THE REPUBLIC OF THE UNION OF MYANMAR
YANGON CITY DEVELOPMENT COMMITTEE (YCDC)

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
URGENT IMPROVEMENT OF
WATER SUPPLY SYSTEM
IN YANGON CITY
IN
THE REPUBLIC OF THE UNION OF MYANMAR

AUGUST 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

TEC INTERNATIONAL CO., LTD.

Summary

1. Country Profile

The Republic of the Union of Myanmar (hereinafter to be referred as Myanmar) is located in the north-western part of Indochina Peninsula. The land area is approximately 680,000 km^2 and the population is approximately 63,670,000 (by IMF in 2012). The area experiences tropical monsoon climate and is divided into three seasons, that is; summer season from March to mid-May, rainy season from mid-May to October and dry season (winter) from October to February. The average annual rainfall is 2,700 mm and 95 % of it concentrates in rainy season between May and October.

According to statistics of IMF, in year 2011, nominal GDP of Myanmar was 43 billion US$ and GDP per capita was 702 US$. Myanmar has been rapidly advancing political and economic reforms since the civilian government has taken over in March 2011. Also economic growth rate is expected to achieve a favorable level of 6.2 % in year 2012 under decision of substantial relaxation of economic sanctions by the western countries.

2. Background, Progression and Outline of the Project

Yangon city is the former capital city of Myanmar and has a population of 5.1 million. Yangon city supplies about 115MGD (523,000m^3/d) of water using raw water resources of surface water and ground water and approximately 42 % of the Yangon population derive benefit from water supply services through these water supply systems. However, the current water services are not sufficient in terms of both water quality and quantity. The surface water which accounts for 90 % of water resources is supplied without sufficient treatment.

In addition, there are many problems in existing water supply services as listed below:

- the superannuated facilities are not replaced and/or repaired satisfactorily.
- water supply duration is approximately 16.5 hours per day in average and too short due to frequent power failure, etc.
- water supply pressure is low.
- the rate of water leakage is over 50%.

To study such problems the Japanese Government provided assistance and the Ministry of Economy, Trade and Industry implemented “The Study on Improvement of Water Supply and Wastewater Treatment in Yangon, Myanmar” in March 2012 and proposed as priority projects “Nyaunghnapin First Phase Water Treatment Plant Water Transmission and Distribution Pump Station Renewal Project” and “Yankin Township Water Distribution Pipeline Renewal Project”. Meanwhile since August 2012 JICA is implementing “The Preparatory Study for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City” aiming at preparation of the master plan and feasibility study of the priority projects.

Under the background mentioned above, the Government of Myanmar requested “The Project for Urgent Rehabilitation of Water Supply System in Yangon City” as Japanese Grant Aid in October 2012

with the follow components:

Construction of Facilities

- Improvement of the Pump Station for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant
- Renewal of aged Water Distribution Pipeline of Yankin Township

3. Summary of the Survey Results and Contents of the Project

Under the above situation, the Government of Japan decided implementation of the preparatory study. Subsequently, JICA dispatched the preparatory study team to the site from early March to the end of March 2013, and discussed with the concerned authorities of Myanmar and made site investigation on the object area. As a result of the preparatory study, the following main points are confirmed:

(1) Construction of New Pump Station Building for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant

The existing pump station building suffered tremendous damage by heavy water flood in the year 2012. As a result of investigation, it became clear that the existing pump station exceeded the limit of repair due to uneven settlement. Accordingly, new pump station for Nyaunghnapin first phase water treatment plant is planned in the same area.

(2) Renewal of Water Pipeline in Yankin Township

Renewal project of the requested pipeline in Yankin Township consists of two (2) components as follows,

- Renewal of water distribution pipeline with outer diameter of 1,050 mm from Kokine Service reservoir to Mayangone Township through Yankin Township
- Renewal of water distribution pipe network in pilot area of Yankin Township

In the result of the careful preparatory survey, as for the scope to be planned for renewal of the distribution network in Yankin Township is a part of block 2 and 3 of pilot area from the points of view of beneficially population, beneficiary population per meter for the renewal of pipe and possibility of devision of distribution area depending on Project scale.

(3) OJT and Soft Component

The instruction on operation and maintenance of pumps for water transmission and distribution in Nyaunghnapin first phase water treatment plant and computers for DMA's monitoring system in Yankin Township are needed for YCDC staffs under OJT sufficiently by the engineer of the pump and computer manufacturers respectively through the Project. This OJT will enable YCDC staffs to carry out sustainable operation and maintenance management of the

pump station in future. Moreover, the instruction on pipe installation work is also given YCDC staff under OJT by the Contractor.

Meanwhile, regarding the data of distribution water and distribution water flow managements in Yankin Township need to be addressed under the Soft Component so that YCDC staffs can contribute improvement of water distribution management efficiently.

(4) Target Year of the Project

The target year is currently decided taking into account the report of JICA-MP study which is being conducted. But, the project for "Reconstruction of Pump Station Building and Improvement of the Pump Station for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant" and the project for "Renewal of Water Distribution Pipeline to Mayangone Township" shall have target year as 2016 which is the expected completion time of both projects because both projects aim at recovery of the current water transmission and distribution amount.

The capacity of pumps after recovery for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant is approximately 204,500 m^3/day and outer diameter of water transmission pipeline to Mayangon Township is 1,050 mm at present. Meanwhile, water distribution pipeline in Yankin Township is planned and designed considering target year 2025 taking into account the needs of future expansion.

(5) Environmental and Social Considerations

The impact identified as "A" (Significant negative impact is expected.) are not expected. The impacts identified as "B" (Negative impact is expected to some extent) are expected on the existing infrastructure and service, the poor, infectious diseases, accidents, landscape, air pollution, waste, noise and vibration. Most of the impacts are temporally during the construction period and can be mitigated and minimized by the implementation of the mitigation measures. The monitoring of implementation of mitigation measures is require

The study team finalized this study report through the domestic work after return to Japan and the local briefing of basic design summary (draft) carried out from July 22 to 26, 2013. The summary of the components are shown below.

(6) Design Criteria and/or Design Standards

Myanmar has no design criteria and/or design standard related to water supply system. Accordingly the design is carried out using authorized international criteria and/or standards. However, YCDC's regulation related to construction shall be considered for laying transmission and distribution pipe along the public road.

The survey team finalized this preparatory survey report through the field survey, domestic work and explanation of draft final report for outline design. The Project components and its contents to be planned in the Project are shown below.

Components to be implemented under the Project

Components and Item	Contents to be implemented
1. Reconstruction of Pump Station Building and Improvement of the Pump Station for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant	
(1) Construction of Pump Station	- Foundation pile work (Steel pipe pile with winng) - Building work (Ground floor: reinforced concrete, 1st floor: concrete pillar and brick wall) - Building utility work (joinery, lighting, overhead crane, floor drain pump, etc.)
(2) Pump/Motor facilities	- Manufacturing and installation work for pump/motor (2850m^3/hr.x 72m, 800kW) - Manufacturing and installation work for 6.6kv electric panel and cable wiring - Manufacturing and installation work for ancillary steel pipe, valves, etc. (1800mm dia., 1500mmdia, 600mm dia.) - Manufacturing and installation work for water-hammer protection equipment (air valve, air commpressor, etc.) - Manufacturing and installation work for instalements for pump
2. Renewal of Water Transmission and Distribution Pipeline from Kokine Service reservoir to Mayangone Township	- Manufacturing and laying work of main pipe (ductile cast iron pipe ,outside dia.: 1,050mm) - Manufacturing and laying work of branch pipe (ductile cast iron pipe 300mm, 200mm) - Ancillary work for pipe laying (pipe bridge, valve, repavement work after completion of pipe laying work)
3. Renewal of pipe network in Yankin Township as pilot area	- Manufactueing and laying distribution pipe (Ductile Cast Iron 400mm to 200mm, less than 150 uPVC) - House connection pipe (PE) and its water meter - Ancillary work for pipe (stop valve, air valve) - Monitoring system for DMA - Soft conponent: Distribution water data and distribution water management

4. Implementation Schedule and Project Cost

The Project is divided into two lots, that is; lot 1:“Reconstruction of Pump Station Building and Improvement of the Pump Station for Water Transmission and Distribution in Nyaunghnapin First Phase Water Treatment Plant” and lot 2: “Renewal of Water Distribution Pipeline to Mayangon township”, and is implemented as single year project. The construction period of lot 1 is 17.5 months including detail design, tender and construction and that of lot 2 is 22 months. The rapid reduction of the capacity of transmission and distribution pumps is the problem to be improved urgently. Therefore, the implementation schedule for lot 1 is set to complete the work on a priority basis.

The project cost is estimated in JPY1, 925 thousand born by Myanmar side.

5. Project Evaluation

(1) Relevance

The project is expected to contribute to the improvement of living environment of inhabitants through improvement of water supply conditions due to urgent rehabilitation of water supply system required in Yangon city where rapid economic development is expected. The appropriateness of Project is high in order to meet two out of three (3) Japanese Assistance Policy for Myanmar (April 2012), that is; “Assistance for the improvement of the lives of the citizenry” and “Assistance for the improvement of the infrastructure system required for sustainable economic growth”.

(2) Effectiveness

・Quantitative Effects

The water supply condition is improved by implementation of the Project as shown below.

Index	Base Year (2011)	Target Year (2016)
The period of water supply (hr./day) (650 thousand persons to be supplied water from the Pump Station in Nyaunghnapin First Phase Water Treatment Plant	16.5	24
The period of water supply (hr./day) (50 thousand persons to be supplied water from Kokine Reservoir to Mayangone Township)	16.5	24
Water leakage ratio in Yankin Township (%)	50	10

・Qualitative Effects

The accident of water pipeline bursting is expected to decrease by renewal of 1050mmφ water distribution pipeline from Kokine reservoir. Accordingly, the traffic blockage decreases and traffic jam is reduced.

The Project for Urgent Improvement of Water Supply System
in Yangon City in the Republic of the Union of Myanmar
Preparatory Survey Report

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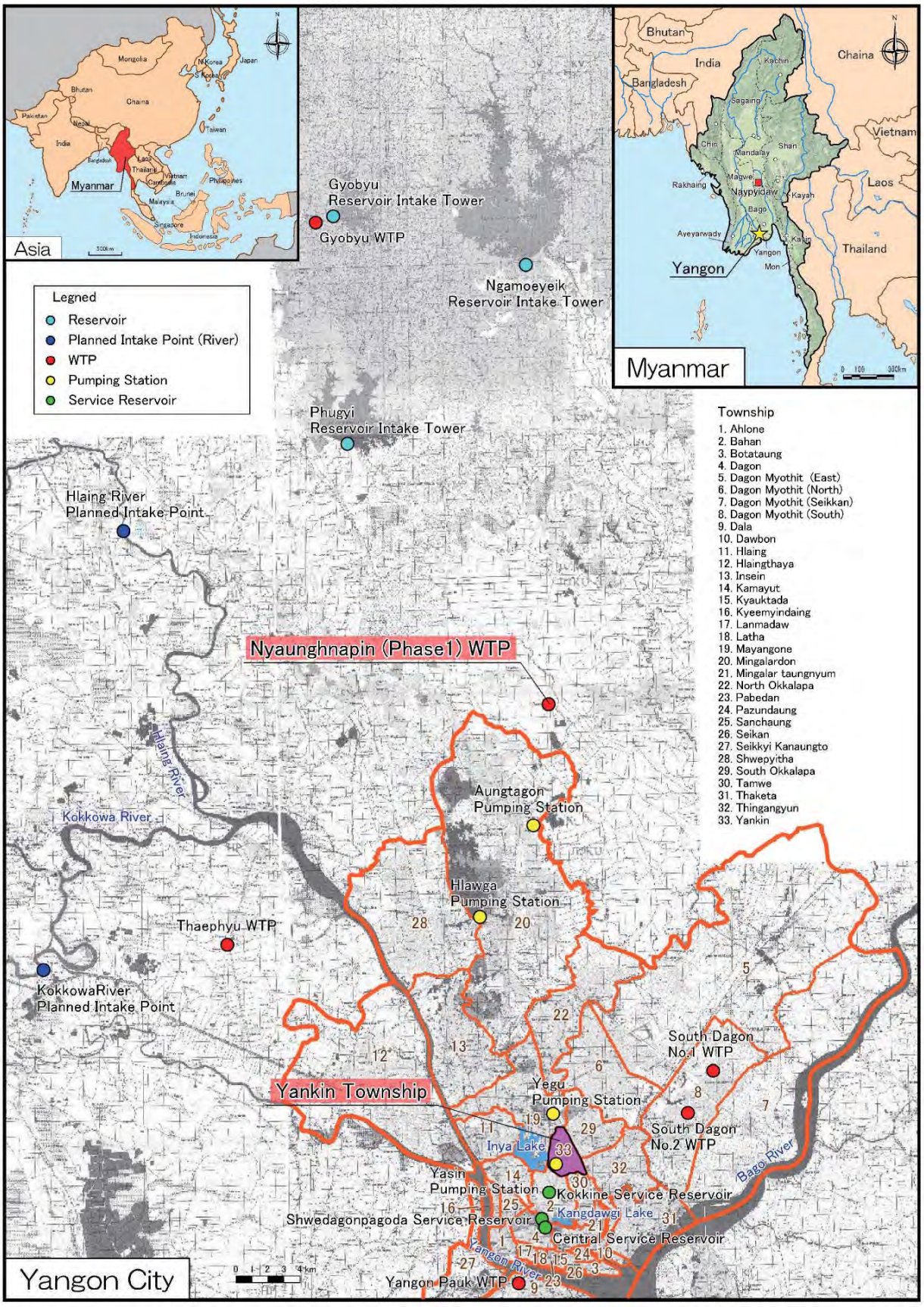

Location Map

Expected Completion Graphic

Nyaunghnapin First Phase Water Treatment Plant Pump Station

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Abbreviation List

CIP	Cast-iron pipe
DIP	Ductile iron pipe
DMA	District Metered Area
E/N	Exchange of Notes
ECC	Environment Conservation Committee
F/S	Feasibility Study
HWL	High Water Level
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
Kyat	Myanmar Kyat
LWL	Low Water Level
M&E	Mechanical & Electrical
METI	Ministry of Economy, Trade and Industry
MG	Million Gallons
MGD	Million Gallons per Day
ML	Million Liters
MLD	Million Liters per Day
MoECF	Ministry of Environment Conservation and Forestry
MoFA	Ministry of Foreign Affairs
N/A	Not Available
NCEA	National Commission for Environmental Affairs
NRW	Non-Revenue Water
O&M	Operation & Maintenance
P/S	Pumping Station
PVC	Polyvinyl Chloride
SCADA	Supervisory Control And Data Acquisition
SEA	Strategic Environmental Assessment
TS	Township
US$、USD	United States Dollars
VAT	Value Added Tax
WTP	Water Treatment Plant
YCDC	Yangon City Development Committee

CHAPTER 1 BACKGROUND OF THE PROJECT

1-1 Background of the Project

Yangon city, which is the former capital city of Myanmar, is the central city having 5.1 million (nearly 10 %) out of total population of about 60 million. The water supply system of Yangon city has old history, and was improved from year 1842 and currently has four reservoirs and many wells as water sources. YCDC has jurisdiction over improvement of the water supply system in Yangon city. The population having water supply services managed by YCDC is presumed as about 42 % of the population in Yangon city.

However the said water supply services are insufficient for water quality and quantity. Although about 90 % of water sources is surface water (water reservoir), two thirds of it is supplied directly without water treatment and even if surface water is treated by the water treatment plant, it has insufficient treatment. Meanwhile as the superannuated various water facilities are not renewed and repaired adequately, many problems like water suspension, low water supply pressure, limited time water supply, 50 % of water leakage, etc. exists. The installation rate of water meters is about 70 % and comparatively high, but water tariff is about 8 yen/m^3 for a domestic house with water meter and is about 170 yen/month for one without water meter, and it is kept low. Therefore it is difficult to say that the amount of money required sufficiently for management of water supply services is collected through water tariff. YCDC has insufficient budget for water supply and sewerage services and only deals with breakdown of the facilities/equipment and water suspension which occurs frequently. Accordingly YCDC has problem on implementation of countermeasure planned for water demand increased rapidly.

The components requested is reconstruction of the pump station building and improvement of the pump station for water transmission and distribution in Nyaunghnapin first phase water treatment plant (hereafter to be referred as P/S for water transmission in first phase WTP), and renewal of the superannuated pipeline in pilot area of Yankin Township and technical assistance for it.

The P/S for water transmission in first phase WTP, which has about 204,500 m^3/day of water transmission rate and supplies about 40 % of total water supply rate (524,000 m^3/day) of Yangon city, is the most essential water supply facilities. The said P/S has four pumps and three pumps are operated ordinarily. However, as of December 2012, only two pumps are operated and the remaining two pumps including a stand-by pump are out of use because of severe damage. The water loss rate due to pump failure is 68,170 m^3/day and it amounts to 13 % of planned daily water supply amount (523,000 m^3/d) to Yangon city. Two operating pumps are working by repair using parts of the failed pumps.

Meanwhile, even if all the pumps failed any time with cause of the ground water spouted into the pump room due to uneven settlement and insufficient water hammer prevention for the pump discharge side, it is not strange. When all the pumps fail, the function of water transmission of Nyaunghnapin first phase WTP is paralyzed and about 40 % of water supply rate to Yangon city is interrupted.

Yankin Township has about 126,000 of population and current daily average water supply rate is about 50,000 m^3/day. Its pilot area, which is objective for renewal of water transmission pipeline, has about 2,500 of population As Yankin Township is sited near Yegu pump station which is the main pump station of water supply for Yangon city, water pressure and amount is abundant in comparison to other townships. However Yankin Township has problems for the superannuated pipeline and frequent leakage due to high water pressure. Although the average leakage rate of the city is 50 %, it is presumed that it of Yankin Township is more than it. The current condition of Yankin Township is detailed below.

The pilot area is the area developed for housing by Housing Bureau and many high rise apartments for middle-income and low-income households are built. Although the water distribution pipeline was improved and maintained by Housing Bureau, maintenance work was hardly carried out. When water leakage occurred, YCDC dealt with it. But the water distribution pipeline maintained by Housing Bureau was transferred fully and officially to YCDC from April 2012. Currently YCDC proceed with understanding the current condition of it.

However, the water supply pipe for each household branch from the water distribution pipeline in a careless way and number of valves installed is little. Therefore water suspension occurs at the extensive area when water leakage occurs from the water distribution pipeline or the water pipe is replaced. Meanwhile the high rise apartment has a water supply pump for each household and water from the distribution pipeline is pressurized. But as the said pump induces surface or underground waste water when water leakage occurs, the improvement of water distribution condition is required urgently.

The main water pipeline, which has an outer diameter of 1,050 mm, distributed from Kokine reservoir to Yankin and Mayangon township consists of cast iron pipe passing more than 60 years after construction. Therefore the laying place changed from the road shoulder to the road by expansion of the road often. Accordingly the said pipeline of which the laying depth is shallow is subject to shock by traffic load and water leakage from joint in a pipe occurs frequently. Owing to it, water suspension under the repair work occurs frequently and its repair work causes traffic jam by a blockade of the main road.

Although Master Plan (MP) for water supply system in Yangon city is specified in “The Study on Improvement of Water Supply System in Yangon City” implemented by JICA in 2002, the most projects proposed have been not carried out for the reason of political situation like economic sanctions, etc. or financial deficit. Owing to it, in view of change of political situation in recent years, “The Preparatory Study for Improvement of Water Supply, Sewerage and Drainage System in Yangon City” is currently implemented by JICA aiming at renewing MP and making feasibility study under target of the planned year 2040.

Meanwhile this Project is based on the projects for “Renewal of Distribution Pumps in Nyaunghnapin First Phase WTP” and “Rehabilitation of old pipes in Yankin Township” proposed as

priority projects under “Study on the Improvement of Water Supply and Waste Water Treatment in Yangon” implemented by the Ministry of Economy, Trade and Industry, Japan (METI).

1-2 Environmental and Social Considerations

1-2-1 Environmental and Social Baseline Data

(1) Natural Environment

1) Overview of Yangon City

The Republic of the Union of Myanmar (hereinafter referred as “Myanmar”) is located in the west of the Indochina, having 676,578 km^2 of land and 62 million of population. After the capital relocation to Nay Pyi Daw, Yangon City has the largest population (five million) and remains as the center of the economy and culture.

Yangon City lies along the Yangon River, east of the Ayeyarwaddy River delta and is located 34 km upstream from the river mouth of Yangon River. Yangon City has low hills which are a long and narrow spur of Pegu Yomas hill range in the central area running in a N-S direction with an average height of 30 m. Other area is fluvial flood plain with less than 5m above sea level.

2) Climate (temperature, rainfall, wind)

Yangon has a tropical monsoon climate which consists of three seasons as listed below. It has an annual rainfall of 2700 mm/year, annual evaporation of 1,347 mm/year, average climate of 27.4 ^oC, maximum mean temperature of 33 ^oC, and minimum mean temperature of 21.8 ^oC. The difference between the monthly maximum and monthly minimum temperatures is more than 20 ^oC from December through February and around 10 ^oC from June through August. The annual mean rainfall is 2800 mm. About 95% of the total rainfall throughout the year is accumulated during the rainy season period from May to October.

