Department of Irrigation, Ministry of Agriculture and Forestry
Lao People's Democratic Republic

PREPARATORY SURVEY
ON THE PROJECT FOR IMPROVEMENT OF IRRIGATED AGRICULTURE IN THA NGON IRRIGATION SCHEME IN LAO PEOPLE'S DEMOCRATIC REPUBLIC

September 2017

Japan International Cooperation Agency (JICA)

Kokusai Kogyo Co., Ltd.

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct this preparatory survey and entrust the survey to Kokusai Kogyo Co., Ltd.

The Survey team held a series of discussions with the officials concerned of the Government of Lao People's Democratic Republic, and conducted field investigations. Following 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 Laos, for their close cooperation extended to the survey team.

September 2017

Kenichi Shishido
Director General
Rural Development Department
Japan International Cooperation Agency

Summary

1. Overview of Lao P.D.R.

(1) Natural Conditions

Lao People's Democratic Republic (hereinafter referred to as "Lao P.D.R.") is a landlocked country covering an area of 240,000 km^2 of the Indochina peninsula. The country has a population of 6.5 million (the Government of Lao PDR, 2015).

Xaithany District is located in the central part of the Vientiane Capital, and the Nam Gum River, a tributary of the Mekong River, flows in the center of the district.

The climate in Lao P.D.R. is designated as savannah climate and is in the equatorial low pressure belt in summer and is in horse latitudes or subtropical highs in winter; therefore, it is divided clearly into rainy season from May to November and dry season from December to April.

(2) Socio-Economic Conditions

The Government of Lao PDR (hereinafter referred to as "GOL") embarked on the economic reform named "New Economic Mechanism" in 1986 to overcome the collapse of the planned economy systems which had been applied in Lao PDR since 1975. Presently, the GOL is introducing market economy and promoting an open economic agenda by various measures including establishment of banking system and taxation system, development of foreign investment regulation, and privatization of national companies.

At the 8th congress of the Lao People's Revolutionary Party (hereinafter referred to as "LPRP") in 2006, it was announced that the policy during the period until the year of 2020 was to move forward to break away from Least Developed Country (LDC) status. Additionally, at the 10th congress of LPRP, continuance of the said policy and long term development plan until the year of 2025/2030 had been approved as well. Furthermore, bilateral investment treaty between Japan and Lao PDR to accelerate socio-economic development through the foreign investment promotion had become effective in August 2008. In this regard, the investment environment is going to be improved based on the dialogue between Japan and Lao PDR in both governments and private sectors.

In the 2015, Gross National Income (GNI) per capita was USD 1,730 in Lao PDR. In 2016, the primary sector industry (agriculture, forestry and fisheries) contributed 17.23 % to the Gross Domestic Product (hereinafter referred to as "GDP"), while the secondary sector industry accounted for 28.76 % of the GDP and the third sector industry accounted for 42.48 % of the GDP.

2. Background of the Project

(1) Superior plans

Lao PDR approved the 8th National Socio-economic Development Plan (hereinafter referred to as "NSEDP") at the 10th congress of LPRP in January 2016.

The policies in the areas of agriculture and forestry, which are mentioned in this plan, are the following: 1) promotion of stable and sustainable food and cash crop production for sustainable and comprehensive economic development; 2) ensuring food security and reduction of malnutrition; 3) reduction of instability in agricultural production; and 4) promotion of agriculture for rural and provincial development. Improvement of irrigation facilities is described as a measure to realize these policies.

In addition, Ministry of Agriculture and Forestry (hereinafter referred to as "MAF") formulated "Agriculture Development Strategy to 2025 and Vision to the Year 2030 "reflecting the 7th NSEDP in May 2015. MAF set the main goals of the strategy as food production and agricultural commodity production to contribute to rural development and poverty reduction, and proposed two measures: 1) overall measures such as defining policy and laws, investment and cooperation with the other organizations; and 2) specific technical measures in order to achieve these goals.

Moreover, the irrigation infrastructure development and agro-irrigation focal area development are stated in the second measure for the purpose of improving the existing irrigation systems of 6,953 projects.

(2) Present Condition and Issues

In Lao PDR, the primary sector industry is the main industry accounting for about 17 % of GDP and about 70 % of the working population. The GOL has promoted irrigated agriculture and construction of relevant facilities, such as intake facilities, pump stations and main canals. The government stated ensuring food supply, promotion of commercial crops production and in particular, establishment of comprehensive irrigation systems, as some of the priority areas in the 8th NSEDP.

In Lao PDR, self-sufficiency rate of rice, which is the staple food in the country, has reached 100 %; however, looking at rural areas individually, there still remain some areas where sufficiency has not been achieved yet because of increasing population and geological conditions. Habitants in rural areas are generally engaged in subsistence agriculture and fisheries. In these areas, quality and productivity are low because production immensely depends on the weather and farmers do not have sufficient technical knowledge. Furthermore, farmers' organizations have not been sufficiently established and this causes limited access to rural finance and market information, and inhibits development of market-oriented agriculture and fisheries. As a result, economic inequality between the rural and rapidly developing urban areas is increasing. Thus, improvement of livelihood in the rural areas is an issue.

(3) Background and description of the Project

1) Background of the Request

Tha Ngon Area, which is the target of the Project for Improvement of Irrigated Agriculture in Tha Ngon Irrigation Scheme (the Project), is located about 20 km north of Vientiane, the capital of Lao PDR. The area has an irrigated area of 658 ha in total, and a high potential for agricultural production because of its convenient location.

This area has been regarded as a model area with a pilot farm for development of modern irrigated agriculture in the Vientiane plain. It is also regarded as a trigger for Japanese assistance to Lao PDR and agricultural modernization in the country through the plan of Tha Ngon Agricultural Development Project settled by GOL under Japanese technical cooperation and the agreement "Project for Establishment of Pilot Farm in Tha Ngon, Lao PDR" with the Japanese government (hereinafter referred to as "GOJ"). Based on the project, the Asia Development Bank (hereinafter referred to as "ADB") arranged the irrigation facilities in "Tha Ngon Agricultural Development Project" in 1978 as a loan project. After this project by ADB, the irrigation pump facilities were replaced in "Tha Ngon Agricultural Development Project" by Japan's Grant Aid in 1987. At present, the facilities are used for rice and vegetable cultivation by local farmers. The facilities have been used for 30 years under maintenance by the Lao side; however, these facilities are losing the original functions by deterioration and causing a decrease of the irrigated area and difficulty in cultivation during the dry season.

Against this background, GOL requested rehabilitation of the irrigation facilities in the area to GOJ to recover irrigation capacities essential for food security through modern agriculture and promotion of cash crops production.

2) Overview of the Request

The following items were requested by GOL.

Replacement of the Pumps, Improvement of the Main Farm Roads and the Secondary Canals with Brick Masonry, Replacement of the Turnouts and the Check Structures

After receiving the request, Japan International Cooperation Agency (hereinafter referred to as "JICA") had preliminary discussions with GOL and carried out surveys at the site. The items confirmed to be necessary are in order of priority: 1) replacement of the pumps; 2) improvement of the turnouts and the check structures; 3) provision of machinery for road improvement; 4) replacement of the irrigation (and drainage) canals; and 5) pavement of the existing main roads. This preparatory survey was conducted with the following objectives: determine the optimal Project scope; evaluate the necessity relevance and priority of the Project; and then, estimate general costs based on general design and the project scope appropriate for Japanese Grant Aid.

3. Overview of the survey and Project contents

The field survey of the Project was implemented from January 2017 to February. After that, the Survey Team conducted a domestic analysis in Japan, and elaborated on the basic design and the outline cost estimate. In August 2017, on the basis of the basic design and the cost estimation, the Survey Team conducted second field survey for explanation and discussion of the Outline Design of the Project.

(1) Overview of the survey

The design conditions of the Project are based on the design conditions established in the grant aid plan implemented in 1987. Each of these conditions is explained in detail below.

1) Farming Conditions

The conditions on irrigation in the Project will be formulated based on the current farming schedule as shown in Figure 1.

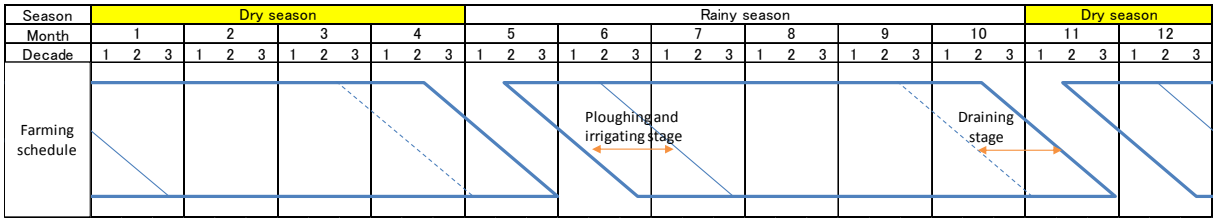


Figure 1 Rice farming schedule

2) Unit Irrigation Water Requirement

In the basic design of the grant aid project implemented in 1987, the potential evapotranspiration calculated with the modified Penman Method, irrigation efficiency of 60 % and the peak water requirement in March were conditions (parameters) to calculate the gross water requirement in the dry season (1.78 ≒ 1.8 L/sec./ha). The gross water requirement in the rainy season (1.03 ≒ 1.0 L/sec./ha) was obtained in the same way as the dry season except that the peak irrigation water requirement for January was used.

Due to losses of conveyance and operation, it is estimated that actual irrigation efficiency under present conditions is 40 % against the proposed one of 60 %. Even if the pumps are replaced, the irrigated area will remain at about 400 ha without improvement of the conveyance and operational efficiencies. It is expected that Water Users Association (WUA) will be activated through the Project and the irrigated efficiency or area will be restored to the level of the original plan with improvement of physical conditions and operation of the irrigation system. Thus, the same values are adopted for the new plan as the original one.

3) Setting of Unit Water Discharge

First, in the basic design of the grant aid project of 1987, the design drainage requirement was decided with the following conditions:

－One day rainfall of 10-year recurrence period is adopted as design rainfall.

－The design daily rainfall should be drained within 24 hours.

－The average water storage capacity of paddy fields should be 45 mm.

Second, in the above-mentioned basic-conditions, the 10-year probable rainfall was estimated at 122mm (with the Gumbel Method) based on the data of daily rainfall measured at Tha Ngon Meteorological Station (between 1971 and 1985) and the unit discharge calculated with this value (122mm) was set at 9.0 L/sec./ha.

The Survey Team obtained the 10-year probable rainfall of 139.4 mm/day with the same method from the latest rainfall data and the unit discharge calculated with this value (139.4 mm) was set at 10.93L/sec./ha in the Project.

In conclusion, the Survey Team decided the specification of the drainage pumps using the value (10.93L/sec./ha) and catchment area (1,168 ha) for drainage pump station.

4) Estimation of the Beneficiary area

The gross area that could be irrigated with the water supplied from the irrigation pump station was estimated at 658 ha from the results of the field reconnaissance of the areas irrigated by the water from Turnouts Nos. 1-13, interview survey and the GPS area measurement conducted in this study. Therefore, this 658 ha area is designated as the gross irrigation area of the Project. In the outline design survey conducted in 1987, the beneficiary area after the rehabilitation of the irrigation system was set at 610 ha. Table 1 shows the breakdown of the gross irrigation area.

Table 1 Gross Irrigation Area

Gross Irrigation area	Area	Remarks
Area that can be irrigated by the irrigation pumps	658 ha	・ Including a 54 ha area irrigated by the floating pumps ・ Including a 85 ha area irrigated by the water from both the irrigation pump station and the Nong Sam Kha Dam 1 ・ Including a 124 ha-area irrigated by the water from both the irrigation pump station and the Nong Sam Kha Dam 2

(2) Project contents

In the Project, for the achievement of the Project Purpose, the necessary equipment and facilities were discussed with the Laotian side. Table 2 will be provided/developed based on the results of the analysis of the request contents, field study and further discussion with the Laotian side.

Table 2 Outline of the plan

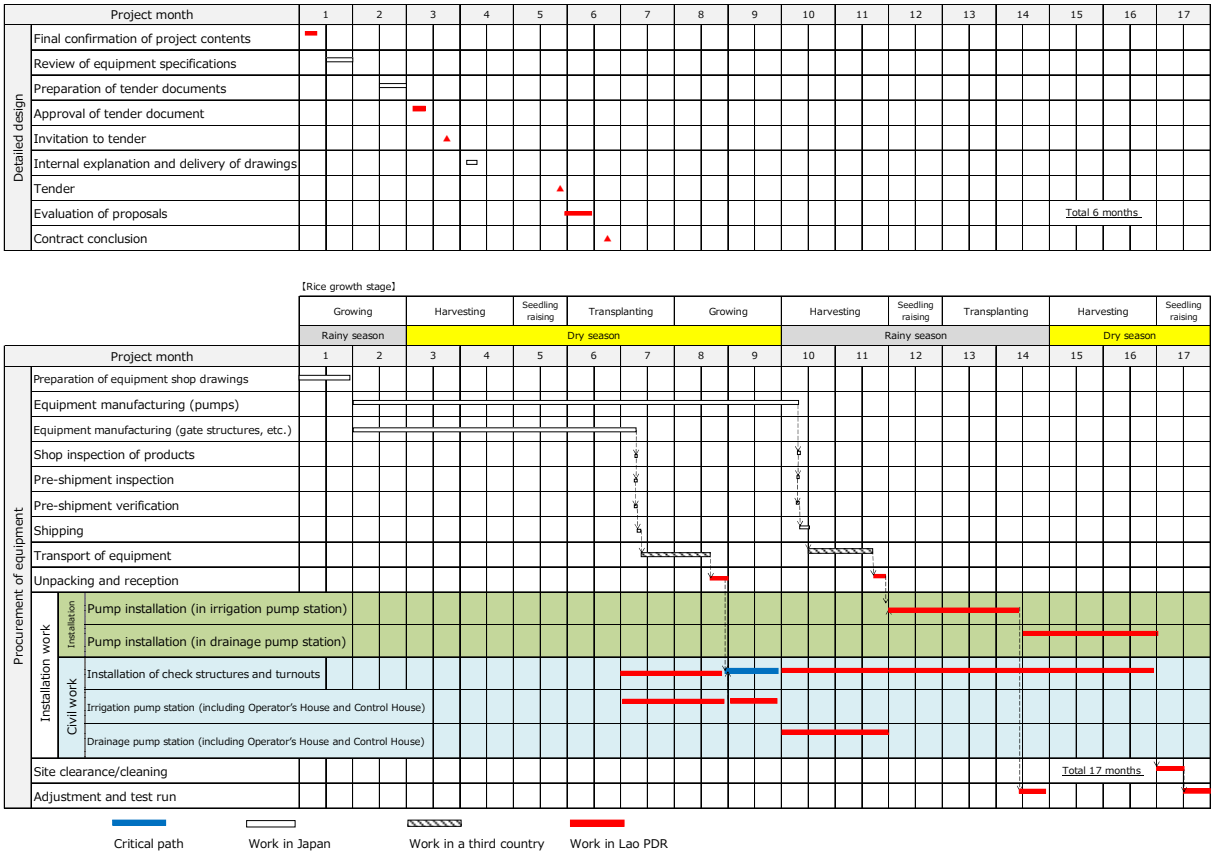
No.	Equipment/Facilities	Outline of the Plan
1	Replacement of pumps	- The three irrigation pumps and auxiliary facilities (including riser pipes, control panels, substation facilities and head gate) will be renewed and an operator's house will be constructed. - The two drainage pumps and auxiliary facilities (including control panel, substation facilities and floating pumps) will be renewed and an operator's house will be constructed.
2	Improvement of the main farm roads	- A motor grader will be provided.
3	Replacement of turnouts and check structures	- Head gate on Reservoir (1 unit), all the turnouts (76 units), check structures (6 units), head gates of the Nong Sam Kha Dams (3 units), etc. in the beneficiary area will be replaced. - The spillway on the reservoir will be replaced with an orifice (1unit).
4	Design and Supervision	- Design and construction supervision services will be provided. - Soft component will be implemented for the capacity development in the operation and maintenance of the irrigation facilities.

4. Implementation Schedule and Project Cost Estimation

(1) Implementation Schedule

The Project will be composed of the following three major stages: 1) detailed design stage; 2) tender stage (preparation of tender documents, invitation to tender, tender, evaluation of bid proposals and conclusion of a procurement contract); and 3) equipment procurement stage. Table 3 shows the Project implementation schedule.

Table 3 Project implementation schedule



(2) Project Cost Estimation

Table 4 shows the costs estimated to be borne by the Laotian side.

Table 4 Costs to be borne by the Laotian side

Cost to be borne by the Laotian side 338,400,000LAK（4,703,760JPY）

Item	Amount (in LAK)	Amount (in JPY)
Waste disposal cost (concrete debris, surplus earth, etc.)	72,000,000	1,000,800
Preparation of the construction site (removal and re-installation of fences)	72,000,000	1,000,800
Lease of the temporary yard	36,000,000	500,400
Furniture purchase cost (beds and desks in the operator's houses)	14,400,000	200,160
Electrical work	72,000,000	1,000,800
Commissions associated with B/A (assumed)	72,000,000	1,000,800
Total	338,400,000	4,703,760

5. Project Evaluation

(1) Relevance

The implementation of the Project within the framework of the Japanese Government's Grant Aid is considered to be relevant for the following reasons:

- GOL intends to increase food production and production of commercial crops by improving the existing irrigation systems in the country for the development of rural areas and poverty reduction. This project is consistent with this intention of GOL,
- GOL also intends to make the project area a model area for the development of modern irrigated agriculture. The implementation of this project will contribute to the creation of this intention of GOL,
- "Agricultural Development and Forest Conservation" is one of the four priority areas in the Country Assistance Policy for Lao PDR of GOJ formulated in 2012 and "to increase productivity with irrigated agriculture" is a pillar in this priority area,
- The degradation of the pump facilities is a limiting factor on rice farming in the dry season because it has reduced the irrigable area and made it difficult to grow rice in some paddies in the dry season. The implementation of the project will contribute greatly to the improvement of the agricultural productivity by realizing reliable and equitable supply of irrigation water,
- Department of Irrigation (DOI), MAF: the implementing agency of the Project, Provincial Agriculture and Forest Office (hereinafter referred to as "PAFO"), and District Agriculture and Forest Office and Tha Ngon Irrigation Project Office, which are both under organization of PAFO, have 40 years of experience in the operation and maintenance of the Tha Ngon Irrigation System; therefore, they are expected to be able to operate and maintain the system continuously, and
- The rehabilitation of the irrigation facilities of large public interest intended in the Project is consistent with the scheme of the Japanese Grant Aid.

(2) Effectiveness

1) Quantitative outcomes

Table 5 shows the quantitative outcomes expected from the implementation of the Project.

Table 5 Quantitative outcomes of the implementation of the Project

Indicators	Baseline (2016)	Target (2022) [three years after the Project completion]
Irrigated area (ha) (dry season)	272	400
Amount of water supply by pump operation (m^3/day)	59,447	93,312
Amount of rice production (t) (dry season)	1,224	2,404
Unit energy consumption (consumed energy per water supply)（kWh/㎥）	0.045	0.032

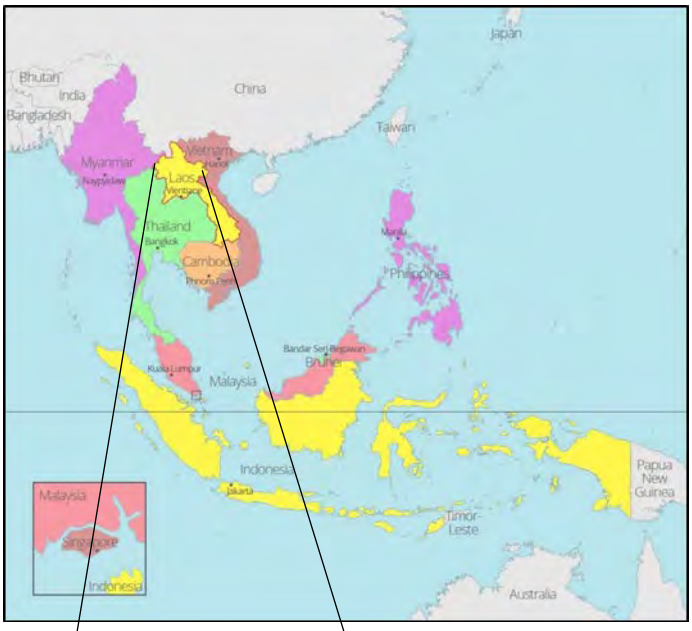
2) Qualitative outcomes

The qualitative outcomes expected from the implementation of the Project are as follows:

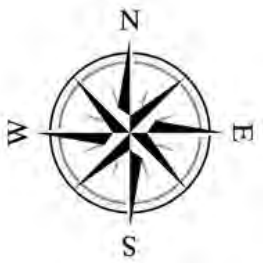
- Farmers will have a sense of security from guaranteed irrigation water in the necessary period and will be motivated to produce more.
- Farmers will transform their farming to become more profitable one with surplus production and their livelihood will beis improved.

CONTENTS

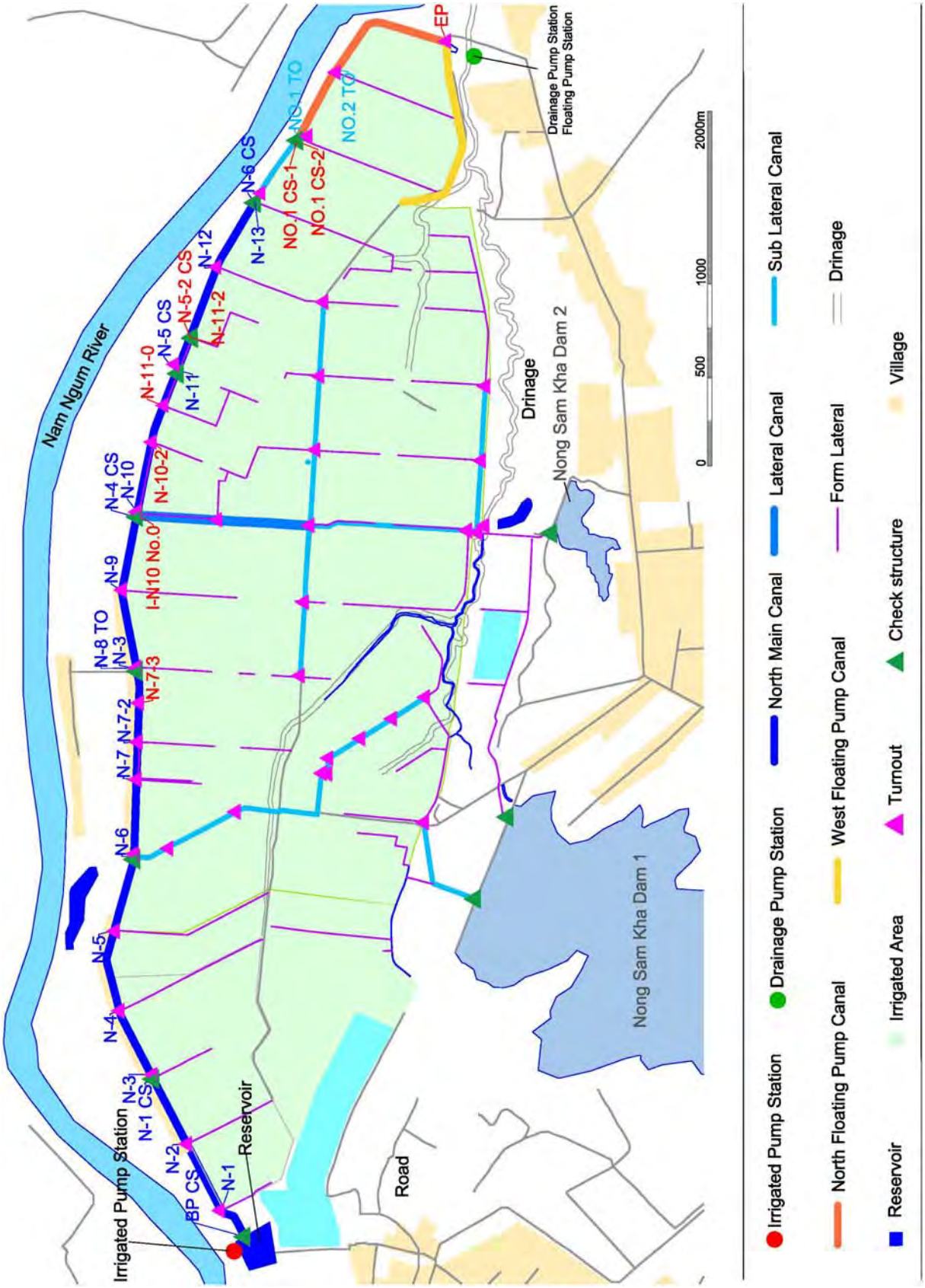
Location Map



Lao People's Democratic Republic



THE PROJECT FOR IMPROVEMENT OF IRRIGATED AGRICULTURE IN THA NGON IRRIGATION SCHEME



General Layout of the Project in Tha Ngon

LIST OF FIGURES & TABLES

ABBREVIATIONS

Abbreviations	Official Name
ADB	Asian Development Bank
DAC	Development Assistance Committee
DAFO	District Agriculture and Forest Office
DOI	Department of Irrigation
EDL	Électricité du Laos
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GNI	Gross National Income
GOJ	Government of Japan
GOL	Government of Laos
IEE	Initial Environmental Examination
IMT	Irrigation Management Transfer
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteers
LAK	Laos Kip
LDC	Least developed country
MAF	Ministry of Agriculture and Forestry
M/D	Minutes of Discussion
MONRE	Ministry of Natural Resource and Environment
NSEDP	the National Socio-Economic Development Plan
OECD	Organization for Economic Co-operation and Development
O&M	Operation and Maintenance
PAFO	Provincial Agriculture and Forest Office
VTE	Vientiane Capital

Chapter 1 Background of the Project

1-1 Background and Description of the Project

Tha Ngon Area, which is the target of the Project for Improvement of Irrigated Agriculture in Tha Ngon Irrigation Scheme (hereinafter referred to as "the Project") has an irrigated area of 658 ha in total. The area has a high potential for agricultural production because it is located about 20 km north of Vientiane, the capital of Lao PDR.

This area has been regarded as a model area with a pilot farm for development of modern irrigated agriculture in the Vientiane plain and as a trigger for Japanese assistance to Lao PDR and agricultural modernization in the country. The GOL elaborated on the plan for Tha Ngon Agricultural Development Project in 1968 under Japanese technical cooperation, and then the agreement "Project for Establishment of Pilot Farm in Tha Ngon, Lao PDR" with the GOJ was concluded in 1970. Following this, based on the above project's policy, the ADB arranged the irrigation facilities in "Tha Ngon Agricultural Development Project" in 1978 as a loan project. After this project by ADB, the irrigation pump facilities were replaced in "Tha Ngon Agricultural Development Project" by Japanese Grant Aid in 1987. At present, the facilities are used for rice and vegetable cultivation by local farmers in the area. These irrigation pump facilities have been used for more than 30 years under maintenance by the Lao side, however, they are losing the original functions by deterioration, and causing a decrease of irrigated area and difficulty in cultivation in the dry season.

Under such circumstances, GOL requested GOJ to implement the rehabilitation of the irrigation facilities in the area to recover irrigation capacities because it is essential to have food security through modern agriculture and promotion of cash crop production.

1-2 Overview of the Request

The following items were requested by Lao PDR.

- Pump replacement
- Main Farm Road
- Secondary Canal Improvement with Brick Masonry
- Turnout and Check Structure Replacement
- After receiving the request, Japan International Cooperation Agency (hereinafter referred to as "JICA") had preliminary discussions with GOL and carried out field survey at the site to grasp detailed contents of the request. As the result, the items confirmed to be necessary are in order of priority; 1) Pump replacement, 2) Turnout and check structure replacement, 3) Provision of machinery for road improvement, 4) Secondary canal improvement with brick masonry and 5) Pavement of the existing main farm roads.
- 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 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 an outline design of the Project.
- -Estimation of costs of the Project.

1-3 Natural Conditions

1-3-1 Topography

Tha Ngon Farm is located on a fluvial terrace of the Nam Ngum River, a tributary of the Mekong River. Tha Ngon Area is mostly flat with the highest and lowest points at approximate elevations of 170 m and 160 m, respectively. The existing documents prove[1] that the elevation of the surface of paddy fields in the area is in the range between 161 m and 167 m.

1-3-2 Climate

The climate in Vientiane is classified as Aw (tropical savanna climate) in the Köppen climate classification system. Its seasons are clearly divided into rainy and dry seasons (from May to October and from November to April, respectively). As seen in Figure 1-1 , the annual range of air temperature is relatively small, with the highest mean monthly maximum air temperature of 34.3ºC in April and the lowest mean monthly minimum air temperature of 16.4ºC in January. The record kept at Tha Ngon meteorological station located near the project area shows that the mean annual precipitation in the 30-year period between 1985 and 2014 was 1,858 mm and most rainfall was observed in the rainy season as shown in Figure 1-2. Table 1-1 shows the meteorological data observed in Vientiane.

[1] P.125, “Third Expert Comprehensive Report on the Pilot Farm Development Plan in the Tha Ngon Area in Laos (1977)”

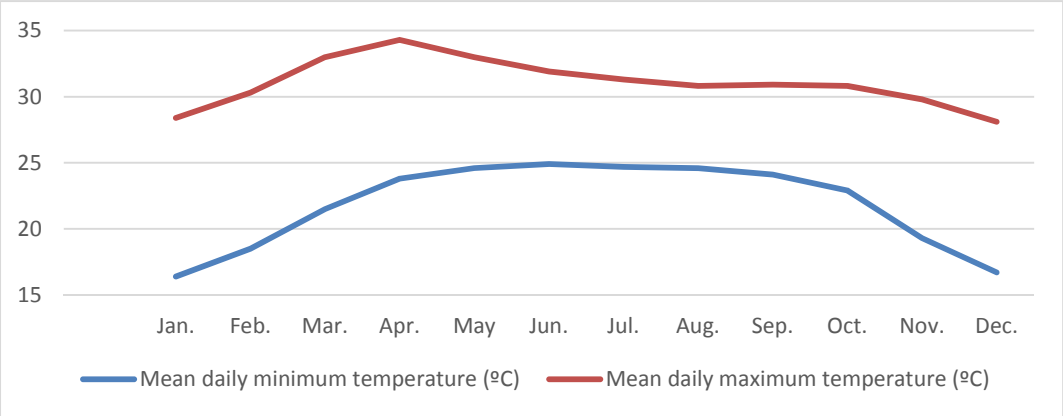


Figure 1-1: Mean daily maximum and minimum temperature in Vientiane

(Averages for the period between 1951 and 2000)

(Source: World Weather Information Service, http://www.worldweather.org/121/c00235. html; Graph: prepared by the Study Team)

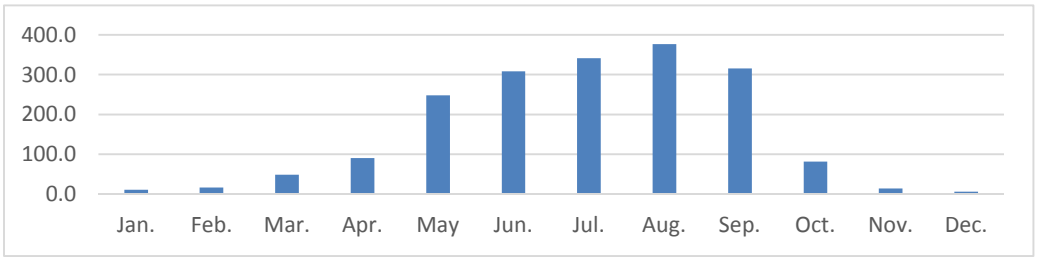


Figure 1-2: Mean monthly rainfall

(Between 1985 – 2014, with the data of 1986 excluded because of the incompleteness of the data)

(Source: Department of Meteorology and Hydrology, Graph: prepared by the Study Team)

Table 1-1: Meteorological data observed in Vientiane

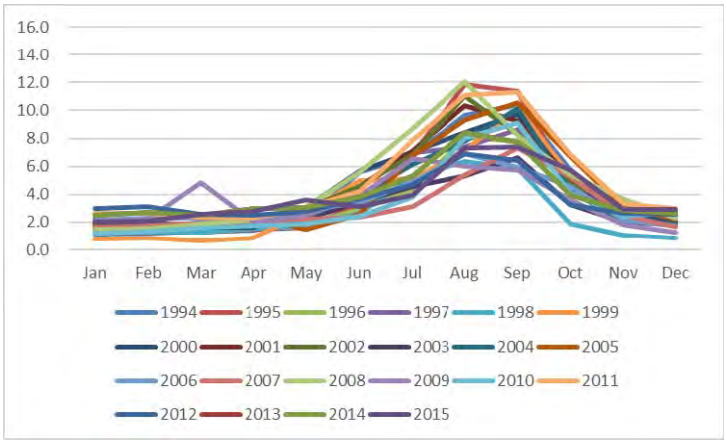
	Unit	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Maximum temperature	℃	28.4	30.3	33.0	34.3	33.0	31.9	31.3	30.8	30.9	30.8	29.8	28.1	31.1
Minimum temperature	℃	16.4	18.5	21.5	23.8	24.6	24.9	24.7	24.6	24.1	22.9	19.3	16.7	21.8
Precipitation	mm	10.80	16.40	48.70	90.20	248.30	308.40	341.40	376.70	315.70	81.30	14.30	6.00	1858.20
Sunshine duration	hr	272.90	217.30	211.80	183.20	234.70	146.00	100.00	140.80	173.60	243.10	258.20	228.30	2409.90

(Sources: Maximum and minimum temperature: World Weather Information Service, http://www.worldweather.org/121/c00235.htm (averages of the period between 1951 and 2000), precipitation: Department of Meteorology and Hydrology of Laos (averages of the period between 1985 and 2014 excluding 1986), sunshine duration: Lao Statistics Bureau, http://www.lsb.gov.la/en/Meteorology14.php (data of 2014).)

1-3-3 Hydrology (Nam Ngum River)

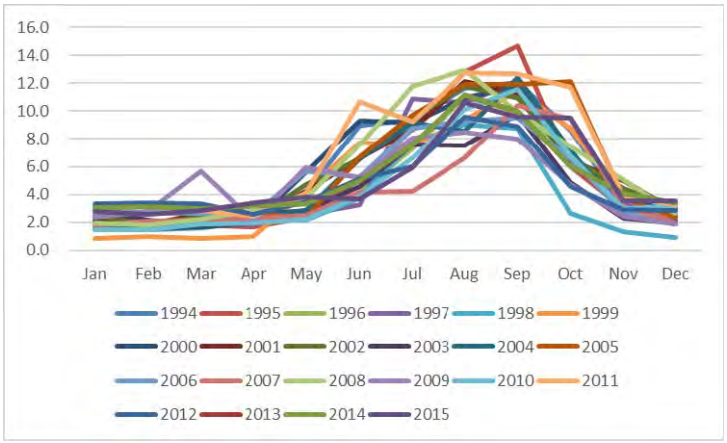
1-3-3-1 Changes in the water level in the river deduced from the data of the Department of Meteorology

There is a dam on the Nam Ngum River upstream of Tha Ngon Farm and the entire flowrate in the river downstream of this dam is controlled by the discharge from the dam. As the climate in Laos is characterized by the existence of the rainy and dry seasons, the flowrate and water level in the river change significantly in accordance with the seasonal change in precipitation. The water level in the river is measured at a water level observatory located to the north of Tha Ngon Farm. Figure 1-3 to Figure 1-6 show the mean, maximum and minimum water levels in the river in each month recorded at the observatory in the past (between 1994 and 2015).



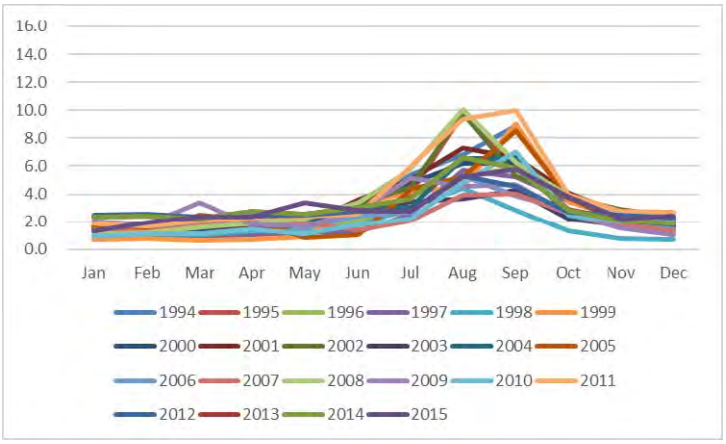
Data source: Department of Meteorology, Graph: prepared by the Study Team

Figure 1-3: Mean water level by month (at the Water Level Observatory)



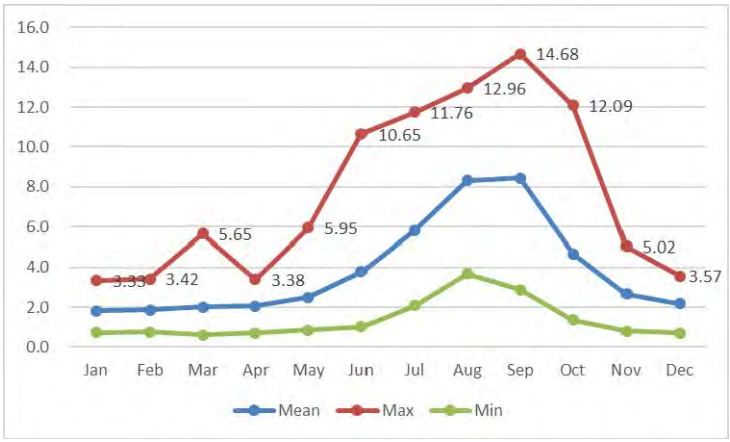
Data source: Department of Meteorology, Graph: prepared by the Study Team

Figure 1-4: Maximum water level by month (at the Water Level Observatory)



Data source: Department of Meteorology, Graph: prepared by the Study Team

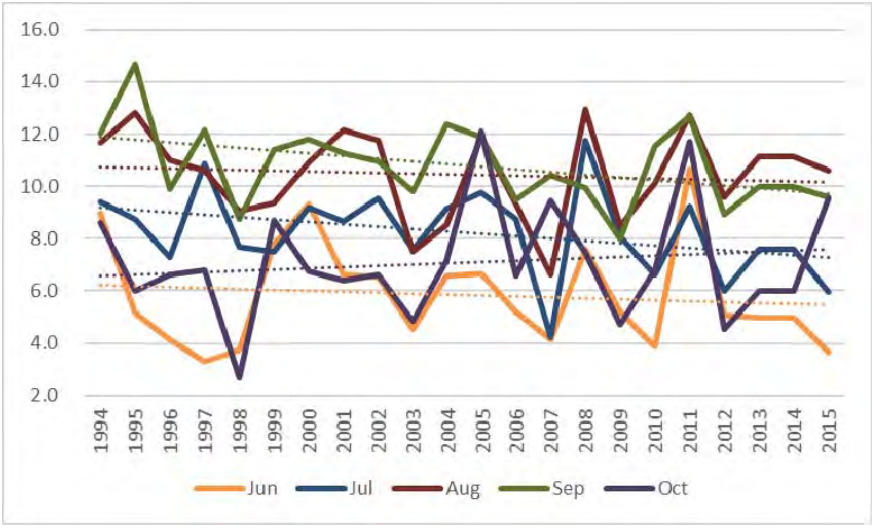
Figure 1-5: Minimum water level by month (at the Water Level Observatory)



Data source: Department of Meteorology, Graph: prepared by the Study Team

Figure 1-6: Mean, maximum and minimum water levels by month (1994 – 2015)

The water level in the river generally changes with the seasonal pattern; high in the rainy season and low in the dry season, although the actual water level differs by year. The highest water level recorded was 14.68 m on 7th and 8th September 1995. Figure 1-7 shows the changes in the maximum water level of each month in the rainy season (June-October) since 1994. The dotted lines in the figure show the linear approximation of the changes in the respective months. Although the values of the monthly maximum water level changed significantly from year to year, the linear approximations show a general tendency of decline except for the line for October. This observation indicates that the maximum water level in the rainy season has been on the decline.



Data source: Department of Meteorology, Graph: prepared by the Study Team

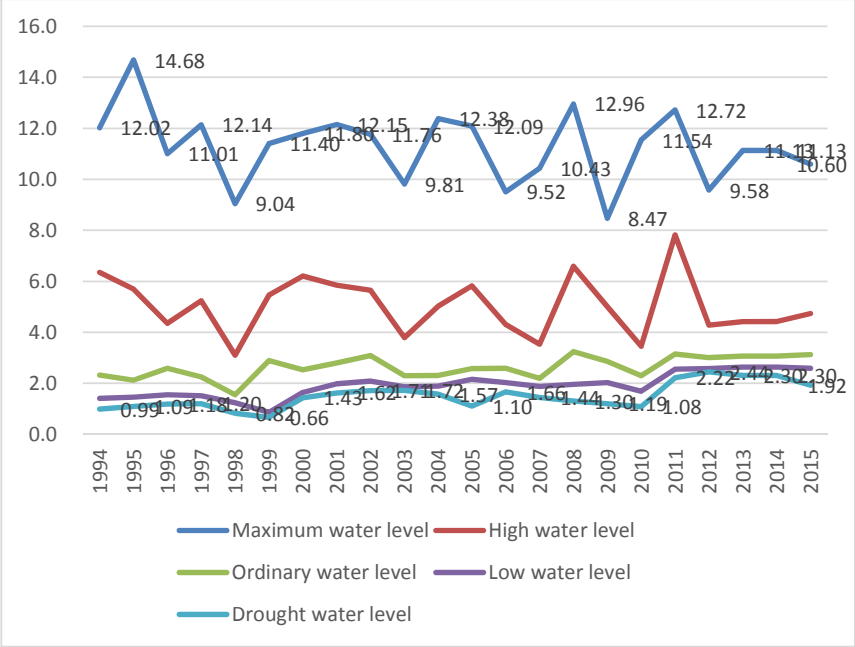
Figure 1-7: Changes in the maximum water level in June - October (1994 - 2015)

Table 1-2 and Figure 1-8 show the water levels (the maximum water level, high water level, ordinary water level, low water level and drought water level, as defined in the Operational Rules for Hydrological Observation (Ministry of Land, Infrastructure, Transport and Tourism of Japan), recorded in the Nam Ngum River. The table shows that the highest maximum water level and the lowest drought water level in the river recorded at the observation point in the ten-year period between 2006 and 2015 were 12.96 m and 1.08 m, respectively.

Table 1-2: Changes in the water levels defined in the Operational Rules on Hydrological Observation (2006 – 2015)

Year	Maximum water level	High water level	Ordinary water level	Low water level	Drought water level
2006	9.52	4.30	2.59	2.03	1.66
2007	10.43	3.53	2.19	1.87	1.44
2008	12.96	6.59	3.24	1.96	1.30
2009	8.47	5.00	2.85	2.02	1.19
2010	11.54	3.45	2.29	1.68	1.08
2011	12.72	7.82	3.15	2.55	2.22
2012	9.58	4.28	3.01	2.57	2.44
2013	11.13	4.42	3.07	2.63	2.30
2014	11.13	4.42	3.07	2.63	2.30
2015	10.60	4.73	3.12	2.59	1.92

Data source: Department of Meteorology, Table: prepared by the Study Team



Data source: Department of Meteorology, Graph: prepared by the Study Team

Figure 1-8: Changes in the water levels defined in the Operational Rules on Hydrological Observation (1994 – 2015)

1-3-3-2 Dam development in the upper reaches of the Nam Ngum River and the water level in the river.

There are three dams on the Nam Ngum River System upstream of Tha Ngon Farm; namely, the Nam Ngum Dam (completed in 1980), the Nam Song Dam (completed in 1995) on the Nam Ngum River and the Nam Lik Dam (completed in 2010) on the Nam Lik River which merges into the Nam Ngum River at the point of 130 km upstream from Tha Ngon area.

All the water in the Nam Ngum River flowing toward Tha Ngon Farm comes through these three dams and the amounts of water discharged from them are controlled. Although there is seasonal change in the water level in the river in a year, its seasonal change is meager. As mentioned above, the maximum water level in the Nam Ngum River in the rainy season has been on the decline for the past 20 years, and the flowrate in the river is appropriately controlled by the dams. Therefore, these observations indicate that rainfall is not expected to cause abrupt change in the water level in the river.

1-3-4 Soils

The soils of the Project Site in Tha Ngon are generally classified into new alluvial immature soils and old alluvial latosols. New alluvial immature soils derive from sediments newly deposited by the Nam Ngum River and its tributaries. The soils in this group are divided into two subgroups; fluvial and hydromorphic soils. Fluvial soils are found along the Nam Ngum River while hydromorphic soils cover most of the flat lowland behind the fluvial soils. On the other hand, old alluvial latosols are distributed on the plateau with gentle slopes which cover the southern part of the Project Site. The soils in this group

are formed from old alluvial sediments through lateritization.[2]

In the report[2], land capability classification is evaluated on a scale of 1 to 4, referring to soil fertility, aptitude for cultivation, soil conservation, aptitude for irrigation and aptitude for drainage. In this evaluation, the northern half of the field, which is the northern side of the main farm road No. 2, is defined as "2-A" (suitable for paddy field cultivation) and the southern side is defined as "3" (suitable for upland farming with contour ditch irrigation or furrow irrigation). However, paddy rice has been cultivated in the southern side as well, and there has been no significant difference on productivity between northern and southern sides; therefore, the difference of the evaluation results is considered to be negligible.

1-4 Environmental and Social Considerations

The Project is classified as a project in a sensitive sector, "Agriculture involving large-scale land clearing or irrigation," according to the "JICA Guidelines for Environmental and Social Considerations." (April 2010). However, it has been concluded that adverse impacts of the Project on the environment and society will be minimal as the Project is not focusing on new development but rehabilitation of the existing facilities. Therefore, the Project has been classified into "Category C" by the definition of the said guidelines.

On the other hand, the Ministry of Natural Resources and Environment (hereinafter referred to as "MONRE") is supposed to conduct environmental impact assessment (hereinafter referred to as "EIA") in Lao PDR. According to laws and regulation of GOL, no EIA and initial environmental evaluation (hereinafter referred to as "IEE") are required for rehabilitation projects.

1-5 Others (including global issues)

GOL has adopted the 8th NSEDP which promotes the development of irrigation facilities as a means to promote agriculture.

Tha Ngon Farm, developed with 1 square ha paddy fields and farm roads, which are rare in Lao PDR, is suitable for the practice of mechanized farming and satisfies all the conditions required for promoting modernization of agriculture. Additionally, Tha Ngon Farm has an advantage and potential with regard to suburban agriculture because it is located close to the Vientiane Capital.

This Project aims at not only establishing stable supply of irrigation water with the rehabilitation of the irrigation pumps, drainage pumps, floating pumps and sluices, whose functions have been severely degraded, but also restoring the irrigated area. The rehabilitation of such equipment and facilities by the Project is expected to increase rice production and enable farming and sales of commercial and cash crops, which is expected to increase the income and improve the livelihood of the farmers in the area. In this way, this Project is expected to contribute greatly to poverty reduction and economic growth in the area.

[2] The report of Basic design study on the Tha Ngon Rehabilitation and Rural Development Project, March, 1987.

Chapter 2 Contents of the Project

2-1 Project Outline

2-1-1 Project Purpose

In "The 8th National Social and Economic Development Plan (2016 – 2020)" stable food supply and promotion of the production of commercial crops are described as the priority issues in the agriculture sector. As a practical measure to realize stable food supply, the government of Lao PDR plans to increase rice production in 600,000 ha of paddies in the 10 major rice-producing provinces – Luang Namtha, Bokeo, Sayaboury, Vientiane, the Capital, Bolikhamxay, Khammouane, Savannakhet, Saravan and Champasak Provinces - to 2.5 million tons by 2020 (cf. the rice production in the entire country in 2013/14 was 4 million tons). The government plans to irrigate 315,000 ha of the 600,000 ha of paddies (the total area of irrigated farmland in the country was 389,911 ha in 2012/13),

In "The Agriculture Development Strategy to 2025 and Vision to the Year 2030," GOL sets the following goals to supply sufficient water for rainy season production in 330,000 ha and for dry season production in 216,000 ha by 2020, and to ensure water supply for rainy season production in 355,000 ha and dry season production in 240,000 ha by 2025. In order to achieve these goals, the GOL makes continuous efforts to improve major infrastructures and canals, improve earth canals into cement/concrete canals, improve and modernize pump stations, construct irrigation reservoirs and construct sluice gates to use the water released from hydroelectric power stations in the downstream areas.

Against this background, "to develop agricultural infrastructure in Tha Ngon Area, Xaythany District, Vientiane Capital by rehabilitating the pump irrigation facilities used for a long period and, then, to contribute to the promotion of modern agriculture in Lao PDR" has been adopted as the purpose of this project,

2-1-2 Project Outline

2-1-2-1 Project Site

The Project site is situated in Tha Ngon Farm on the right bank of the Nam Ngum River. While Tha Ngon Area has an area of 800 ha, the project area (beneficiary area) occupies 658 ha. A map of the beneficiary area and the breakdown of the area are shown in Figure 2-1 and Table 2-1, respectively.

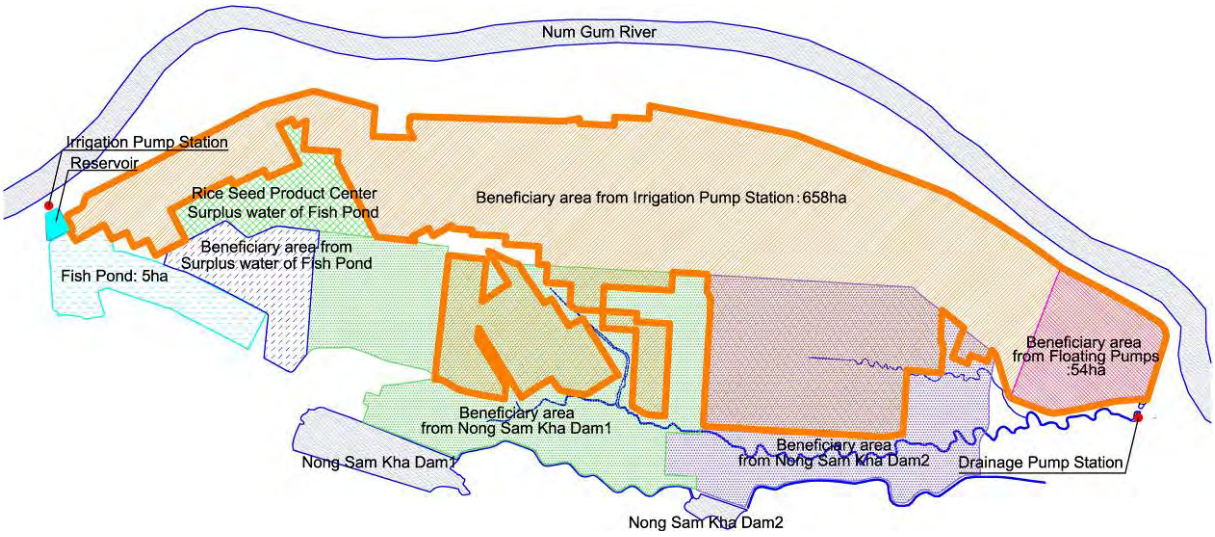


Figure 2-1: Map of the irrigable area

Table 2-1: Irrigable area by village

Village	Area
Kengkhai	73.0 ha
Thasommo	200.5 ha
Latkhoay	144.5 ha
Oudomphon	205.0 ha
Phoukham	35.0 ha
Total	658.0 ha

Source: Documents of Tha Ngon Irrigation Project Office

2-1-2-2 Project contents

In the Project, for the achievement of the Project Purpose, the equipment and facilities mentioned in Table 2-2 will be provided /developed based on the results of the analysis of the request contents, field study and discussion with Laotian side.

Table 2-2: Contents of the request of Lao PDR and evaluated outline plan

No.	Equipment/facilities requested by GOL	Outline of the prepared plan
1	Replacement of pumps	The three irrigation pumps and auxiliary facilities (including riser pipes, control panels, substation facilities and head gate) will be renewed and an operator's house will be constructed. The two drainage pumps and auxiliary facilities (including control panel, substation facilities and floating pumps) will be renewed and an operator's house will be constructed.

No.	Equipment/facilities requested by GOL	Outline of the prepared plan
2	Improvement of the main farm roads	Essential road maintenance equipment for the maintenance of irrigation facilities (a motor grader) will be provided.
3	Rehabilitation of the secondary canals (Lateral and Sub- lateral canals) (with brick-lining)	Implementation of the Rehabilitation will be assumed by Lao PDR
4	Replacement of turnouts and check structures	-Head gate on Reservoir (1 unit), all the turnouts (76 units), check structures (6 units), head gates of the Nong Sam Kha Dams (3 units), etc. in the beneficiary area will be replaced. -The spillway on the reservoir will be replaced with an orifice (1unit).
5	Design and Supervision	-Design and construction supervision services will be provided. -Soft component will be implemented for the capacity development in the operation and maintenance of the irrigation facilities.

Source: Minutes of Discussions, Annex 3 “Items Requested by GOL and JICA Team’s Response”

2-2 Outline Design of Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1). Policy on the Equipment and Facility Plan

The Project aims to improve the capacity of the irrigation system by replacing or renovating facilities for irrigation – which are not able to perform their expected functions due to degradation through almost 30 years of use.

In the Project formulation, in order to achieve the appropriate outputs after the completion of the Project, the required equipment has been selected while the technical and economic relevance of the Project is examined. The basic policy to be used in the selection is outlined as follows.

1). Restoration of the irrigation function

In the field survey, the Survey Team confirmed the irrigated areas of 427 ha in the rainy season in 2016 and 272 ha in the dry season in 2017; however, the average irrigated area in the period between 1993 and 2005 was 503 ha in the rainy season and 444 ha in the dry season (Figure 2-2). The irrigated area in the rainy season remained almost unchanged, but the irrigated area in the dry season has decreased by 40 % compared to the average mentioned above.

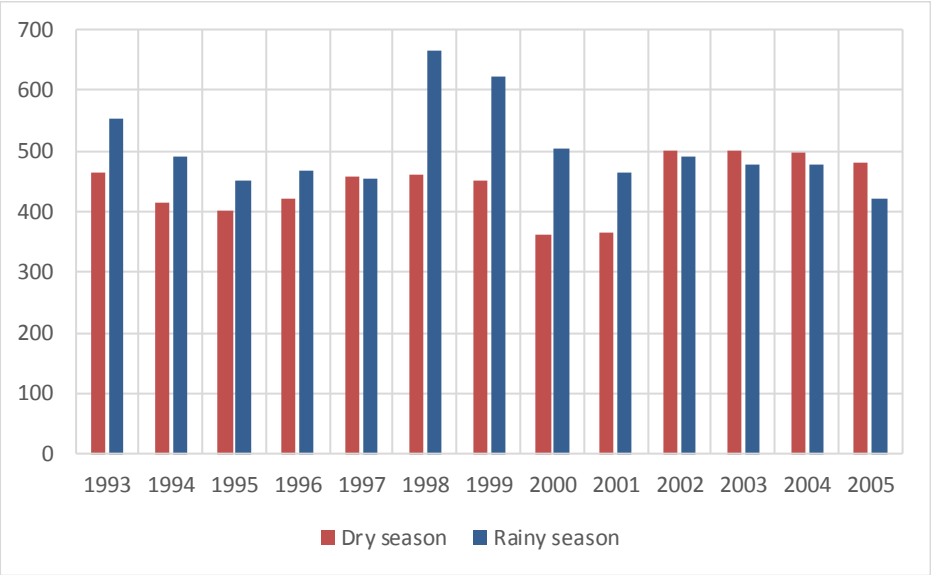


Figure 2-2: Irrigated areas in the dry and rainy seasons in 1993 - 2005

In the short-term, it is difficult to recover irrigable area in the dry season to the same level as ten years ago because of the change of the agricultural situation. However, the Project aims to recover the irrigable area by increasing the amount of irrigation water through rehabilitation and replacement of the facilities which are able to arrange the water level and water distribution.

2). Stable supply of irrigation water

Improvement of the irrigated drainage station as a core facility will increase irrigated area in the large scale in short term. After the Project, the continuous improvement shall be conducted and the irrigated area will recover in accordance with the current agricultural situation. Stable supply of irrigation water

Only one pump is operating at present among three existing ones at the main pump station. In order to avoid serious impact to agricultural production by complete stop of the pump operation, all the pumps will be replaced. Two pumps will be operated rotationally with the other pump for standby and maintenance.

3). Equitable water distribution

The gate plates of almost all the turnouts and check structures are missing; therefore, the irrigation water is used up in the upper reaches of the irrigation system. To rectify this problem and realize equitable water distribution, all the water level control and water distribution functions in the project area will be restored. In practice, all the gate structures including turnouts of the North Main Canal, Lateral and Sub-Lateral Canal and check structures in the project area will be renewed or rehabilitated.

4). Procurement of equipment which can be maintained by WUA and Tha Ngon Irrigation Project Office

The equipment to be installed or rehabilitated in the Project will be maintained by the Tha Ngon Irrigation Project Office and WUA. Therefore, in principle, the equipment and materials which have the similar specifications and operational procedures to the existing ones will be procured.

(2). Policies on Natural and Environmental Conditions

The following are the policies on natural conditions required for the formulation and implementation of the Project.

1). Precipitation

The One-day precipitation of 10-year recurrence period in the Project area was estimated at 139.4mm/day from the precipitation data taken at a meteorological station near Tha Ngon Farm (Tha Ngon Meteorological Station) over the past 30 years (1985-2014), as shown in the Figure 2-3 (the data for 2010 and 2011 are missing).

Obtain the standard deviation of the 28 samples.

Sx= 25.0624

Obtain the values of Sy and y′ in the case where the sample number is 28 (N = 28) from the numerical table used for applying Gumbel distribution to observed data.

Sy= 1.1047
y'= 0.5343

From these values, the following constant terms of the distribution function are obtained.

1/a=Sx/Sy= 22.687
X_0= 88.35

The basic estimation formula is as follows.

X= 88.35+22.687Y

By substituting Y in the above equation with the Y value for the recurrence interval of 10 years (2.25037) the following 10-year rainfall is obtained.

X= 139.4 (unit: mm/day)

Rank	Year	Thomas plot	X_i ① (Maximum annual daily precipitation) mm/day	X_i^2 ②
1	1999	0.032	146.0	21316.00
2	1995	0.065	138.4	19154.56
3	2012	0.097	129.9	16874.01
4	1992	0.129	128.8	16589.44
5	1993	0.161	127.6	16281.76
6	2009	0.194	124.6	15525.16
7	1986	0.226	120.8	14592.64
8	2003	0.258	118.4	14018.56
9	2000	0.290	117.8	13876.84
10	1994	0.323	111.4	12409.96
11	1987	0.355	109.0	11881.00
12	1991	0.387	105.2	11067.04
13	2007	0.419	103.2	10650.24
14	2004	0.452	102.4	10485.76
15	1989	0.484	100.0	10000.00
16	1996	0.516	99.5	9900.25
17	2013	0.548	98.9	9781.21
18	2014	0.581	96.9	9389.61
19	2006	0.613	93.4	8723.56
20	2005	0.645	92.8	8611.84
21	1990	0.677	92.2	8500.84
22	2002	0.710	87.0	7569.00
23	2008	0.742	67.6	4569.76
24	1985	0.774	66.4	4408.96
25	1997	0.806	65.8	4329.64
26	1998	0.839	62.8	3943.84
27	1988	0.871	61.0	3721.00
28	2001	0.903	45.4	2061.16
Total			2813.2	300233.64
1/N			100.5	10722.63

Figure 2-3: Calculation of the probability of precipitation with the Gumbel method

2). Maximum water level in the Nam Ngum River

The water level in the Nam Ngum River fluctuates greatly in a year. The levels in the rainy season and the dry season differ by more than 10 m. However, in recent years the flowrate in the river has been controlled with the dams constructed in the upper reaches of the river. As a consequence, the probability of an abrupt change in the water level in the river has been reduced, although the level still changes seasonally, and the maximum water level in a year has been on the decline. Therefore, the design maximum water level in the Nam Ngum River of +167.70, the 20-year maximum water level estimated in the project for the development of the irrigation system completed in 1977, will be used in the Project to ensure the safety of equipment installation work against the high water level in the river.

3). Drought water level of the Nam Ngum River

The drought water level in the Nam Ngum River has been on the slight increase for the last 30 years as the annual precipitation has been generally on the increase in this period, although the actual annual precipitation has fluctuated from year to year. Nonetheless, the Project will utilize the design drought water level of +152.00, which is the minimum water level estimated in the project for the development of the irrigation system completed in 1977.

