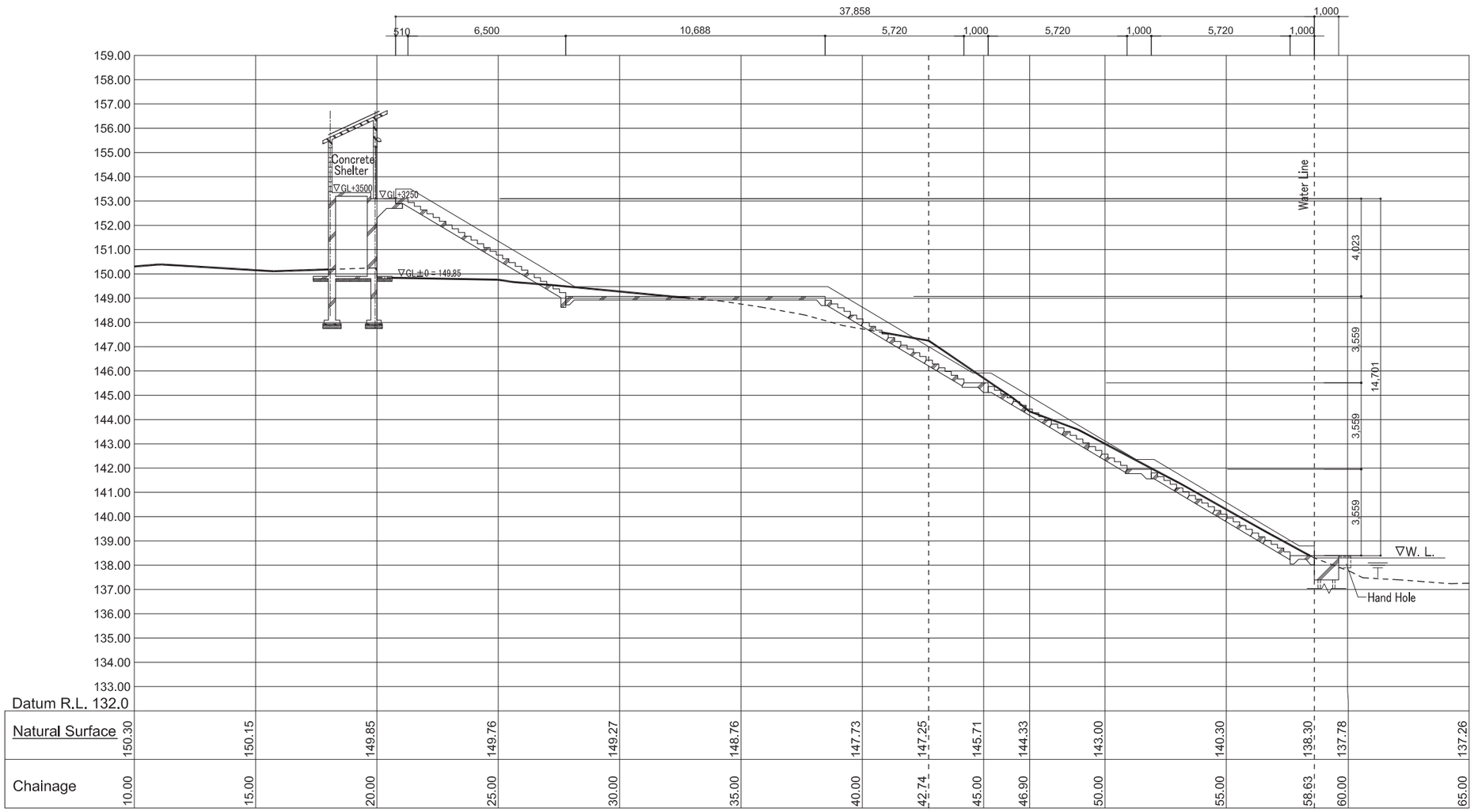
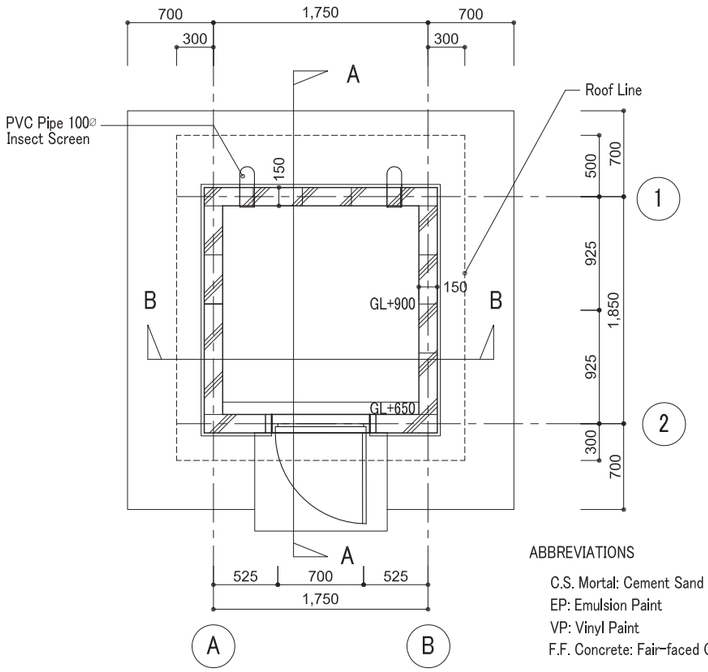


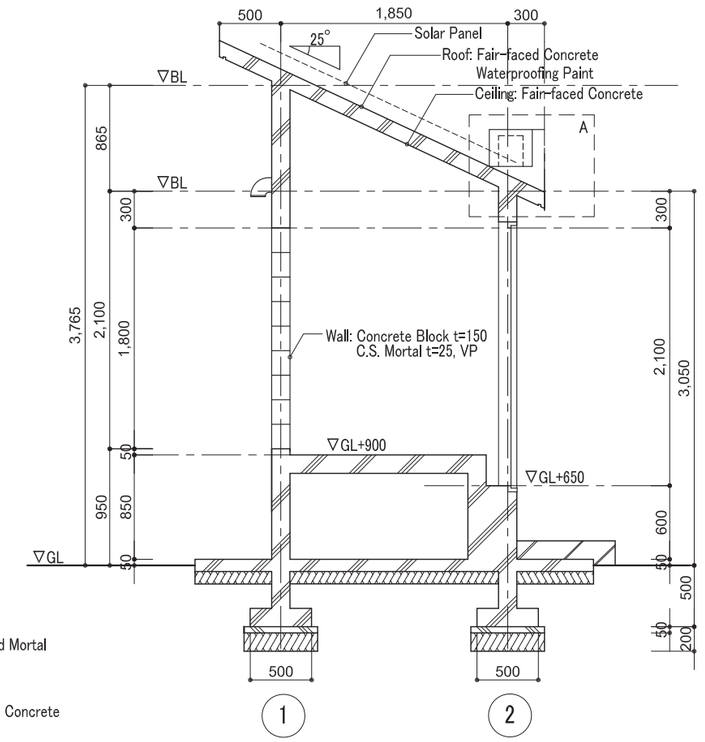
CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE AUTOMATIC WATER LEVEL + RAINFALL OBSERVATION SYSTEM Nang Yong	SCALE 1:200	DRAWING No. AWL - 08



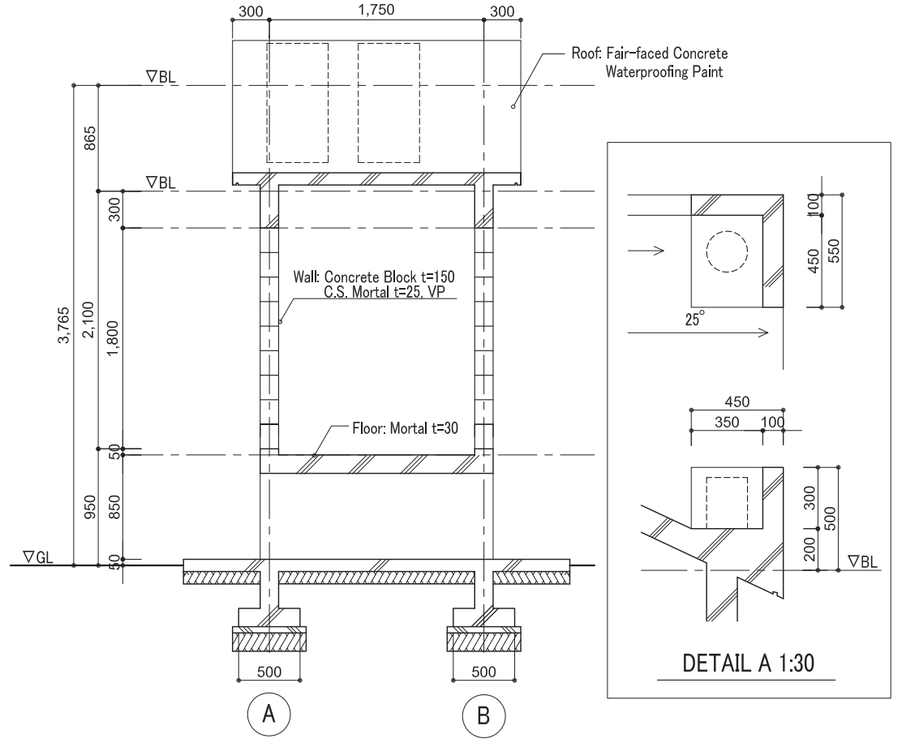
FLOOR PLAN SCALE 1:50

ABBREVIATIONS

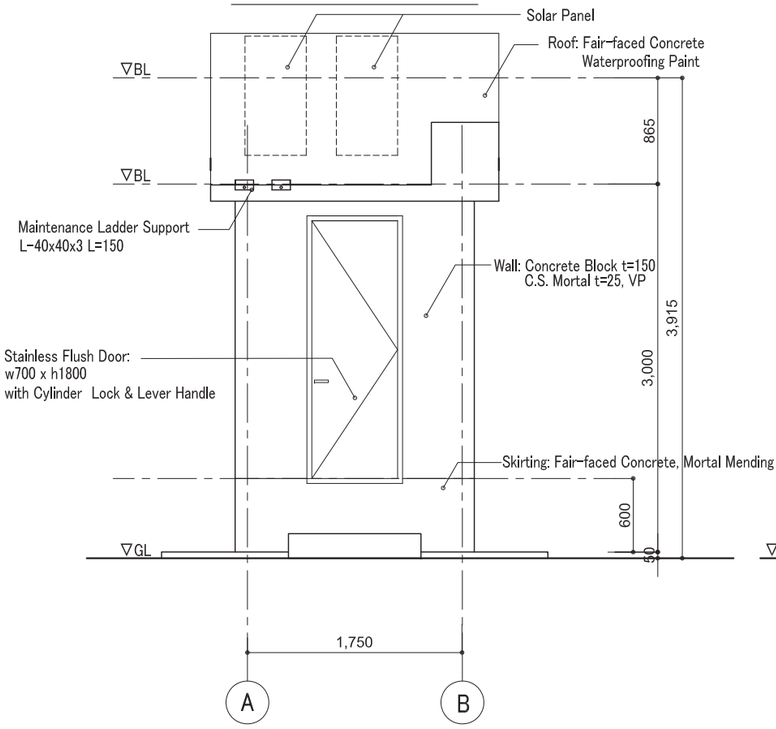
C.S. Mortal: Cement Sand Mortal
EP: Emulsion Paint
VP: Vinyl Paint
F.F. Concrete: Fair-faced Concrete



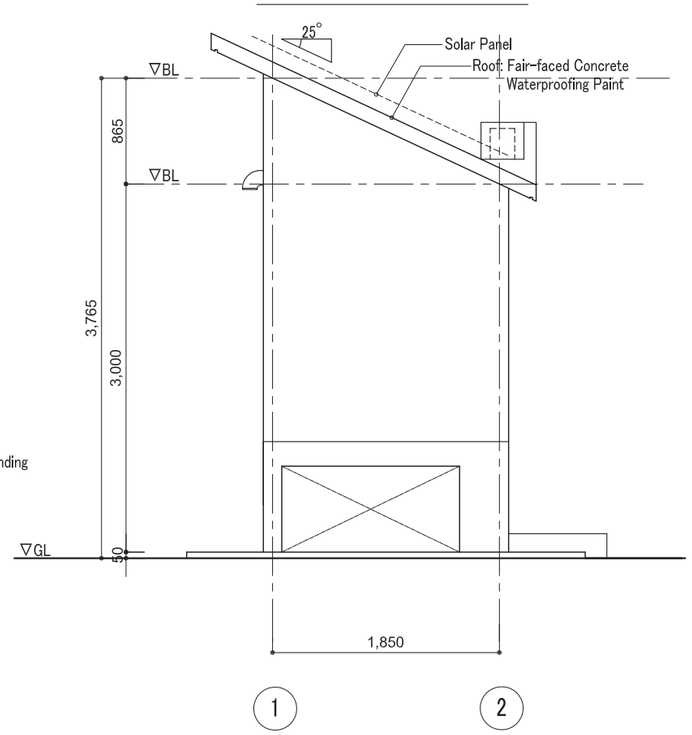
SECTION A-A SCALE 1:50



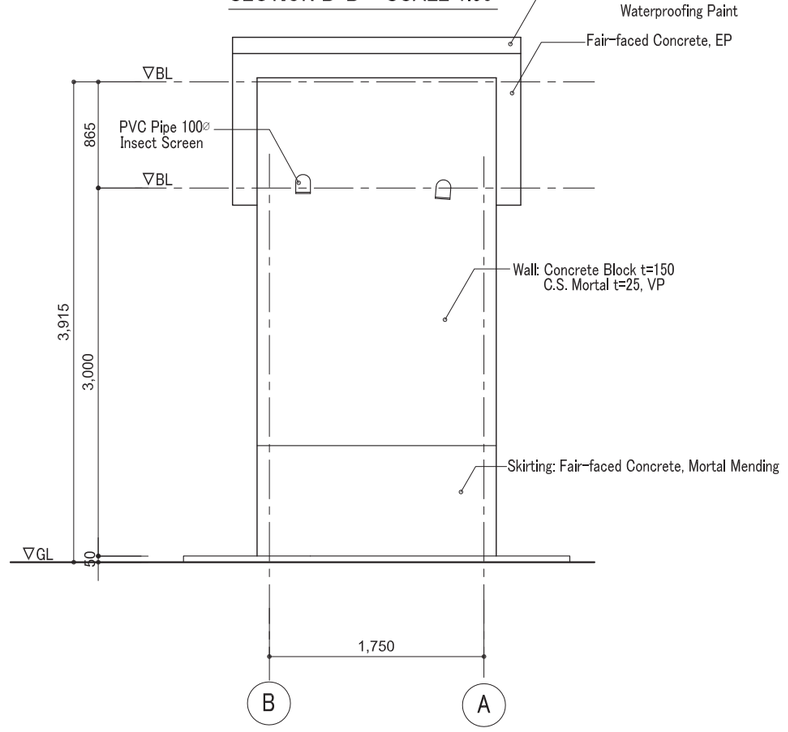
SECTION B-B SCALE 1:50



SOUTH ELEVATION SCALE 1:50



WEST ELEVATION SCALE 1:50



NORTH ELEVATION SCALE 1:50

CONSORTIUM OF JAPAN WEATHER ASSOCIATION (JWA), INTERNATIONAL METEOROLOGICAL CONSULTANT INC. (IMC) AND CTI ENGINEERING INTERNATIONAL CO., LTD. (CTII)	THE PROJECT FOR IMPROVEMENT OF EQUIPMENT AND FACILITIES ON METEOROLOGICAL AND HYDROLOGICAL SERVICES IN LAO PEOPLE'S DEMOCRATIC REPUBLIC	DRAWING TITLE CONCRETE SHELTER FLOOR PLAN, SECTION AND ELEVATION	SCALE 1: 50 1: 30	DRAWING No. CS - 01

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

Coordination among related implementation works for the completion of the Project will be necessary as the Project concerns systematically many fields such as procurement and installation of meteorological, hydrological and communication equipment, construction work, etc. Since the period between May and September in Lao P.D.R. is the rainy season (especially during August when the largest amount of rainfall and occurrence of many hazardous floods have been recorded) and since the manufacturing of meteorological, hydrological and communication equipment takes time, the management of the implementation time schedule should be given particular attention.

1) Implementing agency for the Project

The responsible governmental agency of Lao P.D.R. for the implementation of the Project is DMH under the supervision of the Ministry of Natural Resources and Environment (MONRE) and it will be a signatory of the Consultant Agreement and the Contract as the Client.

2) Consultant

After the signing of the Exchange of Notes (E/N) for the Project between the Government of Lao P.D.R. and the Government of Japan, it is very significant to conclude an Agreement of the Consulting Services for the Project as early as possible. The Agreement of the Consulting Services will be signed by and between the DMH and a consulting firm duly organized and existing under the laws of Japan, having its principal office in Japan and recommended by JICA.

The consulting firm will become the Consultant for the Project by signing the Agreement. The Consultant will then conduct a detailed design study in Lao P.D.R. with the DMH and, in Japan, prepare the tender documents including technical specifications, drawings, diagrams, etc. In addition, the Consultant, instead of the DMH, will conduct a tender and supervise the Project implementation for the successful completion of the Project as part of Japan's Grant Aid Assistance.

3) Contractor

A contractor with the required qualifications (an equipment supplier) incorporated and registered in Japan, having its principal office in Japan, will be selected through an open public tender, in accordance with the tender documents prepared by the Consultant and in accordance with JICA guidelines as approved by the DMH.

2-2-4-2 Implementation Conditions

1) Building Construction Permission

The DMH has confirmed that a construction permission from the Vientiane Urban Development and Administration Authority (VUDAA) for the Ancillary Facilities to be constructed at the DMH Head Office is not required since the planned Ancillary Facilities are quite small.

2) Conditions for the Installation of Equipment

In accordance with the implementation schedule, the dispatch of an electrical engineer is required during the installation, adjustment and wiring of the electric power supply and power back-up system (UPS, AVR, Isolation Transformer, Engine Generator, etc.). In addition, specialized and skilled engineers are needed for the installation, adjustment and commissioning of the data communication and computing equipment as well as the sophisticated meteorological equipment. They are essential to ensure the quality of the installation work necessary for accurate meteorological and hydrological observations. Furthermore, as part of the technology transfer to the DMH staff, specialized and highly skilled engineers are required as on-the-job trainees to ensure that the DMH can operate and maintain the equipment efficiently.

2-2-4-3 Scope of Works

The scope of works to be undertaken by Japan's Grant Aid Assistance and the Lao P.D.R. side for the implementation of the Project are as follows.