Annual mean wind speed at the Kabar-aye station is 1.1 m/s. Maximum wind speed was 42.9 m/s recorded in May 2008 at the time of cyclone Nargis. Cyclones come to the country in April, May and October but Yangon City seldom experiences such cyclone wind. Wind directions are generally SW during the summer (March to Mid. May) and rainy (Mid. May to Mid. October) seasons, and NE in the cool season (Mid. October to February).

3) Protected Area

The protected area within the Greater Yangon is Hlawga Wildlife Park. The Hlawga Wildlife Park is located 35 km north of Yangon and the area is 6.2 km^2 including a wildlife park (3.1 km^2), a mini-zoo (0.3km^2) and a buffer zone (2.7 km^2). The park was established in 1982 to establish an environmental education center near Yangon, to protect the forests and vegetative cover in the catchment of Hlawga Lake, to establish a representative collection of Myanmar indigenous wildlife species of mammals, reptiles and birds, and kept under as near as possible natural conditions in such a

way that they can be readily viewed by visitor. There is no protected area near around the Nyaunghnapin First Phase WTP and distribution pipeline route.

4) Ecology

The biodiversity inventory has not yet been completed in Myanmar, it is officially stated that there are 153 endangered species. In Greater Yangon, it is recorded that four kinds belongs to "Endangered") and one "Vulnerable"). The habitat of these species is not included in the project area.

(2) Pollution

1) Air Quality

YCDC is not monitoring the air quality regularly. The existing data of air quality is the results of the measurements of April 2007 and January 2008 by NCEA. The air quality standards are not established yet in Myanmar. Comparing the WHO standards, the values of PM10 and TSP are higher than the standards.

Table 1-1 Results of Air Quality

Site	Date	TSP (ug/m^3)	PM10 (ug/m^3)	SO2 (ug/m^3)	NO2 (ug/m^3)
1. Commercial site (Traders Hotel)	April, 2007	342.58	177.69	-	-
	Jan, 2008	143.21	71.75	-	-
2. Residential site (IBC)	April, 2007	168.61	68.59	1.14	23.22
	Jan, 2008	118.70	65.30	1.24	22.28
3. Surrounding site near to industrial zone (Forest Department Head Quarter)	April, 2007	127.37	66.95	0.37	28.36
	Jan, 2008	188.66	136.92	0.25	25.42
WHO (2005 updated)		100	50.00	20.00	40.00

Source: DPCC, YCDC

2) River Water Quality

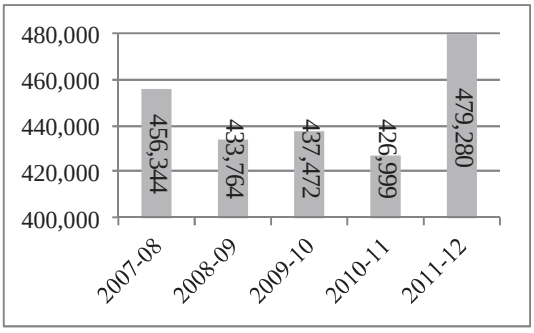
Yangon City is bounded on the south, southeast and southwest by the Yangon, Hlaing and Bago Rivers. At present, only 5.8 % of population receives the sewerage service, only black water from toilet is collected and treated, the rest gray water is discharged into the drain directly. The population that has no access to sewerage service owns the septic tank to treat the black water or discharges into the drain without treatment.

The major drain in the urban area is contaminated by the wastewater from the houses. The level of COD in drain is 2.4 times of the level in river water, BOD level in drain is 1.0 time the level in river water, T-N level in drain is 12.2 times of that in river water, T-P in drain is 4.4 times of river water.

The river water flow (Hlaing, Yangon and Bago Rivers) is huge in rainy season and the condition of water quality in river is minor compared to that of the drain. However, the results show the COD is 72 mg/l (48～128 mg/l), and BOD is 36 mg/l (27～50 mg/l) and river water quality cannot be judged as good.

3) Solid Waste

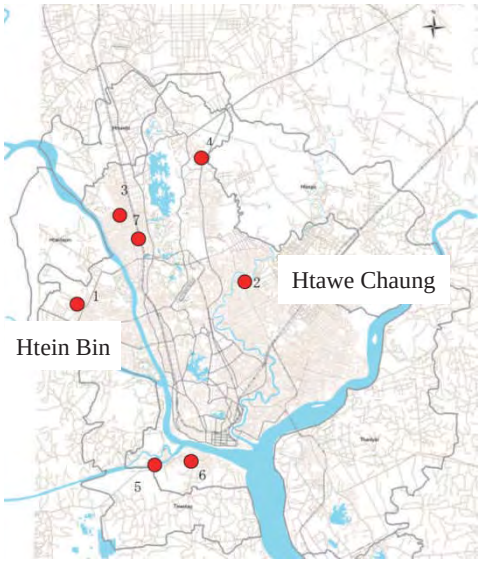
Department of Pollution Control and Cleansing (DPCC) of YCDC are responsible of waste management in Yangon City. DPCC implemented the waste generation survey from 2011 to 2012 and it identified that the waste generation is 0.396 kg per person per day. Among the waste, 76 % is organic, 10% plastic, and 4 % is paper and textile. Waste collected is (1,550 ton per day), around 92 % of total generation. 62 % of collected waste comes from household waste, 35 % from commercial and market waste and 0.1% from the hospital. The amount of disposed waste at the dumping site is 1,250 – 1,400 ton per day in the past 5 years. The amount decreased from 2007 to 2010, but increased from 2010 to 2011. The considerable reasons for decrease are: illegal dumping, recycling activities and capital relocation. The recent increase may be caused by the increase of economic activity and reduction of illegal dumping by control. The amount of waste generation from 2012 to 2013 is 1,690 ton/day.



Source: DPCC、YCDC

Figure 1-1 Amount of Waste Generation (ton/day)

There are two main final disposal sites and five temporary sites in Yangon City. These two disposal sites are open and receive waste for 24 hour/day, operated by DPCC. The temporary sites are supervised by DPCC.



The Htein Bin landfill site is located at 30 km north-west of center of Yangon City. The area is 150 acre (60 ha) and 847 ton /day of solid waste is disposed. The landfill is divided into 16 blocks and one block is 150 m on a side and 3 m depth. The measure to prevent the infiltration to ground is not taken. 10 clocks among 16 blocks are occupied with the solid waste. The Htein Bin landfill accepts the industrial and construction waste and the disposal fee is 5,000 Kyat for first one ton and 2,000 Kyat /ton for the rest of the weight.

The medical waste is incinerated at the incinerator located near the Htein Bin landfill.

The project is under preparation to generate the electricity and 92% biogas by using the methane gas which will be generated from the solid waste. The construction of the facility may start November 2013 at the earliest.

The Htawe Chaung landfill is located at 26 km north of Yangon City. The area is 150 acre (60 ha) and 612 ton /day of solid waste is disposed. The landfill is open dumping and no measurement to prevent the pollution of soil and groundwater is taken. There is the plan to generate electricity by incinerator.

Table 1-2 Recycled Waste

Item	Ton/day
Plastic	5.1
Paper	8.94
Carton	11
Leather	0.1
Iron	0.5
Metal	0.3
Copper	0.3
Lead	0.1
Glass	40.5
Can	5.1

Source: DPCC, YCDC

The recycle activities are implemented by YCDC and the private. The DPCC of YCDC implements the awareness activities to the public and students to enhance the recycle. The amount of recycle waste is 86 ton/day.

4) Noise

The standards for noise and vibration are not established yet in Myanmar and the measurement has not been conducted. The survey was implemented at two locations in Yangon City by the Project for the Strategic Urban Development Plan of the Greater Yangon, and the equivalent sound level for one hour was 50 dB (A) and maximum was from 47.7 dB (A) to 96.8 dB (A).

(3) Social Environment

1) Population

The past populations together with the city area are shown in the table below. Population of 0.73 million in 1953 increased to 0.94 million in 1963. Afterwards together with city area increase, population increased to 2 million in 1973, 3 million in 1993, 4 million in 2003 and 5.14 million in 2011. Average population growth rate has been about over 2 %.

Table 1-3 Trend of Population in Yangon City

Year	Population (Mil.)	Average population growth (%)	Area (km^2)	Pop. Density (person/ km^2)	Remarks
1953	0.73		123.3	5,925	
1963	0.94	2.5	164.2	5,725	
1973	2.01	7.9	221.4	9,077	Expansion of the City in 1965 and 1973
1983	2.51	2.2	346.0	7,254	Expansion in 1983
1993	3.09	2.1	603.5	5,120	
2003	4.10	2.8	794.3	5,161	Expansion in 1991
2011	5.14	2.9	794.3	6,471	Expansion in 2003

Source: YCDC

2) Public Health

The life expectancy of urban cities of Myanmar is 62.1 years for male and 66.2 years for female in 2003, but they are improved to 65.5 and 70.7 years respectively in 2009 (Statistical Yearbook 2010). According to WHO, in 2009 the median life expectancy for male and female of world is 69 and 75, for south-east Asian is 64 and 67 respectively. The life expectancy of Myanmar is little lower than the world median but higher in south-east Asian countries. The table below shows the number of cases and deaths by the disease including water-borne diseases.

Table 1-4 No. of Case and Death by the Diseases

Sr. No	Disease	2007		2008		2009		2010		2011	
		Cases	Death	Cases	Death	Cases	Death	Cases	Death	Cases	Death
1	Diarrhea	17,344	7	17,462	9	13,166	10	11,851	2	10,969	4
2	Dysentery	8,507	0	9,489	-	6,135	0	6,361	0	4,436	0
3	Food Poisoning	244	7	259	3	435	7	255	0	395	0
4	Typhoid & Para Typhoid	103	1	71	1	55	0	98	0	47	0
5	Other Tetanus	2	1	3	1	6	1	4	0	5	0
6	Meningitis/ Encephalitis	32	5	24	2	1	4	9	4	10	2
7	ARI (Acute Respiratory Infections)	23,664	59	21,579	37	3	32	17,008	20	17,568	16
8	Viral Hepatitis	188	6	251	1	14	4	271	3	205	2
9	Rabies	17	17	14	14	10	8	8	8	8	8
10	Malaria	5,155	36	5,741	26	4,605	27	4,374	16	2,226	3
11	Snake Bite	486	62	446	57	401	45	479	45	569	64

Source：Yangon Regional Health Department, Ministry of Health

3) Economy

GRDP of Yangon Region in 2011 is 8,165 million US$, and 1,465 US$ per capita. The industrial structure in Yangon Region is composed of processing and manufacturing sector (37 %), trade sector (25%) and service sector (24%) in 2010/11. Agriculture, livestock and fishery sectors accounted for only 8 % of the total production value. Yangon is commercial and industrial city.

The income distribution based on the result of Household Interview Survey (HIS) of the Project for the Strategic Urban Development Plan of the Greater Yangon is shown in the figure below. It shows that Yankin Township is high income level compared with the average.

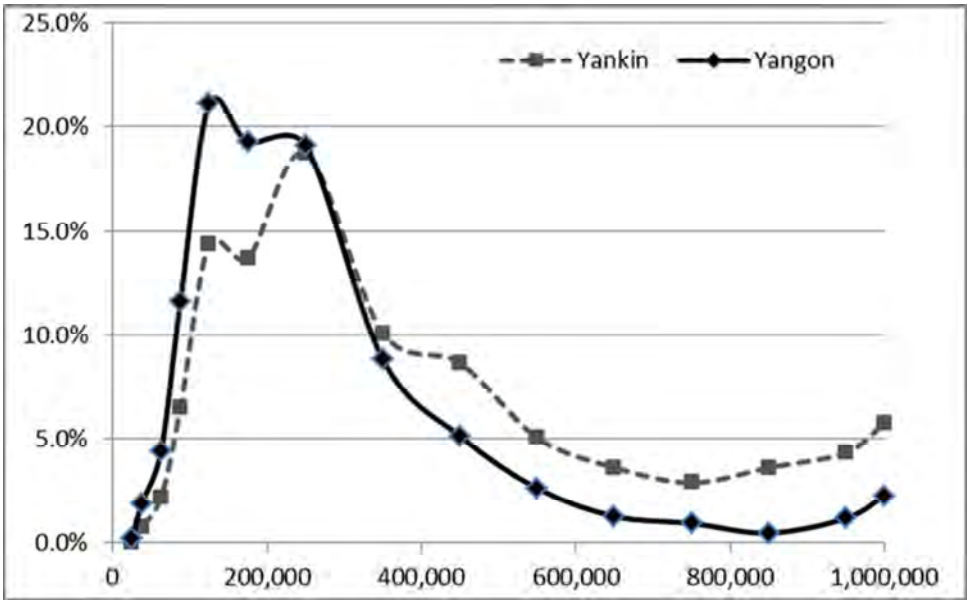


Figure 1-2 Income Distribution

The expenditure for water is also higher. The median is 1,200 Kyat for drinking and 700 Kyat for other use in Yangon, and 2,000 Kyat for drinking and other use in Yankin Township.

4) Historical Building, Heritage

In Yankin Township, there are four heritage buildings as shown below, but these are not included in the Project area.

Table 1-5 Heritage Buildings in Yankin Township

Name	Location
Mogaung Pagoda	Corner of Mogaung Pagoda and Damaryone Street
Hindu Temple	No.(41),Buteryuone Street
Nagarlain Pagoda	Buteryone Street
Kamayarna Temple	Dmaryone Street

Source: Building Department, YCDC

5) Ethnic, Religion

In Myanmar there are major eight races (Kachin, Kayar, Karin, Chin, Myanmar, Mon, Rakhain and Shan). According to the Household Interview Survey (HIS) of the Project for the Strategic Urban Development Plan of the Greater Yangon, the majority of Greater Yangon is Myanmar and the Yankin Township has the same trend.

Table 1-6 Race

	Kachin	Kayar	Karin	Chin	Myanmar	Mon	Rakhine	Shan	Others
Yangon	0.2%	0.1%	2.1%	0.2%	88.1%	0.7%	1.7%	0.4%	6.5%
Yankin	0.0%	0.0%	1.4%	0.0%	86.3%	0.0%	2.2%	0.7%	9.4%

The table below shows the religion in Greater Yangon and Yankin Township. The trend is the same.

Table 1-7 Religion

	Buddhist	Christian	Muslim	Hindu	Others
Yangon	93.6%	2.0%	4.0%	0.3%	0.1%
Yankin	95.0%	0.7%	2.2%	1.4%	0.7%

6) Housing

The majority of housing type in Greater Yangon is detached house (78%), followed by apartment (13 %) and high-rise apartment (5%). In Yankin Township, the percentage of detached house is lower than the Yangon (50 %), instead the apartment is 28 % and high-rise apartment is 10 %.

1-2-2 Framework on Environmental and Social Consideration

(1) Policy, Laws and Administrative Framework

Before the establishment of the Law on Environment Conservation Law in April 2012, the country did not have a law, administrative organization and environmental standards concerning to environmental protection. Laws on environment protection have been established independently in each industrial sector and those laws were regarded to have functions of environmental protection law. However, these laws have been established separately and independently in each sector, they are not enough to control environmental impacts taking whole picture of the impacts into consideration. The recent formation of the Ministry of Environmental Conservation and Forestry demonstrates the government's commitment to improving the planning and management of natural resources and the environment. The 2012 Environment Conservation Law provides the legal basis for implementing a range of enhanced environmental management measures. Now drafting corresponding regulations to enact the Law including EIA law and pollution control standards such as air emission and water effluent is in progress.

(2) Environment Conservation Law 2012

Environment Conservation Law of Union of Myanmar was promulgated on 30th March 2012.

- For implementation of Myanmar National Environment Policy,
- Adoption of basic principles and give guidelines so as to formulate systematic integration of environment conservation tasks for continuous development program,
- To develop good and clean environment for the benefit of present and future generations and conservation of nature and cultural heritage,
- To reveal and discover ecological systems which are starting to fall under oblivion,
- To take measures for prevention of decrease and loss of natural resources and making use of them beneficially and continuously,
- For implementation of propagating environment conservation consciousness and attacking more cooperation of the public, imperative education and teaching programs shall have to adopted,
- To increase international and country wise cooperation in environment conservation tasks,

- For achieving cooperating among government departments, international organizations, Non-governmental Organizations and private individuals.

This Law stipulates the establishment and roles of Environment Conservation Committee (ECC) and Ministry of Environment Conservation and Forestry (MoECF). See more detail in chapter below. In this Law, descriptions related to system of environmental impact assessment (EIA) for development projects and strategic environmental assessment (SEA) is not included.

(3) Laws and Regulations related to Land Acquisition

This British era act, Land Acquisition Act 1894 is still referred to at present due to the lack of any new legislation on the theme. The Act empowers the state to acquire land where it is needed for any public purpose. The Act provides for the relevant procedures, including the required notice to be given, procedures for objections to acquisition, the method of valuation of land, the process for taking possession of land, court processes and appeals, procedures for the temporary occupation of land and the acquisition of land for corporations. There are several laws related to the land, however it is not clear which law is still effective.

- The Land and Revenue Act (1879)
- The Transfer of Property Act (1882)
- The Rangoon Development Trust Act (1922)
- The Transfer of Immovable Property Restriction Act (1987)
- The Law Amending the Transfer of Immovable Property Restriction Act (2005)
- Procedures conferring the Right to Cultivate Land / The Right to Utilize Land (1991)

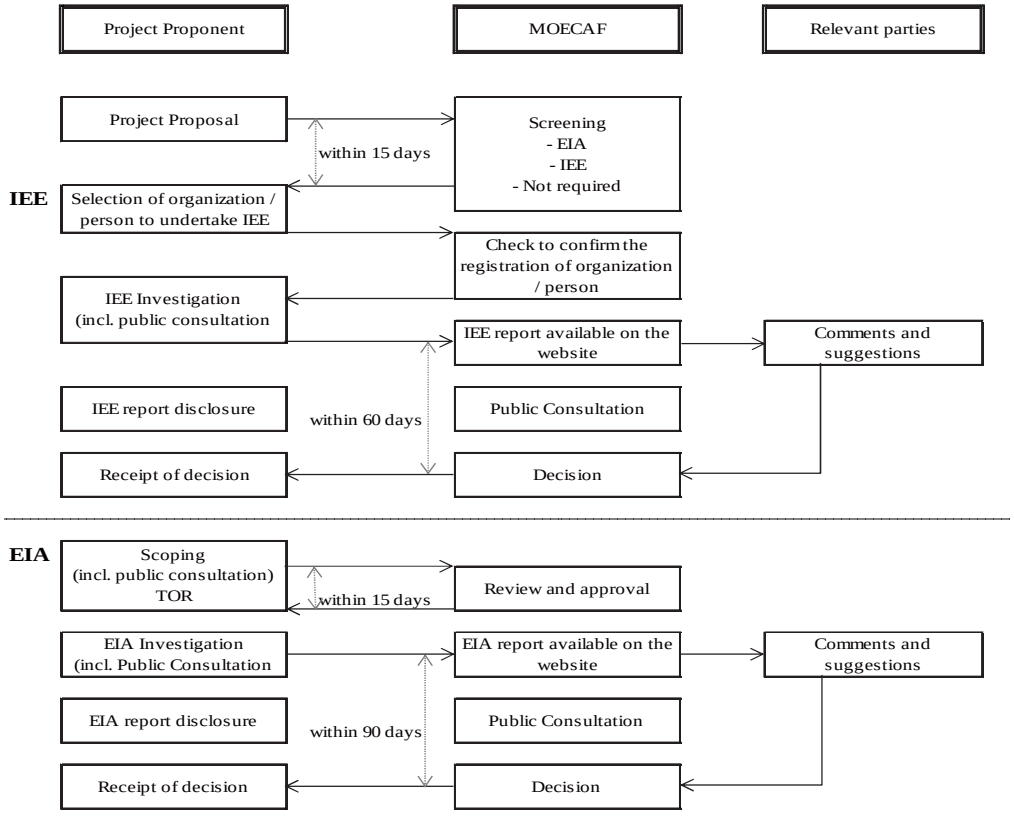
The Farmland Law (No. 11/2012) is enacted in 2012 and the definitions about farmland, farmer and right to use the farmland are established. The contents cover the procedures to obtain the permission to use the farmland, right of the person who has the right to use the farmland, terms and conditions to be complied by the person who has the right to use the farmland, action for the failure to comply terms and conditions, settlement of dispute on the right to use the farmland and appeal, duties and powers of the administrative body of the farmland. In the case of the land confiscation for interests of the State or the public interests, it is stipulated that the compensation will be paid to the person who has the ownership right to use the farmland but no detail about the compensation policy nor compensation calculation method. Based on the Farmland Law, the Farmland Rules is enacted on 31 August 2012 and the detail procedures from the application of the right to use to approval, and transfer / inheritance are described.

(4) Procedures for Environmental and Social Considerations

Based on the information obtained from JICA, it seems that the responsible organization will be Project Appraisal and Progress Reporting Department (PAPRD) under the Ministry of National Planning and Economic Development, and the MoECF will issue the comments on EIA (SIA) reports.