(3). Policy on Socio-economic Conditions

The replacement of the existing facilities in the Project is expected to restore and significantly improve the function of the irrigation system, particularly the performance of the pumps and the functions for equitable water distribution. The restoration and improvement of the irrigation function is expected to realize the improvement of the farming environment, which is expected to increase food production and improve the livelihood of the farmers in the Project area.

The existing irrigation facilities are operated and maintained by the staff of Tha Ngon Irrigation Project Office and the members of WUA. As their capacity in the facility maintenance is at the basic level, it ought to be improved. Upon implementation of the Project, the policy is to make the irrigation users thoroughly understand the planning contents of the Project and to raise their understanding of the operation and maintenance of facilities.

(4). Policies on Construction Work

1). Permits and licenses

i. Land ownership and land-use right

All the land in Lao PDR belongs to the nation and is managed by the Department of Land Administration of Natural Resources and Environment, MONRE. Meanwhile, a person or an organization is entitled to a “land-use right”. A person may own and trade his/her “land-use right.”

Moreover, all the land required for the implementation of the Project is under the jurisdiction of MAF therefore, there is no hindrance to implementation of the Project. However, if land that is not under the

jurisdiction of MAF is to be used, for example, as a temporary yard, the contractor of the Project shall notify DOI and the Tha Ngon Irrigation Project Office of such land-use plan at an early stage so that they can have sufficient time to discuss and negotiate the land use with the land-use right holder.

ii. Custom clearance and tax exemption

The Customs Department, Ministry of Finance (hereinafter referred to as "MOF") is in charge of tax exemption of custom clearance. On the other hand, the External Finance Department of MOF is in charge of tax exemption of indirect taxes on products and materials procured in Lao PDR such as the value added tax (hereinafter referred to as "VAT") and excise tax — taxes imposed on specialized goods and services, in this Project fuel is subjected to excise tax.

Moreover, for customs duties at the time of custom clearance and VAT at the time of domestic procurement, and exemption from indirect tax, DOI must timely prepare the master list and submit it to the respective department of MOF. In particular, for the domestic procurement, the implementation agency, DOI, will be exempted from taxation, VAT and indirect taxes; therefore, the equivalent amount shall be included in the budget. The budget shall be approval by GOL; therefore, the budget of 2019, in which the procured equipment must be exempted from taxation, shall be submitted before February 2018. In case the procedure for the approval is extended, this will affect the schedule of the Project. Thus, even before the Project's implementation starts, DOI, in close coordination with the relevant ministries and departments, shall initiate the process to duly ensure exemption of taxes, duties and other levies involved in the Project.

iii. Application for power facility work

The power facility work concerning the connection with the existing power distribution cable is to be implemented with presence of a representative of Électricité du Laos (hereinafter referred to as "EDL"), the public power generation and distribution company of Lao PDRs, after the application for such work has been approved by EDL. In the Project the demarcation point of responsibility shall be clarified, and then the construction of the facilities shall be implemented.

iv. Application for removal

The pumps and riser pipes in the irrigation system are managed as assets of the nation. They can be removed and disposed of only after the Minister of Agriculture and Forestry has been notified of the removal and disposal from Manager of DOI in writing.

2). Power supply

The project site, Tha Ngon Farm, is located in Vientiane Capital. The electric power is supplied stably to the area except while temporary and scheduled power cut is done for maintenance. There is no planned power outage due to power shortage. The existing irrigation facilities in the project area have been operated only with commercial power supply for nearly 40 years without a major problem. For these reasons, an emergency power supply system will not be required in the irrigation system.

3). Governing laws

The provisions on the minimum wage and working hours in the labor laws in Lao PDR will be followed in the Project. The irrigation law will also be followed.

4). Applicable standards

Standards for the design and supervision of the construction works have not been established in Lao PDR. Therefore, the specifications, qualities and test methods for materials and equipment to be procured and work to be conducted in the Project shall conform to ISO and JIS standards.

5). Availability of materials and equipment

There are many dealers of construction materials including timber, reinforcement bars, cement and various coating materials as well as lease companies of scaffolding, etc. in and around Vientiane. However, these dealers store the reinforcement bars and other construction materials out in the open and they do not have formwork that could withstand the force applied when concrete is cast. Therefore, the quality of materials will be carefully examined in case of local procurement of construction materials.

Ready-mixed concrete will be used where a large quantity of concrete is to be cast, while concrete mixed on-site will be used for small quantities. Because there is a concrete plant performing quality performance tests comparable to those performed by Japanese companies near the construction site, there will be no problem concerning the quality of ready-mixed concrete.

The main equipment components of the Project, such as pumps and gate structures, will be procured in Japan or third countries because products of manufacturers of pumps and gate structures in Lao PDR do not meet the Project specifications.

On the other hand, the motor grader can be procured locally even those are not produced in Lao PDR, because the companies of Japan have distributors in Lao PDR. Also, laptop PCs and their peripherals (including printers) can be procured locally.

(5). Policy on the Use of Local Contractors (Construction Companies)

1). General situation

Lao PDR has construction companies both domestic and ones affiliating with companies in the neighboring countries including Thailand, China and Vietnam. The technical and managerial capacities of the domestic construction companies in the installation of pumps, which requires experience, and construction work of a scale larger than a certain level are not as high as those of the companies financed by foreign capital. However, domestic construction companies can execute relatively small-scale construction work.

Furthermore, some local contractors will join the Project as sub-contractors of Japanese supplier and/or contractors. Therefore, as a policy, a design and construction plan — which includes the construction methods that the subcontractors of the Project, local construction companies, are able to

carry out - should be adopted in the formulation of the Project plan.

i. Equipment Installation

Pumps and gate structures (turnouts and check structures) will be installed in the Project. Because the pump installation involves welding of thick steel plates and delicate work in a limited space, local companies may not be able to perform this work with satisfactory quality. The installation of a pump requires the understanding of the performance of the pump itself. Therefore, a Japanese contractor or a contractor of a third country (e.g. Thailand) will install the pumps under the supervision of a Japanese engineer specialized in the installation of the equipment.

The gate installation does not require special technology because it mostly consists of a small-scale concrete foundation work and installation of gates with anchor bolts. Therefore, a local contractor will be employed to install them.

A cofferdam will have to be installed in the river when the pumps are installed. A local construction company will be utilized in the cofferdam work as a subcontractor under the control of a Japanese supervising engineer.

ii. Building Work

The renovation of the control houses and the construction of the operator's houses will also be included in the Project components. Moreover, the houses may be constructed by a local contractor because both types of the houses are small (with a floor area of approx. 20 m^2).

(6). Policy on Operation and Maintenance

The facilities to be renewed in the Project will be operated and maintained by the Tha Ngon Irrigation Project Office and WUA. Although the office keeps the records concerning the operation and maintenance of the system including the record of the operating hours of pumps and that of their repair/maintenance, these records are kept separately and not managed in a comprehensive manner. The response of the office in case of pump failure has not been quick enough. Therefore, the capacity of the Tha Ngon Irrigation Project Office will be improved with the input of technical assistance (soft component).

(7). Policy on the Facility and Equipment Grade Setting

The basic policies mentioned below will be followed in the setting of grades, the scope and technical level, of the procurement and installation of the materials and equipment in the Project. Durability will be the primary criterion for the selection of equipment and facilities in the Project because their functions can be maintained for a long period under the operation and maintenance of the Project implementing agency, DOI, and management organizations (Tha Ngon Irrigation Office, Provincial Agriculture and Forest Office, Vientiane Capital and WUA). A detailed study will be conducted for the selection of the pumps because these are the most important equipment in the irrigation system.

1). Policy on the scopes of the facilities and equipment

The basic policy of procurement of equipment is to keep original capacity or function of existing one. An irrigation system that will enable efficient and cost-effective operation and maintenance will be designed with these replacements. The capacity of irrigation pumps shall be designed on the basis of 2-1-1-1(Policy on the Equipment and Facility Plan), and the capability setting shall be carried out considering the current situation and the future facility improvement. Moreover, in the system, the data of operating hours and flowrates of the irrigation pumps shall be measured and recorded. A flowmeter shall be installed in the headrace channel, and a data recording device shall be installed in the pump control panel. The measured and recorded data shall be utilized in the irrigation water management of Tha Ngon Farm.

The existing irrigation and drainage pump station buildings and pump control houses shall be utilized. However, minor renovation works such as repair of wall surface, replacement of windows and sashes and paint coating of exterior and interior walls will be carried out on the buildings. The irrigation pump operators have been stationed in a simple wooden management shed. New operator's houses will be constructed for the pump operators near the irrigation and drainage pump stations in the Project.

The spillway of the reservoir, which is not functional, will be replaced with an orifice on the embankment to control the flowrate and waste of water to the neighboring fish ponds.

In addition, the collapsed parts of the walls of the Lateral Canal will be repaired to restore its function and measures to prevent further failure will be taken.

2). Policy on grade setting

As mentioned above, pumps to be installed in the Project shall have the same grades as the existing ones and have no optional function, such as an inverter. Because some of the steel gates installed on the existing gate structures including turnouts and check structures have been too degraded with rust and corrosion, stainless-steel gates will be installed in the Project.

Restoration of the original form shall be the basic policy for the rehabilitation of the existing pump control houses and headrace canals.

(8). Policy on Construction and Procurement Methods and Construction Schedule

1). Construction and procurement methods

The construction methods, which the local contractors can conduct, will be adopted for the equipment and facility maintenance of the Project. The equipment and materials shall be procured in Lao PDR as much as possible. For the equipment and materials — that the local procurement is not possible, or for those which are locally procurable but have quality problems and/or delivery issues — will be procured from Japan or third country.

2). Policy on construction schedule

Glutinous rice is predominantly cultivated in the beneficiary area. There are generally double cropping for the glutinous rice in a year. The cropping cycle in rainy season is as follows: growing seedings in June, transplant in July, and harvest from October to November. The cropping cycle in dry season is as follows: growing seedings in December, transplant in June, and harvest from April to May using pumping water as pre-conditions. T

A schedule of the rehabilitation work that will have the minimum effect on the farming activities in the dry season will be designed considering the above-mentioned farming schedule. In practice, the rehabilitation work will be started at the end of the rainy season, i.e. November, and will be completed in the early part of the following dry season.

i. Irrigation pump station

Seasonal fluctuations of water level in the Nam Ngum River should be duly considered in the preparation of the rehabilitation work schedule of the main pump station. Prior to installation of new pumps, the pump pit should be dried up. Therefore, the existing intake gate should be replaced first. The irrigation pumps will be replaced after water-tightness of the gate has been established.

ii. Drainage pump station

Although the drainage pumps in the drainage pump station has been operated twice or three times during the rainy season so far, the pumps will be replaced in the dry season so that operation of the pumps should not be disturbed.

iii. Rehabilitation of turnouts

All the turnouts installed on the North Main Canal, Lateral Canal and Sub-lateral Canals will be improved. Especially regarding turnouts of the North Main Canal, frames of the existing gates shall be removed first and the concrete shall be poured on the surface, which the frames were installed, and install new turnouts on the surface. A staff gauge for measuring the water level will be installed on every turnout. Moreover, there are five locations on the North Main Canal where GOL has installed the turnouts. The current situations of these turnouts are that even the irrigation water is flowing; the irrigation water is diverted constantly without control through them because these are of simple structure without diversion gates. As water fees have been charged on the users of the irrigation water supplied through these turnouts, new turnouts will be installed at these locations for appropriate management of water distribution and maintenance of canals. Staff-gauges will also be installed on these turnouts.

3). Procurement of equipment for road maintenance

The main farm roads become so muddy in the rainy season that it becomes difficult to drive vehicles on them and the road surface becomes rutted and rugged. The road surface must be levelled to ensure smooth passage of vehicles and agricultural machinery in the dry season. It will be necessary to form cross slopes on the road surface and dig drainage ditches on the edges of the roads in the road

maintenance at the end of the dry season to ensure drainage of water from the road surface in the rainy season.

Therefore, the procurement of road maintenance equipment shall be specified to satisfy these conditions.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

2-2-2-1 Design Conditions

The design conditions of the Project shall be based on the design conditions established in the grant aid plan implemented in 1987. Each of these conditions is explained in detail in the following.

(1). Farming Conditions

The conditions on irrigation of the Project will be formulated based on the current farming schedule as shown in Figure 2-4.

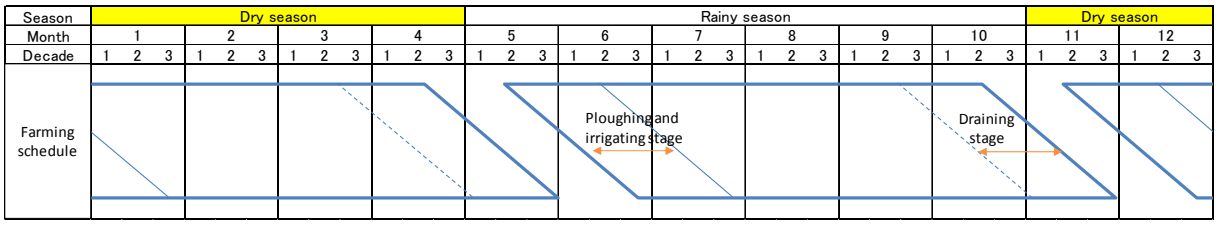


Figure 2-4: Rice farming schedule

(2). Unit Irrigation Water Requirement

In the basic design of the grant aid project implemented in 1987, the potential evapotranspiration calculated with the modified Penman Method, the irrigation efficiency of 60 % and the peak water requirement in March were conditions (parameter) to calculate the gross water requirement in the dry season (1.78 ≒ 1.8 L/sec./ha). The gross water requirement in the rainy season (1.03 ≒ 1.0 L/sec./ha) was obtained using the same calculation method as the dry season, but setting January as the peak irrigation water requirement.

It is estimated that the actual irrigation efficiency under present condition is 40 % against the proposed one of 60 % due to losses of conveyance and operation. In the case that the conveyance and operational efficiencies do not improve even if the pumps are replaced in the Project, the irrigated area in the dry season will remain about 400 ha as it is in the present. However, it is expected that WUA will be activated through the Project and the irrigated efficiency or irrigation area will be restored to the level of the original plan with improvement of physical conditions and operation of the irrigation system. Thus, the same values are adopted for the new plan as the original ones.

(3). Setting of Unit Discharge

First, in the basic design of the grant aid project of 1987, the design drainage requirement was decided with the following conditions.

－One day rainfall of 10-year recurrence period is adopted as design rainfall.
－The design daily rainfall should be drained within 24 hours.
－The average water storage capacity of a paddy fields should be 45 mm.

Second, in the above-mentioned basic-conditions, the 10-year probable rainfall was estimated at 122 mm (with the Gumbel Method) based on the data of daily rainfall measured at Tha Ngon Meteorological Station (between 1971 and 1985) and the unit discharge calculated with this value(122mm) was set at 9.0 L/sec./ha.

The Survey Team obtained the 10-year probable rainfall of 139.4mm/day with the same method from the latest rainfall data and the unit discharge calculated with this value (139.4mm) was set at 10.93 L/sec./ha in the Project.

In conclusion the specification of the drainage pumps will be decided using the value (10.93 L/sec./ha) and catchment area (1168ha) for drainage pump station.

(4). Estimation of the Beneficiary Area

The gross area that could be irrigated with the water supplied from the irrigation pump station was estimated at 658 ha from the results of the field reconnaissance of the areas irrigated by the water from Turnouts Nos. 1-13 which refers to the “Lao PDR THA NGON Irrigated facilities rehabilitation plan’’, interview survey and the GPS area measurement conducted in this study. Therefore, this 658-ha area is designated as the gross irrigation of the Project. In the outline design survey conducted in 1987, the beneficiary area after the rehabilitation of the irrigation system was set at 610 ha, which was the total area of national farms and cooperative union’s farms that existed in the survey of 1987. Table 2-3 shows the breakdown of the irrigable area.

Table 2-3: Gross Irrigation Area

Gross Irrigation area	Area	Remarks
Area that can be irrigated by the irrigation pumps	658 ha	・ Including a 54 ha area irrigated by the floating pumps ・ Including a 85 ha area irrigated by the water from both the irrigation pump station and the Nong Sam Kha Dam 1 ・ Including a 124 ha-area irrigated by the water from both the irrigation pump station and the Nong Sam Kha Dam 2

2-2-2-2 Rehabilitation Plan

(1). Irrigation Pump Station

The headrace will be renovated to ensure the efficient conveyance of the water pumped up from the river to the reservoir. A system to record basic data required for the maintenance of the station, e.g. pump discharge rate and power consumption, will also be installed in the station.

1). Intake gate

An intake gate is installed on the intake facility in the Nam Ngum River to shut off the influx of river water to the pump station for the maintenance and inspection of the irrigation pumps. However, the gate cannot be operated at present because it has been severely corroded and the spindle to operate it has been severed. In order to restore the function of the intake facility to shut off the influx of river water, the existing intake gate will be replaced by a new one in the Project.

When the intake gate is replaced, the intake facility should be dry to avoid flooding during construction. Therefore, a temporary cofferdam will be constructed in front of the headworks to stop the influx of the river water for appropriate period in the dry season during the water level in the river is low, and the intake gate will be replaced when the water inside the cofferdam has been drained.

2). Irrigation pumps

All three existing pumps including the one which is operating at the present will be replaced. The pumps with the specifications mentioned below will be installed to satisfy the design pump flowrate of 1.08 m^3/s [3]. Two of the three replaced pumps will be operated alternately in the normal operation and the remaining one will be a backup to be used when one of the other pumps fails or is maintained.

Type: Submersible pump

Quantity: 3 units

Flowrate: 32.4 m^3/min. (when two pumps are operated: 32.4 m^3/min. × 2 units / 60 seconds = 1.08 m^3/s)

Pump head: 19 m

Pump efficiency:no less than 80 %

A power-receiving board and three pump control panels required for the operation of the irrigation pumps will also be replaced.

3). Piping

Steel pipes will be replaced along with irrigation pumps. The riser pipes up to above the ground level,

[3] The report of the preliminary study on Tha Ngon Rehabilitation and Rural Development Project, September, 1986

90-degree elbows and the flange adaptors connected to the existing pipes will be replaced.

4). Substation facility

The power required for the operation of the pumps is supplied by EDL. The power received at the facility is supplied to the pumps through the existing transformer. The existing transformer will be replaced in the Project because it has been used for a long time.

5). Headrace

The water pumped up by the irrigation pumps will be conveyed to the reservoir through the headrace (L=44.59m). Mortar coating will be applied on the surface of the headrace to protect its structural integrity and prevent degradation in the Project.

6). Flowmeter and data logger

Recording of the operating hours, power consumption and flowrate of the irrigation pumps are important in the operation and maintenance of the facilities. Therefore, a flow meter will be installed in the headrace to monitor the flowrate of the irrigation pumps. In addition, a new system to record readings of the flow meter and the operating hours and power consumptions of the pumps will be installed in the control panels of the pumps, and thus, external utilization of this information/data will be possible.

7). Control house

1) Rehabilitation of the existing control house

Regarding the existing control house, because its major structural components, such as pillars and beams, have no serious problem except for the cracks in concrete-block walls around fittings, it is concluded that it can be utilized with minor renovation. Therefore, the repair of the wall around the fittings, application of coating on the exterior and interior walls and the replacement of the ceiling boards with decorated gypsum boards will be carried out on the house structures. In addition, fittings (including doors and windows) and lighting fixtures will be replaced and an air-conditioner unit will be installed for against heat from the control panels.

2) Construction of an Operator’s House

An operator is in the irrigation pump station 24 hours a day, the operators work in two shifts. At the present a shed is installed near the control house for the operators. However, the living conditions in the shed are rough for the operators especially for the one on the night shift.

Therefore, a new operator’s house will be constructed on the same site. The operator’s house will have a reinforced concrete frame structure with concrete-block walls.

(2). Reservoir

Although there is no need for renovation or repair on the reservoir itself, its auxiliary facilities, such as orifice (spillway) and head gate of the North Main Canal, will be replaced because leakage of water is observed on them due to the degradation over time. In addition, staff-gages are installed so that the monitoring of pump discharge and dead outflow can be carried out by the operators.

1). Orifice (spillway)

A gate is installed on the existing spillway. However, the upper part of the structure has collapsed; therefore, the water in the reservoir is constantly discharged through the collapsed part. Although sandbags are placed at the collapsed part to stop the water flow, they are actually not functioning. Therefore, the existing spillway will be rehabilitated to restore its function and to add function as orifice to arrange the amount of flow rate in the Project. Because the lower part of the spillway structure (of reinforced concrete) has no specific problem, the upper part will be removed and a spillway will be reconstructed on the lower part. The new orifice (spillway) will be of reinforced-concrete box-shaped structure on the wall on the side of the reservoir to control the discharge flowrate. A grating will be installed on the top of the box-structure to make it easy to inspect and clean the orifice.

2). Head gate

The existing head gate on the reservoir at the beginning of the North Main Canal will be replaced because water leakage is observed even when the gate is completely closed. For the ease of maintenance, a stainless-steel gate will be installed as a replacement in the Project.

(3). Drainage Pump Station

The minimum work required for trouble-free operation and maintenance of the pumps will be conducted in the drainage pump station as in the irrigation pump station. In addition, a system to record basic data required for the maintenance of the station, including power consumption, will be installed in the station.

1). Drainage pumps

The amount of water discharge/day is 1,102,592 m^3/day — calculated from unit discharge 10.93 L/sec/ha, and the catchment area of drainage pumps, 1,168 ha, which is measured from a terrain drawing. The discharged water will reach the drainage pump station if the difference of water level is 4.5 m between drainage pump station and the Nam Ngum River. The amount of natural discharge will be 1,049,228 m^3/day and the drainage pump will need to secure the capacity to drain water of 53,364 m^3/day.

In the case that the discharge flowrate of drainage pump is 52.0 m^3/ min, the necessary amount of water is discharged within 17 hours and this means that the drainage pump secures the necessary capacity. Therefore, the discharge flowrate shall be 52.0 m^3/ min in the Project.

The replaced drainage pumps will not be operational all the time but will be operated when the

waterlogged area of the drainage pump station is full. Therefore, the two pumps currently installed in the drainage pump station will be replaced in the Project. The main specifications of the new drainage pumps are mentioned below.

Type: Submersible pump
Quantity: 2 units
Discharge flowrate: 52.0 m^3/min. × 2 units = 104.0 m^3/min.
Pump head: 6 m
Pump efficiency: no less than 80 %
A power-receiving board and two pump control panels required for the operation of the drainage pumps will also be replaced.

2). Piping

The pipes on discharge side will be replaced considering water-tightness of check valve and workability for the construction. The pipes will be ductile cast iron pipes. The replacement will include the riser pipes up to above the ground level, 90-degree elbows, check valves and flange adaptors to connect to the existing pipes.

3). Substation facility

The power required for the operation of the pumps in the drainage pump station is supplied by EDL. The power received at the facility is supplied to the pumps through the existing transformer. The existing transformer has deteriorated, which may affect the new pump system. Thus, the transformer will also be replaced.

4). Floating pump facilities

The two existing floating pumps are used for recycling drained water. Only one of them is operational. They do not function adequately because of deterioration. Both will be replaced in the Project. The barge on which the floating pumps are installed will also be replaced with a new one. The new volute pumps for on ground will be installed on a new barge. The vacuum pumps required for starting the volute pumps will also be installed on the barge. Regarding the pumped-up amount of the floating pump, the planned water volume of 1.08 m^3 / sec was calculated from the planned irrigation area and the coarse water amount, so the water supply to the floating pump beneficial area, 54 ha, is calculated as 1.08 m^3 / s × 60 sec × 54 ha / 658 ha = 5.32 m^3 / min. Therefore, the specification of the floating pump is as follows.

Type: Volute pump for on ground
Quantity: 2 units
Flowrate: 5.4 m^3/min.

Head: 6 m

Pump efficiency: no less than 80 %

5). Control house

i. Rehabilitation of the existing control house

Regarding the existing control house, because its major structural components, such as pillars and beams, have no serious problem except for the cracks in concrete-block walls around fittings, it is concluded that it can be utilized with minor renovation. Therefore, the repair of the wall around the fittings, application of coating on the exterior and interior walls and the replacement of the ceiling boards with decorated gypsum boards will be carried out on the house structures. In addition, fittings (including doors and windows) and lighting fixtures will be replaced and an air-conditioner unit will be installed for against heat from the control panels.

ii. Construction of the operator's house

The operators of the drainage pump station manage the station 24 hours a day while staying in a shed near the control house. The living conditions in the shed are unfriendly to the operators.

Therefore, an operator's house similar to the one to be constructed in the irrigation pump station will be constructed next to the existing control house. The operator's house will have a reinforced concrete frame structure with concrete-block walls.

(4). Gates of Turnouts and Check Structures

All the gates of turnouts and check structures installed on the North Main Canal, Lateral Canal and Sub-lateral Canals will be replaced. In addition, it shall be necessary to construct new turnouts in two locations where water flow constantly through the road-crossing culverts, installed by the WUA, and to construct new turnouts and road-crossing culverts on three locations — one intake point is located about 200 m upstream, the other intake point is located at the downstream of No.11 turnouts, and the last one is located in the west side of the canal. (Reference: Fig 2-5 and Fig. 2-6).

1). North Main Canal

The turnouts diverting water from the North Main Canal and the check structures controlling the flowrate within the North Main Canal will be replaced. Those will be made of stainless-steel. After the removal of the existing gate structures, the parts of the canal damaged by the removal will be repaired with concrete and the new gates will be installed. In addition one of the check structures will be moved.

2). Lateral and sub-lateral canals

Gates required for distributing irrigation water to on-farm canals are installed in diversion boxes on

the Lateral and Sub-lateral Canals. Almost all these structures are useless for water distribution control without gates. Therefore, all the existing gate structures on these canals will be replaced with new ones because the gates are installed in the walls of the existing diversion boxes, part of the walls will be demolished to remove the existing gates and then new ones will be installed.

(5). Nong Sam Kha Dams

The head gates installed on the Nong Sam Kha Dams 1 and 2 will be replaced. The existing ones will be removed from the dam with the concrete base and then new ones will be installed. At the time of renewal of the hate gates, to prevent flooding during construction, a temporary cofferdam will be constructed in front of the headworks to stop the influx of the river water, and the hate gates will be replaced when the water inside the cofferdam has been drained.

2-2-2-1 Procurement of Equipment

Main component of procurement of this plan are shown below.

(1). Pumps and Accessories

The pumps and its major accessories to be procured in this project are shown in Table 2-4, 2-5 and 2-6 show the pumps and major accessories to the pumps to be procured in this project. Sets of the equipment required for the replacement of the pumps in the irrigation and drainage pump stations and that required for the operations of the pumps will be procured.

Table 2-4: Pumps and major accessories (irrigation pump station)

Equipment	Outline specifications
(1) Irrigation pumps	1) Discharge flowrate: 32.4 m^3/min. 2) Total head: 19 m 3) Inner diameter: φ 500 4) Power source: 380 V 5) Frequency: 50 Hz 6) Quantity: 3 units
(2) Riser and column pipes (per irrigation pump)	1) Type: Steel pipes (SS41, double-flanged) 2) Inner diameter: φ 500 3) Length: φ 500 × 3,000 mm: 1 unit, φ 500 × 3,500 mm: 1 unit, φ 500 × 3,560 mm: 1 unit, φ 500 × 500 mm: 1unit 4) Flange joining materials (bolts, nuts and gaskets): six locations, φ 500 5) Metal fittings for pipes: Stainless-steel, φ 500 (including an anchor) x 1 location
(3) Discharge elbows (90-degree elbows)	1) Type: Ductile cast iron pipe 2) Inner diameter: φ 500 3) Quantity: 3 units 4) Flange joining materials (bolts, nuts and gaskets): six locations, φ 500 5) Other: with a hole (φ 150) to install an air valve
(4) Flange adaptors	1) Type: Ductile cast iron pipe

Equipment	Outline specifications
	2) Inner diameter: φ 500 3) Quantity: 3 units 4) Flange joining materials (bolts, nuts and gaskets): six locations, φ 500
(5) Repair valves and air valves	1) Material: Cast iron 2) Inner diameter: φ 150 3) Quantity: 3 (both repair and air valves) 4) Flange joining materials (bolts, nuts and gaskets): φ 150 x 2
(6) Power receiving board and control panels for pumps	1) Power-receiving board for the pumps: 1 unit 2) Pump control panels: 3 units
(7) Transformer	1) 3φ 500 kVA, 22 kV / 380 -220 V
(8) Intake gate	1) Material: Stainless-steel 2) Dimensions: Gate plate width 1.5 m x height 1.5 m × 13.0 m

Table 2-5: Pumps and major accessories (drainage pump station)

Equipment	Outline specifications
(1) Drainage pump	1) Discharge flowrate: 52.0 m^3/min. 2) Total head: 6 m 3) Inner diameter: φ 600 4) Power source: 380 V 5) Frequency: 50 Hz 6) Quantity: 2 units
(2) Riser and column pipes (per drainage pump)	1) Type: Steel pipes (SS41, double-flanged) 2) Inner diameter: φ 600 3) Length: φ 600 x 1,000 mm: 1 unit
(3) Discharge elbows (90-degree elbows)	1) Type: Ductile cast iron pipe 2) Inner diameter: φ 600 3) Quantity: 2 units 4) Flange joining materials (bolts, nuts and gaskets): two locations, φ 600 5) Other: with a hole (φ 150) to install an air valve
(4) Flange adaptors	1) Type: Ductile cast iron pipe 2) Inner diameter: φ 600 3) Quantity: 2 units 4) Flange joining materials (bolts, nuts and gaskets): two locations, φ 600
(5) Repair valves and air valves	1) Material: Cast iron 2) Inner diameter: φ 150 3) Quantity: 3 (both repair and air valves) 4) Flange joining materials (bolts, nuts and gaskets): φ 150 × 2
(6) Check valves	1) Material: Cast iron 2) Inner diameter: φ 600 3) Quantity: 2 units
(7) Power receiving board and control panels for pumps	1) Power-receiving board for the pumps: 1 unit 2) Pump control panels: 2 units
(8) Transformer	1) 3 φ 500 kVA, 22 kV / 380 - 220 V

Table 2-6: Pumps and major accessories (floating pump at drainage pump station)

Equipment	Outline specifications
(1) Floating pumps	1) Discharge flowrate: 5.4 m^3/min. 2) Total head: 6 m 3) Inner diameter: φ 150 4) Power source: 220 V, 22 KV or more 5) Frequency: 50 Hz 6) Quantity: 2 units
(2) Vacuum pumps	1) Inner diameter: φ 150 2) Power source: 380 V 3) Quantity: 2 unit
(3) Irrigation pipes	1) Type: Steel pipes (SS41, double-flanged) 2) Inner diameter: φ 150 3) Length: φ 150 × 1,850 mm: 2 units φ 150 × 800 mm: 2 units φ 500 × 500 mm: 2 units 4) Flange joining materials (bolts, nuts and gaskets): four locations, φ 150 5) Metal fittings for pipes:SUS, φ 150 (including an anchor) * 8 locations
(4) Column pipes	1) Type: Steel pipes (SS41, double-flanged) 2) Inner diameter: φ 150 3) Length: 1.0 m or longer, 2 units
(5) Discharge elbows (90-degree elbows)	1) Type: Ductile cast iron pipe 2) Inner diameter: φ 150 3) Quantity: 2 units 4) Flange joining materials (bolts, nuts and gaskets): four locations, φ 150
(6) Flange adaptors	1) Type: Ductile cast iron pipe 2) Inner diameter: φ 150 3) Quantity: 2 units 4) Flange joining materials (bolts, nuts and gaskets): 18 locations, φ 150
(7) Repair valves and air valves	1) Material: Cast iron 2) Inner diameter: φ 25 3) Quantity: 2 (both repair and air valves)
(8) Gate valves and check valves	1) Material: Cast iron 2) Inner diameter: φ 150 3) Quantity: 2 (isolating and check valves)
(9) Power receiving board and control panels for pumps	1) Pump control panels: 2 units
(10) Pontoon (barge)	1) Structure: Roofed 2) Dimensions: 7 m × 4.5 m × 1 m 3) Load: Load bearing capacity approx. 1.5 t 4) Quantity: 1 unit

(2). Gates

Table 2-7 shows the Gates to be installed and their specifications.

Table 2-7: Gates

Equipment	Outline specifications
(1) Orifice	Material: Stainless-steel, Width: 340mm, Height: 2,220mm, Quantity: 1 unit
(2) Head Gate	Material: Stainless-steel, Width: 1,000mm, Height: 3,200mm, Quantity: 1 unit
(3)Check Structure	Material: Stainless-steel, Width:1,850～1450mm, Height:2,000～2,500mm, Quantity:6 unit
(4)Head Gate	Material: Stainless-steel, Width: 550~1,020m, Height: 3,500～4,050mm, Quantity: 3 unit
(5)Turn Out	Material: Stainless-steel, Width: 300～860mm, Height: 460～1,660mm, Quantity: 76 unit

(3). Road Maintenance Equipment

In the Japanese Grant Aid Project of 1987, a motor grader and other types of maintenance equipment were provided; however, only a motor grader, which has been out of order since 2014, was confirmed on site at the present. For these reasons, equipment for the maintenance of farm roads will be provided in the Project. The conditions for the selection and procurement of the equipment shall be that the equipment can be operated with simple, non-specific instruction and that can be maintained in Lao PDR.

A comparative study of a motor grader, towed grader, and bulldozer on the selection criteria mentioned above has revealed the advantage of motor grader with a free-moving blade in the maintenance of the main farm roads (Table 2-8). Therefore, a motor grader will be provided in the Project.

Table 2-8: Comparison of road maintenance equipment

	Motor grader	Bulldozer	Towed grader
Expected specifications	Operating mass: no less than 14,000 kg Rated engine output: no less than 130 kW Blade width: 3,000 – 3,700mm Blade height: 500 - 800 mm	Operating mass: 37,000 - 42,000 kg Rated engine output: no less than 220 kW Equipped with a ripper Blade capacity: no less than 8.5 m^3 (Blade width: no less than 3,900 mm) Blade height: no less than 1,650 mm	Blade width: 3,700 - 4,100 mm Assumed to be towed by a tractor
Soil disposal direction	Scraped soil can be disposed of to the roadside.	The angle of scraped soil disposal can be adjustable at around 25 degrees.	Scraped soil can be disposed of to the roadside.
Ordinary use	Levelling of sub-base and base course materials Work requiring flatness of the finish, such as levelling of road sub-base and base course material	Excavation, transportation and disposal of soil, levelling and compaction	Levelling of sub-base and base course materials Work requiring flatness of the finish, such as levelling of road sub-base and base course material

	Motor grader	Bulldozer	Towed grader
Advantages	The angle of the blade can be changed both horizontally and vertically, the grader can be used for creating very fine cross slopes on road surface. The blade can be lifted, and the grader can cross the bridges on the main farm road. It is a wheeled vehicle, and it is mobile (the running speed is high). The new one will have almost the same specifications as the existing one, and operators can operate and maintain it very well.	Because it is a crawler, it can be operated on rough roads. It can be used in the work on slopes.	If a wheeled tractor is used for towing, the grader's mobility will be high (it can be driven fast.) If the angle of the blade can be changed both horizontally and vertically, forming of cross slopes is fairly easy.
Disadvantages	It cannot be driven on a highly rugged road, because it is wheeled,	Because it is a crawler, it can only be driven at a very low speed. As its blade moves only upward and downward, the vehicle can only perform excavation and dozing. The blade angle to the horizontal plane is fixed and cannot be changed.	Its blade cannot be lifted; this grader cannot cross the bridges on the main farm roads. It is difficult to operate the blade minutely. Forming cross slopes on road surface for water drainage is difficult. It is wheeled, and this grader cannot be driven on a highly rugged road.
Evaluation	Good (to be adopted)	Fair	Fair
Reason	The bridges on the main farm roads are 3.1 m-wide. The priority criterion in the selection of equipment is the ability to cross the bridges. The equipment to be selected should be able to form cross slopes and ditches at the edges of the roads for draining water from the surface. In the terms of operating mass, Motor Grader is lighter than Bulldozer and has better workability.		

With consideration of the operation and maintenance cost after provision, the Study Team has decided to provide a motor grader with a small-sized blade with specifications sufficient to perform the required operation (Table 2-9).

Table 2-9: Recommended specifications of motor grader

Blade width	Operating speed	Cutting angle	Minimum turning radius	Total width	Other specifics
Approx. 3,000 mm - 3,700 mm	Approx. 40 km/h	Approx. 30 – 80 degrees	Approx. 6.0 m	2,500 mm or less	Blade can be lifted 450 mm above the ground.

2-2-3 Outline Design Drawings

The outline design drawings of this project are shown on the following pages.

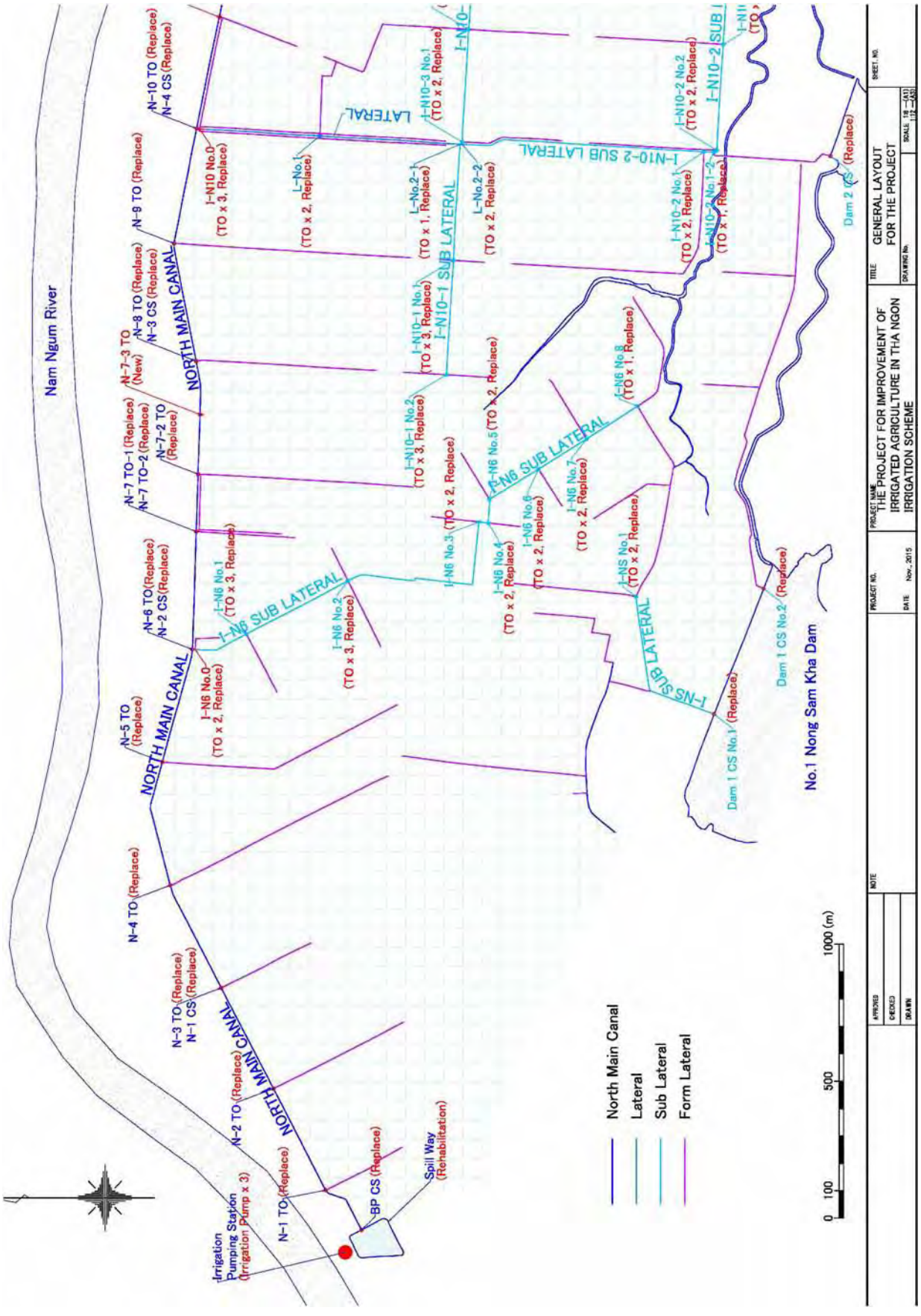


Figure 2-5: General Layout for The Project(1)

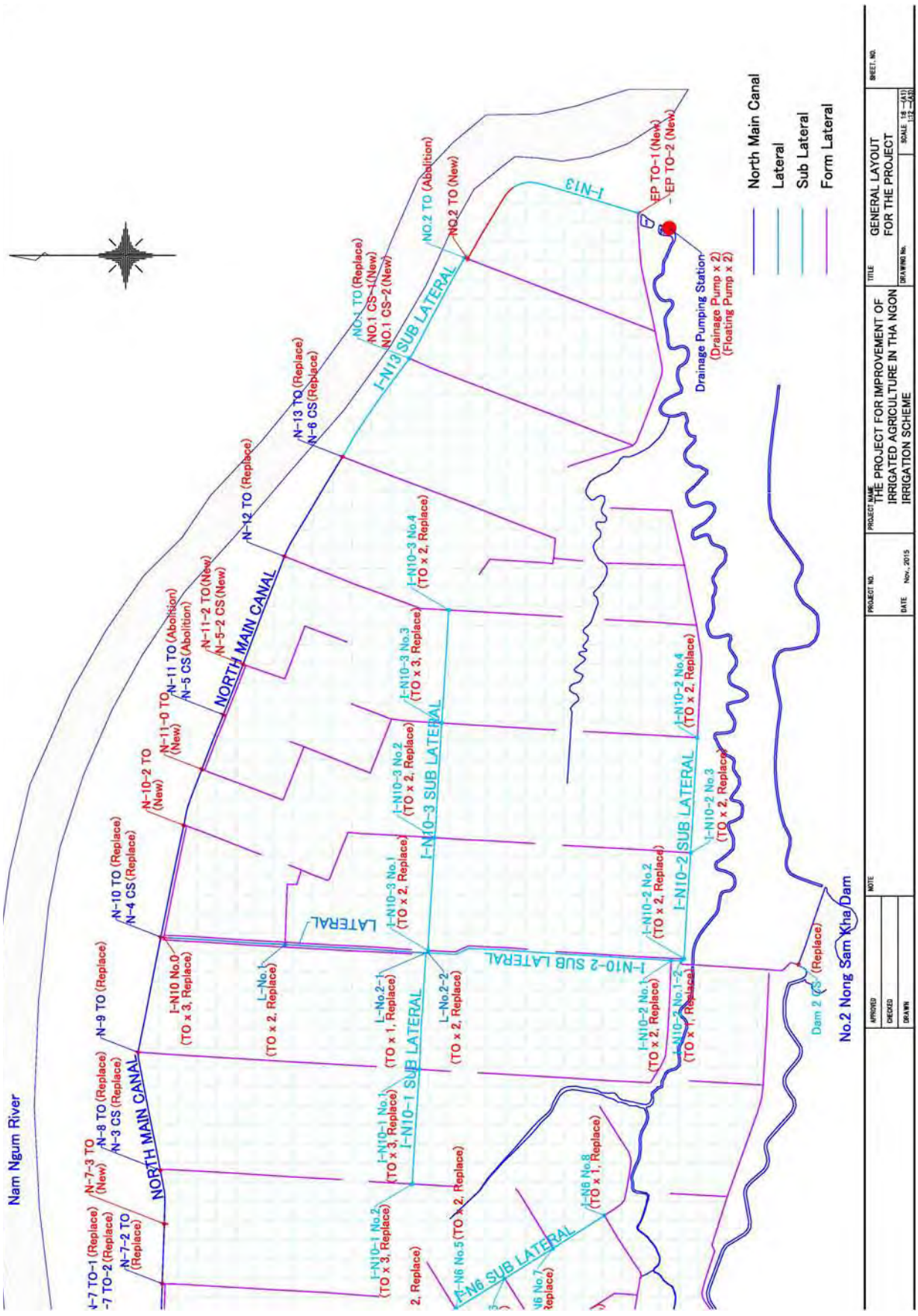


Figure 2-6: General Layout for the Project (2)