Table25: Scope of Works to be undertaken by each side under Implementation of the Project

No	Items	To be covered by Japan's Grant Aid	To be covered by Lao P.D.R. (DMH)
	General Items		
1	To undertake all necessary institutional and juridical procedures in Lao P.D.R.		●
2	To handle duty (Tax) exemption procedures and to take necessary measures as well as provide requisite legal and/or administrative documentations for customs clearance to the customs broker/forwarder to be employed by the Contractor at the port of disembarkation for the materials and equipment imported for the Project.		●
3	To provide necessary working spaces with Internet Connection at the DMH in Vientiane for the Consultant and the Contractor for the implementation of the Project, if required.		●
4	Marine (Air) transportation of the materials and equipment imported from overseas (Japan).	●	
5	In-land transportation from the port of disembarkation in Lao P.D.R. to each Project site.	●	

6	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Lao P.D.R. and stay therein for the smooth and uninterrupted performance of their work i.e. to secure appropriate Visa including its extension/s required by the recipient country in connection thereof.		●
7	To exempt Japanese and other foreign 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 signed contracts.		●
8	To pay bank commission to the Bank of Lao P.D.R. for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.		●
9	To bear all the expenses, other than those to be borne by the Japan's Grant Aid, necessary for the implementation of the Project		●
10	To ensure the security of the whole Project site(s) and of the Japanese and other foreign nationals assigned to the Project prior to commencement and all throughout the Project implementation.		●
	For the Construction of the Ancillary Facility(s)		
11	To clear, level and reclaim the land prior to the commencement of the construction work.		●
12	To secure sufficient spaces at the respective Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.		●
13	To obtain necessary permissions for the construction of the Ancillary Facility(s).		●
14	To provide the incidental facilities such as water supply, telephone line, and internet provision for the Ancillary Facility(s).		●
15	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for construction work.		●
16	To construct the Ancillary Facility(s) including a) Architectural and civil works b) Electrical works including lightning protection system c) Air-conditioning and Ventilation works d) Plumbing works	●	
17	To shift the existing concrete pole (approximately 3m) and replace/extend the power cable for electricity supply.		●
18	To procure standard furniture for the Ancillary Facility(s)	●	
19	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lighting in and around the sites, if necessary.		●
20	To provide On-the-job Trainings (Initial Trainings) by the contractor on the operation and maintenance of the Ancillary Facility(s) as well as its inherent facilities for the DMH.	●	
21	To provide the contractor's written guarantee to the DMH that the Ancillary Facility(s) will be constructed under the Project for a period of twelve (12) months from the completion date of the construction work.	●	
	For Installation Work of the Equipment		
22	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.		●
23	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.		●

24	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).		●
25	To secure ample and strategically located space/s at the existing DMH buildings for the installation of the equipment (PC terminals and peripherals) to be supplied.		●
26	To secure suitable space for the installation of the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).		●
27	To procure, install and adjust the required Equipment (including lightning protection system) for Project implementation	●	
28	To conduct the commissioning for the total system	●	
29	To provide reliable and high-speed Internet environment for the establishment of a Virtual Private Network (VPN) in the DMH.		●
30	To set up new assigned IP addresses under the Project in the existing computing equipment in the DMH.		●
31	To provide On-the-job Trainings (Initial Trainings) by the contractor on the operation and maintenance of the equipment for the DMH	●	
32	To shoulder dispatching cost of the trainees to the training sites, such as, daily allowances, transportation fees, accommodation fees.		●
33	To provide the contractor's written guarantee to the DMH for the Equipment and Installation Work executed under the Project for a period of twelve (12) months from the completion date of the equipment installation work.	●	
	After the completion of the Project		
34	To renovate the existing gates, boundary walls and exterior lighting in and around the sites, if required.		●
35	To assign staff necessary for the smooth operation and maintenance of the equipment.		●
36	To procure the required spare parts and consumables for the smooth operation and maintenance of the equipment.		●
37	To provide adequate maintenance of the Ancillary Facility(s) constructed under the Project, so that they can function effectively.		●
38	To operate, maintain, and properly and effectively utilize the facilities constructed and the equipment procured under the Project.		●
39	To allocate the necessary budget and personnel for appropriate meteorological & hydrological observation and forecasting works.		●

2-2-4-4 Consultant Supervision

1) Principal Guidelines

a) To take responsibility for expediting project implementation as well as providing smooth supervision, in accordance with the guidelines of Japan's Grant Aid Assistance and the Outline Design.

b) To communicate closely with the responsible organizations and personnel of both countries, and complete the Project in time and in accordance with the implementation schedule.

c) To provide appropriate advice to the personnel of the DMH and the contractor.

d) To ensure the safety of the project implementation as its top priority by earlier/advance detection of severe meteorological and hydrological phenomena.

2) Consultant Supervision

a) The Consultant will dispatch at least one responsible and highly capable personnel to Lao P.D.R. during each implementation stage in the Project.
b) Consultant technical specialists will be dispatched to Lao P.D.R. for installation guidance, inspection work, etc. for the installation and configuration work of the major hardware, data communication equipment, computing equipment and system software.
c) The Consultant will attend factory performance tests, configuration verifications and inspections of the equipment on behalf of and instead of the DMH.
d) Qualified engineer(s) will be dispatched for data transmission tests in Lao P.D.R.

3) Scope of Work for Supervision

a) The Consultant, in coordination with the DMH, will prepare the contract in accordance with JICA standards; select a Japanese prime contractor through tendering; and recommend the nominated contractor to the Government of Lao P.D.R.
b) The Consultant will inspect and approve shop-drawings, system drawings & diagrams and material samples submitted by the contractor, and verify the performance and function of all equipment.
c) Based on a review of the implementation schedule, the Consultant will provide instructions to the contractor and submit progress reports on the implementation of the Project to the DMH, the Embassy of Japan in Lao P.D.R., the JICA Laos local office, etc.
d) The Consultant will cooperate in the certification of payment through the examination of notices of approval and invoices in connection with the implementation cost to be disbursed during the implementation period and upon completion of the Project.

2-2-4-5 Quality Control Plan

The quality control plan for the main work is described in the table below.

Table26: Quality Control Plan

Work	Work Type	Control Item	Method	Remarks
Structural Work	Concrete work	Fresh concrete Concrete strength	Slump, air volume, temperature Comprehensive strength test	Strength test at a public test institution
	Reinforcing work	Reinforcing bar Arrangement	Tensile test, mill sheet check Bar arrangement check Factory inspection sheet check	

Finishing Work	Roof work	Workmanship, leakage	Visual inspection, water spray test	
	Plastering work	Workmanship	Visual inspection	
	Door & window work	Products, Installation accuracy	Factory inspection sheet check Visual inspection, dimension check	
	Painting work	Workmanship	Visual inspection	
	Interior work	Products, workmanship	Visual inspection	
Electrical Work	Power Receiving & Transforming	Performance, operation installation check	Factory inspection sheet check; withstand voltage, megar, operation, visual inspection	
	Conduit work	Bending, support check	Visual inspection, dimension check	
	Wiring and cable work	Sheath damage, loose connection check	Performance sheet check, cleaning before laying, marking after bolt fixing	
	Lighting work	Performance, operation, installation check	Performance sheet check, illumination measurement, visual inspection	

2-2-4-6 Procurement Plan

(1) Equipment Procurement

Maintenance requirements and the availability of the necessary parts and consumables in Lao P.D.R. are two of the most important factors in selecting the equipment. The most important areas concerned with the supply of the systems involve operation & maintenance methods as well as the procurement of necessary spare parts long after the completion of the Project. This will surely be a vital factor in determining the success of the Project. In view of the future maintenance aspect of the highly specialized pieces of the meteorological and hydrological equipment by the DMH, it is advantageous to have suppliers that are available within the same region as Lao P.D.R. and/or are in friendly developed countries including Japan. Thus, considering the quality and maintaining levels of sophisticated equipment, it will be essential to procure such components from member countries of the Organization for Economic Cooperation and Development (O.E.C.D.), mainly from Japan. For the quality control of each system, the procurement of the equipment from member countries of the O.E.C.D. will be easier than from other countries. Procurement from member countries of the O.E.C.D. would surely be advantageous to the DMH in consideration of durability & reliability of the systems and easy procurement of spare parts, operating procedures and maintenance techniques of the equipment.

The activities of the private sector in Lao P.D.R. will be useful in the support of the computer systems and other sophisticated systems. There are some local agents/suppliers of computing equipment in the country. The procurement plan for the equipment is designed with a view to achieve the maximum possible degree of standardization as well as facilitating the acquisition of spare parts and maintenance services for the chosen computing equipment.

(2) Procurement of Construction Material

1) Procurement Policy of the Ancillary Facility Construction Material

As the main construction materials can be procured locally, they will, in principle, be procured in Lao P.D.R. Some construction materials imported from the Association of Southeast Asian Nations (ASEAN) are marketed throughout Lao P.D.R. As these imported materials can be easily procured locally, they are considered as part of the procurement of local products. In order to ensure the easy maintenance of the Ancillary Facilities, locally available materials will be utilized for construction.

2) Procurement Plan of Construction Materials

[1] Structural Work

The main materials for the structural works, such as fresh concrete, plywood for form works, etc., can be procured locally. Locally made concrete blocks are available and are a common material for building construction.

[2] Building Exterior and Interior Work

Timber, tiles, paint, glass, aluminum window frames, etc. used for the exterior and interior of a building are imported and, as such, are readily available in the local market. For the proposed Ancillary Facility(s), airtight aluminum and steel doors & windows are required against water, dust and small insects.

[3] Air-Conditioning and Plumbing Work

Imported air-conditioning equipment, exhaust fans, sanitary-fixtures, etc. are popular in Lao P.D.R. As a result, those products can be procured in the local market with a view to ease repair and maintenance. Large air-conditioning units and exhaust fans are also available in the local market.

[4] Electrical Work

Imported and local lighting fixtures, switches, lamps, electrical wires and cables, conduits and other items are available in the local market. They will be procured in Lao P.D.R. for the convenience of repair and maintenance. Custom-made building equipment such as control panels, power distribution boards and switch boards imported from ASEAN countries can also be procured in the local market.

3) Transportation Plan

In principle, the transportation of the equipment from outside of Lao P.D.R. will be via wooden crates or container shipment. The main disembarkation point for maritime cargo to Laos is the Laem Chabang Port (Bangkok) in Thailand. The required number of days and the schedule of vessels from major international ports to the Laem Chabang Port are indicated in the following table.

Table27: Transit time to Laem Chabang Port (Thailand)

Shipping Port	Transit time
Japan (Tokyo, Yokohama)	10-15 days
Australia (Sydney)	10-15 days
EU (Humberg)	30-35 days
USA (Long Beach)	20-25 days

All cargos will be transported to a bonded warehouse in Tanaleng in Laos from Nong Khai via the Mittapab Bridge over the Mekong River for customs clearance. After the customs clearance, it will be delivered to the site by a Laotian transporter. The tax exemption procedure must be cleared by the Lao P.D.R. side in advance.

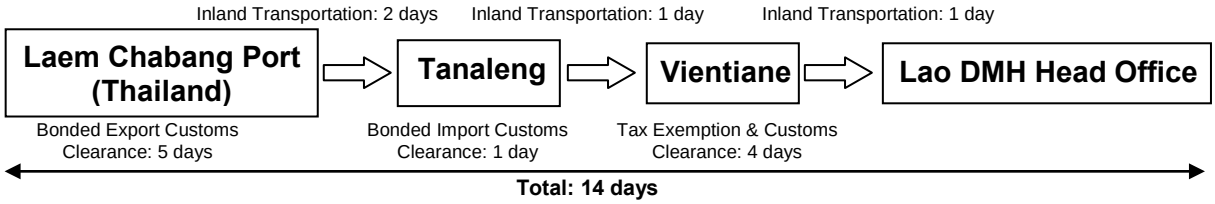


Figure12: Transit time from Laem Chabang Port to Laos

The whole process of the procurement of the equipment from outside of Laos normally takes 1 month. After a vessel leaves from a port, all the documents concerned with the shipment will be sent to Bangkok and Vientiane for the required local procedures. A cargo disembarking at the Bangkok Port will be stored in the transit warehouse until a permission of the Laos tax exemption has been issued by the Government of Lao P.D.R. Approximately 10 days will be required to obtain the permission. To secure this permission, supporting letters form the DMH and the MONRE attached with the invoice, packing list and ocean bill will be submitted to the agencies concerned in the Government of Lao P.D.R. It takes about 30 days.

2-2-4-7 Operational Guidance Plan

The required operational guidance will be implemented through a practical operation simulation of each system in the course of the completion of equipment installation. During the equipment installation period, the operational guidance for cabling, piping, unit replacement/adjustment, etc. of the meteorological observation, forecasting and data communication systems will be imparted to the DMH. As such, operational guidance for the said items will no longer be implemented after the completion of equipment installation. The operational guidance for each system will be implemented at the following places indicated in the table attached hereunder.

Table28: Operation and Maintenance Training (OJT)

Name of System	DMH Head Office	Project Sites
GTS Message Switch System and World Meteorological Organization Information System (WIS) • Computer Network Equipment • Application Software	○	—
High Resolution Meteorological Satellite Data Receiving System • Computer Network Equipment • Application Software	○	—
Automatic Weather System (AWS) • Power Unit (Solar Panel, Controller, Battery) • GSM/GPRS Modem • Each Sensor • Data Acquisition Unit • Application Software	—	○
Automatic Weather Observation Data Management System • Computer Network Equipment • Application Software • Portable Calibration & Maintenance Tools	○	—
Automatic Water Level + Rainfall Observation System (AWL+ROS) • Power Unit (Solar Panel, Controller, Battery) • GSM/GPRS Modem • Each Sensor • Data Acquisition Unit • Application Software	—	○
Automatic Water Level + Rainfall Observation Data Management System • Computer Network Equipment • Application Software • Portable Calibration & Maintenance Tools	○	—

Apart from the Operation and Maintenance Training (OJT), technology transfer through the practical installation and adjustment works to be carried out by the DMH staff together with the Consultant and the contractor will be necessary and quite effective if done during the installation period. In addition, software installation by the DMH staff themselves is important to have further familiarization and technical knowledge. In case of a down in the system, disassembling the system and software reinstallation by the DMH staff may be required. Therefore, all the significant parts of technology transfer must be completed during the installation work period.

2-2-4-8 Soft Component Plan

(1) Background of the Soft Component Plan

A key objective of the Project is the effective mitigation of the adverse effects of natural disasters. To achieve this objective, the implementation of personnel training and the installation of Automatic Weather Observation Systems and Automatic Water Level + Rainfall Observation Systems are absolutely essential. These will largely enhance the capability to monitor meteorological and hydrological phenomena as it will increase the density of meteorological and hydrological stations and will improve the accuracy and frequency of flood forecasts by using a lead time. In addition, the

renewal of the GTS Message Switching System will enable Lao P.D.R. to provide observation data to the rest of the world via GTS for the improvement of global weather forecasts and, in return, receive NWP Products calculated by the global NWP model as well as various meteorological information from developed countries such as the satellite data of Japan. Furthermore, the installation of a High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System will enable the DMH to receive regional meteorological satellite images every 2.5 minutes. The implementation of the Project is highly expected to improve the quality, timeliness and accuracy of the meteorological and hydrological forecasts/warnings of the DMH and contribute to the alleviation of the damages caused by natural disasters.

However, few technicians in the DMH have practical experience to operate and maintain the Automatic Weather Observation Systems, Automatic Water Level + Rainfall Observation System and Data Management System since manual observation and vocal communication using a portable radio are their current practice. For the smooth operation and maintenance of the equipment to be installed and the assurance of the sustainability of the Project outcomes, the implementation of the following technology transfers in the soft component during the Project is required.

(2) Soft Component Target

The Soft Component Targets are as follows.

- Operation, maintenance, fault finding, remedy and recovery of the installed equipment to be appropriately carried out by the DMH
- Prompt and appropriate operation and maintenance of the meteorological & hydrological observation equipment through the use of the system manual summary to be appropriately carried out by the DMH
- Cleaning, maintenance check and confirmation of operation of the Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems to be appropriately carried out by the DMH
- Confirmation of good operational condition of the Systems to be implemented by the DMH

(3) Soft Component Outputs

Soft Component Outputs are as follows.

Table29: Soft Component Outputs

No.	Item	Output
1	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office	Acquisition of technical know-how on the: 1) appropriate and periodical operation & maintenance through the use of the Automatic Weather Observation Systems Manual Summary a. routine maintenance of the system using a Maintenance Terminal b. practice of measuring solar panel output power and battery voltage c. practice of measuring earth resistance d. practice of inputting maintenance record (including pictures) into a

		Maintenance Terminal 2) Observed data comparison review using Portable Data Comparison & Maintenance Tools 3) Input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office 4) Input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range
2	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	Acquisition of technical know-how on the: 1) appropriate and periodical operation & maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary a. routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools b. practice of measuring solar panel output power and battery voltage c. practice of measuring earth resistance d. practice of inputting maintenance record (including pictures) into a Maintenance Terminal 2) Observed data comparison review using Portable Maintenance Tools

(4) Means of Verification on the Achievement of Intended Outputs

The means of verification on the achievement of the intended outputs of the Soft Component are as follows.

Table30: Soft Component Indicators

No.	Item	Objectively Verifiable Indicators	Means of Verification
1	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office Coping process in case of observed data deviated from the normal range are implemented	1) Appropriate and periodical operation & maintenance through the use of the Automatic Weather Observation Systems Manual Summary are carried out. 2) Observed data comparison review using Portable Data Comparison & Maintenance Tools is carried out. 3) Input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office are implemented. 4) Input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range are implemented	1) Confirmation of proficiency on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary 2) Confirmation of proficiency on the observed data comparison review using Portable Data Comparison & Maintenance Tools 3) Confirmation of proficiency on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office 4) Confirmation of proficiency on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range
2	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	1) Appropriate and periodical operation & maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary are carried out. 2) Observed data comparison review using Portable Maintenance Tools is carried out.	1) Confirmation of proficiency on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary 2) Confirmation of proficiency on the observed data comparison review using Portable Maintenance Tools

(5) Scheduled Activities on the Soft Component

Expert Consultants to be in charge of the Soft Component are as follows.

- Automatic Weather Observation Systems operation and maintenance: Output 1
- Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance: Output 2

The Scheduled Activities on the Soft Component are as follows.