EIA and SIA are expected to be implemented in the F/S stage and the public consultation will be required during or after the F/S.

According to the draft Environmental Impact Assessment Procedures, MoECF is in charge of the review of IEE/EIA reports. The procedures of environmental and social considerations described in the draft Environmental Impact Assessment Procedures is shown in the figure below.



Source：JICA Team

Figure 1-3　Procedures for Environmental and Social Considerations

1) Organizations or persons undertaking EIA and IEE

Any organization or person who wishes to prepare an EIA or IEE shall apply to register with the MoECF, MoECF review the materials submitted by applicants and decide the registration. The applicant for registration shall be required to make payment of any fees and charges that may be required by the MoECF in connection with the application submission. No organization or person who is not registered with the MoECF shall prepare, submit or allow the submission of any IEE/EIA report. No project proponent shall prepare or submit IEE/EIA report to the MoECF which has not been prepared by an organization or person duly registered with the MoECF.

2) Screening

The project proponent shall submit a project proposal completed in accordance with Ministry guidelines to the MoECF for screening, and MoECF shall determine whether the project is an EIA

type project, or an IEE type project, or not required. In making its determination for a project as to the type of environmental assessment, the factors below shall be considered.

- Protection of cultural or religious norms, and historical or religious heritage
- Conservation and protection of biodiversity
- Introduction of exotic or alien species
- Adoption of new technologies
- National security
- Climate change and
- Other factors as the MoECF may determine

Within fifteen (15) days of receiving the project proposal, the MoECF shall determine the type of environmental assessment and inform the project proponent in writing about its determination.

3) IEE

Prior to commencement of the IEE investigations, the project proponent shall inform to the MoECF in writing as to the organization and person who has selected to undertake the IEE investigation and reporting and MoECF will check to confirm that such organization and person has been duly registered. The contents which should be included in IEE report is as followings:

- Project description in reasonable detail together with overview and layout maps indicating all relevant features,
- Identification of the project proponent,
- Identification of the IEE experts including which expert is responsible for which part of the IEE report,
- Description of the surrounding environmental conditions of all relevant physical, biological, social and cultural features,
- Identification and assessment of potential adverse impacts,
- Results of the public consultation / public participation process and the project proponent's written response to comments received during that process,
- The environmental protection measures of the project,
- The conclusion of IEE,
- The EMP and
- The budget needed for implementation of the EMP.

The project proponent should disclose information to the public and civil society through local media and arrange the consultation meeting with local communities, potentially project affected persons (PAPs), local authorities, community based organizations (CBO) and civil society.

4) Review and approval of IEE

After completing all investigations and public consultation, the project proponent shall submit the IEE report to the MoECF and disclose the IEE report to civil society, PAPs, local communities and other concerned stakeholders by means of local media, at public meeting places and at the offices of the project proponent. Upon receipt of the IEE report, the MoECF shall make the IEE report available on the website of the MoECF, invite comments and suggestions from all relevant parties, arrange public consultation meetings and make a final decision on approval of the IEE report. If MoECF determines that the IEE report does not satisfy requirements, the MoECF demand the project proponent to undertake necessary amendments and to provide supplementary information. Upon completion of its review of the IEE report, the MoECF shall either (i) approve the IEE report, subject to any conditions as may be prescribed and issue an Environmental Compliance Certificate, or (ii) require that the project undergo EIA and cite the reasons for decision, and inform the project proponent of its decision. The MoECF shall deliver its final decision within sixty (60) days of receipt of an IEE report. All costs incurred in completing the IEE report disclosure and review, including the public consultation process shall be borne by the project proponent.

5) EIA

All EIA type projects shall undergo scoping. The project proponent shall be responsible to ensure that the scoping and the preparation of the TOR for the EIA report are undertaken in a professional manner and in accordance with the procedures and any applicable guidelines issued and adopted by the MoECF. During scoping, the project proponent shall provide an opportunity for consultants, relevant authorities, project developers, interested and affected parties to express their view and concerns regarding the proposal before an EIA proceeds. The contents of scoping report are as follows:

- Executive summary
- Context of the project
- Overview of the policy, legal and institutional framework
- Project description and alternatives
- Description of the environment together with maps indicating all relevant features
- Key potential environmental impacts and mitigation measures
- Public consultation and disclosure
- Conclusions and recommendations

The project proponent shall prepare the TOR for the EIA investigations based on the scoping and submit the scoping report and TOR to MoECF for review and approval. MoECF shall within fifteen (15) days of receipt of the scoping report and TOR either approve them with or without conditions, or require the project proponent to revise the scoping report and TOR in accordance with comments. The contents of the EIA report are as follows:

- Executive summary
- Introduction (introduction of the project proponent, environmental and social experts)

- Policy, legal and institutional framework
- Project description and alternative selection
- Description of the surrounding environment
- Impact and risk assessment and mitigation measures
- Cumulative impact assessment
- Environmental management plan
- Public consultation and disclosure

6) Review and approval of EIA

The process from review to public consultation is as same as IEE. The decision will be made within ninety (90) days of the receipt of the EIA report. The decision will be (i) approve the EIA report, subject to any conditions as may be prescribed and issue an Environmental Compliance Certificate, or (ii) reject the EIA report and cite reasons for doing so. The project proponent, person or organization which has submitted an EIA, or government organization or other person or organization potentially affected by any adverse impacts of the project shall have the right to file an appeal to the ECC with respect to a decision by the MoECF to reject or approve an EIA report within thirty (30) days of the date of decision. The ECC shall within thirty (30) days of its receipt of an appeal consider that appeal and make a decision to (i) uphold the decision of the MoECF, (ii) instruct the MoECF to require the project proponent to revise and resubmit the EIA report to the MoECF, or (iii) instruct the MoECF to alter, revise or cancel its decision on the EIA report and cite its grounds for such instruction.

7) Environmental Compliance Certificate

For projects requiring and IEE or EIA, no permit to proceed with implementation of the project shall be issued by MIC (Myanmar Investment Commission), any ministry, or any other competent authority without an Environmental Compliance Certificate issued by the MoECF. When the MIC or other relevant authority has given approval to a project for which a certificate of environmental clearance has been issued, it shall communicate such approval to the MoECF.

The Environmental Compliance Certificate issued by the MoECF shall be valid for a period of two years from the date of issuance. The project proponent shall commence substantial implementation of the project within such two years period, and shall notify the MoECF in writing of the date of commencement not later than thirty days after such commencement.

8) Monitoring

The project owner shall, during all phases of the project (pre-construction, construction, operation, decommissioning, closure and post closure), engage in continuous, pro-active and comprehensive self-monitoring of the project and activities related thereto, all adverse impacts, and compliance with applicable laws and standards, the Environmental Compliance Certificate and the EMP. The project owner shall timely submit monitoring reports to the MoECF in accordance with a schedule in the EMP. The monitoring reports shall include:

- Documentation of compliance with all conditions,
- Progress made to date on implementation of the EMP against the submitted implementation schedule,
- Difficulties encountered in implementing the EMP and recommendations for remedying those difficulties and steps proposed to prevent or avoid similar future difficulties,
- Number and type of non-compliance with the EMP and proposed remedial measures and timelines for completion of remediation,
- Accidents or incidents relating to the occupational and community health and safety, and the environment, and
- Monitoring data of environmental parameters and conditions as committed in the EMP or otherwise required.

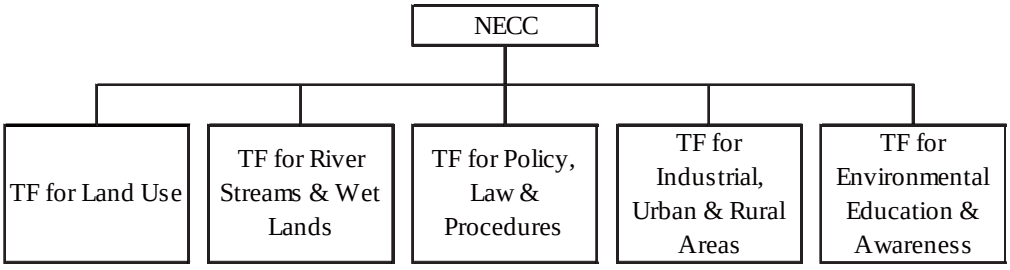
The project owner shall within ten days of completing a monitoring report make the report publicly available on the project's website, at a designated public office as agreed with the MoECF and at the project offices. Any organization or person may request a digital copy of a monitoring report and the project shall within ten days of receiving such request, submit a digital copy via email or as may otherwise be agreed upon with the requestor.

(5) Administrative Framework

1) Environment Conservation Committee (ECC)

The Environment Conservation Law tells the Union Government shall organize Environment Conservation Committee (ECC), assigning Union Minister for the Ministry of Union as the Chairman of the Committee which shall constitute suitable members. ECC shall hold the following authoritative rights:

- Make educative organizing activities and movements on environmental conservation,
- Give advice on making required amendments in school lessons on environmental conservation after making coordination with concerned governmental departments,
- Receive donation funds, cash support, materials and technical assistance and administer these funds, materials and technologies for applying in environmental tasks,
- Give appropriate advice on environmental conservation to concerned government departments and organization and exhort them in implementing the task,
- Request proposals and advice on promoting environmental conservation from concerned governmental department and organizations,
- Forbid concerned government departments and organizations that could damage the environment and if necessary, submit the matter to the Union Government requesting its attitude and policy on the condition,
- Adopt Myanmar National Environment Policies and other related policies in conservation of environment with the approval of the Union government.



TF:Task Force

Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar

2) Ministry of Environment Conservation and Forestry (MoECF)

In the Environment Conservation Law 2012, the obligations and authoritative right of MoECF are stipulated. The ministry has a broad responsibility:

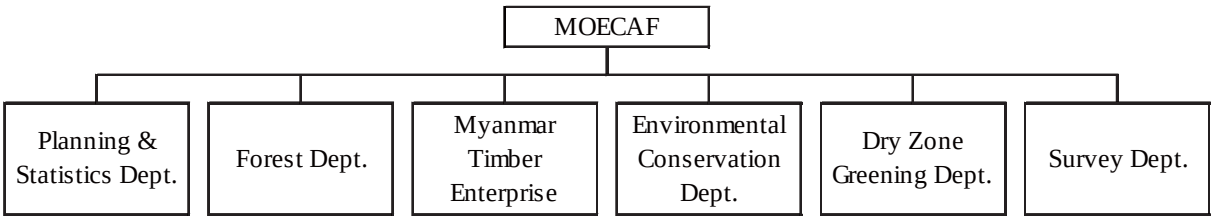
- To implement the policies on environment conservation,
- To plan the environmental management both at the national and regional level,
- To plan, implement and monitor environmental conservation and promotion, and to prevent, control and reduce environmental pollution,
- To pave the way for sustainable development.

In order to do this, the Ministry has the power to create "guidelines for environmental administration, conservation and promotion in different sectors which include ozone layer protection, the conservation of biodiversity, marine coastal conservation, the effort to reduce and balance global warming and climate change, the fight against the increase of desert and waste management". In particular, the Ministry can:

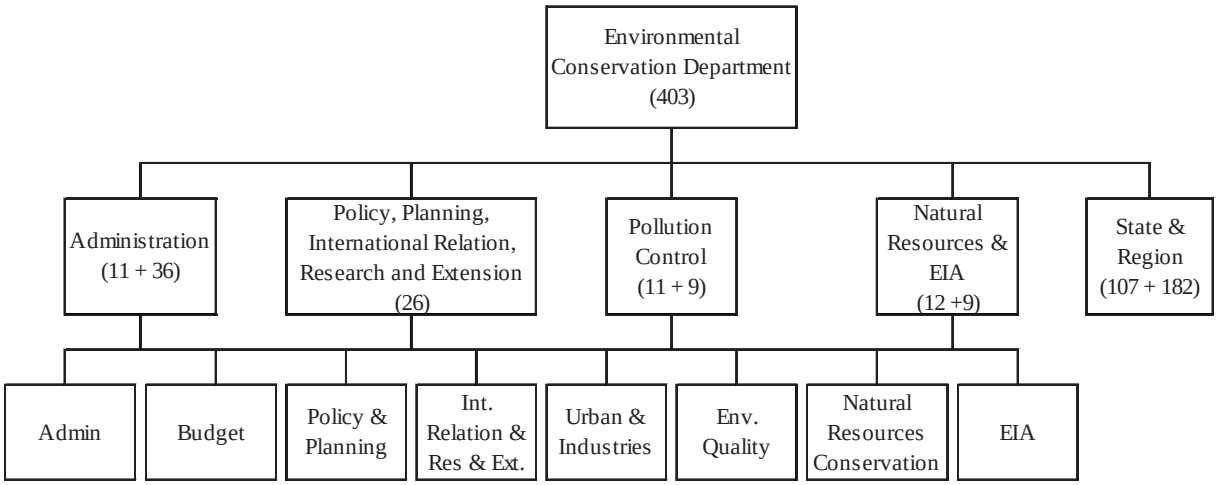
- Set the rules for how much and what type of pollution is allowed, and what businesses and individuals have to do to reduce pollution,
- Set up a system to assess the environmental and social impacts of projects (both those carried out by the government and those done by the private sector),
- Set up a system to monitor pollution from agriculture, industry and mining,
- Decide which types of projects require permission to operate,
- Decide whether to grant the permission to individual projects,
- Require companies to pay for environmental conservation projects to make up for the damage of the companies cause,
- Oversee the system for judging and punishing environmental damage, and
- Negotiate regional and international environmental agreement.

The Ministry, the Committee and the national government share responsibilities for taking action when there is a natural disaster, including warning people about natural disasters.

The MoECF has six departments as shown in the below. The Environmental Conservation Department has the responsibilities on pollution control, natural resources and EIA as described in this section.



Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar



Source: Presentation materials of Myanmar Cooperation Seminar for the Environment Management Master Plan of Myanmar

Policy, Planning, International Relation, Research and Extension

- To develop planning and its implementation, review and report
- To develop legislation related to rules, regulations, guidelines and procedures in different sectors
- To initiate Green growth and economy strategy for low carbon development
- To develop plan of climate change mitigation and adaptation of combat to desertification and ozone layer protection
- To do national report in relation with international agreements
- To do research and development and extension
- To extend the international cooperation

Pollution Control

- To promote clean development technology
- To develop environmental sound management framework for waste and chemical
- To promote environmental sound technology for waste and chemical management
- To develop the environmental quality standards and guidelines in coordination with relevant agencies

- To develop data based assessment and management system of environmental quality
- To develop monitoring system for the prevention of pollution

Natural Resources Conservation and EIA

- To develop data based assessment and management system of natural resources
- To coordinate the sustainable management of natural resources in terms of ecosystem, nature reserve, biodiversity
- To promote renewable energy and energy efficiency technology and mechanism
- To develop EIA review and monitoring guidelines for the development projects
- To monitor the implementation of environment conservation

(6) Environmental and Social Considerations for the Project

As described above, the laws and regulations related to environmental and social considerations are under preparation in Myanmar. Thus, till the laws and regulations about EIA will be enacted, the JICA Guidelines for Environmental and Social Considerations shall be applied to the Project.

The adverse impacts shown in the below are not expected so that the Project is categorized as B and the environmental and social considerations at IEE level was implemented during the study.

- Land acquisition and involuntary resettlement
- Loss of means of living
- Impacts on groundwater and river
- Impact on ecology
- Impact on natural protected area
- Impact or loss of cultural assets and heritage
- Transboundary impact

1-2-3 Analysis of Alternative (including zero option)

(1) Alternatives for Pumping Station of Nyaunghnapin First Phase WTP

1) With/Without Project (Zero option)

If the Project is not implemented, the problems mentioned below will be aggravated. The planed capacity of pumping station in Nyaunghnapin First WTP is 204,500 m^3/d and three pumps are required for this capacity. As of December 2012, two pumps are operating but two pumps including the backup pump are not in use due to the damage. By this, the lost water is 68,000 m^3/d and it is equivalent to 13 % of the amount of water supplied to the Yangon City. This affects the satisfaction of the citizens for not receiving enough water, and management of YCDC due to the increase of the NRW.

Two pumps in operation have the problems such as leakage from the crack and unequal settlement of pumping stations so that the risk of breakdown of remaining two pumps is quite high. If all the pumps stop operation, it leads to stop the distribution of water which is equivalent to 40 % of all water

supply quantity and it will severely damage the citizens' life and economic activities. If the Project is implemented, the problem can be avoided.

2) Construction / Rehabilitation of Pumping Station

The renovation of pumping station is required for above reasons, and the alternative for the construction in adjacent location or reconstruction in the location of existing pumping station was examined. The environmental and social aspects below were studied.

- Generation of construction waste

  To demolish the existing pumping station and reconstruction of new station will generate huge construction waste and the disposal of the waste provides negative impacts on existing waste dumping site. If the pumping station is constructed in adjacent location of existing one, the construction waste is not generated.

- Impact on water use

  The existing pumping station distributes the water equivalent to 40 % of all water supply amount. During the demolition and reconstruction of pumping station, the water cannot be distributed and 40 % of the customers cannot be supplied by water. The water distribution is not disrupted if the pumping station is constructed in adjacent location and the impacts on water use can be avoided.

(2) Alternatives for renewal of distribution pipeline to Mayangone Township

1) With/Without Project (Zero option)

The distribution pipeline from Kokine reservoir to Mayangone Township is old and the frequent leakage creates the disrupted water supply and traffic disturbance due to the repair of the pipeline. The leakage occurred 17 times during these two years. The situation will be expected to get worsen in future and it will provide negative impacts on citizens' life and economic activities. If the Project is implemented, the problem can be avoided.

2) Route of distribution pipeline

To select the route of distribution pipeline, the items below are considered from the point of environmental and social considerations.

- Traffic disturbance

  If the new pipe will be installed in the same route of existing one, to dig up the pipe, cut it for transportation, and transport takes time and traffic restriction is necessary during long time. If the pipe will be installed in the other side of the road, the time for traffic restriction could be reduced and the impact can be mitigated.

- Generation of waste

If the existing pipes are dug up, the disposal of the pipe (dia. 1,050 mm and length 1.7 km, other pipes) is necessary and huge amount of waste will be generated. But if the existing pipe remains underground and pipes are installed newly, the waste will be the remained excavated soil and the impact can be mitigated.

1-2-4 Scoping and TOR for Environmental and Social Survey

By the implementation of the project, the positive impacts can be expected, such as local economics by employment during construction period. During operation period, enough amount of water can be provided to the citizens continuously without disrupt. However, the negative impacts on environment and society are also expected and the expected impacts and TOR for survey to identify the level of impacts are shown in the table below.

Table 1-8 Scoping and TOR for the Survey

Item	Evaluation		Reason	Survey Item	Survey Method
	P/C	O			
Involuntary resettlement and land acquisition	D	D	Pumping station will be constructed within the existing WTP and distribution pipe will be installed under the road, so that the land acquisition and involuntary resettlement are not required. The temporally use of the land may be happened but public land only.	-	-
Local economies, such as employment, livelihood, etc.	B+	D	The increase of employment by the construction can be expected. No land acquisition is required so that no impacts on livelihood and life of citizens.	-	-
Land use and utilization of local resources	D	D	No land acquisition is required so that no impact on land use and utilization of local resources.	-	-
Social institutions	D	D	The impact is not expected. To enhance the public involvement and information disclosure and obtain the cooperation and understanding, the stakeholder meeting will be implemented.	-	-
Existing social infrastructures and services	B-	D	During construction, traffic disturbance due to the road closing and detour, the access to existing infrastructure may be disturbed. After the construction, no impact is expected.	• Situation of infrastructure service around project site.	• Hearing to related organization • Site survey
The poor, indigenous & ethnic people, gender and children's right	D	C	During construction, no activities to provide impact are expected. If there is the difference in water use by gender, the impact may be expected during operation. The installation of water meter and reconnection of service pipe are required. If the poor family exists in the target area, the cost for such installation will provide burden to the poor.	• Water use by gender • Assistance to the poor • Cost burden for meter and service pipe reconnection	• Result of interview survey • Discussion with YCDC
Misdistribution of benefits and	D	B+	The risk of disrupted water supply will be reduced and people can enjoy the stable	-	-

Item	Evaluation		Reason	Survey Item	Survey Method
	P/C	O			
damages			water supply.		
Cultural heritage	D	D	There is no cultural heritage and heritage building in the project site.	-	-
Local conflicts of interest	D	D	No impact is expected.	-	-
Water usage or water rights and rights of common	D	B+	No intake activity is included. The reduction of the risk of disrupted water supply will provide positive impact on water use.	-	-
Hazards (Risk) infectious diseases	B-	D	The infectious diseases may increase by the influx of construction worker.	• Data of infectious diseases	• Hearing from related organization
Accidents	B-	D	The increase of traffic may lead the increase of the accidents during construction.	• Traffic situation	• Site survey
Topography and geographical features	D	D	No impact is expected as the scale of the project is not large.	-	-
Soil erosion	D	D	No impact is expected.	-	-
Groundwater	D	D	No groundwater intake is planned.	-	-
Hydrological situation	D	D	No discharge to the rivers is planned.	-	-
Coastal zone	D	D	No impact is expected.	-	-
Protected area	D	D	No protected area in the project site.	-	-
Flora, fauna and biodiversity	D	D	No protected species exist in and around the project site.	-	-
Meteorology	D	D	No impact is expected as the scale of the project is not large.	-	-
Landscape	B-	D	The landscape gets worse due to the dip up of the road and storage of excavated soil during construction. No impact is expected during operation.	• Situation of the project site	• Site survey
Air pollution	B-	D	The operation of construction machines and other equipment will cause dust to rise and spread throughout the surrounding area during construction. The impact is temporary.	• Air quality standards • Air quality of the site	• Hearing from the related organization
Water pollution	D	D	No impact is expected as no discharge to river.	-	-
Soil pollution	D	D	No impact is expected as no discharge to soil	-	-
Waste	B-	D	The excavated soil will be generated. Other construction waste by the construction of pumping station may not be generated.	• Law and regulations • Disposal method of construction waste • Situation of existing landfill	• Hearing from the related organization
Noise and vibrations	B-	D	Construction machines will cause noise and vibration during construction. The facilities which create noise will be installed inside the building of WTP site. No impact is expected during operation.	• Noise standards	• Hearing from the related organization
Ground subsidence	D	D	No intake of groundwater is planned so that no ground subsidence.	-	-

Item	Evaluation		Reason	Survey Item	Survey Method
	P/C	O			
Offensive odors	D	D	No odor is expected.	-	-
Bottom sediment	D	D	No impact is expected.	-	-
Global warming	D	D	No impact is expected.	-	-

P: Planning, C: Construction, O: Operation
A+/-: Significant positive/negative impact is expected.
B+/-: Positive/Negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown (a further examination is needed, and the impact could be clarified as the study progresses).
D: No impact is expected.