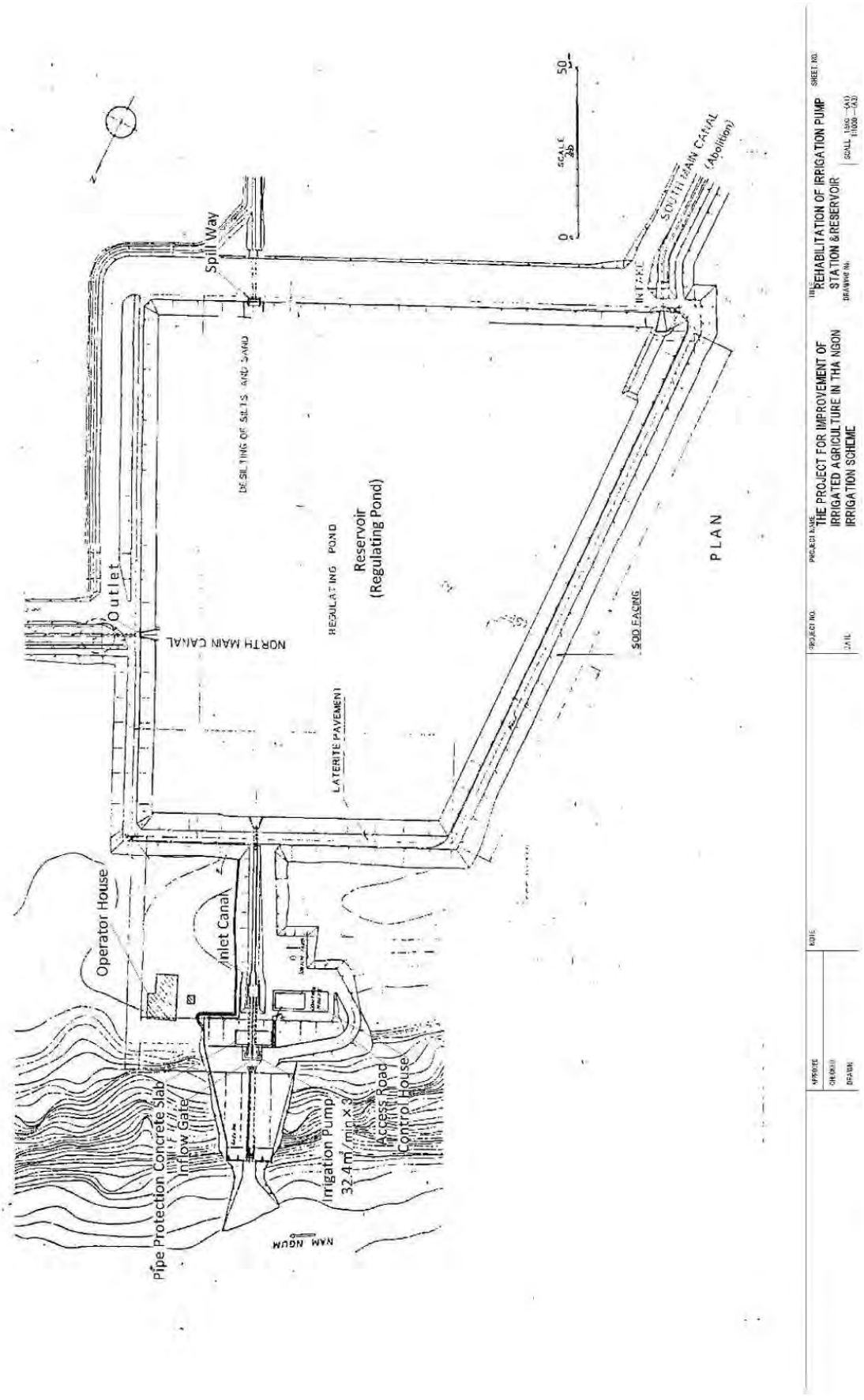


Figure 2-7: Rehabilitation of Irrigation Pump Station and Reservoir

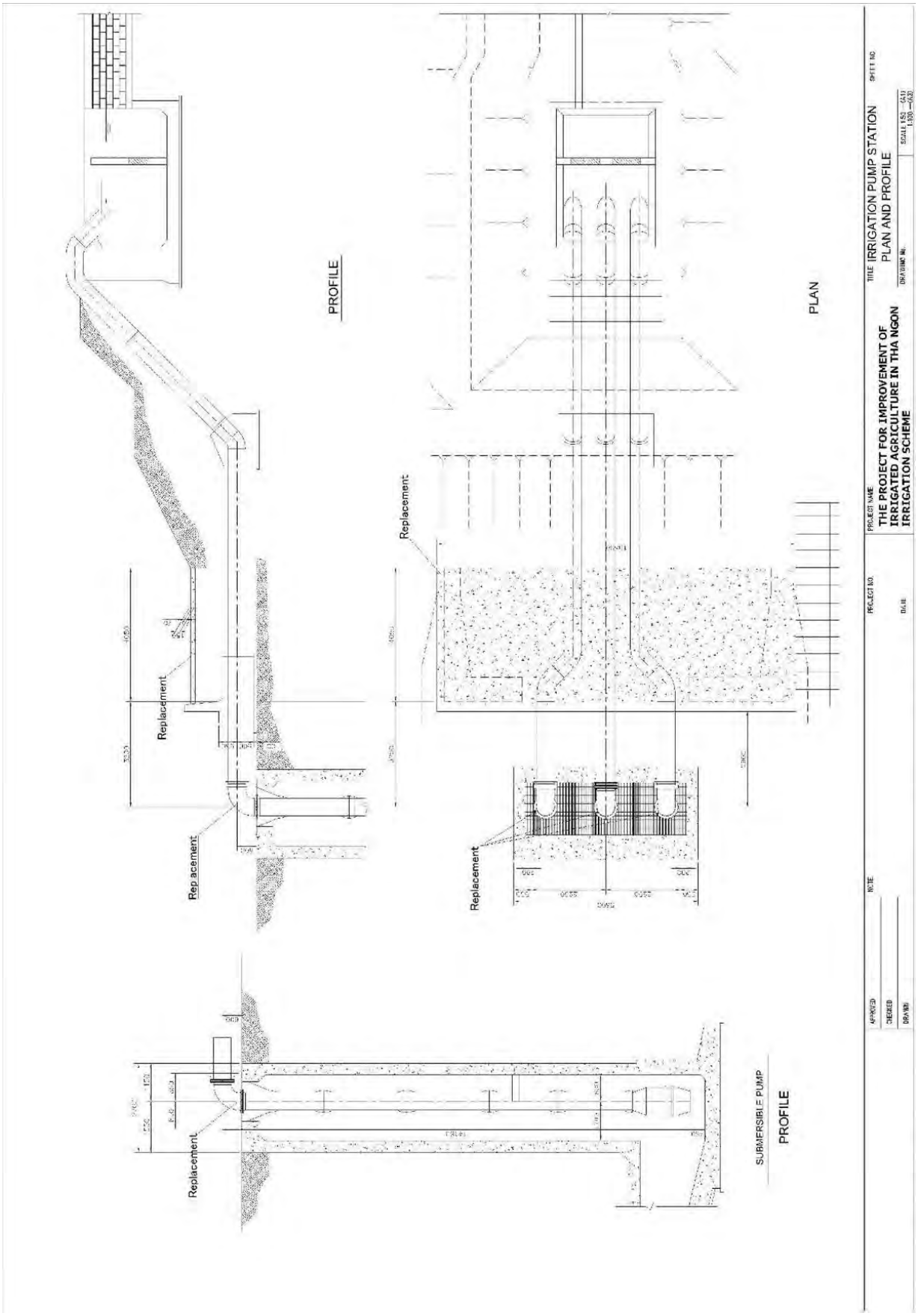


Figure 2-8: Irrigation Pump Station Plan and Profile

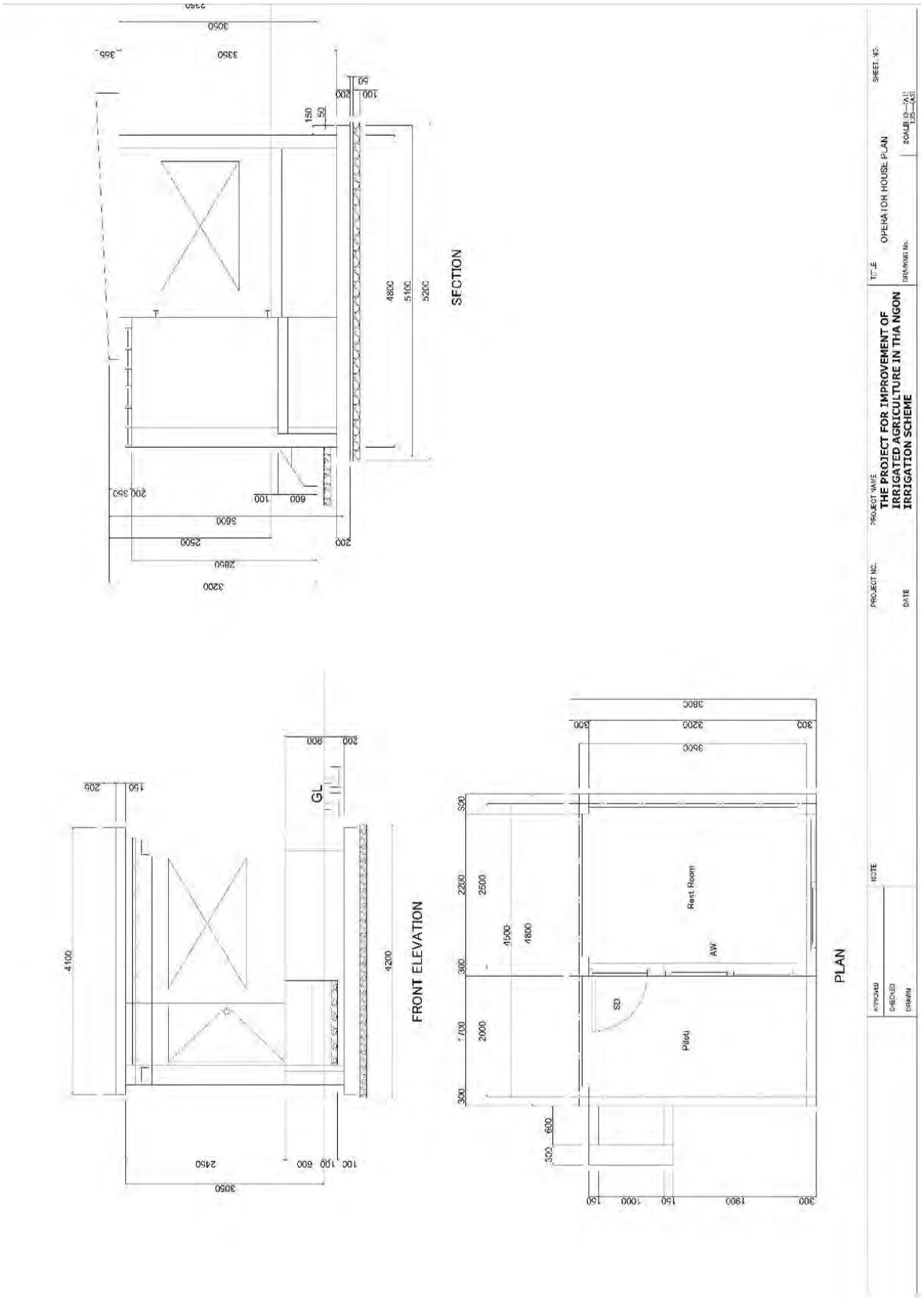


Figure 2-9: Operator House Plan

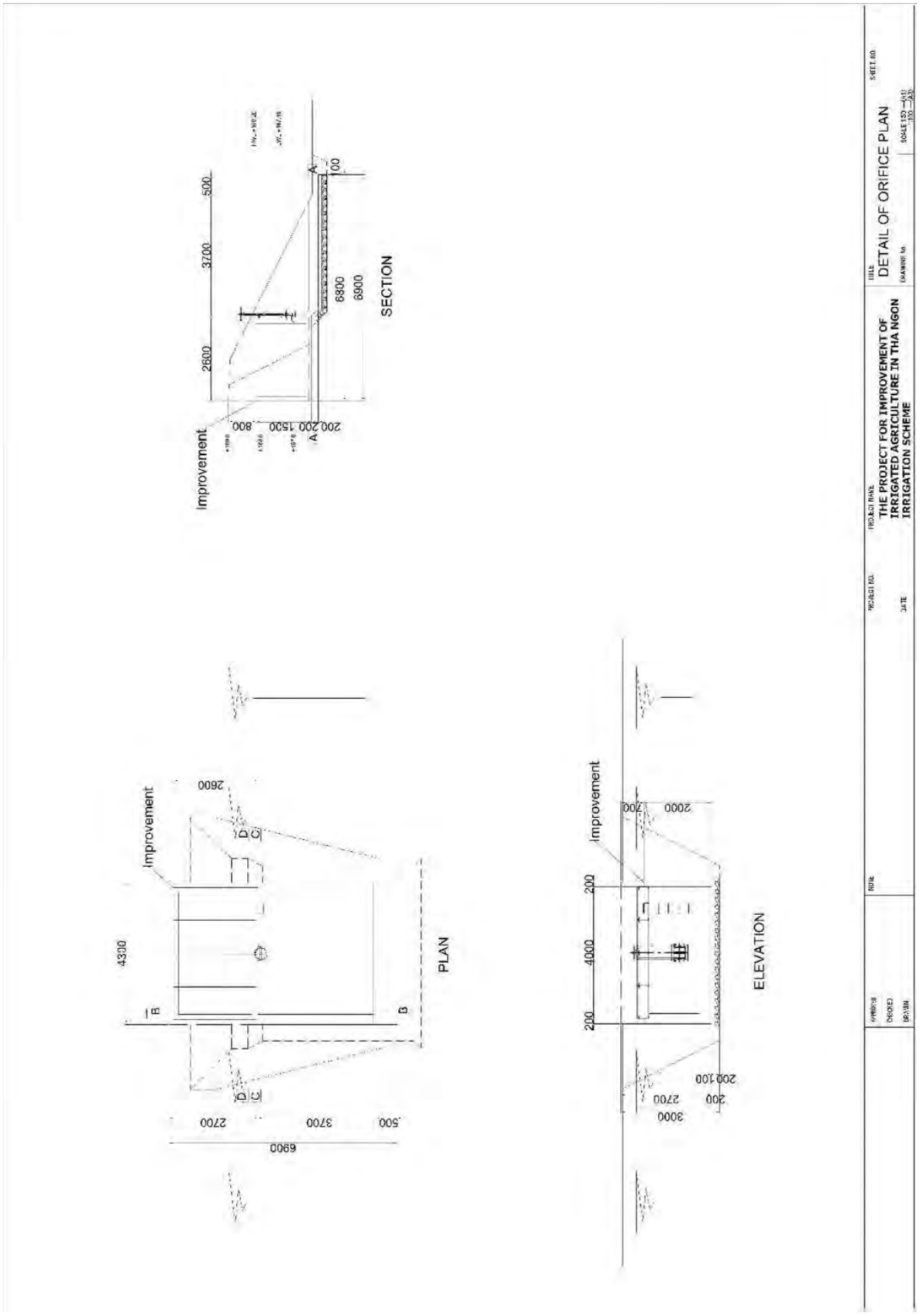


Figure 2-10: Detail of Orifice Plan

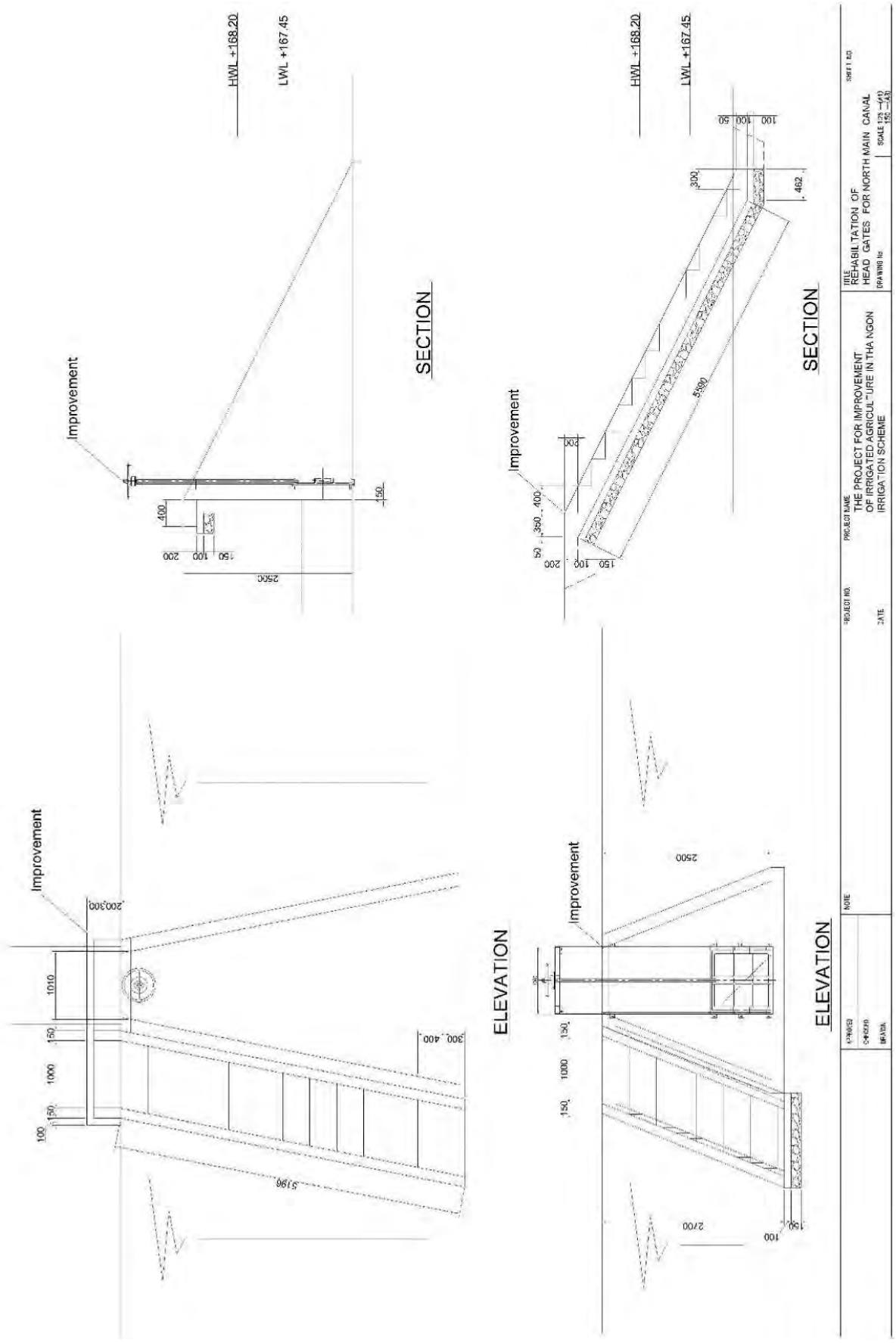


Figure 2-11: Rehabilitation of Head Gate for North Main Canal

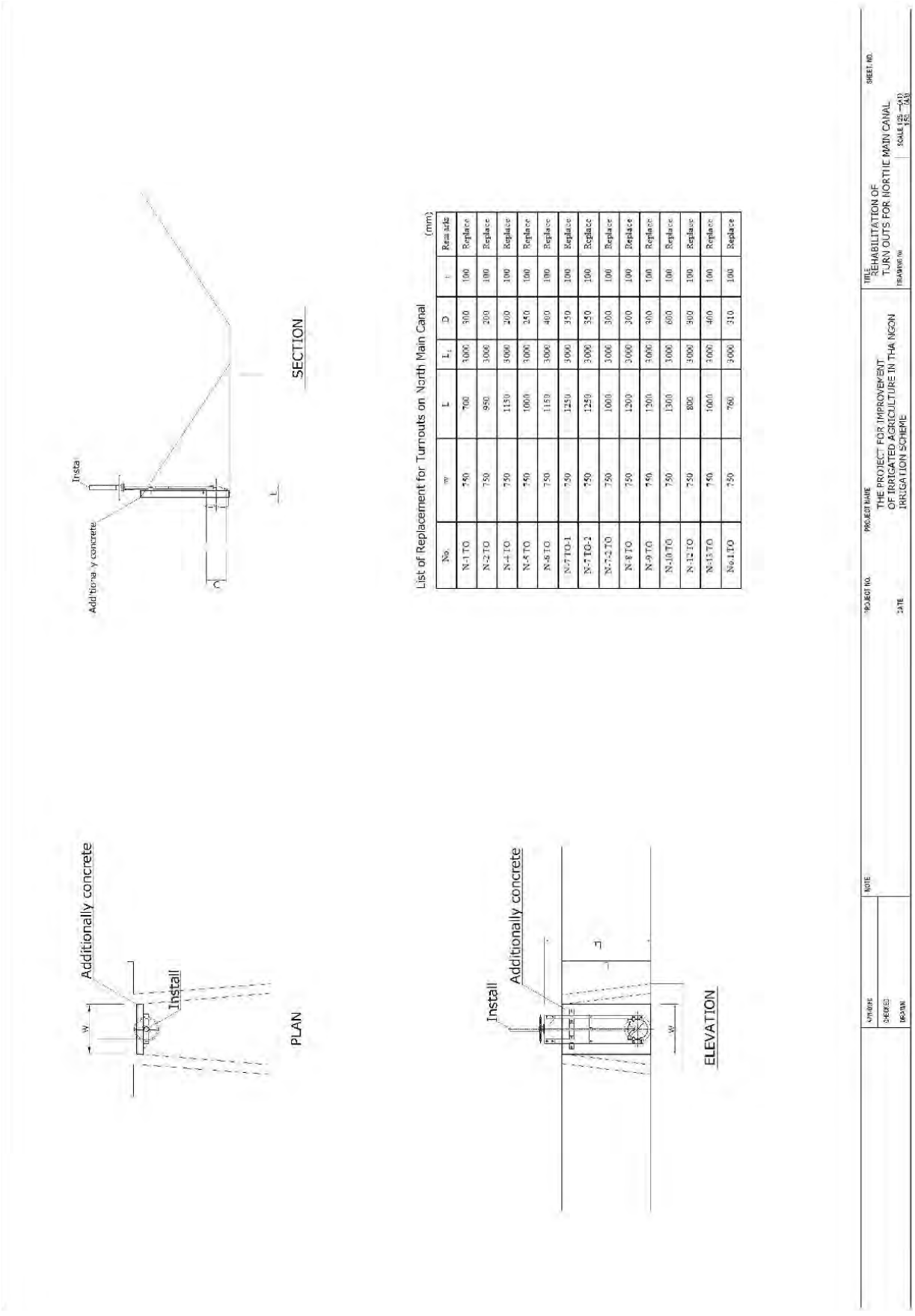


Figure 2-12: Rehabilitation of Turnouts for North Main Canal

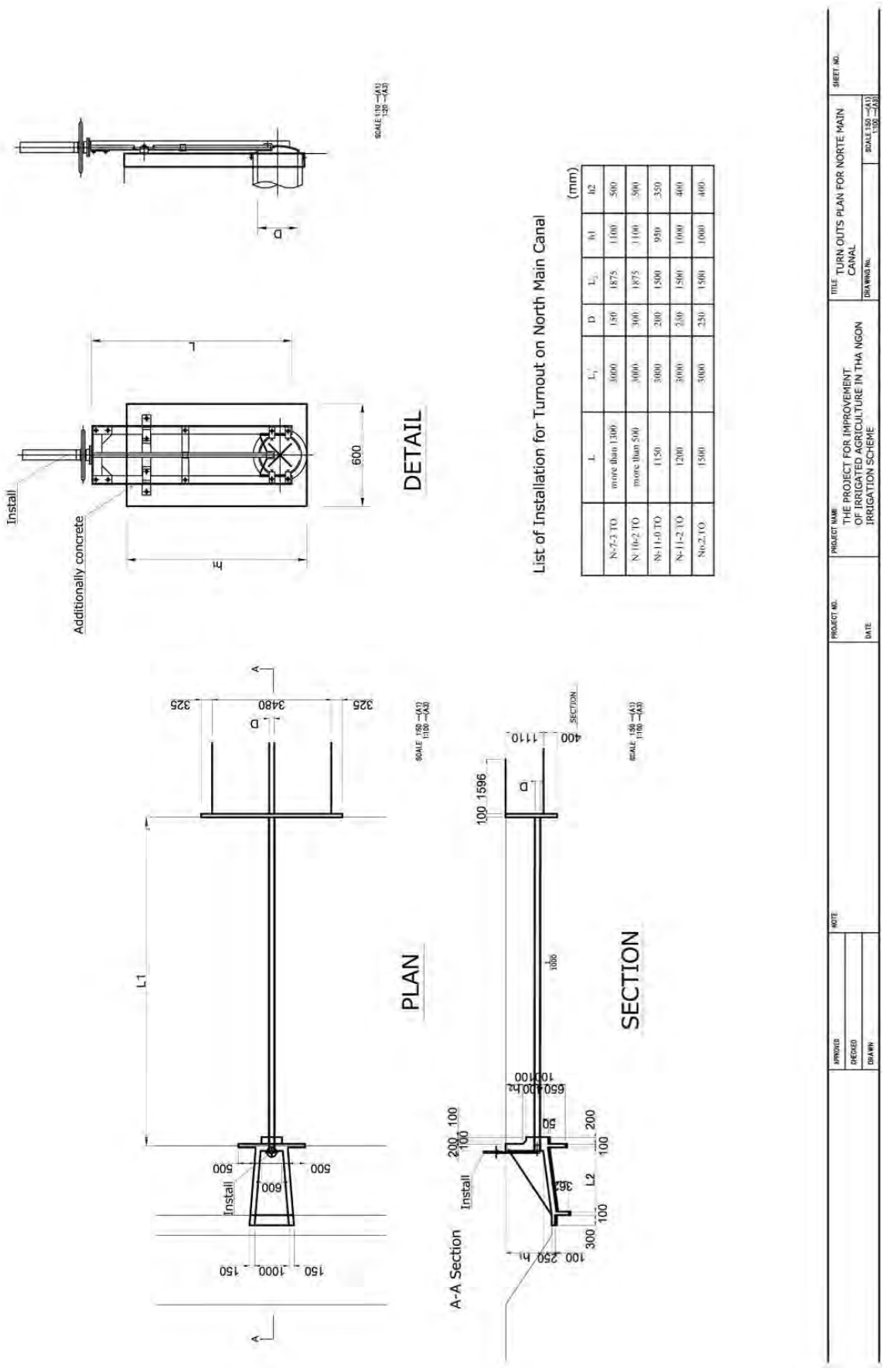
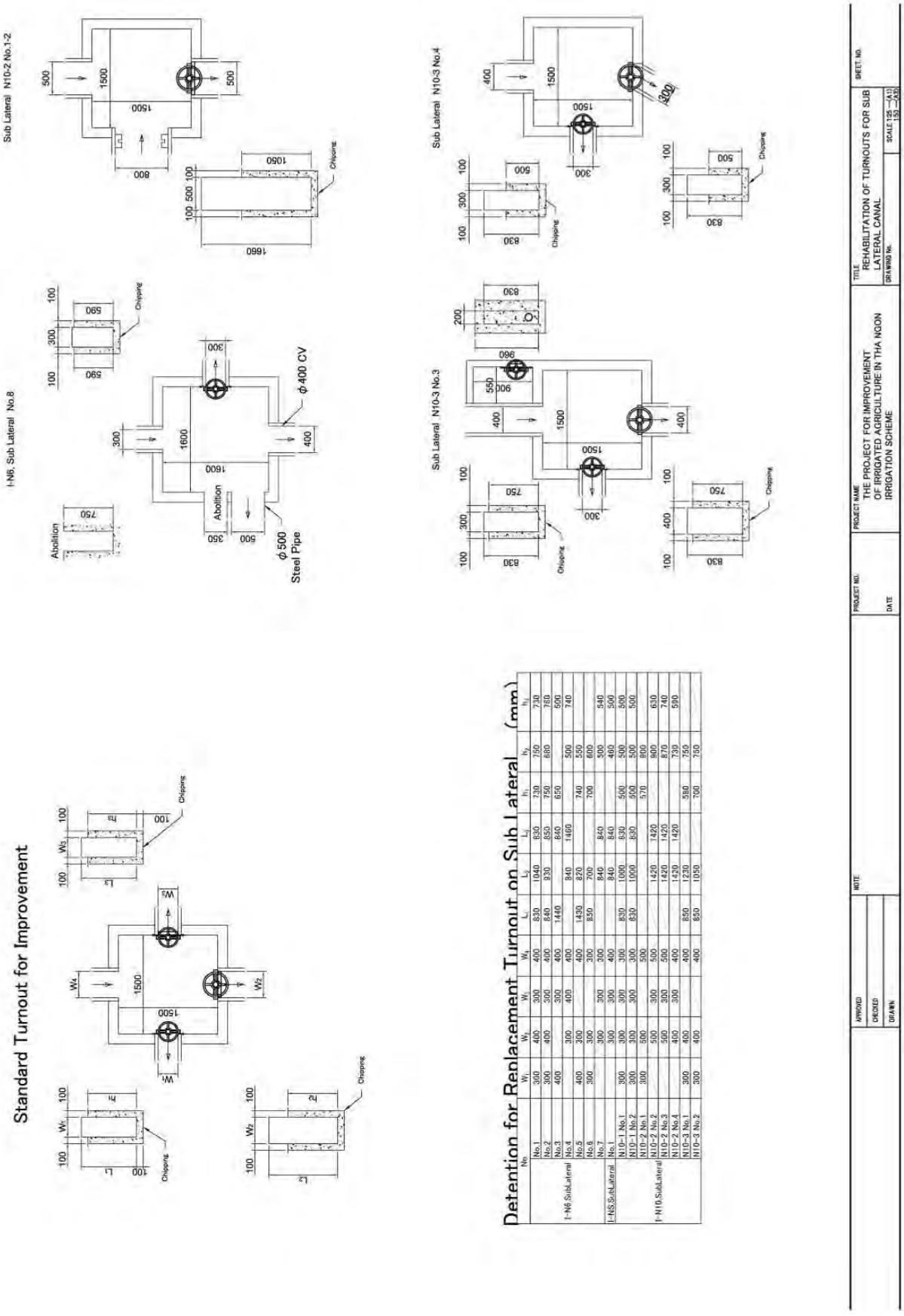


Figure 2-13: Turnouts Plan for North Main Canal



No.		W_1	W_2	W_3	W_4	L_1	L_2	L_3	h_1	h_2	h_3
I-N6,SubLateral	No.1	300	400	300	400	830	1040	830	730	700	730
	No.2	300	400	300	400	840	930	850	750	680	750
	No.3	400		300	400	1440		840	650		500
	No.4		300	400	400		840	1460		500	740
	No.5	400	300		400	1430	820		740	550	
	No.6	300	300		300	850	700		700	600	
	No.7		300	300	300		840	840		500	540
I-N5,SubLateral	No.1		300	300	400		840	840		460	500
	N10-1 No.1	300	300	300	300	830	1000	830	500	500	500
	N10-1 No.2	300	300	300	300	830	1000	830	500	500	500
	N10-2 No.1	300	500		500				570	800	
I-N10,SubLateral	N10-2 No.2		500	300	500		1420	1420		900	630
	N10-2 No.3		500	300	500		1420	1420		870	740
	N10-2 No.4		400	300	400		1420	1420		730	590
	N10-3 No.1	300	400		400	850	1230		580	750	
	N10-3 No.2	300	400		400	850	1050		700	700	

Figure 2-14: Rehabilitation of Turnouts for Sub Lateral Canal

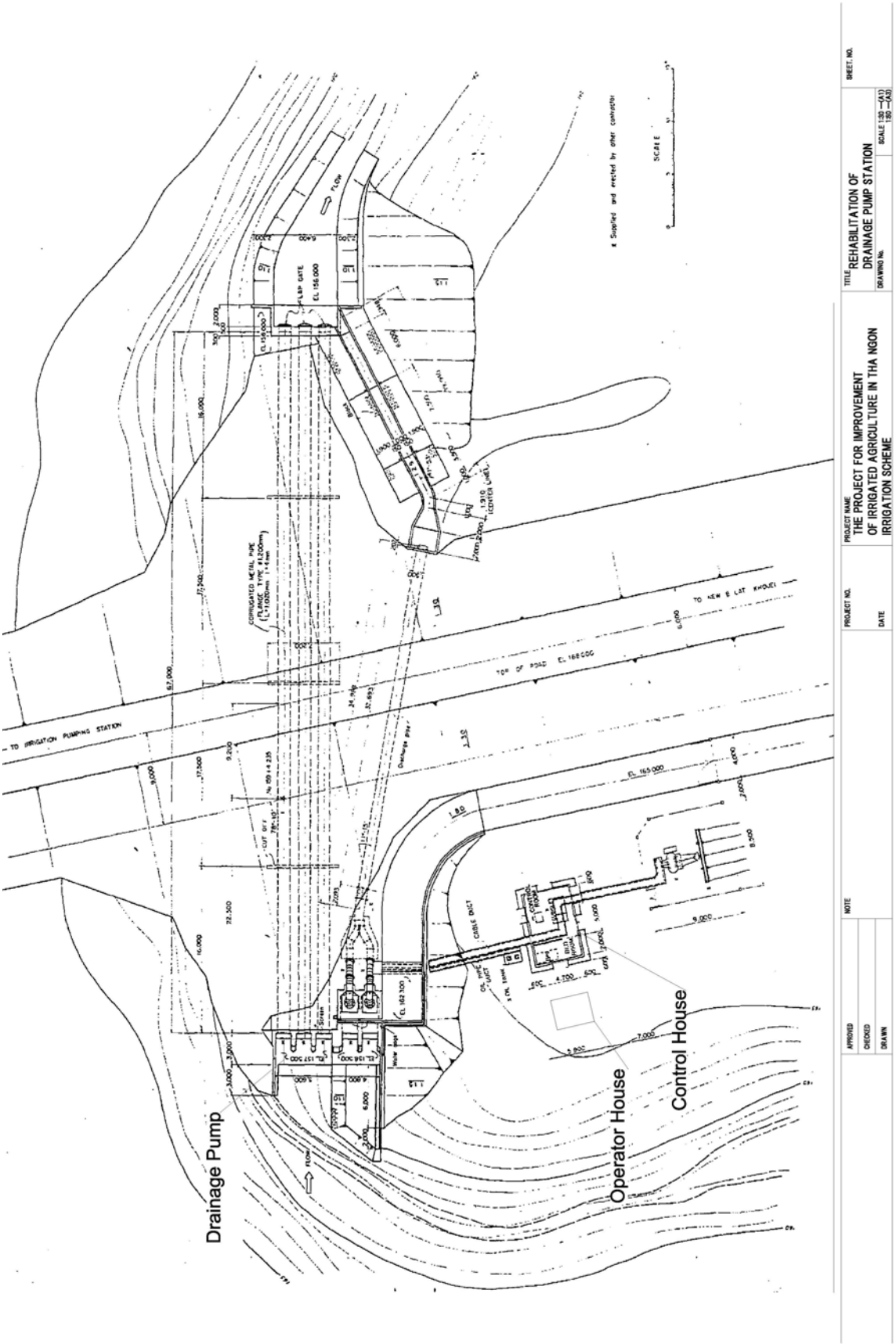


Figure 2-15: Rehabilitation of Drainage Pump Station

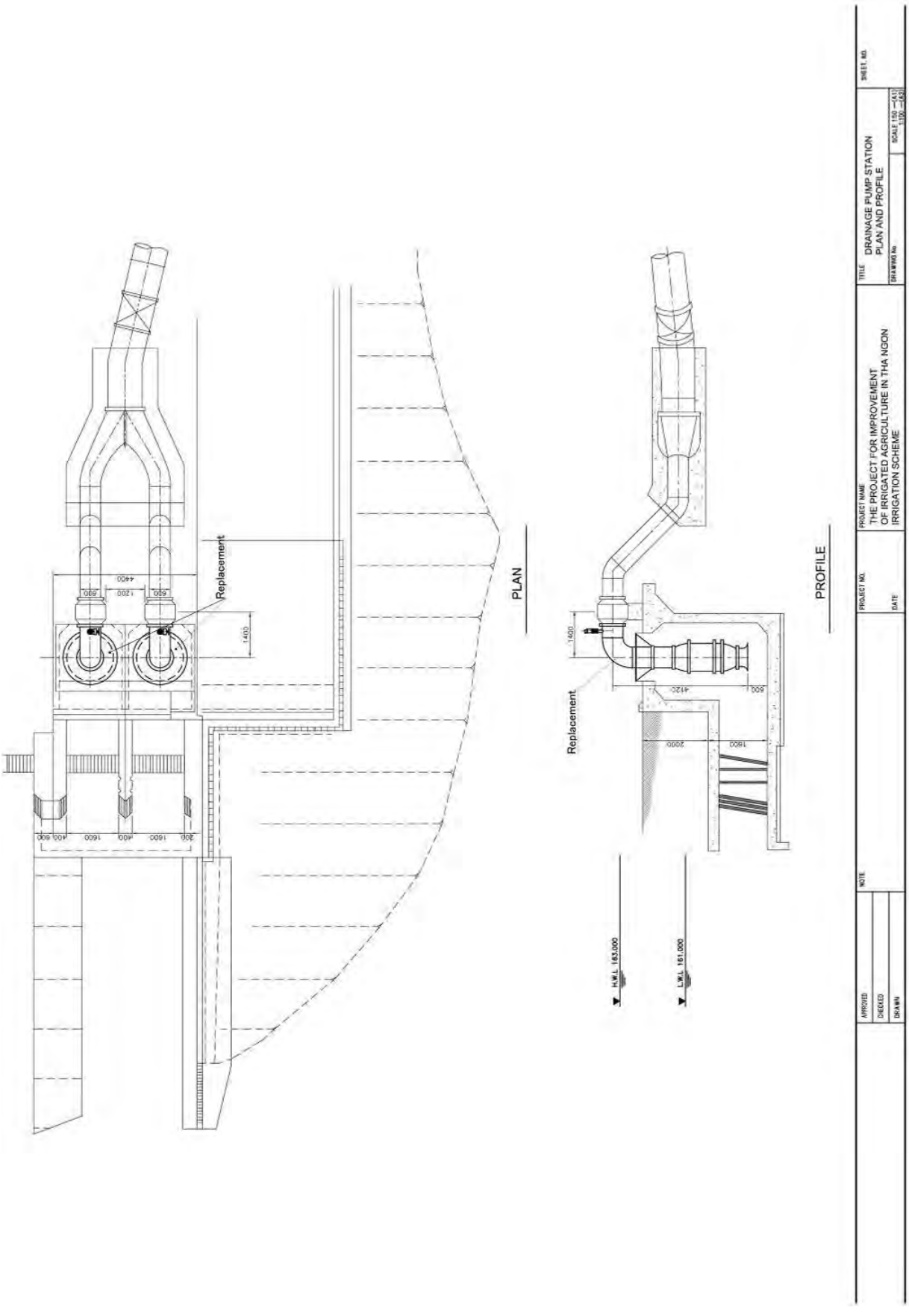


Figure 2-16: Drainage Pump Station Plan and Profile

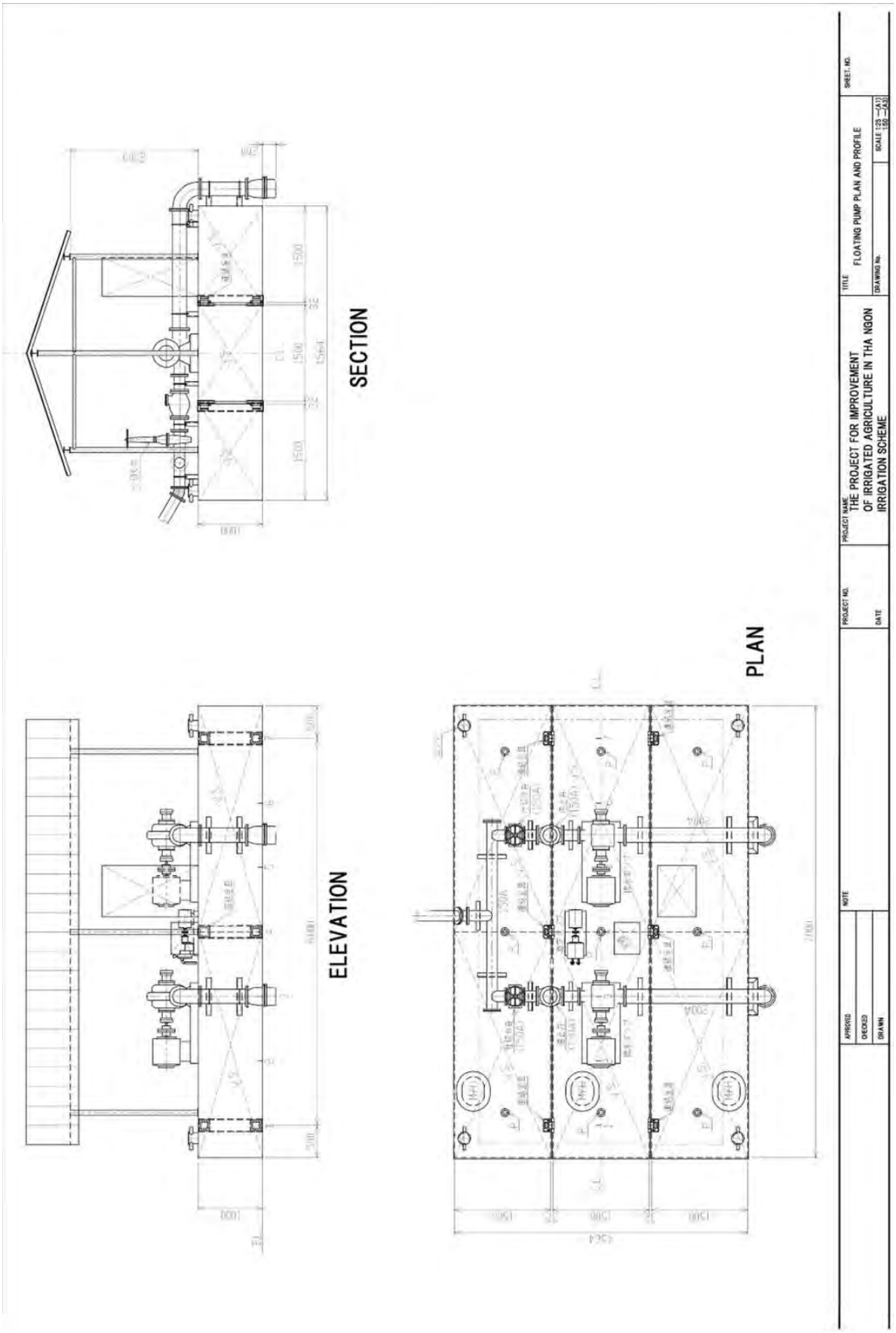


Figure 2-17: Floating Pump Plan and Profile

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The Project shall be implemented in accordance with the scheme of the Japanese Grant Aid. Therefore, it shall be implemented after the approval of the project implementation is made by the GOJ, and the Exchange of Notes (E/N) between GOL and GOJ and the Grant Agreement (G/A) between GOL and JICA have been concluded. The basic issues and the points requiring special considerations in the preparation for the implementation of the Project are described in the following.

(1). Project implementing organization

The Project implementing organization of GOL is the DOI, MAF. DOI shall implement the Project and support Vientiane Capital, Provincial Agriculture and Forest Office, PAFO and the Tha Ngon Irrigation Project Office in the operation and maintenance of the equipment and facilities to be procured and installed in the Project after the completion of the Project. DOI shall appoint persons in charge of the implementation of the Project and have frequent communication and discussion with the Japanese Consultant and contractor to facilitate the Project implementation.

The staff of DOI appointed as the persons in charge of the Project shall explain the background, purpose, and activities of the Project to the staff of DOI, PAFO, Tha Ngon Irrigation Project Office, and WUA making them fully understand the contents of the Project, and motivate them to support the implementation of the Project.

(2). Consultant

A Japanese Consultant recommended to GOL by JICA for the procurement and installation of the equipment shall propose a design and supervisory service contract with DOI and provide the detailed design study and the supervising works in the equipment procurement and installation in the Project. The consultant shall prepare tender documents and hold a tender on behalf of the implementing organization of the Project, DOI.

(3). Suppliers and Contractor

A Japanese supplier and/or contractor selected by GOL in tender procedure in accordance with the scheme of the Japanese Grant Aid shall procure and install the materials and equipment in the Project. The suppliers and/or contractors shall establish a means of communication with the DOI after the completion of the Project with the handover of the materials, equipment and facilities procured and install in the Project to the DOI, as the supply of spare parts and inspection and repair service may be required when the equipment or the facilities have failed during the maker’s warranty period. Besides the maker has to inspect once before expiring warranty period.

(4). Necessity of dispatch of experts

The Project consists of removal and installation of irrigation and drainage (including floating) pumps, facility development and soft component (technical assistance). These construction works involve incidental works such as coffering and drainage work in a river, removal and installation of head gates, installation of check structures and turnouts, construction of operator's houses, renovation of the control houses, etc.

Procurement and installation works of the Project works shall be implemented in a coordinated manner because these works will be implemented at different places in the sites. Simultaneously; therefore, a Japanese site supervisor who can control the construction works comprehensively and give instruction to the contractors in a variety of work must be dispatched, to control the schedule, quality and outputs and ensure safety of these works.

2-2-4-2 Implementation Conditions

(1). Accessibility

The Project site, Tha Ngon Farm, is located approx. 20 km north of the capital, Vientiane. It is a 30-minute drive on a paved national highway from the capital, if there is no traffic congestion.

Roads in the Project site are not paved. Moreover, because these unpaved roads in the site are largely layered clayey and silty materials on surface, it is difficult to drive on these roads in vehicles other than 4WD or large vehicles in the rain. Therefore, the road condition is likely to affect the transport of materials and equipment and the movement of construction vehicles; thus, the schedule of the Project shall be prepared considering the road condition.

(2). Points to be noted in the construction work

The pump pit in the irrigation pump station is deep (12 m). Sufficient measures shall be taken to prevent accidents such as drowning, fall and oxygen deficiency when the intake gates, pumps and irrigation pumps are removed and replaced.

High-voltage cables are installed near the irrigation pump station and the drainage pump station. When a crane truck and other tall construction vehicles are used for the transport of construction materials and equipment, sufficient attention shall be paid not to touch the cables with these vehicles.

Turnouts are located in many places in the site. Moreover, the number of turnouts is large and their structures are similar. Therefore, shop drawings and location map shall be carefully examined to make sure that the right equipment is installed at the right location.

(3). Schedule of the temporary work (cofferdam construction)

It shall be necessary to construct a cofferdam to stop the influx of river water into the pump pit

during the renovation of the pump station. A cofferdam shall be constructed in the river around the intake gate and the water inside the cofferdam will be forcibly drained. Then, the existing intake gate will be replaced by the new one. In this way, the water-tightness of the pump pit will be established before the replacement of the pumps. The safety of the pump replacement work shall be secured during pump replacement by closing the new intake gate while continuing the forced drainage inside the cofferdam.

The cofferdam shall be constructed in the dry season when the water level in the river is low and completed before the pumps procured in Japan will be delivered to the site. In practice, the cofferdam work is desired to be conducted in the period between February and April.

(4). Countries of origin of materials and equipment

All the major equipment to be procured in the Project, except the motor grader, is planned to be procured from Japan. However, as a principle, the construction materials are to be procured in Lao PDR (local procurement). Nevertheless, as a large number of the construction materials available in Lao PDR are manufactured in the neighboring countries, the availability and quality of those materials shall be taken into consideration.

(5). Security measures

Although the Project site is located in an area with few security problems, measures shall be taken to prevent theft of construction materials and equipment and to ensure the safety of construction workers. Therefore, the Japanese contractor shall not only ask GOL to take security measures at the Project site but prepare their own security measures such as assignment of security guards. Sufficient attention shall be paid to ensure not only worker safety but also public safety.

(6). Tax exemption

All of the materials to be procured of custom duty, internal fares and other fiscal levies shall be exempted in accordance with E/N which is concluded between Lao PDR and Japan. DOI must timely prepare the master list and submit it to MOF and other relevant authorities for approval. DOI must also acquire budgetary allocations for their non-cash transaction in particular to cover VAT.

In order to ensure the Japanese Grant Aid’s requirement that customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services must be exempted or borne by its designated authority without using the Grant, the Survey Team, the excecuting agency, i.e.DOI, and the Ministry of Plannning and Investment had a meeting with the Exteral Finance Department (EFD) of the Ministry of Finance (MOF) and confirmed the following.

- As to the items to be imported, a master list must be prepared by the executing agency, DOI/MAF in this case, and be submitted to MOF for approval for duty-and-tax-free procurement.
- As to the items to be domestically purchased, DOI/MAF must obtain relevant budgetary

allocation for non-cash transaction to cover the VAT portion in terms of counterpart fund.

- As to items for domestic purchase where the price already includes certain taxes, such as petrol, contractors must purchase the item and obtain receipt with the tax amount indicated. In that case, the contractors shall only pay the amount excluding the tax amount and DOI/MAF shall cover the tax amount with the non-cash transaction budget.
- Tha exemption of import tax ND duties, and Value Added Tax included in domestic goods and services should comply with the instruction 2695/MOF dated 01 November 2010.

In order to exempt products and materials procured in Lao PDR from VAT and excise tax, the contractors shall submit a procurement plan, in which lists and sources of the procurements are written, to Tax Department of MOF. The contractors shall prepare and submit the required documents giving GOL sufficient time to process them because GOL takes a significant amount of time to approve the master plans. The point is that not only excise tax and VAT but also all other taxes are subject to exemption.

(7). Transportation

Materials and equipment to be procured from Japan and/or third countries for the Project will be transported by sea to and unloaded at the Port of Bangkok in Thailand and transported by land to the Project site in Tha Ngon Area in Laos. As mentioned above, customs duties will not be charged on the materials and equipment. However, the cargo-handling cost should be covered by Japan side. A durable packaging method shall be used for the equipment to be transported from Japan to protect it during the long voyage, unloading at the port, land transport to the project site and storage at the site.

(8). Notes on procurement of materials and equipment

Local contractor and local materials will be used in the facility construction work (civil work) under the supervision of the Consultant. Local procurement, which costs less than the other procurement methods, will be preferred for the procurement of the materials and equipment required for the implementation of the Project. Sufficient measures shall be taken to ensure the quality of the locally procured materials and equipment so that construction works with them should satisfy the specifications used in the Project.

2-2-4-3 Scopes of Works

Table 2-10 shows the scopes of works of the Japanese and Laotian sides in the Project when it is implemented.

Table 2-10: Scopes of work of Japanese and Laotian side

No.	Item	Japanese side	Laotian side
1	Banking Arrangement		
	-To open a bank account -To issue Authorization to Pay (hereinafter referred to as "A/P") for the payment to the consultant through the bank in Japan (the Agent Bank). -To bear bank commission for services of the Agent Bank including authorization of payment and other relevant ones. -To issue A/P to the bank in Japan (the Agent Bank) for the payment to the Supplier. -To bear the following commissions of the bank in Japan for the banking services based upon the B/A. 1) Advising commission of A/P 2) Payment commission for A/P		✓
2	Permits and licenses required for the entry in, exit from and stay in Laos		
	-To secure prompt issuance of visa and relevant permissions to the consultant. -To secure entry into Laos and to accord with Japanese nationals and/or physical persons of third countries (contractors and/or suppliers) whose services may be required in connection with the supply of the products and the services under verified contracts		✓
3	Tax exemption for customs duties, value-added tax and all other taxes		
	-To prepare and submit Master List of equipment to be procured to relevant authorities of Laos for prompt processing exemption from tax, duty and other relevant levies. -To ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and to assist the Supplier with internal transportation therein. -To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services are exempted or borne by its designated authority without using the Grant		✓
4	Preparation of land, etc.		
	-To secure lands for the implementation of the Project -To obtain planning, zoning and building permits including demolition and removal of existing buildings for the implementation of the Project. -To clear, level and reclaim the sites for the implementation of the Project.		✓
5	Supply of necessary utilities		
	-To secure supply of necessary utilities for the implementation of the Project including electricity for the relevant pump stations.		✓
	-Installation of VCTs and transformers downstream of the demarcation point and wiring within the pump stations	✓	
6	Coordination with relevant local authorities and stakeholders		
	-To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.		✓
7	Irrigation water distribution plans		

No.	Item	Japanese side	Laotian side
	-To renew irrigation water distribution plans in cooperation with a relevant water users' association.		✓
8	Project Monitoring Report		
	-To submit Project Monitoring Report (with the result of Detail Design). -To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over and installation.		✓
9	Repairing North Main Canal		
	-To repair 36 m of the north main canal nearby No. 11 Turn out with concrete and to reconstruct the embankment as the initial situation.		✓
10	Costs of the activities related to the project not included in the grant aid cooperation		
	-To bear all the expenses necessary for the implementation of the Project, other than those covered by the Grant.		✓
11	Project Completion Report		
	-To submit a report concerning completion of the Project.		✓
12	Necessary measures for safety		
	-To take necessary measures for safety construction. -Traffic control -Rope off		✓
13	Disposal of waste		
	-To dispose soil, crashed concrete and removed equipment generated by the procurement. -To dispose existing electricity materials such as transformers, voltage and current transformers, cables, etc.		✓

2-2-4-4 Consultant Supervision

The Consultant will facilitate the implementation of the Project by forming a project team that will provide comprehensive detailed design and supervising works to achieve the purpose presented in the outline design prepared in the preparatory survey. The Consultant will also dispatch a Japanese expert to the shop inspection and pre-shipment inspection of the materials and equipment manufactured in Japan, whenever such an inspection is deemed necessary, to prevent trouble with the materials and equipment after they have been delivered to the site. The Consultant will assign at least one engineer to the Project site throughout the stage of the execution/procurement supervision to control the schedule and quality and to ensure safety of the Project.

The basic responsibilities of the Consultant in the supervisory service will be 1) to monitor the progress in the procurement of the materials and equipment and construction of the facilities so that the work in the Project should be completed within the planned project period; 2) to ensure that the materials and equipment satisfying the given specifications on quality and present form of the building compared with ta original design and the due date of procurement; and 3) to monitor the activities of the contractors at the site and give instruction to them so that the safety of the work at the site should be maintained. It will be impossible to follow the overall work schedule of the Project, unless the

procurement and installation of the equipment in each components of the Project have been completed within the set period provided in the work schedule of the component concerned. It is also important for the Consultant to constantly monitor the progress of the work of the Laotian side, which is essential for the smooth progress of the Project. The Consultant is expected to supervise various works, including the procurement of materials and equipment, temporary work, foundation work, building work, facility work and interior work. Therefore, the Consultant will establish and maintain coordinated and cooperative relationships with the implementing organization, the government office concerned with the Project, users of the irrigation system, area residents and the contractors to facilitate the procurement supervision service. The major points to be noted in the supervising work are described in the following.

(1). Schedule control

The Consultant shall compare the execution schedule contracted with the contractor at the conclusion of the contract and the progress in the actual work every month or every week to ensure that the contractor will comply with the handover date stipulated in the Contract. If the delay in the schedule is expected, the Consultant will alert the contractor to the delay, ask the contractor to prepare, submit and implement measures against the delay and give instruction to the contractor so that the construction work and delivery of materials and equipment will be completed within the contract period. The main methods in the comparison between the schedule and the actual progress are as follows:

1) Confirmation of the amount of completed work (including the amount of materials and equipment manufactured in the factory)

2) Confirmation of the materials and equipment delivered to the site (pumps, gates, etc.)

3) Confirmation of the state of the temporary work and preparation of construction machinery

4) Comparison of man-hours and actual numbers of engineers, skilled workers and general laborers on-site

(2). Safety control

The Consultant will ensure the workplace safety to prevent occupational and public disasters, and accidents to third parties in and around the Project site during the implementation period in consultation and cooperation with a representative of the contractor. The following are the key points in the safety control in the Project site.

1) Establishment of the safety control rules and appointment of the safety manager

2) Regular safety control meetings

3) Prevention of accidents with regular inspection of construction machinery

4) Establishment of the routes of traffic of construction vehicles and machinery and strict compliance with driving at low speed

5) Measures to improve the welfare of laborers and encouraging the personnel to take days off

2-2-4-5 Quality Control Plan

The persons in charge of the execution supervision of the Consultant will monitor and verify whether the quality of the materials and equipment procured in the Project and the actual shape of their installation work conform to those provided in the Contract documents (including the technical specifications and design drawings) with the methods mentioned below. When the said persons have doubt on the quality or actual shape, the Consultant shall request corrections, changes and modifications to the contractor.

1) Verification of shop drawings and specifications materials and their equipment
2) Attendance to vendor inspection or examination of the report of the vendor inspection of the materials and equipment
3) Examination of the methods of packaging, transportation and temporary storage at the site
4) Verification of plans and methods of equipment installation
5) Verification of the procedure of the actual test run, adjustment and inspection conducted at the factory and on site and the procedures provided in the manual
6) Supervision of the installation of materials and equipment on site
7) Verification between the factory and installation drawings and the actual shape at the site
8) Examination of the as-built drawings

2-2-4-6 Procurement Plan

(1). Procurement of equipment

1). Pumps and accessories

The existing pumps installed at the site were manufactured in Japan. Although two of the three pumps are out of order, all of them have been operated for almost 30 years and the operators are proficient in their operation.

Furthermore, the pumps to be installed in the Project will be built-to-order. The manufacturing process of the equipment shall be strictly controlled, as the schedule for the installation of the pump facilities - pumps and accessories - shall be prepared to not affect the dry-season farming. For these reasons, the pump facilities shall be procured in Japan.

2). Gate structures

The installation of the intake gate (clearance of 13 m) situated in the irrigation pump station should be completed by the beginning of the rainy season. The installation of this intake gate is the critical path in the Project. If this deadline is missed, the planned works in the Project will not likely to be completed in the currently-assumed Project period. Therefore, the replacement intake gate must be delivered to the site by the scheduled delivery date.

The new gates (gate structures) are to be made of stainless-steel to give them weather resistance and durability. It is difficult to procure such turnouts locally because of the lack of technology to process

stainless-steel materials. For this reason, predictability of the manufacturing period and reliability of the quality of products, the gate structures and turnouts will be procured in Japan.

3). Farm road maintenance equipment

The farm road maintenance equipment, a motor grader, shall be procured in Lao PDR for the ease of procurement of maintenance service and spare parts.

(2). Construction materials and equipment

The materials and equipment for construction shall be procured in Lao PDR as much as possible. However, in the case that the material and/or equipment that is not locally available or that cannot be procured in a required quantity in a set period and in required quality shall be procured in Japan.

The construction materials required for the installation of pump facilities including electric and mechanical parts, cement, aggregate and timber can be procured in Vientiane. The spare parts of the motor grader can also be procured locally. Therefore, local procurement of equipment shall be preferred for the Project.

Table 2-11 shows the source countries of the construction materials and equipment to be procured in the Project.

Table 2-11: Source countries of construction materials and equipment to be procured

Material	Source country			Reason for the selection of the source country Lao PDR
	Lao PDR	Japan	Third country	
Ready-mixed concrete	✓	-	Ready-mixed concrete	✓
Cement	✓	-	Cement	✓
Fine aggregate	✓	-	Fine aggregate	✓
Coarse aggregate	✓	-	Coarse aggregate	✓
Steel materials	✓	-	Steel materials	✓
Framework materials	✓	-	Framework materials	✓
Fuel	✓	-	Fuel	✓
Lining material of headrace	-	✓	Lining material of headrace	-

(3). Construction machinery

General construction machinery required for the rehabilitation work in the Project can be leased in Lao PDR. Taking into consideration the cost of transporting the equipment from Japan and the duration

of the use, the locally leased equipment, which is cheaper than the Japanese lease, shall be used in the Project.

(4). Transportation and packaging plan

When materials and equipment are to be transported from Japan or a third country to Lao PDR, these will be loaded on a container ship or tramp ship at a major port in Japan or the third country, transported to and unloaded at the Port of Bangkok in Thailand and transported by land to Lao PDR, in many cases.

It takes approx. two to three weeks to transport a cargo by sea from Japan to the Port of Bangkok in Thailand. It takes approx. five to six weeks to transport a cargo from the Port of Bangkok to Tha Ngon area, Xaithany District, Vientiane Capital, including an approx. two-week period that is assumed to be required for various paperwork. The time required for the transportation mentioned above shall be taken into consideration in the planning of transportation and packaging of the materials and equipment.

2-2-4-7 Operational Guidance Plan

Considering the operational experience of the existing equipment in Lao PDR there would not be any problem to operate the equipment to be installed; however, operational guidance will be implemented in a trial operation.

2-2-4-8 Soft Component (Technical Assistance) Plan

The irrigation system, mainly the pump facilities in Tha Ngon area will be rehabilitated by implementation of the Project, and the irrigation system will fulfill the original functions. Administration, Operation and Maintenance (A-O&M) will be continued by Tha Ngon Irrigation Project Office in the conventional way though Lao PDR aims to transfer the authorities of A-O&M of the system to WUA in the future. Tha Ngon Irrigation Project Office will basically take the initiative of A-O&M of the irrigation system and the current main role of WUA (the leaders of each group) is collection of water fee.

Tha Ngon Irrigation Project is in charge of the irrigation system (irrigation area: 1,700 ha) constructed by Japanese Grant Aid “the Agricultural, Rural Development Project in the Suburbs of Vientiane (KM6 Project)” (1990-1992) in parallel with the Project; therefore, it is forced to handle A-O&M of the system with limited personnel resources. The current issues which the office has are indicated below.

Issue 1: Necessary information for administration of irrigation system is neither integrated nor organized

Issue 2: Necessary information required for operation and maintenance of irrigation facilities is neither integrated nor organized

Issue 3: Necessary information for A-O&M is not shared between the stakeholders

(1). Objective of Soft Component

The objective of this soft component, technical assistance, is defined that "Tha Ngon Irrigation Project Office establishes contents of basic information necessary for A-O&M and methods to collect, organize and share it" based on the issues mentioned in the previous section. Moreover, the overall goal is set that "Tha Ngon Irrigation Project Office continues A-O&M utilizing the basic information collected and organized."

(2). Outputs of Soft Component

Output 1: Administration Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for administration of the irrigation system.

Output 2: Operation and Maintenance Unit and Extension Unit of Tha Ngon Irrigation Project Office integrate and organize information necessary for operation and maintenance of the irrigation system.

Output 3: Tha Ngon Irrigation Project Office shares information necessary for A-O&M of the irrigation system with the stakeholders.

(3). Outputs and Indicators

Indicators and achievement degrees of the soft component are defined as Table 2-12.

Table 2-12: Indicators of Each Output of the Soft Component

Outputs	Indicators
Output 1: Administration Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for administration of the irrigation system.	The documents regarding administration of the irrigation facilities (e.g. land register, list of WUA members, financial information such as income and expenditure of water fees, minutes of meetings) are classified and organized
Output 2: Operation and Maintenance Unit and Extension Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for operation and maintenance of the irrigation system	The documents regarding operation and maintenance of the irrigation system (e.g. inventory of the irrigation facilities, drawings, pump and distribution flow rates, duration of irrigation, working records) are classified and organized
Output 3: Tha Ngon Irrigation Project Office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders	Data on administration, operation and maintenance are filed in paper folders and are open access

(4). Plan of Soft Component Activities (Input Plan)

In order to produce effects soon after completion of the Project, every kind of recording formats which are both in paper and digital files shall be classified and organized in this soft component. Targets

of all activities are staffs of Administration Unit, Extension Unit and Operation and Maintenance Unit of Tha Ngon Irrigation Project Office.

1). Output 1: Administration Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for administration of the irrigation system.

Activity 1: Grasp the overview of the documents about administration of the irrigation system owned by Tha Ngon Irrigation Project Office
Activity 2: Select contents of the documents necessary for administration of the irrigation system, and classify and organize the documents by the contents
Activity 3: Learn how to prepare documents necessary for O & M of the irrigation system

2). Output 2: Operation and Maintenance Unit and Extension Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for operation and maintenance of the irrigation system

Activity 1: Grasp the overview of the documents about operation and maintenance of the irrigation system owned by Tha Ngon Irrigation Project Office
Activity 2: Select contents of the documents necessary for operation and maintenance of the irrigation system, and classify and organize the documents by the contents
Activity 3: Learn how to prepare documents necessary for O & M of the irrigation system

3). Output 3: Tha Ngon Irrigation Project Office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders

Activity 1: Grasp the approval flow of documents regarding A-O&M of the irrigation system
Activity 2: Specify the approval flow and the persons to prepare and specify the documents regarding A-O&M of the irrigation system
Activity 3: Share the documents regarding A-O&M of the irrigation system

(5). Resources for implementation of soft component

The resources required for the activities in the soft components are mentioned below. The Japanese consultant will provide technical assistance directly to the counterpart personnel in this soft component.

・Japanese consultant (an expert in “A-O&M of irrigation facilities”, and a local interpreter)
・Nine staff members of the three units (Operation and Maintenance Unit, Extension Unit and Administration Unit) of Tha Ngon Irrigation Project Office
・A staff member of the Irrigation Division of PAFO (an observer)

(6). Implementation Schedule of Soft Component

It is preferable that this soft component plan is implemented using the facilities after renovation, in the irrigation period.

(7). Tangible outputs of the Soft Component

Table 2-13 shows the outputs of the Soft Component.

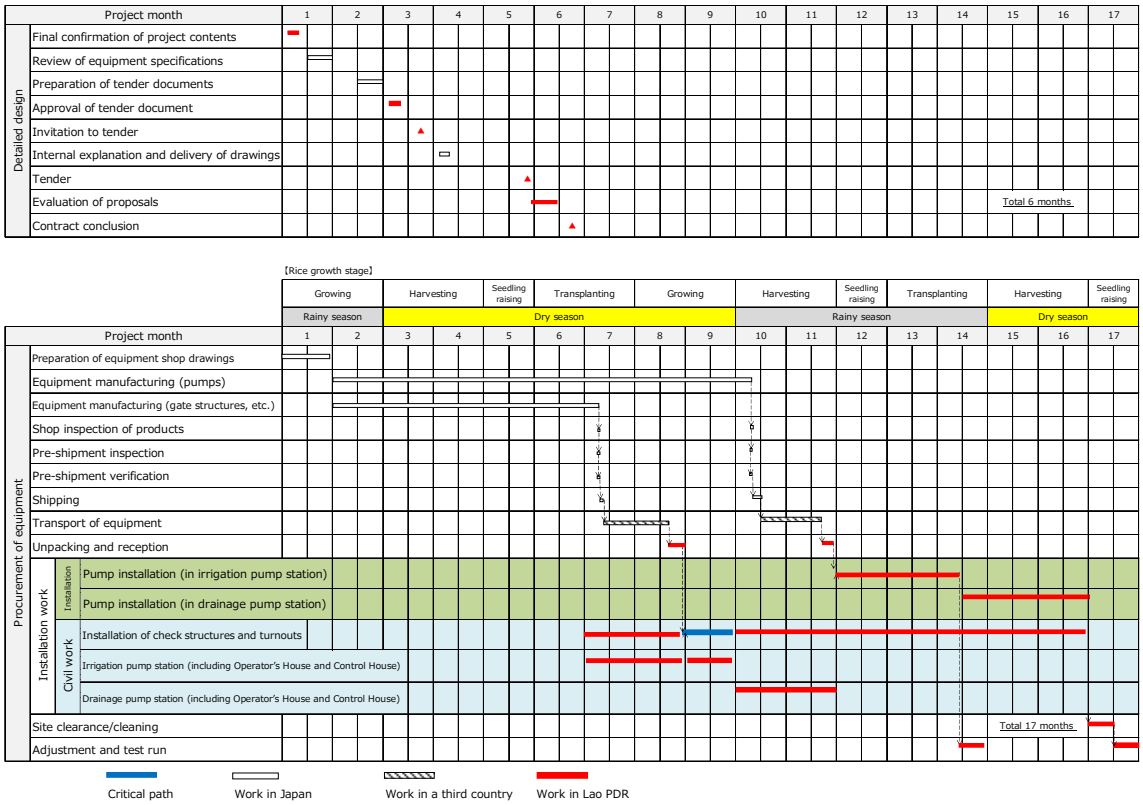
Table 2-13: Outputs of the Soft Component

Outputs	Deliverables
Output 1	Documents necessary for administration the irrigation system (land register, list of WUA members, financial information, minutes of meetings)
Output 2	Documents necessary for operation and maintenance of the irrigation system (pumps operation reports, records of facility maintenance, etc.)
Output 3	Approved list of documents necessary for A-O&M of the irrigation system
Completion of the soft component	Final report

2-2-4-9 Implementation Schedule

The Project commences in accordance with the scheme of the Japanese Grant Aid, when GOJ has approved the implementation of the Project and concluded an E/N on it with GOL. The Project will be composed of three following major stages: 1) detailed design stage; 2) tender stage (preparation of tender documents, invitation to tender, tender, evaluation of bid proposals and conclusion of a procurement contract); and 3) equipment procurement stage. Table 2-14 shows the Project implementation schedule.

Table 2-14: Project implementation schedule



2-3 Obligation of Recipient Country

2-3-1 Securement of commissions provided in the banking arrangement

On the implementation of the Project, DOI as the implementing agency (or any authority designated), should open an account named the GOL with a bank in Japan for the implementation of the Project in accordance with the B/A. When opening the account, DOI has to cover the cost of various fees such as the Advising commission of A/P and the payment commission for A/P. Therefore, DOI will have to secure the budget to pay the commissions stipulated in B/A as early as possible not to delay the various payments for the implementation of the Project.

2-3-2 Tax exemption procedure

The Project is to be implemented in accordance with the scheme of Japanese Grant Aid. The products procured and the service provided by Japanese nationals and nationals of third countries in the Project should be exempt from customs duty, domestic taxes and other financial levies. Equivalent costs for tax exemption will be treated as Non-cash transaction between the relevant agencies, however, the amount of money shall be prepared in a budget of the implementing agency as Counter Part fund. This means that DOI shall apply for next year's budget to MOF from February to April in the previous year and for these reasons, the relevant agencies have to share the information and move forward with the procedures.

2-3-3 Preparation (removal of fences and obstacles, etc. and levelling) and restoration to the original state of the temporary yard site

There will be no need to acquire a new site for construction in the Project because it is for the rehabilitation of the existing facilities. However, there will be a need for space for temporary storage of the equipment and materials required for the construction work. The temporary yard for the work in the irrigation pump station is planned to be established within its premises, fences in the planned yard site shall be removed before the work begins and the removed fences shall be re-installed at their original locations after the work has been completed. The temporary yard for the work in the drainage pump station is planned to be established on an unused lot next to the station. DOI shall make contact with the land-use-right holder of this lot as soon as possible and begin the negotiation on the compensation for the use of the lot.

Moreover DOI shall remove the existing sheds for operators in both Irrigation Pump Station and Drainage Pump Station because the new operator's houses will be built at the place which the existing ones are at present.

2-3-4 Development of access routes to the construction sites (removal of fences, etc.) and restoration to the original state of the access routes

It will be necessary to place construction machinery including a crane in the pump station for the rehabilitation of pump facilities in the Project. Although the access routes of the machinery to the premises of the pump stations are available, fences and trees on the premises shall be removed to move the machinery to the work sites.

2-3-5 Disposal of waste generated by removal of existing facilities

In the Project, the existing pump facilities and gate structures including turnouts will be removed and the removed facilities will be transported to a storage space. While the Japanese side will remove the facilities and transport the removed facilities to the storage space, DOI shall dispose of the waste.

2-3-6 Securing human resources involved in soft component activities

The soft component of the Project aiming at the capacity development in the operation and maintenance of irrigation facilities will be provided to the staff of Tha Ngon Irrigation Project Office. Therefore, DOI and PAFO shall secure human resources that can participate in the soft component activities of the Project and the budget required for their participation in the soft component.

2-3-7 Miscellaneous work

The Laotian side will also be responsible for the activities in the Project outlined in the following:

① Provision of the information and data required for the planning and implementation of the Project

② Quick unloading and customs clearance of materials and equipment at the port of unloading
③ Provision of assistance in the transport of equipment and materials and to the dispatched Japanese experts
④ Payment of all the costs required for the implementation of the Project which are not included in the grant aid assistance of GOJ
⑤ Attendance to the verification of the work and quality inspection of materials and equipment during the construction and installation work periods
⑥ Appropriate use and maintenance of the facilities constructed and the equipment procured with the grant provided by GOJ
⑦ Provision of a field office space and a temporary yard site free of charge

2-4 Project Operation Plan

2-4-1 Systems for Operation and Maintenance (O & M) of Irrigation Facilities

DOI and PAFO have been sharing the information of the operational condition of the irrigation facilities regularly at the meetings of the steering committee that they have jointly organized since the opening of Tha Ngon Farm. They mainly discuss the problems concerning the facilities that PAFO could not solve by itself in the meetings.

On the other hand, Tha Ngon Area Water User Association has been established under the IMT policy, but the operation and maintenance of the irrigation facilities is still carried out by the Tha Ngon Irrigation Project Office. However, the office does not maintain the secondary canals and the Lateral and Sub-Lateral canals. These are maintained by the farmers (Table 2-15). The current facility maintenance system is expected to be pursued for the time being after the completion of the Project.

Table 2-15: Organizations assuming the responsibility of maintenance for irrigation facilities

Facility	Maintenance organization	Remarks
Irrigation pumps	Tha Ngon Irrigation Project Office	-
North Main Canal (including the part irrigated by the floating pumps)	Tha Ngon Irrigation Project Office	・ Tha Ngon Irrigation Project Office operates the turnout gates. ・ WUA cleans the canal.
Secondary canals, Lateral and Sub-Lateral canals	WUA (irrigation water users)	-
Drainage canals	Tha Ngon Irrigation Project Office	-
Drainage pumps	Tha Ngon Irrigation Project Office	-
Floating pumps	Tha Ngon Irrigation Project Office	-
Farm roads	WUA (farmers)	・ Tha Ngon Irrigation Project Office leases the equipment.

Sound operation and management and measures for preventive maintenance are indispensable for

the use of the facilities with sufficient performance for a long period. Therefore, the performance of the facilities shall be monitored with the measurement of various numerical data after the completion of the Project following the manuals and other documents to be prepared in the soft component activities.

This monitoring will preferably be performed jointly by all the stakeholders including DOI, PAFO, Tha Ngon Irrigation Project Office and WUA. Such a monitoring system will be established by reorganizing the above-mentioned steering committee after completion of the rehabilitation work.

2-4-2 Operation and Maintenance Plan

All the stakeholders, including irrigation water users, shall operate and maintain the irrigation facilities in cooperation with each other using the organized information in the soft component.

In the existing system, Tha Ngon Irrigation Project Office takes the initiative in the cleaning and maintenance of the facilities and equipment in cooperation with the WUA. When repair work that will cost one million LAK or more is required, the Tha Ngon Irrigation Project Office files a petition for repair to PAFO. As it is mentioned above, the maintenance system already exists, and it shall be basically continued. However, improving routine cleaning and data management of the operational status of the pumps will be essential for appropriate operation and maintenance.

The pump operators usually record the operational status for maintenance but the records have not been shared and utilized for others. Therefore, a new system shall be composed that organizes the various existing data for utilizing basic information for operation and maintenance through the soft component.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

Under the assumption that this assistance project is implemented as a grant aid assistance project with the scopes of work of the Japanese and Laotian sides mentioned above, the costs of the Project to be borne by the two sides were estimated with the estimation conditions mentioned below. The estimates of the project cost are only approximate values and the cost estimated to be borne by GOJ does not represent the limit of grant stipulated in the E/N. The cost will be examined more in detail at the time when the practical execution of the Project is discussed.

2-5-1-1 Costs to be borne by the Lao side

Table 2-16 shows the costs estimated to be borne by the Lao side.

Table 2-16: Costs to be borne by the Lao side

Cost to be borne by the Laotian side 338,400,000LAK（4,703,760JPY）

Item	Amount (in LAK)	Amount (in JPY)
Waste disposal cost (concrete debris, surplus earth, etc.)	72,000,000	1,000,800
Preparation of the construction site (removal and re-installation of fences)	72,000,000	1,000,800
Lease of the temporary yard	36,000,000	500,400
Furniture purchase cost (beds and desks in the operator's houses)	14,400,000	200,160
Electrical work	72,000,000	1,000,800
Commissions associated with B/A (assumed)	72,000,000	1,000,800
Total	338,400,000	4,703,760

2-5-1-2 Estimation conditions

1). Reference point of estimation

The Project cost was estimated as of February 2017.

2). Foreign exchange rates

The Project cost was calculated using average in 3 months from 1st November 2016 to 31 January 2017.

USD/JPY: 1 USD = 113.97 JPY
LAK/JPY: 1 LAK = 0.0139 JPY

3). Project period

The procurement period is shown in Table 2-13: Project implementation schedule.

4). Miscellaneous matter

The approximate project cost was estimated in accordance with the conditions of the scheme of Japanese Grant Aid.

2-5-2 Operation and Maintenance Cost

2-5-2-1 Operating and Maintenance Cost

(1). Breakdown of the Operating and Maintenance Cost

In accordance with the Irrigation Law (enacted in 2012), the GOL operates and maintains facilities in the medium-scale irrigation systems (100 ha or larger) through PAFO by establishing Irrigation Offices. There is the Tha Ngon Irrigation Project Office established by the Irrigation Division of Vientiane Capital PAFO in the project area. The staff in the office maintains the irrigation system, clean the canal regularly and perform administrative site work including the payment of the electricity bills. The operating and maintenance cost, namely the pump operating cost (mainly the electricity cost); the labor cost of the user fee collectors; the cost of small-scale repairs and miscellaneous expenses; and the cost for the farm road maintenance are paid from the water user fee revenue. Other costs (the costs of expensive repairs and replacement of facilities) are paid by GOL and the Vientiane Capital City. This operation and maintenance policy is expected to be unchanged for the time being.