Table31: Scheduled Activities on the Soft Component

Output	Required Technique and Field	Current Technique and Required Technical Level	Target Group	Means of Implementation	Source of Implementation	Products
1. Appropriate and Periodical Operation & Maintenance through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office Coping process in case of observed data deviated from the normal range are implemented	An engineer who has an adjustment and fault finding technique for the Automatic Weather Observation System	Since technicians in the DMH have no practical experience on the operation and maintenance of an Automatic Weather Observation System and data transmission equipment, it is required that the DMH technicians should acquire the operation and maintenance technique through the use of the system manual summary.	Indicated in the table below	Before Rainy Season Implementation Place: DMH Head Office	Expert Consultant on Automatic Weather Observation System operation and maintenance Direct Support Activity: 0.93 Man-Month (28 days)	Automatic Weather Observation Systems manual summary
				Discussion with the DMH technicians		
				Selection and explanation of the most important points of the Automatic Weather Observation System manual		
				Production of the Automatic Weather Observation System manual summary		
				Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary in the DMH Vientiane.		
				Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and		

				scheduled time data transmission to the DMH Head Office.		
				Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.		
				After Rainy Season Implementation Place: each site of Automatic Weather Observation System		
				Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary	Expert Consultant on Automatic Weather Observation System operation and maintenance Direct Support Activity 1: 1.13 Man-Month (34 days) Activity 2: 1.13 Man-Month (34 days)	
				Practical training on the observed data comparison review using Portable Data Comparison & Maintenance Tools		
2. Appropriate and Periodical Operation & Maintenance through the use	An engineer who has an adjustment and fault finding technique for the Automatic Water Level Observation	Since technicians in the DMH have no practical experience on the operation	Indicated in the table below	After Rainy Season Implementation Place: each site of Automatic Water Level Observation + Rainfall Observation System	Expert Consultant on Automatic Water Level Observation + Rainfall Observation Systems operation	Automatic Water Level Observation + Rainfall Observation Systems manual summary

of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	+ Rainfall Observation Systems	and maintenance of an Automatic Water Level Observation + Rainfall Observation Systems and data transmission equipment, it is required that the DMH technicians should acquire the operation and maintenance technique through the use of the system manual summary.		Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	and maintenance Direct Support 1.30 Man-Month (39 days)	
				Practical training on the observed data comparison review using Portable Maintenance Tools		

As indicated in the table below, the DMH has planned to organize the maintenance teams. Target groups for Output 1 and Output 2 are composed of the technicians from these maintenance teams.

Table32: Target Group for Each Output in Soft Component

Output	Target Group	Number of Personnel
Output 1	Automatic Weather Observation Systems maintenance team 1 (Including the staff of each existing observatory)	6
Output 1	Automatic Weather Observation Systems maintenance team 2 (Including the staff of each existing observatory)	6
Output 2	Automatic Water Level Observation + Rainfall Observation Systems maintenance team (Including the staff of each existing observatory)	7

Timing of each activity commencement in the Soft Component is indicated in the following table.

Table33: Timing of Each Activity Commencement in the Soft Component

Activity of Expert Consultant	Timing of Activity Commencement
Automatic Weather Observation Systems operation and maintenance	Implementation before the rainy season
	This activity is planned to be implemented in Vientiane and to be commenced in April before the rainy season after the completion of the installation work.
	Implementation after the rainy season
	This activity is planned to be commenced in November after the rainy season for all the Automatic Weather Observation Systems to be procured under the Project.
Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance	Implementation of the after the rainy season
	This activity is planned to be commenced in November after the rainy season for all the Automatic Water Level Observation + Rainfall Observation Systems to be procured under the Project.

<Before the Rainy Season>

Trainings on: 1) the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office; and, 2) the input of

observed data into the data input sheet and coping process in case of observed data deviated from the normal range will be conducted at the DMH Head Office (Vientiane) for the DMH personnel of 18 exiting Synoptic/Climate Observation Stations as the proposed sites for the Automatic Weather Observation Systems.

<After the Rainy Season >

Each instrument is installed out in the open environment and is, thus, subjected to harsh conditions during the rainy season. It is definitely expected that the instruments would be damaged and defected and that a sensor tip (pipe) of the Automatic Water Level Observation + Rainfall Observation System would be submerged in mud. Therefore, trainings on: 1) recovering these instruments (and restoring their condition back to its original state before the rainy season); 2) observed data comparison review (confirmation of data accuracy); 3) routine maintenance of the system to ensure the appropriate operation of the system for the coming 6 months (dry season); and, 4) inputting maintenance record will be conducted.

The Soft Component activities are planned to be implemented in April before the rainy season and in November after the rainy season for system maintenance of the Automatic Weather Observation Systems. System maintenance of the Automatic Water Level Observation + Rainfall Observation Systems would also be implemented in November. The reasons why the Soft Component activities would be implemented in April before the rainy season and in November after the rainy season are as follows.

- The DMH has planned to implement system maintenance for the Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems at all the observation stations twice a year (before and after the rainy season).
- Since the DMH is comparatively smaller than the other governmental organizations and conducts routine works around-the-clock with limited manpower, it is difficult to detain several members of the DMH staff over a long period of time for trainings.
- After the rainy season, the Automatic Weather Observation Systems would have already been operated for more than 6 months, thus, practical trainings can be made at all the observation stations.
- It is possible to conduct practical trainings with the maintenance terminal upon acquisition of the observation data from meteorological phenomena which created natural disasters, and which is very important for post-event analysis, during the rainy season.

(6) Procurement Method of the Soft Component Implementation Resource

The Soft Component Implementation Resource is procured with the direct support of Japanese consultants who are in charge of procuring the equipment of the Project. The reasons are as follows.

- For technology transfer, an expert with an advanced technique and knowledge of weather services, Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems is necessary.
- Such an expert usually belongs to weather organizations which actually conduct weather services.
- An expert who has similar experience with the proposed technology transfer is required.

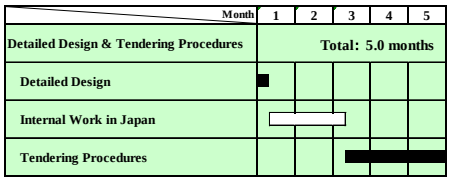
(7) Soft Component Product

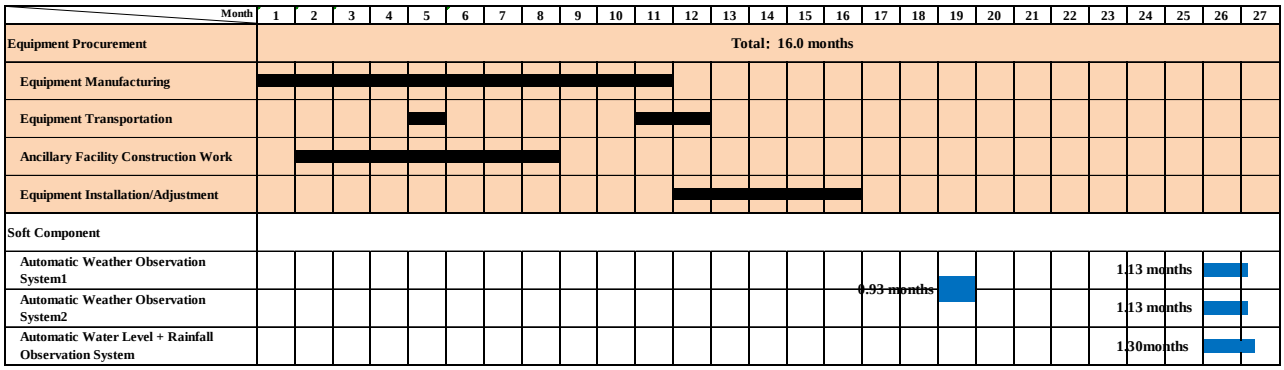
Table34: Soft Component Products during Technology Transfer

Product Name		Submission Time	No. of Pages
Automatic Weather Observation Systems manual summary		After Technology Transfer	30
Automatic Water Level Observation + Rainfall Observation Systems manual summary			30
Output Name	Content	Submission Time	No. of Pages
Soft Component Completion Report	• Scheduled Activities and Actual Achievement • Scheduled Outputs and Achievement • Factors which influence the Achievement of Outputs • Recommendation • Outputs	Completion of Soft Component	40

2-2-4-9 Implementation Schedule

Table35: Implementation Schedule





2-3 Obligations of Recipient Country

In the course of the implementation of the Project under Japan's Grant Aid Assistance, the DMH is responsible for the following tasks.

Table36: Major Undertakings to be done by the DMH for the Implementation of the Project

No	Items
	General Items
1	To undertake all necessary institutional and juridical procedures in Lao P.D.R.
2	To handle duty (Tax) exemption procedures and to take necessary measures as well as provide requisite legal and/or administrative documentations for customs clearance to customs broker/forwarder to be employed by Contractor at the port of disembarkation for the materials and equipment imported for the Project.
3	To provide necessary working spaces with Internet Connection at the DMH Offices in Vientiane for the Consultant and the Contractor for the implementation of the Project, if required.
4	To accord Japanese and other foreign nationals including their dependent/s (if any), whose services may be required in connection with the supply of products and services under the signed contracts, such facilities as may be necessary for their entry into Lao P.D.R. and stay therein for the smooth and uninterrupted performance of their work i.e. to secure appropriate Visa including its extension/s required by the recipient country in connection thereof.
5	To exempt Japanese and other foreign 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 signed contracts.
6	To pay bank commission to the Bank of Lao P.D.R. for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor.
7	To bear all the expenses, other than those to be borne by the Japan's Grant Aid, necessary for the implementation of the Project
8	To ensure the security of the whole Project site(s) and of the Japanese and other foreign nationals assigned to the Project prior to commencement and all throughout the Project implementation.
	For the Construction of the Ancillary Facility(s)
9	To clear, level and reclaim the land prior to commencement of the construction.
10	To secure sufficient spaces at the respective Project sites for temporary facilities such as a contractor's office, workshop, building materials storage, etc. for the construction work.
11	To obtain necessary permissions for the construction of the Ancillary Facility(s), if required.
12	To provide the incidental facilities such as water supply, telephone line, and internet provision for the Ancillary Facility(s).
13	To shift the exiting concrete pole (approximately 3m) and replace/extend the power cable for electricity supply.
14	To provide temporary facilities for the availability or accessibility of electricity, water, etc. for construction work.
15	To undertake incidental outdoor works such as gardening, fencing, gates, boundary walls and exterior lighting in and around the sites, if necessary.
	For Installation Work of the Equipment
16	To remove and relocate the existing facilities if available for the installation of the equipment, if necessary.
17	To provide and allocate secure temporary storage area/room for the materials, tools and equipment needed during the installation process.
18	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).

19	To secure ample and strategically located space/s at the existing DMH buildings for the installation of the equipment (PC terminals and peripherals) to be supplied.
20	To secure suitable space for the installation of the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).
21	To provide reliable and high-speed Internet environment for establishment of Virtual Private Network (VPN) in the DMH.
22	To set up new assigned IP addresses under the Project in the existing computing equipment in the DMH.
23	To shoulder dispatching cost of the trainees to the training sites, such as, daily allowances, transportation fees, accommodation fees.
After the completion of the Project	
24	To renovate the existing gates, boundary walls and exterior lighting in and around the sites, if required.
25	To assign staff necessary for the smooth operation and maintenance of the equipment.
26	To procure the required spare parts and consumables for the smooth operation and maintenance of the equipment.
27	To provide adequate maintenance of the Ancillary Facility(s) constructed under the Project, so that they can function effectively.
28	To operate, maintain, and properly and effectively utilize the facilities constructed and the equipment procured under the Project.
29	To allocate the necessary budget and personnel for appropriate meteorological & hydrological observation and forecasting works.

2-4 Project Operation Plan

(1) Operation and Maintenance Plan for the Equipment

1) Operational Plan of the Automatic Weather Observation System and the Automatic Water Level + Rainfall Observation Systems.

Upon completion of the Project, the yearly data transmission time of each system has been planned and the DMH has agreed to meet the following operational plan.

Table37: Yearly Data Transmission Time of Each System

Annually	Total Number of the Systems	Data Transmission Times			Yearly Data Transmission Times of Each System
		January-April (Dry Season)	May-September (Rainy Season)	October-December (Dry Season)	
Automatic Weather Observation System	18	120 days×24/day at UTC	153 days×24/day at UTC	92 days×24/day at UTC	8,760
Automatic Water Level + Rainfall Observation Systems	8	120 days×1/day at UTC 06:00	153 days×24/day at UTC	92 days×1/day at UTC 06:00	3,884

2) Maintenance Team for the Operation and Maintenance of the Equipment

In order to do the prompt action required for the periodic maintenance and recovering failure of each Automatic Weather Observation System and Automatic Water Level + Rainfall Observation System, the maintenance teams at the DMH Head Office indicated in the following organization chart are required.

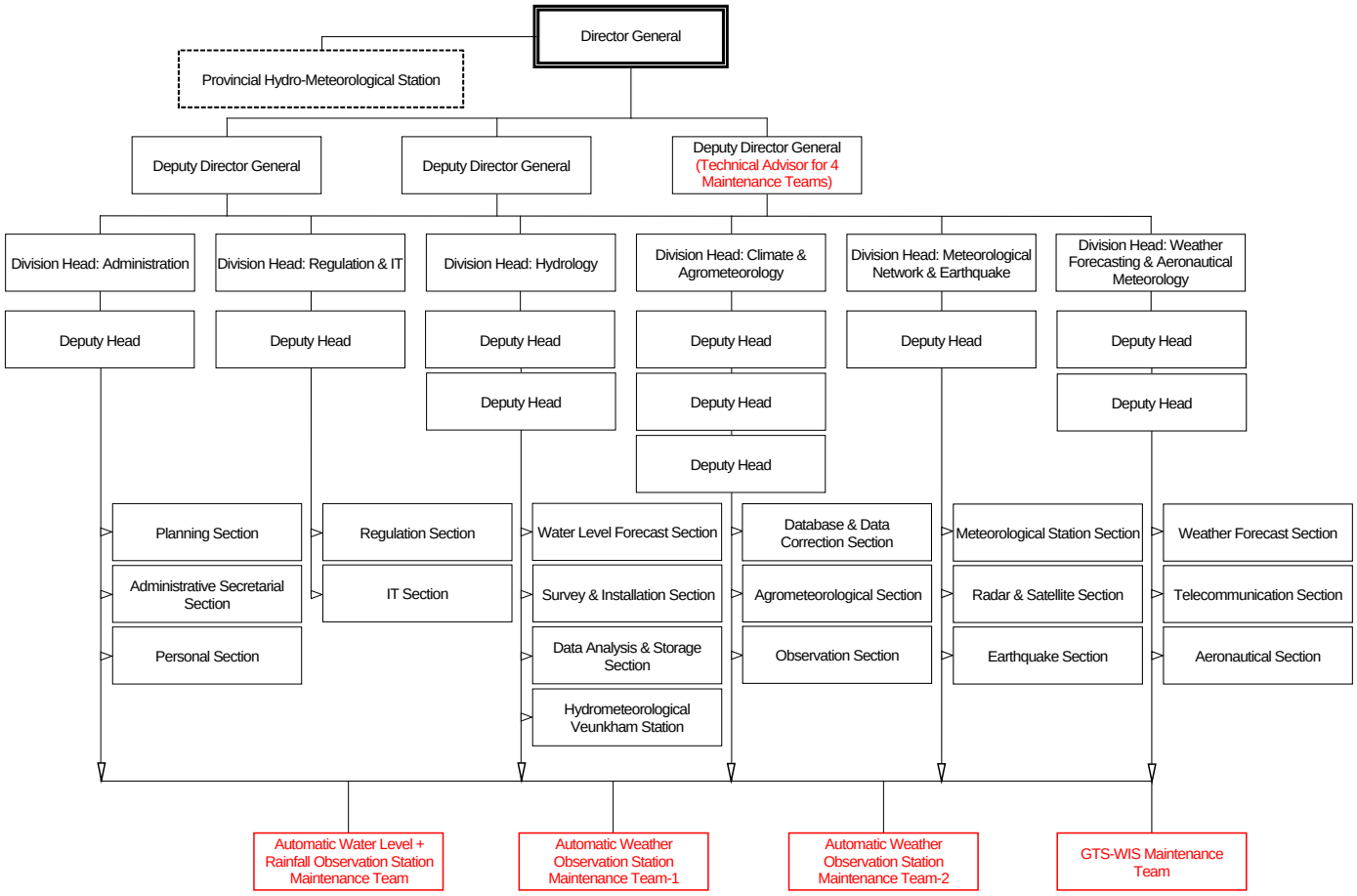


Figure13: DMH Organization Chart including 4 Maintenance Teams

Table38: Required Staff of the Maintenance Team

Maintenance Team	Automatic Water Level + Rainfall Observation Station Maintenance Team	Automatic Weather Observation Station Maintenance Team-1	Automatic Weather Observation Station Maintenance Team-2	GTS-WIS Maintenance Team
Required Number of Engineers	7	6	6	9

Table39: Periodic System Maintenance

Annually	Data Transmission Times		
	April (Dry Season)	May-September (Rainy Season)	November (Dry Season)
Automatic Weather Observation System	Periodic System Maintenance at Each Station by the Teams	System Operation Monitoring at the DMH Head Office by the Teams	Periodic System Maintenance at Each Station by the Teams
Automatic Water Level + Rainfall Observation System	Periodic System Maintenance at Each Station by the Teams	System Operation Monitoring at the DMH Head Office by the Teams Change of Data Transmission Time at UTC03:00 on May 01 and September 30	Periodic System Maintenance at Each Station by the Teams
GTS-WIS	Monthly System Maintenance by the Teams		

3) Operation and Maintenance Plan for the Equipment

In connection with equipment maintenance, consideration must be given to the followings.

- Technical training for the DMH staff
- Establishment of appropriate measures against system failure
- A fully documented maintenance system, with proper document control
- Scheduled replacement of parts and overhauls
- Strengthening of the operation and maintenance structure of the DMH
- Establishment of the technical and financial self-reliance of the DMH

<Recruitment of Engineer/Staff >

Although the DMH currently has the technical capability and organizational system required for operation and maintenance of the Equipment to be procured under the Project, the DMH fully recognizes the need to strengthen its engineering sections for further effective operation and maintenance. The JICA Preparatory Survey Team, therefore, strongly recommends recruiting capable engineer(s) and technical assistant(s) indicated in the following table. For staff recruitment, the MONRE, as the supervising organization of the DMH, should give its effective cooperation and special attention on this matter.

In order for the DMH to become self-reliant in technical areas such as the operation and maintenance of the systems, it is essential that it makes continuing efforts to recruit and promote technology transfer across all staff levels.

Table40: Required Number of Engineers and Technical Assistants to be recruited in the DMH

	Existing	2013-2014	2014-2015	2015-2016	Total
Automatic Water Level + Rainfall Observation Station Maintenance Team	4 (Survey & Installation Section)	1	1	1	7
Automatic Weather Observation Station Maintenance Team-1	2 (Meteorological Station Section)	1	2	2	6
Automatic Weather Observation Station Maintenance Team-2		2	1	2	6
GTS-WIS Maintenance Team	4 (Telecommunication Section)	1	2	3	10

(2) Operation and Maintenance Plan for the Ancillary Facilities

There are three key issues for the maintenance of the Ancillary Facilities to be implemented by the DMH: (i) daily cleaning; (ii) maintenance to cover wear and tear; damage and aging; and (iii) security

measures to ensure safety and to prevent crimes.

The implementation of the daily cleaning of the ancillary facilities gives a good impression to visitors/users and encourages people to respect the ancillary facilities and the equipment. Cleaning is also important to ensure that the equipment continues to operate correctly and helps in the rapid detection and repair of damaged equipment as well as prolongs the life of the equipment. The required inspections are outlined below.