1-2-5 Result of the Survey for Environmental and Social Considerations

(1) Existing social infrastructures and services

The Nyaunghnapin First Phase WTP is located 3 km north at the corner of Road No. 1 and No. 3. The road to the WTP is narrow and connects to the small villages and the traffic volume is not heavy. The increase of traffic by construction may not cause the large impact.

The route of distribution pipeline from Kokine reservoir to Mayangone Township is along the Kabar Aye Road (shown in the photo), one of the main roads from north to south of the City. The road has six lanes. The traffic volume increases 1.5 times from 2004 to 2012 and the traffic jam often happens at some time of the day. The consideration of construction time is necessary. In addition, along the road there are two hotels (Mi Casa Hotel, Marina Residency), a few restaurants and amusement facility, the date and time for construction should be carefully discussed to minimize the impact by construction.

(2) Gender, the Poor

The results of water source of Yankin Township are shown in the table below.

Table 1-9 Main Water Source (for other use except drinking)

	YCDC Supply water	Public Well/Tap	Private Tube Well	Neighbors' Well/Tap (Free of Charge)	Bottled Water	Water Vender	Rain/ Creek/ Canal/ Pond	None
Yankin	84.9%	1.4%	10.8%	2.9%	0.0%	0.0%	0.0%	0.0%
Yangon	12.0%	1.7%	16.9%	5.2%	44.9%	7.0%	12.0%	0.2%

As the main water source for other use except drinking, 85 % use the YCDC water supply, 11 % by private tube well and only 4 % use the public well/tap and neighbors' well/tap in Yankin Township. YCDC water supply is house connection supply and there is no fetching water which creates

difference in gender. In addition, the water use is not different in the household headed by woman. Thus, no special consideration for gender is required

The income level in Yankin Township is higher than the average. However, the poor may exists in the area, the consideration may be required for the water meter installation and reconnection of service pipe. The cost burden for water meter and reconnection of service pipe was discussed with YCDC and for this Project, the cost will be covered by YCDC so that the impact is not expected by construction. The water cost may be increased due to the meter use and this may provide impact to the poor. In the "Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City", the impact level of water tariff on the monthly income of low-income group was simulated and the water tariff is lower that the 3 – 5 % of monthly income of low-income group which is the international standards of water tariff. Thus the impact on the poor may not be expected.

(3) Infectious diseases such as HIV/AIDS

The HIV/AIDS is becoming serious problem recently in Myanmar. According to eh UNAIDS, the disease rate of HIV among adult is 1.3 % (0.2 to 0.57 million) in 2005. The infection is spread among the drug-addicted people and sex workers. The regulations related to working condition are not yet established in Myanmar. To prevent the infectious diseases among the construction workers, the contractor should implement the awareness training to them.

(4) Accident

The traffic situation is described in (1) Existing social infrastructures and services. The contractor is responsible for the prevention of the accidents and the awareness and education to the construction workers should be implemented. The safety measures for the workers should be prepared and implemented by the contractor. For the preparation the standards for ILO shall be applied.

(5) Landscape

The landscape will be worsening due to the dig up of the road, storage of excavated soil and construction materials. To mitigate, the fence to cover the construction site should be considered.

(6) Air Pollution

YCDC is not monitoring the air quality regularly. The existing data of air quality is the results of the measurements of April 2007 and January 2008 by NCEA. The air quality standards are not established yet in Myanmar. Comparing the WHO standards, the values of PM10 and TSP are higher than the standards.

To mitigate the impact during construction, the measures such as proper maintenance of construction vehicles, machinery and equipment, idling off, installation of muffler should be taken not to exceed the WHO standards.

(7) Solid Waste

The excavated soil will be generated and need to be disposed properly. The regulations about solid waste management are not yet established so that the excavated soil and construction waste is disposed at the municipal waste dumping site. Yangon City has two dumping sites and the excavated soil will be disposed of at these landfill sites.

(8) Noise and Vibration

The residential area near around the Nyaunghnapin First Phase WTP is more than 500 m away at the west direction and more than 700 m from the construction site of pumping station. Thus, the noise and vibration by the construction may not cause any impacts on the residential area.

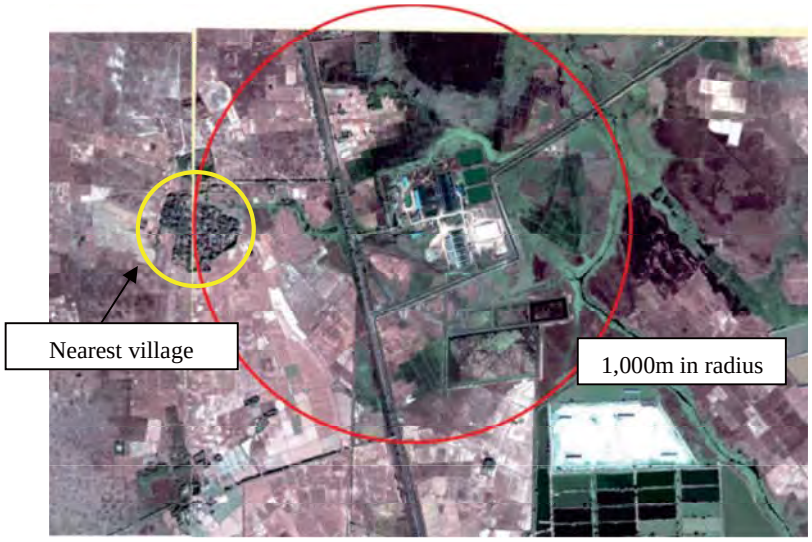


Figure 1-4 Surrounding Area of Nyaunghnapin WTP

The route of distribution pipelines from Kokine reservoir to Mayangone Township is along the Kabar Aye Pagoda road, main road from north to south with six lanes. The traffic volume is heavy in this road. Since there are no standards for noise in Myanmar, the standards of IFC shall be applied to the Project as shown in the table below. Noise problems should be reduced by use of low-noise equipment, preventive maintenance and others.

Table 1-10 Noise Level (One hour LA_{eq} (dBA))

Receptor	Daytime (7:00 – 22:00)	Nighttime: (22:00 – 7:00)
Residential / Institutional / Educational	55	45
Industrial / commercial	70	70

Source: IFC General Health, and Safety (EHS) Guidelines, April 2007

1-2-6 Evaluation of the Impacts, Mitigation Measures and Cost

The evaluation of the impacts, mitigation measures and the required cost for mitigation measures are shown in the table below.

Item	Evaluation of Scoping		Evaluation after study		Reason	Mitigation Measures	Responsible organization	Cost
	P/C	O	P/C	O				
Existing social infrastructures and services	B-	D	B-	D	During construction, traffic disturbance due to the road closing and detour, the access to existing infrastructure may be disturbed.	The construction schedule should be prepared considering the traffic volume to minimize the impacts on traffic. The traffic authorities should be notified of the planned works in a timely manner so that alternative traffic routes can be formed and the public alerted. The rules of construction work and transportation of the construction materials should be established and the compliance by the driver and workers should be controlled by the contractor. Traffic accidents can be avoided by collaborating with the traffic police and posting warning signs and directions to alternative routes. The office which accepts the complaints and demand from the citizens should be established.	Contractor YCDC Traffic police	-
The poor, indigenous & ethnic people, gender and children's right	D	C	D	D	The cost for meter installation and reconnection of the service pipe shall be covered by YCDC and no impact on the poor is expected during construction. The water charge may be increased due to the meter but the simulation results show the affordable level of the poor. So that no impact is expected. The progressive water tariff system is recommended to YCDC for future tariff revision.	The cost for meter installation and reconnection of the service pipe shall be covered by YCDC and no impact on the poor is expected during construction. The water charge may be increased due to the meter and this may provide the impact on the poor. The tariff for the poor should be examined when YCDC set the new water tariff.	YCDC	-
Hazards (Risk) infectious diseases	B-	D	B-	D	The infectious diseases may increase by the influx of construction worker.	The educational plan to reduce the risk of infectious diseases by Influx of the construction workers should be prepared and implemented by the contractor.	Contractor	-
Accidents	B-	D	B-	D	The increase of traffic may lead the increase of the accidents during construction.	The measures to protect the citizens are described in the item "Existing social infrastructures and services". The safety considerations to the construction workers should be	Contractor YCDC Traffic	-

Item	Evaluation of Scoping		Evaluation after study		Reason	Mitigation Measures	Responsible organization	Cost
	P/C	O	P/C	O				
						prepared by the contractor which should meet the requirement of ILO standards to secure the safety of working conditions. The safety training such as wearing working clothes and work shoes, use of temporally toilet, traffic safety and public health should be provided by the contractor.	police	
Landscape	B-	C	B-	D	The landscape gets worse due to the dip up of the road and storage of excavated soil during construction. No impact is expected during operation.	The landscape will be worsening due to the dig up of the road, storage of excavated soil and construction materials. To mitigate, the fence to cover the construction site should be considered. The excavated solid should be removed quickly from the site.	Contractor YCDC	
Air pollution	B-	D	B-	D	The operation of construction machines and other equipment will cause dust to rise and spread throughout the surrounding area during construction. The impact is temporary.	Construction vehicles, machinery and equipment should be in good working condition and well maintained. Dust emissions from piles of soil or any other material during earthwork, excavation and transportation should be controlled by wetting surfaces, using temporary wind breaks and covering truck loads. The office which accepts the complaints and demand from the citizens should be established.	Contractor YCDC	TOR for the contractor should include the conditions on selection the equipment.
Waste	B-	D	B-	D	The excavated soil will be generated. Other construction waste by the construction of pumping station may not be generated.	The excavated soil should be disposed of at the waste dumping site and the discussion with DPCC is necessary. The improvement of legal system should be necessary.	YCDC (EDEWS, DPCC)	The disposal cost is included in the estimation.
Noise and vibrations	B-	D	B-	D	Construction machines will cause noise and vibration during construction.	The standards for noise and vibration are not yet established in Myanmar. The standards of IFC (70 dB) shall be applied till the standards will be established. The noise level should be controlled by proper maintenance of equipment and vehicles, and tuning of engines and mufflers to keep the ELV set by the regulations. The selection of construction machinery will be examined during detailed design. Before the construction of distribution pipeline, the notice of the construction schedule should be issued to the houses and buildings along the route to ask the cooperation and understanding. The office which accepts the complaints and demand from the citizens should be established.	Consultants in charge of detailed design Contractor YCDC	The detail will be examined in the detail design.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/Negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown (a further examination is needed, and the impact could be clarified as the study progresses).
D: No impact is expected.

1-2-7 Monitoring

The monitoring during construction period is necessary. The monitoring on air pollution and noise should be implemented according to the table below. The complaints should be accepted and treated at the office in the construction site and Yankin Township.

For the monitoring during operation, existing monitoring system of pumping station will be applied.

Table 1-11 Monitoring during Construction

Item	Monitoring location	Monitoring item	Frequency	Responsible organization	Budget*
Air quality	Boundary of the WTP Route of distribution pipeline	NOx、SOx、TSP	Whenever necessary (especially after the complaint and high value)	Contractor	- (contractor should arrange)
Noise	Boundary of the WTP Route of distribution pipeline	Noise level (max)	Whenever necessary (especially after the complaint and high value)	Contractor	- (contractor should arrange)
Complaints and demand from citizens	WWTP Yankin Township	Number and contents of complaints/ demand	As needed during construction period.	Contractor YCDC	-

*: personal expenses are not included.

1-2-8 Stakeholder Meeting

The stakeholder meeting was organized by YCDC in cooperation with JICA Study Team on 11 July 2013. As the impacts are limited during the construction period, the impacts by construction of pumping station in WTP are small because the location is away from the residential area, thus the affected people by the rehabilitation of distribution pipeline along the Kabar Aye Pagoda Road and within the pilot area in Yankin Township are the main stakeholder for the Project. During the meeting, the contents of each component, expected impacts by the project implementation and proposed mitigation measures were explained and the understanding and the cooperation of the citizens were requested.

Around thirty (30) persons were participated as following:

- Officer from Yankin and Mayangone Township Office: 4
- Residents, factory, Hotel along the Kabar Aye Pagoda Road: 14
- Fire Department, military: 3
- YCDC, JICA Study Team:10

The main questions and comments raised during the meeting are as follows. The questions not directly related to the meeting were raised and see the detail in the Minutes of Meeting attached in Appendix-6.

- When the pipe will be cut and connected to the new pipeline, how long it takes to reconnect to the new distribution pipeline from the existing one?
  (Answer) Maximum half day is expected.
- When the construction will start?
  (Answer) From now, after the detail design, tender and selection of contractor, the construction will start. The construction of pumping station in Nyaunghnapin First Phase WTP will start first and the construction of pipeline will start latter half of next year, around August 2014. This is the tentative schedule.
- How can you plan for 24 hour lines for Fire Brigades in this DMA pilot area?
  (Answer) If there is a Fire Brigade in DMA Pilot Area, we will give it 24 hour-line. But we need 24 hours electricity as to give 24 hours water supply, we need continuous electricity.

1-2-9 Evaluation

The impact identified as “A” (Significant negative impact) are not expected. The impacts identified as “B” (Negative impact is expected to some extent) are existing infrastructure and service, the poor, infectious diseases, accidents, landscape, air pollution, waste, noise and vibration. The most of the impacts are temporally during the construction period and can be mitigated and minimized by the implementation of the mitigation measures. The monitoring of implementation of mitigation measures is necessary.

1-3 Land Acquisition / Involuntary Resettlement

1-3-1 Necessity of Land Acquisition / Involuntary Resettlement

As described in the above chapter, the land acquisition is not required for the Project and involuntary resettlement may not be occurred.

1-4 Others

1-4-1 Monitoring Form and Environmental Check List

(1) Monitoring Form (draft)

In Myanmar, as the monitoring system is not yet established, the monitoring results should be reported to YCDC and JICA. The draft monitoring form is proposed.

- If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring

based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

- When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

＜Construction Phase>

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from YCDC	

2. Pollution

- Noise / Vibration

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level at WTP	dB					
Noise level at Kabar Aye Pagoda Road	dB					

- Air Pollution

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
NO_2	ug/m^3					
SO_2	ug/m^3					
TSP	ug/m^3					

(2) Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) - (c) - (d) -	(a) The laws and regulations related to EIA are under preparation in Myanmar. The necessity of EIA report is not yet clear for the Project. Environmental and social considerations at IEE level was implemented in F/S stage according to JICA Guidelines. (b) - (c) - (d) -
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) N (b) -	(a) The laws and regulations do not stipulate the stakeholder meeting in Myanmar. The stakeholder meeting according to JICA Guidelines will be held in July 2013. (b) -
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) For pumping station, the alternatives for reconstruction and for rehabilitation were examined. For distribution pipe with dia. 1,050 mm, the alternatives for replacement or for new installation were examined. From the environmental and social considerations, the generation of solid waste, impacts on social infrastructure (mainly for traffic disturbance) and water use were examined.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) N (b) -	(a) The chlorine storage facility is not included in the Project. (b) -
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) -	(a) The water treatment plant is not included in the Project.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) -	(a) The waste will not be generated by the operation of the project facilities.
	(4) Noise and	(a) Do noise and vibrations generated from the facilities, such as pumping stations	(a) -	(a) The standards for noise and vibration are not yet established in

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Vibration	comply with the country's standards?		Myanmar. The standards of IFC (70 dB) shall be applied till the standards will be established. The pumping station will be located within water treatment plant and 500 m away from the boundary. The noise and vibration level may not exceed the IFC standards.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) The extraction of water is not included in the Project.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a) Protected area does not exist in the Project area.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?(b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?(d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	(a)N (b)N (c)- (d)N	(a) These are not included in the Project area. (b) These are not included in the Project area. (c) The project activities are construction of pumping stations in the existing water treatment plant, the installation of distribution pipes along the road, and these do not provide any impacts on ecology. (d) These are not included in the Project area.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a)N	(a) It is not included in the Project.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement?	(a)N (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-	(a) The land acquisition is not required for the project and involuntary resettlement may not be occurred. The temporal land acquisition due to construction may be required but the land should be public area. (b)- (c)- (d)- (e)- (f)- (g)- (h)- (i)- (j)-

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?(b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a)N (b)N	(a) The Project will not adversely affect the living conditions as there is no involuntary resettlement nor land acquisition. The traffic disturbance may be expected to provide impacts on people's daily life and the mitigation measures are described in (1) Impacts during Construction of Category 5 Others. (b) Intake of water is not included in the Project.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a)N	(a) There are four heritage buildings in Yankin Township (2 Pagodas, 2 Hindu temples) but not within the Project site.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)N	(a) The distribution pipes are under the road and pumping station is inside the water treatment plant, thus there is no impact on the landscape.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)- (b)-	(a) There are no ethnic minorities and indigenous peoples within the Project site and no impact is expected. (b)-
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned	(a)- (b)Y (c)Y (d)Y	(a) Laws and regulations related to working conditions are not yet established. (b) The safety considerations should be prepared by the contractor which should meet the requirement of ILO standards to secure the safety of working conditions. (c) The safety training such as wearing working clothes and work shoes, use of temporally toilet, traffic

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?		safety and public health should be provided by the contractor. (d) The education such as behavior and tongue to the citizen, the action to the complaint etc. should be provided to the security guard by the contractor.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b)N (c)N (d)Y	(a) For the noise, vibration, dust and exhaust gases, the measures such as consideration of construction time, properly maintenance of construction vehicle, idling off and installation of mufflers should be taken. The excavated soil should be disposed of at the existing landfill. (b) No impact is expected. (c) No impact is expected. (d) During construction, the traffic disturbance may be expected. The mitigation measures such as prior notice of construction, provision of proper notice at site and alternative routes should be taken in cooperation with traffic police.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?(b) What are the items, methods and frequencies of the monitoring program?(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)- (c)Y (d)-	(a) The monitoring system is not yet developed in Myanmar so that the proposed monitoring shall be implemented according to the JICA Guidelines. (b) No items, methods nor frequencies are stipulated. The monitoring of the complaints and actions to the complaint, noise and air quality shall be implemented. (c) The monitoring will be implemented during construction period and the responsible organization is the contractor under the supervision of YCDC. During operation period, the pipes are installed underground so that no impacts may be occurred. The pumping station is the replacement of existing one so that the existing monitoring can be applied. (d) The monitoring system is not yet developed, the report is sent to YCDC only.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a)-	(a)-

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)-	(a)-

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

Although Master Plan (MP) for water supply system in Yangon city is specified in "The Study on Improvement of Water Supply System in Yangon City" implemented by JICA in 2002, the most projects proposed have been not carried out for the reason of political situation like economic sanctions, etc. or financial deficit. Owing to it, in view of change of political situation in recent years, "The Preparatory Study for Improvement of Water Supply, Sewerage and Drainage System in Yangon City" is currently implemented by JICA aiming at renewing MP and making feasibility study under target of the planned year 2040.

Meanwhile this Project is based on the projects for "Renewal of Distribution Pumps in Nyaunghnapin First Phase WTP" and "Rehabilitation of old pipes in Yankin Township" proposed as priority projects under "Study on the Improvement of Water Supply and Waste Water Treatment in Yangon" implemented by the Ministry of Economy, Trade and Industry, Japan (METI).

The Grant Aid Project "The Project for Urgent Improvement of Water Supply System in Yangon City in the Republic of the Union of Myanmar" targets at Yangon City in the Republic of the Union of Myanmar and contributes to improvement of water supply service by implementation of the purpose of improvement of transmission and distribution P/S in Nyaunghnapin First Phase WTP, replacement of distribution pipeline from Kokine reservoir to Mayangon Township and replacement of distribution network in pilot area of Yankin Township.