1). Revenue

Table 2-17 shows the projection of the water user fee revenue. The water user fees in the dry and rainy seasons are 470,000 LAK/ha and 236,000 LAK/ha, respectively, at present. The following conditions were used in the projection.

i. Water fee -Water user fees for the use of farmland (fees collected by WUA)

- Current water fee will not be changed.
- The farming area will not increase during the Project period. (The actual value in 2016 was used in the projection.)
- A percentage of the fee-collected area was calculated as “area for which the fee is collected”/“total farming area” × 100.
- The water fee revenue was projected for the 20-year period after the completion of the Project.

Table 2-17: Amount of user fees to be collected by WUA

Year	Farming area (ha: in the dry season)	Fee-collected area (ha: in the dry season)	Percentage of fee-collected area	Collected fees (Kip: in the dry season)	Farming area (ha: in the rainy season)	Fee-collected area (ha: in the rainy season)	Percentage of fee-collected area	Collected fees (Kip: in the rainy season)	Collected fees (Kip)
Actual figure in 2016	272	185.42	68%	87,309,600	427	217.72	51%	51,480,000	138,789,600
2017	272	185	68%	87,147,400	427	218	51%	51,381,900	138,529,300
2018	272	185	68%	87,147,400	427	218	51%	51,381,900	138,529,300
2019	272	185	68%	87,147,400	427	218	51%	51,381,900	138,529,300
2020	272	185	68%	87,147,400	427	218	51%	51,381,900	138,529,300
2021	312	213	68%	99,963,200	460	314	68%	74,004,400	173,967,600
2022	352	240	68%	112,779,000	500	341	68%	80,439,600	193,218,600
2023	392	267	68%	125,594,800	540	368	68%	86,874,700	212,469,500
2024	432	294	68%	138,410,600	580	395	68%	93,309,900	231,720,500
2025	472	322	68%	151,226,400	620	423	68%	99,745,100	250,971,500
2026	512	349	68%	164,042,200	640	436	68%	102,962,600	267,004,800
2027	552	376	68%	176,858,000	658	463	70%	109,169,400	286,027,400
2028	592	404	68%	189,673,800	658	489	74%	115,376,200	305,050,000
2029	632	431	68%	202,489,500	658	515	78%	121,583,000	324,072,500
2030	658	457	69%	214,850,500	658	541	82%	127,789,800	342,640,300
2031	658	483	73%	227,211,500	658	568	86%	133,996,600	361,208,100
2032	658	510	77%	239,572,500	658	594	90%	140,203,400	379,775,900
2033	658	536	81%	251,933,500	658	620	94%	146,410,200	398,343,700
2034	658	562	85%	264,294,500	658	647	98%	152,617,000	416,911,500
2035	658	589	89%	276,655,500	658	658	100%	155,288,000	431,943,500
2036	658	615	93%	289,016,500	658	658	100%	155,403,600	444,420,100
2037	658	641	97%	301,377,500	658	658	100%	155,403,600	456,781,100
2038	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600
2039	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600
2040	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600
2041	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600
2042	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600
2043	658	658	100%	309,260,000	658	658	100%	155,403,600	464,663,600

＊The use of the renovated irrigation system by the Project is assumed to begin in the dry season of 2021. The values for 2017 and later years are projections.

＊The dry season of each year actually begins in the previous year. For example, the year 2021 in the table consists of the 2020/21 dry season and the 2021 rainy season.

ii. Crop yield

Crop yield is 4.50 t/ha in the dry season and 4.76 t/ha in the rainy season respectively, and the price of unhulled rice is 2,500 LAK/kg according to past records. From these values, the total annual sales of the crops will be added to the revenue in accordance with the cropping area.

2). Expenditure – the amount required to be paid from the water fee revenue (the budget that the WUA should raise)

i. Pump operating cost (electricity charge)

The dedicated high-voltage power transmission lines of EDL have been extended to the irrigation pump station and drainage pump station. The new pumps will be operated with the power provided through these lines after the completion of the Project. It is necessary to calculate the annual operating hours of the pumps to estimate their operating costs. In this estimation, the season of the pump operation and the gross water requirement in each season is to be identified as the basic data for the estimation of their operating hours. Because the irrigation pump will not be operated in the rainy season, in principle,

only the pump operation in the dry season was considered in the estimation.

① Gross water requirement

Gross water requirement is estimated from the Daily water requirement rate and Duration of each growth stage as seen in Table 2-18 and loss rate is set as 40 %. Moreover, the water requirement is set as 200 mm during Ploughing and Irrigating growth stage based on the past report and the vertical infiltration in the reservoir from the result of the preparatory survey. In the estimation, the existing para-meter referred from the report "Feasibility Study on Agricultural, Rural Development Project in the Suburbs of Vientiane'' is used because the evaporation of the preparatory survey was measured in a simple way.

Table 2-18: Estimation of gross water requirements

Growth stage	Date			(A)	(1) (mm/day)	(2) (mm/day)	(1) - (2) (mm/day)	(3) (m^3/ha)	(4) (m^3/ha)	Note
Ploughing and Irrigating	12/15	~	1/7	24	15.53	0.00	15.53	3727.20	6212.00	Water requirement : 200mm
Rooting	1/8	~	1/16	9	12.20	0.00	12.20	1098.00	1830.00	Shallow flooding
Pre-Tillering	1/17	~	1/25	9	12.20	0.00	12.20	1098.00	1830.00	Shallow flooding
Tillering	1/26	~	2/3	9	7.20	0.00	7.20	648.00	1080.00	Wet duration
Midsummer drainage	2/4	~	2/8	5	0.00	0.00	0.00	0.00	0.00	Water outage
Maximum Tillering	2/9	~	2/13	5	3.60	0.00	3.60	180.00	300.00	Intermittent irrigation
Panicle formation	2/14	~	2/25	12	12.20	0.00	12.20	1464.00	2440.00	Wet duration
Booting	2/26	~	3/2	5	3.60	0.00	3.60	180.00	300.00	Intermittent irrigation
Meiosis	3/3	~	3/8	6	12.20	0.00	12.20	732.00	1220.00	Wet duration
Heading and Flowering	3/9	~	3/13	5	7.20	0.00	7.20	360.00	600.00	Wet duration
Dough-Ripening	3/14	~	4/3	21	3.60	6.00	0.00	0.00	0.00	Intermittent irrigation
Yellow-Ripening	4/4	~	4/8	5	0.00	6.00	0.00	0.00	0.00	Surface drainage
Maturity	4/9	~	4/13	5	0.00	6.00	0.00	0.00	0.00	Surface drainage
Total				120	-	-	-	9487.20	15812.00	

(A): Duration in days, (1): Daily water requirement rate, (2): Effective rainfall, (3): Net water requirement

(4): Goss water requirement

*Ploughing and irrigating: Add 200 mm / ha during a term in principle and add evaporation (4.2 mm / day) and vertical infiltration (3 mm / day)

*Wet duration：Evaporation + vertical infiltration

*Shallow flooding：Add 5mm/day to the total of evaporation and vertical infiltration

*Intermittent irrigation： 1/2 of Wet duration（3.6 mm / day）

② Irrigation efficiency and water consumption

The irrigation system in Tha Ngon Farm is designed with the irrigation efficiency of 60 %. However, the measurement of water leakage from the concrete parts of the North Main, Lateral and Sub-lateral Canals conducted in the field study confirmed the leakage of approx. 40 % of water from the canals. If the actual water conveyance efficiency (Ec) is assumed to have dropped from the design efficiency of 90 % to 60 %, the current irrigation efficiency is estimated at;

Irrigation efficiency (E) = 85 % (Ea) × 80 % (Eo) × 60 % (Ec)

≒40 %

Ea: water application efficiency

Eo: overall irrigation efficiency

The water consumption was projected with the irrigation efficiency of each year in future projected under the assumption that the irrigation efficiency at present was 40 % and that the irrigation efficiency would increase up to 90 % by 2030 with the repair of canals at the same rate as the increase in the irrigated area up to 658 ha in the same period (Table 2-19). Moreover, water source of 352ha, Farming area in the dry season is from Irrigation pump station.

Table 2-19: Irrigation efficiency and water consumption (in dry season)

Year	Farming area (in dry season: ha)			Irrigation efficiency E	Water consumption (m^3)		
	Total	Irrigation pump station	Floating pumps		Total	Irrigation pump station	Floating pumps
2016	---	---	---	---	---	---	---
2017	272	0.0	28.0	0.40	6,451,296	6,451,296	664,104
2018	272	272.0	28.0	0.40	6,451,296	6,451,296	664,104
2019	272	272.0	28.0	0.40	6,451,296	6,451,296	664,104
2020	272	272.0	28.0	0.40	6,451,296	6,451,296	664,104
2021	312	312.0	32.1	0.42	7,047,634	7,047,634	725,492
2022	352	352.0	36.2	0.44	7,589,760	7,589,760	781,299
2023	392	392.0	40.4	0.46	8,084,744	8,084,744	832,253
2024	432	432.0	44.5	0.48	8,538,480	8,538,480	878,961
2025	472	472.0	48.6	0.50	8,955,917	8,955,917	921,933
2026	512	512.0	52.7	0.52	9,341,243	9,341,243	961,599
2027	552	552.0	54.0	0.54	9,698,027	9,698,027	948,720
2028	592	592.0	54.0	0.56	10,029,326	10,029,326	914,837
2029	632	632.0	54.0	0.58	10,337,777	10,337,777	883,291
2030	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848

Year	Farming area (in dry season: ha)			Irrigation efficiency E	Water consumption (m^3)		
	Total	Irrigation pump station	Floating pumps		Total	Irrigation pump station	Floating pumps
2031	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2032	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2033	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2034	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2035	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2036	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2037	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2038	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2039	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2040	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2041	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2042	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848
2043	658	658.0	54.0	0.60	10,404,296	10,404,296	853,848

③ Power consumption

Table 2-20 shows the projected changes in the power consumption estimated from the water consumption projection mentioned above. Operation of two 32.4 m^3/min. pumps in the irrigation pump station and one 5.4 m^3/min floating pump was assumed in the projection of the operating hours of the pumps. The projection of power consumptions was conducted under the assumption that the two irrigation pumps consumed 155 kWh of power per hour and the one floating pump consumed 11 kWh of power per hour.

Table 2-20: Power consumption

Year	Pump operating hours (h)		Power consumption (kWh)	
	Irrigation pump station	Floating pump	Irrigation pump station	Floating pump
2016	---	---	---	---
2017	1,800	2,050	279,010	22,547
2018	1,800	2,050	279,010	22,547
2019	1,800	2,050	279,010	22,547
2020	1,800	2,050	279,010	22,547
2021	983	2,239	217,552	24,631
2022	1,059	2,411	234,287	26,526
2023	1,128	2,569	249,566	28,256
2024	1,191	2,713	263,572	29,841
2025	1,249	2,845	276,458	31,300
2026	1,303	2,968	288,353	32,647
2027	1,353	2,928	299,366	32,210
2028	1,399	2,824	309,593	31,059
2029	1,442	2,726	319,115	29,988
2030	1,452	2,635	321,168	28,989
2031	1,452	2,635	321,168	28,989
2032	1,452	2,635	321,168	28,989
2033	1,452	2,635	321,168	28,989
2034	1,452	2,635	321,168	28,989
2035	1,452	2,635	321,168	28,989
2036	1,452	2,635	321,168	28,989
2037	1,452	2,635	321,168	28,989
2038	1,452	2,635	321,168	28,989
2039	1,452	2,635	321,168	28,989
2040	1,452	2,635	321,168	28,989
2041	1,452	2,635	321,168	28,989
2042	1,452	2,635	321,168	28,989
2043	1,452	2,635	321,168	28,989

ii. Labor cost and user fee revenue

The labor cost of the pump operators will not be included in the cost estimation as employees of the Tha Ngon Irrigation Project Office are supposed to operate the pumps.

iii. Repair cost

The water user fee revenue is used for repair work that costs less than 10 million LAK.

iv. Farm road maintenance cost (excluding the labor cost of the grader operator)

The farm road maintenance cost consists of the operating cost of the motor grader (labor cost of the operator and fuel cost) and repair cost. The labor cost of the operator in the operating cost is technically paid by the Tha Ngon Irrigation Project Office. However, as the actual source for the payment of the labor cost was the water user fee revenue, it was included in the estimation. As the fuel cost of the grader was paid by a farmer who requested its service, the fuel cost was excluded from the estimation.

v. Pumps depreciation cost

The pumps depreciation cost will be included in the cost estimation.

2-5-2-2 Estimation of Revenue and Expenditure

Table 2-21 shows the projection of the revenue and expenditure of WUA on the items mentioned above. As precondition 50% of rice production will be sold and the rest of it will be consumed in the farmers producing rice.

Table 2-21: Projection of the revenue and expenditure (with the current water user fees)

Year	Revenue			Expenditure	Balance	
	Collected fees	Crop Yield	Total	Total	Annual balance	cumulative balance
Actual figure in 2016	138,790	---	---	---	---	---
2017	138,529	4,070,650	4,209,179	214,390	3,994,789	3,994,789
2018	138,529	4,070,650	4,209,179	214,390	3,994,789	7,989,578
2019	138,529	4,070,650	4,209,179	5,255,500	-1,046,321	6,943,257
2020	138,529	4,070,650	4,209,179	5,255,500	-1,046,321	5,896,936
2021	173,968	4,492,000	4,665,968	5,284,911	-618,944	5,277,993
2022	193,219	4,955,000	5,148,219	5,301,280	-153,062	5,124,931
2023	212,470	5,418,000	5,630,470	5,316,812	313,657	5,438,588
2024	231,721	5,881,000	6,112,721	5,331,611	781,109	6,219,698
2025	250,972	6,344,000	6,594,972	5,345,765	1,249,206	7,468,904
2026	267,005	6,688,000	6,955,005	317,112	6,637,892	14,106,796
2027	286,027	7,020,100	7,306,127	329,238	6,976,889	21,083,686
2028	305,050	7,245,100	7,550,150	340,589	7,209,561	28,293,247
2029	324,073	7,470,100	7,794,173	351,616	7,442,557	35,735,804
2030	342,640	7,616,350	7,958,990	358,659	7,600,331	43,336,135
2031	361,208	7,616,350	7,977,558	365,158	7,612,400	50,948,535
2032	379,776	7,616,350	7,996,126	371,657	7,624,469	58,573,005
2033	398,344	7,616,350	8,014,694	378,155	7,636,538	66,209,543

Year	Revenue			Expenditure	Balance	
	Collected fees	Crop Yield	Total	Total	Annual balance	cumulative balance
2034	416,912	7,616,350	8,033,262	384,654	7,648,608	73,858,151
2035	431,944	7,616,350	8,048,294	389,915	7,658,378	81,516,529
2036	444,420	7,616,350	8,060,770	394,282	7,666,488	89,183,017
2037	456,781	7,616,350	8,073,131	398,608	7,674,523	96,857,540
2038	464,664	7,616,350	8,081,014	401,367	7,679,646	104,537,186
2039	464,664	7,616,350	8,081,014	401,367	7,679,646	112,216,833
2040	464,664	7,616,350	8,081,014	401,367	7,679,646	119,896,479
2041	464,664	7,616,350	8,081,014	401,367	7,679,646	127,576,125
2042	464,664	7,616,350	8,081,014	401,367	7,679,646	135,255,772
2043	464,664	7,616,350	8,081,014	401,367	7,679,646	142,935,418

Unit: In 1,000LAK

Chapter 3 Project Evaluation

3-1 Preconditions for the Project Implementation

For the smooth implementation of the Project, pre-conditions to be corresponded by the Laotian side are shown in Table 3-1 and Table 3-2. It is important that these are conducted properly and timely by the Laotian side.

Table 3-1: Pre-conditions for the Project implementation (before the tender)

Pre-condition	Implementation deadline
To open a bank account (B/A).	Within 1 month after signing of G/A
To issue Authorization to Pay (A/P) for the payment to the consultant through the bank in Japan (the Agent Bank).	Within 1 month after signing of the contract
To bear bank commission for services of the Agent Bank including authorization of payment and other relevant ones.	Within 1 month after verification of contract of JICA
To secure prompt issuance of visa and relevant permissions to the consultant.	As needed
To prepare and submit Master List of equipment to be procured to relevant authorities of Laos for prompt processing exemption from tax, duty and other relevant levies.	Up to 2 weeks before the procurement equipment arrival at the port from Japan or third country
To secure land for the implementation of the Project.	Before notice of the Tender document
To obtain planning, zoning and building permits including demolition and removal of existing buildings for the implementation of the Project.	Same as above
To clear, level and reclaim the sites for the implementation of the Project.	Same as above
To secure supply of necessary utilities for the implementation of the Project including electricity for the relevant pump stations.	Same as above
To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	With 1 month after signing of G/A
To renew irrigation water distribution plans in cooperation with a relevant water users' association.	Before preparing Tender documents
To submit Project Monitoring Report (with the result of Detail Design).	Same as above
To coordinate with relevant authorities, acquires necessary budget to cover VAT portion for fiscal year 2019	Before Tender (February 2018)

Table 3-2: Pre-conditions for the Project implementation (during the project implementation period)

Pre-condition	Implementation deadline
To issue A/P to the bank in Japan (the Agent Bank) for the payment to the Suppliers.	Within 1 month after the signing of the contract(s)
To bear the following commissions of the bank in Japan for the banking services based upon the B/A.	
1) Advising commission of A/P.	Within 1 month after the signing of the contract(s)
2) Payment commission for A/P.	Every payment
To ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and to assist the Supplier with internal transportation therein.	During the Project
To secure entry into Laos and to accord with Japanese nationals and/or physical persons of third countries (contractors and/or suppliers) whose services may be required in connection with the supply of the products and the services under verified contracts	Same as above
To ensure those customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services are exempted or borne by its designated authority without using the Grant.	Same as above
To bear all the expenses necessary for the implementation of the Project, other than those covered by the Grant.	Same as above
To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over and installation.	Within 1 month after completion of each work
To submit a report concerning completion of the Project.	Within 6 months after completion of the Project
To take necessary measures for safety construction. -Traffic control -Rope off	During the Project
To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	During the Project
To dispose soil, crashed concrete and removed equipment generated by the Project	During the Project
To dispose existing electricity materials such as transformers, voltage and current transformers and cables, etc.	During the Project

3-2 Necessary Inputs by the Recipient Country

3-2-1 Continuation of assistance to Tha Ngon Irrigation Office from DOI and PAFO

Tha Ngon Farm has a steering committee co-chaired by the directors of DOI and PAFO for 40 years since the operation of the irrigation system began. The committee has regular meetings, twice a year in principle, and other meetings are also held when it is necessary. However, to sustain, operate and maintain the rehabilitated irrigation after the Project, daily management, planning and implementation of appropriate maintenance plan, and continuous monitoring are necessary. In addition, appropriate amounts of fees (water user fees) should be charged to and collected from water users and the revenue from the fees should be spent appropriately.

Documents and data required for the O&M of the irrigation system will be collected and organized according to the planned soft component. However, the continuous support of the DOI and PAFO is important for the Tha Ngon Irrigation Office to carry out the sustainable activities.

3-2-2 Assistance in strengthening WUA and organizing irrigation water users

Groups of the irrigation water users in some water supply systems were formed in January 2016 as a result of JICA partnership project “Participatory Irrigation System and Irrigated Agriculture Technique Promotion Project”. In other water supply systems, the members of WUA are not keen on its activities and WUA, as an organization, is not engaged in daily management of irrigation facilities, although the water irrigation fee collectors are appointed.

The Tha Ngon Irrigation Office collectively calls the farmers who have concluded a contract on the use of the irrigation water with the office the WUA. On the other hand, there are farmers who use the water only paying the water user fees without concluding a contract with the office. These farmers do not have to follow the rules of WUA and, therefore, they have no obligation to cooperate or participate in the maintenance of the irrigation facilities.

As mentioned above, the irrigation water users do not contribute to the maintenance of the irrigation facilities. As the active participation of the users is indispensable for appropriate maintenance of facilities, it will be important to take measures to strengthen the functions of WUA and organize irrigation water users.

3-3 Important Assumptions

Important assumptions for the implementation of the Project are as follows:

- The policy of GOL on the rehabilitation and development of the irrigation system will remain unchanged,
- The policy that DOI and the Tha Ngon Irrigation Office shall provide technical assistance to Tha Ngon Farm will remain unchanged.

3-4 Project Evaluation

3-4-1 Relevance

The implementation of the Project by the Japanese Government's grant aid is considered to be appropriate for the following reasons:

- GOL intends to increase food production and production of commercial crops by improving the existing irrigation system in the country for the development of rural areas and poverty reduction. The Project is consistent with this intention of GOL,

- GOL also intends to make the Project area a model area for the development of modern irrigated agriculture. The implementation of the Project will contribute to the creation of the model area,

- According to the Country Assistance Policy for Lao PDR of GOJ, which was formulated in 2012, the "Agricultural Development and Forest Conservation" is one of the four priority fields of this policy, and "to increase productivity with irrigated agriculture" is a pillar in this priority field.

- The degradation of the pump facilities is a limiting factor on rice farming in the dry season because it has reduced the irrigable area and made it difficult to grow rice in some paddies in the dry season. The implementation of the Project will contribute greatly to the improvement of the agricultural productivity by realizing reliable and equitable supply of irrigation water,

- DOI, the implementing agency of the Project; and the Vientiane Capital PAFO, operation and maintenance organization of irrigation facilities; and DAFO and Tha Ngon Irrigation Project Office, under PAFO, have 40 years of experience in operating and maintaining the Tha Ngon Irrigation System; therefore, it is expected that these organizations will be able to operate and maintain the system continuously in future, and

- The rehabilitation of the irrigation system in the Project has a large public interest; therefore it is consistent with the scheme of the grant aid assistance of GOJ.

3-4-2 Effectiveness

3-4-2-1 Quantitative impacts

Table 3-3 shows the quantitative effects expected from the implementation of the Project.

Table 3-3: Quantitative effects of the implementation of the Project

Indicator	Reference value (value measured in 2017)	Target value (2022) [three years after the completion of the Project]
Irrigated area	272 ha (in the dry season)	400 ha (in the dry season)
Discharge flowrate of irrigation pumps	59,447 m^3/day	93,312 m^3/day
Rice yield (in the dry season)	1,224 tons	2,404 tons
Energy cost（Energy consumption per amount of pumped water amount） (kWh/ m^3)	0.045kWh/ m^3	0.032kWh/ m^3

The projected values in the table above are obtained as detailed below.

(1). Irrigated area

- As 272 ha of paddies were irrigated and used for rice farming in the dry season of 2017, this figure was used as the reference value.
- The target value in 2022 was set with reference to the past record.

(2). Discharge flowrate of the irrigation pumps

The reference and target discharge flowrates of the irrigation pumps were calculated as follows.

Flowrate in 2017 (reference): 47.18 m^3/min. (the flowrate measured in the headrace: 1 unit) × 60 min. × 21 hrs. /day = 59,447 m^3/day

Flowrate in 2022 (target): 64.8 m^3/min. (2 units) × 60 min. × 24hrs. /day = 93,312 m^3/day

Moreover,

· 47.18 m^3 / min is the measured Flowrate (single pump operation)

· 64.8 m^3 / min is the planned discharge when operating two pumps

i. Rice yields

Yield in 2017 (reference): 4.5 tons/ha × 272 ha = 1,224 tons

Yield in 2022 (target): 5.63 tons/ha × 400 ha = 2,404ons

Moreover,

- 4.5 tons/ha is the average rice yield per hectare in Tha Ngon Area in 2014/15 and
- 5.63 tons/ha is the average rice yield per hectare in Xaithany District in 2014/15
- 427 ha is the most recent irrigated area for rainy season in 2016.

ii. Yield Cost (energy consumption per pumped amount)

2017 (Reference): 279,010 kWh / 6, 195, 004 m^3 = 0.045 kWh / m^3

2022 (Target): 234, 287 kWh / 7,288, 240 m^3 = 0.032 kWh / m^3

Moreover,

- 279,010 kWh (kW per hour) is the amount of power consumption to irrigate 272 ha, i.e. actual payment for power usage divided by the theoretical unit-cost of power.
- 6,195,004 m^3 is the necessary amount of pumped water (calculated value) to irrigate 272 ha
- 234,287 kWh is the amount of power consumption to irrigate 352 ha, i.e. actual payment for power usage divided by the theoretical unit-cost of power.
- 7,288,240 m^3 is the necessary amount of pumped water (calculated value) to irrigate 352 ha

The irrigable area of 352 ha, is the current irrigable area in the dry season (272 ha) and the planned irrigable area (80 ha) to be increased through repairing the irrigation pumps and the floating pumps. (the above-mentioned target irrigable area 400 ha and the actual irrigable area 427 ha include the water sources for farming , such as dams, apart of pumps to be repaired).

3-4-2-2 Qualitative effects

The qualitative effects expected from the implementation of the Project are as follows:

- Farmers will have a sense of security from guaranteed irrigation water in the necessary period and will be motivated to produce more.

- Farmers will transform their farming to become more profitable with surplus production and their livelihood will be improved.

Based on the above contents, the relevance of the implementation of the Project is high and can be expected to be effective.

3-5 Recommendations on Future Cooperation

After the completion of the Project, the agricultural productivity is expected to increase and the agricultural production base, on which intensive agriculture can develop, will be established. As future activities of the national plan, the irrigation facilities are planned to be operated, maintained and managed by WUA, under the IMT Policy. Moreover, PAFO, DAFO and the Tha Ngon Irrigation Office will provide technical support in farming to WUA. However, the irrigation facilities in Tha Ngon Farm are practically operated and maintained by the Tha Ngon Irrigation Office and WUA only functions as a user fee collecting organization.

WUAs are formed in each branch line of irrigation system but there is not any organization to unify these groups. Thus, the connection of each group is fragile and capability of operation and maintenance is lacking.

Furthermore, some problems are seen regarding the area and with skills in farming (e.g. lack of basic skills in irrigated agriculture, failure to follow the instruction on fertilizer application, and poor

conditions for mechanization). Other problems are socio-economic problems (e.g. low morale in farming, crop market practices unfavorable to producers and the shortage of labor force due to the aging of the population). These problems are related and a comprehensive perspective is necessary to resolve the problems.

In order to tackle these problems, the Japan side shall lead to create a large movement for the improvement of the situation, actively motivating not only the local community, irrigation water users and WUA but also DOI, Tha Ngon Irrigation Office and its senior sector, PAFO and DAFO as targets of the Project. This can be done through some measures such as dispatching JICA-long-term experts (advisors and/or follow-up experts) in the related areas and JOCV (Japan Overseas Cooperation Volunteers).

It will be preferable to formulate a plan to facilitate the use of Tha Ngon Irrigation System based on a consensus among the stakeholders and to provide assistance at the project site in parallel with the above plan. If the issues are resolved, it will be due to synergetic effects, and the assistance of the Project will be very effective. It will be possible to study the contents of the assistance, time of its implementation and types of inputs to be made by conducting a “cost-efficiency analysis” and other surveys and determine the feasibility of the assistance based on the results of these surveys.

The three areas below are expected to be the spheres of such assistance. As these areas are closely interrelated, the assistance is expected to be provided as multipurpose assistance. The assistance will contribute to the improvement of sustainability of the operation and maintenance of the Tha Ngon Irrigation System by increasing the number of farmers earning sufficient income from farming.

A) Technical guidance in irrigated agriculture (use of appropriate technology, guidance in the operation and management of irrigation facilities and promotion of mechanization)
B) Assistance in transition to market-oriented agriculture (commercial crop production, promotion of value-addition, etc.)
C) Organizational strengthening of WUA (including the strengthening of the functions of the association and establishment of farmers’ groups and cooperatives.)

A) Technical guidance in irrigated agriculture (use of appropriate technology, guidance in the operation and management of irrigation facilities and promotion of mechanization)

[Background of the assistance]

Although irrigated farming using the irrigation facilities has been practiced in the dry season for decades, it has not been practiced optimally because of the lack of understanding of the basic technology used for water management in accordance with the growth stages, repair of the irrigation facilities and irrigation and drainage management. Therefore, the irrigation and drainage systems are not used effectively and productivity remains low.

[Assistance strategy]

Foundation for the development of the area will be established by providing farmers with an

opportunity to learn basic irrigated agriculture technology.

In practice, demonstration and experimental farm shall be established in the project area, and then training on the basic technology for the maintenance of agricultural irrigation system, (e.g. the practice of the irrigation and drainage water management and activities for the maintenance (repair and overhaul) of the irrigation facilities) will be provided.

Awareness creation activities will also be implemented to create a sense of ownership of the irrigation system in the water users and to facilitate the use of the irrigation system.

B) Assistance in transition to market-oriented agriculture (commercial crop production, promotion of value-addition, etc.)

[Background of the assistance]

While glutinous rice is the staple food in Lao PDR, ordinary rice is the staple food in the neighboring countries and the demand for ordinary rice even in Lao PDR is on the increase. Therefore, it will be possible to produce ordinary rice commercially, if a reliable market of the rice is found. Farmers will be able to increase their income, even in small cultivated areas, if a system has been established that allows farmers to sell cash crops they have grown, excluding rice

[Assistance strategy]

It will be necessary to establish a system to study and analyze the marketability, profitability and possibility of growing new crops and provide extension services to farmers on the cultivation of the crops selected in the study and analysis for market. A study will also be conducted on ways to increase added value to the area through cash crops.

C) Organizational strengthening (including capacity building of WUA and establishment of farmers' groups and cooperatives.)

[Background of the assistance]

The activities to well-organize farmers' groups are on the increase as exemplified by the following: the establishment of WUAs in certain parts of the irrigation system in the project under "JICA Partnership Program"; the promotion of the activities of the "Agriculture Mechanization Promotion Committee"; and the establishment of agricultural production groups led by DAFO, which supervises the farming activities in the project area. Establishment of well-organized farmers' groups is expected to create a foundation for stable production, including a system to reduce production cost with group purchase and outsourcing of farm work, and improve the livelihood of small-scale farmers. However, the current WUA, which has been in existence since Tha Ngon Farm opened, in reality, functions only to collect water fees.

Although well-organized farmers' groups will be required, the existing WUA has not been able to implement activities on its own initiative (by farmer members) and its sustainability cannot be maintained without assistance from the administration.

[Assistance strategy]

Assistance will be provided after the farmers' groups to be established have been identified and a scheme to assist creation of such groups has been established in the administration. Such assistance shall include measures to create a sense of ownership of the irrigation system in the farmers and ensure sustainability of the groups.

【Appendices】

1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussion
5. Soft Component Plan
6. Other Relevant Data
7. References

Appendix 1
Member List of the Study Team

Appendix 1 Member List of the Study Team

	Name	Designation	Affiliation
1	Nobuo SAMBE (Mr)	Team leader	Japan International Cooperation Agency (JICA) Senior Advisor
2	Hajime NABETA (Mr)	Cooperation Planning-1	Japan International Cooperation Agency (JICA) Senior Assistant Director Team 4 Agricultural and Rural Development Group 2 Rural Development Department
3	Tomohiro TERAMINAMI (Mr)	Cooperation Planning-2	Japan International Cooperation Agency (JICA) Associate Expert Team 4 Agricultural and Rural Development Group 2 Rural Development Department
4	Daisuke NAKAJIMA (Mr)	Chief Consultant / Improvement Ground Works for Agricultural Productivity	Kokusai Kogyo Co., Ltd.
5	Kenji SHINODA (Mr)	Improvement Pump / Control Panel and Instrumentation	Kokusai Kogyo Co., Ltd.
6	Shinichi OGAWA (Mr)	Water usage planning / Design / Environmental and Social Considerations	Kokusai Kogyo Co., Ltd.
7	Chizuru SUGIHARA (Ms)	Procurement Planning / Cost Estimation	Kokusai Kogyo Co., Ltd.

Appendix 2
Study Schedule

Appendix 2 Study Schedule

2-1 The First Field Survey

The First Field Survey Schedule: 9 January 2017 to 20 February 2017

		JICA			Consultant			
		Leader	Cooperation Planning-1	Cooperation Planning-2	Chief Consultant / Improvement Ground Works for Agricultural Productivity	Improvement Pump / Control Panel and Instrumentation	Water usage planning / Design / Environmental and Social Considerations	Procurement Planning / Cost Estimation
		Nobuo Sambe	Hajime Nabeta	Tomohiro Teraminami	Daisuke Nakajima	Kenji Shinoda	Shinichi Ogawa	Chizuru Sugihara
Date	Day	Agenda						
9-Jan	Mon	Dept. Jakarta						
10-Jan	Tue	Arriv. VTE	Dept. Japan, Arriv. VTE				Dept. Japan, Arriv. VTE	
		Courtesy call (JICA, EOJ)					Courtesy call (JICA, EOJ)	
11-Jan	Wed	Courtesy call (MAF-DOI, MAF-DOPC, MoPI) M/D and IC-R discussion (MAF-DOI)					Courtesy call (MAF-DOI, MAF-DOPC, MoPI), M/D and IC-R discussion (MAF-DOI)	
12-Jan	Thu	Courtesy call (Tha Ngon Irrigation Project Office) Field survey					Courtesy call (Tha Ngon Irrigation Project Office) / Field survey	
13-Jan	Fri	Field survey M/D discussion (MAF-DOI)					Field survey / M/D discussion (MAF-DOI)	
14-Jan	Sat	Internal meeting, documentation					Internal meeting, documentation	
15-Jan	Sun	Internal meeting, documentation					Internal meeting, documentation	
16-Jan	Mon	M/D discussion (MAF-DOI) M/D signing					Field survey	
17-Jan	Tue	JICA Office report					Field survey (facilities)	
		Dept. VTE, Arriv. Jakarta	Discussion with DOI / Documentation	Dept. VTE	Discussion with MAF-DOI			
18-Jan	Wed		Documentation / Field survey	Arriv. Japan	Discussion with MAF-DOI / Data collection		Field survey (facilities)	Dept. Japan, Arriv. VTE
			Dept. VTE					
19-Jan	Thu		Arriv. Japan		Data collection (Tha Ngon Irrigation Project Office)		Field survey (facilities)	Field survey / Data collection (procurement planning)
20-Jan	Fri				Discussion with MAF-DOI / Data collection (National plans)		Field survey (facilities)	Field survey / Data collection (procurement planning)
21-Jan	Sat				Documentation	Dept. Japan, Arriv. VTE	Documentation	Documentation
22-Jan	Sun				Internal meeting			
23-Jan	Mon				Discussion with MAF-DOI / Field survey (facilities)	Discussion with MAF-DOI / Field survey (facilities)	Discussion with MAF-DOI / Data collection (IEE / EIA)	Data collection (procurement planning)
24-Jan	Tue				Data collection (National plans)	Field survey (facilities)	Field survey (facilities)	Data collection (procurement planning)
25-Jan	Wed				Discussion with MAF-DOI / Data collection (Other donors' projects)	Field survey (facilities)	Field survey (facilities)	Data collection (procurement planning)
26-Jan	Thu				Data collection(PAFO) / documentation	Data collection (Tax, EDL)	Data collection (MONRE-DMH)	Data collection (Tax, EDL)
27-Jan	Fri				Data collection (Organizations, staff, budget, etc. of DOI, PAFO, WUA, etc.)	Field survey (facilities)	Field survey (facilities)	Data collection (procurement planning)
28-Jan	Sat				Documentation			
29-Jan	Sun				Documentation			

VTE: Vientiane (Laos)
EOJ: Embassy of Japan

		JICA			Consultant			
		Leader	Cooperation Planning-1	Cooperation Planning-2	Chief Consultant / Improvement Ground Works for Agricultural Productivity	Improvement Pump / Control Panel and Instrumentation	Water usage planning / Design / Environmental and Social Considerations	Procurement Planning / Cost Estimation
		Nobuo Sambe	Hajime Nabeta	Tomohiro Teraminami	Daisuke Nakajima	Kenji Shinoda	Shinichi Ogawa	Chizuru Sugihara
Date	Day	Agenda						
30-Jan	Mon				Data collection (Organizations, staff, budget, etc. of DOI, PAFO, WUA, etc.)	Field survey (pump facilities)	Preparation for field survey (canal flow, leveling, etc.)	Data collection (procurement planning)
31-Jan	Tue				Field survey (canal flow)	Field survey (canal flow)	Field survey (canal flow)	Field survey (canal flow)
1-Feb	Wed				Field survey (roads)	Field survey (leveling)	Field survey (canal flow)	Field survey (leveling)
2-Feb	Thu				Data collection (WUA, Tha Ngon Office)	Field survey (leveling)	Field survey (canal flow)	Field survey (leveling)
3-Feb	Fri				Data collection (Tha Ngon Office)	Field survey (leveling)	Field survey (canal flow)	Field survey (leveling)
4-Feb	Sat				Field survey (canal flow, turn out)			
5-Feb	Sun				Documentation			
6-Feb	Mon				Discussion with MAF-DOI / Data collection (National plans)	Field survey (pump facilities)	Field survey (irrigation area)	Data collection (procurement planning)
7-Feb	Tue				Discussion with MAF-DOI (mejor undertakings)	Field survey (pump facilities)	Field survey (irrigation area)	Data collection (procurement planning)
8-Feb	Wed				Discussion with MAF-DOI / Data collecting for Soft Component	Data collection (procurement planning)	Data collection (procurement planning)	Data collection (cost estimation)
9-Feb	Thu				Data collecting (Tha Ngon Office, farmers, agribusiness firm)	Documentation	Data collection (procurement planning)	Data collection (cost estimation)
10-Feb	Fri				Reporting (JICA / EOJ)	Reporting (JICA / EOJ)	Data collection (procurement planning)	Data collection (cost estimation)
11-Feb	Sat				Field survey (turn out, drainage pump)			
12-Feb	Sun				Field survey (canal flow) / documentation			
13-Feb	Mon				Data collecting (O&M)	Draft design (facilities)	Data collection (procurement planning)	Data collection (cost estimation)
14-Feb	Tue				Data collecting (Tha Ngon office)	Draft design (facilities)	Data collection (procurement planning)	Data collection (cost estimation)
15-Feb	Wed				Discussion with MAF-DOI (mejor undertakings)	Field survey (secondary canals)	Field survey (secondary canals)	Data collection (cost estimation)
16-Feb	Thu				Data collection(PAFO)	Draft design (facilities)	Draft design (facilities)	Data collection (cost estimation)
17-Feb	Fri				Discussion with MAF-DOI / documentation	Draft design (facilities)	Draft design (facilities)	Data collection (cost estimation)
18-Feb	Sat				Documentation			
19-Feb	Sun				Dep. VTE			
20-Feb	Mon				Arriv. Japan			

2-2 The Second Field Survey

The Second Field Survey Schedule: 1 August 2017 to 12 August 2017

		JICA			Consultant		
		Leader	Cooperation Planning-1	Cooperation Planning-2	Chief Consultant / Improvement Ground Works for Agricultural Productivity	Improvement Pump / Control Panel and Instrumentation	Procurement Planning / Cost Estimation
		Nobuo Sambe	Hajime Nabeta	Tomohiro Teraminami	Daisuke Nakajima	Kenji Shinoda	Chizuru Sugihara
Date	Day	Agenda					
1-Aug	Tue					Dept. Japan, Arriv. VTE	
2-Aug	Wed					Data collection (EDL, MONRE)	
						Filed survey / Data collection (meteorological data)	
3-Aug	Thu					Data collection (Organizations, staff, budget, etc. of PAFO and DAFO)	
4-Aug	Fri					Pre-explanation of Draft Report (MAF-DOI)	
5-Aug	Sat					Data collection (tax exemption)	
6-Aug	Sun	E				Documentation	Dept. Japan, Arriv. VTE
7-Aug	Mon	Internal meeting, documentation Courtesy call (JICA, EOJ) Explanation of Draft Report, Discussion of M/D and Major undertakings (MAF-DOI, MAF-DOPC)					
8-Aug	Tue	Explanation of Draft Report, Discussion of M/D and Major undertakings (MAF-DOI, MAF-DOPC) Courtesy call (MoPI-DOIC) Discussion for Tax exemption (MOF-DTD, MoPI－DOIC, MAF-DOI)					
9-Aug	Wed	Discussion with Tha Ngon Irrigation Project Office for work-shop about O&M by WUA				Data collection (Organizations, staff, budget, etc. of PAFO and DAFO)	
		Work-shop about O&M by WUA					
10-Aug	Thu	Discussion of M/D (MAF-DOI)				Data collection (Other donors' projects, Organizations, staff, budget, etc. of VTE)	
		Reporting (EOJ)					
11-Aug	Fri	M/D Singing Dep. VTE					
12-Aug	Sat	Arri. Japan					

VTE: Vientiane (Laos)
EOJ: Embassy of Japan

Appendix 3
List of Parties Concerned in the Recipient Country

Appendix 3 List of Parties Concerned in the Recipient Country

The Government of Lao PDR

（1） Department of Irrigation, Ministry of Agriculture and Forestry

Mr. Maykong PHONEPHOMMAVONG	Director General
Mr. Nouanedeng RAJVONG	Deputy Director General
Mr. Somphone THANASACK	Deputy Director General
Mr. Pasonexay INSISIENGMAY	Director of Planning and Cooperation Division
Mr. Khamhou PHATHAVONG	Deputy Director of Planning and Cooperation Division
Mr. Phommy INTHICHACK	Director of International Cooperation Division
Mr. Soulivanh VORAVONG	Deputy Head of International Cooperation Division
Mr. Bouakeo DOUANGPASEUTH	Director of Irrigation Survey and Design Center
Mr. Phouthone SIRIPHANTHONG	Deputy Director of Operation and Maintenance Division
Mr. Thanongsack CHATHALA	Technical Officer of Operation and Maintenance Division

（2） Department of Planning and Cooperation, Ministry of Agriculture and Forestry

Ms. Chindavone PHORPIDA	Technical Officer

（3） Department of International Cooperation, Ministry of Planning and Investment

Ms. Sisomboun OUNAVONG	Director General
Mr. Sysomphorn PHETDAOHEUANG	Deputy Director General
Mr. Kouthong SOMMALA	Director of Asia-Pacific and Africa Division
Mr. Somekhit KAOYAHOUANG	Department of International Cooperation

（4） Provincial Agriculture and Forestry Office (PAFO), Vientiane Capital

Mr. Linkham DOUANGSAVANH	Director General
Mr. Saykham PHENGKHAMMY	Head of Irrigation Division
Mr. Bounthanom THOUMMAVONG	Deputy Head of Irrigation Division
Mr. Khamphouth SOUDAVANH	Deputy Head of Irrigation Division
Mr. Sengmouong SICTSIVORSAN	Head of Technical of Irrigation Division

（5）District Agriculture and Forestry Office (DAFO), Xaithany District

Mr. Thongsouk BOUALIKHANH	Chief of Xaithany District Office for the Agriculture and Forestry

（6）Tha Ngon Irrigation Project Office, Department of Agriculture and Forestry, Vientiane Capital

Mr. Paksavant SYLOVAM	Director General
Mr. Soukanh PHIMMASONE	Deputy Director（Operation and Maintenance Unit）
Mr. Sitixay SOUDAVONE	Deputy Director（Promotion Unit）
Mr. Vantho CHANNGAKHAM	Deputy Director（Administration Unit）
Mr. Aonphone SIVONGXAY	Staff（Operation and Maintenance Unit）
Mr. Udomsap RADSAWAN	Staff（Promotion Unit）

（7）Water Users Association, Tha Ngon Irrigation Project

Ms. Khamsone KEDPHILA	Head of Canal No.8
Mr. Pheung KNOUNPHON	Head of Canal No.9, 10, 11, 12, 13, 14, 15
Mr. Somkhit SENGKHANYONG	Head of Canal No.6, 7-1, 7-2
Mr. Bounchan LEVANGLIT	Water User (Thasommor Village Chief)

（8）Department of Customs, Ministry of Finance

Mr. Canda SINPASEUTH	Technical officer of Customs Clearance and Formality Division
Mr. Panemalay LUANGSOUVANH	Technical officer

（9）Department of External Finance, Loan and Grant Management Division, Ministry of Finance

Mr. Angkhansada Mouangkham	Deputy Director General
Mr. Bounpaseuth SISOUVANH	Deputy Director

（10）Department of Meteorology and Hydrology, Ministry of Natural Resources and Environment

Mr. Khanmany KHOUNPHONH	Director General

（11）Hydrological Division, Department of Meteorology and Hydrology, Ministry of Natural Resources and Environment

Mr. Somphanh VITHAYA	Deputy Chief

（12）Finance's Department, Vientiane Capital

Mr. Khamphan Malabandith	Director

（13）Électricité du Laos (EDL)

Mr. Vongsa NANTHAVONG	Deputy Director, Power Distribution Department of Vientiane Capital,
Mr. Khamsavanb PHAVONG	Deputy Manager of Billing Division office

Embassy of Japan in the Lao PDR

Mr. Kentaro NAKAJIMA	Second Secretary

JICA Laos Office

Mr. Yusuke MURAKAMI	Former Chief Representative
Mr. Yoshiharu YONEYAMA	Chief Representative
Ms. Saeda MAKIMOTO	Senior Representative
Mr. Shuhei TERADA	Former Representative (Agriculture and Rural Development)
Mr. Yutaka MACHIDA	Representative (Agriculture and Rural Development)
Mr. Viengsavanh SISOMBATH	Program Officer

Appendix 4
Minutes of Discussions

Appendix 4 Minutes of Discussions

4-1 Minutes of Discussion (16 January 2017)

Minutes of Discussions
on
The Preparatory Survey
for
The Project for Improvement of Tha Ngon Irrigation System

In response to the request from the Government of Lao People's Democratic Republic (hereinafter referred to as "GOL"), Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team for the Outline Design (hereinafter referred to as "the Team") of the Project for Improvement of Tha Ngon Irrigation System (hereinafter referred to as "the Project") to Lao People's Democratic Republic (hereinafter referred to as "Lao PDR"), headed by Mr. Nobuo Sambe, Senior Advisor to JICA, from 10th to 18th January 2017.

The Team held a series of discussions with the officials concerned of GOL and conducted field surveys. In the course of the discussions, both sides have confirmed the main items described in the Attachment.

Vientiane, 16th January 2017

三部 信雄

Mr. Nobuo Sambe
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr. Maykong Phonephommavong
Director General
Department of Irrigation
Ministry of Agriculture and Forestry
Lao People's Democratic Republic

ATTACHMENT

1. Objective of the Project

The objective of the Project is to improve Tha Ngon irrigation system, located in Xaithany district, Vientiane capital, by rehabilitating key elements of the existing pump irrigation system used for a long time, thereby contributing to the development of a model of modernized agriculture in Lao PDR).

2. Title of the Preparatory Survey

Both sides tentatively confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Improvement of Tha Ngon Irrigation System."

3. Project site

Both sides confirmed that the Project site is Tha Ngon irrigation scheme area, located in Xaithany district, Vientiane capital, which is shown in Annex 1.

4. Responsible authority for the Project

Both sides confirmed the authorities responsible for the Project as follows:

4-1. The Department of Irrigation (DOI), the Ministry of Agriculture and Forestry (MAF) of the Government of Lao PDR, is the executing agency for the Project (hereinafter referred to as "the Executing Agency").

DOI as the Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be properly and timely managed by relevant authorities. The organization charts are shown in Annex 2.

5. Items requested by GOL

5-1. As a result of discussions, both sides confirmed that the items requested by GOL, and the Team's response as to the priorities of the requested items are as described in Annex 3.

5-2. JICA will assess the feasibility of the above requested items through the survey and will report the findings to the Government of Japan (GOJ). The final scope of the Project will be decided by the Government of Japan.

6. Procedures and Basic Principles of Japanese Grant

6-1. The GOL side agreed that the procedures and basic principles of Japanese Grant as described in Annex 4 (with Supplements) shall be applied to the Project. As for the monitoring of implementation of the Project, JICA requires GOL side to submit the Project Monitoring Report, the form of which is attached as Annex 5.

6-2. The GOL side agreed to take the necessary measures of undertakings, as described in Annex 6, for smooth implementation of the Project.

The contents of the Annex 6 will be elaborated and refined during the Preparatory Survey and be agreed in the next mission to be dispatched for the explanation of the Draft Preparatory Survey Report (in August 2017, tentatively). The contents of Annex 6 will also be updated as the Preparatory Survey progresses, and eventually will be used as an attachment to the Grant Agreement (G/A is explained in Annex 4).

6-3. GOJ requests GOL to exempt all customs duties, internal taxes and other fiscal levies including, but not limited to, VAT, commercial tax, income tax, corporate tax, resident tax, fuel tax, which may be imposed in the recipient country with respect to the purchase of the products and/or services, since the Grant fund, coming from the taxpayers of Japan, does not cover these costs. In this regard, the GOL side assured to take necessary measures and coordination including allocation of necessary budgets as precondition of implementation of the Project.

7. Schedule of the Survey

7-1. The Team will proceed further with the present survey in Lao PDR until 20th February 2017.

7-2. The official request, prepared by DOI of MAF, to GOJ for the Project was already submitted in August 2015.

7-3. JICA will prepare a draft Preparatory Survey Report in English and dispatch a mission to Lao PDR in order to explain its contents around August 2017.

7-4. If the contents of the draft Preparatory Survey Report is accepted and the undertakings for the Project are fully agreed by GOL side, JICA will finalize the Preparatory Survey Report and send it to GOL around September 2017.

7-5. The above schedule is tentative and subject to change.

8. Environmental and Social Considerations

8-1. The GOL side confirmed to give due environmental and social considerations before and during implementation, and after completion of the Project, in accordance with the JICA Guidelines for Environmental and Social Considerations (April, 2010).

8-2. The Project is presently categorized as "B" from the following considerations: The Project is not located in a sensitive area, nor has sensitive characteristics, nor falls into sensitive sectors under the JICA Guidelines for Environmental and Social Considerations, and the Project is not likely to have significant adverse impact on the environment.

8-3. As to the possibility that the Project acquires land, both side confirmed that the Project will not require acquisition of land and/or land right because of the nature of the Project being rehabilitation of the existing irrigation scheme. Both sides further confirmed that in case physical works of the Project should require additional working space beyond the Project's administration, GOL leases land on contract basis.

8-4. Both sides also confirmed that when GOL leases land, "informed consent" and "power of choice" should be ensured. Here, "informed consent" means that the landowners and/or leaseholders involved are fully knowledgeable about the Project, its implications and consequences, and they freely agree to participate in the lease contract; "power of choice" means that the landowners and/or leaseholders involved have the option to agree or disagree with the lease, without adverse consequences imposed formally or informally by the state.

8-5. Furthermore, both sides agreed that in case of lease, GOL examines whether any informal settlers are occupying the land, and if any, compensation and/or assistance will be provided to the Project Affected Persons (PAPs) in line with laws and regulations of GOL and JICA Guidelines.

8-6. Concerning the possibility of water pollution of Nam Ngum River during implementation, both sides confirmed that there would practically be no water pollution because the Project would in principle only replace existing pumps, involving no large scale civil works.

9. Other Relevant Issues

9-1. As to the "Title of the Preparatory Survey," while both sides tentatively confirmed the title as shown in Section 2, Lao PDR side proposed that the title of the Project be modified as "the Project for Improvement of Irrigated Agriculture in Tha Ngon Irrigation Scheme," because the Project will be a model of modernized irrigated agriculture in Lao PDR. The Team took note of the proposal and confirmed to convey it to the Government of Japan for consideration.

9-2. Some water distributions beyond the original irrigation command area were found during the field visit by the Team. Prior to formulation of the outline

design, it shall be decided if those areas should be included in the plan and design. The Team requested DOI to officially inform the Team's Chief Consultant by the end of January 2017 whether the new areas should be included. The Team also requested DOI to inform the Chief Consultant of relevant information (location, area, crops, etc.), if the answer to the above query is yes.

9-3. Contribution to the Climate Change Adaptation: Both sides agreed that the Project will contribute to the adaptation to climate change impacts, since the Project aims to expand irrigated areas at the Project site.

9-4. Gender consideration: Both sides agreed that the Project would consider gender aspects in planning and implementation through stakeholder consultation.

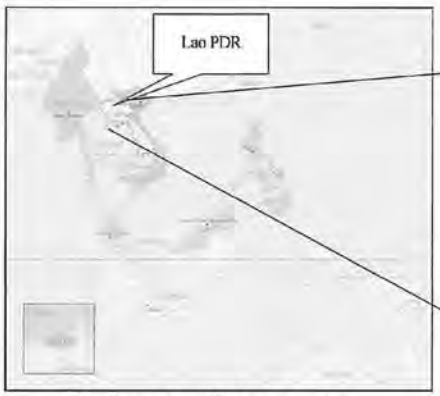
9-5. Questionnaire: DOI shall answer the Questionnaire, submitted by the Team, in English and with relevant documents by 1st February 2017.

9-6. The list of participants of the meetings is available in Annex 7.

Annex 1: Project Site
Annex 2: Organization Charts
Annex 3: Items Requested by GOL and JICA Team's Response
Annex 4: Japanese Grant (with Supplements)
Annex 5: Project Monitoring Report (template)
Annex 6: Major Undertakings to be Taken by GOL (tentative)
Annex 7: List of Participants

Annex 1

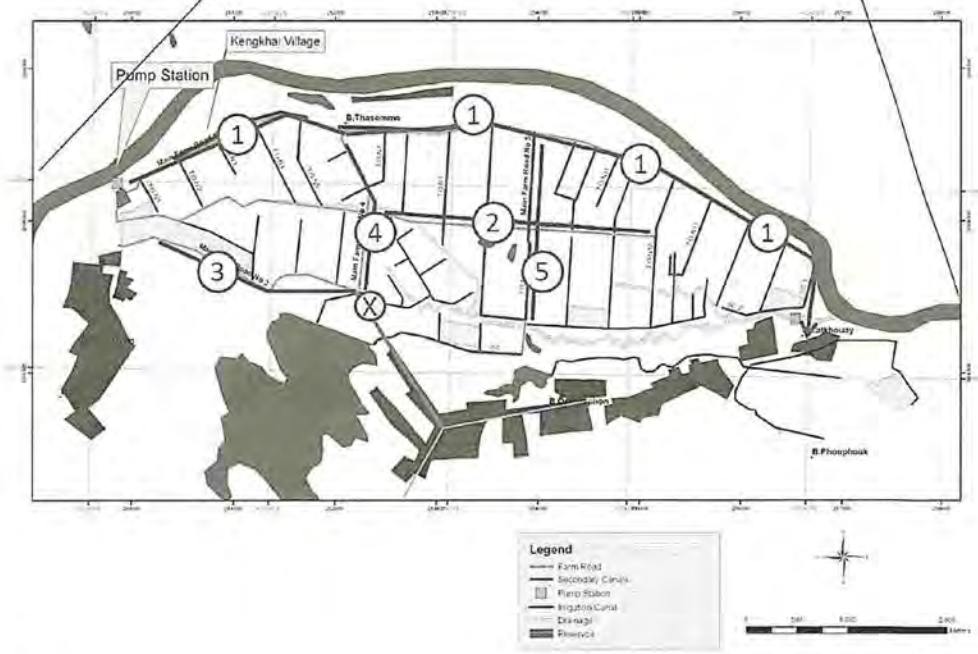
Project Site



http://aseanup.com/free-maps-asean-sou

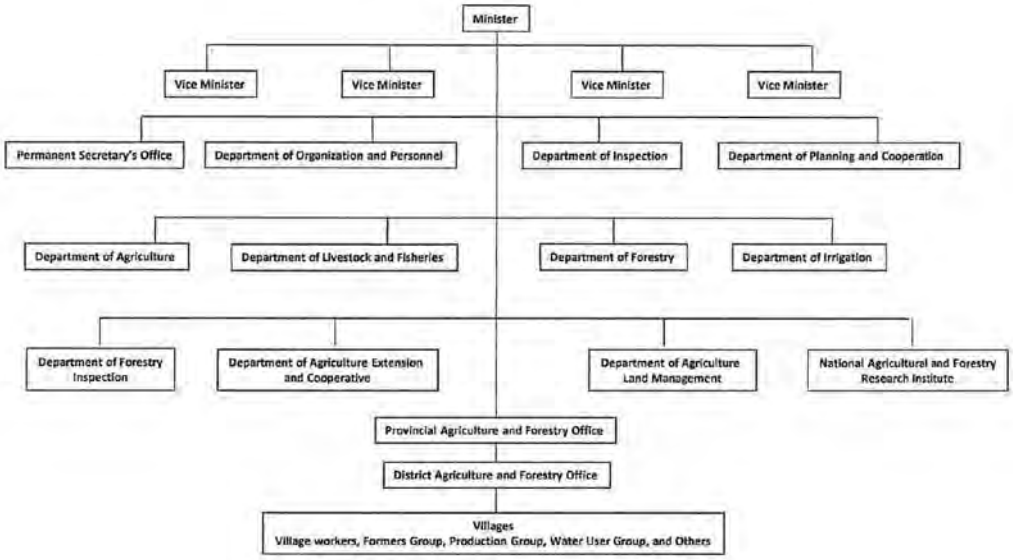
http://www.mapcruzin.com/free-maps-laos/laos_pol_2003.jpg

Map of Tha Ngon Irrigation Scheme

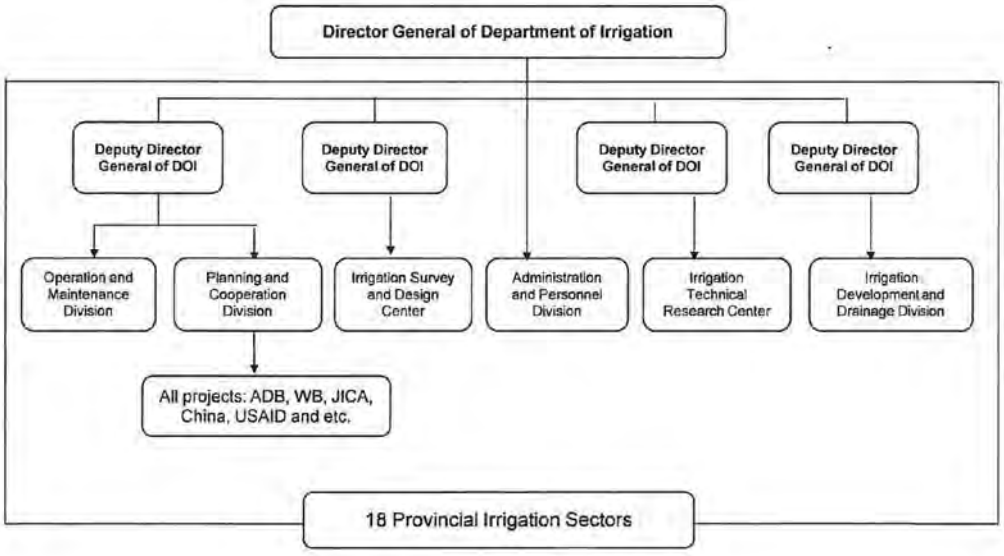


Annex 2

Organization Chart of Ministry of Agriculture and Forestry

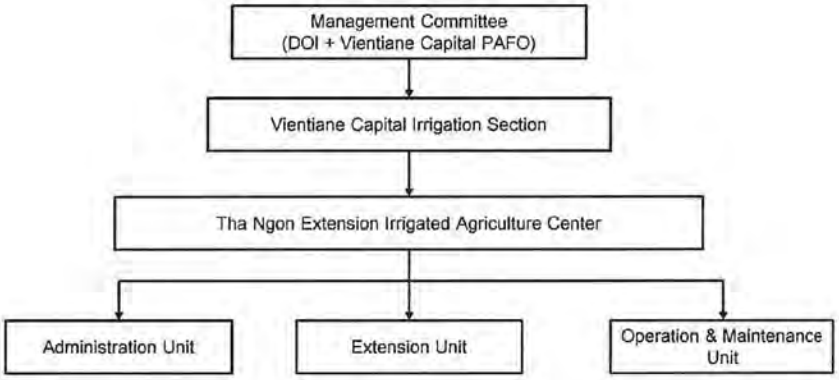


Organization Chart of Department of Irrigation



Annex 2

Organization Chart of Tha Ngon Irrigated Agriculture Scheme



Annex 3

Items Requested by GOL and JICA Team's Response

No.	Items Requested in the Official Request	JICA Team's Response	Priority
1	Pump Replacement	- The three intake pumps will be the first priorities. - The two drainage pumps will be the second priorities.	1 2
2	Main Farm Road	- While farm roads will not be studied, possibility will be examined for provision of equipment or machinery useful for improving the roads essential to the maintenance of the irrigation system. This will be the fourth priority. - Since farm road improvement is costly, inclusion of this item is not practical for the Project with limited financial resources; alternately, examination will be done for the above-mentioned equipment or machinery so that GOL can improve roads on its own.	4
3	Secondary Canal Improvement with Brick Masonry	- As to this item, only quick and simple studies will be carried out on selective basis for GOL's own implementation. - This item is of the lowest priority for the Project with limited financial resources.	5
4	Turnout and Check Structure Replacement	- Quick and simple studies will be carried out on turnout and check structure along the main canal. - Repair and/or improvement of selected structures, essential for proper water conveyance, will be the third priority.	3

Annex 4

JAPANESE GRANT

The Japanese Grant is non-reimbursable fund provided to a recipient country (hereinafter referred to as "the Recipient") to purchase the products and/or 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. Followings are the basic features of the project grants operated by JICA (hereinafter referred to as "Project Grants").