Table41 Outline of Regular Inspection for the Ancillary Facilities

	Items of Maintenance Work	Frequency
Exterior	Repair and repainting of external walls	Repair: every 5 years, Repaint: every 15 years
	Inspection and repair of roofs	Inspection: every year Repair: as required
Interior	Renewal of interior finishing	As required
	Repair and repainting of partition walls	As required
	Adjustment of window and door fitting	Every year

It is important that regular preventive maintenance of the building equipment is carried out before the equipment fails or before it requires repair or replacement of part(s). The longevity of the air-conditioning equipment can be significantly extended through proper operation and regular inspection, lubrication, adjustment and cleaning. These regular inspections can prevent equipment failure and accidents. Regular inspection, replacement of consumables and cleaning/replacement of filters for air-conditioning units should be carried out in accordance with the maintenance manual.

It is essential to establish a proper maintenance structure in the DMH, involving the rigorous implementation of regular inspection and maintenance procedures. The general life expectancy of the major building equipment is shown below.

Table42: Life Expectancy of Building Equipment

System	Building Equipment	Life Expectancy
Electrical System	• Distribution panels • LED lamps	20-30 years 30,000-40,000 hours
Air-Conditioning System	• Pipes • Air-conditioning units	15 years 15 years

2-5 Project Cost Estimate

2-5-1 Estimate of Project Cost and Capital Cost to be borne by the DMH

The required capital cost for the Project to be borne by the DMH has been estimated and is shown in the following tables.

Project Cost to be borne by the DMH

Total Project Cost: 354,760,000 Kip (approx. 4.6 Million JP Yen)

Table43: Estimated Capital Cost to be borne by the DMH

No.	Items	Capital Cost (Kip)
1	To pay bank commission to the Bank of Lao P.D.R. for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor (Project Cost × 0.12% + JPY25,000).	56,000,000
2	To obtain necessary lands for the installation of the Automatic Water Level + Rainfall Observation Systems (8 sites).	120,000,000
3	To undertake incidental outdoor works such as fencing (11 stations for AWS), gates, boundary walls and exterior lighting in and around the sites, if necessary.	95,000,000
4	To shift the existing concrete pole (approximately 3m), replace/extend the power cables and connect the electricity to the Ancillary Facilities constructed in the DMH Head Office	18,000,000
5	To shift the existing meteorological instruments from Saybouly to Parklay and from Thakhek to Xaybuathong	30,600,000
6	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).	560,000
7	To provide reliable and high-speed Internet environment for the establishment of a Virtual Private Network (VPN) at the DMH.	9,600,000
8	To shoulder dispatching cost of the trainees to the training sites, such as daily allowances, transportation fees, accommodation fees.	25,000,000
	Total	354,760,000

Applied Exchange Rates: US$ 1 =100.47JP Yen, 1 kip =0.013JP Yen

2-5-2 Estimate of the Recurrent Cost for the Project to be borne by Lao P.D.R.

(1) Recurrent Cost to be borne by the DMH

The annual recurrent costs considered a 5% annual inflation rate to be borne by the DMH for the first decade after the completion of the Project are attached hereunder. The recurrent costs have been calculated in accordance with the following fundamental conditions.

- Operation and maintenance to be carried out by the DMH
- Appropriate operation in accordance with the operations manuals
- Regular and proper maintenance according to the maintenance manuals

Table44: Estimated Recurrent Cost to be borne by the DMH

Equipment

No.	Equipment	Item	Q'ty	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Computers	Hard Disk (24 h operation)	6				4,514,736				5,487,690			Every 4 years
		Hard Disk (8 h/day operation)	12							10,452,744				Every 7 years
		Hard Disk (4 h/day operation)	18									17,286,228		Every 9 years
		DVD for Data Storage (20 pcs/set)	1	125,000	131,250	137,813	144,704	151,939	159,536	167,513	175,889	184,683	193,917	
2	Printer	Printer Ink Cartridge (2 printers × 2 times/year)	4	2,000,000	2,100,000	2,205,000	2,315,252	2,431,016	2,552,568	2,680,196	2,814,204	2,954,916	3,102,660	
		Paper (500 sheets/pack)	6	240,000	252,000	264,600	277,830	291,720	306,306	321,624	337,704	354,588	372,318	
		Main Unit	2				3,843,316				4,671,574			Every 4 years
3	Compact UPS	Main Unit (for DMH Head Office)	8				6,177,088				7,508,288			Every 4 years
		Main Unit (for Existing Meteorological Observation Stations)	18			13,236,624			15,323,040			17,738,334		Every 3 years
4	Power Supply Capacitor	AC Fan	3										4,653,984	Every 10 years
		Arrester Set (6 pcs/set)	1										2,016,728	Every 10 years
5	Diesel Engine Generator	Oil Seal	2	500,000	525,000	551,250	578,812	607,752	638,140	670,048	703,550	738,728	775,664	Every year
		Filter	2		2,100,000		2,315,250		2,552,562		2,814,200		3,102,656	Every 2 years
		Engine Oil (3 litters)	1	200,000	210,000	220,500	231,525	243,101	255,256	268,019	281,420	295,491	310,266	Every year
		Battery for Engine Start	2					1,215,508					1,551,330	Every 5 years
6	Vacuum Cleaner		1					486,203					620,532	Every 5 years
7	Consumables for Maintenance	Contact Cleaner, Detergent, etc	1	630,000	661,500	694,575	729,304	765,769	804,057	844,260	886,473	930,797	977,337	Every year
8	Automatic Weather Observation System	Spare Parts	1					85,085,438					108,592,977	Every 5 years
		Long Life Battery	18									66,485,493	69,809,769	Every 9 and 10 years
9	Automatic Water Level + Rainfall Observation System	Spare Parts	1					12,155,063					15,513,283	Every 5 years
		Long Life Battery	8									22,161,832	23,269,924	Every 9 and 10 years
		Sub Total (Kip)		3,695,000	5,979,750	17,310,362	21,127,817	103,433,509	22,591,465	15,404,404	25,680,992	129,131,090	234,863,345	

Others

No.	Cost Item	Details	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year	Remarks
1	Electricity	53,751 kWh × 799 Kip	42,947,049	45,094,401	47,349,121	49,716,577	52,202,406	54,812,526	57,553,152	60,430,810	63,452,351	66,624,969	*1
2	Fuel for Engine Generator	9 litters × 8,830 Kip	79,470	83,444	87,616	91,997	96,597	101,427	106,498	111,823	117,414	123,285	*2
3	GSM Data Transmission	((8,760 short message/year × 18 stations) + (3,884 short messages/year × 8 stations)) × 100 Kip	18,875,200	19,818,960	20,809,908	21,850,403	22,942,923	24,090,069	25,294,572	26,559,301	27,887,266	29,281,629	
4	Internet Connection	DMH Head Office: 9,600,000 Kip/year (2Mbps Optical Fiber Line)	9,600,000	10,080,000	10,584,000	11,113,200	11,668,860	12,252,303	12,864,918	13,508,164	14,183,572	14,892,751	
		Existing Meteorological Observation Stations: 50,000 Kip/month (5,000MB 3G connection) × 12 months × 18 observation stations	10,800,000	11,340,000	11,907,000	12,502,350	13,127,468	13,783,841	14,473,033	15,196,685	15,956,519	16,754,345	
5	Accommodation + Daily Allowance	(2 maintenance teams (2 staff/team) × 9 sites × 3 days/site × 2 times/year + 1 maintenance team (2 staff) × 8 sites × 3 days/site × 2 times/year) × 105,000 Kip = 312 days/year × 105,000 Kip	32,760,000	34,398,000	36,117,900	37,923,795	39,819,985	41,810,984	43,901,533	46,096,610	48,401,441	50,821,513	
6	Transportation (Bus)	(2 maintenance teams (2 staff/team) × 9 sites × 2 times/year + 1 maintenance team (2 staff) × 8 sites × 2 times/year) × 400,000 Kip	41,600,000	43,680,000	45,864,000	48,157,200	50,565,060	53,093,313	55,747,979	58,535,378	61,462,147	64,535,254	
		Sub Total (Kip)	156,661,719	164,494,805	172,719,545	181,355,522	190,423,299	199,944,463	209,941,685	220,438,771	231,460,710	243,033,746	
		Total (Kip)	**160,356,719**	**170,474,555**	**190,029,907**	**202,483,339**	**293,856,808**	**222,535,928**	**225,346,089**	**246,119,763**	**360,591,800**	**477,897,091**	
		Total (JPY)	**¥1,924,281**	**¥2,045,695**	**¥2,280,359**	**¥2,429,800**	**¥3,526,282**	**¥2,670,431**	**¥2,704,153**	**¥2,953,437**	**¥4,327,102**	**¥5,734,765**	

Estimation of Annual Electricity Charge

Annual Power Consumption of Commercial Power	(kWh)	53,751				
Annual Power Consumption of D.E.G.	(kWh)	37				
Annual Fuel Consumption	(litter)	9	Fuel Consumption of DEG=	0.25	litter/kWh	
*1 Annual Electricity Charge of Commercial Power	(Kip)	42,947,049	Electrical Charge=	799	Kip/kWh	
*2 Annual Fuel Cost of D.E.G.	(Kip)	79,470	Fuel Cost=	8,830	Kip/litter	
*Considered Annual Inflation Rate: 5%			Exchange Rate	0.012	JPY/Kip (As of August 2013, JICA Exchange Rate)	

(2) Annual Budget Trends

The estimated recurrent cost of the DMH is only approximately 5% of the total annual budget of the DMH while the cost of the operation & maintenance of the equipment such as utilities, communications and technical management is approximately 10% of the budget. In addition, the DMH, under the supervision of the Ministry of Natural Resources and Environment, has committed to the Preparatory Survey Team to

allocate the required budget for the Project. Therefore, it has been assessed that there is no problem in this regard.

Table45: Movement of the DMH Annual Budget

Year (October - September)	Budget (Thousand Kip)	Comparison with the previous year (%)
2009-2010	1,525,000	-
2010-2011	1,785,000	117.0
2011-2012	3,232,600	181.1
2012-2013	3,568,000	104.3
2013-2014	4,261,000	110.4
2014-2015 (Prospective)	4,932,000	115.7

Table46: Movement of the DMH Annual Budget only for operation & maintenance of the equipment such as utilities (electricity & water), communications and technical management

Year (October - September)	Budget (Thousand Kip)	Comparison with the previous year (%)
2009-2010	836,000	-
2010-2011	1,055,000	126.2
2011-2012	1,245,600	118.1
2012-2013	1,355,000	108.8
2013-2014	1,721,000	127.0
2014-2015 (Prospective)	1,982,000	115.2

Chapter 3
Project Evaluation

Chapter 3 Project Evaluation

3-1 Preconditions

The procedures required for the implementation of this Project are as follows.

Table47: Required Procedures for Permission of the Laos Tax Exemption

Required Procedures	Office Concerned	Submission Time	Required Period	Required Documents	Applicant
Permission of the Laos Tax Exemption	Foreign Investment & Management Committee (FIMC) Ministry of Commerce Ministry of Finance Department of Commerce Department of Customs Tax Department Thanaleng Customs house	Immediately after shipment completion	30 days	◆ Supporting Letter of the Ministry of Natural Resources and Environment ◆ Invoice ◆ Packing List ◆ Ocean Bill	DMH

3-2 Necessary Inputs from the Recipient Country

In order to further enhance the benefits of this Project, the following recommendations are strongly encouraged and should accordingly be implemented, namely:

1) Manpower Development

   a) Continuous recruitment of human resources for the next generation; and,

   b) Development of more qualified technical personnel through training and other related manpower development programs.

2) Natural Disaster Prevention and Management

   a) Further strengthening of the collaboration among various government agencies, the mass media and other meteorological organizations in the WMO Region II for a more effective disaster prevention and management strategy;

   b) Setting up of redundancies in the announcement of warnings and other information dissemination methods through multi-channels to ensure reaching out to the general populace; and,

   c) Continuing educational activities for the general public in coordination with various related disaster management agencies and mass media for a more effective natural disaster prevention and management strategy.

   d) Conducting research to increase the level of understanding/knowledge about the natural disaster and its mechanism along with other related meteorological and hydrological phenomena.

3) Longer Life Span of the Equipment procured and the Ancillary Facilities constructed under the Project

a) Regularly secure the necessary budget for the efficient operation and maintenance of the systems and building equipment, and the procurement of requisite spare parts and consumables for all the equipment to be supplied under the Project;

b) Ensure the protection of the buildings, equipment and facilities against theft and vandalism; and,

c) Regularly paint the Ancillary Facilities and caulk the pipe opens/gaps.

3-3 Important Assumptions

1) Utilization of meteorological & hydrological information/data and forecasts/warnings by the mass media (TV, radio, newspaper), the Prime Minister's Office, the National Disaster Management Office (NDMO), the Lao National Mekong Committee (LNMCS), police departments, fire stations, other government-affiliated organizations, the Mekong River Commission (MRC), Red Cross, etc.

2) No change in global warming countermeasures, natural disaster countermeasures, and meteorological and hydrological service policies as determined by the Government of Lao P.D.R.

3) Maintenance of a cooperative structure among the mass media (TV, radio, newspaper) , the Prime Minister's Office, the NDMO, the LNMCS, police departments, fire stations, other government-affiliated organizations, the MRC, Red Cross, etc.

4) Continuance of service by a DMH staff who has received the relevant technical trainings related to the Project.

3-4 Project Evaluation

3-4-1 Relevance

1) Population to directly benefit from the Implementation of the Project

The overall objective of the Project is to reduce the devastation by improvement of the DMH's capability for meteorological and hydrological observation through deployment of automatic meteorological and hydrological observation systems under the Project. Typhoons and floods caused by monsoon heavy rain are extreme manifestations of nature that may lead to immeasurable loss and distress for quite a number of people. Lao P.D.R. seriously experiences huge economic losses coupled with human anguish and sufferings generated by destructive floods. They have caused significant damage to agriculture which is a vital industry in Lao P.D.R., thereby inflicting widespread poverty on its people. In addition, it is expected

that Lao P.D.R. will receive further damage by destructive floods due to acceleration of global warming. Therefore, the population to be benefited both directly and indirectly by the Project will be the whole nation of Lao P.D.R. (estimated 5.43 million (approx. 6.26 million in 2010)). It is also expected that the number of population to directly benefit from the implementation of the Project will proportionally increase due to the fact that the population of Lao P.D.R. has been increasing by 2% annually, that is, 20% in 10 years.

Table48: Administrative District and Population of Lao P.D.R.

No.	Administrative District	Capital	Area(km²)	Population (2004)
1	Attapeu	Attapeu	10,320	114,300
2	Bokeo	Ban Houayxay	6,196	149,700
3	Bolikhamsai	Paksan	14,863	214,900
4	Champasak	Pakse	15,415	575,600
5	Hua Phan	Xam Neua	16,500	322,200
6	Khammouane	Thakhek	16,315	358,800
7	Luang Namtha	Luang Namtha	9,325	150,100
8	Luang Phrabang	Luang Phrabang	16,875	408,800
9	Oudomxay	Muang Xay	15,370	275,300
10	Phongsali	Phongsali	16,270	199,900
11	Sayabouly	Sayabouly	16,389	382,200
12	Salavan	Salavan	10,691	336,600
13	Savannakhet	Savannakhet	21,774	721,500
14	Sekong	Sekong	7,665	83,600
15	Vientiane	Vientiane	3,920	726,000
16	Vientiane	Muang Phon-Hong	15,927	373,700
17	Xieng Khouang	Phonsavan	15,880	37,507
		Total	229,695	5,430,707

2) Objectives of the Project

A key objective of the Project is the effective mitigation of the adverse effects of natural disasters. To achieve this objective, the increase of the density of meteorological and hydrological observation stations, accuracy of observation data and the real-time transmission frequency of observation data is important for the improvement of the weather monitoring capabilities and the accuracy of flood forecasts by using a lead time. Thus, the installation of Automatic Weather Observation Systems and Automatic Water Level + Rainfall Observation Systems is highly required. In addition, the renewal of GTS Message Switching System will enable Lao P.D.R. to provide the observation data to the rest of the world via GTS for the improvement of world' weather forecasts and in return receive the NWP Products calculated by the global NWP model or various meteorological information from the developed countries such as the satellite data of Japan. Furthermore, the installation of High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System will enable the DMH to receive the regional meteorological satellite image every 2.5 minutes. The implementation of the Project is highly expected to improve the meteorological and hydrological forecasts/warnings of the DMH and contribute to the alleviation of the damages caused by natural disasters.

3) Development Plan of Lao P.D.R.

Recently, the climate change has become a big issue to be discussed in Lao P.D.R. To cope with various negative impacts on the main sectors (agriculture, forestry, water resources and health) by the climate change, the National Adaptation Program of Action (NAPA) was formulated in 2009. In the concrete, it includes the enhancement of disaster prevention capabilities of National Disaster Management Committee (NDMC), the improvement and expansion of meteorological & hydrological network and weather monitoring system and the establishment of early warning system in the flood risk areas, etc. In 2020, the Government of Lao P.D.R. approved the National Strategy of Climate Change (NSCC) which contains "Graduation from LDC along with the Green Growth Strategy" "Formulation of Five-Year Socio-economic Development Plan including the climate change", etc. These mean that the adaptation and mitigation policy for the climate change has been reflected in the national development plan. To mitigate the flood damages which are predicted to increase due to the climate change in Lao P.D.R., it is absolutely important to strengthen the DMH's capabilities of monitoring meteorological and hydrological phenomena and transmitting the prompt and accurate weather or flood information/warnings to each disaster prevention organization, local governments and the mass media under the Project.

4) Aid Policy of Japan

The Government of Lao P.D.R. has set a national goal of achieving the Millennium Development Goals (MDGs) and graduating from the Least-Developed Countries (LDC) index. Based on these goals, the Government of Japan has promoted the assistance of Lao P.D.R. Since Lao P.D.R. is surrounded by five countries, the assistance of Lao P.D.R. is considered to contribute to the security and prosperity of the Mekong Region and furthermore, ASEAN as a whole.

Japan has selected four issues of "Development of Economic and Social Infrastructure", "Agricultural Development and Forest Conservations", "Improvement of Educational Environment and Human Resource Development" and "Improvement of Health Care Services" as priority areas of its assistance in light of the matters promoted by ASEAN integration, stronger connectivity and narrowing intra-regional disparities. In particular, Japan provides its assistance with greater emphasis on the promotion of environmentally compatible economic growth.

"Development of Economic and Social Infrastructure", one of the priority areas indicated above, contains the assistance for "Improvement of Capabilities to cope with Natural Disasters due to Climate Change". This confirms the Project is accordance with Japan's aid policy to Lao P.D.R.