In order to achieve the targets mentioned below, the reconstruction of transmission and distribution P/S in Nyaunghnapin First Phase WTP, replacement of transmission and distribution pump equipment, renewal of distribution pipe from Kokine service reservoir to Mayangon Township and renewal of distribution network in the pilot area in Yankin Township are planned. The summary of facilities to be constructed and soft component is mentioned below.

(1) Summary of Facilities to be implemented

Table 2-1 Summary of Facilities to be implemented

Items	Facilities
1. Reconstruction of the Pump Station for Water Transmission and Distribution of Nyaunghnapin First Phase Water Treatment Plant	・Construction of pump station building ・Replacement of pump/motor Horizontal shaft double suction centrifugal pump ($2,850m^3$/hr.x 4 nos) ・Ancillary equipment: electrical panel, water hammer prevention devices and attendant piping, etc.
2. Renewal of Water Distribution Pipeline (outside diameter: 1,050 mm) from Kokine Reservoir	・Outer diameter of 1,050mm, Ductile cast iron pipe and valve ・Branch pipe: 200mm and 300mm, Ductile cast iron pipe and valve
3. Renewal of Distribution Pipeline in the Pilot Area of Yankin Toenship	・Pipe laying work 400mm ~ 200mm: Ductile cast iron pipe, less than 150mm: uPVC or PE

	・Accessories Valve, air valve, house connection, water meter ・DMA monitoring system equipment

(2) Soft Component (Technical Transfer)

The number of target trainees is 10 from YCDC south region sales office, Yankin Township office and pipeline management sector (east), and the technical support regarding distribution data management and distribution management will be given to trainees.

2-2 Outline Design of the Japanese Assistance

As a result of the preparatory survey, the concept of request contents confirmed are shown below.

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1) Target Year Planned

The target year planned is decided taking into account the report of JICA-MP study being carried out currently. The Project for "Improvement of the Pump Station for Water Transmission and Distribution of Nyaunghnapin First Phase Water Treatment Plant" and "Renewal of Water Distribution Pipeline in Mayangon Township" aims at recovering the current water transmission/distribution amount. Accordingly the taget year planned is to be year 2016 when is one year after the expected completion time of the Project. Therefore, the capacity of the said pump station is approximately 204,500 m^3/day and the outside diameter of the main pipeline for water distribution for Mayangon township is 1,050mm.

Meanwhile the water distribution pipeline in Yankin Township is designed based on the target year planned as year 2025 taking the future expansion plan into consideration.

(2) Design Criteria and/or Design Standards

Myanmar has no design criterion and/or design standard related to water supply system. Accordingly the design is made based on the international criteria and/or standards authorized internatianallyas shown below.

Table 2-2 Design Criteria and Design Standards

Application	Criteria/Standards
Pump	ISO or equivalent
Motor	IEC or equivalent
Electrical Equipment	IEC or equivalent
Piping Materials	AWWA, ASTM, JIS or equivalent
Construction Code/Standard	Codes/Standards authorized in Japan or internationally
Pavement Standard	In accordance with YCDC criteria

(3) Construction of New Pump Station Building for Water Transmission and Distribution of Nyaunghnapin First Phase Water Treatment Plant

The existing pump station building suffered tremendous damage by heavy water flood year 2012. As a result of investigation, it became clear that it exceeded the limit of repair due to uneven settlement. Accordingly the new pump station for Nyaunghnapin first phase WTP is planned in the same area.

(4) Renewal of Water Distribution Pipeline from Kokine Reservoir to Mayangon Township

The length of the target route for rehabilitation of pipeline is approximately 1.7km from Sedona hotel to the north direction along with Kabar Aye Pagoda Street where frequent leakage accidents have occurred. Moreover, the branch pipes for house connection are not directly diverged from main pipe (outer diameter: 1,050mm) and it is diverged from side pipes.

(5) Plan in Yankin Township and Pipeline under 400 mmφ

The target of renewal of the said distribution pipeline in pilot area in Yankin Township is planned as below.

- The target area is to be block 2 and a part of block 3 in the pilot area.
- The replacement of small pipes less than diameter of 400 mm and house connection including water meter were scope of work of Myanmar side, however, YCDC strongly requested to change it to the scope of work of Japanese side and, if this component is implemented by Myanmar side, the expression of effectiveness of the Project will be late due to delay of securement of budget and procurement/construction. Thus, the replacement of small pipes is responsible for Japanese side.

(6) OJT and Soft Component

The instruction on operation and maintenance of pumps for water transmission and distribution in Nyaunghnapin first phase water treatment plant is given to YCDC staffs with OJT sufficiently by the engineer of the pump manufacturer through the Project. This OJT intends YCDC staffs to be able to do sustainable operation and maintenance management of the pump station in future. Moreover, the instruction on pipe installation work is also given YCDC staff under OJT by the Contractor.

Meanwhile, regarding the pipeline network in Yankin Township, the method suitable for establishment of DMA, renewal of pipeline, etc. are addressed as the Soft Component so that YCDC staffs can contribute improvement of water distribution management skill.

Based on the above, the component to be implemented under this Project is shown below.

2-2-1-2 Policy for Natural Environmental Condition

(1) Climatic Condition

The climatic condition to be applied to the Project is shown below.

Table 2-3 Climatic Condition for Design

Item	Design Criteria
Ambient Temperature (Maximum)	50℃
Annal Average Maximum Temperature	30℃
Ambient Temperature (Minimum)	0℃
Relative Humidity	80-100%
Annual Average Rainfall	2,700mm

Because of having much rainfall in rainy season, the existing pump station building was flooded above the floor level in the past and the water transmission pumps installed on the underground floor were submerged.. Therefore the elevation of the first floor and entrance of new pump station building is required to be higher than the ground level.

(2) Policy for Earthquake

Although the earthquakes occurred in Myanmar, these earthquakes occur at the north region of Myanmar where it is far from Yangon. Therefore the horizontal seismic coefficient to be used for design around Yangon city is considered to become modest. As Myanmar has neither seismic data nor horizontal seismic coefficient criterion, the seismic design criteria are used as reference nearby countries of Myanmar.

2-2-1-3 Policy for Socio Economic Condition

A part of the target area of the Project in Yankin Township is included in pilot area where YCDC is going to implement improvement of distribution network. Therefore the design of house connection is considered to be fair price of water meter, which is generally citizen's burden, for the inhabitant in this Project area and one in the future Project implemented by YCDC.

2-2-1-4 Policy for Construction/Procurement Condition

The equipment and materials able to be procured in Myanmar are procured in Myanmar. The equipment and materials unable to be procured or unable to secure the required quality in Myanmar are procured from Japan or the third countries.

Currently the applicable codes/standards used locally for the industrial products are mixed with ISO (International Organization for Standardization), BS (British Standard), ASTM (American Society of Testing and Materials), TIS (Thai Industrial Standard) for the reason of the supplier's side, etc.

Under this Project, the equipment and materials to be procured from Japan or the third countries are based on ISO standards taking into account quality control, constructability, and maintainability after construction. Even if the other international standards are applied, the compatibility with ISO standards is considered.

The spare parts and/or consumables for the equipment procured under the Project is to be able to be purchased through the agents in Myanmar so that the sustainable operation and maintenance work can be done by Myanmar side in the future.

Meanwhile the permission of use for the communication line for the monitoring system is taken by YCDC. The both parties deal with the interface between the monitoring system adjusted by Japanese side and the communication system so that data transmission of the monitoring system can be made smoothly.

2-2-1-5 Policy for Use of Local Contractor

Many projects for improvement of the infrastructure are implemented in many places at the head of Yangon city. Therefore many local contractors having construction experiences for civil and building works exist. It is judged that they have a certain level of technical capabilities. Also the local engineers and technicians work for civil and building construction. Accordingly the use of local contractors familiar with local constructive and social conditions as subcontractors of Japanese contractor can reduce cost and also can proceed with construction work smoothly.

2-2-1-6 Policy for Operation and Maintenance

YCDC has no problem for maintenance of pump/motor because they have technical capability of maintenance by experience of overhaul of pump/motor.

It is first experience for YCDC to establish DMA and operate monitoring system, thus, the explanation of manual of software and hardware, and training of operation and maintenance are required. It is planned to support YCDC including technical transfer in conditioning/trial stage and training by soft component.

2-2-1-7 Policy for Grade Setting of Facility/Equipment

The new pump station for water transmission and distribution of Nyaunghnapin first phase WTP has consistency with the existing pump station on the operating system taking into account the local operation skill.

Meanwhile, power supply to Yangon city has many non-plan blackouts and operation of the water supply facilities is interrupted. However, the blackout time is below one hour and short relatively. Considering that the existing pump station has no private power generator, it is not provided under this Project to restrain the construction cost.

In the monitoring system on DMA for distribution network in Yankin Township, installation of UPS (Uninterrupted Power Supply) for short time is designed to avoid power interruption.

2-2-1-8 Policy for Construction/Procurement Method and Construction Period

The Project can be divided into two lots based on the area and the component planned, that is; lot 1: "Reconstruction of the Pump Station for Water Transmission and Distribution of Nyaunghnapin First Phase Water Treatment Plant" and lot 2: "Renewal of Water Distribution Pipeline in Yankin Township".

Meanwhile the Project aims at early completion according to request by Myanmar side. Therefore the Project is divided into two lots as shown the above and the lot 1, of which the construction period is short, aims to complete earlier. As soon as the construction of lot 1 is finished, the operation for turn-over is commenced. Also in order to give top priority to shortening of the construction period, the special piling construction method is adopted and the temporary facilities and/or materials use Japanese products. Accordingly the construction period for each lot is expected as follows. Currently, the rapid reduction of the capacity of transmission and distribution pumps is indicated and pump equipments have the risk of interruption of transmission and distribution water at any time. Therefore, in order to implement early completion of the work for reconstruction of the pump station, it is judged that the division of a lot is relevant plan.

- Lot 1: 12 months after contract award
- Lot 2: 15 months after contract award.

2-2-1-9 Policy for Environmental and Social Considerations

The renewal work of distribution pipe with big diameter (outer diameter: 1,050mm) from Kokine service reservoir to Mayangon Township is implemented in main road with 6 lanes. The method of renewal work is open cut and pipe jacking method is selected in the case of road crossing.

During renewal works of the existing facilities, the construction method and implementation schedule is set to avoid impact for lives of residents and to reduce the number of water supply interruptions.

2-2-2 Basic Plan (Construction Plan)

2-2-2-1 Reconstruction of the Pump Station for Water Transmission and Distribution of Nyaunghnapin First Phase Water Treatment Plant

(1) Location of Pump Station Building

The pump station building to be reconstructed is expected to be located at the south side of the existing pump station building or at the north-east side of it. However the location of the south side has no sufficient space for the new pump station building and for connection from the pump discharge header to the water transmission pipeline downstream side of the isolating valve. Therefore the new pump station building is located at the north-east side of the existing pump station building. The location drawing is attached in section 2-3 Basic Design Drawings.

Meanwhile the new pump pit is required to be connected with underground pipeline from the existing clear well. This underground connecting pipeline consists of diameter of 1800 mm and the length of approximately 90 m. The friction loss of this pipeline is approximately 0.27 m under three pumps operation and there is no problem for pump operation.

As the pump discharge header is connected to the end of water transmission pipeline, the connecting work of the pipe is not difficult.

(2) Size of Pump Station Building

The size of the pump station building is designed taking into account layout of the equipment and space for operation/maintenance of it (refer to Figure 2-1).

The underground floor height is designed taking into account water flood above the floor, water level of the existing clear well and the pump layout, and the first floor height is done taking into account carrying-in/carrying-out of electrical panels, pumps and motors (refer to Figure 2-2).

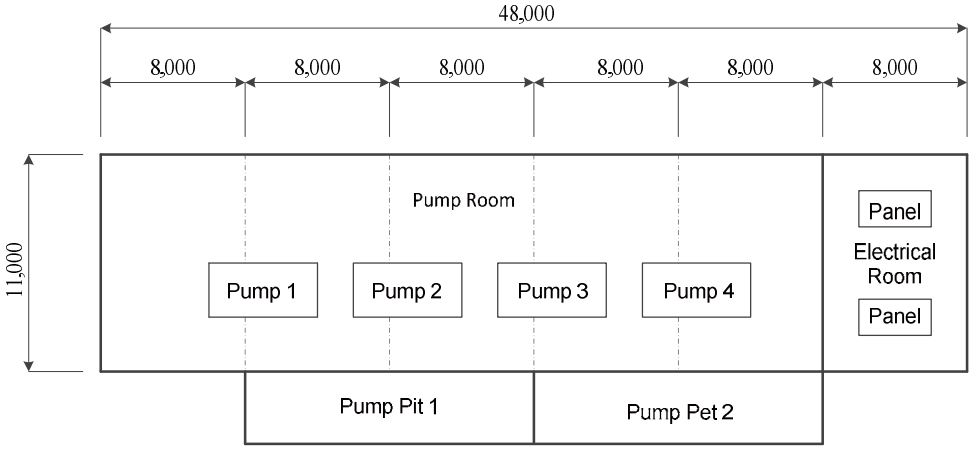


Figure 2-1 Pump Station Building Plan View

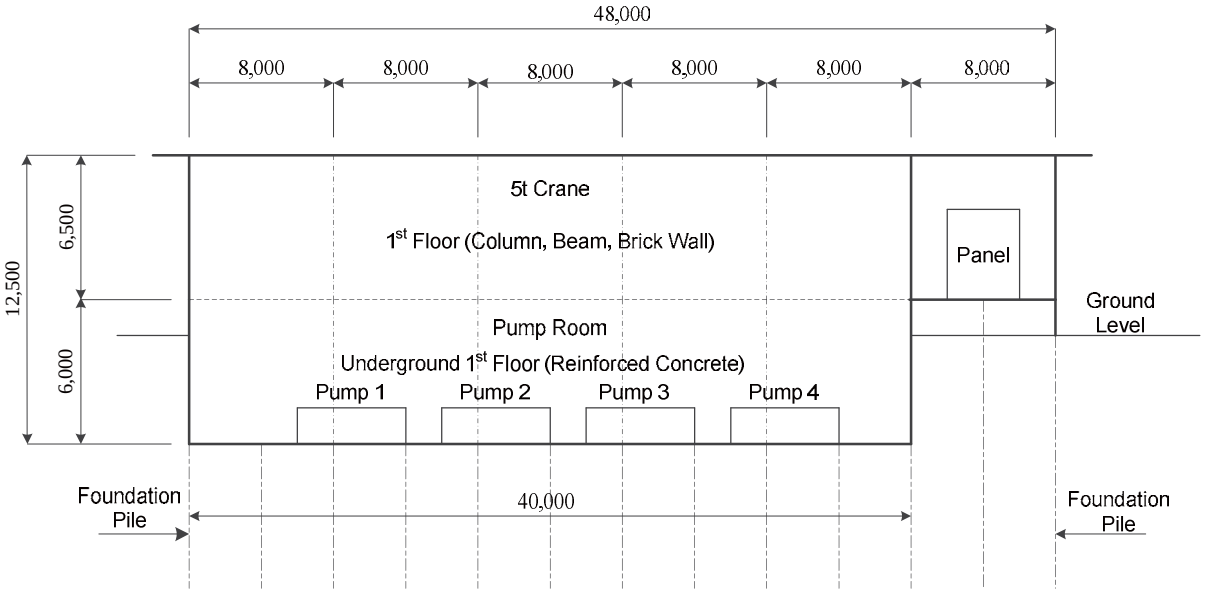


Figure 2-2 Pump Station Building Section View

The major equipment in the pump station building is shown below.

Table 2-4 Major Equipment in Pump Station Building

Item	Quantity	Room
Water Transmission and Distribution Pump including Motor Capacity: 2,850 m^3/h, Size: 600 mm x 500 mm, Head: 72.0 m, Motor Output: 800 kW	4 sets	Pump Room
DN600 Suction Valve	4 sets	
DN600 Suction Valve	4 sets	
DN600 Electric Driven Discharge Valve	4 sets	
5 ton Overhead Travelling Crane	1 set	
Transformer Panel	1 panel	Electrical Room
400V Feeder Panel	1 panel	
230V Feeder Panel	1 panel	
Pump High Tension Starter Panel	4 panels	
Operating/Monitoring Panel	1 panel	

(3) Structure of Pump Station Building

The underground part of the pump room is made of reinforced concrete because the loads due to earth pressure and/or water pressure are worked. Meanwhile the aboveground part for the pump room and electrical room is made from the column, beam and wall (brick) used for construction of the building locally and ordinarily.

(4) Foundation of Pump Station Building

The pile foundation is used for the foundation of the new pump station building because the existing pump station building has uneven settlement due to mat foundation. Meanwhile it was found by the soil investigation that the soft silt clay layer exists. The local pile foundation is constructed by the non-vibration cast-in-place pile method or jacked rectangular concrete pile method. This Project adopts the steel pipe pile with wing (refer to Table 2-5) from a point of view of shortening of the construction period. The said pile is that two semicircular steel plates are welded with incline at the end of steel pipe pile and the direction of incline is changed each other so as to be able to have more end bearing capacity. This pile-driving work is the simple method able to be done by penetrating the pile in the ground with rotation of it. Meanwhile the pile driving facilities consists of the pile driver and the auger motor to be equipped on the pile driver to rotate a pile. This piling method can be worked with smaller facilities than other methods.

Table 2-5 Comparison of Foundation Piling Work Method

Item	(1) Steel Pipe Pile with Wing Method	Cast-in-Place Pile Method	Jacked Pile Method	(4) Inside Drilling Pile Method
Construction Method	Method penetrating by rotating a steel pipe pile with wing welded at end of pile by an auger motor	Method excavating by rotating the bucket with protection of the surface of the ground by the work casing pipe. In this case, the stabilizer is injected to avoid collapse of the	The heavy weight is required to penetrate a pile. Method penetrating with up and down stroke repeatedly by the hydraulic	The auger screw is installed inside the pile. Method penetrating with excavation by the auger screw. The soil at the end of pile is solidified by cement

Item	(1) Steel Pipe Pile with Wing Method	Cast-in-Place Pile Method	Jacked Pile Method	(4) Inside Drilling Pile Method
		hollow wall. After excavation till the supporting layer, the reinforcement cage is inserted and the concrete is placed by tremie pipe.	jack putting heavy weight.	milk.
Particulars of Construction Method	The diameter of the wing welded at the end of pile is 1.5 or 2.0 times more than it of the pile. Accordingly the pile has large end bearing capacity. No surplus soil is discharged.	Many facilities and process are required for pile driving and the waste water treatment facilities are required for stabilizer. In addition to the above, water, rebar and concrete are required at the site.	The heavy weight is required to penetrate a pile. Transfer of the hydraulic Jack with heavy weight from pile to pile is required.	The excess excavation is required to avoid so as not to collapse the soil at the end of pile and around the pile. The end bearing capacity is large by solidifying the end.
Pile Size	φ318.5～1,200mm	φ800～3,000mm	Rectangular 150～350mm	φ400～1,200mm
Pile Length	～60m	～65m	～40m	～70m
Applicable Soil for Pile End	Sand Layer or Gravel Layer	Sand Layer or Gravel Layer	Sand Layer or Gravel Layer	Sand Layer or Gravel Layer
Design Formula for Bearing Capacity	Ru=qd・Aw＋U・ΣLi・fi Asc: Wing Projected Area U: Pile perimeter	Ru=qd・A＋U・ΣLi・fi A: Pile End Area U: Pile Perimeter	Same as left	Same as left
Pile End Bearing Capacity Rate (qd)	Sand layer 135・N (≦6,750 kN/m^2) ※ 1.5 times of pile size 100・N (≦5,000 kN/m^2) ※ 2.0 time of pile size Gravel layer 150・N (≦7,500 kN/m^2) ※ 1.5 times of pile size 100・N (≦7,500 kN/m^2) ※ 2.0 time of pile size	Sand Layer 3,000 kN/m^2 Gravel Layer 5,000kN/m^2	Same as left	Sand Layer 150・N (≦7,500 kN/m^2) Gravel Layer 200・N (≦10,000 kN/m^2) ※Cement milk spout stirring method
Peripheral Surface Friction Force Rate (fi) Sandy Soil	2・N(≦100 kN/m^2)	Same as left	Same as left	Same as left
Peripheral Surface Friction Force Rate (fi) Cohesive Soil	10・N(≦80 kN/m^2)	Road:8・N(≦100kN/m^2)	Same as left	Same as left
Ground Property	Suitable for comparative soft ground	The pile driving work has the case difficult for artesian water.	Suitable for comparative soft ground	None
Noise/vibration	Low noise/Low vibration construction method	Same as left	Same as left	Same as left
Excavated Surplus Soil	None	Much	None	Comparative little
Stabilizer	Not used	Used	Not used	Same as left
Cement Milk	Not used	Same as left	Same as left	Used for the pile end only
Constructability	The pile driving facilities is little mechanically and the pile is penetrated by rotating itself. The construction process is little and simple. The construction period is short.	Although the hollow wall is stabilized with stabilizer, it is in danger of collapse. The reinforcement cage in the excavated hollow is inserted and concrete is placed by the tremie pipe and is cured. The pile driving facilities need many machines and the construction process is a lot. Accordingly the construction period is long.	It takes time to procure the heavy weight for penetration of the pile. It takes time to transfer from pile to pile the pile driving machine with heavy weight. It takes time to penetrate the pile with the hydraulic jack owing to up and down stroke repeatedly.	The pile driving facilities require more machines than it for the steel pipe pile with wing. The auger screw is installed inside the pile and the pile is penetrated with excavation by the auger screw. The soil at the end of pile is solidified by cement milk. The construction period is longer than it of the steel pipe pile with wing.