1. Procedures of Project Grants

Project Grants are conducted through following procedures (See "PROCEDURES OF JAPANESE GRANT (Supplement 1)" for details):

(1) Preparation

- The Preparatory Survey (hereinafter referred to as "the Survey") conducted by JICA

(2) Appraisal

-Appraisal by the government of Japan (hereinafter referred to as "GOJ") and JICA, and Approval by the Japanese Cabinet

(3) Implementation

Exchange of Notes

-The Notes exchanged between the GOJ and the government of the Recipient

Grant Agreement (hereinafter referred to as "the G/A")

-Agreement concluded between JICA and the Recipient

Banking Arrangement (hereinafter referred to as "the B/A")

-Opening of bank account by the Recipient in a bank in Japan (hereinafter referred to as "the Bank") to receive the grant

Construction works/procurement

-Implementation of the project (hereinafter referred to as "the Project") on the basis of the G/A

(4) Ex-post Monitoring and Evaluation

-Monitoring and evaluation at post-implementation stage

2. Preparatory Survey

(1) Contents of the Survey

The aim of the Survey is to provide basic documents necessary for the appraisal of the 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 necessary for the implementation of the Project.

- Evaluation of the feasibility of the Project to be implemented under the Japanese Grant 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 an outline design of the Project.
- Estimation of costs of the Project.
- Confirmation of Environmental and Social Considerations

The contents of the original request by the Recipient are not necessarily approved in their initial form. The Outline Design of the Project is confirmed based on the guidelines of the Japanese Grant.

JICA requests the Recipient to take 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 executing agency of the Project. Therefore, the contents of the Project are confirmed by all relevant organizations of the Recipient based on the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Survey, JICA contracts with (a) 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 feasibility of the Project.

3. Basic Principles of Project Grants

(1) Implementation Stage

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 to make a pledge for assistance, which is followed by the conclusion of the G/A between JICA and the Recipient to define the necessary articles, in accordance with the E/N, to implement the Project, such as conditions of disbursement, responsibilities of the Recipient, and procurement conditions. The terms and conditions generally applicable to the Japanese Grant are stipulated in the "General Terms and Conditions for Japanese Grant (January 2016)."

2) Banking Arrangements (B/A) (See "Financial Flow of Japanese Grant (A/P Type) (Supplement 2)" for details)

a) The Recipient shall open an account or shall cause its designated authority to open an account under the name of the Recipient in the Bank, in principle. JICA will disburse the Japanese Grant in Japanese yen for the Recipient to cover the obligations incurred by the Recipient under the verified contracts.

b) The Japanese Grant will be disbursed when payment requests are submitted by the Bank to JICA under an Authorization to Pay (A/P) issued by the Recipient.

3) Procurement Procedure

The products and/or services necessary for the implementation of the Project shall be procured in accordance with JICA's procurement guidelines as stipulated in the G/A.

4) 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 to continue to work on the Project's implementation after the E/N and G/A.

5) Eligible source country

In using the Japanese Grant disbursed by JICA for the purchase of products and/or services, the eligible source countries of such products and/or services shall be Japan and/or the Recipient. The Japanese Grant may be used for the purchase of the products and/or services of a third country as eligible, if necessary, taking into account the quality, competitiveness and economic rationality of products and/or services necessary for achieving the objective of the Project. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm, which enter into contracts with the Recipient, are limited to "Japanese nationals", in principle.

6) Contracts and Concurrence by JICA

The Recipient will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be concurred by JICA in order to be verified as eligible for using the Japanese Grant.

7) Monitoring

The Recipient is required to take their initiative to carefully monitor the progress of the Project in order to ensure its smooth implementation as part of their responsibility in the G/A, and to regularly report to JICA about its status by using the Project Monitoring Report (PMR).

8) Safety Measures

The Recipient must ensure that the safety is highly observed during the implementation of the Project.

9) Construction Quality Control Meeting

Construction Quality Control Meeting (hereinafter referred to as the "Meeting") will be held for quality assurance and smooth implementation of the Works at each stage of the Works. The member of the Meeting will be composed by the Recipient (or executing agency), the Consultant, the Contractor and JICA. The functions of the Meeting are as followings:

a) Sharing information on the objective, concept and conditions of design from the Contractor, before start of construction.

b) Discussing the issues affecting the Works such as modification of the design, test, inspection, safety control and the Client's obligation, during of construction.

(2) Ex-post Monitoring and Evaluation Stage

1) After the project completion, JICA will continue to keep in close contact with the Recipient in order to monitor that the outputs of the Project is used and maintained properly to attain its expected outcomes.

2) In principle, JICA will conduct ex-post evaluation of the Project after three years from the completion. It is required for the Recipient to furnish any necessary information as JICA may reasonably request.

(3) Others

1) Environmental and Social Considerations

The Recipient shall carefully consider environmental and social impacts by the Project and must comply with the environmental regulations of the Recipient and JICA Guidelines for Environmental and Social Considerations (April, 2010).

2) Major undertakings to be taken by the Government of the Recipient

For the smooth and proper implementation of the Project, the Recipient is required to undertake necessary measures including land acquisition, and bear an advising commission of the A/P and payment commissions paid to the Bank as agreed with the GOJ and/or JICA. The Government of the Recipient shall ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the Recipient with respect to the purchase of the Products and/or the Services be exempted or be borne by its designated authority without using the Grant and its accrued interest, since the grant fund comes from the Japanese taxpayers.

3) Proper Use

The Recipient is required to maintain and use properly and effectively the products and/or services under the Project (including the facilities constructed and the equipment purchased), to assign staff necessary for this operation and maintenance and to bear all the expenses other than those covered by the Japanese Grant.

4) Export and Re-export

The products purchased under the Japanese Grant should not be exported or re-exported from the Recipient.

Annex 4
Supplement 1

PROCEDURES OF JAPANESE GRANT

Stage	Procedures	Remarks	Recipient Government	Japanese Government	JICA	Consultants	Contractors	Agent Bank
Official Request	Request for grants through diplomatic channel	Request shall be submitted before appraisal stage.	x	x				
1. Preparation	(1) Preparatory Survey Preparation of outline design and cost estimate		x		x	x		
2. Appraisal	(2)Preparatory Survey Explanation of draft outline design, including cost estimate, undertakings, etc.		x		x	x		
	(3)Agreement on conditions for implementation	Conditions will be explained with the draft notes (E/N) and Grant Agreement (G/A) which will be signed before approval by Japanese government.	x	x (E/N)	x (G/A)			
	(4) Approval by the Japanese cabinet			x				
3. Implementation	(5) Exchange of Notes (E/N)		x	x				
	(6) Signing of Grant Agreement (G/A)		x		x			
	(7) Banking Arrangement (B/A)	Need to be informed to JICA	x					x
	(8) Contracting with consultant and issuance of Authorization to Pay (A/P)	Concurrence by JICA is required	x			x		x
	(9) Detail design (D/D)		x			x		
	(10) Preparation of bidding documents	Concurrence by JICA is required	x			x		
	(11) Bidding	Concurrence by JICA is required	x			x	x	
	(12) Contracting with contractor/supplier and issuance of A/P	Concurrence by JICA is required	x				x	x
	(13) Construction works/procurement	Concurrence by JICA is required for major modification of design and amendment of contracts.	x			x	x	
	(14) Completion certificate		x			x	x	
4. Ex-post monitoring & evaluation	(15) Ex-post monitoring	To be implemented generally after 1, 3, 10 years of completion, subject to change	x		x			
	(16) Ex-post evaluation	To be implemented basically after 3 years of completion	x		x			

notes:

1. Project Monitoring Report and Report for Project Completion shall be submitted to JICA as agreed in the G/A.

2. Concurrence by JICA is required for allocation of grant for remaining amount and/or contingencies as agreed in the G/A.

Financial Flow of Japanese Grant (A/P Type)

[Precondition]
- Currency of disbursement: Japanese Yen (10)
- Currency of contract: Japanese Yen (4)
- Currency of payment: Japanese Yen (11)

Annex 4
Supplement 2

Annex 5
G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX

20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Executing Agency	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:
Line Ministry	Person in Charge (Designation) Contacts Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

1: Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr)	Target (Yr)
Qualitative indicators to measure the attainment of project objectives		

2: Details of the Project

2-1 Location

Components	Original *(proposed in the outline design)*	Actual
1.		

2-2 Scope of the work

Components	Original* *(proposed in the outline design)*	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	*(at the time of signing the Grant Agreement)*	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations

See Attachment 2.

2-4-2 Activities

See Attachment 3.

2-4-3 Report on RD

See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original *(proposed in the outline design)*	Actual *(in case of any modification)*	Original[1),2)] *(proposed in the outline design)*	Actual
	1.			

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks (*at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

	Contingency Plan (if applicable):
Actual Situation and Countermeasures	
(PMR)	

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	1% of Contract Price D	Condition of payment	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials

(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)

-
-
-

Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 6

Major Undertakings to be taken by the Government of Lao PDR

1. Specific obligations of the Government of Lao PDR which will not be funded with the Grant

(i) Before the Tender

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To open bank account (B/A).	within 1 month after signing of G/A	TBD	TBD	
2	To issue authorization to pay (A/P) to the bank in Japan (the Agent Bank) for the payment to the consultant.	within 1 month after signing of contract	TBD	TBD	
3	To bear the commissions paid to the Agent Bank for banking services including authorization of pay, payment, and other relevant ones.	TBD	TBD	TBD	
4	To secure prompt issuance of visa and relevant permissions to the consultant.	TBD	TBD	TBD	
5	To prepare Master List of equipment to be procured and submit it to relevant authorities of Laos for prompt processing for exemption of tax, duty and other relevant levies.	TBD	TBD	TBD	
6	To secure and clear lands for implementation of the Project.	before notice of the bidding document	DOI	TBD	
7	To obtain planning, zoning, and building permits, including those for demolition and removal of existing buildings, necessary for the implementation of the Project.	same as above	DOI	TBD	
8	To clear, level and reclaim the sites for the implementation of the Project.	same as above	DOI	TBD	
9	To secure supply of utilities necessary for the implementation of the Project including electricity to the relevant pump stations.	same as above	DOI	TBD	
10	To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	TBD	DOI	TBD	
11	To renew water distribution plans in cooperation with relevant water users' associations.	before preparing bidding documents	DOI	TBD	
12	To submit Project Monitoring Report (with the result of Detail Design).	same as above	DOI	TBD	
	This list will be elaborated as the Preparatory Survey progresses				

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	during the Project	DOI	TBD	
2	To accord Japanese nationals and/or physical persons of third countries (contractors and/or suppliers) whose services may be required in connection with the supply of the products and the services such facilities as are necessary for their entry into Laos and stay therein for the performance of their work.	same as above	TBD	TBD	
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services be exempted or borne by its designated authority without using the Grant.	same as above	TBD	TBD	
4	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project	same as above	TBD	TBD	
	This list will be elaborated as the Preparatory Survey progresses				

(3) After the Project

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To ensure that the equipment and facilities procured for the Project should be used and maintained properly and efficiently for the implementation of the Project.	after the Project	DOI	TBD	
2	To secure and execute budgets for all the expenses, other than those covered by the Grant, necessary for the implementation of the Project.	same as above	DOI	TBD	
3	To properly operate and maintain the entire irrigation and drainage system of the Project.	same as above	DOI	TBD	
	This list will be elaborated as the Preparatory Survey progresses				

2. Other obligations of the Government of Lao PDR for items funded with the Grant

NO	Items	Deadline	Amount (Million Japanese Yen)*
1	To be discussed and confirmed as adequate.		
2			
	Total		

*** The Amount is provisional. This is subject to the approval of the Government of Japan.**

Annex 7

List of Participants

Ministry of Agriculture and Forestry

Name	Department/Division	Designation
Mr. Maykong Phonephommavong	Department of Irrigation	Director General
Mr. Nouanedeng Rajvong	do.	Deputy Director General
Mr. Phouthone Siriphanthong	do.	Deputy Director of O&M
Mr. Soulivanh Voravong	do.	Deputy Head of International Cooperation Sector
Mr. Thanongsack Chathala	do.	Technical Officer
Ms. Chindavone Phorpida	Department of Planning and Cooperation	Technical Officer

Ministry of Planning and Investment

Name	Department/Division	Designation
Mr. Sysomphorn Phetdaoheuang	Department of International Cooperation	Deputy Director General
Mr. Kouthong Sommala	Department of International Cooperation, Asia-Pacific and Africa Division	Director
Mr. Somekhit Kaoyahouang	Department of International Cooperation	

Tha Ngon Irrigation Project Office

Name	Department/Division	Designation
Mr. Soukanh Phimmasore		Director
Mr. Paksavanl Sylovam	Control and Irrigation	Deputy Director

JICA Laos Office

Name	Department/Division	Designation
Mr. Shuhei Terada	Agriculture and Rural Development	Representative
Mr. Viengsavanh Sisombath		Program Officer

JICA Preparatory Survey Team

Name	Department/Division	Designation
Mr. Nobuo Sambe	JICA	Leader
Mr. Hajime Nabeta	JICA Rural Development Department	Cooperation Planning
Dr. Tomohiro Teraminami	do.	Cooperation Planning 2
Mr. Daisuke Nakajima	Kokusai Kogyo Co., Ltd.	Chief Consultant / Improvement of Ground Works for Agricultural Productivity
Mr. Shinichi Ogawa	do.	Water Usage Planning / Design / Environmental and Social Considerations

4-2 Minutes of Discussion (11 January 2017)

Minutes of Discussions
on
the Preparatory Survey
for
The Project for Improvement of Irrigated Agriculture
in Tha Ngon Irrigation Scheme
(Explanation on Draft Preparatory Survey Report)

With reference to the minutes of discussions signed between the Department of Irrigation, Ministry of Agriculture and Forestry and the Japan International Cooperation Agency (hereinafter referred to as "JICA") on 16th January 2017 and in response to the request from the Government of Lao People's Democratic Republic (hereinafter referred to as "GOL") dated 4th August 2015, JICA dispatched the Preparatory Survey Team (hereinafter referred to as "the Team") for the explanation of Draft Preparatory Survey Report (hereinafter referred to as "the Draft Report") for the Project for Improvement of Irrigated Agriculture in Tha Ngon Irrigation Scheme (hereinafter referred to as "the Project"), headed by Mr. Nobuo Sambe, Senior Advisor to JICA from 7th August to 11th August, 2017.

As a result of the discussions, both sides agreed on the main items described in the attached sheets.

Vientiane, 11th August, 2017

Mr. Nobuo Sambe
Leader
Preparatory Survey Team
Japan International Cooperation Agency
Japan

Mr. Maykong Phonephommavong
Director General
Department of Irrigation
Ministry of Agriculture and Forestry
Lao People's Democratic Republic

ATTACHEMENT

1. **Objective of the Project**

The objective of the Project is to improve Tha Ngon Irrigation System by rehabilitating key elements of the existing pump irrigation system used for a long time, thereby contributing to the development of a model of modernized agriculture in Lao PDR.

2. **Title of the Preparatory Survey**

Both sides confirmed the title of the Preparatory Survey as "the Preparatory Survey for the Project for Improvement of Irrigated Agriculture in Tha Ngon Irrigation Scheme".

3. **Project site**

Both sides confirmed that the site of the Project is in Tha Ngon irrigation scheme area, located in Xaithany district, Vientiane capital, which is shown in Annex 1.

4. **Responsible authority for the Project**

Both sides confirmed the authorities responsible for the Project are as follows:
The Department of Irrigation (DOI), the Ministry of Agriculture and Forestry (MAF) of the GOL, will be the executing agency for the Project (hereinafter referred to as "the Executing Agency"). The Executing Agency shall coordinate with all the relevant authorities to ensure smooth implementation of the Project and ensure that the undertakings for the Project shall be taken care by relevant authorities properly and on time. The organization charts are shown in Annex 2.

5. **Contents of the Draft Report**

After the explanation of the contents of the Draft Report including scope of the Project summarised in Annex 3 by the Team, the GOL side agreed to its contents.

6. **Cost estimate**

Both sides confirmed that the cost estimate including the contingency described in Annex 4 and the Draft Report was provisional and would be examined further by the Government of Japan for its approval. The contingency would cover the additional cost attributed to natural disaster, unexpected natural conditions, etc.

7. **Confidentiality of the cost estimate and technical specifications**
Both sides confirmed that the cost estimate and technical specifications in the Draft Report should never be duplicated or disclosed to any third parties until all the contracts under the Project are concluded.

8. **Timeline for the project implementation**
The Team explained to the GOL side that the expected timeline for the project implementation is as attached in Annex 5.

9. **Expected outcomes and indicators**
Both sides agreed that key indicators for expected outcomes are as follows. The GOL side will be responsible for the achievement of agreed key indicators targeted in year 2022 and shall monitor the progress based on those indicators.

[Quantitative outcomes]

Indicators	Baseline (2016)	Target (2022) 3 years after the Project completion
Irrigation areas (ha) (dry season)	272	400
Amount of water supply by pump operation (m^3/day)	59,447	93,312
Amount of rice production (t) (dry season)	1,224	2,404
Unit energy consumption (consumed energy per water supply) (kWh/m^3)	0.045	0.032

[Qualitative outcomes]

1) Farmers will have a sense of security from guaranteed irrigation water and are motivated to produce more.
2) Farmers will transform their farming to more profitable one with surplus production and their livelihood is improved.

10. **Technical assistance ("Soft Component" of the Project)**
The GOL side requested the soft component to be conducted to ensure sustainable operation and maintenance of the Tha Ngon Irrigation System after completion of the Project. The both side confirmed the contents of the soft component proposed

by the Team. The GOL side agreed to assign necessary counterparts appropriate and competent in terms of its purpose of the technical assistance as described in the Draft Report.

11. Undertakings of the Project

Both sides confirmed the undertakings of the Project as described in Annex 6. With regard to exemption of customs duties, internal taxes and other fiscal levies as stipulated in (2)-5 of Annex 6, both sides confirmed that such customs duties, internal taxes and other fiscal levies include VAT, commercial tax, income tax and corporate tax, which shall be clarified in the bid documents by DOI, MAF during the implementation stage of the Project.

The GOL side assured to take the necessary measures and coordination including allocation of the necessary budget which are preconditions of implementation of the Project. It is further agreed that the costs are indicative, i.e. at Outline Design level. More accurate costs will be calculated at the Detailed Design stage.

Both sides also confirmed that the Annex 6 will be used as an attachment of G/A.

Both sides confirmed that in order for smooth implementation of the Project the master list of goods and services, which are to be procured under the Project and the subject of the above-mentioned exemption of duties, tax and fiscal levies, should be prepared by DOI and submitted by MAF to the Ministry of Finance for their timely approval after exchange of Note Verval on the Project is concluded and as soon as the actual prices of goods and services are available.

12. Monitoring during the implementation

The Project will be monitored by the Executing Agency and reported to JICA by using the form of Project Monitoring Report (PMR) attached as Annex 7. The timing of submission of the PMR is described in Annex 6.

13. Project completion

Both sides confirmed that the project completes when all the facilities constructed and equipment procured by the grant are in operation. The completion of the Project will be reported to JICA promptly, but in any event not later than six months after completion of the Project.

14. Ex-Post Evaluation

JICA will conduct ex-post evaluation after three (3) years from the project completion, in principle, with respect to five evaluation criteria (Relevance, Effectiveness, Efficiency, Impact, Sustainability). The result of the evaluation will be publicized. The GOL side is required to provide necessary support for the data collection.

15. Schedule of the Study

JICA will finalize the Preparatory Survey Report based on the confirmed items. The report will be sent to the GOL side around September, 2017.

16. Environmental and Social Considerations

16-1 General Issues

According to laws and regulations of GOL, no environmental study or examination is required for rehabilitation projects.

The Team explained that 'JICA Guidelines for Environmental and Social Considerations (April 2010)' (hereinafter referred to as "the Guidelines") is applicable for the Project. The Project is categorized as C because the Project is likely to have minimal adverse impact on the environment under the Guidelines.

17. Other Relevant Issues

17-1. Disclosure of Information

Both sides confirmed that the Preparatory Survey Report from which project cost is excluded will be disclosed to the public after completion of the Preparatory Survey. The comprehensive report including the project cost will be disclosed to the public after all the contracts under the Project are concluded.

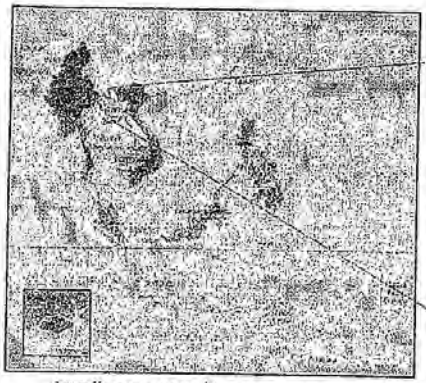
17-2. Responsibilities of Beneficiaries

Both sides also confirmed that, as stated in the attached minutes of the meeting of the Water User's Association (Annex 8), the beneficiary farmers are ready to fulfil the responsibilities of operation and maintenance of canals and gates to manage the irrigation and drainage system effectively, and to realize more efficient and equitable use of water for the benefit of all farmers.

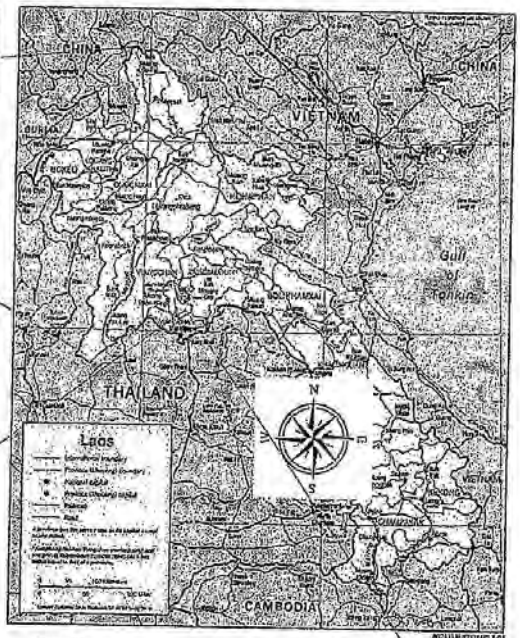
Annex 1 Project Site
Annex 2 Organization Chart
Annex 3 Project Scope
Annex 4 Tentative Project Cost Estimation
Annex 5 Tentative Project Implementation Schedule
Annex 6 Major Undertakings taken by the Government of Lao PDR
Annex 7 Project Monitoring Report (template)
Annex 8 Minutes of the Meeting of the Water User's Association

Annex 1

Project Site



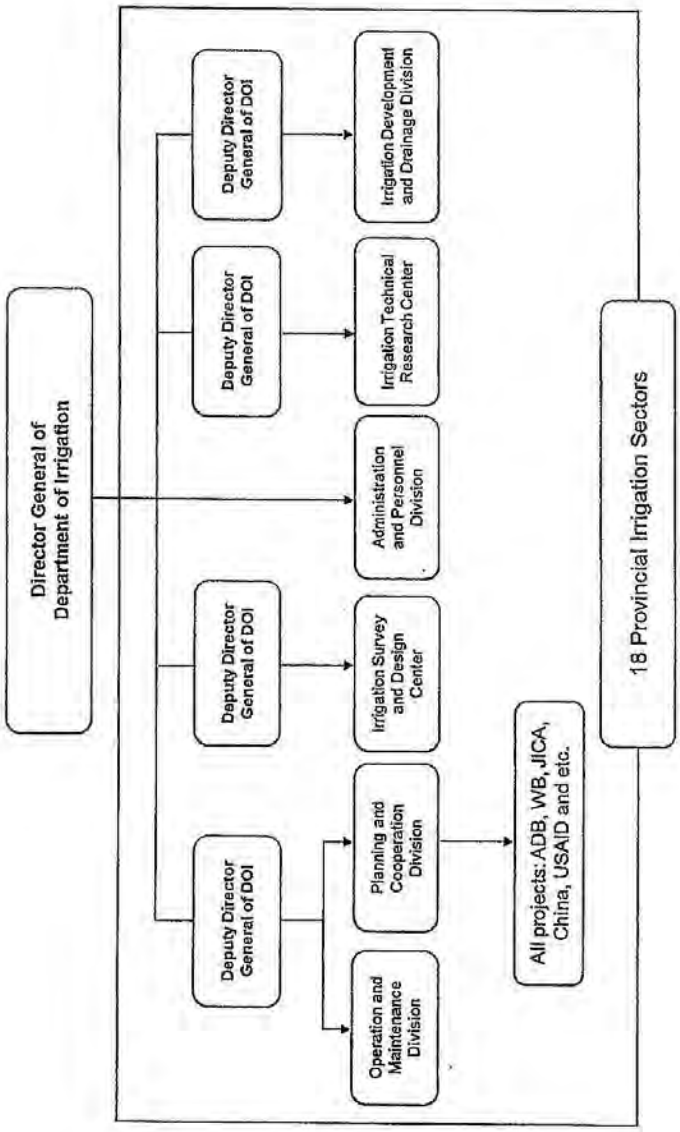
http://aseanup.com/free-maps-asean-sou



http://www.mapcruzin.com/free-maps-laos_pol_2003.jpg

Annex 2

Organization Chart of Department of Irrigation

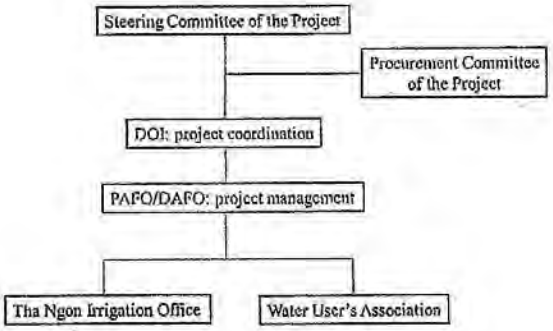


Annex 2

Organization Chart of Ministry of Agriculture and Forestry

Annex 2

Implementation Organization



Steering Committee of the Project
Main Roles
- overall coordination

Procurement Committee of the Project
Main Roles
- prepare to select the bidding processes

DOI
Main Roles
- project coordination
- coordination of procurement (preparation of the master list)
- financial arrangement
- approval of project management issues
- selection of contractors

PAFO/DAFO
Main Roles
- financial arrangement
- setting a project management unit
- approval of project management issues
- selection of contractors
- inspection of the construction

Tha Ngon Irrigation Office
Main Roles
- carry out field activities in coordination with PAFO/DAFO

Water User's Association
Main Roles
- coordination among beneficiaries during the project implementation

PAFO: Provincial Agriculture and Forestry Office, Vientiane Capital
DAFO: District Agriculture and Forestry Office, Vientiane Capital

Annex 3

Project Scope

Items	Descriptions	Quantity
Facilities	Operator House in Irrigation Pump Station and Drainage Pump Station	2 (About 20 m^2)
	Control House in Irrigation Pump Station and Drainage Pump Station	2 (About 20 m^2)
Equipment	Irrigation pumps	3
	Drainage pumps	2
	Floating pumps	2
	Intake gate in Irrigation Pump Station	1
	Spillway on Reservoir	1
	Head Gate to North Main Canal	1
	Check Structures on North Main Canal	6
	Turnouts on North Main Canal and Lateral and Sub lateral Canals	76
	head gates on Nong Sam Kha Dams	3
	Control Panels for Pumps	2
	Power receiving boards and Transformers	2
	Motor Grader	1
Consulting service and Soft component	Detailed design service, the supervisory service in the equipment procurement and preparing tender documents	
	To construct O&M system to manage information of water fee, irrigation area and flow rate of the Tha Ngon Irrigation Project Office.	

Annex 4

CONFIDENTIAL

Tentative Project Cost Estimation

1. Cost to be Borne by the Government of Japan

Total Cost:

Components	Cost Estimation (Million Yen)
Equipment	
Detail Design and Procurement Supervision	
Contingency	
Total	

Notes:

The cost estimates in the above table are provisional and will be further examined by the Government of Japan for the approval of the Grant.

2. Cost to be Borne by the Government of LAO PDR (GOL)

Total Cost: Approximately 338.4 million LAK (Approximately 4.7 Million Yen)

Undertakings by the GOL side	Cost Estimation	
	(Million LAK)	(Million Yen)
Waste Disposal Cost (Concrete Debris, Surplus Earth, Etc.)	72.0	1.0
Preparation of the Construction Site (Removal and Re-installation of Fences)	72.0	1.0
Lease of the Temporary Yard	36.0	0.5
Furniture Purchase Cost (Beds and Desks in the Operator's Houses)	14.4	0.2
Electrical Work	72.0	1.0
Banking arrangement fee	72.0	1.0
Total	338.4	4.7

Annex 4

3. Condition of the Cost Estimation

- Estimated timing: February, 2017
- Exchange rates: LAK 1 = Yen 0.0139
  USD 1 = Yen 113.97
- Others:
  The Project is implemented in accordance with the system of Japan's Grant Aid

Annex 5

Tentative Project Implementation Schedule

	Process	2018 JPFY2017 1	2	3	4	5	6	7	8	9	10	11	12	2019 JPFY2018 1	2	3	4	5	6	7	8	9	10	11	12	2019 JPFY2019
Detailed Design	Final confirmation of Project Content																									
	Review of equipment specificatons, etc																									
	Preparation of tender documents																									
	Approval of tender documents																									
	Announcement of tender				▲																					
	Distribution of drawings, briefing																									
	Tender						▲																			
	Tender Evaluation of bids							▲																		
	Procurement agreement								▲																	
Procurement	Product of equipment																									
	Product inspection, pre-shipment inspection																	△								
	Pre-loading survey																	△								
	Ocean/inland freight																									
	Installation of Equipment																									
	Adjustment, trial operation, start-up and operation training																									
	Acceptance inspection, handover																									▲

: Work in Lao PDR
: Work in Japan

Annex 6

Major Undertakings to be taken by the Government of Lao PDR

1. Specific obligations of the Government of Lao PDR which will not be funded with the Grant

(1) Before the Tender

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To open a bank account (B/A).	within 1 month after signing of G/A	DOI	72 million LAK	*
2	To issue Authorization to Pay (A/P) for the payment to the consultant through the bank in Japan (the Agent Bank).	within 1 month after signing of the contract	DOI		
3	To bear bank commission for services of the Agent Bank including authorization of payment and other relevant ones.	within 1 month after verification of contract by JICA	DOI		
4	To secure prompt issuance of visa and relevant permissions to the consultant.	as needed	DOI		
5	To prepare and submit Master List of equipment to be procured to relevant authorities of Laos for prompt processing exemption from tax, duty and other relevant levies.	up to 2 weeks before the procurement equipment arrival at the port from Japan or third country	DOI/MAF		
6	To secure lands for the implementation of the Project.	before notice of the Tender document	DOI/PAFO	36 million LAK	
7	To obtain planning, zoning and building permits including demolition and removal of existing buildings for the implementation of the Project.	same as above	DOI		
8	To clear, level and reclaim the sites for the implementation of the Project.	same as above	DOI/PAFO	72 million LAK	
9	To secure supply of necessary utilities for the implementation of the Project including electricity for the relevant pump stations.	same as above	DOI/PAFO		
10	To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	within 1 month after signing of G/A	DOI/PAFO		
11	To renew irrigation water distribution plans in cooperation with a relevant water users' association.	before preparing Tender documents	DOI/PAFO		
12	To submit Project Monitoring Report (with the result of Detail Design).	same as above	DOI		
13	To coordinate with relevant authorities, acquires necessary budget to cover VAT portion for fiscal year 2019	before tender (February 2018)	DOI	647 million LAK	

DOI: Department of Irrigation
PAFO: Provincial Agriculture and Forest Office, Vientiane Capital
MAF: Ministry of Agriculture and Forestry

Note: 72 million LAK in No. 1 covers all items with asterisk (*) in all three tables.

(3) 2

(2) During the Project Implementation

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To issue A/P to the bank in Japan (the Agent Bank) for the payment to the Supplier.	within 1 month after the signing of the contract(s)	DOI		*
2	To bear the following commissions of the bank in Japan for the banking services based upon the B/A.				
	1) Advising commission of A/P.	within 1 month after the signing of the contract(s)	DOI		*
	2) Payment commission for A/P.	every payment	DOI		*
3	To ensure prompt unloading and customs clearance at ports of disembarkation in the recipient country and to assist the Supplier with internal transportation therein.	during the Project	DOI/MOF		
4	To secure entry into Laos and to accord with Japanese nationals and/or physical persons of third countries (contractors and/or suppliers) whose services may be required in connection with the supply of the products and the services under verified contracts	same as above	DOI		
5	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services are exempted or borne by its designated authority without using the Grant.	same as above	DOI/MOF		
6	To bear all the expenses necessary for the implementation of the Project, other than those covered by the Grant.	same as above	DOI/MOF		
7	To submit Project Monitoring Report after each work under the contract(s) such as shipping, hand over and installation.	within 1month after completion of each work	DOI		
8	To submit a report concerning completion of the Project.	within 6 months after completion of the Project	DOI		
9	To take necessary measures for safety construction. -Traffic control -Rope off	during the Project	DOI/PAFO		
10	To coordinate with relevant local authorities and stakeholders for smooth implementation of the Project.	during the Project	DOI/PAFO		
11	To dispose soil, crashed concrete and removed equipment generated by the project.	during the Project	DOI/PAFO	72 million LAK	
12	To dispose existing electricity materials such as transformers, Voltage and Current Transformers, cables, etc.	during the Project	DOI/PAFO		

DOI: Department of Irrigation
PAFO: Provincial Agriculture and Forest Office, Vientiane Capital
MOF: Ministry of Finance

(2)

2

(3) After the Project

NO	Items	Deadline	In charge	Estimated cost	Ref.
1	To ensure that the equipment and facilities procured for the Project are used and maintained properly and efficiently for the implementation of the Project.	after the Project	DOI/PAFO		
2	To operate and maintain properly the entire irrigation and drainage systems of the Project.	same as above	DOI/PAFO	as indicated in the final report	
3	To take necessary measures for adequate utilization of the Project. 1) Promotion for irrigated agriculture 2) Cleaning and maintenance of irrigation facilities 3) Prepare fixtures for operator house	same as above	DOI/PAFO	14.4 million LAK for 3)	
4	To assign trucks for transportation of soil to use for road-maintenance with a motor grader	same as above	DOI/PAFO		

DOI: Department of Irrigation
PAFO: Provincial Agriculture and Forest Office, Vientiane Capital

2. Other obligations of the Government of Lao PDR for items funded with the Grant

Even before the Project's implementation starts, DOI, in close coordination with relevant ministries and departments, shall initiate the processes to duly ensure exemption of taxes, duties and other levies involved in the Project stated below; DOI must timely prepare the master list and submit it to MOF and other relevant authorities for approval. DOI must also acquire budgetary allocations for their non-cash transaction in particular to cover VAT.

In order to ensure the Japanese Grant Aid's requirement that customs duties, internal taxes and other fiscal levies which may be imposed in Laos with respect to the purchase of the products and/or the services must be exempted or borne by its designated authority without using the Grant, the Team, the executing agency, i.e. DOI, and the Ministry of Planning and Investment had a meeting with the External Finance Department (EFD) of the Ministry of Finance (MOF) and confirmed the following.

- As to the items to be imported, a master list must be prepared by the executing agency, DOI/MAF in this case, and be submitted to MOF for approval for duty-and-tax-free procurement.
- As to the items to be domestically purchased, DOI/MAF must obtain relevant budgetary allocation for non-cash transaction to cover the VAT portion in terms of counterpart fund.
- As to the items for domestic purchase where the price already includes certain taxes, such as petrol, contractors must purchase the item and obtain receipt with the tax amount indicated. In that case, the contractors shall only pay the amount excluding the tax amount and DOI/MAF shall cover the tax amount with the non-cash transaction budget.
- The exemption of import tax and duties, and Value Added Tax included in domestic goods and services should comply with the instruction 2695/MOF dated 01 November 2010.

*** The amounts are provisional. Finalization is subject to approval by the Government of Japan.**

Annex 7
G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Project Monitoring Report
on
Project Name
Grant Agreement No. XXXXXXX
20XX, Month

Organizational Information

Signer of the G/A (Recipient)	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Executing Agency	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:
Line Ministry	Person in Charge	(Designation)
	Contacts	Address: Phone/FAX: Email:

General Information:

Project Title	
E/N	Signed date: Duration:
G/A	Signed date: Duration:
Source of Finance	Government of Japan: Not exceeding JPY _____ mil. Government of (_____): _____

1

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

1. Project Description

1-1 Project Objective

1-2 Project Rationale

- Higher-level objectives to which the project contributes (national/regional/sectoral policies and strategies)
- Situation of the target groups to which the project addresses

1-3 Indicators for measurement of "Effectiveness"

Quantitative indicators to measure the attainment of project objectives		
Indicators	Original (Yr.)	Target (Yr.)
Qualitative indicators to measure the attainment of project objectives		

2. Details of the Project

2-1 Location

Components	Original (proposed in the outline design)	Actual
1.		

2-2 Scope of the work

Components	Original* (proposed in the outline design)	Actual*
1.		

Reasons for modification of scope (if any).

(PMR)

2

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

2-3 Implementation Schedule

Items	Original		Actual
	(proposed in the outline design)	(at the time of signing the Grant Agreement)	

Reasons for any changes of the schedule, and their effects on the project (if any)

2-4 Obligations by the Recipient

2-4-1 Progress of Specific Obligations
See Attachment 2.

2-4-2 Activities
See Attachment 3.

2-4-3 Report on RD
See Attachment 11.

2-5 Project Cost

2-5-1 Cost borne by the Grant(Confidential until the Bidding)

Components			Cost (Million Yen)	
	Original (proposed in the outline design)	Actual (in case of any modification)	Original[1],[2] (proposed in the outline design)	Actual
	1.			
Total				

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar = Yen

2-5-2 Cost borne by the Recipient

Components			Cost (1,000 Taka)	
	Original (proposed in the outline design)	Actual (in case of any modification)	Original[1],[2] (proposed in the outline design)	Actual
	1.			

3

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Note: 1) Date of estimation:
2) Exchange rate: 1 US Dollar =

Reasons for the remarkable gaps between the original and actual cost, and the countermeasures (if any)

(PMR)

2-6 Executing Agency

- Organization's role, financial position, capacity, cost recovery etc,
- Organization Chart including the unit in charge of the implementation and number of employees.

Original *(at the time of outline design)* name: role: financial situation: institutional and organizational arrangement (organogram): human resources (number and ability of staff):
Actual *(PMR)*

2-7 Environmental and Social Impacts

- The results of environmental monitoring based on Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- The results of social monitoring based on in Attachment 5 (in accordance with Schedule 4 of the Grant Agreement).
- Disclosed information related to results of environmental and social monitoring to local stakeholders (whenever applicable).

3: Operation and Maintenance (O&M)

3-1 Physical Arrangement

- Plan for O&M (number and skills of the staff in the responsible division or section, availability of manuals and guidelines, availability of spareparts, etc.)

Original *(at the time of outline design)*
Actual *(PMR)*

3-2 Budgetary Arrangement

- Required O&M cost and actual budget allocation for O&M

Original *(at the time of outline design)*

Actual *(PMR)*

4: Potential Risks and Mitigation Measures

- Potential risks which may affect the project implementation, attainment of objectives, sustainability
- Mitigation measures corresponding to the potential risks

Assessment of Potential Risks *(at the time of outline design)*

Potential Risks	Assessment
1. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
2. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:
	Contingency Plan (if applicable):
3. (Description of Risk)	Probability: High/Moderate/Low
	Impact: High/Moderate/Low
	Analysis of Probability and Impact:
	Mitigation Measures:
	Action required during the implementation stage:

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

	Contingency Plan (if applicable):

Actual Situation and Countermeasures
(PMR)

5: Evaluation and Monitoring Plan (after the work completion)

5-1 Overall evaluation

Please describe your overall evaluation on the project.

5-2 Lessons Learnt and Recommendations

Please raise any lessons learned from the project experience, which might be valuable for the future assistance or similar type of projects, as well as any recommendations, which might be beneficial for better realization of the project effect, impact and assurance of sustainability.

5-3 Monitoring Plan of the Indicators for Post-Evaluation

Please describe monitoring methods, section(s)/department(s) in charge of monitoring, frequency, the term to monitor the indicators stipulated in 1-3.

G/A NO. XXXXXXX
PMR prepared on DD/MM/YY

Attachment

1. Project Location Map
2. Specific obligations of the Recipient which will not be funded with the Grant
3. Monthly Report submitted by the Consultant

Appendix - Photocopy of Contractor's Progress Report (if any)
- Consultant Member List
- Contractor's Main Staff List

4. Check list for the Contract (including Record of Amendment of the Contract/ Agreement and Schedule of Payment)
5. Environmental Monitoring Form / Social Monitoring Form
6. Monitoring sheet on price of specified materials (Quarterly)
7. Report on Proportion of Procurement (Recipient Country, Japan and Third Countries) (PMR (final)only)
8. Pictures (by JPEG style by CD-R) (PMR (final)only)
9. Equipment List (PMR (final)only)
10. Drawing (PMR (final)only)
11. Report on RD (After project)

7

Attachment 6

Monitoring sheet on price of specified materials

1. Initial Conditions (Confirmed)

	Items of Specified Materials	Initial Volume A	Initial Unit Price (¥) B	Initial total Price C=A×B	% of Contract Price D	Condition of payments	
						Price (Decreased) E=C−D	Price (Increased) F=C+D
1	Item 1	●●t	●	●	●	●	●
2	Item 2	●●t	●	●	●		
3	Item 3						
4	Item 4						
5	Item 5						

2. Monitoring of the Unit Price of Specified Materials
(1) Method of Monitoring : ●●

(2) Result of the Monitoring Survey on Unit Price for each specified materials

	Items of Specified Materials	1st ●month, 2015	2nd ●month, 2015	3rd ●month, 2015	4th	5th	6th
1	Item 1						
2	Item 2						
3	Item 3						
4	Item 4						
5	Item 5						

(3) Summary of Discussion with Contractor (if necessary)
-
-
-

Attachment 7

Report on Proportion of Procurement (Recipient Country, Japan and Third Countries)
(Actual Expenditure by Construction and Equipment each)

	Domestic Procurement (Recipient Country) A	Foreign Procurement (Japan) B	Foreign Procurement (Third Countries) C	Total D
Construction Cost	(A/D%)	(B/D%)	(C/D%)	
Direct Construction Cost	(A/D%)	(B/D%)	(C/D%)	
others	(A/D%)	(B/D%)	(C/D%)	
Equipment Cost	(A/D%)	(B/D%)	(C/D%)	
Design and Supervision Cost	(A/D%)	(B/D%)	(C/D%)	
Total	(A/D%)	(B/D%)	(C/D%)	

Annex 8

ບົດບັນທຶກກອງປະຊຸມ
ຮ່ວມກັບອຳນາດການປົກຄອງບ້ານ, ຫົວໜ້າຄອງ, ກຸ່ມຜູ້ນຳໃຊ້ນ້ຳ

ພາຍຫຼັງກອງປະຊຸມຮ່ວມລະຫວ່າງອຳນາດການປົກຄອງບ້ານ, ຫົວໜ້າຄອງເໝືອງ ແລະ ກຸ່ມຜູ້ນຳໃຊ້ນ້ຳ ທີ່ດຳເນີນການໂດຍຫົວໜ້າຫ້ອງການໂຄງການຊົນລະປະທານຫຼັກ 6 ທ່າງ່ອນ ໂດຍມີຕາງໜ້າກົມຊົນລະປະທານ, ກະຊວງກະສິກຳ-ປ່າໄມ້ ເປັນປະທານ, ໃນກອງປະຊຸມ ທີມງານສຳຫຼວດຂໍ້ມູນຈາກອົງການ ໄຈກ້າ (JICA) ໄດ້ສະເໜີກ່ຽວກັບບັນຫາຕ່າງໆທີ່ພົບເຫັນໃນໄລຍະທີ່ລົງສຳຫຼວດຂໍ້ມູນ ໂດຍສະເພາະແມ່ນສິ່ງທີ່ເປັນຂໍ້ບົກຜ່ອງໃນໜ້າວຽກຂອງການຄຸ້ມຄອງ, ການນຳໃຊ້, ການບຳລຸງຮັກສາ, ຄວາມສະເໝີພາບໃນການຈັດສັນ ແລະ ແບ່ງປັນນ້ຳ.

ໂດຍອີງຕາມການສະເໜີ ແລະ ການປຶກສາຫາລື ຕໍ່ບັນຫາຂ້າງເທິງ ເພື່ອເປັນການປັບປຸງແກ້ໄຂໃນຕໍ່ໜ້າ, ສະມາຊິກຜູ້ນຳໃຊ້ນ້ຳ ແມ່ນຈະໃຫ້ການຮ່ວມມື ດັ່ງຕໍ່ໄປນີ້:

1. ຕ້ອງເປັນເຈົ້າການໃນການບຳລຸງຮັກສາຄອງເໝືອງຕ່າງໆ ເຊັ່ນ ມີຄວາມຕື່ນຕົວໃນການອານາໄມ ແລະ ສ້ອມແປງຄອງເໝືອງ, ຕ້ອງຕັ້ງໜ້າຕິດຕາມ ແລະ ແກ້ໄຂບັນຫາທີ່ເກີດຂຶ້ນດ້ວຍຄວາມເອົາໃຈໃສ່ ໃນນາມສະມາຊິກຜູ້ນຳໃຊ້ນ້ຳ;
2. ຕ້ອງປັບປຸງການຄຸ້ມຄອງນ້ຳ, ການນຳໃຊ້ປະຕູນ້ຳ ແລະ ອາຄານຕາມຄອງເໝືອງຕ່າງໆ ຢ່າງຖືກຕ້ອງ, ເໝາະສົມ ແລະ ຕ້ອງຄຳນຶງເຖິງຄວາມສະເໝີພາບໃນການແຈກຢາຍແບ່ງປັນນ້ຳໃຫ້ບັນດາຜູ້ນຳໃຊ້ທັງໝົດ ແລະ ການໃຊ້ນ້ຳຢ່າງປະຢັດ (ລວມທັງຄ່າໄຟຟ້າ);

ເມື່ອໃນກອງປະຊຸມໃນຄັ້ງນີ້, ໃຫ້ຫົວໜ້າກຸ່ມຜູ້ນຳໃຊ້ນ້ຳ ສົມທົບກັບອຳນາດການປົກຄອງບ້ານຜັນຂະຫຍາຍສູ່ບັນດາສະມາຊິກຜູ້ນຳໃຊ້ ທັນທີ ເພື່ອຄວາມເປັນເອກະພາບໃນການຈັດຕັ້ງປະຕິບັດ.

ຊື່ບ້ານ	ລາຍເຊັນຫົວໜ້າກຸ່ມຜູ້ນຳໃຊ້ນ້ຳ	ຊື່ ແລະ ນາມສະກຸນ
ທ່າສົ້ມມີ	[signature]	[illegible]
ແກ້ງໄຄ້	[signature]	[illegible]
ໂພຄຳ	[signature]	[illegible]
ອຸດົມສິນ	[signature]	[illegible]
ລາດຄວາຍ	[signature]	[illegible]

ວັນທີ [illegible] 18/20[illegible]

ຜູ້ບັນທຶກ

[signature]

ເອກະສານຄັດຕິດ:
- ລາຍຊື່ຜູ້ເຂົ້າຮ່ວມ

ນາຍບ້ານ ທ່າສົ້ມມີ

[stamp: ນາຍບ້ານ ບ້ານ ທ່າສົ້ມມີ] [signature]

ວົງແກ້ວ ບານນະຄອນສີ
Vongkeo BANNAKHONESY

(3)

ບັນຊີລາຍຊື່ຜູ້ເຂົ້າຮ່ວມກອງປະຊຸມ

ຄັ້ງວັນທີ 9/8/2017

ຫົວຂໍ້ປະຊຸມ: .....

ປະທານກອງປະຊຸມ: .....

ລ/ດ	ຊື່ ແລະ ນາມສະກຸນ	ພາກສ່ວນ	ໜ້າທີ່ຮັບຜິດຊອບ	ເບີໂທ	ລາຍເຊັນ
1					
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	ລວມ				

ບັນຊີລາຍຊື່ຜູ້ເຂົ້າຮ່ວມກອງປະຊຸມ

ຄັ້ງວັນທີ ....9/8/2017..........

ຫົວຂໍ້ປະຊຸມ: ....

ປະທານກອງປະຊຸມ: ....

ລ/ດ	ຊື່ ແລະ ນາມສະກຸນ	ພາກສ່ວນ	ໜ້າທີ່ຮັບຜິດຊອບ	ເບີໂທ	ລາຍເຊັນ
1	[illegible]	[illegible]	[illegible]	55646479	
2	[illegible]	[illegible]	[illegible]	55490061	
3	[illegible]	[illegible]	[illegible]	55902909	
4	[illegible]	[illegible]	[illegible]	0305230757	
5	Hajime Nabeta	JICA	Coordinator	+81-3-5226-8427	
6	[illegible]	[illegible]	[illegible]	0305250229	
7	Mr. Oudomxay RASAVONG	[illegible]	Staff	94593535	
8	[illegible]	[illegible]	[illegible]	22453075	
9	[illegible]	[illegible]		0309807897	
10	[illegible]	[illegible]	[illegible]	02059783491	
11	Kenji SHINODA	JICA consultant	team Member		
12	Tomohiro Teraminami	JICA	team member		
13	Chizuru Sugihara	consultant	Team member		
14	Nobuo SAMBE	JICA	Mission Member		
15	Daisuke Nakajima	consultant	Team leader of consultant		
16	[illegible]	[illegible]	[illegible]	99664732	
	ລວມ				

(3)

2

Appendix 5
Soft Component Plan

Appendix 5 Soft Component Plan

Lao People's Democratic republic

The Project for Improvement of Tha Ngon Irrigation System

Soft Component Plan

September, 2017

Kokusai Kogyo Co., Ltd.

Soft Component Plan

1. Background of Soft Component Plan

The objectives of "The Project for Improvement of Tha Ngon Irrigation System" are to develop agricultural infrastructure in Tha Ngon area, Xaithany District, Vientiane Capital through rehabilitation of the pump irrigation facilities used over a long period, and then, to contribute to promotion of modern agriculture in Lao PDR. In this project, in addition to procurement of necessary equipment which will be implemented to achieve the project purpose, technical support through a soft component will be implemented at the same time for development of administration, operation and maintenance (A-O&M) structure for smooth utilization of the procured equipment.

1－1 Situation of maintenance of irrigation facilities

（1）Current Structure for Administration, Operation and Maintenance

Irrigation facilities in Lao PDR are classified into the following three types according to their areas: small (less than 100 ha); medium (100 to 1000 ha); and large (more than 1000 ha). The Government of Laos (GOL) is responsible for maintaining medium and large-scaled facilities. To be precise, GOL has ownership of the main facilities and responsibilities of their construction and replacement. However, the sub canals and the other facilities are managed in cooperation between GOL and Water User Association (WUA). In the case of Tha Ngon area, Tha Ngon Irrigation Project Office (hereinafter "the office") is in charge of management of the irrigation pump station, the drainage pump station, the reservoir, the main canal, the main drainage canal and No.1 / No.2 Nong Sam Kha Dam whose water source are different from the irrigation pump station. The office assigns operators for both the irrigation and drainage pump stations and delegates operation of the turnouts on the main canal and the check structures to local famers. The secondary canals branched from the turnouts are managed by WUA. However, users are in charge of cleaning each part of the main canal passing through each village.

Water fees are collected by collectors (group leaders as described below) assigned in five groups (as described below) set in WUA. The collectors receive 17 % of the fees, and 3 % is returned as management fee to the six villages which the groups belong to.

Moreover, the farmers who have a contract for use of irrigation water with the office before the dry season every year are recognized as members of WUA. Most of the irrigation users are members of WUA, however, there are some farmers who are charged for water use without a contract (e.g. the farmers who draw irrigation water by siphons on the north side of the main canal). The farmers who do not have a contract do not need to follow the rules of WUA, and they do not have responsibility for A-O&M of the irrigation system.

（2）Operating Structure and Situation of the office

The office belongs to the Provincial Agriculture and Forestry Office of the Vientiane Capital (PAFO as described in 6-1 (3)). There are totally 14 members including the director in the office. Seven of them are officers of the Vientiane Capital. The other seven consists of an employee by contract and volunteers paid from water fee (six persons). The office has three units under the director. They are Administration Unit (3 persons), Extension Unit (3 persons) and Operation and Maintenance Unit (5 persons). Moreover, two operators are located in the irrigation pump station and one in the drainage pump station, but all of them are contracted or volunteer staff. The organization chart of the office is shown in Figure 1.

A-O&M of Tha Ngon irrigation system by GOL is mainly conducted by Operation and Maintenance Unit and Administration Unit of the office. These units are respectively in charge of O&M of the system and accounting operations such as collection of water fees. The Extension Unit works on agricultural guidance in the target area, and it has a close relationship with irrigation agricultural promotion.

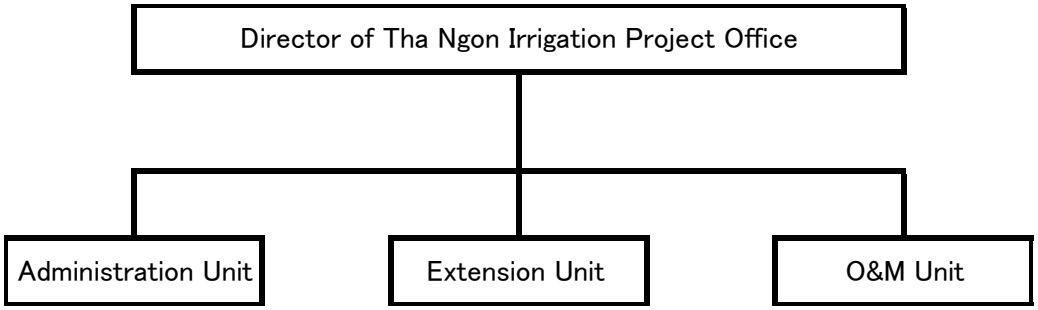

Figure 1: Organization chart of Tha Ngon Irrigation Project Office

The two units call representatives of the irrigation users together for meetings to announce water allotment and irrigation schedule every September or October, before the irrigation period begins. Amounts of water intake are continuously unequal between the upstream and downstream during the irrigation period, which is not as the office planned, due to malfunction of the turnouts. Furthermore, during the irrigation period, the office is in charge of pump operation and various problems regarding O&M of the facilities.

The office also has an Extension Unit and hopes to implement guidance for farm management, cooperating with other organizations such as the Rice Seed Product Center. However, this activity has not fully started because the person in charge has just been assigned to the office.

（3）System and Activities of WUA

WUA consists of five villages (groups) divided by the boundaries between the villages and the sub canals branched from the turnouts as shown in Table 1. The farmers who have a contract with the office are recognized as members of WUA as mentioned above. The numbers of the members in the dry season 2017, which started from October 2016, are indicated in Table 1.

There is a group leader in each group of WUA, who is elected by mutual vote among the farmers. They are in charge of (1) confirmation of water allotment rules in general meetings, (2) cleaning of the main canal, (3) management of irrigation water use, (4) monitoring of irrigation water use (data collection such as cultivation area during the cultivation period and calculation of payment amounts), (5) necessary information supply on pests and diseases, and (6) collection of water fees. Among these, the role as collectors of water fees is the most important. Consequently, the office takes initiative of the activities of WUA.

Table 1: Number of the WUA Members in the Dry Season 2017

Groups	No. of the sub canals	Sub-total	Total	Remarks
Ban Kengkhai Group	No.1, No.4	13	30	Sub canal No.3 is used by Rice Seed Product Center
	No.2, No.5	17		
Ban Thasommor Group	No.6	16	110	
	No.7-1	14		
	No.7-2	12		
	No.8	21		
	No.9	24		
	No.10	4		
	No.11, No.12	19		
Ban Lakhouay Group	SC1	21	31	The northern and western canals of the floating pump (not functioning as No. 13)
	SC2	10		
Ban Oudomphon Group	I-NS	13	39	
	I-SS	19		
	Others	7		
Ban Phoukham Group	Secondary: No.1 Tertiary: No. 3	35	35	
Total			245	

１－２ Background of Implementation of Soft Component

The irrigation facilities, mainly the pump facilities in Tha Ngon area, will be rehabilitated by implementation of the project and will fulfill their original functions. A-O&M of the system will be continued by the existing organizations as currently done for the near term, though Lao PDR aims to transfer the O&M authorities of the facilities to WUA in the future. The office will basically take the initiative of O&M of the facilities and the main role of WUA (the group leaders) will be collection of water fees.

The office is in charge of the irrigation system (irrigated area: 1,700 ha) constructed by Japan's Grant Aid "the Agricultural, Rural Development Project in the Suburbs of Vientiane (KM6 Project)" (1990-1992) in parallel with this project. Therefore, it is forced to handle A-O&M of the irrigation system with limited personnel resources. The current issues about the handling the information based on the collecting water fee and A-O&M of the system which the office has are indicated below.

Issue 1: Necessary information for administration of irrigation system is neither integrated nor organized.

In order to implement administration of irrigation system effectively, it is necessary that basic information such as land register, list of WUA members, financial information, minutes of meetings is integrated and organized systematically.

Although land registers are organized only in some areas, and data of water fees is also summarized as a list by the persons in charge, a system for integration and organizing of information has not been established in the office.

Issue 2: Necessary information for O&M of irrigation system is neither integrated nor organized.

O&M of the system is undertaken by the staff of Operation and Maintenance Unit. The staff has dealt with different problems not by systematic procedures but by general rule of thumb.

The information is neither integrated nor organized, as inventory of the irrigation facilities and drawings are scattered and pump and distribution flow rates, duration of irrigation and working records are stored at the individual level by the person in charge.

Issue 3: Necessary information for A-O&M is not shared between the stakeholders.

Although each unit has defined work, the staff neither share the documents regarding conditions of A-O&M nor comprehend the whole vision of the documents. They exchange information by spoken communication because they do not have rule to judge with whom information should be shared.

Various kinds of documents necessary for A-O&M are not so organized that the staff can browse them as necessary, although they store the documents by their hands.

2. Objective of Soft Component

The objective of this soft component is defined as "The office establishes contents of basic information necessary for A-O&M and methods to integrate, organize and share information" based on the issues mentioned in the previous section. The overall goal is set as "The office continues administration, operation and maintenance utilizing the basic integrated and organized information."

3. Outputs of Soft Component

Expected outputs of the soft component are as follows:

Output 1: Administration Unit of the office integrates and organizes information necessary for administration of the irrigation system.

Output 2: Operation and Maintenance Unit and Extension Unit of the office integrates and organizes information necessary for operation and maintenance of the irrigation system.

Output 3: The office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders.

4. Procedure of Confirming the Achievement of Outputs

Indicators to confirm the degree of output achievement of the soft component are defined in Table 2.

Table 1: Indicator of Each Output in the Soft Component

Outputs	Indicators
Output 1: Administration Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for administration of the irrigation system.	The documents regarding administration of the irrigation system (e.g. land register, list of WUA members, financial information such as income and expenditure of water fees, minutes of meetings) are classified and organized
Output 2: Operation and Maintenance Unit and Extension Unit of Tha Ngon Irrigation Project Office integrates and organizes information necessary for operation and maintenance of the irrigation system	The documents regarding maintenance of the irrigation system (e.g. inventory of the irrigation facilities, drawings, pump and distribution flow rates, duration of irrigation, working records) are classified and organized
Output 3: Tha Ngon Irrigation Project Office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders	Data on operation and maintenance are filed in paper folders and are open access

5. Plan of Soft Component Activities (Input Plan)

In order to produce effects soon after completion of the Project, various kinds of forms will be classified and organized in this soft component. Staffs of the Administration Unit, the Extension Unit and the Operation and Maintenance Unit of the office are the targets of all activities.

5－1 Output 1: Administration Unit of the office integrates and organizes information necessary for administration of the irrigation system.

Activity 1: Grasp the overview of the documents regarding administration of the irrigation system owned by the office

Activity 2: Select contents of the documents necessary for administration of the irrigation system, and classify and organize the documents by the contents

Activity 3: Learn how to prepare documents necessary for administration of the irrigation system

The documents regarding administration of the irrigation system (e.g. land register, list of WUA members, financial information such as income and expenditure of water fees, minutes of meetings) prepared by the office will be grasped, and then, the contents will be reviewed and the documents will be classified and organized. Later, the office staff will learn how to prepare documents using actual data with support from the Japanese consultant team.