3-4-2 Effectiveness

Table49: Achievement Indicator

Indicator	Present (Base Line)	Target
Enhancement of Severe Weather Monitoring Capability of the DMH	No operation of automatic monitor of severe weather in Lao P.D.R.	Operation of automatic monitor of severe weather at the 18 points in Lao P.D.R. (observation resolution mesh: approximately 115km)
	Data volume of the existing 19 synoptic observation station: 55,480 data/year=19×8 data/day×365 days	Data volume of the 18 automatic weather observation systems: between 141,912 data (90%)/year =18×24 data/day×365 days×0.9 (data transmission error: 10%) and 157,680 data (100%)/year=18×24 data/day×365 days (data transmission error: 0%)
	Observation intervals of the 19 existing synoptic observation stations: manually 180 minutes	Observation intervals of the 18 automatic weather observation systems: automatically 60 minutes (interval: adjustable)
	Manual observation data collection from the 19 existing synoptic observation stations by the single side band radio at the DMH Head Office: approximately 60-70 minutes for the completion	Automatic observation data collection from the 18 automatic weather observation systems at the DMH Head Office: approximately 10 minutes for the completion
	Positive/negative bias contained in the observation data obtained by the 19 existing synoptic observation stations	Almost no bias contained in the observation data obtained by the 18 automatic weather observation systems
	More than 1.5 hour time delay of the observation data transmission (manual data input) through the GTS to the global meteorological community	Approximately 10 minutes time delay of the automatic observation data transmission through the GTS to the global meteorological community
	Receiving intervals of satellite images (MTSAT-1R/2): 30-60 minutes intervals	Receiving intervals of satellite images (Himawari - 8/9): minimum 10 minutes intervals via a commercial telecommunication satellite/Internet
Enhancement of Weather Warning Capability of the DMH	Issuance of a heavy rain warning: 1 time/day	Issuance/update/withdrawal of a heavy rain warning: 2 times/day or more
	Observed data availability in the DMH Head Office for judgment for issuance of a heavy rain warning: 4-24 hours intervals	Observed data availability in the DMH Head Office for judgment for issuance, update/renewal and cancellation of a heavy rain warning: 70 minutes intervals
Enhancement of Water Level Monitoring and Flood Warning capability of the DMH for; ■ Xe Bangfai River, ■ Xe Banghiang River, ■ Xe Done River and, ■ Xe Kong River	■ Xe Bangfai River (Xe Noi River: a major tributary of Xe Bangfai River) Estimated flood propagation time between Ban Dong Makfai and Na Teu (Observation Points): approximately 6 hours	
	• Water level observation interval: 12 hours (manual reading by an observer) • Manual data transmission to the DMH Head Office in rainy season (short mail message transmission with a mobile phone by an observer): whenever water level exceeded the warning level • Flood peak observation and flood arrival time forecasting: undoable	• Water level observation interval: 1 hour (automatic) • Automatic data transmission to the DMH Head Office in rainy season: hourly • Hourly flood warning dissemination: doable • Accurate flood propagation time: obtainable
	■ Xe Banghiang River (Xe Champhon River: a major tributary of Xe Banghiang River) Estimated flood propagation time between Bang Kengkok and Dong Hence (Observation Points): approximately 3 hours	
	• Water level observation interval: 12 hours (manual reading by an observer) • Manual data transmission to the DMH Head Office in rainy season (short mail message transmission with a mobile phone by an observer): whenever water level exceeded the warning level • Flood peak observation and flood arrival time forecasting: undoable	• Water level observation interval: 1 hour (automatic) • Automatic data transmission to the DMH Head Office in rainy season: hourly • Hourly flood warning dissemination: doable • Accurate flood propagation time: obtainable
	■ Xe Done River Estimated flood propagation time between; Phonbok and Souvannkhily (Observation Points): approximately 8 hours, and Phonbok (Observation Point) and Pakse (the third biggest city of Lao P.D.R.): approximately 10 hours	
	• Water level observation interval: 12 hours	• Water level observation interval: 1 hour

	(manual reading by an observer) • Manual data transmission to the DMH Head Office in rainy season (short mail message transmission with a mobile phone by an observer): whenever water level exceeded the warning level • Flood peak observation and flood arrival time forecasting: undoable	(automatic) • Automatic data transmission to the DMH Head Office in rainy season: hourly • Hourly flood warning dissemination: doable • Accurate flood propagation time: obtainable • Provision of 10 hours lead time for evacuation to Pakse City
	■ Xe Kong River Estimated flood propagation time between; Phon Xai and Nang Yong (Observation Points): approximately 2 hours, and Phon Xai (Observation Point) and Attapu (one of a major city of South Lao P.D.R.): approximately 14 hours	
	• Water level observation interval: 12 hours (manual reading by an observer) • Manual data transmission to the DMH Head Office in rainy season (short mail message transmission with a mobile phone by an observer): whenever water level exceeded the warning level • Flood peak observation and flood arrival time forecasting: undoable	• Water level observation interval: 1 hour (automatic) • Automatic data transmission to the DMH Head Office in rainy season: hourly • Hourly flood warning dissemination: doable • Accurate flood propagation time: obtainable • Provision of 14 hours lead time for evacuation to Attapu City

<Project Effectiveness for the Global Meteorological Communities including Japan>

Project Effectiveness for the Global Meteorological Communities including Japan is indicated in the figure attached hereto.

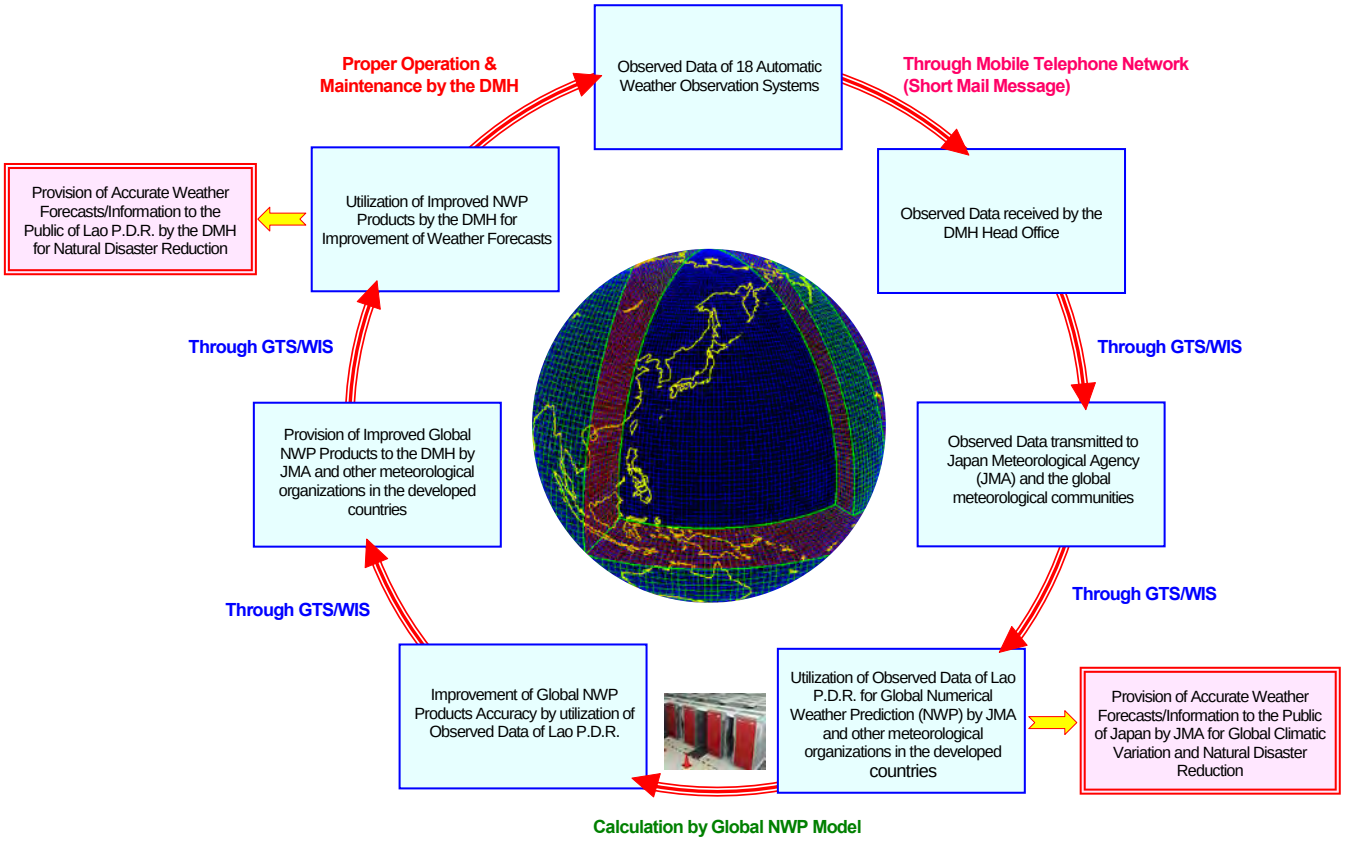


Figure14: Laos Observed Data Circulation in the Global Meteorological Communities

As adequately pointed out in careful and comprehensive evaluation of the effects of the Project, considerable and enhanced benefits can be achieved vis-à-vis the improvement of the DMH's capabilities in reducing human loss and the recurrent economic set-back brought about by meteorological disasters such as floods, etc. caused by typhoon and heavy rain. In addition, the climate change mainly due to accelerating global warming has a potential to increase the meteorological disasters and become the greatest threat to the sustainability of the very foundations of human survival and has been a serious global issue which all the countries must deal with through mutually beneficial cooperation. In this situation, the improvement of the DMH's capabilities of monitoring meteorological and hydrological phenomena and the provision of observation data to the rest of world under the Project will surely contribute to the disaster mitigation in Asia as well as Lao P.D.R. The Project is, therefore, considered to be of great significance in terms of the international cooperation of Japan.

Moreover, in order to reduce the DMH's operational and maintenance costs, the equipment and facilities were designed to minimize spare parts and consumables. As a result, the DMH's budget is expected to be able to cover the Lao portion of the capital and recurrent costs of the Project.

In conclusion, the implementation of the Project is considered to be an appropriately suitable and worthwhile endeavor.

Appendices

Appendix 1. Member List of the Study Team

(1) Preparatory Survey (1) Team

Mr. Shiro NAKASONE	Team Leader	Director, Disaster Management Division 1, Water Resources and Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Kota KATSUMATA	Project Planning and Management	Disaster Management Division 1, Water Resources and Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Kunio AKATSU	Meteorological Observation	Technical Advisor, Water Resources and Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Chief Consultant/Meteorological & Flood Disasters Prevention Planning	Japan Weather Association (JWA)
Mr. Soshi IWATA	Meteorological Observation Equipment Planning	Japan Weather Association (JWA)
Mr. Kazuhiro NAKAMURA	Hydrological Observation Equipment Planning	CTI Engineering International Co., Ltd.
Mr. Toshihide ENDO	Communication System Planning	International Meteorological Consultant Inc. (IMC)
Ms. Motoko KANOME	Procurement Planning/Cost Estimate	International Meteorological Consultant Inc. (IMC)

(2) Preparatory Survey (2) Team

Mr. Katsuji MIYATA	Team Leader	Director, Disaster Management Division 1, Water Resources and Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Kota KATSUMATA	Project Planning and Management	Disaster Management Division 1, Water Resources and Disaster Management Group, Global Environment Department, Japan International Cooperation Agency (JICA)
Mr. Yoshihisa UCHIDA	Chief Consultant/Meteorological & Flood Disasters Prevention Planning	Japan Weather Association (JWA)
Mr. Kazuhiro NAKAMURA	Hydrological Observation Equipment Planning	CTI Engineering International Co., Ltd.
Mr. Toshihide ENDO	Communication System Planning	International Meteorological Consultant Inc. (IMC)

(3) Preparatory Survey (3) Team

Mr. Yoshihisa UCHIDA	Chief Consultant/Meteorological & Flood Disasters Prevention Planning	Japan Weather Association (JWA)
Mr. Kazuhiro NAKAMURA	Hydrological Observation Equipment Planning	CTI Engineering International Co., Ltd.
Mr. Toshihide ENDO	Communication System Planning	International Meteorological Consultant Inc. (IMC)
Mr. Kenji MORI	Natural Conditions Survey / Construction Plannning	Japan Weather Association (JWA)
Mr. Soshi IWATA	Meteorological Observation Equipment Planning	Japan Weather Association (JWA)

Appendix 2. Study Schedule

Preparatory Survey 1

Schedule 2013			Governmental Member			Consultant Member				
			Mr. Shiro NAKASONE	Mr. Kota KATSUMATA	Mr. Kunio AKATSU	Mr. Yoshihisa UCHIDA	Mr. Soshi IWATA	Mr. Kazuhiro NAKAMURA	Mr. Toshihide ENDO	Ms. Motoko KANOME
			Team Leader	Project Planning and Management	Meteorological Observation	Chief Consultant/Meteorological & Flood Disasters Prevention Planning	Meteorological Observation Equipment Planning	Hydrological Observation Equipment Planning	Communication System Planning	Procurement Planning/Cost Estimate
1	7 Aug	Wed				Tokyo → Bangkok → Vientiane		Tokyo → Bangkok → Vientiane		
2	8 Aug	Thu				Discussion with JICA Laos Office, Discussion with DMH, Site Survey at DMH Head Office		Discussion with JICA Laos Office, Discussion with DMH, Site Survey at DMH Head Office		
3	9 Aug	Fri				Discussion with DMH, Site Survey at DMH Head Office, Discussion with LTC		Discussion with DMH, Site Survey at DMH Head Office, Discussion with LTC		
4	10 Aug	Sat				Data Collection, Study for Unit Price of Civil Work & Equipment Installation Materials		Data Collection, Study for Unit Price of Civil Work & Equipment Installation Materials		
5	11 Aug	Sun	Tokyo → Bangkok → Vientiane			Data Collection, Internal Meeting		Data Collection, Internal Meeting		
6	12 Aug	Mon	Discussion with JICA Laos Office, Courtesy call on Embassy of Japan, Discussion with DMH			Discussion with JICA Laos Office, Courtesy call on Embassy of Japan, Discussion with DMH		Discussion with JICA Laos Office, Courtesy call on Embassy of Japan, Discussion with DMH		
7	13 Aug	Tue	Courtesy call on MONRE, Courtesy call on NDMO, Discussion with DMH			Courtesy call on MONRE, Courtesy call on NDMO, Discussion with DMH		Courtesy call on MONRE, Courtesy call on NDMO, Discussion with DMH		
8	14 Aug	Wed	Discussion with DMH			Discussion with DMH		Discussion with DMH		
9	15 Aug	Thu	Discussion with DMH, Confirmation of Minutes of Discussions, Signing on Minutes of Discussions			Discussion with DMH, Confirmation of Minutes of Discussions, Signing on Minutes of Discussions		Discussion with DMH, Confirmation of Minutes of Discussions, Signing on Minutes of Discussions		
10	16 Aug	Fri	Report to JICA Laos Office, Courtesy call on MONRE (Deputy Minister) Vientiane → Bangkok			Report to JICA Laos Office, Courtesy call on MONRE (Deputy Minister)	Tokyo → Bangkok → Vientiane	Discussion with DMH		Tokyo → Bangkok → Vientiane
11	17 Aug	Sat	Bangkok → Tokyo			Site Survey	Data Collection, Internal Meeting, Study for Unit Price of Civil Work & Equipment Installation Materials, Data Collection, Preparation of Project Site Survey	Bangkok → Tokyo	Site Survey (Vang Vieng, Luang Prabang)	Data Collection, Internal Meeting, Study for Unit Price of Civil Work & Equipment Installation Materials, Data Collection, Preparation of Project Site Survey
12	18 Aug	Sun				Site Survey	Data Collection		Site Survey (Oudomexai)	Data Collection
13	19 Aug	Mon				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Site Survey (Xieng Khouang)	Discussion with DMH, Data Collection, Study for Unit Price of Civil Work & Equipment Installation Materials
14	20 Aug	Tue				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Site Survey (Vientiane)	Arrangement for Topographic Survey, Data Collection, Study for Unit Price of Civil Work & Equipment Installation Materials
15	21 Aug	Wed				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Site Survey (Sayabouly)	Discussion with DMH, Data Collection
16	22 Aug	Thu				Discussion with DMH, Data Collection, Discussion with LTC	Discussion with DMH, Data Collection		Site Survey (Vientiane)	Discussion with DMH, Data Collection
17	23 Aug	Fri				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Site Survey (Vientiane)	Discussion with DMH, Data Collection
18	24 Aug	Sat				Site Survey	Site Survey		Site Survey (Nongbok, Thakhek, Seno)	Discussion with DMH, Data Collection
19	25 Aug	Sun				Site Survey	Site Survey		Site Survey (Khongxedone, SouKhoumma)	Discussion with DMH, Data Collection
20	26 Aug	Mon				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Site Survey (Pakxong, Thateng, Samouai)	Discussion with DMH, Data Collection
21	27 Aug	Tue				Discussion with DMH, Data Collection	Discussion with DMH, Data Collection		Samouai→Pakxan	Arrangement for Topographic Survey, Data Collection, Study for Unit Price of Civil Work & Equipment Installation Materials
22	28 Aug	Wed				Discussion with DMH, Site Survey at DMH Head Office, Discussion with LTC	Discussion with DMH, Data Collection		Site Survey (Pakxan)	Discussion with DMH, Data Collection
23	29 Aug	Thu				Discussion with DMH, Report to JICA Laos Office Vientiane → Bangkok			Site Survey (Vientiane), Report to JICA Laos Office Vientiane → Bangkok	Discussion with DMH, Report to JICA Laos Office Vientiane → Bangkok
24	30 Aug	Fri				Bangkok → Tokyo			Bangkok → Tokyo	

DMH: Department of Meteorology and Hydrology
DIC: Department of International Cooperation
NDMO: National Disaster Management Office
LTC: Lao Telecommunication Company

Appendix 2. Study Schedule

Preparatory Survey 2

Schedule 2013			Governmental Member		Consultant Member		
			Mr. Katsuji MIYATA	Mr. Kota KATSUMATA	Mr. Yoshihisa UCHIDA	Mr. Kazuhiro NAKAMURA	Mr. Toshihide ENDO
			Team Leader	Project Planning and Management	Chief Consultant/Meteorological & Flood Disasters Prevention Planning	Hydrological Observation Equipment Planning	Communication System Planning
1	27 Nov	Wed			Tokyo → Bangkok → Vientiane		
2	28 Nov	Thu			Explanation of Draft Final Report to DMH, Discussion with DMH	Tokyo → Bangkok → Vientiane	
3	29 Nov	Fri			Explanation of Draft Final Report to DMH, Discussion with DMH		
4	30 Nov	Sat			Data Collection, Internal Meeting		Site Survey (Viengthon)
5	1 Dec	Sun			Data Collection, Internal Meeting		Site Survey (Viengthon)
6	2 Dec	Mon	Tokyo → Bangkok → Vientiane		Data Collection, Internal Meeting		
7	3 Dec	Tue	Discussion with JICA Laos Office, Courtesy call on Embassy of Japan, Discussion with DMH		Discussion with JICA Laos Office, Courtesy call on Embassy of Japan, Discussion with DMH		
8	4 Dec	Wed	Discussion with DMH Signing on the Minutes of Discussions		Discussion with DMH, Signing on the Minutes of Discussions		
9	5 Dec	Thu	Discussion with DMH, Report to JICA Laos Office and Embassy of Japan Vientiane → Bangkok		Discussion with DMH, Report to JICA Laos Office and Embassy of Japan		Site Survey (Vientiane→Phonsavan)
10	6 Dec	Fri	Bangkok → Tokyo		Discussion with DMH	Vientiane → Bangkok	Site Survey (Viengxai)
11	7 Dec	Sat			Discussion with DMH	Bangkok → Tokyo	Site Survey (Xam Neua→Phonsavan)
12	8 Dec	Sun			Discussion with DMH		Site Survey (Phonsavan→Vientiane)
13	9 Dec	Mon			Report to JICA Laos Office Vientiane → Bangkok		Discussion with DMH Vientiane → Bangkok
14	10 Dec	Tue					