Item	(1) Steel Pipe Pile with Wing Method	Cast-in-Place Pile Method	Jacked Pile Method	(4) Inside Drilling Pile Method
Cost Performance	Little expensive	Little expensive	Cheapest	Most expensive
Overall Evaluation	Although the pile driving machine is required, the machinery is little. As the pile has the wing, it has large end bearing capacity. Accordingly the quantity of the piles decreases. Although this construction method is slightly less economical, it has the following merits; -Less number of piles -Easy pile driving work -No curing work -Excellent constructability Accordingly this construction method is adopted. ◎	The minimum pile size is large. The earth drilling machine, the stabilizer plant, the work casing, and the tremie pipe are required and in addition the rebar fabrication shop is required. This construction method has many construction processes and concrete is required to cure. Accordingly the constructability is inferior. △	As the end bearing capacity of the pile is less than it of the steel pipe pile with wing, the quantity of the piles is more. It takes time to penetrate the pile with the hydraulic jack owing to up and down stroke repeatedly. Accordingly the constructability is inferior to it of the steel pipe pile with wing. ○	As the pile driving work requires the pile driving machine with auger screw and cement mill facilities, this construction method is inferior economically. Meanwhile, as it is required to cure cement milk for solidification of the soil, the constructability is inferior. △

(5) Building Mechanical and Electrical Facilities in Pump Station Building

The pump room and the electrical room in the pump station building have the lighting fixtures and the receptacles so as to be able to the repair or inspection work in the night. Meanwhile, as the machinery/ electrical facilities like motors, electrical panels, etc. located in the pump station building generate heat, the study on air temperature rise in the pump station building was made. The result of study is shown below.

1) Heat Intensity radiated from Heat Element

The heat intensity radiated from the heat element is shown in the table below.

Name of Heat Element	Radiated Heat Intensity
Motor (800 kW x 3 sets)	86,943 kcal/h*
Electrical/Instrumentation Panel (10 panels) and Transformer (100 kVA)	7,482 kcal/h
Total	94,425 kcal/h

Note: *Although the rated output of a motor is 800 kW, it is considered that actual output under ordinary operation is 750 kW.

2) Required Ventilation Rate

When the pump station building has the radiated heat intensity shown in the above 1) and the ambient temperature outside the said building is taken as 30℃, the ventilation rate required to keep the temperature inside the said building below 40℃ can be calculated based on the following formula;

$$V = Q / \rho \times Cp \times \Delta t \times 60$$

Hereupon,

V：Required ventilation rate（m^3/min）

Q：Radiated heat intensity（94,425 kcal/h）

ρ：Air density at 40℃（1.128 kg/m^3）

Cp：Specific heat of air at constant pressure（0.241 kcal/kg℃）

Δt：Temperature difference between inside and outside of building（40℃－30℃=10℃）

From the above formula, the required ventilation rate is calculated as V=579m^3/min.

3) Ventilation Rate by Forced Ventilation System and Specification of Ventilation Fan

In order to secure the required ventilation rate calculated by the above 2), the air supply fan and air exhaust fan are installed on the side wall of the said building. The quantity and specification of ventilation fans are shown below.

Item	Quantity	Specification
Air Supply Ventilation Fan	4 sets	Size: above 60 cm, Flow rate: above 150 m^3/min
Air Exhaust Ventilation Fan	4 sets	Size: above 60 cm, Flow rate: above 150 m^3/min

As the ventilation rate having more than 600 m^3/min are secured by the ventilation fans, the temperature in the said building can be kept below 40℃.

(6) Finish and Fittings for Pump Station Building

The finish of the pump station used in the local building ordinarily is adopted. But water proofing for the outside of underground part of the pump station building and the inside of the pump pit is given in addition to the ordinary finish. The fittings use the aluminum fittings resistant to rust in principle taking into account the rainy season.

Floor:	Metal trowel finish
Ceiling:	Metal trowel finish (pump pit and valve room)
Outside of Underground Wall:	Bare concrete
Inside of Underground Wall:	Bare concrete
Outside of Aboveground Wall:	Mortar finish
Inside of Aboveground Wall:	Mortal finish
Roof:	Asphalt sheet waterproofing, concrete pressing
Outside Waterproofing:	Hydrated silica penetrable waterproofing (only outside of perimeter wall below the ground level)
Inside Waterproofing:	Epoxy coating (only the bottom and inside wall in the pump pit)
Sash:	Aluminum
Door:	Aluminum
Shutter:	Steel

(7) Study on Water Level for Pump Operation

The pump pressurizes and carries the treated water for water transmission/distribution reserved into the clear well of the water treatment plant. When the water level in the clear well lowers below a certain level, the cavitation occurs in the pump and the pump cannot carry water. Therefore it is required to enlarge the range of water level able to operate the pump as far as possible in order to make stable operation of the pump for a long time.

Ordinarily three (3) pumps are operated. In this case, each pump is operated near the rated capacity. However, when water demand lower in the night, one (1) pump may be operated. In this case, a pump is operated over the rated capacity due to reducing friction loss of the water transmission pipeline. As a result of it, there is a high possibility that cavitation occurs in the pump. Regarding one (1) pump operation, the range of water level able to operate the pump is calculated for the existing pump and the renewed pump as shown below.

1) The Existing Pump

Specification of Pump

- Type: Horizontal shaft double suction Centrifugal pump
- Capacity: 2,850 m^3/h
- Head: 72 m
- Rotation speed: below 1,500 rpm
- Motor output: 800 kW

The maximum capacity of a pump is assumed as 3,705 m^3/h (1.3 times of the rated capacity).

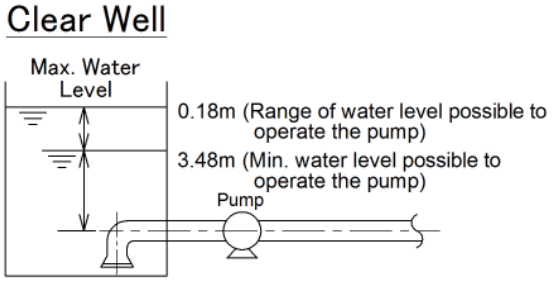
The minimum water level is calculated by the formula below:

Minimum suction pressure (minimum water level) = Required Net Positive Suction Head (NPSHr)－Ambient Pressure + Water Vapor Pressure－Pump Suction Pipe Friction Loss+Allowance, that is;

Minimum suction pressure (minimum water level)＝12m-10.33m+0.46m+0,35m+1m=3.48m

Note: 1. NPSHr (12 m) is assumed from NPSHr (7.5 m) at the rated capacity of pump.
2. Allowance is estimated as 1 m.

Based on the result of calculation, the water level is illustrated as follows;



From the above figure, the range of water level able to operate the pump is 0.18 m.

2) Renewed Pump

Specification of Pump

- Type: Horizontal shaft double suction centrifugal pump
- Capacity: 2,850 m^3/h
- Head: 72 m
- Rotation speed: below 1,000 rpm
- Motor output: 800 kW

The maximum capacity of a pump is assumed as 3,705 m^3/h (1.3 times of the rated capacity).

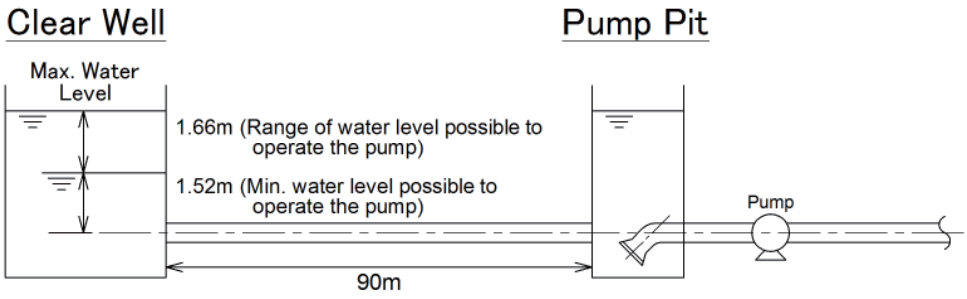
The minimum water level is calculated by the formula below:

Minimum suction pressure (minimum water level) = Required Net Positive Suction Head (NPSHr)－Ambient Pressure + Water Vapor Pressure－Pump Suction Pipe Friction Loss+Allowance, that is;

Minimum suction pressure (minimum water level)＝10m-10.33m+0.46m+0.39m+1m=1.52m

Note: 1. NPSHr (10 m) is taken from NPSHr shown in the pump performance curve.
2. Allowance is estimated as 1 m.

Based on the result of calculation, the water level is illustrated as follows;



From the result of the above study, the range of water level able to operate the existing pump and the renewed pump is 0.18 m and 1.66 m, respectively. Accordingly the range of water level for the renewed pump is much larger than it for the existing pump. This arises from lowering NPSHr by decrease of the rotation speed of the renewed pump, that is; it of the renewed pump is below 1,000 rpm and it of the existing pump is 1,500 rpm. As a result of it, the renewed pump can be operated stably against variation of the water level.

(8) Study on Water hammer due to Pump Stop and Prevention Countermeasure

1) Water Hammer Analysis

Water hammer of the existing pump station and pipeline occurs when the pumps are stopped due to power failure, etc. and there a possibility that water column separation is generated at four points on the water transmission pipeline shown in Figure 2-3.

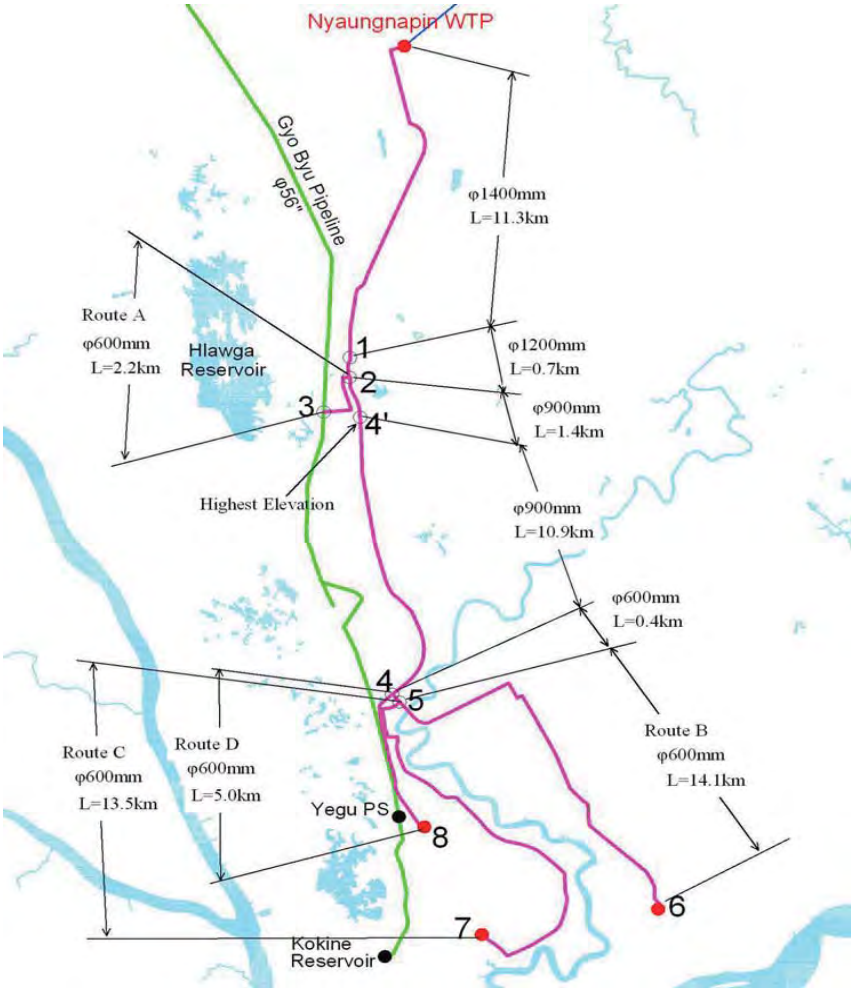


Figure 2-3 Route of Water Transmission Pipeline

Detail of four points is as follows;

i) Around Node 2 (Maximum negative pressure: －7.9m)

ii) Node 4'/Highest point of transmission pipeline (Maximum negative pressure: －9.7 m)

iii) Around 7 km upper stream from Node 6 (Maximum negative pressure: －7.0m)

iv) Around 6.5 km upper stream from Node 7 (Maximum negative pressure: －7.0m)

At the same time, there a possibility that the check valve and/or the transmission pipeline are damaged due to sudden pressure rise at downstream of the check valve occurring from delay of close action of the existing swing type check valve installed at the pump discharged side.

2) Countermeasure for Water Hammer Prevention

Countermeasure for Water Column Separation Prevention

The countermeasure for water column separation prevention of the existing facilities depends upon air supply from the existing air vessels when negative pressure occurs. As shown in the above water hammer analysis, there a possibility that water column separation is generated at four points on the water transmission pipeline.

To prevent these water column separations, the suitable air valves are installed and the column separation can be avoided by supplying air from the air valves. When the air valves are installed near the location where water column separations may be generated, the negative pressure decreases as shown below:

i) Around Node 2 (Maximum negative pressure: －0.0m)
ii) Around 10.5km upstream from Node 6 (Maximum negative pressure: －3.6 m)
iii) Around 10.0 km upstream from Node 7 (Maximum negative pressure: －3.8 m)
iv) Around 10.0 km upstream from Node 8 (Maximum negative pressure: －1.8 m)

Meanwhile, from the result of the above analysis, the maximum negative pressure in the water transmission pipeline between the pump station and the air vessels shows －3.0m. Accordingly no water column separation occurs in the said pipeline. However the air valve is installed on the said pipeline as a backup of air supply from the existing air vessels. Finally the air valves are installed at five locations.

Two air valves including one standby are installed at a location in order to make operation and maintenance successfully. Accordingly when water hammer occurs during maintenance work of one air valve, another can serve.

Countermeasure for Pressure Rise Prevention at downstream of Check Valve

The water hammer free swing type check valve with counter weight and bypass valve is used instead of the existing swing type check valve. The said check valve has no pressure rise due to backflow at sudden pump stop.

3) Equipment for Water Hammer Prevention

a) Air Vessel

The existing air vessels are used. Specification of the air vessel is as follows;

- Capacity: 65 m^3
- Materials: Carbon Steel Plate
- Accessories: Pressure Instrument
- Note: The existing pressure gage is replaced with the pressure instrument.

b) Air Compressor

When the water transmission pumps are operated, the pressure in the air vessels is required to be kept in 6.3－7.0kg/cm^2 constantly. Accordingly one standby is installed. Specification of the air compressor is as follows:

Item	Specification
Type	Portable Type Air Compressor
Capacity	Above 0.605m^3/min
Maximum Pressure	0.69～0.93MPa
Air Tank Volume	Above 170L
Motor Output	Above 5.5kW
Power Supply	AC400V 50Hz
Quantity	2 sets

c) Air Valve

The air valve induces air when water hammer occurs and then exhausts air automatically after restart of the water transmission pump. Specification of the air valve is as follows;

Item	Specification
Type	Automatically Air Intake and Exhaust Valve
Size	100mm（4 sets- Upstream of Node 6 & 7） 150mm（2 sets- around Node 4'） 200mm（4 sets- between Pump Station and Air Vessel, and around Node 2）
Maximum Working Pressure	0.98MPa
Quantity	10 sets（2 sets/location）

(9) Pump/Motor

The capacity and head of the pumps renewed and the output of the motors renewed are the same as the existing pumps and motors. However, the rotation speed of the pumps renewed is below 1,000 rpm as written in the above (7). Specification of the pump, the motor and ancillary equipment is shown below.

1) Specification of Pump/Motor

a) Specification of Pump

Item	Specification
Type	Horizontal Shaft Double Suction Centrifugal Pump
Suction Size	φ600mm
Discharge Size	φ500mm
Head	72m
Capacity	2850m^3/hr
Rotation Speed	Below 1000 rpm
Efficiency	Above 87%
Applicable Code	ISO
Fluid	Drinking Water
Materials	Casing：Cast Iron or equivalent
	Impeller：Bronze Cast or equivalent
	Shaft：Carbon Steel or equivalent
Quantity	4 sets

b) Specification of Motor

Item	Specification
Type	Totally Enclosed Fan Cooled 3 Phase Squirrel Cage Horizontal Shaft Induction Motor
Output	Below 800 kW
Rotation Speed	Below 1000 rpm
Poles	6P
Voltage	AC 6600V
Frequency	50 Hz
Insulation	Class F
Starting Method	Korndorfer
Speed Control	Non
Applicable Code	IEC
Quantity	4 sets

2) Ancillary Equipment

The equipment ancillary to the pump/motor is suction valves, discharge valves, check valves and flexible fittings (flange adapters). The method starting the pump on condition that the discharge valve is closed fully lessens starting torque of the motor and can reduce electric power consumption. Meanwhile the pump is stopped after the discharge valve is closed fully. As water hammer occurs when the discharge valve is closed rapidly, it is required to close it slowly. Accordingly the discharge valve uses the motor-operated valve so as to be closed smoothly at constant speed.

(10) Electrical Facilities

1) Tie-in with Existing Electrical Facilities

The electric power is supplied to Nyaunghnapin first phase water treatment plant with 33 kV power transmission line. The voltage is decreased from 33 kV to 6.6 kV by the step-down transformer installed at the transformer station in the said water treatment plant. Then the electric power is supplied to the existing pump station through the incoming panel and five (5) feeder panels in the substation located near the transformer station. As the electric power to the pump station renewed is supplied from the said five (5) feeder panels, the power cable from the said feeder panels to the existing pump station is removed and the new power cable is laid down from the said feeder panels to the renewed pump station. Accordingly the tie-in between the existing electrical facilities and the renewed one is made in the said feeder panels.

2) Electrical Single Line Diagram

As written in the above 1), the scope of the renewed electrical facilities is since the power cable connected with the existing five (5) feeder panels. The electrical single line diagram for the renewed electrical facilities is shown in the basic plan drawings.

3) Specification of Electrical Panel

As the power failure often occurs, the pump high tension starter panel includes a device starting the motor by korndorfer, which lessens starting current of the motor, in order to reduce electrical power consumptions when the pump starts.

(11) Incidental Facilities for Pump Station

The following equipment is provided as the incidental facilities for the pump station;

Name of Equipment	Service
1. Overhead Travelling Crane	Installation, loading/unloading, dismantling, assembling, etc. for pump/motor, electrical panel, etc.
2. Floor Drain Pump	Drain of leaking water from pump and pipe, washing water for pump, etc.

(12) Operation/Monitoring for Pump Station

1) Operating/Monitoring System

The operating/monitoring panel is installed to carry out operation and monitoring for the water transmission pump. This panel is installed adjacent to the electrical panel and the pump start/stop, urgent pump stop at emergency, daily monitoring for pump/motor, etc. can be made from the panel. This panel has the following function;

- Start/stop of pump/motor
- Open/close of motor-operated pump discharge valve
- Monitoring of water level in pump pit, and alarm and automatic pump stop due to low water level
- Monitoring of flow rate and pressure in pump discharge header
- Monitoring of air pressure in air vessel and alarm due to low air pressure
- Monitoring of pump bearing temperature, and alarm and automatic pump stop due to high temperature
- Monitoring of motor bearing temperature, and alarm and automatic motor stop due to high temperature
- Monitoring of motor coil temperature, and alarm and automatic motor stop due to high temperature

2) Monitoring Instrument

Specification of the instrument renewed is as follows;

a) Water Level Meter

Item	Specification
Type	Ultrasonic Water Level Meter
Measuring Range	0 – 8 m
Non-detectable Range	Below 80 cm
Accuracy	More accurate than ± 1 %
Output	DC 4 to 20 mA
Power Supply	AC 230 50 Hz
Quantity	2 sets

b) Flow Meter

Item	Specification
Type	Ultrasonic Flow Meter, Clamp-on Mounting
Size of Pipe	φ1400mm
Water Velocity	0.1－5.0m/s
Accuracy	More accurate than ±1% at reading value
Analog Output	DC 4 to 20 mA
Digital Output	More than 1 poiny
IP Protection	IP65 or more
Power Supply	AC 230V, 50 Hz
Accessories	Detector Mounting Device 1 lot
	Dedicate Cable（100m） 1 lot
Quantity	1 set

c) Pressure Instrument

Type	Specification
Type	Pressure Transmitter (Water-proof Type)
Measuring Point	Pump Discharge, Discharge Header, Air Vessel
Measuring Range	0－1.6 Mpa
Accuracy	More accurate than ±1%
Output	DC4 to 20mA
Housing	Stainless Steel or Aluminum Alloy
Mounting	Stem Mounting
Power Supply	DC24V
Quantity	6 sets

2-2-2-2 Renewal of Water Distribution Pipeline (outside diameter: 1,050 mm) from Kokine Reservoir

(1) Scope of Renewed Pipeline

The scope of the renewed pipeline having outside diameter of 1,050 mm is about 1.7 km to the north direction of Kabar Aye Pagoda from Sedona Hotel. Meanwhile, although the existing pipeline is connected with the branch line, the renewed pipeline (1,050 mmφ) is not connected with the branch line. The bypass line is laid down separately and connected with the branch line.