5－2 Output 2: Operation and Maintenance Unit and Extension Unit of the office integrates and organizes information necessary for O&M of the irrigation system.

Activity 1: Grasp the overview of the documents regarding O&M of the irrigation system owned by the office

Activity 2: Select contents of the documents necessary for O&M of the irrigation system, and classify and organize the documents by the contents

Activity 3: Learn how to prepare documents necessary for O&M of the irrigation system

The documents regarding O&M of the irrigation system (e.g. inventory of the irrigation facilities, drawings, pump and distribution flow rates, duration of irrigation, working records) prepared by the office will be grasped, and then, the contents will be reviewed and the documents will be classified and organized after examining the contents. Later, the office staff will learn how to prepare documents using actual data with support from the Japanese consultant team.

5－3 Output 3: The office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders.

Activity 1: Grasp the approval flow of documents regarding administration, operation and maintenance of the irrigation system

Activity 2: Specify the approval flow and the persons to prepare and share the documents regarding administration, operation and maintenance of the irrigation system

Activity 3: Share the documents regarding administration, operation and maintenance of the irrigation system

The office will specify the related persons and how to share and approve the documents necessary for A-O&M of the irrigation system. Then, data on A-O&M will be open access.

6. Procurement Methods of Implementation Resources

To carry out the activities of this soft component it is necessary to have similar experiences to the planned contents, in addition to technical skills and knowledge on participatory irrigation management. Therefore, the activities will be carried out directly by Japanese consultants.

6－1 Human Resources

(1) Japanese Consultant Team (an expert of "A-O&M of irrigation system" and a local interpreter)

A Japanese consultant will be in charge of preparation, management and reports in all the activities. A consultant who has experience and knowledge regarding A-O&M and soft component of irrigation system is qualified for implementation of the activities in the short term. Understanding the local situation is also required. Therefore, it is recommended to procure human resource from the consulting firm contracted for the detailed design. In addition, procurement of a Lao-English interpreter is also needed because the office members do not understand English.

(2) The office (Targets of the soft component)

Nine persons consisting of the leaders, group leaders and sub-group leaders or other members from the three units of the office (Operation and Maintenance Unit, Extension Unit and Administration Unit) are expected to be targets of the soft component.

They are engineers, extension workers and accountants respectively. Therefore, the activities of Output 1 are mainly conducted by Administration Unit and those of Output 2 are conducted by Operation and Maintenance Unit and Extension Unit although members from all of the units will be asked to participate in

all of the activities. Output 3 is expected to be conducted in cooperation between the three units.

(3) Provincial Agriculture and Forestry Office (PAFO)

PAFO exercises jurisdiction over the office and has authority to apply to the national government for, and distribute appropriately, budget to cover the cost of A-O&M of the system. Therefore, support by PAFO is essential for maintenance after this soft component and implementation of monitoring plan. Although the office receives support from PAFO at the moment, to strengthen collaboration and deepen mutual understanding with the office, participation of members from the Irrigation Division of PAFO as observers of the soft component will be requested.

6－2 Other Resources

Other resources required for implementation of this soft component are shown below in Table 3.

Table 3: Necessary Resources

Items	Descriptions
Vehicles	For transportation of the Japanese consultant team and the interpreter
Computers and multifunction printer (Scan function included)	For document preparation, saving and printing
Folders	For document organizing
Copy paper	For document printing
Projector and screen	For explanation and confirmation of documents with the office staff
Shelves	For document disclosure

7. Implementation Schedule of Soft Component

It is preferable that this soft component plan is implemented using the facilities after renovation, in the irrigation period. The Japanese consultant team will be dispatched once, and a Lao-English interpreter will be employed throughout the implementation schedule as indicated in Table 4 and 5.

Table 4: Implementation Plan of the Soft Component

Schedule of Activities	Months 1	Months 2
Duration of Assingment	■	■
(1) Preparation in Lao PDR	■	
(2) Output 1 Administration Unit of the office integrates and organizes information necessary for administration of the irrigation system	■	■
Activity 1 Grasp the overview of the documents regarding administration of the irrigation system owned by Tha Ngon Irrigation Office	■	
Activity 2 Select contents of the documents necessary for administration of the irrigation system, and classify and organize the documents by the contents	■	■
Activity 3 Learn how to prepare documents necessary for maintenance of the irrigation system	■	■
(3) Output 2 Operation and Maintenance Unit and Extension Unit of the office integrate and organize information necessary for operation and maintenance of the irrigation system	■	■
Activity 1 Grasp the overview of the documents regarding operation and maintenance of the irrigation system owned by the office	■	
Activity 2 Select contents of the documents necessary for operation and maintenance of the irrigation system, and classify and organize the documents by the contents	■	■
Activity 3 Learn how to prepare documents necessary for operation and maintenance of the irrigation system	■	■
(4) Output 4 The office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders	■	■
Activity 1 Grasp the approval flow of documents regarding administration, operation and maintenance of the irrigation system	■	
Activity 2 Specify the approval flow and the persons to prepare and share the documents regarding administration, operation and maintenance of the irrigation system	■	■
Activity 3 Share the documents regarding administration, operation and maintenance of the irrigation system	■	■
(5) Preparation of final report		■

Table 5: Required Time for Implementation of the Soft Component

Outputs	Activities		Days
(Preparation in Lao PDR)	(Grasp the documents for Administration, Operation and Maintenance, etc.)		2
Output 1: Administration Unit of the office integrates and organizes information necessary for administration of the irrigation system	Activity 1	Grasp the overview of the documents regarding administration of the irrigation system owned by the office	3
	Activity 2	Select contents of the documents necessary for administration of the irrigation system, and classify and organize the documents by the contents	3
	Activity 3	Learn how to prepare documents necessary for administration of the irrigation system	5
Output 2: Operation and Maintenance Unit and Extension Unit of the office integrate and organize information necessary for O&M of the irrigation system	Activity 1	Grasp the overview of the documents regarding O&M of the irrigation system owned by the office	3
	Activity 2	Select contents of the documents necessary for O&M of the irrigation system, and classify and organize the documents by the contents	3
	Activity 3	Learn how to prepare documents necessary for O&M of the irrigation system	5
Output 3: The office shares information necessary for administration, operation and maintenance of the irrigation system with the stakeholders	Activity 1	Grasp the approval flow of documents regarding administration, operation and maintenance of the irrigation system	4
	Activity 2	Specify the approval flow and the persons to prepare and share the documents regarding administration, operation and maintenance of the irrigation system	4

Outputs	Activities		Days
	Activity 3	Share the documents regarding administration, operation and maintenance of the irrigation system	5
Final Report	－	－	1
Sub-total	－	－	38
International Travel	－	－	3
Summarizing	－	－	10
Total	－	－	51

Required number of days for each activity is separately calculated for convenience. However, the activities will be implemented in parallel as shown in Table 3.

8. Deliverables of the Soft Component

Deliverables of this soft component are as shown in Table 6.

Table 6: Deliverables of the Soft Component

Outputs	Deliverables
Output 1	Documents necessary for administration of the irrigation system (land register, list of WUA members, financial information, minutes of meetings)
Output 2	Documents necessary for operation and maintenance of the irrigation system (pump operation reports, records of facility maintenance, etc.)
Output 3	Approved list of documents necessary for A-O&M of the irrigation system
Completion of the soft component	Final report

9. Obligation of the Recipient Country

To achieve the objective of the soft component, continuous A-O&M by PAFO and the office is indispensable, in addition to the outputs of the soft component. Continued support by the implementation agency (DOI) is also required to maintain the A-O&M structure which will be organized by this soft component plan. Necessary duties of each organization are as follows.

［Department of Irrigation, Ministry of Agriculture and Forestry (DOI)］

- Holding of meetings at suitable times for Tha Ngon irrigated system management committee (DOI+PAFO) and awareness of the conditions of the facilities
- Comprehension of contents for A-O&M plan of the irrigation system in Tha Ngon and guidance for PAFO
- Appropriate budget approval for A-O&M of the irrigation system in Tha Ngon

［Provincial Agriculture and Forestry Office (PAFO)］

- Holding of meetings at suitable times for Tha Ngon irrigated system management committee (DOI+PAFO) and report on results of monitoring of the conditions of the facilities to DOI
- Comprehension of plan for A-O&M of the irrigation system in Tha Ngon and monitoring

- Appropriate budget application for A-O&M of the irrigation system in Tha Ngon
- Appropriate personnel assignment for implementation of plan for A-O&M of the irrigation system in Tha Ngon

［The office］

- Report on results of monitoring to PAFO
- Implementation of the A-O&M activities based on the plan
- Preparation and sharing of various documents regarding A-O&M
- Technical guidance and communication to WUA
- Provision of necessary resources (Folders for document organizing, Copy paper for document printing, Shelves for document disclosure)

Appendix 6
Other Relevant Data

Appendix 6 Other Relevant Data

6-1 Rainfall (1985-2014, Tha Ngon Station, Data unavailable: 2010 and 2011)

Station : Thangone
Daily Rainfall in mm

Year : 1985

Max 66.4
Total 1817.8

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	32.3	45.4	0.8	12.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	16.1	0.0	27.6	0.8	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	10.8	1.7	4.4	0.0	0.0	0.0
4	0.0	11.7	0.0	0.0	0.0	44.2	0.0	16.2	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	28.0	0.0	5.1	12.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	59.5	0.0	0.0	0.0	12.8	0.0	0.0	0.0
8	0.0	0.0	0.0	16.3	0.0	0.0	3.6	1.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	7.0	43.2	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	4.0	7.2	3.2	13.6	4.6	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	3.4	0.0	49.5	4.1	13.1	2.8	0.0	0.0
12	0.0	0.0	0.0	0.0	7.0	61.8	4.3	0.0	53.4	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	9.9	22.4	6.8	0.0	15.7	0.5	0.0	0.0
14	0.0	0.0	0.0	0.0	66.4	27.4	22.3	7.0	4.8	0.0	0.0	0.0
15	0.0	1.0	0.0	0.0	0.6	1.8	0.0	3.0	0.6	0.0	0.0	0.0
16	0.0	11.0	0.0	1.8	1.5	0.0	0.0	2.4	1.5	32.2	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	25.0	14.6	2.8	0.0	40.8	0.0	0.0
18	0.0	0.0	0.0	24.0	0.0	57.6	12.4	47.2	0.0	1.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	50.5	65.8	9.8	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	20.3	14.4	0.0	2.4	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	25.4	0.0	19.2	0.0	15.6	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	36.4	0.1	46.2	25.8	0.0	0.0
23	0.0	0.0	0.0	0.0	5.1	9.9	4.8	2.8	20.0	4.0	0.0	0.0
24	0.0	8.0	0.0	1.4	8.4	0.0	0.0	2.4	0.0	0.0	0.0	0.0
25	16.0	0.0	15.4	9.2	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	4.4	0.2	17.6	0.8	0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	8.3	0.0	6.5	0.6	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	1.2	5.4	7.7	4.0	0.4	45.0	2.2	0.0
29	0.0		0.0	0.0	1.3	62.3	10.6	1.9	18.0	0.6	0.0	0.0
30	0.0		0.0	3.0	2.8	9.3	0.8	0.0	0.0	1.2	0.0	0.0
31	0.0		0.0		7.2		9.0	24.0		0.0		0.0
Total	20.4	31.9	31.0	56.5	191.2	490.8	359.8	214.2	249.5	170.3	2.2	0.0
Maxi	16.0	11.7	17.6	24.0	66.4	62.3	65.8	47.2	53.4	45.0	2.2	0.0

Station : Thangone
Daily Rainfall in mm

Year : 1986

Max 120.8
Total 479.9

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	12.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8
5	0.0	0.0	0.0	7.6	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.2
6	0.0	0.0	0.0	28.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	4.2
8	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	25.7	0.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	12.8	0.0	120.8	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	28.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	16.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	12.9	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	9.0	0.0	18.4	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	5.4	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	27.2	0.0	52.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	20.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0		0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		0.0		0.0		0.0	0.0		0.0		0.0
Total	0.0	0.0	0.0	173.8	0.0	299.9	0.0	0.0	0.0	0.0	0.0	6.2
Maxi	0.0	0.0	0.0	28.0	0.0	120.8	0.0	0.0	0.0	0.0	0.0	4.2

Station : Thangone
Daily Rainfall in mm

Year : 1987

Max 109.0
Total 1869.5

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	19.0	0.0	35.8	2.0	15.8	0.0	0.0
2	0.0	0.0	5.0	0.0	0.0	13.8	0.0	4.4	44.6	30.9	11.0	0.0
3	0.0	0.0	3.0	0.0	0.0	0.0	3.0	55.0	31.2	0.0	0.5	0.0
4	0.0	0.0	0.3	0.0	11.0	18.8	0.3	0.0	6.2	0.0	0.0	0.0
5	0.0	0.0	20.0	0.0	3.0	39.0	1.2	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.2	0.0	6.2	0.0	1.1	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	22.0	0.0	13.5	0.0	0.0	44.7	0.8	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	25.1	0.0	0.6	5.8	1.2	0.1	0.0
9	0.0	0.0	0.0	0.0	0.0	15.5	20.5	4.7	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	15.0	0.2	15.6	8.5	0.0	0.0	0.0
11	0.0	0.0	0.2	5.8	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	86.0	0.0	6.7	0.0	0.0	0.0	0.0
13	0.0	0.0	10.0	0.0	7.0	2.0	0.0	0.0	0.5	0.0	4.2	0.0
14	0.0	0.0	0.0	0.0	0.0	4.6	0.0	1.6	0.0	0.0	5.8	0.0
15	0.0	0.0	77.2	0.0	0.0	2.0	5.7	7.8	0.0	0.0	32.2	0.0
16	0.0	0.0	0.0	0.0	0.0	10.4	76.4	35.0	2.2	0.0	0.0	0.0
17	0.0	0.0	0.0	10.0	0.0	1.0	109.0	47.8	0.4	0.0	9.8	0.0
18	0.0	0.0	0.0	0.0	17.6	0.0	0.8	17.9	16.4	14.8	19.4	0.0
19	0.0	0.0	0.0	0.0	0.0	7.2	0.6	7.2	4.8	0.0	0.0	0.0
20	0.0	9.2	0.0	0.0	0.0	7.8	0.0	0.4	10.2	1.2	0.0	0.0
21	0.0	33.2	12.8	4.8	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	12.8	0.0	56.2	0.8	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	58.0	73.4	7.2	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.6	4.1	1.2	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4	86.0	0.0	0.0	0.0
26	0.0	0.0	0.0	17.4	0.0	0.0	5.4	0.8	14.8	0.0	0.0	0.0
27	0.0	0.0	0.0	0.4	2.0	52.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	2.0	0.0	25.7	0.0	0.0	0.0	0.0	0.0
29	0.0		4.0	0.0	14.8	25.0	0.4	0.0	37.4	0.0	0.0	0.0
30	0.0		0.0	0.0	0.0	0.0	5.2	1.0	4.4	0.0	0.0	0.0
31	0.0		0.0		0.0		13.2	2.0		0.0		0.0
Total	0.0	42.4	132.7	58.4	63.6	385.5	327.9	382.0	329.3	64.7	83.0	0.0
Maxi	0.0	33.2	77.2	22.0	17.6	86.0	109.0	73.4	86.0	30.9	32.2	0.0

Station : Thangone
Daily Rainfall in mm

Year : 1988

Max 61.0
Total 1294.0

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	32.0	6.5	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	10.7	0.0	4.7	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	16.4	0.0	2.5	10.5	0.0	0.0	0.0	0.0
4	0.0	0.0	0.2	0.0	4.0	2.5	9.7	2.2	0.0	0.0	0.0	0.0
5	0.0	0.0	0.9	0.0	0.0	19.0	0.0	14.6	15.8	1.6	0.0	0.0
6	0.0	0.0	0.0	0.9	6.8	6.4	0.0	3.3	0.0	16.6	0.0	0.0
7	0.0	0.0	9.1	0.0	2.2	0.0	0.0	23.2	18.2	38.7	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	4.0	20.0	0.0	0.0
9	0.0	0.0	0.0	0.0	2.2	1.4	0.0	0.6	0.0	2.6	0.0	0.0
10	0.0	0.0	0.0	0.0	4.4	0.0	0.0	15.4	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	57.2	0.0	0.0	1.4	41.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	8.7	0.0	8.7	11.8	0.0	1.0	0.0	0.0
13	0.0	0.0	0.0	61.0	18.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	2.8	0.0	0.0
15	0.0	0.0	0.0	10.2	11.8	0.0	45.4	0.2	14.0	4.4	0.0	0.0
16	0.0	0.0	0.0	0.0	38.2	2.6	0.6	0.0	0.0	4.6	0.0	0.0
17	0.0	0.0	0.0	0.0	32.6	0.0	15.0	28.2	0.0	5.2	0.0	0.0
18	0.0	0.0	0.0	9.4	0.0	33.0	3.2	54.0	0.0	5.8	0.0	0.0
19	0.0	0.0	0.0	0.4	0.0	3.8	1.0	4.0	0.0	0.0	0.0	0.0
20	0.0	0.0	10.4	0.0	0.0	0.0	4.1	58.8	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.4	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	8.2	0.0	11.4	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.6	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.8	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	18.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	4.0	31.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	40.0	0.0	2.1	0.0	2.2	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	7.1	5.8	25.0	1.2	6.8	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	3.2	0.0	2.5	24.0	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	0.0	27.6	0.0	57.4	0.0	0.0	0.0	0.0
31	0.0		0.0		0.0		0.0	30.8		0.0		0.0
Total	0.0	0.0	20.6	81.9	252.8	157.9	134.5	401.6	102.0	142.7	0.0	0.0
Maxi	0.0	0.0	10.4	61.0	57.2	33.0	45.4	58.8	41.0	38.7	0.0	0.0

Station : Thangore
Daily Rainfall in mm

Year : 1989

Max 100.0
Total 1329.8

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	2.2	0.0			0.6	26.2	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0			3.7	0.0	8.8	0.0	0.0
3	0.0	0.0	0.0	0.0	7.0			37.2	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.6			100.0	0.0	4.5	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0			6.5	0.0	7.7	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0			0.0	39.8	34.2	0.0	0.0
7	0.0	0.0	5.0	0.0	0.0			0.0	1.5	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0			9.8	32.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0			3.2	2.5	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	7.0			33.0	0.0	1.7	0.0	0.0
11	0.0	0.0	0.0	0.0	1.4			11.7	18.4	0.4	0.0	0.0
12	1.0	0.0	0.0	0.0	0.0			3.2	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	68.8			5.8	54.0	8.4	0.0	0.0
14	0.0	0.0	9.1	0.0	49.2			12.1	0.0	24.1	0.0	0.0
15	0.0	0.0	0.0	0.0	15.0			0.0	0.0	1.2	0.0	0.0
16	0.0	0.0	1.2	0.0	4.0			0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0			0.0	12.8	1.2	0.0	0.0
18	0.0	0.0	0.0	0.0	1.2			12.6	9.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0			0.0	0.0	1.2	0.0	0.0
20	0.0	0.0	0.4	0.0	0.0			23.6	0.2	0.0	0.0	0.0
21	0.0	0.0	0.7	0.0	0.0			24.0	58.4	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0			11.3	20.4	3.6	0.0	0.0
23	0.0	0.0	12.0	0.0	1.8			17.0	79.6	0.0	0.0	0.0
24	0.1	0.0	0.0	6.4	0.3			32.8	27.6	0.0	0.0	0.0
25	0.0	0.0	0.0	2.4	6.6			29.4	0.6	0.0	0.0	0.0
26	3.2	0.0	0.0	16.6	30.0			30.0	0.0	0.0	0.0	0.0
27	20.6	0.0	0.0	1.0	29.5			0.4	1.8	0.6	0.0	0.0
28	11.0	0.0	2.6	0.0	13.8			32.8	0.0	0.2	0.0	0.0
29	0.0		0.0	7.4	2.7			1.4	0.0	0.0	0.0	0.0
30	0.0		24.0	3.6	1.0			0.6	0.0	0.0	0.0	0.0
31	0.0		5.5		28.0			0.0		0.0		0.0
Total	35.9	0.0	60.5	39.6	267.9	0.0	0.0	442.7	385.4	97.8	0.0	0.0
Maxi	20.6	0.0	24.0	16.6	68.8	0.0	0.0	100.0	79.6	34.2	0.0	0.0

Station : Thangore
Daily Rainfall in mm

Year : 1990

Max 92.2
Total 1604.7

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.6	0.0	0.0	33.1	0.0	3.6	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	39.2	8.0	0.0	14.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	2.2	45.8	3.6	13.2	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	92.2	0.7	12.5	43.6	4.8	1.6	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	27.8	1.2	0.0
6	0.0	0.0	0.0	0.3	0.0	0.0	10.6	0.0	3.0	1.0	35.2	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	24.8	8.7	8.0	0.0
8	0.0	0.0	0.3	0.4	0.0	0.0	0.0	0.0	39.2	0.0	0.0	0.0
9	0.0	0.0	1.8	0.0	0.0	32.2	0.0	0.0	11.2	0.0	7.6	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	20.6	0.0	0.0	0.0
11	11.3	0.0	0.0	0.0	0.0	49.0	8.4	10.3	22.4	0.0	0.0	0.0
12	0.0	3.8	0.0	0.0	0.0	12.3	0.0	0.0	10.6	0.0	0.6	0.0
13	0.0	0.0	26.4	7.2	0.0	0.2	0.0	0.0	58.2	0.0	0.0	0.0
14	0.0	0.0	1.3	0.0	0.0	0.0	0.0	4.0	8.8	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	18.0	1.1	1.0	0.2	5.2	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	1.6	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	6.8	0.0	26.2	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	14.7	7.6	33.4	0.0	1.2	0.0	0.0	0.0
20	0.0	0.0	14.8	0.1	31.9	0.6	16.6	0.0	17.4	5.2	0.0	0.0
21	0.0	0.0	1.2	0.0	22.9	4.7	6.8	0.0	0.8	0.4	0.0	0.0
22	0.0	0.0	2.6	0.0	14.4	0.0	10.2	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	23.2	0.2	1.0	19.8	0.0	0.0	0.0	0.0
24	0.0	6.4	0.0	0.0	33.4	15.0	3.6	12.2	51.6	0.0	0.0	0.0
25	0.0	0.8	0.0	21.2	0.4	3.5	0.1	59.0	12.9	0.0	0.0	0.0
26	0.0	0.0	0.0	1.4	0.0	6.4	17.4	2.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	10.0	21.8	0.0	8.4	42.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.2	19.6	6.2	0.4	6.6	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	21.0	0.0	0.9	25.3	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	21.0	0.0	4.0	5.8	31.8	0.0	0.0	0.0
31	0.0		0.0		11.9		28.6	1.9		0.0		0.0
Total	11.3	11.0	48.4	30.8	343.6	279.6	194.1	226.0	362.9	44.4	52.6	0.0
Maxi	11.3	6.4	26.4	21.2	92.2	49.0	33.4	59.0	58.2	27.8	35.2	0.0

Station : Thangone
Daily Rainfall in mm

Year : 1991

Max 105.2
Total 1294.5

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	8.4	0.0	0.0	0.0	0.0	1.8	0.0	10.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.0	7.8	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	31.4	8.4	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	15.7	1.2	0.0	1.6	0.0	0.0	0.0
5	0.0	0.0	0.0	2.0	0.0	0.0	2.6	9.8	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	0.0	3.6	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	1.2	9.2	64.2	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	22.6	2.6	0.0	5.4	0.5	0.8	0.0	0.0
9	0.0	0.0	0.0	0.0	81.6	0.0	0.0	0.0	47.6	0.0	0.0	0.0
10	0.0	0.0	0.0	2.0	0.0	1.2	0.0	0.0	32.4	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.6	2.8	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	2.2	8.2	4.2	0.6	0.0	0.0	0.0
13	0.0	0.0	10.8	0.0	12.6	2.0	15.2	3.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	10.3	14.8	9.2	0.0	0.0	0.0
15	0.0	0.0	0.0	0.6	4.4	0.0	61.4	19.7	105.2	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	8.0	0.0	17.4	0.0	2.7	0.0	0.0
18	0.0	0.0	0.0	0.0	1.2	0.0	0.0	19.4	47.3	0.0	0.0	0.0
19	0.0	0.0	0.0	22.0	0.0	0.2	0.0	6.6	4.2	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	1.0	56.2	0.0	0.0	24.2	3.4	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	1.3	4.2	0.2	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	5.9	54.3	4.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	2.0	5.0	32.4	1.2	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	1.2	29.2	10.0	0.7	0.0	0.0	0.0
26	0.0	0.0	0.0	19.6	1.8	7.8	16.0	11.6	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.6	0.0	8.8	0.0	2.4	48.8	0.0	0.0	6.2
28	0.0	0.0	0.0	0.0	0.0	7.0	13.0	8.4	26.6	0.0	0.0	0.0
29	0.0		4.0	0.0	0.0	0.0	1.2	11.0	10.0	0.0	0.0	2.2
30	0.0		28.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0
31	0.0		0.2		2.2		0.0	3.3		0.0		0.0
Total	0.0	0.0	51.4	47.8	182.6	67.1	224.8	305.0	379.1	28.3	0.0	8.4
Maxi	0.0	0.0	28.0	22.0	81.6	15.7	61.4	64.2	105.2	10.0	0.0	6.2

Station : Thangone
Daily Rainfall in mm

Year : 1992

Max 128.8
Total 2072.3

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	6.4	0.0	0.0	0.0	0.0	0.0	25.8	19.4	57.5	0.0	0.0
2	21.6	0.0	0.0	0.0	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.0
3	32.2	0.0	0.0	0.0	0.0	0.5	0.0	43.0	0.4	20.3	0.0	0.0
4	5.4	0.0	0.0	0.0	55.6	128.8	0.0	4.6	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	3.4	0.0	10.6	20.2	0.0	0.0	0.0
6	8.4	0.0	0.0	0.0	0.0	24.4	8.1	13.2	0.4	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	43.7	8.8	0.0	1.3	0.0	0.0	0.0
8	1.2	0.0	0.0	0.0	0.0	1.6	26.3	0.0	13.8	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	89.5	30.8	1.2	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	2.6	0.0	1.0	4.4	0.1	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	8.0	60.3	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	9.3	6.6	39.5	22.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	24.6	9.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	14.0	0.8	78.2	0.0	29.6	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.8	48.0	37.0	4.0	20.0	0.0	0.6	0.0
16	0.0	0.0	0.0	0.0	7.2	7.8	0.0	19.0	0.6	0.6	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.7	2.4	0.2	0.0	0.0
18	0.0	0.0	0.0	0.0	28.4	2.0	0.0	0.0	19.8	0.2	0.0	0.0
19	0.0	0.0	0.0	0.0	36.6	5.2	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	1.8	0.2	0.0	39.4	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.6	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	2.4	0.0	26.4	52.0	0.6	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	87.8	0.0	24.4	11.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	5.8	38.6	1.6	6.0	87.6	8.3	0.0	0.0	25.8
25	0.0	0.0	0.0	0.0	2.8	0.0	35.7	0.0	0.0	0.0	0.0	0.2
26	0.0	30.0	0.0	0.0	8.6	0.0	28.4	8.8	0.0	0.0	0.0	0.0
27	0.0	2.5	0.0	0.0	4.6	1.5	1.2	45.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	8.5	0.0	0.0	6.4	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	16.8	0.0	0.0	6.4	119.2	0.0	2.8	0.0	0.0
30	0.0		0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		0.0		0.0		21.4	12.2		0.0		0.0
Total	68.8	38.9	0.0	22.6	315.8	365.3	453.3	521.9	177.5	81.6	0.6	26.0
Maxi	32.2	30.0	0.0	16.8	87.8	128.8	89.5	119.2	39.4	57.5	0.6	25.8

Station : Thangore
Daily Rainfall in mm

Year : 1993

Max 127.6
Total 1635.8

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	1.2	5.0	1.2	4.5	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	12.2	12.8	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.4	37.8	127.6	1.0	12.2	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	2.2	0.2	48.9	11.7	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	13.6	7.3	0.2	2.2	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	15.4	0.0	0.6	13.8	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.4	4.2	0.0	4.0	10.9	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	64.4	9.2	3.6	21.5	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	8.7	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	3.3	8.0	2.2	33.6	0.0	0.0	0.0
12	0.0	0.0	0.0	0.4	11.4	3.8	67.5	0.0	2.8	0.0	0.0	0.0
13	0.0	0.0	0.0	2.8	0.3	0.0	11.8	18.0	0.0	0.0	0.9	0.0
14	0.0	0.0	0.0	0.0	0.0	2.5	17.2	2.4	0.8	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	3.0	1.4	34.9	0.3	7.2	0.0	0.0	0.0
16	0.0	4.2	0.0	0.0	0.0	0.0	0.0	6.6	2.8	0.0	0.0	0.0
17	0.0	0.0	0.0	2.2	8.6	0.0	13.5	8.7	46.2	0.0	0.0	0.0
18	0.0	1.6	0.0	0.0	32.4	0.0	0.7	0.0	14.8	0.4	0.0	0.0
19	0.0	0.0	0.0	0.0	24.4	0.0	0.0	0.0	0.6	0.2	0.0	0.0
20	0.0	0.0	0.0	0.0	21.4	0.3	0.0	0.0	22.8	0.0	0.0	0.0
21	0.0	0.0	13.2	6.4	0.0	0.0	0.0	2.5	0.2	0.0	0.0	0.0
22	0.0	0.0	0.0	3.6	40.8	22.6	0.0	10.5	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	10.6	81.0	0.0	5.0	26.8	0.0	0.0	0.0
24	0.0	0.0	1.0	0.0	4.4	7.2	4.0	1.8	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	12.8	29.4	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	62.6	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	33.2	68.8	4.4	2.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	5.0	14.6	7.7	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.6	8.0	61.1	0.0	32.6	9.8	0.0	0.0	0.0
30	0.0		0.0	0.0	0.6	72.3	7.6	2.6	8.5	0.0	0.0	0.0
31	0.0		0.0		14.2		0.8	19.0		0.0		0.0
Total	0.0	5.8	14.2	21.0	261.2	544.2	365.5	171.5	246.4	5.1	0.9	0.0
Maxi	0.0	4.2	13.2	6.4	40.8	81.0	127.6	32.6	46.2	4.5	0.9	0.0

Station : Thangore
Daily Rainfall in mm

Year : 1994

Max 111.4
Total 2355.0

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.6	0.0	24.2	4.8	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	16.3	0.0	12.0	20.7	0.0	0.0	39.0
3	0.0	0.0	0.0	0.0	0.0	4.6	0.0	96.4	2.6	0.0	0.0	14.2
4	0.0	0.0	0.0	0.0	0.0	12.3	0.0	2.2	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	111.4	1.0	0.2	2.2	6.4	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	10.8	0.6	9.8	15.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	46.6	0.0	13.8	1.4	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	24.0	11.6	4.6	37.0	5.6	0.0	0.0	0.0
9	0.0	10.8	0.0	0.0	25.6	59.9	10.6	1.5	3.2	0.0	0.0	0.0
10	0.0	0.0	2.2	0.0	19.8	8.8	10.0	0.0	24.8	75.6	0.0	0.0
11	0.0	0.0	0.0	0.0	1.4	20.9	0.0	0.0	0.0	15.2	0.0	0.0
12	0.0	17.2	0.0	0.0	0.0	1.4	2.0	0.0	0.2	23.2	0.0	0.0
13	0.0	0.0	0.0	0.2	12.6	1.8	11.3	0.0	2.9	7.8	0.0	0.0
14	0.0	0.0	21.2	0.6	0.0	0.0	23.3	2.6	7.0	5.4	0.0	0.0
15	0.0	10.4	0.0	0.0	0.0	4.8	35.8	31.6	29.6	4.0	0.0	0.0
16	0.0	0.0	0.0	0.0	31.8	0.0	38.9	83.4	59.6	10.4	0.0	0.0
17	0.0	0.0	0.0	0.0	0.3	1.8	28.2	10.5	7.2	1.1	0.0	0.0
18	0.0	0.0	0.0	6.7	38.2	1.1	18.3	9.7	12.4	0.0	0.0	0.0
19	0.0	0.0	0.0	4.0	16.0	76.0	0.3	8.9	14.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	36.4	7.3	0.0	23.2	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	24.0	23.9	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	72.6	0.0	0.0	16.8	0.0	1.0	59.4	0.0	0.0	0.0
23	0.0	0.0	26.5	0.0	0.0	4.6	0.0	1.0	7.1	0.0	0.0	0.0
24	0.0	0.0	0.4	0.0	0.0	4.1	0.0	18.7	32.6	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.3	0.0	16.5	0.2	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	19.2	1.6	0.0	7.4	0.7	0.0	0.0	0.0
27	0.0	0.0	20.2	36.4	4.1	15.6	4.5	0.0	7.0	0.0	0.1	0.0
28	0.0	0.0	1.3	0.0	0.4	0.0	0.4	0.0	0.0	0.0	0.1	0.0
29	0.0		0.0	0.0	0.0	20.4	0.0	24.4	0.0	0.0	0.0	0.0
30	0.0		12.6	0.0	24.6	31.0	31.0	39.5	0.0	0.0	0.0	0.0
31	0.0		0.0		32.9		52.2	13.9		0.0		0.0
Total	0.0	38.4	157.0	47.9	311.3	516.3	273.0	489.4	320.2	148.1	0.2	53.2
Maxi	0.0	17.2	72.6	36.4	38.2	111.4	52.2	96.4	59.6	75.6	0.1	39.0

Station : Thangone
Daily Rainfall in mm

Year : 1995

Max 138.4
Total 2493.5

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	10.3	44.0	0.0	18.7	8.4	21.2	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	16.1	11.5	0.0	24.6	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	47.8	0.0	43.8	20.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	3.8	17.0	71.8	4.8	4.2	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	3.4	34.4	61.2	12.2	0.6	0.0	0.0
6	0.0	0.0	0.0	20.6	0.0	21.2	32.7	95.4	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	12.3	1.8	18.2	37.7	17.5	16.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.4	16.4	8.9	2.1	25.8	2.2	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	19.2	0.0	0.0	13.0	0.0	0.0	0.0
10	0.0	0.0	4.0	0.0	101.3	61.6	1.6	63.6	0.0	2.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.4	16.6	0.4	7.3	23.8	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.8	10.2	0.0	19.6	0.6	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	37.8	7.1	69.4	93.4	0.8	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	10.0	27.4	17.3	88.6	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	39.2	0.0	30.4	0.0	0.4	0.0	1.6	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	10.4	0.0	53.4	8.8	2.2	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	4.5	0.0	8.2	0.6	11.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	36.4	10.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	1.5	6.1	35.4	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	6.8	0.0	20.2	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	27.1	8.2	4.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	50.9	0.7	4.2	0.0	0.0	0.0
24	0.0	0.0	0.0	5.4	0.0	6.2	0.5	0.6	0.0	0.0	0.0	0.0
25	0.6	0.0	0.0	0.0	0.0	9.4	90.2	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	5.4	0.0	6.0	27.4	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	9.0	5.3	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	29.2	5.6	7.4	133.4	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	0.0	7.3	29.0	138.4	0.0	0.0	0.0	0.0
31	0.0		0.0		10.6		64.2	23.3		0.0		0.0
Total	0.6	0.0	4.0	38.3	262.6	374.5	638.1	932.0	191.6	50.2	1.6	0.0
Maxi	0.6	0.0	4.0	20.6	101.3	61.6	90.2	138.4	43.8	21.2	1.6	0.0

Station : Thangone
Daily Rainfall in mm

Year : 1996

Max 99.5
Total 1728.1

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.8	11.3	0.0	0.0	0.0	0.0	0.8	0.0
2	0.0	0.0	0.0	0.0	0.0	5.2	7.2	0.0	29.4	0.0	0.0	0.0
3	0.0	0.0	0.0	1.2	2.7	0.0	0.0	4.6	54.4	0.0	3.7	0.0
4	0.0	0.0	0.0	0.0	0.0	0.2	0.0	22.6	4.6	19.4	24.2	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	6.6	0.0	0.0	15.2	16.6	0.0
6	0.0	0.0	0.0	0.0	0.4	2.2	0.0	0.0	4.2	12.8	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	16.4	9.6	0.0
8	0.0	0.0	0.0	0.0	4.2	20.2	0.0	0.0	0.0	1.2	0.0	0.0
9	0.0	0.0	0.0	0.0	5.0	6.4	0.0	0.7	0.0	0.0	0.0	0.0
10	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	0.0
11	0.0	0.0	0.0	49.4	2.3	0.0	86.8	21.0	7.6	0.0	0.3	0.0
12	0.0	0.0	0.0	0.0	0.0	9.4	28.2	28.1	2.8	0.0	0.0	0.0
13	0.6	0.0	0.0	0.0	0.0	12.8	6.8	8.4	4.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	3.0	0.0	4.2	39.4	0.0	0.0	0.0
15	0.0	0.0	0.0	0.6	0.0	28.2	0.0	5.0	31.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.8	38.2	7.7	0.0	4.6	0.0	0.0	0.0
17	0.0	0.0	0.0	55.8	5.4	1.7	29.6	0.0	17.8	0.0	0.0	0.0
18	0.0	15.4	0.0	0.0	4.0	10.4	6.0	0.0	13.4	0.0	0.0	0.0
19	0.0	13.0	0.0	22.9	22.3	0.0	13.4	3.8	10.8	0.0	0.0	0.0
20	0.0	15.6	0.0	0.0	0.0	9.8	0.0	0.2	5.4	0.0	0.0	0.0
21	0.0	7.0	0.0	2.8	0.0	1.0	20.8	0.0	3.5	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	8.8	0.0	0.4	8.6	54.2	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	1.2	0.0	0.8	18.8	99.5	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.4	20.2	4.0	0.0	50.0	0.0	0.0	0.0
25	0.0	0.0	3.4	12.6	20.8	49.5	19.0	4.5	0.0	0.2	0.0	0.0
26	0.0	0.0	10.7	0.0	0.0	0.6	1.8	37.9	0.0	0.0	0.0	0.0
27	0.0	0.0	44.6	13.4	0.0	2.4	3.2	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	6.6	6.0	6.4	28.1	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	7.3	12.4	0.2	17.0	0.0	0.0	0.0	0.0	0.0
30	0.0		0.0	0.9	5.2	0.5	7.0	0.0	0.0	0.0	0.0	0.0
31	0.0		0.0		0.0		4.4	54.0		0.0		0.0
Total	0.6	51.0	66.3	172.9	103.1	267.5	270.7	222.4	453.2	65.2	55.2	0.0
Maxi	0.6	15.6	44.6	55.8	22.3	49.5	86.8	54.0	99.5	19.4	24.2	0.0

Station : Thangore
Daily Rainfall in mm

Year : 1997

Max 65.8
Total 1571.2

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	7.0	6.2	18.4	1.8	0.0	0.0
2	0.0	0.0	0.0	2.8	0.0	0.0	36.1	2.2	26.2	9.8	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	40.8	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	7.0	0.7	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	35.8	0.0	1.9	36.2	0.0	0.0
6	0.0	8.0	0.0	1.4	0.0	0.0	0.8	0.0	34.1	0.8	0.0	0.0
7	0.0	0.0	0.0	18.8	0.0	4.0	0.0	3.2	1.7	0.0	0.0	0.0
8	0.0	0.0	0.0	3.8	0.0	0.0	1.2	0.0	7.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	19.6	0.0	4.8	6.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	15.8	0.0	6.4	3.6	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	8.4	41.2	0.0	1.6	0.0	0.0
12	0.0	0.0	0.0	65.8	0.0	0.0	1.8	10.7	0.0	28.8	0.0	0.0
13	0.0	0.0	0.0	24.0	4.9	0.0	24.0	4.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	23.0	14.8	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.6	0.0	29.6	27.6	3.4	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	8.2	0.0	3.8	14.6	11.4	1.8	0.0	0.0	0.0
17	0.0	0.0	18.6	0.0	0.0	11.4	12.6	35.8	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	35.2	12.0	33.2	0.4	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	15.4	0.0	0.0	24.5	0.0	2.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	24.8	0.0	13.4	0.0	0.0	0.0	0.0	0.0
21	0.5	0.0	0.0	1.4	0.0	0.0	47.2	0.0	0.0	0.0	0.0	0.0
22	0.7	0.0	0.8	0.0	0.8	0.0	59.6	13.5	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.2	1.2	3.6	34.6	0.0	0.0	0.0	0.0
24	0.0	0.0	0.4	23.0	0.0	0.2	3.2	0.1	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	36.2	1.6	10.2	34.8	13.9	0.0	0.0	0.0	0.0
26	0.0	0.0	0.2	0.0	4.1	4.7	22.5	32.3	3.7	0.0	0.0	0.0
27	0.0	0.0	2.6	0.0	0.0	12.8	21.5	8.6	0.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.4	25.6	1.6	3.0	0.0	0.0	0.0
29	0.0		0.0	0.0	9.0	5.8	18.3	46.3	0.0	0.0	0.0	0.0
30	0.0		3.4	0.0	0.0	5.6	17.4	3.8	0.1	0.0	0.0	0.0
31	0.0		0.0		0.0		22.7	25.0		0.0		0.0
Total	1.2	8.0	26.0	201.4	116.0	124.7	543.4	321.7	149.1	79.7	0.0	0.0
Maxi	0.7	8.0	18.6	65.8	35.2	29.6	59.6	46.3	40.8	36.2	0.0	0.0

Station : Thangore
Daily Rainfall in mm

Year : 1998

Max 62.8
Total 1465.2

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.6	0.0	0.0	4.0	35.6	38.8	1.9	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	1.7	16.8	5.0	23.4	0.0	0.0	0.0
3	0.0	0.0	8.0	21.2	0.0	6.7	49.9	0.0	0.1	0.0	0.0	0.0
4	0.0	10.6	14.4	0.0	1.9	3.7	15.9	0.0	0.0	0.0	0.0	0.0
5	0.0	0.7	6.0	0.1	0.0	34.2	7.3	0.6	39.6	0.0	0.0	0.0
6	0.0	0.0	1.1	0.0	0.0	40.0	3.2	8.0	10.2	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	4.0	1.6	0.0	11.0	30.1	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	1.3	4.4	9.6	46.4	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	30.2	37.0	49.3	8.0	20.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	19.0	16.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	3.1	11.6	0.0	0.0	2.4	12.4	0.0	0.0
12	0.0	0.0	0.0	0.0	40.4	0.0	0.4	0.0	0.0	3.6	0.0	0.0
13	0.0	0.0	0.0	0.0	3.5	0.0	24.0	5.6	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	13.9	15.5	5.3	20.1	0.0	0.0	0.0
15	0.0	0.0	0.0	13.6	0.0	0.0	1.2	0.0	0.2	0.0	0.0	0.0
16	0.0	0.0	0.0	12.8	0.0	0.0	7.1	9.8	3.8	0.0	0.0	0.0
17	0.0	0.0	0.0	0.1	11.2	7.8	0.0	0.0	0.0	32.2	0.4	0.0
18	0.0	0.0	0.0	3.0	0.0	0.0	2.0	11.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	22.5	0.8	0.0	7.9	14.6	0.0	0.0	0.0
20	0.0	0.0	0.0	2.8	0.0	0.6	0.0	14.2	0.0	0.0	1.6	0.0
21	0.0	0.0	0.0	0.0	0.0	2.2	0.0	15.8	0.6	0.0	1.9	0.0
22	0.0	0.0	0.0	0.0	0.0	2.1	0.0	13.8	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	12.9	31.4	5.2	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0
25	0.0	0.0	8.8	0.0	20.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	1.0	2.2	57.2	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	31.2	0.0	21.6	14.2	0.0	0.0	5.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	13.6	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	6.6	0.0	0.0	3.8	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	12.2	40.5	3.6	0.0	0.0	0.0	0.0	0.0
31	0.0		26.6		0.0		3.4	62.8		0.0		0.0
Total	0.0	11.3	96.1	53.6	148.6	233.6	316.4	321.1	212.4	68.2	3.9	0.0
Maxi	0.0	10.6	31.2	21.2	40.4	40.5	57.2	62.8	46.4	32.2	1.9	0.0

Station : Thangone
Daily Rainfall in mm

Year : 1999

Max 146.0
Total 2422.9

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	26.2	19.2	1.6	0.0	0.2	0.0
2	0.0	0.0	0.0	0.0	0.0	17.9	2.0	0.6	0.7	25.2	2.0	0.0
3	0.0	0.0	0.0	0.0	0.6	4.4	15.8	2.4	0.0	3.1	0.0	0.2
4	0.0	0.0	0.0	0.0	23.2	0.1	9.8	8.2	71.6	4.0	0.0	0.4
5	0.0	0.0	0.0	0.0	134.6	0.0	45.0	2.0	146.0	0.0	0.0	0.2
6	0.0	0.0	0.0	0.0	2.4	24.0	0.8	0.0	9.9	0.0	0.0	0.7
7	0.0	0.0	0.0	12.2	97.2	13.7	0.0	0.0	6.9	0.8	1.2	0.0
8	0.0	0.0	0.0	88.4	49.4	0.6	0.0	0.0	2.4	0.0	0.0	0.0
9	0.0	0.0	0.0	39.2	1.2	27.2	1.0	0.0	5.9	38.6	0.0	0.0
10	0.0	0.0	0.0	1.1	0.8	5.8	0.0	20.7	6.6	0.0	0.0	0.0
11	0.0	0.0	0.0	0.1	0.0	2.4	0.7	2.7	67.8	5.4	0.0	0.0
12	1.5	0.0	0.0	0.0	0.0	17.7	0.0	0.0	8.8	0.0	0.0	0.0
13	0.8	0.0	0.0	11.8	62.0	27.8	0.0	4.6	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	24.3	1.6	32.0	1.6	4.4	63.0	0.0	0.0	1.6
15	0.0	0.0	0.0	10.1	4.4	0.0	0.0	0.0	29.0	8.0	0.0	0.0
16	0.0	0.0	0.0	1.0	2.5	6.0	3.8	2.1	7.4	5.6	0.0	0.0
17	0.0	0.0	0.0	1.9	0.0	0.0	12.6	1.2	6.6	0.0	0.0	0.0
18	0.0	0.0	0.0	32.2	29.5	35.2	2.8	4.7	1.4	0.0	0.0	0.0
19	0.0	0.0	0.0	5.5	0.0	29.6	7.2	5.4	72.7	1.0	0.0	0.0
20	0.0	0.0	0.0	10.0	7.2	13.6	0.0	0.0	52.3	5.2	0.0	0.0
21	0.0	0.0	0.0	0.0	56.6	5.0	0.0	0.0	11.5	0.0	0.0	0.0
22	0.0	0.0	0.5	0.0	19.4	0.0	0.2	8.4	40.4	0.0	0.0	0.0
23	0.0	0.0	10.0	0.0	15.2	11.4	7.4	39.3	4.3	0.0	0.0	0.0
24	0.0	0.0	0.4	0.0	23.3	0.0	21.3	6.2	2.5	0.0	0.0	0.0
25	0.0	0.0	5.6	5.6	6.7	29.2	9.6	5.4	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	25.6	4.5	0.0	0.0	50.8	1.0	2.2	0.0	0.0
27	0.0	0.0	0.0	0.0	2.9	0.0	2.2	1.8	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	29.5	0.0	0.0	2.8	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	15.1	0.0	9.6	0.0	24.4	0.0	0.0	0.0
30	0.0		0.0	0.0	4.1	5.2	1.0	14.9	1.6	0.0	0.0	0.0
31	0.0		0.0		1.2		20.5	51.1		17.5		0.0
Total	2.3	0.0	16.5	267.0	594.9	388.8	207.1	258.9	646.3	114.6	3.4	3.1
Maxi	1.5	0.0	10.0	88.4	134.6	35.2	45.0	51.1	146.0	38.6	2.0	1.6

Station : Thangone
Daily Rainfall in mm

Year : 2000

Max 117.8
Total 1789.4

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	2.2	0.0	9.4	0.0	0.0	2.0	5.4	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	22.4	0.0	6.6	6.1	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	50.2	0.0	0.2	29.3	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	13.2	0.3	117.8	1.1	11.8	11.5	0.0	0.0
5	0.0	0.0	0.0	3.4	10.1	0.0	0.0	0.2	1.3	0.0	0.0	0.0
6	0.0	0.0	0.0	1.6	0.0	0.8	4.3	17.3	3.2	0.0	0.0	0.0
7	2.7	0.0	0.0	0.0	0.0	25.1	0.0	10.4	2.5	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	15.7	5.8	39.4	2.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	1.6	7.8	6.4	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	3.7	1.0	16.6	7.1	0.0	11.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.3	6.8	1.2	40.0	0.0	18.5	0.0	0.0	0.0
12	0.0	0.0	0.0	2.8	14.9	3.6	3.9	1.6	75.0	0.0	0.0	0.0
13	0.0	0.0	0.0	4.4	0.2	0.0	0.2	0.0	45.7	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	1.0	1.0	6.0	0.0	5.2	0.0	0.0	0.0
15	0.0	0.0	0.0	0.7	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	3.0	10.6	41.4	2.0	0.5	0.0	2.8	0.0	0.0
17	0.0	0.0	0.0	0.0	34.9	41.0	4.6	30.8	0.0	1.4	0.0	0.0
18	0.0	0.0	0.0	0.0	90.4	7.2	0.0	23.8	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	4.3	13.6	24.2	0.8	1.4	0.0	1.2	0.0	0.0
20	0.0	1.2	0.0	18.4	17.4	33.2	0.0	22.2	0.0	24.8	0.0	0.0
21	0.0	0.0	0.0	0.0	14.6	17.3	0.4	0.0	0.0	0.6	0.0	0.0
22	0.0	0.0	0.0	1.9	0.8	15.1	0.0	1.2	0.0	68.6	0.0	0.0
23	0.0	0.0	6.6	0.0	2.0	20.5	0.0	0.0	8.2	1.2	0.0	0.0
24	0.0	5.0	0.0	0.0	2.1	0.4	0.0	0.0	0.0	4.4	0.0	0.0
25	0.0	0.0	0.0	6.8	0.0	58.6	1.2	15.8	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	9.7	0.0	13.3	0.0	40.5	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.4	0.0	2.5	1.0	33.0	26.8	0.0	0.0	0.0
28	0.0	0.1	0.0	25.7	1.4	0.0	18.0	2.2	0.0	0.0	0.0	0.0
29	0.0	9.8	0.0	38.0	11.5	7.0	0.4	0.0	0.0	0.0	0.0	0.0
30	0.0		0.0	0.6	0.0	0.0	0.0	0.0	0.0	1.8	0.0	0.0
31	0.0		0.0		67.6		14.4	8.6		0.0		0.0
Total	2.7	16.1	8.8	125.7	325.1	447.0	234.3	258.8	254.4	116.5	0.0	0.0
Maxi	2.7	9.8	6.6	38.0	90.4	58.6	117.8	40.5	75.0	68.6	0.0	0.0

Station : Thangore
Daily Rainfall in mm

Year : 2001

Max 45.4
Total 1278.3

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	3.4	2.2	3.2	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	8.2	0.4	0.0	43.6	1.2	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	10.6	0.0	9.0	9.8	9.0	2.6	0.0	0.0
4	0.0	0.0	0.0	0.0	35.2	0.0	14.7	0.0	29.2	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	9.2	0.0	0.2	0.6	9.1	0.7	0.0	0.0
6	0.0	0.0	1.4	0.0	0.0	5.8	0.0	19.3	1.4	7.5	0.0	0.0
7	0.0	0.0	0.0	0.0	1.6	4.6	0.2	32.8	5.0	0.0	0.0	0.0
8	0.0	0.0	9.2	0.0	0.0	4.0	30.1	13.1	15.8	8.2	0.0	0.0
9	0.0	0.0	31.0	0.0	1.0	0.4	7.4	6.5	2.7	5.4	0.0	0.0
10	0.0	0.0	3.8	0.0	1.2	0.2	5.1	5.2	14.8	0.0	0.0	0.0
11	0.0	0.0	1.6	3.7	0.0	11.6	1.9	31.9	6.8	0.0	0.0	0.0
12	0.0	0.0	7.8	1.6	0.0	37.0	0.0	2.2	11.6	0.0	0.0	0.0
13	0.0	0.0	6.0	0.0	0.0	1.2	3.6	9.6	1.4	0.0	0.0	0.0
14	0.0	0.0	0.7	0.0	45.4	0.0	6.9	11.0	0.0	0.0	2.5	0.0
15	0.0	0.0	2.1	0.0	7.8	8.6	2.7	0.9	0.0	0.4	0.0	0.0
16	0.0	0.0	0.0	0.0	2.0	0.0	3.0	7.8	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	5.0	0.0	16.6	0.0	7.0	11.4	2.4	0.0	0.0	0.0
19	0.0	0.0	5.6	0.0	4.8	0.0	0.5	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	24.6	0.0	25.0	4.4	0.4	0.0	0.0	0.0
21	0.0	0.0	6.8	0.0	8.8	0.0	9.4	0.0	3.4	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	22.0	10.0	31.8	0.0	2.8	0.0	0.0	0.0
23	0.0	0.0	0.0	1.1	7.2	7.2	5.4	0.0	15.5	7.8	0.0	0.0
24	0.0	0.0	1.6	33.8	5.2	30.4	2.0	0.0	0.0	4.4	0.0	0.0
25	0.0	0.0	0.0	0.0	17.0	11.0	3.6	0.0	0.0	20.1	0.0	0.0
26	0.0	0.0	14.7	0.0	0.0	8.0	13.0	17.6	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	27.5	9.4	0.0	3.2	0.0	0.9	0.0	0.0
28	0.0	0.0	0.0	0.0	15.0	1.6	0.0	14.4	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	13.0	8.1	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	17.6	8.6	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		0.0		0.0		1.6	0.0		0.0		0.0
Total	0.0	0.0	97.3	40.2	344.9	170.3	187.3	245.3	132.5	58.0	2.5	0.0
Maxi	0.0	0.0	31.0	33.8	45.4	37.0	31.8	43.6	29.2	20.1	2.5	0.0

Station : Thangore
Daily Rainfall in mm

Year : 2002

Max 87.0
Total 1907.8

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.6	0.0	0.0	0.0	0.6	17.8	18.4	10.2	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	13.2	3.2	0.0	0.0	0.0
3	0.0	0.0	0.0	0.7	0.0	23.2	0.8	0.0	13.6	0.0	0.0	0.0
4	0.0	0.0	0.0	5.4	6.4	35.0	0.0	38.4	6.8	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	1.6	2.3	0.1	26.0	26.2	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	9.8	17.4	9.7	8.0	8.8	38.6	0.0	0.0
7	0.0	0.0	3.4	0.0	0.0	9.6	0.0	5.9	52.1	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	15.4	0.7	2.6	9.1	0.0	0.0	2.4
9	0.0	0.0	0.0	0.0	0.1	22.3	22.0	0.0	4.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	1.8	8.6	0.6	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.6	0.0	32.6	28.8	8.0	9.2	2.6	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	41.0	2.6	8.7	42.4	0.0	0.0	0.0	0.0
13	2.8	0.0	0.0	0.0	19.3	2.9	0.0	1.8	3.7	0.0	0.0	0.0
14	0.6	0.0	0.0	5.3	6.2	41.7	0.4	1.6	5.2	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	26.0	0.0	40.2	7.2	37.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	10.2	18.5	27.3	0.0	2.8	0.0	0.0	0.0
17	0.0	0.0	5.6	0.0	24.3	5.6	4.6	6.6	12.2	0.0	14.8	0.0
18	0.0	0.0	0.0	0.0	0.2	0.0	0.0	32.4	34.5	0.0	1.0	0.0
19	0.0	0.0	0.0	0.0	0.0	13.9	0.0	4.6	5.8	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	7.2	5.6	0.0	3.8	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	19.1	13.4	0.4	2.6	0.0	0.0
22	0.0	0.0	0.0	1.0	0.0	0.0	2.9	3.8	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	8.8	1.4	0.0	36.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	30.2	4.6	0.4	39.7	0.0	0.0	0.0	0.0
25	0.0	12.4	0.0	0.2	1.5	2.4	0.0	1.5	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	2.4	47.4	0.7	0.0	0.0	7.8	0.0	31.0
27	0.0	10.4	0.0	16.6	9.0	0.0	20.4	38.4	1.0	8.1	0.6	0.0
28	0.0	0.0	0.0	1.5	4.4	27.4	45.2	10.8	50.6	3.2	0.0	0.0
29	0.0		0.0	0.0	13.7	19.8	87.0	7.7	28.0	18.2	0.0	0.0
30	0.0		4.0	0.0	0.4	0.0	35.0	46.6	0.0	0.0	0.0	0.0
31	0.0		2.1		0.0		0.0	3.2		0.0		0.0
Total	3.4	22.8	15.7	30.7	249.9	358.0	340.2	418.8	329.8	88.7	16.4	33.4
Maxi	2.8	12.4	5.6	16.6	41.0	47.4	87.0	46.6	52.1	38.6	14.8	31.0

Station : Thangone
Daily Rainfall in mm

Year : 2003

Max 118.4
Total 2032.5

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	40.3	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	5.6	28.5	0.0	0.0	12.6	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	22.5	13.7	0.0	56.8	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	10.2	0.0	0.0	0.0
5	1.1	0.0	0.0	0.0	0.0	29.3	0.0	0.0	7.5	0.2	0.0	0.0
6	9.9	0.0	0.0	0.0	0.0	0.0	0.0	10.3	3.8	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	13.7	27.4	0.0	0.0	0.0	0.0
8	0.0	0.0	4.0	0.0	11.8	17.8	10.3	0.0	69.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.5	10.1	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	70.4	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	17.5	0.0	52.6	0.0	0.0	0.0
12	0.0	0.2	0.0	0.0	40.0	0.0	14.3	0.0	42.0	0.0	0.0	0.0
13	0.0	8.7	20.4	0.0	7.2	0.0	0.0	0.0	16.9	16.4	0.0	0.0
14	0.0	0.2	0.0	0.0	90.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	6.1	6.7	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	3.3	0.0	34.4	5.7	0.0	14.1	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	2.8	73.5	0.0	0.0	23.0	0.0	0.0	0.0
18	0.0	0.0	0.0	41.6	0.8	5.3	0.0	41.2	69.4	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.7	2.4	0.0	0.0	0.0
20	0.0	0.0	4.4	0.0	13.4	17.5	0.0	26.5	16.9	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	15.9	44.5	2.2	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	2.6	0.0	27.8	44.6	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	49.0	0.0	118.4	50.0	38.5	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	2.6	5.3	17.3	13.1	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	26.5	5.7	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	0.0	0.0	0.0
27	0.0	12.2	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0		0.6	0.8	57.0	16.6	6.5	0.0	0.8	0.0	0.0	0.0
30	0.0		16.6	0.0	8.3	63.7	14.7	0.0	1.8	0.0	0.0	0.0
31	0.0		0.0		45.8		12.7	0.0		0.0		0.0
Total	11.0	21.3	47.2	94.7	314.4	494.3	243.2	307.3	482.5	16.6	0.0	0.0
Maxi	9.9	12.2	20.4	49.0	90.0	118.4	50.0	48.5	70.4	16.4	0.0	0.0

Station : Thangone
Daily Rainfall in mm

Year : 2004

Max 102.4
Total 1872.5

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	35.2	0.0	0.1	0.0	18.0	3.2	0.0	0.0	0.0
2	0.0	0.0	0.0	25.6	20.0	0.0	0.8	11.2	51.4	0.0	0.0	0.0
3	0.0	0.0	0.0	10.6	9.2	0.0	7.0	34.2	30.8	0.0	0.0	0.0
4	0.0	0.0	0.0	8.2	5.5	4.0	16.8	1.8	15.4	0.0	0.0	0.0
5	0.0	8.6	0.0	0.0	1.0	0.2	3.0	0.8	0.0	0.0	0.0	0.0
6	0.0	39.0	0.0	0.0	0.2	0.6	3.8	5.2	0.0	0.0	0.0	0.0
7	0.0	20.0	0.0	0.0	1.2	2.8	12.0	18.2	9.2	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.4	10.1	0.0	4.7	15.8	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	8.3	5.8	44.0	49.1	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	5.6	0.4	0.1	23.2	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	11.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	27.4	0.0	13.4	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	12.0	9.4	58.6	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	1.4	17.2	28.6	2.0	40.8	0.0	0.0	0.0
15	0.0	0.0	0.0	2.2	40.1	102.4	7.0	2.4	15.8	0.0	0.0	0.0
16	0.0	0.0	5.6	0.0	71.8	28.4	0.0	59.2	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	23.6	2.2	1.7	3.2	0.0	0.0	0.0	0.0
18	4.5	0.0	0.0	42.2	0.0	2.6	0.0	59.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	6.9	10.6	0.8	0.0	5.0	69.6	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	1.8	0.0	20.0	15.2	25.3	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	2.0	0.0	0.7	0.0	0.2	0.0	0.0	0.0
22	0.0	0.0	1.2	20.0	0.0	0.0	23.8	4.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	7.8	10.6	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	32.8	0.0	5.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	4.0	0.0	0.5	0.0
26	0.0	0.0	0.0	0.0	5.4	0.0	9.6	0.0	0.0	0.0	3.2	0.0
27	0.0	0.0	0.0	85.2	8.6	37.0	14.2	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	4.8	5.0	4.7	0.0	5.2	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.8	0.0	1.2	2.6	0.0	0.0	0.0	0.0
30	0.0		2.8	0.0	8.6	14.6	5.0	5.0	0.0	0.0	0.0	0.0
31	0.0		0.0		30.4		44.2	7.8		0.0		0.0
Total	4.5	67.6	9.6	240.9	292.4	251.0	315.4	320.2	367.2	0.0	3.7	0.0
Maxi	4.5	39.0	5.6	85.2	71.8	102.4	58.6	59.2	69.6	0.0	3.2	0.0