Appendix 2. Study Schedule

Preparatory Survey 3

Schedule 2014			Consultant Member				
			Mr. Yoshihisa UCHIDA	Mr. Kazuhiro NAKAMURA	Mr. Toshihide ENDO	Mr. Kenji MORI	Mr. Soshi IWATA
			Chief Consultant /Meteorological & Flood Disasters Prevention Planning	Hydrological Observation Equipment Planning	Communication System Planning	Natural Conditions Survey / Construction Plannning	Meteorological Observation Equipment Planning
1	26 Dec	Thu			Tokyo → Bangkok → Vientiane		
2	27 Dec	Fri			Discussion with DMH	Tokyo → Bangkok → Vientiane	
3	28 Dec	Sat			Site Survey (Vientiane → Xepon)	Site Survey (Vientiane → Xepon)	
4	29 Dec	Sun			Site Survey (Xepon → Vientiane)	Site Survey (Xepon → Vientiane)	
5	30 Dec	Mon			Discussion with DMH, Data Collection, Disucussion with LTC	Data Collection, Internal Meeting	
6	31 Dec	Tue			Data Collection, Internal Meeting	Data Collection, Internal Meeting	
7	1 Jan	Wed			Data Collection, Internal Meeting	Data Collection, Internal Meeting	
8	2 Jan	Thu	Tokyo → Bangkok → Vientiane		Discussion with DMH	Discussion with DMH	
9	3 Jan	Fri	Discussion with DMH		Discussion with DMH	Discussion with DMH	
10	4 Jan	Sat	Data Collection, Internal Meeting		Data Collection, Internal Meeting	Data Collection, Internal Meeting	
11	5 Jan	Sun	Data Collection, Internal Meeting	Tokyo → Bangkok → Vientiane	Data Collection, Internal Meeting	Data Collection, Internal Meeting	Tokyo → Bangkok → Vientiane
12	6 Jan	Mon	Site Survey (Vientiane → Thakhek)	Site Survey (Vientiane → Thakhek)	Site Survey (Vientiane → Thakhek)	Site Survey (Vientiane → Thakhek)	Site Survey (Vientiane → Thakhek)
13	7 Jan	Tue	Site Survey (Ban Dong Makfai)	Site Survey (Ban Dong Makfai)	Site Survey (Ban Dong Makfai)	Site Survey (Ban Dong Makfai)	Site Survey (Ban Dong Makfai)
14	8 Jan	Wed	Site Survey (Dong Hence)	Site Survey (Dong Hence)	Site Survey (Dong Hence)	Site Survey (Dong Hence)	Site Survey (Dong Hence)
15	9 Jan	Thu	Site Survey (Na Teu)	Site Survey (Na Teu)	Site Survey (Dong Hence→Vientiane)	Site Survey (Dong Hence→Vientiane)	Site Survey (Na Teu)
16	10 Jan	Fri	Site Survey (Ban Kengkok)	Site Survey (Ban Kengkok)	Discussion with DMH	Topographic and Geotechnical Survey Follow-up	Site Survey (Ban Kengkok)
17	11 Jan	Sat	Site Survey (Souvannkhily, Phonbok)	Site Survey (Souvannkhily, Phonbok)	Site Survey (Vientiane → Luang Prabang)	Data Collection, Internal Meeting	Site Survey (Souvannkhily, Phonbok)
18	12 Jan	Sun	Site Survey (Nang Yong, Phon Xai)	Site Survey (Nang Yong, Phon Xai)	Site Survey (Vieng Phoukha)	Data Collection, Internal Meeting	Site Survey (Nang Yong, Phon Xai)
19	13 Jan	Mon	Site Survey (Phon Xai→Vientiane)	Site Survey (Phon Xai→Vientiane)	Site Survey (Vieng Phoukha → Phong Saly)	Discussion with DMH, Discussion with Ministry of Finance	Site Survey (Phon Xai→Vientiane)
20	14 Jan	Tue	Discussion with DMH, Discussion with Ministry of Finance Vientiane → Bangkok	Discussion with DMH	Site Survey (Phong Saly)	Discussion with DMH, Discussion with Ministry of Finance	Discussion with DMH
21	15 Jan	Wed	Bangkok → Tokyo	Discussion with DMH	Site Survey (Phong Saly → Luang Prabang)	Discussion with DMH, Topographic and Geotechnical Survey Follow-up	Discussion with DMH
22	16 Jan	Thu		Discussion with DMH	Site Survey (Luang Prabang → Vientiane)	Discussion with DMH, Topographic and Geotechnical Survey Follow-up	Discussion with DMH
23	17 Jan	Fri		Discussion with DMH	Discussion with DMH, Vientiane → Bangkok	Discussion with DMH, Topographic and Geotechnical Survey Follow-up	Discussion with DMH
24	18 Jan	Sat		Data Collection, Internal Meeting	Bangkok → Tokyo	Vientiane → Bangkok	Data Collection, Internal Meeting
25	19 Jan	Sun		Data Collection, Internal Meeting		Bangkok → Tokyo	Data Collection, Internal Meeting
26	20 Jan	Mon		Discussion with DMH			Discussion with DMH
27	21 Jan	Tue		Discussion with DMH			Discussion with DMH, Vientiane → Bangkok
28	22 Jan	Wed		Discussion with DMH, Vientiane → Bangkok			Bangkok → Tokyo
29	23 Jan	Thu		Bangkok → Tokyo			

Appendix 3. List of Parties Concerned in the Recipient Country

- **Ministry of Home Affairs**

National Geographic Department (NGD)

Mr. Sisombath CHANTHAPHIM	Director of Topographic Survey Division

- **Ministry of Labour and Social Welfare**

National Disaster Management Office (NDMO)

Mr. Vilayphong SISOMVANG	Director

- **Ministry of Natural Resources and Environment**

Mr. Sisavath VITHAXAY	Vice Minister

Department of Meteorology and Hydrology

Mr. KhamPhene PHANGVILADONE	Head of Administration & Personnel Division
Mr. Singthong PATHOUMMADY	Deputy Director General
Mr. Surinh KOUSONSAVATH	Deputy Director of Agro-Climate Division
Mr. Boualaythong KOUMPHONH	Deputy Director of Climate Division
Mr. Nikhong KEOSAVABG	Chief of Climate Division
Mr. Bounseuk INTHAPATHA	Chief of Hydrological Division
Mr. Vanhdy DOUANGMALA	Director of Weather Forecasting and Aeronautical Division
Mr. Bounteum SYSOUPHANTHAVONG	Deputy Head of Weather Forecasting and Aeronautical Division
Ms. Sinthaly CHANTHANA	Deputy Director of Weather Forecasting and Aeronautical Division
Mr. Vinliam BOUNLOM	Chief of Meteorological Network and and Earthquake Division
Mr. Sonboon PONGKHAMSAO	Chief of Weather Forecasting and Warning Unit
Ms. Phetsakhone MISOMOHANE	Technician of Weather Forecasting and Aeronautical Division
Mr. Thatsana CHANVILAY	Technician of Weather Forecasting and Aeronautical Division

Mr. Akhom THAMALANGSY	Technician of Weather Forecasting and Aeronautical Division

Department of Planning and Cooperation

Mr. Virana SONNASINH	Acting Director of Planning Division

- **Ministry of Agriculture and Forestry**

Mr. Phonesavauh VANMIXAY	Deputy of Center for Agriculture Statistic

- **Ministry of Finance**

Tax Department

Mr. Hongkham PHOMVILATH	Deputy Director of Registration Division
Mr. Vongsavanh DETHVONGSA	Deputy Director of Registration Division

External Finance Department

Ms. Vienphet VONGMOONTY	Deputy Director of Loan and Grant Management Division
Mr. Sayduangvanh BOUNLAVONG	Deputy Director of International Cooperation Financial Division

Appendix 4-1. Minutes of Discussions

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF
EQUIPMENT AND FACILITIES ON
METEOROLOGICAL AND HYDROLOGICAL SERVICES
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to a request from the Government of the Lao People's Democratic Republic (hereinafter referred to as "Lao P.D.R."), the Government of Japan decided to conduct the Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Improvement of Equipment and Facilities on Meteorological and Hydrological Services (hereinafter referred to as "the Project") and entrusted the Survey to Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Shiro Nakasone, Director of Disaster Management Division 1, Global Environment Department, JICA, and was scheduled to stay in the country from August 11 to August 16.

The Team held discussions with the officials concerned of the Government of Lao P.D.R. and conducted a field survey at the Survey area.

In the course of discussions and field survey, both parties confirmed the main items described in the attached sheets. The Team will proceed to further works and prepare the Preparatory Survey Report.

Vientiane, August 15, 2013

Shiro Nakasone
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Sithanh Southichack
Director General
Department of Meteorology and Hydrology
Ministry of Natural Resources and Environment
Lao People's Democratic Republic

ATTACHMENT

1. Objective of the Project

Both sides agreed that the objective of the Project is to contribute to the reduction of meteorological and hydrological disasters in Lao P.D.R. by timely providing more accurate information of hazardous phenomena.

2. Contents of the Inception Report

The Team explained the Inception Report to the Department of Meteorology and Hydrology (hereinafter referred to as "DMH"), the Ministry of Natural Resources and Environment (hereinafter referred to as "MONRE"). DMH agreed and accepted the contents of the Inception Report.

3. Project Title

Both sides agreed to the Project Title as "the Project for Improvement of Equipment and Facilities on Meteorological and Hydrological Services".

4. Items requested by DMH

Through discussions between the Team and DMH, the requested components were confirmed as follows.

(1) GTS Message Switching System (hereinafter referred as GTS/MSS) and Equipment for World Meteorological Organization Information System (hereinafter referred to as "WIS") with Isolation Transformer, Automatic Voltage Regulator (AVR) and UPS including engine generators

- One (1) for Vientiane (in the DMH Headquarters)

(2) Automatic Weather Observation System (hereinafter referred to as "AWS") with GSM/GPRS modem

- Installation of AWSs for Eighteen (18) existing DMH weather observation stations, instead of originally proposed sixteen (16), was proposed by DMH. The quantity and site locations shall be determined through the Survey.

(3) Meteorological data encoding computer for DMH weather observation stations

- The quantity and site locations shall be determined through the Survey out of eighteen (18) candidate sites of AWSs.

(4) Travelling Calibration and Maintenance tools for Meteorological Observation Instrument including AWS

- Two (2) sets

(5) Automatic Water Level Observation System with GSM/GPRS modem

- Eight (8) Automatic Water Level Observation Systems (two (2) sites from Xebangfai, Xebanghieng, Xedon and Xekong Rivers respectively)

  The quantity and site locations shall be determined through the Survey.

(6) Travelling Maintenance tool for Automatic Water Level Observation Systems

- One (1) set

(7) Automatic Rain Gauge System with GSM/GPRS modem

- Eight (8) Automatic Rain Gauges Systems for the same sites of the Automatic Water Level Observation Systems were proposed by DMH whereas the twenty (20) of them were originally requested. The quantity and site locations shall be determined by the Team and DMH through the Survey.

(8) High Resolution Meteorological Satellite (the new HIMAWARI to be launched by the Government of Japan) Data Direct Receiving System with analysis software

- One (1) for Vientiane (in the DMH Headquarters)

(9) Other incidental systems and/or ancillary facilities based upon the result of the Survey

5. Responsible and Implementing Agency

The responsible and implementing agency for the Project are as follows.

Responsible Agency: DMH

Implementing Agency: DMH

DMH promised to assign the responsible person(s) who has(have) ample experience with the Japan's Grant Aid Project and the Technical Cooperation Project between JICA and DMH for smooth implementation of the Project until completion of the Project.

6. Japan's Grant Aid Scheme

6-1 The Lao side understood the Japan's Grant Aid Scheme explained by the Team, as described in Annex 3. The Lao side also understood the procedures of the Japan's Grant Aid from the application of a request to follow-up of the Project as illustrated in Annex 4.

6-2 The Lao side will take the necessary measures, as described in Annex 5, for smooth implementation of the Project, as the condition for the Japan's Grant Aid to be implemented.

7. Schedule of the Survey

7-1 The Team will proceed for further surveys in Lao P.D.R. until the end of August 2013.

7-2 Based on the Survey, the Team will conduct analysis in Japan such as designing, cost estimation, etc. until the end of November 2013.

7-3 Based on a result of the survey, the Team will prepare the draft preparatory survey report in English and dispatch a mission in order to explain its contents to the Lao side in December 2013.

7-4 The Team will conduct 2nd field survey in the dry season to collect additional data of local weather observation stations and candidate sites of Automatic Water Level Observation Systems to decide the specification of equipment. The 2nd field survey is planned to be conducted in January 2014.

7-5 Based on a result of the 2nd field survey, the Team will finalize the report and send it to the Lao side around March 2014.

8. Undertakings to be taken by the Lao side

Both sides confirmed that the Lao side shall complete the following undertakings shown in accordance with the implementation schedule of the Project;

(1) To provide the Team with available relevant data, information and materials necessary for the execution of the Study;

(2) To prepare the answers for the Questionnaire presented by the Team;

(3) To assign full-time counterparts to the Team during their stay in Lao P.D.R., to play the following roles as the coordinator to the Team;

- To make the appointments, set up the meetings with the authorities, departments and all other organizations whatever the Team intends to visit.
- To attend all the site surveys and any other visiting place with the Team and to make any convenience on accommodation, working room, adequate transportation, getting the permissions if required, etc.
- To assist and to advise the Team for their collection of data and information as much as possible.

(4) To take any measures deemed necessary to secure the safety of the members of the Team;

(5) To ensure necessary budget and staff to realize smooth implementation of the Project;

(6) To obtain an agreement letter(s) from the owner of site(s) for installation of the Automatic Water Level Observation Systems and the Automatic Rain Gauges about approval of its use by March 2014 in order to secure necessary land;

(7) To provide information about current status of candidate sites for AWS such as condition of facilities, availability of air conditioner, internet connection, etc. by the end of September 2013;

(8) To ensure stable and high-speed internet connection for DMH Headquarters in order to utilize WIS;

(9) To ensure the required electricity supply for the equipment to be procured by the Project; and

(10) To improve disaster risk management with the equipment to be procured by the Project.

9. Other relevant issues

9-1 Environmental and Social Considerations

The Lao side promised to clear necessary procedures for environmental and social considerations and obtain a necessary approval by relevant authorities before commencement of the procurement in accordance with the relevant guidelines in Lao P.D.R., including Environmental Impact Assessment (EIA), if required.

9-2 Necessary Budget and Adequate Number of Specialized Staff for Operation and Maintenance

Necessary budget and adequate number of specialized staff for operation and maintenance of the Project after the completion of the Project will be estimated through the Survey. The Lao side promised to ensure necessary budget and staff for proper operation and maintenance.

9-3 Confidentiality of the Project

The Team explained that the preparatory survey report to be prepared at the end of the Survey shall be disclosed to the public in principle in Japan. However, the Team also explained that a confidential part which might affect bidding process such as cost estimation should be kept undisclosed until the bidding has been completed.

9-4 Tax Exemption

The tax exemption including Value Added Tax (VAT), custom duty, and any other taxes and fiscal levies in Lao P.D.R. which is to be arisen from the Project activities shall be ensured by DMH. DMH shall take any procedures necessary for tax exemption with the Ministry of Finance of Lao P.D.R. at their responsibility.

Annex 1: Project Site
Annex 2: Organization Chart of DMH
Annex 3: JAPAN'S GRANT AID
Annex 4: Flow Chart of JAPAN'S GRANT AID Procedure
Annex 5: Major Undertakings to be taken by Each Government

Annex 1

Project Site

Table: Proposed Sites (Existing DMH Observation Stations) for Automatic Weather Observation Systems

No.	Name of Proposed Site	District	Type
1	Vientiane	Vientiane	Synoptic
2	Vang Vieng	Vientiane	Climate
3	Phong Saly	Phong Saly	Synoptic
4	Vieng Phukhar	Vieng Phukhar	Climate
5	Oudomexai	Oudomexai	Synoptic
6	Viengxai	Houa Phanh	Climate
7	Luang Prabang	Luang Prabang	Synoptic
8	Xieng Khouang	Xieng Khouang	Synoptic
9	Sayabouly	Sayabouly	Synoptic
10	Viengthong	Viengthong	Climate
11	Nongbok	Nongbok	Climate
12	Thakhek	Khammouane	Synoptic
13	Seno	Outhoumphon	Synoptic
14	Samouai	Salavanh	Climate
15	Khongxedon	Salavanh	Climate
16	Thateng	Xekong	Climate
17	Pakxong	Champasack	Climate
18	Soukhoumma	Champasack	Climate

Table: Proposed Sites for Automatic Water Level Observation + Automatic Rain Gauge Systems

No.	River	Name of Proposed Site	District
1	Xe Bangfai	Ban Veun	Nongbok
		Na Teu	Vilabouly
2	Xe Banghiang	Ban Kengkok	Champhone
		Dong Hen	Atsaphangthong
3	Xe Done	Souvannkhily	Sanasomboon
		Dan Gnai	Saravane
4	Xe Kong	Ban Keng Xai	Xaysetha
		Ban Song Khone	Lamarm

Annex 2

Organization Chart of DMH

Rev_2, 17 May 2013

Annex 3

JAPAN'S GRANT AID

The Government of Japan (hereinafter referred to as "the GOJ") is implementing the organizational reforms to improve the quality of ODA operations, and as a part of this realignment, a new JICA law was entered into effect on October 1, 2008. Based on this law and the decision of the GOJ, JICA has become the executing agency of the Grant Aid for General Projects, for Fisheries and for Cultural Cooperation, etc.

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

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures :

- ·Preparatory Survey
  - The Survey conducted by JICA
- ·Appraisal &Approval
  - -Appraisal by the GOJ and JICA, and Approval by the Japanese Cabinet
- ·Authority for Determining Implementation
  - -The Notes exchanged between the GOJ and a recipient country
- ·Grant Agreement (hereinafter referred to as "the G/A")
  - -Agreement concluded between JICA and a recipient country
- ·Implementation
  - -Implementation of the Project on the basis of the G/A

2. Preparatory Survey

(1) Contents of the Survey

The aim of the preparatory Survey is to provide a basic document necessary for the appraisal of the Project made by the GOJ and JICA. The contents of the Survey are as follows:

- Confirmation of the background, objectives, and benefits of the Project and also institutional capacity of relevant agencies of the recipient country necessary for the implementation of the Project.
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, financial, social and economic point of view.
- Confirmation of items agreed between both parties concerning the basic concept of the Project.