(2) Renewed Pipeline Plan

The outside diameter of the renewed pipeline is 1,050 mm as well as it of the existing pipeline.

About 1.7 km of the pipeline out of total length about 4.5 km is renewed from a point view of urgency and necessity, because this part of the pipeline has water leakage with high frequency due to overage of the pipe. Therefore it is not expected that total length of the pipeline is renewed taking into account future conditions.

All the pipes more than 200 mmφ use the ductile cast iron pipe. Meanwhile the size of the bypass line is estimated based on flow rate of the existing branch lines. The water distribution flow rate from each branch line is presumed as below.

Table 2-6 Branch Lines and Water Distribution Rate in the western part of Kabar Aye Pagoda

Size	Water Distribution Area of Branch Line	No of Connection	Flow Rate (m^3/d)
100mm	Mayangon	56	110
200mm	Inya lake hotel	1	1,300
200mm	Factory	1	1,300
150mm	Factory	1	650
150mm	Mayangon	70	138
100mm	Mayangon		
100mm	Recreation centre	1	220
Total			3,718

Table 2-7 Branch Lines and Water Distribution Rate in the eastern part of Kabar Aye Pagoda

Size	Water Distribution Area of Branch Line	Flow Rate (m^3/d)
100mm	Pyaytawaye St.	220
150mm	Micasa hotel	650
Total		870

The pipe size of the bypass line is calculated by Hazen-Williams formula based on total water demand rate adding future demand rate to the above water demand rate. This formula is shown in other section. When the hydraulic gradient is assumed as 3 ‰, the adequate size of the bypass line is 300 mm for the western part of Kabar Aye Pagoda and 200 mm for the eastern part of Kabar Aye Pagoda. The route of the main pipeline (1,050 mmφ) and the east and west side bypass lines in Kabar Aye Pagoda Street are shown in Figure 2-4 and the length of the pipeline renewed is shown in Table 2-8.

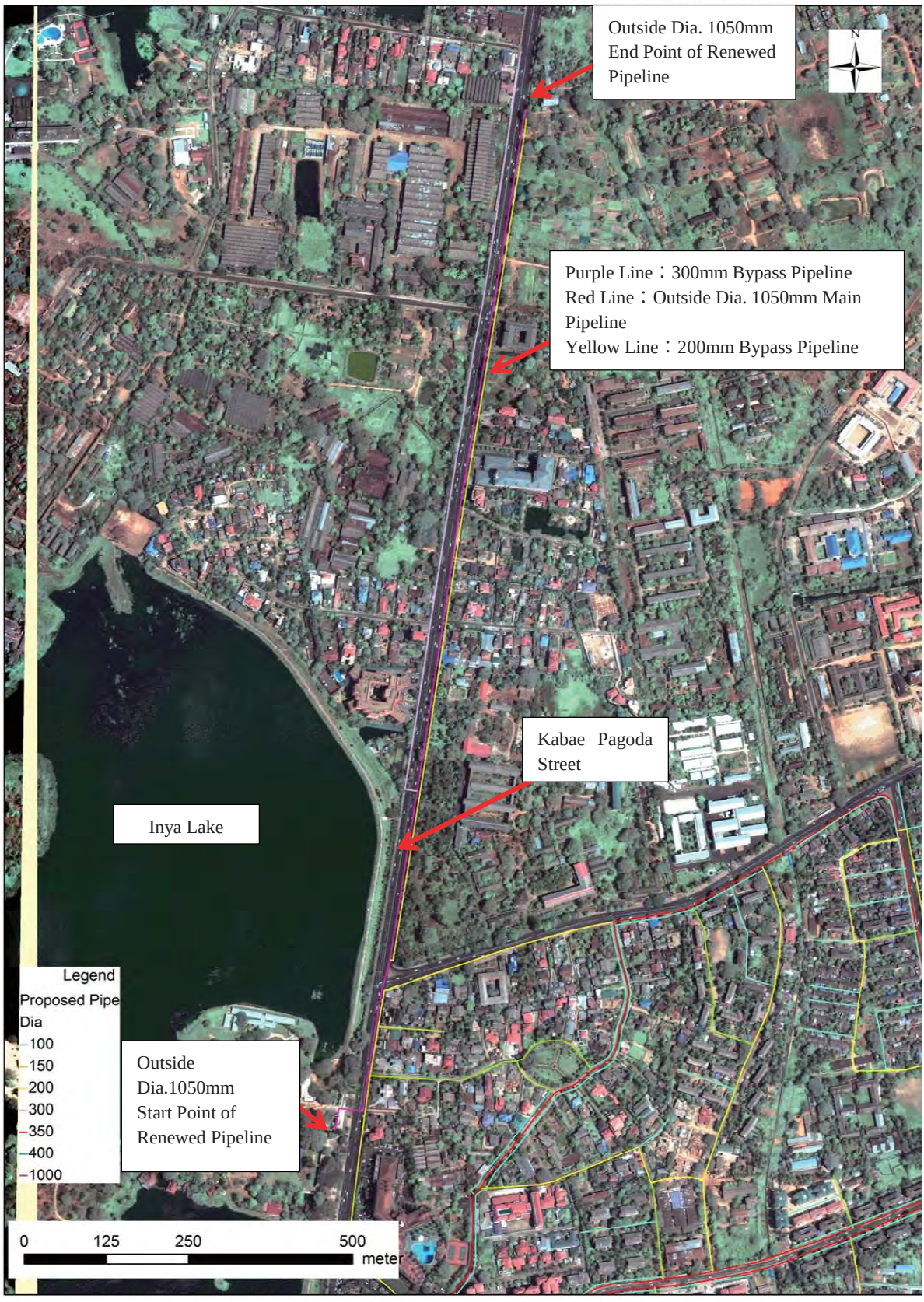


Figure 2-4　Route of Outer Diameter 1,050mm Pipeline, East and West Side Pipeline in Kabar Aye Pagoda Street

Table 2-8 Renewed Pipeline Length for Each Size

Pipe Size (mmφ)	Approximate Length (m)
1,050	1,700
300	1,200
200	1,400
Total	4,200

(3) Selection of Construction Method for Pipe Laying

As Kabar Aye Pagoda Street is the main road having three (3) lanes in each direction, there is concern about influence to the traffic due to the pipe laying work. Especially when the pipe laying work is done in the crossing of the road, it is required to block the traffic. To avoid it, the construction method for the main pipeline and the bypass line in the crossing of the road adopts the pipe jacking method. Also where the drainage channel is crossed under Kabar Aye Pagoda Street, the pipe jacking method is adopted when it is difficult to lay the pipe under the drainage channel. The other straight part adopts open-cut method because the pipe laying work can be done under one lane traffic control only.

Table 2-9 Number of Location of Pipe Jacking Method

Pipe Size (mmφ)	Number of Locations
1,050	Two (2) Road Crossings, One (1) Drainage Channel
300	One (1) Road Crossing, One (1) Drainage Channel
200	One (1) Drainage Channel

2-2-2-3 Renewal of Distribution Pipeline in the Pilot Area of Yankin Township

(1) Target Year

The target year shall be completion year of the Project; however, in order to meet the future water demand, pipe diameter shall be changed to big size and the replacement work shall be implemented for it again. Therefore, in this Project, the target year is set as year 2025 which is 10 years after the completion year of the Project.

(2) Target Area

Comparing with other Townships, Yankin Township has advantage of renewal of distribution pipe from the points of view mentioned below and YCDC selected Yankin Township as pilot area since the priority of renewal of distribution pipe in Yankin Township is high.

- There are many apartments and population density is high compared with other Township; therefore, the impact for improvement of NRW is large.

- There are many aged existing pipes installed in the year 1960s and it is assumed that the impact of NRW is generated after renewal of distribution pipe

In block 1 to 6 of Yankin Township, the old apartments exist built and managed by YCDC housing department. The pipelines to distribute water to these apartments have been aging and the number of leakage accidents is large; therefore, the renewal of distribution pipe in these blocks has been urgent issue. In this Project, the appropriate project scale is studied and block 1 to 6 are prioritized in accordance with Figure 2-5 and the area between block 2 and 3 is selected as the target area for renewal of distribution pipe. The setting process of priority for the target area of renewal of distribution pipe is shown in below.

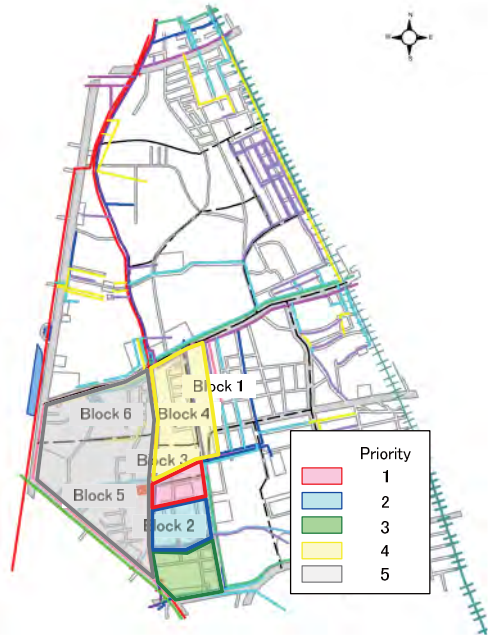
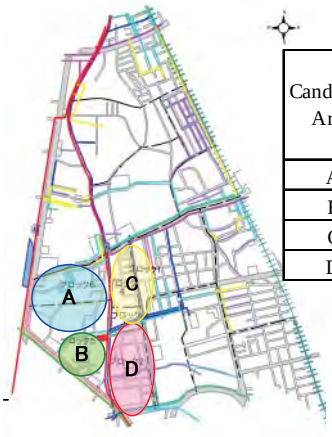


Figure 2-5 Priority of the Target Area for Renewal of Distribution Pipe

BOX: Setting process of priority for the target area of renewal of distribution pipe



Location of the candidate area

Evaluatoin 1

Candidate Area	Indicator 1 Beneficiary population (Persons)
A	6,871
B	3,628
C	6,090
D	6,743

Area A, C, D are selected.

Evaluatoin 2

Candidate Area	Indicator 2 Beneficiary population per meter for the renewed pipe (Persons/m)	Indicator 3 Division of distribution area by Projyect scale
A	0.97	It is difficult. Because road route is relatively complecated.
C	0.95	Possible to devide into 4 areas
D	1.09	Possible to devide into 3 areas

Firstly, block 1 to 6 in Yankin Township is devided into 4 areas from A to D and priority of all areas is evaluated. In the evaluation 1, area A, C and D where beneficiary population is large are selected as area with high priority. In the evaluation 2, area D where beneficiary population per meter for the renewal of pipe is large and it is possible to devide area depending on Project scale is selected as highest priority and area D is devided as Figure 2-5 and the renewal of pipe is implemented from the upstream of distribution pipe (Priority 1 in the Figure 2-5). Beneficiary population per meter for the renewal of pipe in area C is slightly smallaer than A; however, it is possible to devide area C and area C is selected as area with second highest priority. Area A and B is selected as areas with third priority and renewal work shall be considered implementation from area A with large beneficiary population.

(3) Planned Population Served and Planned Water Supply Amount

Based on the planned water supply in 2025 for Yankin Township estimated in "JICA-MP" survey, the design water supply amount in pilot area as the target area of the Project is estimated. The result is shown in Table 2-11. The design criteria to be used for calculation of water supply amount are described below.

Table 2-10 Design Criteria used for Calculation of Water Supply Amount

Items	Year	2011	2025
Per capita consumption	plod	139	150
Coverage ratio	%	85%	100%
Ratio of Domestic water supply and Non-Domestic water supply	%	60:40	60:40
Leakage Ratio	%	50	25

Table 2-11 Planned Water Supply Amount in Pilot Area in Yankin Township

Items	Population		Population Served		Daily water supply (m^3/d)		Daily Max Water Supply (m^3/d)	
	2011	2025	2011	2025	2011	2025	2011	2025
Whole Yankin TS	107,023	125,909			49,586	41,969	54,545	46,166
Pilot Area	2,538	2,986	2,538	2,986	1,176	995	1,294	1,095

※Coefficient of Daily Maximum: 1.1, TS: Township

(4) Planned Water Pressure

The planned minimum water pressure in the Project is 0.15Mpa.

(5) Distribution Network Analysis

The network analysis software EPANET2 of the US EPA is used to decide the diameters of the water transmission and distribution system. The Hazen-Williams equation below is used for loss calculations for pipelines.

$H = 10.666\, C^{-1.85}\, D^{-4.87}\, Q^{1.85} \cdot L$

H: Friction loss (m)

Q: Flow rate (m^3/sec)

D: Pipeline diameter (m)

L: Pipeline length (m)

C= Hazen-Williams Head Loss Coefficient

(6) Setting of DMA

The whole distribution network in the Project area is divided into the DMAs from the viewpoint of administrative district boundaries, topography and geography. The setting of DMA is done by followings. As for a scale of DMA, according to Non-Revenue Wter Control in World Bank Project or other similar Project, 2,000 house connections per DMA are recommended.

The number of house connections is 555 and if the number of house connections per DMA is assumed 2,000,

Figure 2-6 DMA Location in Yankin Township

the total number of DMAs in pilot area is 1. Considering viewpoints of topography and condition of the road, the planning of 1 DMA is appropriate. The result of the study of setting of DMAs is reported to YCDC and the result is approved.

In each DMA, the distribution network to supply enough amount of water for peak demand is planned and it targets 24 hours water supply. If it reaches 24 hours water supply, it is possible to remove private wells, private pumps and roof tanks in each household. Furthermore, interfusion of sewage by negative pressure can be avoided and it is possible to carry out safety water supply.

Water supply to Block 2 to 3 in Yankin Township where it is the target area in this Project is shown in the Figure 2-6 and started from transmission and distribution pipe (dia. 1,400mm) from Yegu pumping station.

(7) Distribution network plan

Based on the result of distribution network analysis, the replacement length of distribution network is estimated and shown in the following.

Table 2-12 Outline length of Replacement of Distribution Network in Pilot Area in Yankin Township

Diameter (mm)	Length (m)
400	40
350	620
200	370
100	2,460
Total	3,490

The pipe material with diameter of upper 200mm is ductile iron pipe (DIP) and the pipe material with diameter of 150mm and 100mm is polyvinyl chloride pipe (PVC, rubber ring type). In the existing distribution network, old type of cast-iron pipe, steel pipe and PVC pipe are mainly installed; however, DIP is adopted because it is generally used, high intensity and high workability. The pipe material with small diameter is PVC; however, the joint method of pipe is changed an existing joint by adhesion bond to push-on joint by rubber ring to reduce water leakage by construction failure. The planned distribution network route is shown in Figure 2-7. Additionally, the renewal plan of distribution pipe in block 1 to 6 is shown in Appendix-6.

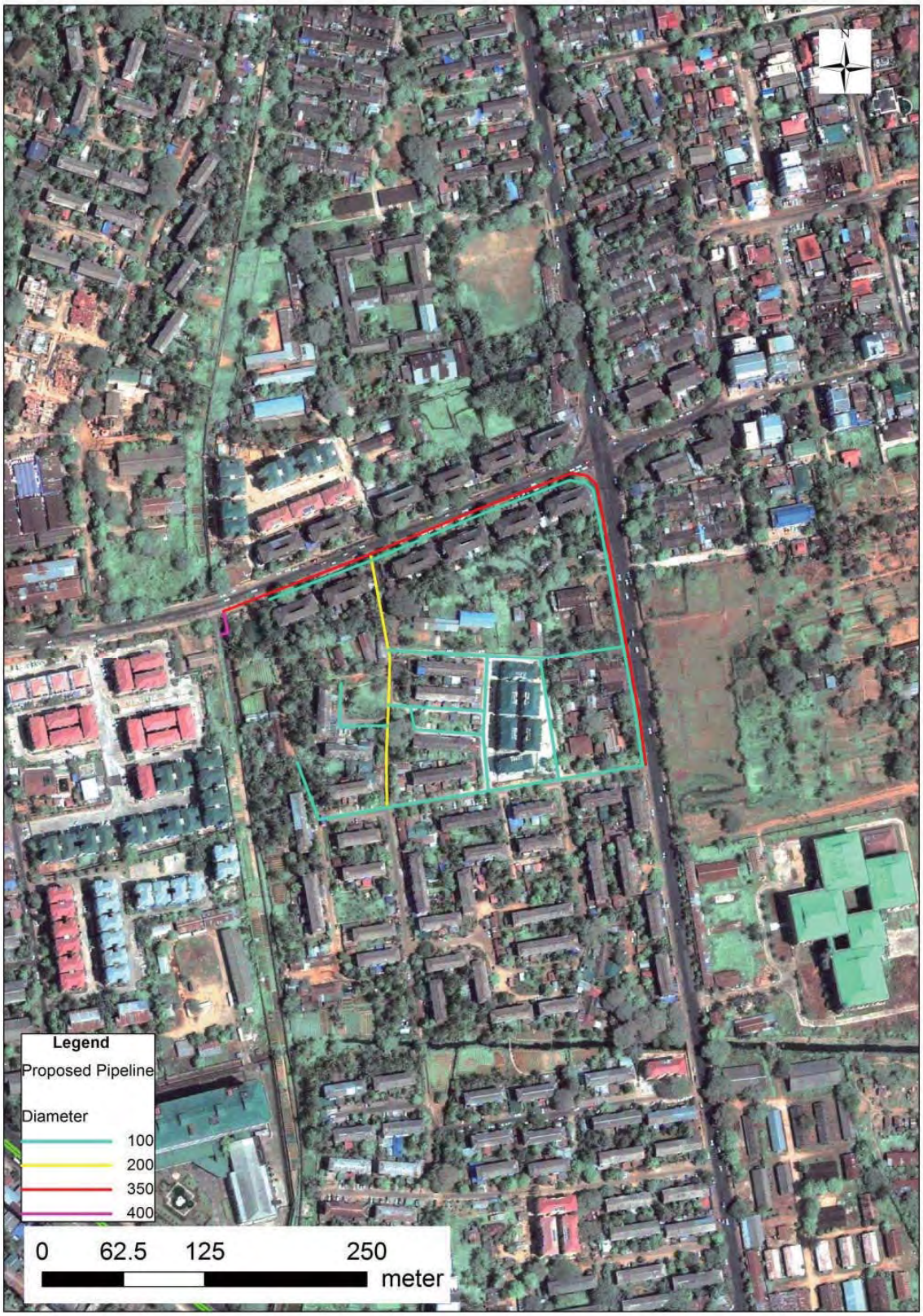


Figure 2-7 Planned Distribution Networks in Pilot Area in Yankin Township

(8) Selection of the installation method of distribution pipe.

It is difficult to stop transmission and distribution water from Yegu pumping station in the time of implementation of connection construction for branch pipe which is starting point of replacement of distribution network, from the existing pipeline with diameter of 1400mm. Thus, the under pressure tapping method is adopted for this construction method. The number of lanes for the main road in the target area of a replacement of distribution network is 2 lanes each way. The main pipeline with diameter of 350mm is installed at the side of main road and the laying work is implemented by open cut method after transportation is controlled.

(9) Installation of house connection

In this Project, installation work of house connection is responsible for Japanese side in addition to house connection materials. The number of types of house connection is three and the schematic figures for each type are shown below.