Station : Thangore
Daily Rainfall in mm

Year : 2005

Max 92.8
Total 2111.3

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	37.8	0.0	0.0	53.8	3.6	0.0	12.5	0.0	0.0
2	0.0	0.0	0.0	6.4	0.0	15.8	18.2	4.4	21.0	0.3	4.2	0.0
3	0.0	25.2	0.0	0.0	0.0	0.5	0.8	0.0	0.0	48.6	0.0	0.0
4	0.0	6.0	0.0	0.2	0.0	0.0	31.4	0.6	13.0	20.8	1.1	0.0
5	0.0	0.0	0.0	1.8	0.0	0.1	0.4	0.0	39.0	0.0	3.8	0.0
6	0.0	0.0	0.0	0.0	0.0	6.2	0.0	1.2	15.4	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	12.6	12.2	0.0	37.4	4.8	0.0	26.2	0.0
8	0.0	0.0	0.0	0.0	2.6	65.6	9.2	3.0	0.2	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	5.2	48.4	1.8	41.6	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	7.2	0.2	0.0	6.8	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.4	19.0	0.0	63.5	41.3	0.0	3.4	0.0
12	0.0	0.0	0.0	0.7	8.0	0.5	5.8	42.8	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	1.6	1.8	33.6	7.4	2.4	37.6	0.0	0.0
14	0.0	0.0	0.6	0.0	0.0	10.6	0.0	27.4	9.7	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	12.6	0.0	0.0	0.6	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	16.6	0.0	10.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	31.2	1.0	31.4	0.0	1.0	0.0	0.0
18	0.0	0.0	0.0	0.0	6.8	31.8	0.0	66.4	82.4	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	24.2	19.4	1.0	11.9	0.0	0.0	0.0
20	0.0	0.0	0.0	0.3	2.6	0.0	10.8	0.0	66.5	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	6.0	4.9	59.4	2.8	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	3.6	0.1	78.4	32.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	89.8	7.4	0.2	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	13.8	5.0	10.8	0.0	0.0	0.0	0.0
25	0.0	0.0	12.4	0.0	0.0	7.2	5.0	0.0	0.8	1.4	0.0	0.0
26	0.0	0.0	0.0	17.0	0.0	15.8	4.8	0.4	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	15.0	1.1	0.0	37.2	92.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	6.4	0.0	0.0	0.6	9.3	0.0	0.0	0.0
29	0.0		0.0	2.8	0.2	28.0	0.8	4.6	0.2	0.0	0.0	0.0
30	0.0		0.0	0.0	5.7	3.2	0.0	90.0	0.0	0.0	0.0	0.0
31	0.0		0.0		17.0		0.8	11.6		0.0		0.0
Total	0.0	31.2	13.0	67.0	82.5	425.6	320.1	548.7	462.5	122.0	38.7	0.0
Maxi	0.0	25.2	12.4	37.8	17.0	89.8	78.4	90.0	92.8	48.6	26.2	0.0

Station : Thangore
Daily Rainfall in mm

Year : 2006

Max 93.4
Total 1800.7

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.6	0.0	4.0	1.2	1.5	4.8	0.0	0.1	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	20.4	1.2	0.0	0.0	0.5	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.6	0.0	0.0
4	0.0	0.0	0.0	0.0	1.8	0.0	5.0	0.0	23.6	0.6	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	8.8	0.0	1.0	0.2	0.0	0.0
6	0.0	0.0	6.8	2.2	0.0	0.0	1.6	0.0	0.6	0.5	0.0	0.0
7	0.0	0.0	0.0	5.8	61.4	0.0	4.9	4.4	0.0	0.1	0.0	0.0
8	0.0	0.0	0.0	10.0	0.0	0.0	0.0	10.8	0.0	3.1	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	3.0	0.0	11.2	5.4	0.0	0.0
10	0.0	0.0	0.0	0.0	0.4	0.0	7.2	0.0	30.6	0.4	0.0	0.0
11	0.0	0.0	0.0	0.0	29.8	0.0	2.4	0.0	1.5	0.8	0.0	0.0
12	0.0	1.5	0.0	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	13.2	9.9	0.4	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	1.2	0.0	23.8	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	2.0	0.0	0.0	0.6	17.5	3.4	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	14.8	1.4	10.2	4.2	0.0	0.0	0.0
17	0.0	0.1	0.0	0.0	0.0	14.2	13.8	19.8	3.2	0.0	0.0	0.0
18	0.0	0.0	0.0	10.8	1.8	22.8	91.0	31.9	19.3	0.0	0.0	0.0
19	0.0	0.0	50.2	0.0	0.4	8.4	3.5	25.2	1.4	3.2	0.0	0.0
20	0.0	0.0	6.6	0.0	0.6	9.0	0.8	0.0	18.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	12.0	2.2	24.8	3.6	1.0	0.0	0.0	0.0
22	0.0	0.0	22.0	3.1	57.2	0.0	0.0	2.8	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	12.2	0.0	24.4	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	2.2	15.3	0.0	93.4	45.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	22.4	68.2	2.5	16.6	0.0	0.0	0.0
26	0.0	0.0	0.0	6.9	0.0	13.2	12.6	37.4	0.8	0.0	0.0	0.0
27	0.0	0.0	0.0	39.0	0.0	0.8	0.0	13.6	6.0	0.0	0.0	0.0
28	0.0	0.0	22.4	3.8	20.6	15.6	0.0	0.0	0.4	0.0	0.0	0.0
29	0.0		17.0	57.4	29.6	7.4	3.0	0.6	0.0	0.0	0.0	0.0
30	0.0		0.0	7.2	59.4	19.4	90.0	78.6	0.0	0.0	0.0	0.0
31	0.0		0.0		3.4		50.4	1.6		0.0		0.0
Total	0.0	1.6	125.0	151.6	309.9	214.0	523.4	316.9	142.8	15.5	0.0	0.0
Maxi	0.0	1.5	50.2	57.4	61.4	23.8	93.4	78.6	30.6	5.4	0.0	0.0

Station : Thangone
Daily Rainfall in mm

Year : 2007

Max 103.2
Total 1674.3

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.3	0.2	8.8	0.4	12.0	0.0	6.4	0.0
2	0.0	0.0	0.8	0.0	3.2	0.0	0.0	4.1	10.4	0.0	0.0	0.0
3	0.0	0.0	0.0	4.0	3.4	2.6	0.0	0.0	9.5	8.2	0.0	0.0
4	0.0	0.0	0.0	0.0	7.0	1.8	0.4	0.0	63.5	55.2	0.0	0.0
5	0.0	0.0	0.0	0.0	17.5	2.1	21.2	0.3	3.2	62.6	0.0	0.0
6	0.0	0.0	0.0	0.0	8.2	0.0	4.0	4.6	48.6	35.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	1.2	19.7	2.0	44.6	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.9	8.3	0.1	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.6	100.1	0.5	0.0	0.0
10	0.0	0.0	0.0	3.0	0.0	0.0	0.0	23.6	9.7	0.0	0.0	0.0
11	0.0	0.0	0.0	10.6	0.0	0.0	0.0	0.9	7.8	0.0	0.9	0.0
12	0.0	0.0	0.0	0.0	0.6	0.9	0.0	0.0	18.4	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	4.6	0.0	0.0	0.4	0.0	0.0	0.0
14	0.0	3.8	0.0	2.5	66.0	0.0	0.0	0.0	15.7	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	8.7	6.6	2.4	18.9	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	1.4	88.8	0.4	1.1	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	5.0	6.2	1.2	0.0	1.0	0.0	0.0	0.0
18	0.0	0.0	0.0	1.8	4.8	38.8	0.0	11.4	26.2	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	10.8	0.7	0.2	56.6	1.3	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.4	0.0	0.0	30.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	5.0	0.0	2.6	0.5	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	1.2	31.6	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	1.1	4.5	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.4	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	16.6	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	6.8	0.0	0.0	4.0	68.8	0.0	3.0	1.9	0.0	0.0	0.0
27	0.0	1.3	0.0	0.0	0.0	72.5	0.0	4.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	1.2	13.8	1.0	0.0	48.4	35.7	0.0	0.0	0.0
29	0.0		0.0	0.0	0.2	0.0	31.4	19.9	0.0	0.0	0.0	0.0
30	0.0		0.0	0.0	40.2	0.0	103.2	12.1	0.0	0.0	0.0	0.0
31	0.0		0.0		11.4		15.6	3.6		2.8		0.0
Total	0.0	11.9	0.8	23.1	211.9	314.6	194.9	325.1	375.7	209.0	7.3	0.0
Maxi	0.0	6.8	0.8	10.6	66.0	88.8	103.2	56.6	100.1	62.6	6.4	0.0

Station : Thangone
Daily Rainfall in mm

Year : 2008

Max 67.6
Total 2352.8

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	12.0	0.0	8.3	1.8	51.4	1.9	3.4	12.5	0.0	53.0	0.0
2	0.0	5.0	0.0	2.0	0.0	10.4	29.2	5.4	0.0	0.0	67.4	0.0
3	0.0	8.2	0.0	0.0	57.2	12.3	13.0	0.0	13.2	1.0	5.4	0.0
4	0.0	0.0	0.0	0.0	0.0	49.9	0.0	4.6	10.6	1.1	3.0	0.0
5	0.0	0.0	0.0	0.0	14.2	11.6	0.0	6.8	14.4	20.8	0.0	0.0
6	0.0	0.0	0.0	0.0	13.6	61.0	2.3	23.2	0.3	24.6	0.0	0.0
7	0.0	0.0	0.0	2.8	39.4	0.6	1.7	0.6	14.6	4.8	0.0	0.0
8	0.0	0.0	0.0	0.0	1.4	19.2	39.2	1.0	6.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	25.2	0.0	31.3	0.9	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	26.6	8.6	0.8	2.8	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.4	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	5.4	0.7	31.7	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	5.8	0.0	31.8	1.8	1.6	4.8	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	26.2	46.8	3.2	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4	4.4	0.0	0.0
16	0.0	0.0	3.6	0.0	1.0	18.2	6.4	0.0	18.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	9.0	4.2	4.1	0.0	38.6	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	2.3	21.3	31.0	47.6	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	47.7	29.6	4.4	3.6	19.8	12.4	0.0	0.0
20	0.0	0.0	15.0	0.0	0.0	9.4	0.8	0.0	3.6	15.6	0.0	0.0
21	0.0	0.0	22.2	0.0	0.0	0.0	67.6	4.2	27.0	0.0	0.0	0.0
22	0.0	0.0	16.2	2.6	5.4	0.0	27.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	1.0	0.0	0.0	0.0	3.0	25.0	0.0	0.0	0.0	0.0
24	1.5	0.0	0.4	0.0	7.4	0.0	18.2	36.4	0.0	0.0	0.0	0.0
25	0.0	0.0	0.1	0.0	5.2	0.0	13.0	23.8	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.6	0.0	16.6	17.5	3.8	4.2	0.0	0.0
27	0.0	0.0	0.0	46.2	2.2	2.0	2.2	0.0	0.0	7.6	0.0	0.6
28	0.8	0.0	0.0	21.4	5.4	40.4	12.8	37.8	23.4	0.0	0.0	0.0
29	0.0	0.0	0.0	1.6	34.4	1.1	0.0	0.1	0.0	1.4	0.0	0.0
30	41.0		23.0	1.0	0.4	21.8	61.2	62.8	23.8	17.8	0.0	0.0
31	7.0		0.0		3.0		21.6	30.6		5.8		0.0
Total	50.3	18.2	81.5	91.7	303.4	434.4	458.6	415.0	248.8	121.5	128.8	0.6
Maxi	41.0	12.0	23.0	46.2	57.2	61.0	67.6	62.8	38.6	24.6	67.4	0.6

Station : Thangore
Daily Rainfall in mm

Year : 2009

Max 124.6
Total 1949.7

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.2	0.0	0.0	0.0	0.0	25.0	1.0	0.0	12.4	0.0	0.0	0.0
2	1.2	0.0	0.0	0.0	2.2	0.0	1.3	0.0	0.0	13.3	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.2	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	16.0	25.8	0.0	0.3	0.0	0.0	0.0
5	0.0	0.0	0.0	9.8	0.0	1.0	11.5	0.0	16.8	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	22.4	8.7	1.4	0.0	13.8	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	6.6	8.1	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	12.0	0.0	18.2	1.4	1.6	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	8.2	1.6	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	1.8	10.2	0.0	0.0	23.4	0.2	34.4	0.0	0.0
11	0.0	0.0	0.0	10.2	0.8	37.4	0.0	0.4	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	26.6	0.4	49.5	12.6	0.0	0.0	0.0	0.0
13	0.0	0.0	2.0	0.8	0.0	0.0	42.0	22.5	10.4	0.0	0.0	0.0
14	0.0	0.0	0.0	2.0	0.0	12.6	3.6	4.9	6.3	0.0	0.0	0.0
15	0.0	0.0	0.0	6.0	16.2	91.0	0.6	21.9	98.6	0.3	0.0	0.0
16	0.0	0.0	0.0	0.0	2.8	25.4	34.4	1.9	12.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	56.0	56.9	18.4	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	1.6	3.6	0.8	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	14.8	0.0	1.2	26.6	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	4.4	0.0	0.0	2.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	11.5	54.5	20.8	25.3	0.0	0.0
22	0.0	0.0	0.0	0.0	8.0	2.2	124.6	19.9	1.0	0.8	0.0	0.0
23	0.0	0.0	24.8	0.0	0.8	24.6	6.3	1.7	1.1	0.0	0.0	0.0
24	0.0	0.0	9.6	0.0	2.6	0.0	0.0	0.1	50.3	0.0	0.0	0.0
25	0.0	0.0	0.8	120.6	13.4	0.0	47.6	6.3	22.2	14.2	0.0	0.0
26	0.0	0.0	0.0	0.0	86.4	0.0	16.9	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.8	0.0	14.6	11.2	0.0	4.6	0.0	0.0	0.0	0.0
28	0.0	3.2	0.0	0.0	5.0	4.8	26.4	31.5	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	11.8	1.6	10.6	10.5	0.0	0.0	0.0	0.0
30	0.0		0.2	0.0	38.2	2.0	2.4	23.4	1.4	0.0	0.0	0.0
31	0.0		0.0		4.4		4.4	0.0		0.0		0.0
Total	1.4	7.6	53.0	151.2	249.8	367.4	492.2	269.4	255.6	102.1	0.0	0.0
Maxi	1.2	4.4	24.8	120.6	86.4	91.0	124.6	54.5	98.6	34.4	0.0	0.0

Station : Thangore
Daily Rainfall in mm

Year : 2012

Max 129.9
Total 1717.9

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.6	0.0	0.0	5.7	37.3	0.0	3.4	0.0	0.0	0.0
2	0.0	4.3	0.0	0.0	7.7	30.6	0.3	0.0	26.0	0.0	0.0	0.0
3	0.0	13.5	11.6	0.0	8.5	11.2	0.9	0.0	0.0	2.4	0.0	0.0
4	0.0	0.0	0.0	16.8	0.0	0.0	75.7	1.1	19.6	7.4	0.0	0.0
5	0.0	0.0	0.0	0.0	18.7	0.0	1.0	0.0	2.2	7.8	0.0	0.0
6	0.0	0.0	0.0	9.3	20.0	31.6	0.0	0.0	5.4	0.0	0.0	0.0
7	0.0	0.0	0.0	2.1	5.0	23.3	0.0	7.5	33.9	0.2	0.0	0.0
8	0.0	0.0	0.0	0.0	0.2	10.0	39.0	70.3	104.4	0.0	0.0	0.0
9	0.0	0.0	8.8	0.0	0.0	2.9	0.4	80.5	16.8	0.0	0.0	0.0
10	0.0	5.4	12.4	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0
11	0.0	0.0	0.3	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	1.2
12	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	20.5	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	6.9	0.0	32.7	0.0	21.0	7.2	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	3.0	0.0	0.0	77.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	16.6	37.4	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	19.6	0.0	0.0	1.5	1.3	0.5	0.0	4.8	0.0	0.0
18	0.0	0.0	0.0	0.0	4.5	0.0	0.0	15.8	7.9	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	23.3	0.0	0.3	3.3	5.7	0.0	0.0	0.0
20	4.8	0.0	0.0	0.0	2.2	24.5	0.0	0.4	6.7	0.0	0.0	0.0
21	27.2	0.0	0.0	48.0	2.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	3.2	10.9	15.4	22.4	7.7	41.4	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	1.6	0.0	15.8	0.0	0.0	0.0	0.6	0.0
25	0.0	0.0	0.0	0.0	5.1	0.2	5.4	5.0	9.9	0.0	6.2	0.0
26	0.0	0.0	0.0	12.5	0.0	0.0	14.0	15.0	0.4	0.0	2.2	0.0
27	0.0	0.8	0.0	4.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
28	0.0	0.0	0.0	17.2	35.0	0.0	0.2	0.0	0.0	0.0	3.4	0.0
29	0.0	0.0	0.0	0.0	13.4	0.0	17.8	12.0	0.0	0.0	0.0	0.0
30	0.0		0.0	3.0	0.8	19.5	15.6	0.8	0.0	0.0	0.0	0.0
31	0.0		0.0		129.9		10.0	2.5		0.0		0.0
Total	32.0	22.0	59.6	116.6	343.9	215.6	298.9	309.1	284.0	22.6	12.4	1.2
Maxi	27.2	13.5	19.6	48.0	129.9	37.4	75.7	80.5	104.4	7.8	6.2	1.2

Station : Thangone
Daily Rainfall in mm

Year : 2013

Max 98.9
Total 1637.7

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2	20.8	1.4	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	2.0	0.1	7.6	1.0	0.0	0.0	0.0
3	0.0	0.0	60.5	0.0	11.0	10.2	14.0	0.0	0.1	0.0	0.0	0.0
4	0.0	0.0	1.3	0.0	28.3	1.0	0.0	8.2	40.9	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	98.9	0.0	0.0	12.3	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	5.2	0.0	61.0	2.6	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	17.8	0.0	19.7	30.0	8.4	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	29.7	18.8	58.1	19.8	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	53.0	19.0	45.1	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.3	16.4	25.0	26.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	2.0	0.9	2.3	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	17.9	0.0	0.0	0.0	33.0	2.5	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	6.7	24.0	11.3	5.5	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	22.6	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	23.7
16	0.0	0.0	0.0	0.0	0.0	0.0	17.0	3.0	11.5	42.8	0.0	2.1
17	0.0	0.0	0.0	0.0	16.6	0.0	0.1	0.3	1.0	5.9	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	7.6	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	24.8	7.6	20.6	0.0	0.2	0.0	0.0	0.0
20	0.0	0.0	0.0	17.3	1.2	10.1	23.6	11.8	1.3	0.0	0.0	0.0
21	0.0	0.0	0.0	2.0	4.4	6.0	16.4	50.5	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	18.7	4.3	22.6	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	6.0	13.3	0.2	7.4	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	3.4	7.8	61.4	3.9	10.9	4.0	0.0	0.0
25	0.0	0.0	0.0	0.0	5.4	10.1	9.9	0.0	0.6	0.4	0.0	0.0
26	0.0	0.0	0.0	3.9	24.6	0.5	4.6	0.0	0.6	0.0	0.0	0.0
27	4.1	0.0	0.0	0.0	0.0	0.0	9.3	1.1	4.4	0.0	0.0	0.0
28	0.0	3.1	0.0	0.3	0.0	0.0	30.0	0.0	38.0	0.0	0.0	0.0
29	0.0		0.0	6.4	0.0	0.0	4.0	20.0	0.7	0.0	0.0	0.0
30	0.0		0.0	0.0	1.5	0.0	5.6	12.5	8.7	0.0	0.0	0.0
31	3.0		0.0		0.0		0.0	8.1		0.0		0.0
Total	7.1	3.1	61.8	29.9	165.2	238.4	377.4	393.3	273.2	62.5	0.0	25.8
Maxi	4.1	3.1	60.5	17.3	28.3	98.9	61.4	61.0	45.1	42.8	0.0	23.7

Station : Thangone
Daily Rainfall in mm

Year : 2014

Max 96.9
Total 1911.4

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0	61.7	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	46.5	0.0	0.0	0.0
3	0.0	0.0	0.0	6.4	0.0	0.0	0.0	4.9	38.6	0.0	0.0	0.0
4	0.0	0.0	0.0	17.3	0.0	0.0	0.0	19.8	96.9	0.0	0.0	0.0
5	0.0	0.0	0.0	0.2	0.0	1.9	0.0	14.5	54.0	0.0	0.0	0.0
6	0.0	0.0	0.0	29.6	0.0	1.8	4.8	6.6	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	39.3	3.1	3.2	18.1	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	4.1	9.5	4.1	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	7.4	2.0	31.6	29.5	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	31.3	0.1	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.4	2.3	0.2	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	20.1	7.6	0.0	71.4	0.0	0.0	0.0
13	0.0	0.0	0.0	13.0	36.5	9.0	18.2	0.9	25.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	11.2	7.1	29.8	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	12.5	18.1	22.3	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	1.0	18.0	4.5	5.5	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	32.4	38.0	0.0	1.8	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	32.7	9.9	0.0	3.2	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.3	0.2	14.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.2	0.1	49.9	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	13.2	0.1	2.9	44.3	0.5	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	5.2	21.6	0.1	7.6	1.2	0.0	0.0
23	0.0	0.0	0.4	0.0	0.0	5.2	0.0	26.8	1.3	7.9	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	9.5	52.4	0.4	0.0	0.0	0.0	0.0
25	0.0	0.0	0.2	0.0	0.0	9.8	46.8	46.5	0.1	0.0	0.0	0.0
26	0.0	0.0	0.0	2.0	0.0	5.6	67.4	4.7	0.5	0.0	0.0	0.0
27	0.0	0.0	0.0	28.6	0.0	0.1	15.9	9.1	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	48.0	3.3	0.0	1.4	33.8	14.2	1.2	0.0	0.0
29	0.0		0.0	72.6	11.5	17.6	4.0	9.7	0.2	2.0	0.0	0.0
30	0.0		0.0	0.0	5.8	19.8	70.7	41.8	2.4	0.8	0.0	0.0
31	0.0		0.0		0.0		0.4	0.0		0.0		0.0
Total	0.0	0.0	0.7	217.7	122.1	227.6	467.2	434.8	428.0	13.3	0.0	0.0
Maxi	0.0	0.0	0.4	72.6	39.3	32.7	70.7	49.9	96.9	7.9	0.0	0.0

6-2 Nam Gum River water level (January 1994- July 2017: Venkham Station)

Station Characteristics of station : 231201
Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 1994

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.60	1.51	1.00	1.68	1.32	5.42	6.61	7.34	11.89	8.60	3.28	2.36
2	1.60	1.50	1.01	1.60	1.28	3.75	6.65	8.34	12.02	8.26	2.92	2.35
3	1.56	1.50	1.00	1.57	1.28	3.71	6.65	8.63	12.01	7.92	2.85	2.41
4	1.10	1.58	0.99	1.39	1.40	5.38	6.18	9.26	11.94	7.56	2.69	2.24
5	1.13	1.65	1.36	1.31	1.32	3.29	5.90	10.05	11.82	7.20	2.65	2.18
6	1.10	1.61	1.42	1.32	1.27	3.85	5.51	9.84	11.62	6.88	2.68	2.18
7	1.14	1.62	1.45	1.32	1.26	5.24	5.36	9.50	11.39	6.59	2.50	2.18
8	1.11	1.58	0.88	1.36	1.25	5.70	5.83	9.21	11.11	6.33	2.54	2.14
9	1.11	1.30	0.96	1.45	1.34	6.30	5.63	8.91	10.90	6.08	2.56	2.14
10	1.05	1.03	0.98	1.49	1.55	7.86	5.62	8.56	10.68	5.88	2.56	2.10
11	1.02	1.03	1.10	1.44	2.01	8.76	6.99	8.20	10.45	5.77	2.52	2.08
12	1.01	1.14	0.91	1.33	2.04	8.95	7.48	7.79	10.25	5.68	2.52	2.06
13	1.02	1.14	0.87	1.30	2.21	8.85	6.95	7.32	9.92	5.68	2.46	2.06
14	0.99	1.01	1.40	1.31	2.27	7.58	6.38	6.97	9.57	5.78	2.46	1.99
15	1.02	1.01	1.35	1.37	2.11	6.66	6.06	6.83	9.29	6.10	2.40	2.03
16	1.10	1.02	1.36	1.54	1.99	5.93	6.39	6.96	9.38	6.28	2.35	2.03
17	1.00	1.06	1.49	1.55	1.92	5.36	7.43	8.28	9.59	6.16	2.36	2.00
18	1.09	1.07	1.52	1.54	1.92	4.78	8.76	9.55	9.78	5.80	2.32	1.95
19	1.10	1.03	1.47	1.52	2.17	4.38	9.39	10.32	9.93	5.52	2.32	1.99
20	1.13	1.01	1.35	1.50	2.53	4.24	9.32	10.90	10.24	5.28	2.32	1.99
21	1.15	1.00	1.35	1.42	2.75	4.52	8.95	11.26	10.33	5.19	2.33	1.93
22	1.15	1.00	1.35	1.25	3.22	4.74	8.53	11.48	10.21	5.02	2.30	1.96
23	1.13	0.99	1.41	1.02	4.15	4.62	7.85	11.60	10.34	4.82	2.26	1.96
24	1.09	0.96	1.47	1.02	3.97	5.01	7.25	11.67	10.33	4.65	2.18	1.96
25	1.08	0.92	1.57	1.33	3.51	5.63	6.76	11.66	10.22	4.34	2.13	1.95
26	1.06	0.94	1.55	1.35	2.39	5.85	6.35	11.56	10.04	4.18	2.30	1.95
27	1.03	1.00	1.54	1.33	2.03	6.30	5.92	11.47	9.62	4.07	2.18	1.93
28	1.05	1.00	1.55	1.33	2.50	6.65	5.67	11.39	9.33	4.02	2.12	1.90
29	1.22		1.90	1.36	2.96	6.70	5.58	11.28	9.16	3.99	2.12	1.90
30	1.65		1.96	1.36	2.51	6.62	5.77	11.29	8.90	3.86	2.18	1.92
31	1.50		1.78		3.11		6.25	11.65		3.60		1.91
Mean	1.16	1.19	1.33	1.39	2.17	5.62	6.77	9.65	10.41	5.71	2.45	2.06
Max	1.65	1.65	1.96	1.68	4.15	8.95	9.39	11.67	12.02	8.60	3.28	2.41
Min	0.99	0.92	0.87	1.02	1.25	3.29	5.36	6.83	8.90	3.60	2.12	1.90

Station Characteristics of station : 231201
Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 1995

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.89	1.57	1.59	1.61	1.24	1.97	4.28	9.79	12.27	5.98	2.96	2.00
2	1.86	1.67	1.34	1.53	1.06	2.01	4.18	10.55	12.73	5.93	2.82	1.98
3	1.86	1.51	1.35	1.40	1.07	2.12	4.02	10.71	13.35	5.86	2.75	1.99
4	1.82	1.59	1.32	1.41	1.07	2.05	5.15	10.49	14.06	5.74	2.73	1.96
5	1.53	1.51	1.11	1.38	1.09	2.46	5.50	10.30	14.48	5.69	2.68	1.94
6	1.39	1.48	1.10	1.41	1.11	2.59	5.85	10.86	14.63	5.88	2.67	1.93
7	1.36	1.47	1.10	1.49	1.12	2.94	7.20	11.65	14.68	6.00	2.57	1.89
8	1.35	1.41	1.11	1.52	1.13	2.83	7.05	12.12	14.68	5.88	2.48	1.75
9	1.32	1.34	1.11	1.53	1.16	2.96	7.02	12.58	14.55	5.77	2.41	1.85
10	1.31	1.28	1.02	1.47	1.18	3.33	7.38	12.25	14.32	5.60	2.64	1.92
11	1.29	1.00	1.00	1.42	1.14	3.59	7.07	12.21	14.04	5.32	2.35	1.89
12	1.29	1.29	1.00	1.45	1.26	3.72	6.37	12.10	13.74	5.12	2.36	1.89
13	1.29	1.37	0.98	1.46	1.48	4.18	5.85	12.02	13.49	4.70	2.34	1.93
14	1.22	1.40	1.01	1.58	1.45	5.11	5.65	12.17	13.20	4.34	2.55	1.90
15	1.20	1.41	1.13	1.62	1.48	5.14	5.95	12.34	12.78	4.22	2.32	1.92
16	1.21	1.40	1.16	1.66	1.40	4.54	6.89	12.54	12.41	4.35	2.72	1.92
17	1.21	1.41	1.14	1.69	2.39	4.06	8.02	12.70	11.96	4.40	2.69	1.90
18	1.20	1.40	1.15	1.68	2.14	3.65	8.46	12.82	11.52	4.14	2.47	1.92
19	1.21	1.38	1.17	1.67	2.28	3.34	8.27	12.81	10.99	4.80	2.48	1.90
20	1.19	1.25	1.15	1.64	2.30	3.42	7.62	12.76	10.36	3.80	2.49	1.88
21	1.19	1.07	1.12	1.64	2.12	3.78	7.03	12.68	9.57	3.64	2.30	1.84
22	1.19	1.33	1.12	1.61	2.00	3.72	6.95	12.62	8.96	3.46	2.32	1.81
23	1.18	1.38	1.11	1.65	1.92	3.52	6.74	12.44	8.44	3.32	2.16	1.84
24	1.17	1.38	1.17	1.65	1.87	3.32	6.80	12.23	7.94	3.54	2.16	1.86
25	1.18	1.61	1.30	1.42	1.82	3.40	7.15	11.98	7.64	3.36	2.16	1.81
26	1.16	1.58	1.56	1.16	1.80	3.26	7.58	11.38	7.38	3.20	2.13	1.80
27	1.17	1.57	1.63	1.15	1.80	3.40	8.18	11.70	7.03	3.15	2.13	1.71
28	1.47	1.52	1.55	1.13	1.81	3.04	8.61	11.46	6.64	3.56	2.12	1.62
29	1.75		1.62	1.13	1.87	3.48	8.53	11.27	6.28	2.96	2.13	1.62
30	1.69		1.82	1.10	1.88	3.85	8.75	11.18	6.07	2.93	2.14	1.31
31	1.58		1.57		1.90		8.49	11.80		2.92		1.52
Mean	1.38	1.41	1.25	1.47	1.59	3.36	6.87	11.82	11.34	4.50	2.44	1.84
Max	1.89	1.67	1.82	1.69	2.39	5.14	8.75	12.82	14.68	6.00	2.96	2.00
Min	1.16	1.00	0.98	1.10	1.06	1.97	4.02	9.79	6.07	2.92	2.12	1.31

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 1996

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.80	1.60	1.47	1.24	1.89	2.08	3.27	7.57	8.94	6.60	3.21	2.84
2	1.87	1.58	1.43	1.23	1.61	2.08	2.97	7.47	9.12	6.03	2.95	2.87
3	1.42	1.48	1.41	1.31	1.60	2.14	2.75	7.18	9.89	5.72	2.75	2.90
4	1.32	1.52	1.42	1.33	1.85	2.24	2.83	7.59	9.91	5.03	2.72	2.80
5	1.29	1.51	1.43	1.29	1.98	2.22	3.84	6.94	9.60	4.79	2.93	2.80
6	1.29	1.48	1.42	1.32	1.84	2.22	4.37	7.37	9.10	4.88	3.43	2.79
7	1.30	1.49	1.38	1.30	1.69	2.18	3.65	7.13	8.42	5.16	3.79	2.76
8	1.32	1.49	1.37	1.32	1.64	2.28	3.51	6.73	8.12	5.45	3.88	2.77
9	1.31	1.48	1.04	1.29	1.55	2.46	3.52	6.40	7.68	6.19	4.31	2.71
10	1.26	1.48	1.41	1.27	1.56	2.50	3.59	5.99	7.11	6.44	4.34	2.56
11	2.27	1.48	1.44	1.27	1.54	2.88	3.32	5.60	6.90	6.43	3.89	2.51
12	1.21	1.46	1.45	1.61	1.49	2.26	3.31	5.36	6.70	6.07	3.77	2.70
13	1.19	1.46	1.46	1.76	1.47	2.19	3.60	5.33	6.36	5.68	3.64	2.73
14	1.18	1.45	1.56	1.76	1.46	2.45	3.83	6.37	5.98	5.36	3.47	2.62
15	1.20	1.41	1.58	1.79	1.47	3.06	3.84	6.71	5.83	5.17	3.34	2.52
16	1.19	1.41	1.57	1.77	1.68	3.27	3.76	7.30	5.99	5.01	3.46	2.50
17	1.18	1.48	1.49	1.74	1.86	3.32	3.66	8.19	6.44	4.86	3.04	2.50
18	1.24	1.56	1.56	1.42	1.97	3.40	3.76	8.46	6.96	4.70	2.90	2.54
19	1.24	1.64	1.51	1.62	2.01	3.52	4.80	9.01	6.66	4.59	2.83	2.58
20	1.17	1.66	1.54	1.76	2.05	3.82	5.20	9.59	6.84	4.35	2.82	2.59
21	1.25	1.66	1.25	1.67	2.05	3.69	4.82	9.60	6.15	4.29	2.68	2.58
22	1.20	1.69	1.14	2.04	2.06	4.12	4.42	9.27	7.47	4.22	2.82	2.59
23	1.20	1.70	1.11	1.64	2.24	3.66	4.74	8.88	8.60	4.02	3.03	2.57
24	1.18	1.71	1.13	1.47	2.10	3.24	4.86	9.64	9.36	3.88	3.04	2.54
25	1.06	1.66	1.11	1.35	2.16	2.99	4.61	10.93	9.32	3.80	3.09	2.51
26	1.39	1.56	1.11	1.30	2.13	3.44	5.06	11.01	9.00	3.72	3.02	2.55
27	1.50	1.50	1.18	1.43	2.24	3.66	5.72	10.79	8.81	3.62	2.94	2.41
28	1.53	1.50	1.19	1.96	2.24	3.64	6.84	10.44	8.38	3.45	2.94	1.97
29	1.56	1.44	1.22	2.11	2.09	3.45	6.79	9.92	7.83	3.49	2.90	1.96
30	1.60		1.27	2.06	2.06	3.45	6.97	9.37	7.21	3.47	2.89	1.95
31	1.70		1.29		2.04		7.28	9.16		3.45		2.01
Mean	1.37	1.54	1.35	1.55	1.86	2.91	4.37	8.10	7.82	4.84	3.23	2.56
Max	2.27	1.71	1.58	2.11	2.24	4.12	7.28	11.01	9.91	6.60	4.34	2.90
Min	1.06	1.41	1.04	1.23	1.46	2.08	2.75	5.33	5.83	3.45	2.68	1.95

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 1997

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.00	1.58	1.31	1.89	1.24	2.41	2.55	10.60	8.87	5.52	3.32	2.24
2	2.00	1.72	1.31	1.89	1.26	2.51	3.90	10.32	8.48	5.81	3.11	2.25
3	1.90	1.73	1.28	1.89	1.25	2.55	5.53	10.03	10.42	6.20	2.88	2.23
4	1.99	1.75	1.11	1.89	1.23	2.51	4.45	9.52	11.18	6.24	2.75	2.19
5	2.01	1.72	1.11	1.87	1.26	2.56	4.87	9.25	11.62	6.24	2.80	2.13
6	1.88	1.78	1.11	1.81	1.26	2.48	4.85	9.07	11.86	6.36	2.80	2.12
7	1.99	1.83	1.19	1.83	1.25	2.42	4.15	8.65	12.09	6.51	2.80	2.09
8	1.25	1.82	1.30	1.81	1.26	2.40	3.72	8.05	12.14	6.56	2.70	2.11
9	1.40	1.87	1.30	1.82	1.28	2.39	3.58	7.54	12.07	6.79	2.65	2.08
10	1.42	1.82	1.31	1.84	1.30	1.29	3.44	7.08	11.84	6.09	2.65	2.09
11	1.30	1.80	1.21	1.84	1.30	1.27	3.43	6.52	11.63	5.90	2.65	2.19
12	1.30	1.23	1.17	1.82	1.31	1.29	3.65	6.76	11.24	5.69	2.63	2.10
13	1.35	1.31	1.15	1.81	1.36	2.24	4.78	6.86	10.76	5.64	2.60	1.95
14	1.40	1.38	1.21	1.84	1.98	2.21	5.22	7.10	10.13	5.69	2.59	1.93
15	1.41	1.38	1.21	1.82	1.99	2.16	5.47	7.12	9.39	5.52	2.49	1.94
16	1.41	1.30	1.23	1.81	2.03	2.31	6.68	7.02	8.48	5.34	2.46	1.98
17	1.48	1.30	1.19	1.83	2.10	2.34	7.21	7.08	7.76	5.10	2.46	1.99
18	1.47	1.30	1.11	1.80	2.03	2.36	7.54	7.09	7.24	4.78	2.46	1.95
19	1.45	1.30	1.11	1.82	2.26	2.60	8.14	7.14	6.83	4.60	2.36	1.99
20	1.46	1.30	1.18	1.82	2.24	2.70	9.00	6.83	6.58	4.40	2.34	1.99
21	1.45	1.29	1.20	1.82	2.21	2.71	9.06	6.55	6.21	4.32	2.33	1.89
22	1.34	1.31	1.23	1.75	2.16	2.71	9.49	6.20	6.19	4.20	2.34	1.84
23	1.37	1.33	1.28	1.73	2.31	2.70	10.22	5.81	6.05	4.03	2.33	1.83
24	1.33	1.32	1.29	1.71	2.28	2.69	10.66	5.70	5.81	3.88	2.34	1.68
25	1.34	1.32	1.23	1.22	2.35	2.81	10.79	5.90	5.51	3.82	2.38	1.61
26	1.32	1.31	1.21	1.22	2.57	2.83	10.78	5.91	5.23	3.76	2.36	1.61
27	1.31	1.31	1.32	1.23	2.52	3.17	10.54	6.03	5.30	3.70	2.32	1.59
28	1.30	1.31	1.84	1.25	1.47	3.18	10.54	6.11	6.21	3.76	2.25	1.55
29	1.32		1.88	1.31	2.49	3.24	10.60	6.00	6.16	3.78	2.22	1.53
30	1.34		1.57	1.29	2.50	3.29	10.78	6.60	5.81	3.64	2.23	1.53
31	1.56		1.87		2.50		10.85	8.44		3.53		1.51
Mean	1.51	1.49	1.30	1.71	1.82	2.48	6.96	7.38	8.64	5.08	2.55	1.93
Max	2.01	1.87	1.88	1.89	2.57	3.29	10.85	10.60	12.14	6.79	3.32	2.25
Min	1.25	1.23	1.11	1.22	1.23	1.27	2.55	5.70	5.23	3.53	2.22	1.51

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham

WATER LEVEL HISTORICAL, YEAR 1998

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.50	1.42	1.19	1.35	1.43	2.21	3.07	4.96	6.31	2.66	1.36	0.79
2	1.51	1.39	1.09	1.38	1.43	3.00	3.35	4.95	6.43	2.38	1.25	0.79
3	1.52	1.40	1.16	1.42	1.43	3.08	4.86	4.89	6.41	2.32	1.19	0.81
4	1.53	1.40	1.13	1.56	1.51	2.65	7.32	4.71	6.35	2.29	1.23	0.79
5	1.52	1.40	1.22	1.47	1.54	2.47	7.70	4.55	6.25	2.14	1.22	0.84
6	1.54	1.43	1.23	1.39	1.59	2.56	6.95	4.44	6.73	2.05	1.23	0.88
7	1.53	1.42	1.22	1.38	1.42	3.03	6.28	4.63	7.42	1.99	1.23	0.86
8	1.53	1.42	1.21	1.39	1.39	3.51	5.36	5.29	8.24	1.91	1.15	0.89
9	1.52	1.43	1.05	1.50	1.44	3.16	5.12	5.90	8.70	1.89	1.04	0.82
10	1.52	1.48	1.17	1.49	1.42	2.85	5.22	6.22	8.73	1.83	1.21	0.87
11	1.53	1.48	1.17	1.47	1.41	2.83	5.34	6.96	8.45	1.79	1.21	0.87
12	1.53	1.49	1.17	1.52	1.35	3.69	5.55	7.27	8.09	1.65	1.13	0.88
13	1.51	1.44	1.17	1.47	1.45	3.72	4.72	6.39	7.64	1.73	1.11	0.91
14	1.54	1.48	1.48	1.73	1.58	3.10	4.52	6.74	7.25	1.74	1.07	0.94
15	1.55	1.42	1.55	1.80	1.82	2.49	4.64	6.79	6.72	1.74	1.09	0.91
16	1.55	1.23	1.24	1.84	1.82	2.47	6.20	6.45	6.20	1.76	0.97	0.93
17	1.56	1.46	1.61	1.81	1.86	2.37	6.50	6.25	5.66	1.79	0.99	0.92
18	1.53	1.50	1.56	1.90	1.58	2.35	6.56	6.31	5.51	1.76	1.00	0.95
19	1.55	1.25	1.36	2.13	1.80	2.26	6.51	6.14	5.29	2.36	0.99	0.91
20	1.54	1.16	1.15	1.80	1.99	2.18	6.08	6.12	5.23	2.33	1.01	0.92
21	1.53	1.12	1.17	1.69	1.96	2.03	5.38	6.35	5.07	2.19	1.02	0.91
22	1.54	1.14	1.22	1.44	2.00	1.77	5.16	6.62	4.67	1.97	0.98	0.88
23	1.54	1.14	1.16	1.40	1.92	2.09	5.32	7.35	4.28	1.82	0.98	0.82
24	1.57	1.16	1.12	1.36	1.87	2.10	4.90	8.30	4.07	1.67	0.90	0.84
25	1.45	1.16	1.22	1.33	1.85	2.08	4.66	8.79	3.84	1.63	0.93	0.84
26	1.41	1.19	1.23	1.42	1.95	2.08	4.43	9.04	3.52	1.55	0.90	0.84
27	1.40	1.19	1.19	1.32	2.15	2.28	4.30	8.48	3.33	1.44	0.85	0.83
28	1.39	1.17	1.18	1.33	2.08	2.52	4.31	7.29	3.20	1.43	0.84	0.72
29	1.39		1.37	1.32	2.08	2.88	4.23	6.73	3.03	1.42	0.81	0.71
30	1.36		1.21	1.37	2.04	3.12	4.22	6.38	2.87	1.42	0.80	0.73
31	1.39		1.34		2.12		4.59	6.28		1.35		0.74
Mean	1.50	1.33	1.25	1.54	1.70	2.62	5.27	6.37	5.85	1.87	1.06	0.85
Max	1.56	1.50	1.61	2.13	2.15	3.72	7.70	9.04	8.73	2.66	1.36	0.95
Min	1.36	1.12	1.05	1.32	1.31	1.77	3.07	4.44	2.87	1.35	0.80	0.71

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham

WATER LEVEL HISTORICAL, YEAR 1999

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.75	0.75	0.85	0.71	0.96	3.90	4.22	4.54	9.86	8.72	3.57	2.27
2	0.76	0.77	0.84	0.71	1.01	3.87	4.62	5.37	10.12	7.96	3.66	2.23
3	0.75	0.75	0.81	0.70	0.98	3.56	4.81	6.03	9.97	7.53	3.53	2.26
4	0.74	0.75	0.72	0.70	0.95	3.60	4.52	6.23	9.62	7.31	3.60	2.23
5	0.75	0.75	0.70	0.71	1.06	3.66	4.73	6.31	9.40	7.11	3.52	2.22
6	0.79	0.76	0.68	0.70	1.62	3.70	6.17	6.76	9.28	6.85	3.46	2.18
7	0.78	0.75	0.70	0.71	2.16	3.60	7.47	7.00	9.26	6.42	3.54	2.21
8	0.81	0.78	0.67	0.73	2.68	3.54	7.50	6.89	9.10	6.09	3.73	2.19
9	0.83	0.80	0.68	0.76	3.05	3.42	6.90	6.64	9.22	6.01	3.68	2.20
10	0.83	0.81	0.62	0.93	2.89	3.33	6.17	6.36	9.08	5.85	3.59	2.17
11	0.81	0.79	0.61	0.97	3.18	3.99	5.51	6.27	8.99	6.00	3.32	1.99
12	0.80	0.80	0.61	0.87	2.97	5.30	5.28	7.09	9.87	5.76	3.37	2.12
13	0.83	0.82	0.61	0.85	2.70	7.75	5.05	7.53	10.56	5.71	3.37	2.22
14	0.85	0.86	0.64	0.91	2.28	6.19	4.64	7.33	10.77	5.59	3.27	2.07
15	0.85	0.90	0.68	0.86	2.10	6.19	4.39	7.16	10.73	5.30	3.11	2.09
16	0.84	0.90	0.64	0.86	2.00	5.57	4.22	6.95	10.66	5.06	2.98	2.20
17	0.75	0.87	0.64	0.91	2.20	5.04	4.12	6.82	10.48	4.93	3.03	2.18
18	0.73	0.96	0.66	1.02	2.28	4.65	4.12	7.52	10.40	4.67	2.93	2.18
19	0.75	0.97	0.68	0.92	2.48	4.92	4.29	8.12	10.18	4.53	2.76	2.13
20	0.75	0.97	0.66	0.92	2.81	5.13	4.39	8.06	10.46	4.39	2.59	2.13
21	0.74	0.77	0.67	0.97	2.81	6.09	4.33	7.53	10.88	4.21	2.64	2.11
22	0.76	0.84	0.68	0.97	2.89	6.79	4.36	7.07	11.08	4.17	2.47	2.09
23	0.83	0.82	0.65	0.97	3.57	7.37	4.39	6.90	11.24	4.08	2.44	2.09
24	0.75	0.86	0.65	0.95	4.11	6.56	4.56	6.99	11.39	3.97	2.37	2.08
25	0.76	0.88	0.67	0.96	4.19	5.83	5.79	7.04	11.40	3.87	2.35	2.06
26	0.74	0.90	0.64	0.96	4.15	5.46	6.33	7.00	11.18	3.77	2.35	2.00
27	0.74	0.86	0.68	0.99	4.06	5.64	6.05	7.26	10.83	3.46	2.31	2.07
28	0.74	0.87	0.72	0.96	3.88	5.58	5.62	8.15	10.45	3.50	2.29	2.14
29	0.74		0.72	0.95	3.67	5.05	5.33	8.79	10.09	3.90	2.29	2.16
30	0.75		0.71	0.95	4.13	4.40	5.05	9.00	9.46	3.97	2.26	2.19
31	0.75		0.71		4.12		4.54	9.38		3.82		2.18
Mean	0.78	0.83	0.68	0.87	2.71	4.99	5.14	7.10	10.20	5.31	3.01	2.15
Max	0.85	0.97	0.85	1.02	4.19	7.75	7.50	9.38	11.40	8.72	3.73	2.27
Min	0.73	0.75	0.61	0.70	0.95	3.33	4.12	4.54	8.99	3.46	2.26	1.99

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 2000

DAY	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.18	1.45	1.56	1.61	1.97	3.36	7.11	9.09	8.06	6.74	4.02	1.81
2	1.86	1.42	1.56	1.62	1.79	3.80	6.03	9.00	8.27	6.57	3.95	1.89
3	1.83	1.41	1.56	1.61	1.77	3.79	5.38	8.84	8.40	6.24	3.81	1.76
4	1.74	1.43	1.57	1.60	1.80	3.83	4.98	8.34	9.39	6.01	3.74	1.65
5	1.66	1.42	1.71	1.63	1.96	3.89	5.14	7.94	10.39	5.69	3.66	1.67
6	1.63	1.41	1.68	1.66	2.06	3.93	5.35	8.96	11.05	5.54	3.61	1.75
7	1.64	1.43	1.68	1.63	2.16	3.73	5.12	9.93	11.41	5.60	3.61	1.78
8	1.57	1.43	1.61	1.62	2.15	3.69	4.83	10.35	11.50	5.48	3.59	1.79
9	1.56	1.42	1.62	1.65	2.05	4.74	4.75	10.68	11.59	5.40	3.38	1.80
10	1.60	1.42	1.58	1.64	1.92	6.53	4.85	10.88	11.71	5.41	3.10	1.69
11	1.63	1.43	1.58	1.68	1.97	6.26	4.75	10.92	11.59	5.22	3.12	1.61
12	1.64	1.44	1.55	1.68	2.06	5.46	4.98	10.40	11.43	5.05	2.85	1.69
13	1.62	1.43	1.59	1.69	2.16	4.71	6.33	9.73	11.55	4.88	2.73	1.72
14	1.63	1.44	1.61	1.68	2.16	4.23	7.29	8.80	11.73	4.53	2.65	1.73
15	1.62	1.42	1.60	1.68	2.26	3.88	7.70	8.33	11.80	4.39	2.63	1.78
16	1.65	1.42	1.61	1.65	2.44	3.76	7.61	7.89	11.74	4.21	2.56	2.18
17	1.63	1.46	1.61	1.52	2.75	3.87	7.47	7.90	11.49	4.07	2.47	2.21
18	1.63	1.44	1.43	1.55	5.58	4.46	7.53	8.12	11.23	3.99	2.35	1.89
19	1.62	1.44	1.48	1.54	4.11	6.08	7.74	8.00	10.77	3.92	2.24	2.16
20	1.62	1.46	1.61	1.53	4.56	6.68	7.60	7.79	10.35	3.84	2.14	2.16
21	1.62	1.47	1.63	1.55	5.06	6.84	7.50	7.57	9.83	3.84	2.16	2.21
22	1.62	1.47	1.63	1.71	5.37	7.06	7.89	7.18	8.60	4.03	2.06	2.34
23	1.62	1.46	1.64	1.71	4.88	7.25	8.34	6.70	8.41	4.41	2.00	2.52
24	1.64	1.46	1.63	1.71	4.43	7.56	8.91	6.36	7.84	4.80	1.97	2.49
25	1.64	1.46	1.62	1.69	4.07	7.88	9.10	6.18	7.50	4.99	1.87	2.41
26	1.63	1.46	1.64	1.56	3.81	7.84	9.10	6.19	7.21	4.75	1.84	2.50
27	1.62	1.46	1.62	1.67	3.83	8.66	9.10	6.58	6.57	4.48	1.80	2.55
28	1.52	1.46	1.62	1.69	3.75	9.32	9.09	7.13	6.79	4.30	1.81	2.52
29	1.55	1.57	1.63	1.76	3.52	8.96	9.18	8.27	7.07	4.15	1.82	2.52
30	1.56		1.62	1.94	3.40	7.98	9.19	8.36	6.20	4.04	1.78	2.53
31	1.52		1.61		3.28		9.15	8.39		4.00		2.51
Mean	1.65	1.44	1.60	1.65	3.07	5.67	7.07	8.41	9.72	4.86	2.71	2.06
Max.	2.18	1.57	1.71	1.94	5.58	9.32	9.19	10.92	11.80	6.74	4.02	2.53
Min.	1.52	1.41	1.43	1.52	1.77	3.36	4.75	6.18	6.20	3.84	1.78	1.61

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 2001

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.33	1.79	1.64	1.86	1.98	4.92	6.22	7.49	10.56	6.39	4.55	2.54
2	1.94	1.80	1.63	1.83	2.00	4.92	5.57	7.31	10.00	5.97	4.60	2.43
3	1.78	1.78	1.62	1.81	2.02	4.49	5.03	7.30	9.69	5.69	4.68	2.33
4	1.67	1.72	1.70	1.82	2.08	3.94	5.28	7.97	9.84	5.61	4.95	2.41
5	1.67	1.67	1.71	1.80	2.10	4.06	6.65	8.66	9.97	5.59	4.72	2.39
6	1.65	1.71	1.72	1.78	1.97	4.25	7.11	8.79	10.22	5.66	4.54	2.40
7	1.68	1.72	1.73	2.05	1.77	4.22	6.88	9.03	10.04	5.59	4.28	2.41
8	1.64	1.72	1.73	2.13	1.91	4.48	6.25	9.61	11.29	5.37	4.19	2.39
9	1.63	1.69	1.80	2.15	1.98	4.67	6.26	10.37	11.26	5.23	4.10	2.41
10	1.63	1.68	1.87	2.13	2.05	4.67	7.20	10.92	11.20	5.66	3.99	2.23
11	1.61	1.71	1.99	2.14	2.09	4.74	7.37	11.04	11.19	5.90	3.66	2.30
12	1.63	1.75	1.96	2.14	2.18	5.31	6.99	11.21	11.14	5.84	3.35	2.28
13	1.62	1.76	1.96	2.15	2.06	5.58	6.62	11.40	11.09	5.75	3.13	2.27
14	1.63	1.70	1.96	2.20	1.92	5.26	6.33	11.66	10.89	5.60	3.06	2.27
15	1.62	1.72	2.04	2.23	2.09	4.74	6.57	11.94	10.64	5.44	3.04	2.29
16	1.59	1.69	2.02	2.22	2.14	4.50	6.80	12.08	10.18	5.68	3.04	2.30
17	1.54	1.71	2.13	2.20	2.28	4.17	6.88	12.12	9.67	5.52	3.10	2.59
18	1.50	1.69	2.38	2.19	2.31	3.97	6.89	12.15	9.25	5.18	3.10	2.61
19	1.51	1.64	2.46	2.18	2.31	3.97	6.74	12.15	8.86	4.82	2.86	2.62
20	1.51	1.65	2.66	2.14	2.33	3.82	6.78	12.08	8.34	4.41	2.70	2.61
21	1.72	1.68	2.59	2.16	2.31	3.75	6.75	11.90	8.27	4.41	2.80	2.70
22	1.72	1.68	2.58	2.14	2.52	3.62	7.89	11.57	7.71	4.25	2.94	2.81
23	1.59	1.72	1.99	2.13	2.79	3.58	8.37	11.17	7.54	4.16	2.92	2.83
24	1.62	1.70	1.91	2.15	2.85	3.88	8.42	10.65	7.39	4.10	2.74	2.80
25	1.71	1.69	1.87	2.15	2.87	4.25	8.17	10.30	7.37	4.10	2.72	2.62
26	1.81	1.55	1.85	2.13	2.74	4.46	8.39	10.04	7.21	4.23	2.54	2.76
27	1.84	1.57	1.85	2.02	2.78	4.51	8.58	9.72	7.05	4.54	2.56	2.75
28	1.89	1.73	1.92	1.98	3.12	5.06	8.66	9.72	6.91	4.49	2.58	2.67
29	1.89		2.04	2.00	3.93	6.52	8.40	10.00	6.81	4.51	2.58	2.66
30	1.83		1.95	2.00	4.03	6.63	8.08	10.34	6.61	4.50	2.56	2.66
31	1.80		1.88		4.21		7.82	10.44		4.51		2.65
Mean	1.70	1.70	1.97	2.07	2.44	4.56	7.10	10.36	9.27	5.12	3.42	2.52
Max	2.33	1.80	2.66	2.23	4.21	6.63	8.66	12.15	11.29	6.39	4.95	2.83
Min	1.50	1.55	1.62	1.78	1.77	3.58	5.03	7.30	6.61	4.10	2.54	2.23

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2002

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.47	1.91	1.94	2.10	2.09	4.45	5.40	9.77	10.96	6.39	4.42	2.96
2	2.04	1.88	2.09	2.11	2.06	3.93	5.20	9.84	10.72	5.86	3.87	2.75
3	1.88	1.88	2.15	2.11	2.06	3.53	4.92	10.18	10.71	5.86	3.80	2.72
4	1.73	1.82	2.09	2.11	2.07	3.32	4.61	10.20	10.59	5.71	3.75	2.83
5	1.70	1.78	1.88	2.12	2.05	3.51	4.47	10.23	10.48	5.64	3.59	2.83
6	1.67	1.74	1.78	2.10	2.06	3.55	4.56	10.63	10.48	5.68	3.48	2.77
7	1.67	1.74	1.72	2.10	2.05	3.89	4.73	10.80	10.75	6.00	3.37	2.74
8	1.71	1.73	1.72	2.09	2.04	4.33	5.29	11.36	10.84	6.29	3.25	2.72
9	1.70	1.73	1.72	2.07	2.01	4.48	5.52	11.42	10.85	6.63	3.17	2.73
10	1.74	1.73	1.71	2.07	2.03	5.45	5.83	11.42	10.62	5.72	3.11	2.75
11	1.72	1.73	1.73	2.11	2.04	5.44	6.34	11.32	10.04	5.38	3.06	2.89
12	1.71	1.83	1.73	2.11	2.14	6.52	6.50	11.18	9.33	5.15	3.00	2.87
13	1.70	1.82	1.71	2.13	2.59	6.24	6.23	11.15	8.69	4.82	2.96	2.81
14	1.74	1.82	1.72	2.13	2.93	5.51	6.06	11.22	7.91	4.61	2.91	2.80
15	1.85	1.82	1.69	2.12	2.94	5.51	6.03	11.30	7.33	4.41	2.90	2.75
16	1.80	1.81	1.71	2.14	2.96	6.27	6.19	11.33	7.03	4.25	2.89	2.74
17	1.81	1.82	1.70	2.15	3.02	5.54	6.80	11.32	7.07	4.12	2.91	2.73
18	1.80	1.80	1.71	2.15	3.57	4.71	7.93	11.33	7.17	4.17	2.96	2.70
19	1.84	1.80	1.71	2.13	4.18	4.30	8.34	11.53	7.23	3.92	3.26	2.69
20	1.85	1.80	1.71	2.13	3.99	4.16	7.96	11.76	7.33	3.92	3.06	2.75
21	1.85	1.81	1.73	2.12	3.82	4.01	7.65	11.75	7.47	3.85	3.28	2.67
22	1.84	1.82	2.12	2.12	3.72	3.85	7.64	11.55	7.18	3.80	3.15	2.69
23	1.82	1.80	2.34	2.08	3.43	3.68	8.42	11.31	6.83	3.80	3.21	2.68
24	1.82	1.80	2.02	2.09	3.32	3.53	8.76	11.20	6.51	3.76	3.22	2.50
25	1.82	1.80	2.16	2.09	3.32	3.48	8.53	11.25	6.35	3.83	3.16	2.35
26	1.92	1.81	2.20	2.09	3.56	3.63	8.19	11.17	5.99	3.87	3.09	2.52
27	1.90	1.80	2.10	2.08	4.16	3.65	8.06	11.31	5.63	3.80	3.07	2.78
28	1.86	1.80	2.09	2.10	4.50	5.45	8.13	10.87	5.30	3.79	3.12	2.97
29	1.89		2.13	2.09	4.04	5.85	8.38	10.93	5.65	3.84	3.06	3.00
30	1.89		2.09	2.08	3.86	5.56	9.00	11.09	6.21	4.38	3.00	2.96
31	1.90		2.11		4.67		9.54	11.04		5.07		2.94
Mean	1.83	1.80	1.90	2.11	3.00	4.58	6.81	11.06	8.31	4.78	3.24	2.76
Max	2.47	1.91	2.34	2.15	4.67	6.52	9.54	11.76	10.96	6.63	4.42	3.00
Min	1.67	1.73	1.69	2.07	2.01	3.32	4.47	9.77	5.30	3.76	2.89	2.35