- Preparation of a outline design of the Project.
- Estimation of costs of the Project.

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Outline Design of the Project is confirmed based on the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures necessary to achieve its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization of the recipient country which actually implements the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA employs (a) registered consulting firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms.

(3) Result of the Survey

JICA reviews the Report on the results of the Survey and recommends the GOJ to appraise the implementation of the Project after confirming the appropriateness of the Project.

3. Japan's Grant Aid Scheme

(1) The E/N and the G/A

After the Project is approved by the Cabinet of Japan, the Exchange of Notes(hereinafter referred to as "the E/N") will be singed between the GOJ and the Government of the recipient country to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

(2) Selection of Consultants

In order to maintain technical consistency, the consulting firm(s) which conducted the Survey will be recommended by JICA to the recipient country to continue to work on the Project's implementation after the E/N and G/A.

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated

authority 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, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(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 JICA. This "Verification" is deemed necessary to fulfill accountability to Japanese taxpayers.

(5) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex.

(6) "Proper Use"

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

(7) "Export and Re-export"

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

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA 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.

b) The payments will be made when payment requests are presented by the Bank to JICA under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

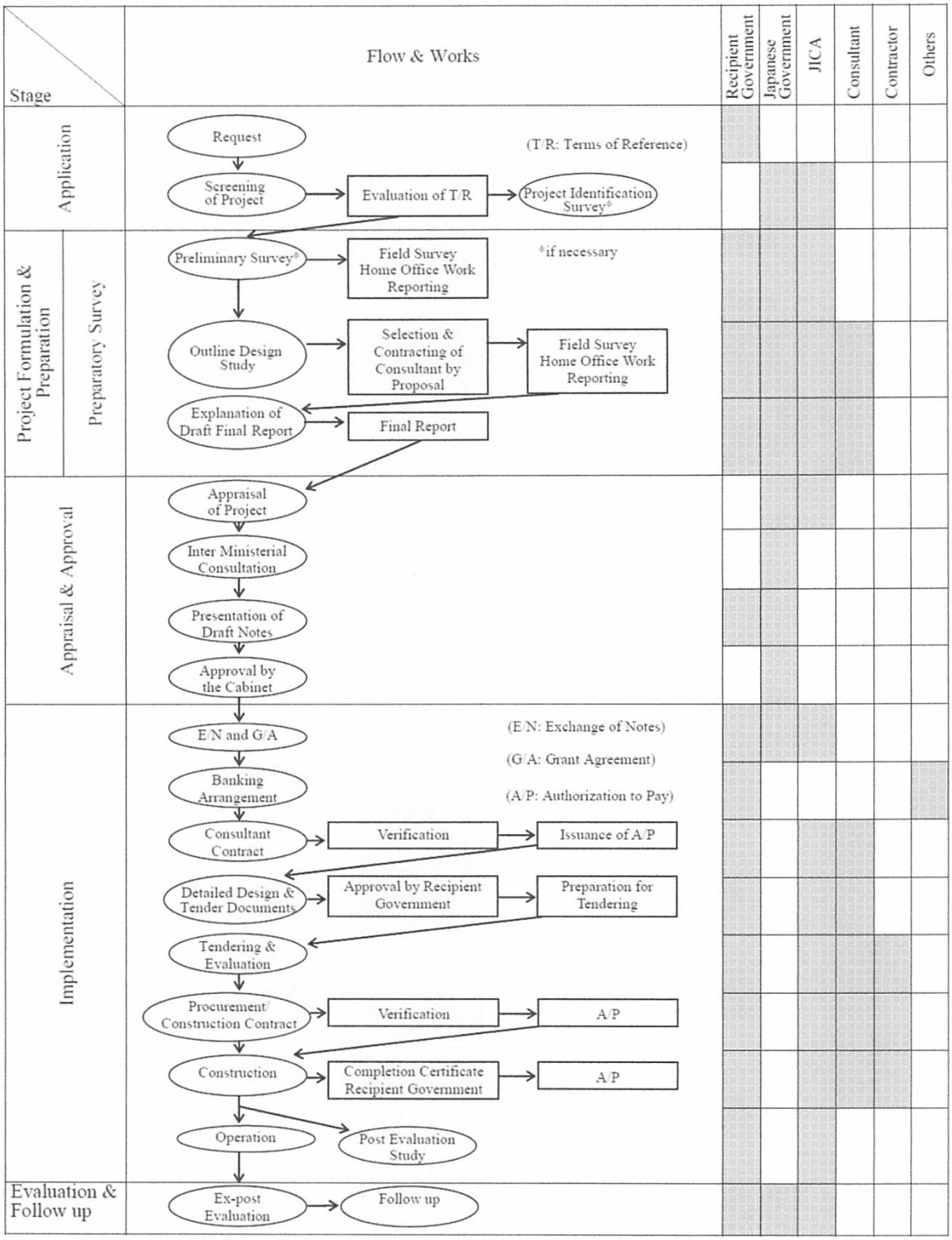
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

A recipient country must carefully consider social and environmental impacts by the Project and must comply with the environmental regulations of the recipient country and JICA socio-environmental guidelines.

Annex 4

Flow Chart of JAPAN'S GRANT AID Procedure



Annex 5

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 lots of land necessary for the implementation of the Project and to clear the sites		●
2	To construct the following facilities		
	1) The building	●	
	2) The gates and fences in and around the site		●
	3) The parking lot	●	
	4) The road within the site	●	
	5) The road outside the site		●
3	To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities necessary for the implementation of the Project outside the sites		
	1) Electricity		
	a. The distributing power line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm sewer and others to the site)		●
	b. The drainage system (for toilet sewer, common waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
4	To ensure prompt customs clearance of the products and to assist internal transportation of the products in the recipient country		
	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	(●)	(●)*
5	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 exempted		●
6	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		●
7	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
8	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
9	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
10	To give due environmental and social consideration in the implementation of the Project.		●

(B/A : Banking Arrangement, A/P : Authorization to pay)

* Internal transportation to the sites where Japanese nationals cannot enter due to the security situation would be covered by the Lao Side.

Appendix 4-2. Minutes of Discussions

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
ON
THE PROJECT FOR IMPROVEMENT OF
EQUIPMENT AND FACILITIES ON
METEOROLOGICAL AND HYDROLOGICAL SERVICES
IN
LAO PEOPLE'S DEMOCRATIC REPUBLIC
(Explanation of the Draft Preparatory Survey Report)

In August 2013, Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Improvement of Equipment and Facilities on Meteorological and Hydrological Services (hereinafter referred to as "the Project") to Lao People's Democratic Republic (hereinafter referred to as "Lao P.D.R."), and through discussions, field survey and technical examination of the results in Japan, JICA prepared the Draft Preparatory Survey Report of the Project.

In order to explain and to consult with the officials concerned of the Government of the Lao P.D.R. on the components of the Draft Preparatory Survey Report, JICA sent the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Katsuji Miyata, Director, Disaster Management Division 1, Water Resources and Disaster Management Group, Global Environment Department, JICA to Lao P.D.R., from November 27th to December 5th, 2013. As a result of discussions, both sides confirmed the main items described in the attached sheets.

Vientiane, December 4th, 2013

宮田 克二	
Katsuji Miyata Leader Preparatory Survey Team Japan International Cooperation Agency	Sithanh Southichack Director General Department of Meteorology and Hydrology Ministry of Natural Resources and Environment Lao People's Democratic Republic

ATTACHMENT

1. Components of the Draft Preparatory Survey Report (Draft Outline Design Report)

The Lao side agreed and accepted in principle the components of the Draft Preparatory Survey Report (Draft Outline Design Report) as explained by the Team. The project sites and the project components are shown in Annex-1 and Annex-2 respectively.

2. Cost Estimation of the Project

2-1. The Team explained the cost estimation of the Project as described in Annex-3.

2-2. Both sides agreed that cost estimation of the Project as attached in Annex-3 should never be duplicated or released to any third parties before the signing of all the contract(s) for the Project.

2-3. The Lao side understood that cost estimation of the Project described in Annex-3 is a provisional one as a result of the Survey and could be subject to change according to further examination or situation changed.

3. Undertakings to be taken by the Lao side

Both sides confirmed that the Lao side shall complete the following undertakings shown in accordance with the implementation schedule of the Project, in addition to the Minutes of Discussions signed on 15th August 2013;

- To obtain an agreement letter(s) from the owner of site(s) for installation of the Automatic Water Level Observation Systems and the Automatic Rain Gauges about approval of its use by March 2014 in order to secure necessary land;
- To shift the exiting concrete pole (approximately 3m) and replace/extend the power cable for electricity supply for construction of the Ancillary Facilities (Power Back-up Shed and Equipment Shed) in the premises of the DMH Head Office by September 2014;
- To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS) by September 2015;
- To provide reliable and high-speed Internet environment for the establishment of a Virtual Private Network (VPN) in the DMH by September 2014;
- To set up new assigned IP addresses under the Project in the existing computing equipment in the DMH by September 2014;
- To shoulder dispatching cost of the trainees to the training sites, such as, daily allowances, transportation fees, accommodation fees;
- To assign staff necessary for the smooth operation and maintenance of the equipment and to effectively utilize the facilities constructed and the equipment procured under the Project.

4. Implementation Structure

Both sides reconfirmed that there is no change in the responsible agency and implementation agencies which were confirmed in the Minutes of Discussions signed on 15th August 2013.

5. Tentative Schedule of the Project

5-1. The Team shall complete the Preparatory Survey Report in English and send it to Lao P.D.R. by the end of March 2014.

5-2. Both sides confirmed the Project shall be carried out in accordance with the tentative schedule as shown in Annex-4.

5-3. Both sides confirmed that the tender notice would be delayed or the exclusion of the Project components would be considered if undertakings by the Lao side mentioned in the item No. 3 of ATTACHMENT are not met by the designated timing.

6. Other Relevant Issues

6-1. Confidentiality of the Draft Preparatory Survey Report and the Preparatory Survey Report

The Team explained that the Draft Preparatory Survey Report and the Preparatory Survey Report to be prepared at the end of the Survey shall be disclosed to the public in principle in Japan. However, the Team also explained that a confidential part which might affect tendering process such as cost estimation should be kept undisclosed until the tendering has been completed.

6-2. Visibility of the Project

The Team explained that the visibility of the Project should be ensured as a token of cooperation from the Japanese people if the Project was realized. The following ideas could be considered to enhance publicity of the Project:

(a) To display commemoration panels and/or stickers on the equipment procured and at the facilities where the equipment installed by the Grant Aid, and
(b) To publicize the Project in the mass media after the Project is approved by both governments.

Annex-1	Project Sites Map
Annex-2	Project Components
Annex-3	Project Cost Estimate
Annex-4	Tentative Implementation Schedule

Annex-1

Table: Proposed Sites for Automatic Weather Observation System Installation

No.	Station Name	Province	Category
1	Vientiane	Vientiane Capital	Synoptic
2	Vang Vieng	Vientiane	Climate
3	Phong Saly	Phong Saly	Synoptic
4	Vieng Phoukha	Luangnamtha	Climate
5	Oudomxai	Oudomexai	Synoptic
6	Viengxai	Houa Phanh	Synoptic
7	Luang Prabang	Luang Prabang	Synoptic
8	Xieng Khouang	Xieng Khouang	Synoptic
9	Sayabouly	Sayabouly	Synoptic
10	Viengthong	Bolikhamxai	Climate
11	Pakxan	Bolikhamxai	Synoptic
12	Thakhek	Khammouane	Synoptic
13	Seno	Savannakhet	Synoptic
14	Samouai	Salavanh	Climate
15	Khongxedon	Salavanh	Climate
16	Xepon	Savannakhet	Climate
17	Pakxong	Champasack	Climate
18	Soukhoumma	Champasack	Climate

: Proposed Sites for Evaporation Gauge

Table: Proposed Sites for Water Level + Rainfall Observation System Installation

No.	River Name	Observation Site	District	Province
1	Xe Bangfai	Ban Veun	Atsaphone	Savannakhet
		Na Teu	Vilabouly	Savannakhet
2	Xe Banghiang	Ban Kengkok	Champhone	Savannakhet
		Dong Hen	Atsaphangthong	Savannakhet
3	Xe Done	Souvannakhily	Sanasomboon	Champasack
		Dan Gnai	Salavan	Salavan
4	Xe Kong	Ban Keng Xai	Xaysetha	Attapeu
		Ban Song Khone	Lamarm	Xe Kong

DMH in Vientiane

Annex-2

Project Components

No.	Component	Places	Quantity
	Procurement and Installation of Equipment		
1	GTS Message Switch System and World Meteorological Organization Information System(WIS) (including Power Back-up Apparatus and Lightning Protection)	DMH Head Office (Vientiane)	1
2	High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan) Data Receiving System	DMH Head Office (Vientiane)	1
3	Automatic Weather Observation System + Meteorological Data Encoding PC (including Evaporation Gauge: 10)	Exiting Synoptic/Climate Observation Station	18
4	Automatic Water Level + Rainfall Observation System	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
5	Automatic Weather Observation Data Management System (including 2 sets of Portable Data Comparison & Maintenance Tools and 1 set of Data Comparison & Maintenance Tools (Standard Devices) for DMH Maintenance Teams to be organized at the DMH Head Office)	DMH Head Office (Vientiane)	1
6	Automatic Water Level + Rainfall Observation Data Management System (including Portable Maintenance Tools for DMH Maintenance Team to be organized at the DMH Head Office: 1 set)	DMH Head Office (Vientiane)	1
	Construction of Ancillary Facilities		
7	Power Back-up Shed	DMH Head Office (Vientiane)	1
8	Equipment Shed	DMH Head Office (Vientiane)	1
9	Concrete Shelter and Water Level Observation Facility	Xe Bangfai River Xe Banghiang River Xe Done River Xe Kong River	8 (2 × 4 Rivers)
10	Soft Component	1	

Annex-3

Project Cost Estimate

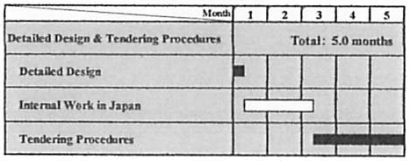
This item is closed due to the confidentiality

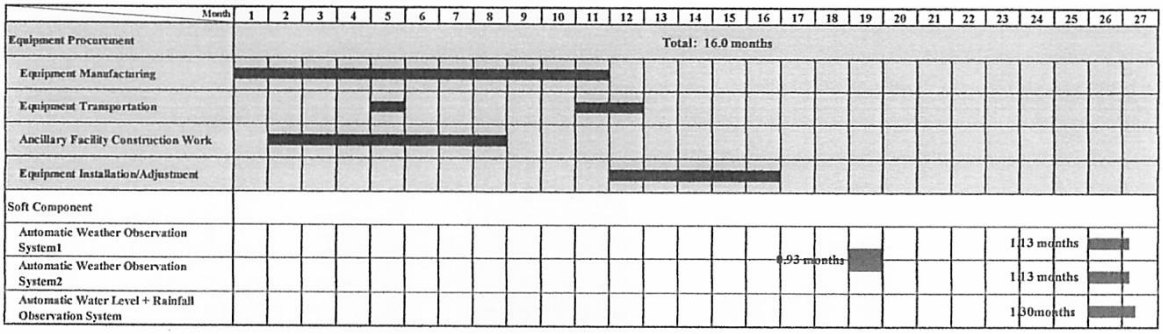
Estimated Capital Cost to be borne by the DMH

No.	Items	Capital Cost (Kip)
1	To pay bank commission to the Bank of Lao P.D.R. for issuance of the Authorization to Pay (A/P) and amendments of A/P, if required, for the Consultant and the Contractor (Project Cost × 0.12% + JPY25,000).	57,500,000
2	To obtain necessary lands for the installation of the Automatic Water Level + Rainfall Observation Systems (8 sites).	120,000,000
3	To undertake incidental outdoor works such as fencing (11 stations for AWS), gates, boundary walls and exterior lighting in and around the sites, if necessary.	95,000,000
4	To shift the existing concrete pole (approximately 3m), replace/extend the power cables and connect the electricity to the Ancillary Facilities constructed in the DMH Head Office	18,000,000
5	To shift the existing meteorological instruments from Saybouly to Parklay and from Thakhek to Xaybuathong	30,600,000
6	To procure mobile SIM card (GSM/GPRS) for transmitting/receiving data observed by the Automatic Weather Observation Systems (AWS) and the Automatic Water Level + Rainfall Observation Systems (AWL+ROS).	560,000
7	To provide reliable and high-speed Internet environment for the establishment of a Virtual Private Network (VPN) at the DMH.	9,600,000
8	To shoulder dispatching cost of the trainees to the training sites such as daily allowances, transportation fees, accommodation fees.	25,000,000
	Total	356,260,000

Annex-4

Implementation Schedule





Appendix 5. Soft Component Plan

Soft Component Plan

<Background of the Soft Component Plan>

Lao P.D.R. is an inland country located in Indochina with about 1,700km of length from north to south. About 80% of the national land is composed of mountains, and the Mekong River flows from the northern mountains to the central and southern plains along the border shared with Thailand. The majority of the population lives in the plains or hilly areas stretching from the Mekong River or its tributaries which are directly and greatly damaged by floods or flash floods caused by negative weather phenomena such as heavy rain due to the southwestern monsoon or typhoon/tropical depression coming from the South China Sea. Flooding in 2011, which brought about unimaginable catastrophic damages to Lao P.D.R., Thailand, Cambodia, etc., is still a fresh memory. That year, five typhoons hit Lao P.D.R., bringing with them unprecedented heavy rain, which is double the average number of typhoons which hit the country (2.4/year). In the recent years, the frequency of abnormal weather due to the climate change induced by global warming has increased drastically all over the world. Lao P.D.R. has also experienced such abnormal weather phenomena as heavy rain, extreme high temperature, dry weather, etc.

Under these circumstances, in 2010, the Government of Lao P.D.R. has requested the government of Japan to procure and install the required equipment as well as to provide the relevant systems and facilities, etc. under Japan's Grant Aid Assistance scheme for the purpose of improving meteorological and hydrological observation capability, implementing wide-area and long-term forecasting, receiving meteorological information and products from developed countries and transmitting observation data from Lao P.D.R. to the rest of the world, etc.

A key objective of the Project is the effective mitigation of the adverse effects of natural disasters. To achieve this objective, the implementation of personnel training and the installation of Automatic Weather Observation Systems and Automatic Water Level + Rainfall Observation Systems are absolutely essential. These will largely enhance the capability to monitor meteorological and hydrological phenomena as it will increase the density of meteorological and hydrological stations and will improve the accuracy and frequency of flood forecasts by using a lead time.

In addition, the renewal of the GTS Message Switching System will enable Lao P.D.R. to provide observation data to the rest of the world via GTS for the improvement of global weather forecasts and, in return, receive NWP Products calculated by the global NWP model as well as various meteorological information from developed countries such as the satellite data of Japan. Furthermore, the installation of a High Resolution Meteorological Satellite ("HIMAWARI" to be launched by the Government of Japan)

Data Receiving System will enable the DMH to receive regional meteorological satellite images every 2.5 minutes. The implementation of the Project is highly expected to improve the quality, timeliness and accuracy of the meteorological and hydrological forecasts/warnings of the DMH and contribute to the alleviation of the damages caused by natural disasters.

However, few technicians in the DMH have practical experience to operate and maintain the Automatic Weather Observation Systems, Automatic Water Level + Rainfall Observation System and Data Management System since manual observation and vocal communication using a portable radio are their current practice. For the smooth operation and maintenance of the equipment to be installed and the assurance of the sustainability of the Project outcomes, the implementation of the following technology transfers in the soft component during the Project is required.

<Soft Component Target>

The Soft Component Targets are as follows.

- Operation, maintenance, fault finding, remedy and recovery of the installed equipment to be appropriately carried out by the DMH
- Prompt and appropriate operation and maintenance of the meteorological & hydrological observation equipment through the use of the system manual summary to be appropriately carried out by the DMH
- Cleaning, maintenance check and confirmation of operation of the Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems to be appropriately carried out by the DMH
- Confirmation of good operational condition of the Systems to be implemented by the DMH

<Soft Component Outputs>

Soft Component Outputs are as follows.

Table: Soft Component Outputs

No.	Item	Output
1	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office	Acquisition of technical know-how on the: 1) appropriate and periodical operation & maintenance through the use of the Automatic Weather Observation Systems Manual Summary a. routine maintenance of the system using a Maintenance Terminal b. practice of measuring solar panel output power and battery voltage c. practice of measuring earth resistance d. practice of inputting maintenance record (including pictures) into a Maintenance Terminal 2) Observed data comparison review using Portable Data Comparison & Maintenance Tools 3) Input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office 4) Input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range
2	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	Acquisition of technical know-how on the: 1) appropriate and periodical operation & maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary a. routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools b. practice of measuring solar panel output power and battery voltage c. practice of measuring earth resistance d. practice of inputting maintenance record (including pictures) into a Maintenance Terminal 2) Observed data comparison review using Portable Maintenance Tools

<Means of Verification on the Achievement of Intended Outputs>

The means of verification on the achievement of the intended outputs of the Soft Component are as follows.

Table: Soft Component Indicators

No.	Item	Objectively Verifiable Indicators	Means of Verification
1	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office Coping process in case of observed data deviated from the normal range are implemented	1) Appropriate and periodical operation & maintenance through the use of the Automatic Weather Observation Systems Manual Summary are carried out. 2) Observed data comparison review using Portable Data Comparison & Maintenance Tools is carried out. 3) Input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office are implemented. 4) Input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range are implemented	1) Confirmation of proficiency on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary 2) Confirmation of proficiency on the observed data comparison review using Portable Data Comparison & Maintenance Tools 3) Confirmation of proficiency on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office 4) Confirmation of proficiency on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range
2	Appropriate and Periodical Operation & Maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	1) Appropriate and periodical operation & maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary are carried out. 2) Observed data comparison review using Portable Maintenance Tools is carried out.	1) Confirmation of proficiency on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary 2) Confirmation of proficiency on the observed data comparison review using Portable Maintenance Tools

<Scheduled Activities on the Soft Component>

Expert Consultants to be in charge of the Soft Component are as follows.

- Automatic Weather Observation Systems operation and maintenance: Output 1
- Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance: Output 2

The Scheduled Activities on the Soft Component are as follows.

Table: Scheduled Activities on the Soft Component

Output	Required Technique and Field	Current Technique and Required Technical Level	Target Group	Means of Implementation	Source of Implementation	Products
1. Appropriate and Periodical Operation & Maintenance	An engineer who has an adjustment and fault finding technique for the Automatic Weather	Since technicians in the DMH have no practical experience on	Indicated in the table below	Before Rainy Season Implementation Place: DMH Head Office Discussion with the DMH technicians	Expert Consultant on Automatic Weather Observation System operation and maintenance	Automatic Weather Observation Systems manual summary

through the use of the Automatic Weather Observation Systems Manual Summary and Preparation of Maintenance Record Input of Observation Data and Scheduled Time Data Transmission to the DMH Head Office Coping process in case of observed data deviated from the normal range are implemented	Observation System	the operation and maintenance of an Automatic Weather Observation System and data transmission equipment, it is required that the DMH technicians should acquire the operation and maintenance technique through the use of the system manual summary.		Selection and explanation of the most important points of the Automatic Weather Observation System manual	Direct Support Activity: 0.93 Man-Month (28 days)	
				Production of the Automatic Weather Observation System manual summary		
				Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary in the DMH Vientiane.		
				Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office.		
				Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.		
				After Rainy Season Implementation Place: each site of Automatic Weather Observation System	Expert Consultant on Automatic Weather Observation System operation and maintenance	

				Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary	Direct Support Activity 1: 1.13 Man-Month (34 days) Activity 2: 1.13 Man-Month (34 days)	
				Practical training on the observed data comparison review using Portable Data Comparison & Maintenance Tools		
2. Appropriate and Periodical Operation & Maintenance through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	An engineer who has an adjustment and fault finding technique for the Automatic Water Level Observation + Rainfall Observation Systems	Since technicians in the DMH have no practical experience on the operation and maintenance of an Automatic Water Level Observation + Rainfall Observation Systems and data transmission equipment, it is required that the DMH technicians should acquire the operation and maintenance technique through the use of the system manual summary.	Indicated in the table below	After Rainy Season Implementation Place: each site of Automatic Water Level Observation + Rainfall Observation System		Automatic Water Level Observation + Rainfall Observation Systems manual summary
				Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary	Expert Consultant on Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance Direct Support 1.30 Man-Month (39 days)	
				Practical training on the observed data comparison review using Portable Maintenance Tools		

As indicated in the table below, the DMH has planned to organize the maintenance teams. Target groups for Output 1 and Output 2 are composed of the technicians from these maintenance teams.

Table: Target Group for Each Output in Soft Component

Output	Target Group	Number of Personnel
Output 1	Automatic Weather Observation Systems maintenance team 1 (Including the staff of each existing observatory)	6
Output 1	Automatic Weather Observation Systems maintenance team 2 (Including the staff of each existing observatory)	6
Output 2	Automatic Water Level Observation + Rainfall Observation Systems maintenance team (Including the staff of each existing observatory)	7

Timing of each activity commencement in the Soft Component is indicated in the following table.

Table: Timing of Each Activity Commencement in the Soft Component

Activity of Expert Consultant	Timing of Activity Commencement
Automatic Weather Observation Systems operation and maintenance	Implementation before the rainy season
	This activity is planned to be implemented in Vientiane and to be commenced in April before the rainy season after the completion of the installation work.
	Implementation after the rainy season
	This activity is planned to be commenced in November after the rainy season for all the Automatic Weather Observation Systems to be procured under the Project.
Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance	Implementation of the after the rainy season
	This activity is planned to be commenced in November after the rainy season for all the Automatic Water Level Observation + Rainfall Observation Systems to be procured under the Project.

<Before the Rainy Season>

Trainings on: 1) the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office; and, 2) the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range will be conducted at the DMH Head Office (Vientiane) for the DMH personnel of 18 exiting Synoptic/Climate Observation Stations as the proposed sites for the Automatic Weather Observation Systems.

<After the Rainy Season >

Each instrument is installed out in the open environment and is, thus, subjected to harsh conditions during the rainy season. It is definitely expected that the instruments would be damaged and defected and that a sensor tip (pipe) of the Automatic Water Level Observation + Rainfall Observation System would be submerged in mud. Therefore, trainings on: 1) recovering these instruments (and restoring their condition back to its original state before the rainy season); 2) observed data comparison review (confirmation of data accuracy); 3) routine maintenance of the system to ensure the appropriate operation of the system for the coming 6 months (dry season); and, 4) inputting maintenance record will be conducted.

The Soft Component activities are planned to be implemented in April before the rainy season and in November after the rainy season for system maintenance of the Automatic Weather Observation Systems. System maintenance of the Automatic Water Level Observation + Rainfall Observation Systems would also be implemented in November. The reasons why the Soft Component activities would be

implemented in April before the rainy season and in November after the rainy season are as follows.

- The DMH has planned to implement system maintenance for the Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems at all the observation stations twice a year (before and after the rainy season).
- Since the DMH is comparatively smaller than the other governmental organizations and conducts routine works around-the-clock with limited manpower, it is difficult to detain several members of the DMH staff over a long period of time for trainings.
- After the rainy season, the Automatic Weather Observation Systems would have already been operated for more than 6 months, thus, practical trainings can be made at all the observation stations.
- It is possible to conduct practical trainings with the maintenance terminal upon acquisition of the observation data from meteorological phenomena which created natural disasters, and which is very important for post-event analysis, during the rainy season.

Details of each activity schedule are as follows.

Table: Details of the Activity Schedule of the Soft Component in April before the Rainy Season (to be Planned)

	Expert Consultants of the Soft Component Activities
Date	Automatic Weather Observation Systems operation and maintenance (Automatic Weather Observation Systems maintenance team 1 & 2)
1	Japan → Laos
2	・Orientation of the training procedure and schedule ・Technical discussion with the DMH head office technicians and lecture
3	(Sat.)
4	(Sun.)
5	Selection and explanation of the most important points of the Automatic Weather Observation Systems manual
6	Production of the Automatic Weather Observation Systems manual summary (Draft)
7	
8	Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary in the DMH Vientiane.
9	Group 1: 6 Observation Stations ・Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office. ・Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.
10	(Sat.)
11	(Sun.)
12	・Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office. ・Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.
13	
14	Group 2: 6 Observation Stations

15	・Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office. ・Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.
16	
17	(Sat.)
18	(Sun.)
19	Group 3: 6 Observation Stations ・Practical training on the input of manual observation/automatic observation data into the Meteorological Data Encoding PC and scheduled time data transmission to the DMH Head Office. ・Practical training on the input of observed data into the data input sheet and coping process in case of observed data deviated from the normal range.
20	
21	
22	Production of Individual Soft Component Completion Report
23	
24	(Sat.)
25	(Sun.)
26	Production of Individual Soft Component Completion Report
27	Technical discussion with the DMH (Automatic Weather Observation Systems maintenance team 1), preparation for departure (Laos)
28	Laos → Japan

Table: Details of the Activity Schedule of the Soft Component in November after the Rainy Season (to be Planned)

	Expert Consultants of the Soft Component Activities	
Date	Automatic Weather Observation Systems operation and maintenance (Automatic Weather Observation Systems maintenance team 1)	Automatic Weather Observation Systems operation and maintenance (Automatic Weather Observation Systems maintenance team 2)
1	Japan → Laos	Japan → Laos
2	・Orientation of the training procedure and schedule ・Technical discussion with the DMH head office technicians and lecture	・Orientation of the training procedure and schedule ・Technical discussion with the DMH head office technicians and lecture
3	Review of the Automatic Weather Observation manual summary and instruction for use of Data Comparison & Maintenance Tools (Standard Devices)	Review of the Automatic Weather Observation manual summary and instruction for use of Data Comparison & Maintenance Tools (Standard Devices)
4	Practical training on the observed data comparison review using Portable Data Comparison & Maintenance Tools and Data Comparison & Maintenance Tools (Standard Devices) Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	Practical training on the observed data comparison review using Portable Data Comparison & Maintenance Tools and Data Comparison & Maintenance Tools (Standard Devices) Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
5	Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary in the DMH Vientiane.	Vientiane → Pakxong
6	(Sat.)	(Sat.)
7	(Sun.)	(Sun.)
8	Vientiane → Sayabouly	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools

9	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	Pakxong → Viengthong
10	Sayabouly → Vientiane	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
11	Vientiane → Vang Vieng	Viengthong → Thakhek
12	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
13	Vang Vieng → Luang Prabang (Sat.)	Thakhek → Seno (Sat.)
14	(Sun.)	(Sun.)
15	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
16	Luang Prabang → Vieng Phoukha	Seno → Xepon
17	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
18	Vieng Phoukha → Oudomxai	Xepon → Khongxedone
19	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
20	Oudomxai → Phong Saly (Sat.)	Khongxedone → Pakxon (Sat.)
21	(Sun.)	(Sun.)

22	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
23	Phong Saly → Oudomxai	Pakxon → Soukhoumma
24	Oudomxai → Viengxai	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
25	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools	Soukhoumma → Samouai
26	Viengxai → Xieg Khouang	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools
27	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Weather Observation Systems Manual Summary ・Practical training on the observed data (Automatic Weather Observation System) comparison review using Portable Data Comparison & Maintenance Tools (Sat.)	(Sat.)
28	(Sun.)	Samouai → Seno (Sun.)
29	Xieg Khouang → Vientiane	Seno → Vientiane
30 31 32	Production of Individual Soft Component Completion Report	Production of Individual Soft Component Completion Report
33	Technical discussion with the DMH (Automatic Weather Observation Systems maintenance team 1), preparation for departure (Laos)	Technical discussion with the DMH (Automatic Weather Observation Systems maintenance team 2), preparation for departure (Laos)
34	Laos → Japan (Sat.)	Laos → Japan (Sat.)

	Expert Consultants of the Soft Component Activities
Date	Automatic Water Level Observation + Rainfall Observation Systems operation and maintenance (Automatic Water Level Observation + Rainfall Observation Systems maintenance team)
1	Japan → Laos

2	・Orientation of the training procedure and schedule ・Technical discussion with the DMH head office technicians and lecture
3	Review of the Automatic Water Level Observation + Rainfall Observation Systems manual summary and Instruction for use of Portable Maintenance Tools
4	
5	Vientiane → Xe Bangfai (Sat.)
6	(Sun.)
7	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary at Na Teu and Ban Dong Makfai
8	
9	
10	
11	・Practical training on the observed data comparison review using Portable Maintenance Tools
12	Xe Bangfai →Xe Banghiang (Sat.)
13	(Sun.)
14	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary at Ban Kengkok and Dong Hence
15	
16	
17	
18	・Practical training on the observed data comparison review using Portable Maintenance Tools
19	Xe Banghiang → Xe Done (Sat.)
20	(Sun.)
21	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary at Souvannkhily and Phonbok
22	
23	
24	
25	・Practical training on the observed data comparison review using Portable Maintenance Tools
26	Xe Done → Xe Kong (Sat.)
27	(Sun.)
28	・Practical training on the: a) routine maintenance of the system using a Maintenance Terminal and Portable Maintenance Tools; b) practice of measuring solar panel output power and battery voltage; c) practice of measuring earth resistance; and, d) practice of inputting maintenance record (including pictures) into a Maintenance Terminal through the use of the Automatic Water Level Observation + Rainfall Observation Systems Manual Summary at Phon Xai and Nang Yong
29	
30	
31	
32	・Practical training on the observed data comparison review using Portable Maintenance Tools
33	Xe Kong → Seno (Sat.)
34	Seno → Vientiane (Sun.)
35	Production of Individual Soft Component Completion Report
36	
37	
38	Technical discussion with the DMH
39	Laos → Japan

<Procurement Method of the Soft Component Implementation Resource>

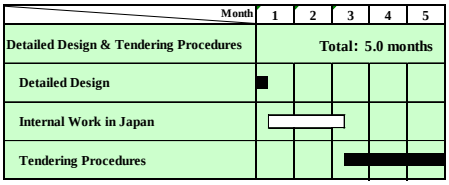
The Soft Component Implementation Resource is procured with the direct support of Japanese consultants who are in charge of procuring the equipment of the Project. The reasons are as follows.

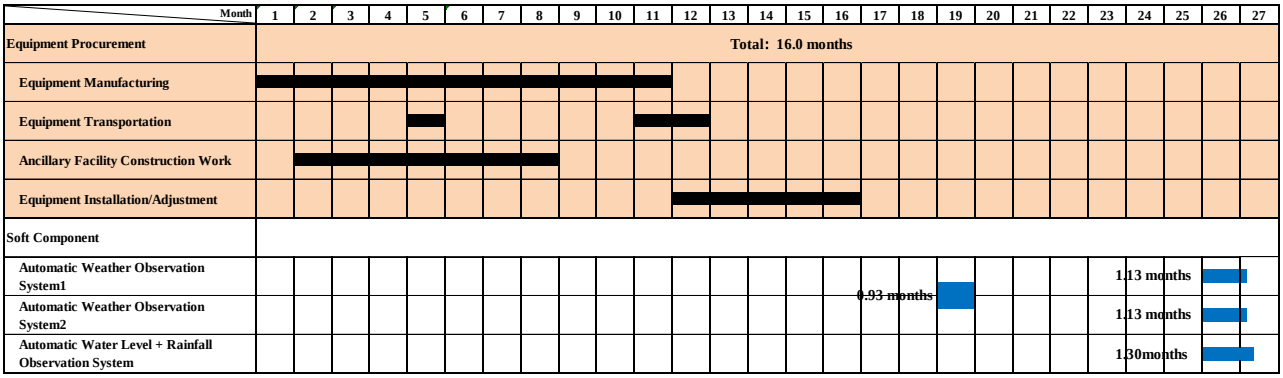
- For technology transfer, an expert with an advanced technique and knowledge of weather services, Automatic Weather Observation Systems and Automatic Water Level Observation + Rainfall Observation Systems is necessary.
- Such an expert usually belongs to weather organizations which actually conduct weather services.
- An expert who has similar experience with the proposed technology transfer is required.

<Implementation Schedule>

The implementation schedule of the whole Project including the soft component is indicated in the following table.

Table: Implementation Schedule





<Soft Component Product>

Soft Component Products are as follows.

Table: Soft Component Products during Technology Transfer

Product Name		Submission Time	No. of Pages
Automatic Weather Observation Systems manual summary		After Technology Transfer	30
Automatic Water Level Observation + Rainfall Observation Systems manual summary			30
Output Name	Content	Submission Time	No. of Pages
Soft Component Completion Report	• Scheduled Activities and Actual Achievement • Scheduled Outputs and Achievement • Factors which influence the Achievement of Outputs • Recommendation • Outputs	Completion of Soft Component	40

<Obligations of the Recipient Country>

The obligations of the DMH for the implementation of the Soft Component are as follows.

1) Manpower Development
   a) Continuous recruitment of human resources for the next generation
   b) Development of more qualified technical personnel through training and other related manpower development programs
2) Longer Life Span of the Equipment procured under the Project
   a) Regularly secure the necessary budget for the efficient operation and maintenance of the systems and building equipment, and the procurement of requisite spare parts and consumables for all the equipment to be supplied under the Project
   b) Ensure protection of the equipment and facilities against theft and vandalism

The DMH will be able to implement the above obligations through its organizational and personnel capabilities. Most especially, the "Continuous recruitment of human resources for the next generation" is of vital concern. It is imperative for the DMH to become self-reliant in particular technical areas such as the operation and maintenance of meteorological and hydrological observation equipment. Hence, it is essential that it makes continued efforts to recruit and fill vacancies, thereby, promoting and guaranteeing technology transfer for all the technicians and engineer(s). The DMH fully recognizes the need to strengthen its technical section/s. With regards to staff recruitment, the Ministry of Natural Resources and Environment is the supervising organization of the DMH and should cooperate and give special attention to this matter.