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2003

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.87	2.10	1.80	1.78	1.84	3.17	3.49	6.69	5.24	4.64	2.25	1.68
2	2.78	2.11	1.81	1.78	1.83	3.40	4.60	6.62	5.08	4.84	2.30	1.80
3	2.70	2.11	1.76	1.73	1.82	3.36	4.53	6.03	5.20	4.70	2.24	1.83
4	2.74	2.10	1.67	1.74	1.81	3.34	4.30	5.34	5.44	4.51	2.23	1.94
5	2.66	2.10	1.64	1.85	1.81	3.53	4.05	4.99	5.89	4.28	2.15	1.89
6	2.69	2.09	1.62	2.17	1.80	4.54	3.84	4.80	6.18	4.00	2.12	1.87
7	2.32	2.08	1.61	2.15	1.80	4.52	3.46	4.86	6.54	3.56	2.12	1.79
8	2.20	2.08	1.74	2.22	1.80	3.85	3.45	4.63	6.45	3.37	2.12	1.63
9	2.17	2.05	1.77	2.25	1.79	3.42	3.61	4.39	6.65	3.27	2.10	1.79
10	2.16	2.04	1.77	2.29	1.79	3.23	3.84	4.15	6.89	3.19	2.01	1.84
11	2.13	2.02	1.77	2.36	1.85	3.40	3.84	4.07	7.36	3.11	2.01	1.81
12	2.17	2.05	1.74	2.43	1.85	3.86	3.79	3.89	8.53	3.32	2.00	1.82
13	2.21	2.02	1.78	2.45	1.86	3.80	4.16	3.71	9.37	3.37	1.98	1.85
14	2.21	2.09	1.79	2.48	1.84	3.72	4.18	3.71	9.81	3.33	1.95	1.73
15	2.18	2.13	1.79	2.48	1.90	3.64	4.49	3.88	9.80	3.07	1.94	1.72
16	2.12	2.14	1.81	2.49	1.88	3.64	4.29	3.87	9.32	3.22	1.98	1.80
17	2.10	2.08	1.81	2.49	2.24	3.84	4.16	3.68	8.75	3.64	1.87	1.79
18	2.10	1.93	1.83	2.46	2.59	3.85	4.09	4.11	8.07	3.82	1.92	1.83
19	2.08	1.86	1.68	2.56	2.58	3.20	3.84	4.59	8.69	3.92	1.96	1.85
20	2.07	1.84	1.73	2.56	2.53	3.21	3.52	5.11	7.08	2.75	1.98	1.84
21	2.05	1.82	1.76	2.57	2.54	3.14	3.77	5.68	6.61	2.70	1.99	1.81
22	2.05	1.82	1.74	2.39	2.68	3.02	3.62	5.81	6.31	2.67	1.99	1.55
23	2.04	1.81	1.74	2.06	2.84	3.13	3.76	7.02	6.02	2.55	1.98	1.75
24	2.02	1.79	1.77	1.92	2.73	3.49	6.51	7.52	5.63	2.55	1.74	1.81
25	2.02	1.82	1.83	1.88	2.69	3.54	7.58	7.42	5.33	2.43	1.87	1.86
26	2.01	1.81	1.82	1.89	2.62	3.46	6.56	7.44	5.09	2.43	1.91	1.86
27	2.01	1.80	1.75	1.86	2.65	3.26	5.54	7.04	4.83	2.38	1.90	1.87
28	1.99	1.81	1.75	1.85	2.64	3.00	5.42	6.62	4.54	2.32	1.91	1.71
29	2.11		1.76	1.84	2.55	2.85	7.53	5.98	4.29	2.22	1.92	1.69
30	2.11		1.77	1.83	2.57	2.89	5.96	5.76	4.42	2.25	1.77	1.76
31	2.10		1.76		2.79		5.76	5.66		2.25		1.80
Mean	2.23	1.98	1.75	2.16	2.21	3.45	4.57	5.32	6.65	3.25	2.01	1.79
Max	2.87	2.14	1.83	2.57	2.84	4.54	7.58	7.52	9.81	4.84	2.30	1.94
Min	1.99	1.79	1.61	1.73	1.79	2.85	3.45	3.68	4.29	2.22	1.74	1.55

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2004

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.83	1.42	1.68	2.17	2.25	3.08	3.62	7.04	6.58	7.14	2.30	1.92
2	1.81	1.47	1.70	2.20	2.24	3.77	3.69	7.41	6.72	6.74	2.28	1.92
3	1.77	1.60	1.88	2.31	2.27	4.23	3.70	7.39	7.48	6.44	2.36	1.90
4	1.76	1.63	1.89	2.40	2.33	4.04	3.05	7.36	8.32	6.16	2.36	1.80
5	1.56	1.66	1.90	2.45	2.34	3.70	3.31	7.55	9.06	5.88	2.48	1.82
6	1.72	1.68	1.91	2.37	2.29	3.50	3.68	7.56	9.43	5.60	2.33	1.80
7	1.77	1.73	1.86	2.32	2.28	3.30	4.95	7.20	9.72	5.30	2.22	1.76
8	1.82	1.82	1.88	2.29	2.59	3.22	6.20	7.49	9.36	5.03	2.20	1.87
9	1.85	1.77	1.88	2.25	1.81	3.31	6.20	7.96	9.02	4.78	2.12	1.88
10	1.80	1.72	1.88	2.24	1.79	3.42	5.83	8.17	9.55	4.62	2.18	1.86
11	1.71	1.72	1.87	2.37	2.17	3.53	4.66	8.52	10.74	4.66	2.17	1.83
12	1.52	1.70	1.87	2.39	2.20	3.48	4.62	8.53	11.57	4.60	2.14	1.92
13	1.74	1.59	1.80	2.36	2.19	3.36	6.12	8.26	12.04	4.48	2.17	1.66
14	1.75	1.41	1.98	2.41	2.23	3.32	8.05	7.93	12.24	4.44	2.16	1.70
15	1.69	1.62	1.89	2.31	2.21	3.24	9.13	7.61	12.38	4.12	1.94	1.78
16	1.66	1.30	1.89	2.28	2.25	3.61	8.57	7.32	12.37	4.34	2.07	1.76
17	1.68	1.57	1.95	2.24	2.45	4.87	8.10	7.51	12.31	4.28	2.18	1.76
18	1.59	1.70	2.10	2.21	2.64	6.30	7.82	8.25	12.21	4.19	2.19	1.76
19	1.51	1.67	1.64	2.28	2.80	6.58	6.85	8.48	11.96	3.76	2.16	1.75
20	1.63	1.66	1.50	2.27	2.72	5.98	6.09	8.23	11.67	3.26	2.13	1.78
21	1.62	1.66	1.58	2.31	2.79	5.06	5.85	8.33	11.53	3.18	2.06	1.96
22	1.63	1.66	2.13	2.28	2.84	4.57	6.18	8.14	11.42	3.10	1.86	2.06
23	1.63	1.64	2.18	2.27	2.60	4.07	6.27	8.29	11.20	2.94	1.96	2.06
24	1.62	1.65	2.20	2.22	2.28	3.65	6.28	7.76	10.94	2.90	2.01	2.04
25	1.42	1.64	2.19	2.23	2.15	3.40	6.67	8.36	10.50	2.84	1.94	2.03
26	1.42	1.64	2.17	2.23	2.29	3.22	6.94	8.32	9.87	2.80	2.04	2.02
27	1.54	1.62	2.16	2.21	2.59	3.13	7.14	8.19	9.33	2.72	2.00	2.01
28	1.59	1.63	2.17	2.26	2.68	3.29	7.80	7.80	8.73	2.62	1.91	2.04
29	1.59	1.66	2.18	2.29	2.71	3.61	7.82	7.24	8.11	2.54	1.81	2.07
30	1.58		2.18	2.31	2.59	3.81	7.57	6.82	7.61	2.45	1.90	2.08
31	1.58		2.17		2.64		7.27	6.57		2.43		2.08
Mean	1.66	1.63	1.94	2.29	2.39	3.92	6.13	7.79	10.13	4.20	2.12	1.89
Max	1.85	1.82	2.20	2.45	2.84	6.58	9.13	8.53	12.38	7.14	2.48	2.08
Min	1.42	1.30	1.50	2.17	1.79	3.08	3.05	6.57	6.58	2.43	1.81	1.66

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2005

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.07	1.91	2.63	2.53	2.27	1.17	4.37	6.83	11.90	12.01	3.64	2.22
2	1.79	1.32	2.62	2.58	2.02	1.13	4.87	6.89	11.77	12.09	3.48	2.31
3	1.66	1.97	2.62	2.58	1.93	1.02	6.86	8.00	11.56	11.92	3.15	2.31
4	1.76	2.03	2.62	2.59	1.93	1.15	7.91	7.83	11.48	11.52	3.05	2.30
5	1.77	2.11	2.62	2.60	1.82	1.19	7.73	7.37	11.37	11.17	3.13	2.29
6	1.76	2.10	2.56	2.63	1.88	1.03	7.12	6.80	11.20	10.59	3.21	2.29
7	1.78	2.07	2.54	2.62	2.00	1.10	6.21	6.32	11.25	10.08	3.23	2.36
8	1.96	2.13	2.58	2.58	1.83	1.60	5.17	5.91	11.29	9.28	3.41	2.34
9	1.94	2.11	2.58	2.57	1.74	1.78	4.79	5.70	11.32	8.68	3.63	2.25
10	1.71	2.10	2.58	2.58	1.79	1.75	5.52	5.25	11.32	8.01	3.73	2.24
11	1.83	2.08	2.58	2.54	1.74	2.02	6.90	5.29	11.35	7.32	3.63	2.23
12	1.89	2.02	2.57	2.56	1.71	2.11	7.08	5.76	11.51	6.78	3.61	2.22
13	2.22	2.07	2.57	2.57	1.63	2.05	6.58	7.95	11.57	6.36	3.63	2.22
14	2.46	2.25	2.56	2.54	1.66	1.74	6.39	9.50	11.45	6.13	3.62	2.22
15	2.43	2.39	2.56	2.54	1.70	1.72	6.25	10.45	10.97	5.85	3.53	2.22
16	2.39	2.05	2.55	2.54	1.45	1.55	5.84	10.70	10.46	5.53	3.49	2.22
17	1.99	2.07	2.55	2.56	1.60	1.54	5.42	10.62	9.67	5.27	3.47	2.22
18	2.30	2.35	2.57	2.53	1.40	1.99	5.16	10.55	8.85	5.04	3.42	2.21
19	2.38	2.60	2.56	2.50	1.25	2.71	5.45	10.85	8.52	4.85	2.97	2.21
20	2.14	2.65	2.55	2.50	1.26	3.30	5.65	11.11	9.20	4.69	2.82	2.20
21	1.93	2.64	2.56	2.56	1.42	3.20	5.63	11.25	9.96	4.56	2.77	2.20
22	1.96	2.64	2.53	2.56	1.29	3.15	5.80	11.38	10.12	4.43	2.71	2.20
23	1.92	2.64	2.54	2.50	1.02	2.73	7.34	11.67	9.95	4.18	2.45	2.19
24	1.62	2.67	2.56	2.28	1.11	2.71	8.74	11.88	9.55	4.05	2.31	2.16
25	1.88	2.69	2.56	2.23	0.97	3.90	9.54	11.90	9.27	3.98	2.28	2.16
26	1.93	2.64	2.57	2.18	0.96	6.35	9.70	11.85	9.00	3.92	2.24	2.15
27	1.96	2.64	2.55	2.22	0.86	6.67	9.74	11.84	9.11	3.91	2.28	2.16
28	2.02	2.34	2.53	2.28	1.07	5.82	9.26	11.83	9.59	3.87	2.28	2.14
29	2.01		2.52	2.30	1.05	4.92	8.51	11.82	11.10	3.83	2.22	2.16
30	2.01		2.52	2.30	1.08	4.39	7.76	11.82	11.71	3.77	2.13	2.17
31	1.77		2.50		1.09		7.00	11.90		3.72		2.17
Mean	1.98	2.26	2.56	2.49	1.50	2.58	6.78	9.32	10.58	6.69	3.05	2.22
Max	2.46	2.69	2.63	2.63	2.27	6.67	9.74	11.90	11.90	12.09	3.73	2.36
Min	1.62	1.32	2.50	2.18	0.86	1.02	4.37	5.25	8.52	3.72	2.13	2.14

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 2006

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.13	2.73	1.95	2.48	2.57	4.03	2.67	7.48	9.45	4.08	2.80	1.88
2	2.12	2.72	1.96	2.47	2.87	4.32	2.75	7.44	9.52	4.03	2.81	1.89
3	2.13	2.71	1.97	2.43	2.69	5.01	3.11	7.40	9.24	3.91	2.72	1.87
4	2.34	2.72	1.96	2.39	2.01	4.99	3.05	6.97	8.74	3.73	2.62	1.86
5	2.28	2.71	1.96	2.40	1.68	5.22	2.92	6.52	8.06	3.63	2.59	1.82
6	2.04	2.71	1.97	2.36	1.54	4.93	3.81	5.96	7.74	3.79	2.43	1.79
7	2.04	2.72	2.06	2.36	1.58	4.23	4.36	5.80	7.21	4.23	2.33	1.81
8	2.03	2.70	2.00	2.36	1.67	3.91	4.48	5.59	6.58	3.91	2.23	1.84
9	2.03	2.69	1.98	2.35	1.70	3.77	4.18	5.59	6.41	4.32	2.17	1.84
10	2.00	2.70	2.08	2.36	2.52	3.59	3.65	5.90	6.21	5.92	2.15	1.81
11	2.00	2.70	2.30	2.37	2.61	3.36	3.53	5.91	6.30	6.58	2.11	1.68
12	2.00	2.71	2.59	2.38	2.60	3.36	3.93	6.01	6.12	6.16	2.10	1.76
13	2.00	2.72	2.62	2.37	2.59	3.15	4.30	5.58	6.47	5.66	1.99	1.77
14	2.00	2.50	2.58	2.33	2.59	3.01	3.87	5.86	5.68	5.92	2.03	1.78
15	2.01	2.06	2.46	2.33	2.58	3.05	3.76	5.75	5.34	6.37	2.01	1.79
16	2.01	2.03	2.39	2.33	2.59	2.99	3.66	5.55	4.97	6.49	1.98	1.73
17	2.02	2.00	2.38	2.37	2.60	2.97	3.72	5.33	4.70	6.48	1.96	1.73
18	2.01	2.00	2.38	2.37	2.59	2.89	3.81	5.37	3.88	6.15	1.94	1.46
19	2.01	2.00	2.38	2.37	2.58	2.93	4.41	5.88	4.05	5.75	1.96	1.64
20	2.00	1.99	2.48	2.32	2.54	2.49	4.79	7.12	4.00	5.31	2.08	1.69
21	2.02	1.99	2.53	2.32	2.26	3.08	6.61	7.90	4.09	4.94	2.29	1.71
22	2.01	1.99	2.53	2.32	2.22	3.03	6.73	8.39	4.20	4.62	2.23	1.70
23	2.01	1.91	2.52	2.32	2.40	2.98	6.30	7.77	4.96	4.12	1.96	1.67
24	2.01	1.68	2.52	2.26	4.23	2.92	6.53	7.39	5.32	3.83	1.90	1.61
25	2.00	1.89	2.41	2.30	5.64	2.91	6.35	7.24	5.21	3.55	1.93	1.65
26	2.11	1.95	2.40	2.47	5.33	2.77	6.64	7.38	5.14	3.35	1.86	1.66
27	2.41	1.95	2.40	2.48	4.94	2.51	8.72	7.79	4.99	3.25	1.75	1.72
28	2.45	1.92	2.39	2.43	4.25	2.43	8.75	8.72	4.80	3.13	1.92	1.62
29	2.73		2.40	2.41	3.83	2.60	7.98	9.19	4.57	3.08	1.92	1.62
30	2.74		2.45	2.45	3.58	2.67	7.11	9.26	4.82	2.90	1.90	1.60
31	2.74		2.47		4.35		6.63	9.32		2.84		1.61
Mean	2.14	2.32	2.30	2.37	2.89	3.40	4.94	6.88	5.95	4.58	2.15	1.73
Max	2.74	2.73	2.62	2.48	5.64	5.22	8.75	9.32	9.52	6.58	2.81	1.89
Min	2.00	1.68	1.95	2.26	1.54	2.43	2.67	5.33	3.88	2.84	1.75	1.46

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Venkham
WATER LEVEL HISTORICAL, YEAR 2007

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.42	1.61	2.16	2.02	2.18	2.62	3.71	4.66	6.11	3.82	3.07	1.93
2	1.45	1.52	2.14	2.01	2.19	2.37	3.51	5.35	6.13	3.73	3.11	1.76
3	1.73	1.54	2.12	2.08	2.09	2.13	3.49	6.28	5.89	3.55	3.10	1.49
4	1.79	1.45	2.09	2.08	2.07	2.31	3.66	6.10	6.20	3.39	2.54	1.76
5	1.74	1.28	1.75	2.14	2.14	2.23	3.53	5.42	7.68	3.37	1.98	1.82
6	1.63	1.53	1.81	1.99	2.12	2.25	3.41	4.84	9.46	4.79	2.83	1.80
7	1.51	1.63	1.83	1.87	1.97	2.31	3.28	5.01	10.09	8.00	2.94	1.80
8	1.50	1.75	1.84	1.87	2.15	2.24	3.23	5.22	10.43	9.46	2.90	1.78
9	1.59	1.74	1.85	1.88	2.14	2.20	3.19	5.56	10.01	9.42	2.96	1.43
10	1.74	1.77	2.03	1.88	2.15	1.86	3.14	5.69	9.54	9.08	2.94	1.42
11	1.78	1.70	2.15	2.09	2.12	1.48	3.21	5.70	9.37	8.84	2.58	1.63
12	1.67	1.59	1.76	2.18	2.05	1.60	3.20	5.60	9.08	8.25	2.38	1.74
13	1.62	1.85	2.02	2.27	1.98	1.67	3.17	5.16	9.00	7.65	2.59	1.77
14	1.68	1.95	2.09	2.18	1.94	1.52	2.97	4.83	8.55	6.81	2.61	1.78
15	1.55	1.98	1.97	2.21	1.95	1.45	2.26	4.47	8.63	6.35	2.60	1.74
16	1.57	1.98	2.08	2.07	2.06	1.40	2.87	3.94	7.49	6.17	2.34	1.76
17	1.57	1.99	2.06	2.13	2.16	2.09	2.59	4.12	7.08	5.75	2.51	1.35
18	1.57	1.94	2.11	2.16	2.20	1.92	2.65	4.71	7.12	6.03	2.52	1.62
19	1.62	1.66	1.82	2.17	2.44	2.85	2.69	4.48	7.62	5.30	2.52	1.67
20	1.61	1.84	2.01	2.16	2.24	2.98	2.72	4.81	8.15	4.97	2.50	1.75
21	1.55	1.97	2.04	2.20	2.16	2.82	2.78	5.17	7.88	4.24	2.48	1.92
22	1.47	2.02	2.07	2.27	2.41	2.61	2.12	5.66	6.98	3.81	2.50	1.96
23	1.54	2.06	2.09	2.06	2.46	2.79	2.10	5.71	6.79	3.88	2.50	1.35
24	1.55	2.07	2.10	2.16	2.47	2.20	2.17	6.19	6.67	3.75	2.47	1.36
25	1.57	1.89	2.09	2.18	2.40	2.07	3.14	6.03	5.29	3.61	2.43	1.79
26	1.40	1.69	1.73	2.23	2.46	2.56	3.13	6.60	5.37	3.54	1.92	1.90
27	1.70	1.94	1.88	2.19	2.48	2.99	3.26	6.58	4.56	3.48	2.05	1.86
28	1.67	2.12	1.94	2.20	2.37	3.79	3.62	6.02	4.31	3.30	2.06	1.88
29	1.45		1.95	2.21	2.46	4.14	3.88	5.46	4.10	2.79	1.83	1.90
30	1.57		1.97	1.94	2.47	3.99	4.04	5.48	3.98	3.05	1.86	1.44
31	1.65		1.92		2.44		4.23	5.68		2.62		1.34
Mean	1.59	1.79	1.98	2.10	2.22	2.38	3.12	5.37	7.32	5.25	2.52	1.69
Max	1.79	2.12	2.16	2.27	2.48	4.14	4.23	6.60	10.43	9.46	3.11	1.96
Min	1.40	1.28	1.73	1.87	1.94	1.40	2.10	3.94	3.98	2.62	1.83	1.34

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2008

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.78	1.74	1.74	2.06	2.32	3.42	6.48	11.95	9.95	6.68	4.02	2.62
2	1.81	1.71	1.66	2.34	2.36	3.99	7.25	12.18	9.69	6.73	4.00	2.55
3	1.84	1.58	1.69	2.78	2.28	4.10	7.27	12.35	9.47	6.51	4.26	2.50
4	1.83	1.50	1.91	2.86	2.26	4.21	6.93	12.39	9.20	6.35	4.65	2.50
5	1.93	1.56	2.16	2.81	2.34	4.79	6.51	12.35	8.88	6.26	4.95	2.50
6	1.26	1.53	2.18	2.27	2.24	4.86	6.18	12.31	8.83	6.14	4.86	2.45
7	1.14	1.51	2.20	2.15	2.66	6.33	6.02	12.23	9.17	6.29	4.93	2.34
8	1.31	1.44	2.18	2.30	3.04	6.23	5.87	12.14	9.22	7.02	5.02	2.41
9	1.57	1.29	1.86	2.36	3.20	5.73	5.77	12.08	9.42	7.47	4.97	2.42
10	1.57	1.30	1.71	2.30	3.21	5.24	7.06	12.03	9.27	7.10	4.92	2.43
11	1.53	1.24	2.13	2.37	3.14	5.04	7.57	11.99	8.76	6.68	4.62	2.40
12	1.58	1.21	1.62	2.33	3.56	5.83	7.80	11.99	8.64	6.22	4.21	2.43
13	1.23	1.23	1.93	2.08	3.75	4.81	7.72	12.3	8.34	5.90	4.01	2.42
14	1.45	1.58	1.75	1.94	3.38	5.29	7.61	12.64	8.05	5.60	3.74	2.32
15	1.58	1.66	1.76	1.96	3.24	6.22	7.90	12.86	7.72	5.30	3.52	2.27
16	1.58	1.74	1.77	1.96	3.15	6.98	7.49	12.96	7.51	5.03	3.35	2.38
17	1.57	1.61	1.79	1.96	2.65	6.86	6.85	12.94	7.36	4.79	3.24	2.38
18	1.53	1.52	1.79	2.25	2.75	6.54	7.34	12.86	7.28	4.62	3.11	2.36
19	1.53	1.64	1.82	2.32	2.83	6.45	8.30	12.77	7.40	4.50	3.03	2.32
20	1.27	1.72	1.81	2.19	3.12	7.25	10.80	12.65	7.70	4.41	2.96	2.36
21	1.11	1.72	1.85	2.09	3.39	7.61	11.38	12.54	8.18	4.51	2.91	2.22
22	1.44	1.75	1.91	2.05	3.25	6.99	11.55	12.44	8.37	4.43	2.86	2.13
23	1.58	1.72	1.92	1.96	3.54	6.39	11.45	12.3	8.45	4.30	2.84	2.23
24	1.54	1.59	1.97	1.94	3.41	5.98	11.18	12.14	8.20	4.28	2.81	2.32
25	1.56	1.51	1.93	1.94	3.28	5.41	11.05	11.98	7.65	4.45	3.01	2.28
26	1.55	1.74	1.88	1.94	3.73	5.16	11.17	11.73	7.17	4.35	2.91	2.23
27	1.20	1.72	1.86	1.98	3.26	4.98	11.37	11.43	6.76	4.12	2.83	2.19
28	1.09	1.74	2.00	2.00	3.24	4.85	11.47	11.11	6.46	4.20	2.80	2.03
29	1.44	1.83	2.06	1.91	3.32	5.38	11.61	10.69	6.30	4.28	2.93	1.95
30	1.56		1.96	2.03	3.26	6.09	11.69	10.38	6.59	4.16	2.73	2.00
31	1.65		1.99		3.28		11.76	10.06		3.84		2.14
Mean	1.50	1.57	1.90	2.18	3.04	5.63	8.72	12.09	8.20	5.37	3.70	2.33
Max	1.93	1.83	2.2	2.86	3.75	7.61	11.76	12.96	9.95	7.47	5.02	2.62
Min	1.09	1.21	1.62	1.91	2.24	3.42	5.77	10.06	6.3	3.84	2.73	1.95

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2009

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.14	2.01	5.49	2.02	2.18	5.18	5.56	5.72	6.40	4.70	2.42	1.52
2	2.14	1.84	4.77	2.04	2.10	4.87	5.65	4.97	6.19	4.44	2.37	1.37
3	2.15	1.85	5.14	2.04	2.00	4.36	5.83	5.09	5.96	4.22	2.27	1.37
4	2.08	1.90	5.28	2.02	1.98	4.48	5.78	5.00	5.88	3.80	2.26	1.40
5	2.10	2.00	5.21	2.01	2.02	3.51	5.46	4.93	5.84	3.76	2.23	1.33
6	2.00	2.00	5.18	2.02	1.98	3.41	6.62	4.75	5.86	3.92	2.21	1.29
7	2.00	2.01	5.73	2.04	1.94	4.04	7.87	4.61	5.78	3.93	2.19	1.36
8	2.24	2.02	5.42	2.03	1.94	4.51	7.92	4.58	5.73	4.02	2.15	1.32
9	2.32	2.06	4.67	2.02	1.64	4.22	8.06	4.98	5.59	4.06	2.11	1.25
10	2.38	2.34	5.04	2.03	1.92	3.79	7.97	5.15	5.21	4.10	1.84	1.85
11	2.15	2.32	5.10	2.00	1.94	3.36	7.41	5.35	4.90	3.60	1.79	1.73
12	2.10	2.41	5.10	2.03	1.95	3.18	6.77	5.77	4.88	3.54	1.72	1.61
13	2.12	2.43	5.13	2.02	2.06	3.01	6.56	5.90	4.80	3.78	1.85	1.42
14	2.22	2.25	4.62	2.04	2.03	2.90	6.77	6.14	4.70	3.62	1.81	1.39
15	2.18	2.22	4.50	2.10	2.06	2.80	6.72	7.33	4.79	3.56	1.69	1.55
16	2.15	1.98	5.61	2.03	2.18	2.85	6.50	8.47	5.50	3.43	1.63	1.55
17	2.12	2.31	5.65	2.02	2.30	3.09	6.32	7.95	6.22	3.40	1.62	1.39
18	2.10	2.28	5.30	2.03	2.30	3.75	6.53	7.29	7.51	3.12	1.58	1.31
19	2.08	2.72	5.01	1.79	2.28	4.28	6.68	6.55	7.99	3.07	1.64	1.30
20	2.05	2.77	5.00	1.78	2.26	4.53	6.54	6.30	7.09	3.47	1.57	1.24
21	2.06	2.62	4.64	1.96	2.22	4.59	6.17	6.05	6.36	3.64	1.57	1.02
22	2.08	2.68	4.56	1.95	2.28	4.35	5.93	5.94	6.04	4.24	1.52	1.14
23	2.08	2.40	4.74	2.02	2.28	3.85	6.31	6.60	5.80	3.92	1.55	1.09
24	2.06	2.15	5.17	1.99	2.56	3.73	7.11	6.81	5.68	3.80	1.52	1.07
25	2.04	2.10	4.98	1.96	2.50	3.97	7.25	6.50	5.56	3.32	1.52	1.05
26	2.08	2.12	4.92	2.02	2.63	3.97	7.05	6.25	5.35	3.02	1.58	1.03
27	2.05	2.10	4.96	2.00	2.90	3.83	6.71	6.16	4.98	2.90	1.55	1.04
28	2.03	2.10	4.89	2.12	3.70	3.95	6.21	6.12	4.96	3.04	1.55	1.19
29	2.08		4.82	2.08	5.44	4.07	5.62	6.51	5.11	2.76	1.59	1.03
30	2.02		4.91	2.08	5.11	4.70	5.40	6.73	4.89	2.60	1.60	1.06
31	2.02		4.94		5.95		5.19	6.52		2.54		1.05
Mean	2.11	2.21	4.85	2.01	2.54	3.90	6.55	6.03	5.72	3.59	1.81	1.30
Max	2.38	2.77	5.65	2.12	5.95	5.18	8.06	8.47	7.99	4.70	2.42	1.85
Min	2.00	1.84	3.42	1.78	1.64	2.80	5.19	4.58	4.70	2.54	1.52	1.02

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2010

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.02	1.12	1.15	1.64	1.80	2.07	2.43	4.93	9.69	6.79	2.96	2.33
2	1.01	1.30	1.56	1.65	1.67	2.00	2.19	4.81	10.00	6.39	2.89	2.38
3	1.10	1.38	1.72	1.66	1.65	2.16	2.56	5.85	9.97	6.00	2.88	2.40
4	1.12	1.39	1.78	1.58	1.82	2.14	3.25	6.75	9.39	5.81	2.82	2.31
5	1.06	1.42	1.72	1.49	1.93	2.16	3.33	7.46	8.93	5.66	2.68	2.25
6	1.07	1.38	1.74	1.63	1.98	1.94	2.92	8.35	8.59	5.38	2.62	2.20
7	1.05	1.19	1.30	1.70	1.98	2.16	2.65	9.01	8.59	5.14	2.43	2.31
8	1.08	1.15	1.43	1.72	1.86	2.26	2.92	8.99	8.28	4.88	2.33	2.31
9	1.08	1.30	1.54	1.76	1.88	2.92	3.24	8.91	7.85	4.71	2.41	2.29
10	1.06	1.41	1.66	1.72	1.92	2.96	3.09	8.39	7.70	4.18	2.45	2.47
11	1.05	1.39	1.72	1.56	1.86	2.76	2.33	7.82	7.48	4.16	2.41	2.53
12	1.04	1.40	1.70	1.66	2.00	2.60	2.27	7.60	7.14	3.93	2.38	2.56
13	1.03	1.42	1.72	1.80	2.02	2.24	2.64	7.78	7.03	3.57	2.35	2.56
14	1.40	1.28	1.56	1.86	1.21	2.28	2.62	7.99	8.17	3.41	2.20	2.55
15	1.44	1.31	1.52	1.72	1.96	2.42	2.55	7.95	9.70	3.51	2.11	2.57
16	1.42	1.31	1.84	1.71	1.94	2.45	2.49	7.95	11.10	3.58	2.24	2.56
17	1.08	1.34	1.89	1.73	1.90	2.40	2.52	8.11	11.54	3.47	2.28	2.57
18	1.30	1.44	1.83	1.72	1.98	2.30	2.71	9.44	11.52	3.45	2.49	2.59
19	1.28	1.43	1.69	1.74	2.10	2.24	4.50	10.01	11.21	3.44	2.46	2.82
20	1.25	1.44	1.68	1.87	2.12	1.94	5.73	10.11	10.78	3.47	2.49	3.11
21	1.34	1.24	1.54	1.92	2.14	1.80	5.46	9.40	10.37	3.41	2.48	3.18
22	1.40	1.12	1.50	1.90	1.12	2.30	4.74	8.19	9.79	3.39	2.29	3.19
23	1.49	1.32	1.66	1.97	1.67	2.58	4.51	7.61	9.48	3.14	2.40	3.17
24	1.57	1.41	1.70	1.97	1.80	2.42	4.79	7.22	8.90	2.94	2.25	3.17
25	1.29	1.42	1.69	1.86	2.00	2.67	5.70	7.28	9.14	2.91	2.33	3.15
26	1.44	1.45	1.66	1.54	2.15	3.88	6.63	8.53	8.97	2.95	2.19	3.16
27	1.45	1.42	1.65	1.71	2.20	3.06	6.49	9.15	8.10	3.32	2.21	3.14
28	1.42	1.24	1.63	1.72	2.23	2.46	5.67	8.67	8.28	3.76	2.03	3.12
29	1.39		1.60	1.74	2.22	2.22	4.94	7.87	7.75	3.70	2.10	3.14
30	1.37		1.64	1.81	1.80	2.42	5.01	7.42	7.35	2.53	2.16	3.15
31	1.22		1.67		1.68		4.96	8.27		3.30		3.18
Mean	1.23	1.34	1.64	1.74	1.89	2.41	3.80	7.99	9.09	4.07	2.41	2.72
Max	1.49	1.45	1.89	1.97	2.23	3.88	6.63	10.11	11.54	6.79	2.96	3.19
Min	1.01	1.12	1.15	1.49	1.12	1.80	2.19	4.81	7.03	2.53	2.03	2.20

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East
River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2
Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

Vennkham
WATER LEVEL HISTORICAL, YEAR 2011

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.14	2.14	2.81	2.32	2.46	2.92	7.98	9.40	11.72	11.73	3.89	3.13
2	3.14	2.40	2.42	2.31	2.52	2.66	7.82	10.50	11.31	10.60	3.86	3.13
3	3.24	2.53	2.26	2.30	2.55	2.57	9.05	10.98	10.86	10.75	3.86	3.12
4	3.25	2.94	2.23	2.30	2.47	2.58	9.24	11.34	10.52	10.79	3.88	3.12
5	3.26	2.87	2.24	2.27	2.46	2.61	8.74	11.32	10.55	10.58	3.87	3.11
6	3.23	2.15	2.11	2.28	2.52	2.99	8.08	11.02	10.45	10.18	3.84	3.06
7	3.24	1.70	2.21	2.28	2.59	3.68	7.66	10.64	10.46	9.52	3.79	2.84
8	3.23	2.62	2.23	2.28	2.58	4.00	7.18	10.27	10.56	8.90	3.76	2.82
9	2.75	2.61	2.24	2.27	2.57	3.65	6.10	9.97	10.52	8.32	3.74	2.81
10	3.22	2.56	2.24	2.31	2.53	3.36	6.02	9.56	10.43	7.72	3.74	2.76
11	3.23	2.59	2.23	2.30	2.57	3.20	6.57	9.37	10.24	7.22	3.76	2.79
12	3.21	2.50	2.24	2.32	2.76	3.02	6.65	9.72	10.01	6.74	3.72	2.77
13	2.52	2.44	2.24	2.28	2.78	3.72	7.88	9.98	10.05	6.44	3.68	2.75
14	2.51	2.06	2.25	2.32	2.76	4.12	6.81	10.23	10.53	6.28	3.60	2.75
15	2.49	2.33	2.30	2.35	2.76	3.83	6.90	10.32	10.92	6.20	3.42	2.75
16	2.42	2.56	2.36	2.34	2.88	3.55	7.84	10.17	11.33	6.44	2.95	2.74
17	2.16	2.60	2.44	2.34	3.06	3.27	8.76	9.80	11.55	6.32	2.92	2.74
18	2.24	2.68	2.57	2.34	2.98	3.04	9.15	9.89	11.85	6.04	2.90	2.75
19	2.44	3.15	2.72	2.31	3.02	2.91	8.97	10.24	12.21	5.76	2.87	2.79
20	2.52	2.85	2.77	2.33	3.37	2.85	8.62	11.22	12.52	5.44	2.97	3.02
21	2.47	2.67	2.88	2.33	3.97	2.96	7.99	12.00	12.67	5.27	2.98	3.03
22	2.46	2.92	2.50	2.34	4.06	3.82	7.82	12.36	12.63	5.07	2.84	3.05
23	2.41	3.17	2.44	2.34	3.87	3.96	7.75	12.56	12.50	4.84	2.80	3.07
24	2.20	3.23	2.36	2.36	3.73	3.50	7.79	12.67	12.38	4.72	2.80	3.11
25	2.22	3.14	2.35	2.34	3.64	3.24	8.34	12.72	12.31	4.52	2.86	3.07
26	2.44	3.12	2.32	2.42	3.31	4.94	8.35	12.72	12.14	4.28	2.92	3.05
27	2.47	2.71	2.31	2.38	3.37	9.87	8.51	12.67	11.86	4.15	2.93	3.24
28	2.45	2.55	2.32	2.36	3.79	10.65	8.53	12.61	11.53	4.10	2.86	3.26
29	2.47		2.30	2.41	3.70	10.35	8.12	12.48	11.42	4.03	3.08	3.28
30	2.16		2.34	2.42	3.72	9.34	7.84	12.29	11.15	4.00	3.14	3.27
31	1.88		2.34		3.38		7.86	12.02		3.95		3.28
Mean	2.68	2.63	2.36	2.33	3.06	4.24	7.89	11.07	11.31	6.80	3.33	2.98
Max	3.26	3.23	2.81	2.42	4.06	10.65	9.24	12.72	12.67	11.73	3.89	3.28
Min	1.88	1.70	2.11	2.27	2.46	2.57	6.02	9.37	10.01	3.95	2.80	2.74

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2012

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.27	2.58	3.20	2.45	2.60	3.56	2.78	6.58	7.40	4.58	2.80	2.85
2	3.27	2.70	3.19	2.42	2.57	3.75	2.93	6.86	8.02	4.58	2.76	2.67
3	3.26	2.90	3.20	2.47	2.56	4.56	4.28	6.96	8.57	4.20	2.74	2.58
4	3.26	3.01	3.31	2.47	2.51	5.08	4.54	6.92	8.91	4.05	2.70	2.56
5	3.27	2.88	3.12	2.52	2.51	4.92	4.10	6.57	8.90	3.98	2.70	2.55
6	3.27	3.32	2.61	2.40	2.50	4.52	4.22	6.08	8.52	3.99	2.84	2.54
7	3.28	3.38	2.48	2.51	2.54	4.36	4.18	5.54	8.14	3.76	2.87	2.53
8	3.32	3.40	2.47	2.51	2.56	4.26	4.62	5.33	8.04	3.52	2.85	2.53
9	3.33	3.13	2.45	2.52	2.58	4.45	4.98	5.62	7.99	3.45	2.81	2.43
10	3.32	3.30	2.42	2.53	2.58	4.46	5.30	6.96	7.94	3.40	2.64	2.52
11	3.31	3.30	2.44	2.50	2.68	4.40	5.19	9.37	7.42	3.32	2.54	2.52
12	3.31	3.38	2.42	2.50	2.88	4.31	5.02	9.58	6.78	3.34	2.61	2.52
13	3.32	3.39	2.42	2.50	2.88	4.00	4.96	8.94	6.30	3.00	2.59	2.54
14	3.32	3.42	2.47	2.51	2.77	3.70	5.30	8.03	6.04	3.22	2.59	2.57
15	3.16	3.26	2.69	2.50	2.88	3.26	5.38	7.44	5.80	3.20	2.58	2.54
16	3.29	3.10	2.36	2.49	2.89	3.03	5.10	6.85	5.66	3.10	2.57	2.52
17	3.32	3.05	2.44	2.48	2.72	3.02	4.78	6.45	5.57	3.02	2.56	2.50
18	3.30	3.06	2.46	2.46	2.64	3.19	4.55	6.42	5.52	2.90	2.54	2.49
19	2.80	3.05	2.44	2.46	2.69	3.51	4.34	6.10	5.60	2.96	2.53	2.49
20	2.63	3.04	2.47	2.46	2.69	3.42	4.25	6.06	5.88	2.94	2.52	2.48
21	2.62	3.03	2.50	2.45	2.69	3.39	4.36	6.02	5.79	2.93	2.51	2.49
22	2.61	3.18	2.50	2.52	2.62	3.40	4.30	6.12	5.34	2.92	2.51	2.50
23	2.61	3.17	2.52	2.52	2.86	3.56	4.21	6.27	4.96	2.76	2.51	2.49
24	2.61	3.18	2.72	2.51	2.96	3.32	4.17	6.50	4.86	2.72	2.53	2.48
25	2.60	3.18	2.68	2.50	3.00	3.29	4.30	7.02	5.12	2.68	2.56	2.47
26	2.59	3.06	2.51	2.46	3.16	3.26	5.40	7.24	5.07	2.70	2.57	2.30
27	2.58	3.18	2.49	2.46	3.44	3.14	5.62	7.31	4.96	2.76	2.57	2.80
28	2.52	3.18	2.47	2.45	3.53	2.85	5.37	7.48	4.74	2.77	2.58	2.72
29	2.58		2.46	2.44	2.97	2.78	5.28	7.35	4.60	2.74	2.65	2.69
30	2.59		2.46	2.58	3.45	2.74	5.52	7.34	4.58	2.70	2.89	2.68
31	2.60		2.46		3.13		6.01	7.35		2.79		2.65
Mean	3.00	3.14	2.61	2.49	2.80	3.71	4.69	6.92	6.43	3.25	2.64	2.56
Max	3.33	3.42	3.31	2.58	3.45	5.08	6.01	9.58	8.91	4.58	2.89	2.85
Min	2.52	2.58	2.36	2.40	2.50	2.74	2.78	5.33	4.58	2.68	2.51	2.30

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2013

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.74	2.54	2.44	2.96	3.08	3.05	4.28	7.41	7.19	5.98	4.09	2.49
2	3.08	3.04	2.42	2.96	3.13	3.06	4.33	7.52	7.18	5.72	3.72	2.06
3	3.00	3.14	2.40	2.95	3.16	3.05	5.85	7.56	6.92	5.35	2.98	2.50
4	2.56	3.15	2.42	2.87	3.11	3.11	5.98	7.80	6.60	5.14	2.95	2.65
5	2.33	3.14	2.42	2.79	3.05	3.38	4.13	7.97	6.38	4.98	3.02	2.59
6	2.36	3.12	2.41	2.82	2.99	3.83	3.94	8.92	8.42	4.82	3.06	2.39
7	2.38	3.12	2.40	2.83	3.06	4.41	3.64	8.19	9.23	4.67	3.07	2.40
8	2.39	3.12	2.40	2.84	3.10	4.24	4.16	7.90	9.99	4.52	3.05	2.56
9	2.47	3.12	2.75	2.81	3.09	4.04	4.45	8.90	9.98	4.39	3.01	2.51
10	2.46	3.12	2.95	2.84	3.07	4.15	4.31	10.35	9.96	4.32	2.97	3.06
11	2.46	3.13	3.00	2.82	3.07	4.37	4.42	10.93	9.81	4.26	2.95	2.94
12	2.48	3.11	3.00	2.84	3.10	4.12	5.46	11.13	9.47	4.14	2.93	3.04
13	2.45	2.71	3.00	2.83	3.01	4.36	5.65	11.13	9.17	3.66	2.90	3.27
14	2.46	2.51	2.99	3.08	3.02	4.22	5.49	10.97	9.50	3.52	2.88	3.41
15	2.47	2.47	2.98	3.18	3.08	4.03	5.32	10.75	8.84	3.81	2.88	3.16
16	2.50	2.45	2.63	3.20	3.07	3.71	5.21	10.32	8.52	3.65	2.87	3.03
17	2.50	2.45	2.35	3.18	3.06	3.42	4.85	9.79	8.07	3.60	2.84	3.24
18	2.50	2.44	2.32	2.97	3.05	3.21	5.45	9.15	7.66	3.39	2.84	2.66
19	2.53	2.44	2.31	2.86	3.06	3.09	5.96	8.45	7.46	3.35	2.82	2.47
20	2.53	2.44	2.28	2.86	3.06	3.06	5.64	7.79	7.27	3.38	2.78	2.92
21	2.49	2.43	2.24	3.01	3.08	3.12	5.40	7.05	7.01	3.15	2.53	3.40
22	2.51	2.44	2.30	3.03	3.08	3.28	5.48	6.86	6.78	3.34	2.75	3.09
23	2.51	2.44	2.32	3.04	3.04	3.27	6.14	7.26	6.55	2.93	2.67	2.63
24	2.51	2.44	2.32	2.97	3.05	3.33	6.07	7.79	6.28	2.85	2.25	2.57
25	2.51	2.45	2.32	3.03	3.13	3.88	6.12	7.90	5.93	2.85	2.09	2.47
26	2.52	2.44	2.33	3.04	3.19	4.70	6.68	7.64	5.84	3.19	2.24	2.36
27	2.48	2.43	2.32	3.06	3.31	4.96	6.86	7.11	6.23	3.35	2.65	2.31
28	2.53	2.42	2.31	3.04	3.28	4.69	6.84	7.25	6.44	3.44	2.65	2.33
29	2.48		2.30	3.05	2.85	4.47	6.59	6.61	6.51	3.58	2.63	1.90
30	2.44		2.53	3.04	2.57	4.40	7.15	6.61	6.35	3.58	2.61	2.02
31	2.42		2.88		2.90		7.58	6.78		3.35		2.21
Mean	2.52	2.72	2.52	2.96	3.06	3.80	5.33	8.44	7.72	3.94	2.85	2.66
Max	3.08	3.15	3.00	3.20	3.31	4.96	7.58	11.13	9.99	5.98	4.09	3.41
Min	2.33	2.42	2.24	2.79	2.57	3.05	3.64	6.61	5.84	2.85	2.09	1.90

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2014

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.31	2.51	2.50	2.52	2.64	2.58	3.00	6.94	8.64	6.02	3.38	2.36
2	2.28	2.48	2.58	2.64	2.63	2.44	3.01	6.73	8.43	5.81	3.06	2.39
3	2.28	2.50	2.50	2.67	2.62	2.27	2.95	6.48	9.64	5.72	2.52	2.42
4	2.30	2.50	2.49	2.70	2.58	2.29	2.82	6.47	9.72	5.61	3.02	2.43
5	2.32	2.49	2.50	2.67	2.54	2.26	2.73	6.80	9.81	5.47	3.00	2.42
6	2.33	2.50	2.50	2.72	2.52	2.20	2.65	7.69	9.87	5.29	3.16	2.42
7	2.47	2.50	2.48	2.62	2.52	2.27	2.59	8.56	9.78	5.00	3.10	2.27
8	2.57	2.48	2.48	2.58	2.55	2.32	2.46	8.06	9.54	4.96	3.19	2.10
9	2.80	2.48	2.49	2.69	2.58	2.28	2.55	7.49	9.14	4.83	3.18	2.28
10	2.58	2.47	2.48	2.70	2.76	2.16	2.71	7.05	8.46	4.73	3.07	2.38
11	2.54	2.46	2.50	2.70	2.85	2.24	2.88	6.81	7.86	4.66	3.19	2.40
12	2.54	2.40	2.50	2.70	2.85	2.35	3.23	6.39	7.48	4.59	3.15	2.40
13	2.53	2.45	2.49	2.67	2.86	2.44	3.62	5.97	7.42	4.42	3.16	2.56
14	2.53	2.46	2.44	2.57	2.81	2.45	4.09	5.56	7.56	4.25	3.14	2.42
15	2.54	2.47	2.48	2.53	2.81	2.38	4.22	5.80	7.66	4.14	3.12	2.35
16	2.54	2.48	2.52	2.52	2.90	2.37	4.09	6.25	7.40	4.10	3.10	2.53
17	2.52	2.44	2.50	2.53	2.92	2.61	3.93	6.23	7.10	4.08	2.96	2.57
18	2.51	2.44	2.50	2.51	2.92	2.84	4.21	6.21	7.24	4.12	3.02	2.57
19	2.52	2.43	2.63	2.51	2.90	3.11	4.70	6.15	7.30	4.11	3.10	2.57
20	2.52	2.43	2.66	2.49	2.88	3.44	4.94	6.26	7.36	4.03	3.09	2.57
21	2.53	2.44	2.67	2.46	2.85	3.46	4.88	6.48	7.14	3.99	2.87	2.22
22	2.50	2.44	2.68	2.46	2.63	3.30	4.81	6.69	6.85	3.63	2.75	2.07
23	2.50	2.45	2.67	2.47	2.76	3.06	4.62	6.79	6.90	3.63	2.55	2.32
24	2.50	2.45	2.68	2.48	2.77	2.90	4.36	6.84	7.54	3.57	2.43	2.36
25	2.52	2.44	2.56	2.48	2.67	2.91	4.59	6.59	7.94	3.40	2.58	2.32
26	2.58	2.44	2.57	2.51	2.54	3.11	5.60	6.40	7.86	2.96	2.68	2.39
27	2.51	2.44	2.65	2.54	2.53	3.14	6.29	6.83	7.37	2.80	2.64	2.39
28	2.50	2.48	2.69	2.54	2.53	3.08	7.17	6.75	6.88	3.41	2.64	2.39
29	2.51		2.67	2.58	2.56	2.97	7.85	6.63	6.33	3.44	2.64	2.38
30	2.51		2.68	2.62	2.56	2.96	7.54	7.83	6.02	3.43	2.49	2.51
31	2.52		2.58		2.60		7.02	8.52		3.40		2.34
Mean	2.49	2.46	2.56	2.58	2.70	2.67	4.26	6.78	7.94	4.31	2.93	2.39
Max	2.80	2.51	2.69	2.72	2.92	3.46	7.85	8.56	9.87	6.02	3.38	2.57
Min	2.28	2.40	2.44	2.46	2.52	2.16	2.46	5.56	6.02	2.80	2.43	2.07

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37" North Longitude : 102° 336' 53" East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2015

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.34	2.12	2.64	2.80	3.60	3.28	2.81	7.58	5.97	6.08	3.51	3.57
2	2.12	1.97	2.62	2.66	3.64	3.27	2.85	7.97	7.09	5.71	3.40	3.36
3	1.98	2.04	2.59	2.64	3.64	3.28	2.88	9.05	7.70	5.74	3.36	3.36
4	1.62	2.05	2.53	2.81	3.60	3.26	2.86	9.61	9.14	5.56	3.33	3.20
5	1.35	2.03	2.50	2.68	3.62	3.24	2.83	10.42	9.57	5.15	3.21	3.57
6	1.80	2.00	2.48	2.34	3.65	3.17	2.81	10.60	9.40	5.34	3.18	2.52
7	1.92	2.00	2.49	2.59	3.64	3.12	2.79	10.35	9.18	5.36	3.18	2.59
8	1.92	1.96	2.50	2.77	3.64	3.07	2.89	10.01	8.83	5.46	3.08	2.71
9	1.89	2.10	2.50	2.82	3.63	3.14	2.98	9.37	8.05	5.66	2.85	2.96
10	1.88	1.98	2.49	2.82	3.64	3.14	3.31	8.62	7.65	6.47	2.86	2.98
11	1.90	1.99	2.51	2.82	3.63	3.17	3.12	7.77	7.42	6.77	2.84	2.99
12	1.92	1.96	2.53	2.82	3.62	3.22	3.11	7.33	7.09	9.19	2.86	2.96
13	2.10	1.98	2.52	2.82	3.60	3.22	3.02	7.40	7.14	9.54	2.79	2.66
14	2.15	2.00	2.49	2.82	3.61	3.22	3.12	7.62	6.95	8.74	2.77	2.42
15	2.18	1.99	2.54	2.80	3.61	3.16	3.40	7.44	6.81	8.01	2.79	2.58
16	2.16	1.99	2.54	2.81	3.60	3.32	3.42	7.30	6.60	7.16	2.72	2.67
17	2.16	1.98	2.52	2.81	3.61	3.65	3.58	6.91	6.27	6.65	2.67	2.69
18	2.18	2.00	2.52	2.83	3.62	3.58	3.74	6.66	5.88	6.27	2.63	2.77
19	1.85	2.00	2.53	2.82	3.63	3.44	3.84	6.20	5.77	5.82	2.65	2.67
20	2.04	2.00	2.59	2.84	3.63	3.30	3.79	5.89	6.31	5.33	2.66	2.59
21	2.10	2.04	2.72	2.82	3.62	3.24	4.63	6.00	6.50	5.11	2.70	2.58
22	2.12	2.03	2.66	2.82	3.61	3.17	5.78	6.19	6.35	5.00	2.34	2.53
23	2.30	2.25	2.62	2.84	3.60	2.96	5.94	6.01	6.89	4.86	2.25	2.65
24	2.08	2.44	2.59	2.82	3.60	2.90	5.53	5.73	7.86	4.73	2.22	2.83
25	2.08	2.46	2.56	2.86	3.61	2.90	5.12	5.46	8.23	4.19	2.43	2.82
26	2.04	2.49	2.82	2.86	3.61	2.91	5.12	5.27	8.00	4.06	3.16	2.90
27	2.05	2.52	2.69	2.86	3.63	2.86	5.21	5.45	7.66	4.32	3.37	3.09
28	2.05	2.59	2.62	2.84	3.70	2.85	5.19	5.58	7.31	4.34	3.37	3.14
29	2.12		2.62	2.84	3.80	2.82	5.30	5.48	6.87	4.32	3.38	3.17
30	2.10		2.34	3.38	3.54	2.85	5.92	5.54	6.48	4.30	3.37	3.30
31	1.90		2.52		3.39		5.62	5.48		3.79		3.31
Mean	2.03	2.11	2.56	2.80	3.62	3.16	3.95	7.30	7.36	5.77	2.93	2.90
Max	2.30	2.59	2.82	3.38	3.80	3.65	5.94	10.60	9.57	9.54	3.51	3.57
Min	1.35	1.96	2.34	2.34	3.39	2.82	2.79	5.27	5.77	3.79	2.22	2.42

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37'' North Longitude : 102° 336' 53'' East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2016

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3.21	3.28	3.06	3.15	3.19	3.21	5.24	4.86	6.25	6.08	3.69	2.85
2	2.64	3.33	3.12	3.16	3.18	3.40	5.33	4.24	6.12	5.69	3.53	2.86
3	2.44	3.36	3.12	3.14	3.14	3.37	6.00	4.12	5.73	5.57	3.37	3.28
4	2.49	3.35	3.11	3.15	3.14	3.42	6.14	4.01	5.30	5.21	3.28	3.49
5	3.00	2.95	3.13	3.15	3.15	3.35	5.36	4.31	4.93	4.81	3.23	3.52
6	3.00	2.65	3.13	3.14	3.14	3.45	4.75	5.60	5.80	4.88	3.24	3.50
7	3.00	2.71	3.14	3.15	3.13	3.59	4.58	6.02	6.48	5.23	3.25	3.51
8	2.97	2.88	3.14	3.13	3.10	3.49	4.85	5.51	6.90	4.72	3.17	3.51
9	2.90	2.57	3.12	3.13	3.10	3.46	4.96	5.11	7.97	4.38	3.37	3.51
10	2.72	2.57	3.13	3.12	3.10	3.37	5.00	4.87	8.43	4.60	3.74	3.51
11	2.61	2.56	3.13	3.10	3.09	3.28	4.82	4.74	7.95	4.96	4.05	3.48
12	2.57	2.57	3.12	3.10	3.08	3.25	4.81	4.73	7.99	5.11	4.04	3.39
13	2.54	2.56	3.11	3.09	3.08	3.24	4.59	4.80	7.78	4.88	3.77	3.25
14	2.47	2.56	3.11	3.12	3.08	3.15	4.40	4.96	7.68	4.40	3.54	3.21
15	2.70	2.46	3.10	3.12	3.08	3.13	4.87	5.26	7.27	4.40	3.43	3.20
16	2.86	2.47	3.10	3.12	3.08	3.11	5.52	6.38	6.86	3.89	3.41	3.20
17	3.13	2.43	3.11	3.10	3.07	3.13	5.06	7.26	6.43	3.78	3.45	3.19
18	3.18	2.44	3.11	3.09	3.06	3.28	4.60	7.01	6.33	3.56	3.45	3.18
19	3.22	2.45	3.11	3.09	3.07	3.39	4.35	6.63	6.11	3.60	3.40	3.17
20	3.25	2.41	3.12	3.08	3.07	3.30	4.18	6.80	6.40	3.50	3.32	2.89
21	3.29	2.40	3.09	3.08	3.06	3.19	4.25	8.39	6.84	3.47	3.23	2.81
22	2.95	2.45	3.12	3.07	3.11	3.13	4.25	8.68	7.37	3.42	3.15	2.96
23	2.98	2.53	3.03	3.07	3.08	2.97	4.24	8.28	7.09	3.57	3.09	3.07
24	2.97	2.53	3.09	3.06	3.09	3.11	4.22	7.80	6.82	3.82	3.02	3.03
25	2.96	2.54	3.03	3.05	3.09	3.51	4.23	7.51	6.52	4.07	2.99	2.61
26	3.23	2.67	3.09	3.04	3.09	3.99	4.16	7.36	6.54	4.16	2.94	2.46
27	3.39	2.66	3.11	3.04	3.14	3.60	4.64	7.37	6.66	4.03	2.93	2.42
28	3.39	2.63	3.13	3.05	3.26	4.19	4.81	7.01	6.97	3.93	2.90	2.43
29	3.36	2.67	3.14	3.11	3.29	4.16	4.96	6.67	7.03	3.88	2.88	2.39
30	3.53		2.64	3.14	3.14	4.48	5.16	6.64	6.60	3.83	2.87	2.30
31	3.33		2.63		3.10		5.17	6.38		3.85		2.27
Mean	2.97	2.66	3.08	3.10	3.11	3.42	4.82	6.10	6.77	4.36	3.32	3.04
Max	3.39	3.36	3.14	3.16	3.29	4.48	6.14	8.68	8.43	6.08	4.05	3.52
Min	2.44	2.40	2.63	3.04	3.06	2.97	4.16	4.01	4.93	3.42	2.87	2.27

Station Characteristics of station : 231201

Station name : Venkham Latitude : 18° 10' 37'' North Longitude : 102° 336' 53'' East

River : Nam Ngum Altitude : 178.00 m Catchment area : .000 km2

Province : Vientiane Capital Country : Lao PDR Agency : Hydro-met Lao PDR

WATER LEVEL HISTORICAL, YEAR 2017

Days	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	2.27	3.04	2.52	3.41	3.23	3.76	3.59					
2	2.27	3.29	2.55	3.37	3.30	3.66	3.59					
3	2.29	3.26	2.50	3.21	3.48	3.67	3.68					
4	2.30	3.25	2.48	3.20	3.54	3.65	3.59					
5	2.68	3.22	2.48	3.37	3.56	3.60	3.49					
6	2.73	3.09	2.47	3.45	3.56	3.58	3.44					
7	2.92	3.03	2.47	3.43	3.44	3.56	3.07					
8	2.78	3.07	2.47	3.45	3.21	3.38	3.44					
9	2.74	3.11	2.47	3.39	3.18	3.79	3.82					
10	2.73	3.06	2.47	3.22	3.41	3.64	4.37					
11	2.74	3.13	2.46	3.22	3.51	3.76	3.90					
12	2.80	3.00	2.47	3.37	3.60	3.81	4.44					
13	3.06	2.71	2.53	3.47	3.67	3.83	4.42					
14	3.14	2.51	2.47	3.49	3.68	3.69	4.58					
15	2.97	2.50	2.46	3.51	3.60	3.51	4.63					
16	2.97	2.50	2.46	3.48	3.69	4.00	4.70					
17	2.99	2.45	2.46	3.33	4.04	4.09	4.66					
18	3.11	2.50	2.47	3.23	4.22	3.43	5.27					
19	3.26	2.42	2.48	3.28	4.34	3.03	6.78					
20	3.15	2.44	2.64	3.29	4.72	3.26	7.01					
21	3.24	2.55	2.92	3.33	4.66	3.37	6.70					
22	3.11	2.58	3.07	3.35	4.45	3.50	6.60					
23	3.06	2.53	3.21	3.35	4.36	3.44	6.43					
24	3.09	2.59	3.22	3.24	4.18	3.30	6.11					
25	3.22	2.60	3.21	3.15	4.06	3.12	5.93					
26	3.17	2.54	3.06	3.34	4.04	3.11	5.74					
27	3.16	2.51	2.92	3.43	4.03	3.42	5.82					
28	3.24	2.56	3.16	3.48	4.02	3.46	5.87					
29	3.21		3.34	3.42	3.88	3.55	6.36					
30	3.15		3.37	3.43	3.82	3.65	6.88					
31	3.11		3.39		3.72		7.30					
Mean	2.92	2.78	2.73	3.35	3.81	3.55	5.04					
Maxi	3.26	3.29	3.39	3.51	4.72	4.09	7.30					
Mini	2.27	2.42	2.46	3.15	3.18	3.03	3.07					

Appendix 7
References

Appendix 7 References

Collected data list

No	Title	Type Book/Video/Photo/Etc	Original /Copy	Issuing Institution	Issue Year
1	8th Five-Year National Socio-economic Development Plan (2016-2020) (8th NSEDP)	Book	Copy	Ministry of Planning and Investment	2016
2	Agriculture Development Strategy to 2025 and Vision to the Year 2030	Book	Copy	Ministry of Agriculture and Forestry	2015
3	Eighth (8th)Five-Year Agricultural and Forestry Development Plan (2016-2020)	Book	Copy	Ministry of Agriculture and Forestry	2016
4	Agricultural Master Plan 2011 to 2015	Book	Copy	Ministry of Agriculture and Forestry	2010
5	Strategy for Agricultural Development 2011 to 2020	Book	Copy	Ministry of Agriculture and Forestry	2010
6	Agricultural Statistics Yearbook 2016	Book	Copy	Ministry of Agriculture and Forestry, Department of Planning and Cooperation	2017
7	Lao Census of Agriculture 2010/11 Highlights	Book	Copy	Steering Committee for the Agricultural Census, Agricultural Census Office	2012
8	Water and Water Resources Law	Book	Copy	Lao PDR	1996
9	Law on Agriculture	Book	Copy	Lao PDR	1998
10	Law on aquatic and wildlife	Book	Copy	Lao PDR	2007
11	Law on Fisheries	Book	Copy	Lao PDR	2009
12	Law on Forestry	Book	Copy	Lao PDR	2007
13	Law on Irrigation	Book	Copy	Lao PDR	2013
14	Law on livestock and veterinary	Book	Copy	Lao PDR	2008
15	Law on Plant Protection	Book	Copy	Lao PDR	2008
16	Tax Law	Book	Copy	Lao PDR	2015
17	Instructions of the Minister of Finance on the Implementation of Value Added Tax Law	Book	Copy	Lao PDR	2014
18	Law on Value-Added Tax	Book	Copy	Lao PDR	2014
19	Decision on Official Development Assistance Financial Management Rules	Book	Copy	Lao PDR	2010