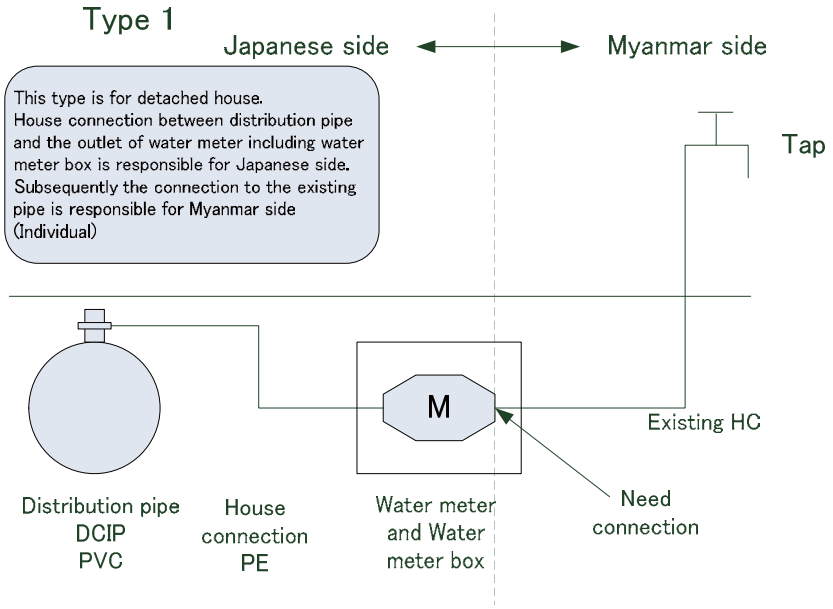


Figure 2-8 Type 1 House connections for households

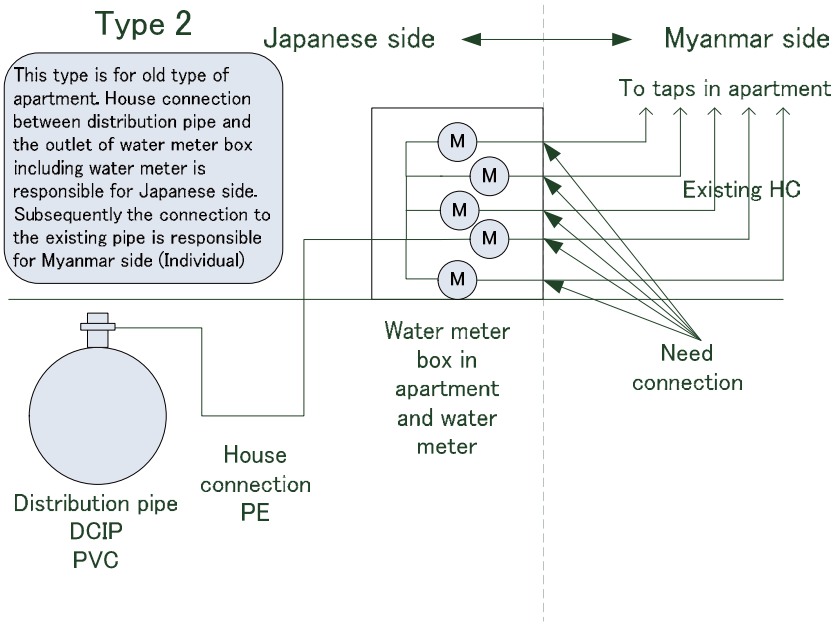


Figure 2-9 Type 2 House connections for old type of apartment

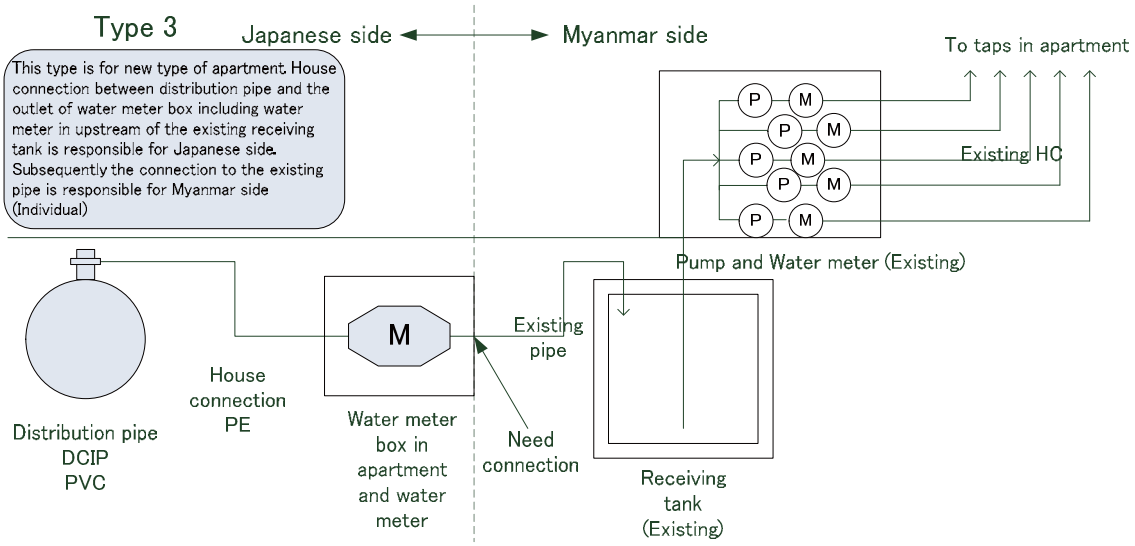


Figure 2-10 House connections for new type of apartment

The material of house connection is polyethylene pipe. The valve is installed at upstream of water meter for an appropriate operation and maintenance of water meter and house connection.

(10) Installation of monitoring system

1) Purpose of establishment of monitoring system

In this Project, water flow meters, pressure transmitters and residual chlorine gauges are installed in the inlet of each DMA, and the central monitoring stations (at YCDC or a related office) monitor residual chlorine, pressure and flow data transmitted from the facilities to be monitored. Then, it will understand the condition of Non-Revenue Water and confirm safety of water supply. YCDC can

recommend some improvement idea for Non-Revenue Water control. Additionally, YCDC improve an unequal water distribution and prevent drift water after it is possible to control valve immediately by monitoring of water flow and pressure in the central monitoring stations.

2) Target facilities for monitoring system

Target facilities to be monitored are described below. In those locations, in the inlet of DMA of distribution network in Yankin Township, water flow, water pressure and residual chlorine are monitored.

Central monitoring station

- Department of water supply and sanitation in YCDC or related office: 1 location

Distribution network in Yankin Township

- Inlet of DMA: 1 location

3) Monitoring system

The central monitoring stations will be located at Department of water supply and sanitation or related office and receive, analyze and accumulate pressure and flow data transmitted from the facilities to be monitored. An interface panel consists of converter and GPRS（General Packet Radio Service）modem. Field data are collected at the interval of 15 minutes and transmitted once a day to the central monitoring station. The accumulation time at the interface panel shall be 24 hours. The mobile communication network (GPRS or GSM) is used to transmit the data.

The central monitoring system consists of GPRS router, server, monitoring display, printer and power supply unit (including UPS), and these equipment is installed on the desk. The server collects data from the interface panels in the field and holds them. In addition, it makes out historical trend graph/chart and reports (daily, monthly and annually) based on the data collected. These reports shall be made out and printed by efficient and easy-to-use software tools. The process and historical data shall be stored for one year and the report data shall be stored for five years. The system configuration is shown below.

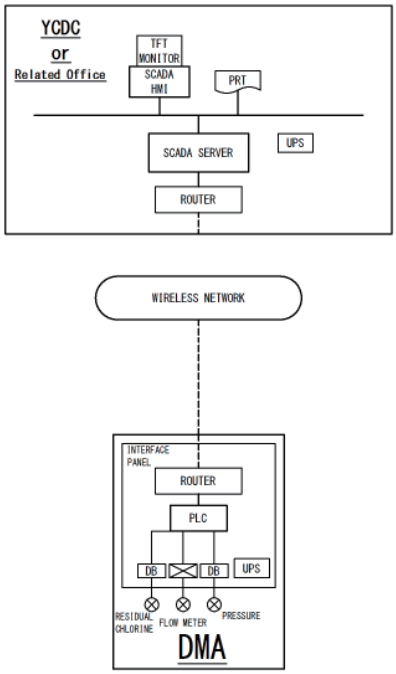


Figure 2-11　Outline diagram of monitoring system

① Installation of central monitoring system

GPRS router, server, monitoring display, printer and power supply unit (including UPS), are installed on the desk of the central monitoring system. The type of wire connection is open wiring on floor.

② Installation of Branch station

The valve pit shall be constructed for operation and maintenance at the flow meters which is installed in the site. As for the pressure transmitter, the sampling pipe is installed and drawn into kiosk with residual chlorine gauge. The water flow data is also taken into kiosk in a similar way and transmitted to the central monitoring station.

The common plywood is used for formwork in the time of construction of valve pit. As for reinforcing bar, SD 345 or equivalent standard is used and the standard of design concrete intensity shall be 24N/mm^2.

The system needs electric power supply (alternate current 220V, 50Hz). Especially, for installation of interface panel in DMAs, Myanmar side shall arrange electric power supply. Prior arrangement by Myanmar side shall be conducted, because the maximum required electric energy is approximately 100W. The type of signal wire is open wiring between each transmitter and interface panel.

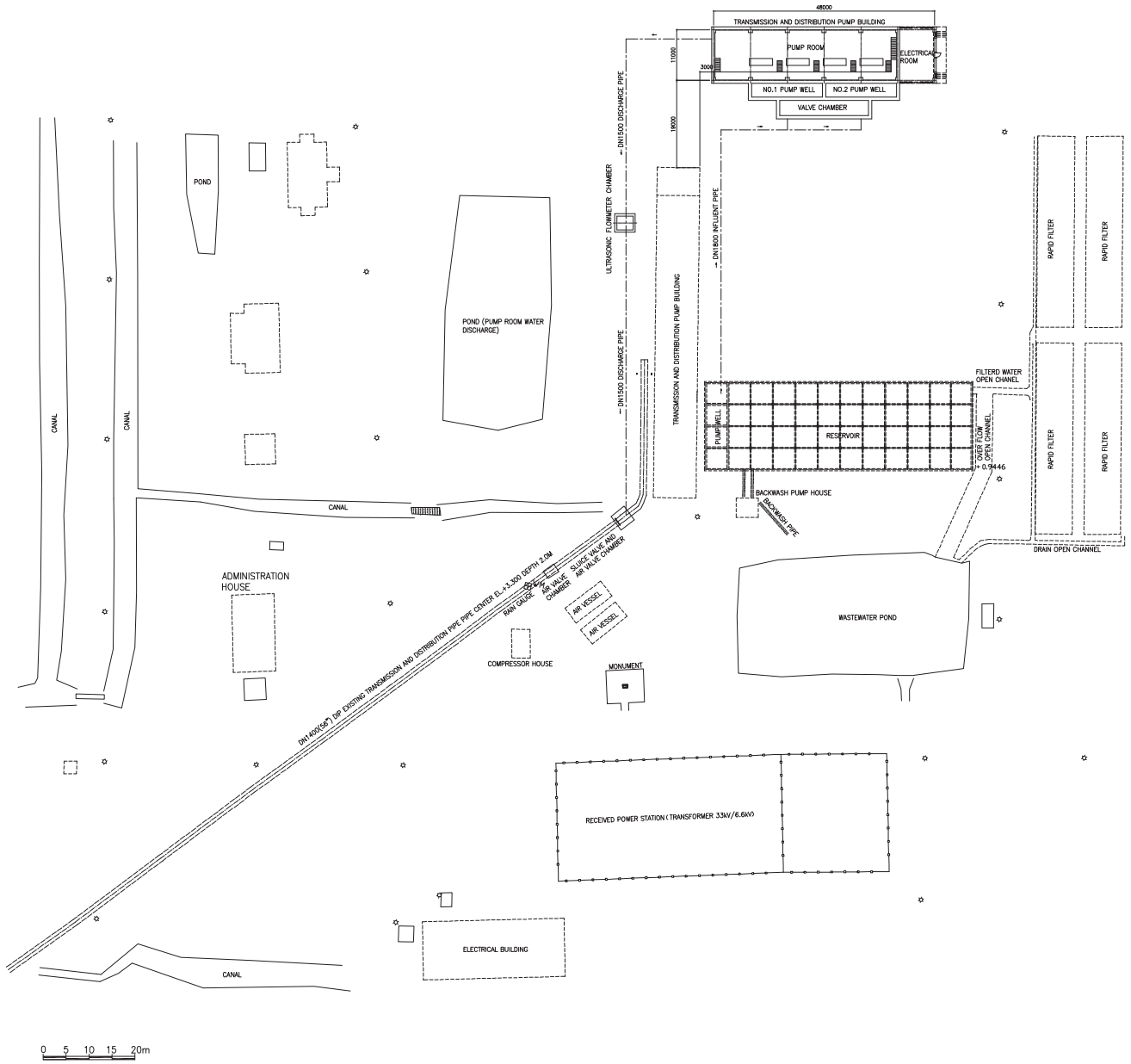
③ Initial operation training and Operation training plan

The work of the initial operation training and Operation training plan is described below. The installation, test and training are implemented by Japanese technician and expert and training for local staff is also implemented.

- Confirmation of normal actuation for communication system between the central monitoring station and all interface panels
- Confirmation of network connection and implementation of trial input test from the branch stations at the side.
- Confirmation of signal from censor of the branch stations (Confirmation of all I/O points)
- Confirmation of normal process to prepare the ledger for the central monitoring station
- Confirmation of normal functionality of network in the time of simultaneous transmission from several sites
- Confirmation of normal actuation of all display in the central monitoring station

2-2-3 Outline Design Drawing

Drawing No.	Title of Drawing	Scale
DWG-1	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Location Plan	1:1000
DWG-2	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Plan of 1st Basement Floor	1:200
DWG-3	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Plan of 1st Floor	1:200
DWG-4	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Plane of Roof Floor	1:200
DWG-5	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Elevation of South and East	1:200
DWG-6	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Elevation of North and West	1:200
DWG-7	Nyaunghnapin First Phase Water Treatment Plant Pump Station Building Section	1:200
DWG-8	Electrical Single Line Diagram	NONE
DWG-9	Plane of Distribution Pipeline with Outer Dia. 1,050 mm from Kokine Reservoir	NONE
DWG-10	Plane of Distribution Pipeline in Pilot Area in Yankin Township	NONE



NYAUNG HNA PIN WATER TREATMENT PLANT (PHASE – 1) PLAN

REMARKS :

1)Water pressure : 1.0MPa
2)Steel pipe : ISO9329-1(1989)
3)Flange : ISO7005
4)Air valve : ISO??
5)Sluice valve : ISO7259(1988)

THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR

YANGON CITY DEVELOPMENT COMMITEE (YCDC)
THE REPUBLIC OF THE UNION MYANMAR

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

TEC INTERNATIONAL CO., LTD.
JAPAN

TITLE :

ニャウフナッピン第一期浄水場平面図
WATER TREATMENT PLANT PLAN

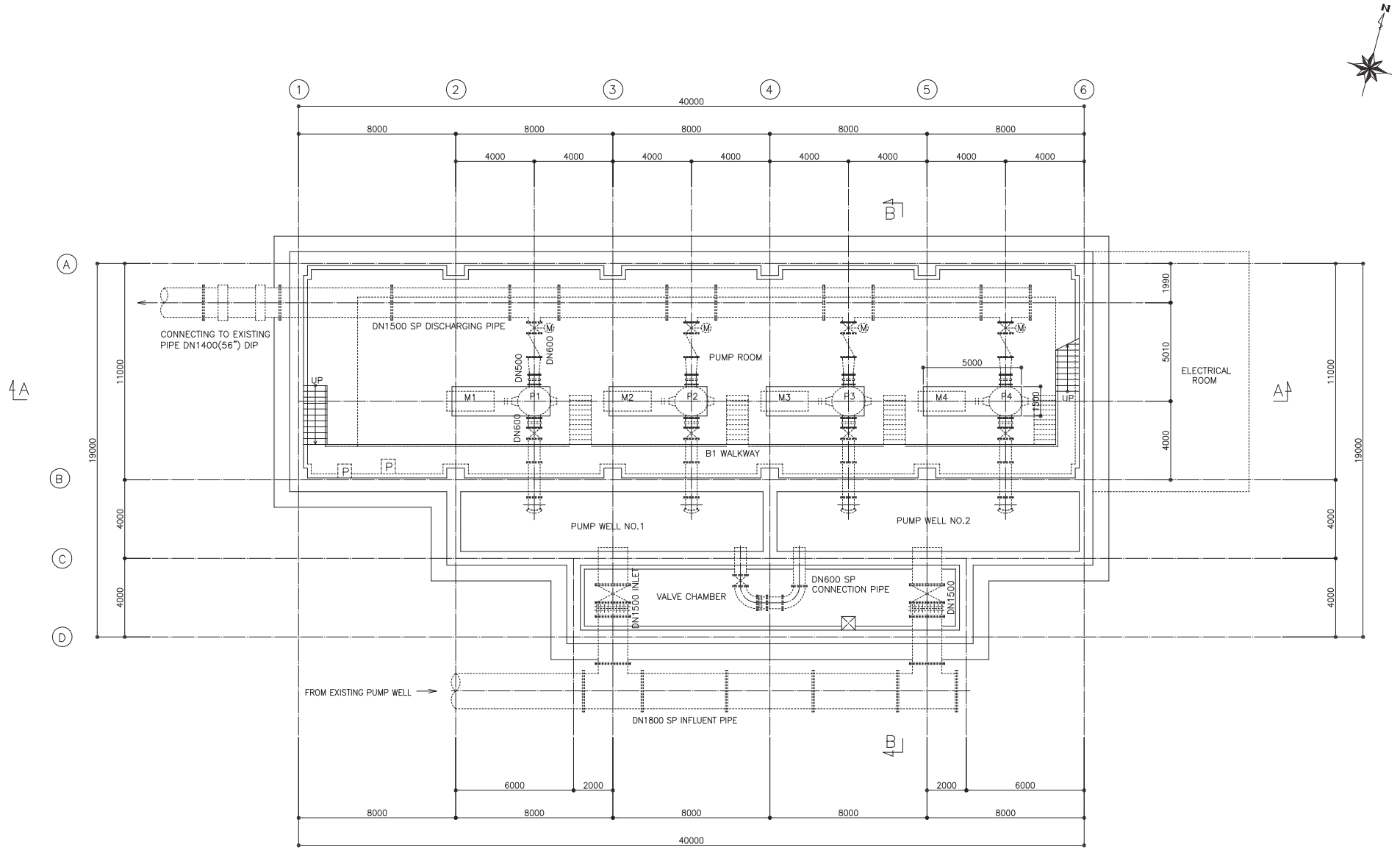
SCALE : S=1:1000

DRAWING NO. : DWG-1

APPROVED BY : NONE

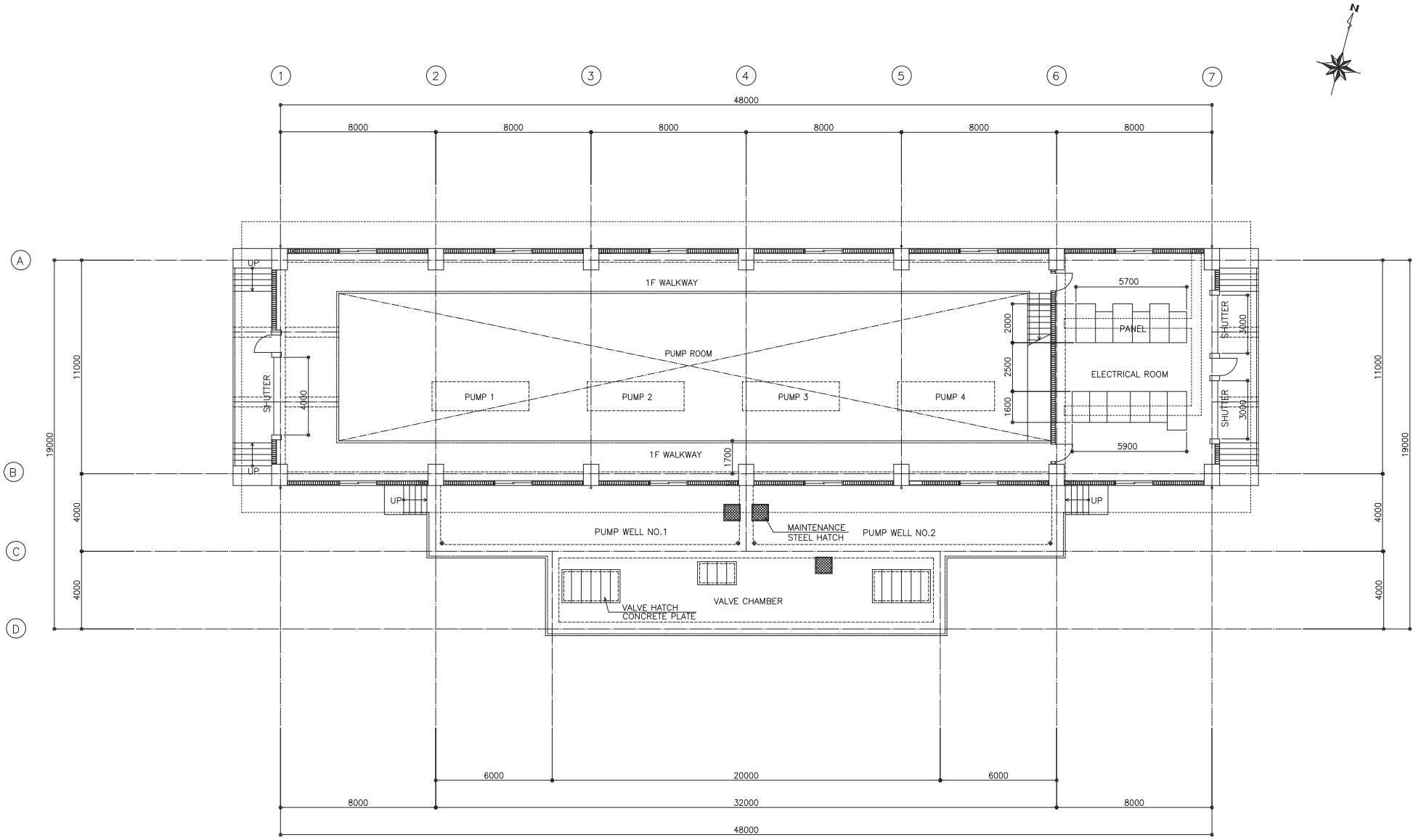
PREPARED BY : NONE

DATE : JULY 2013



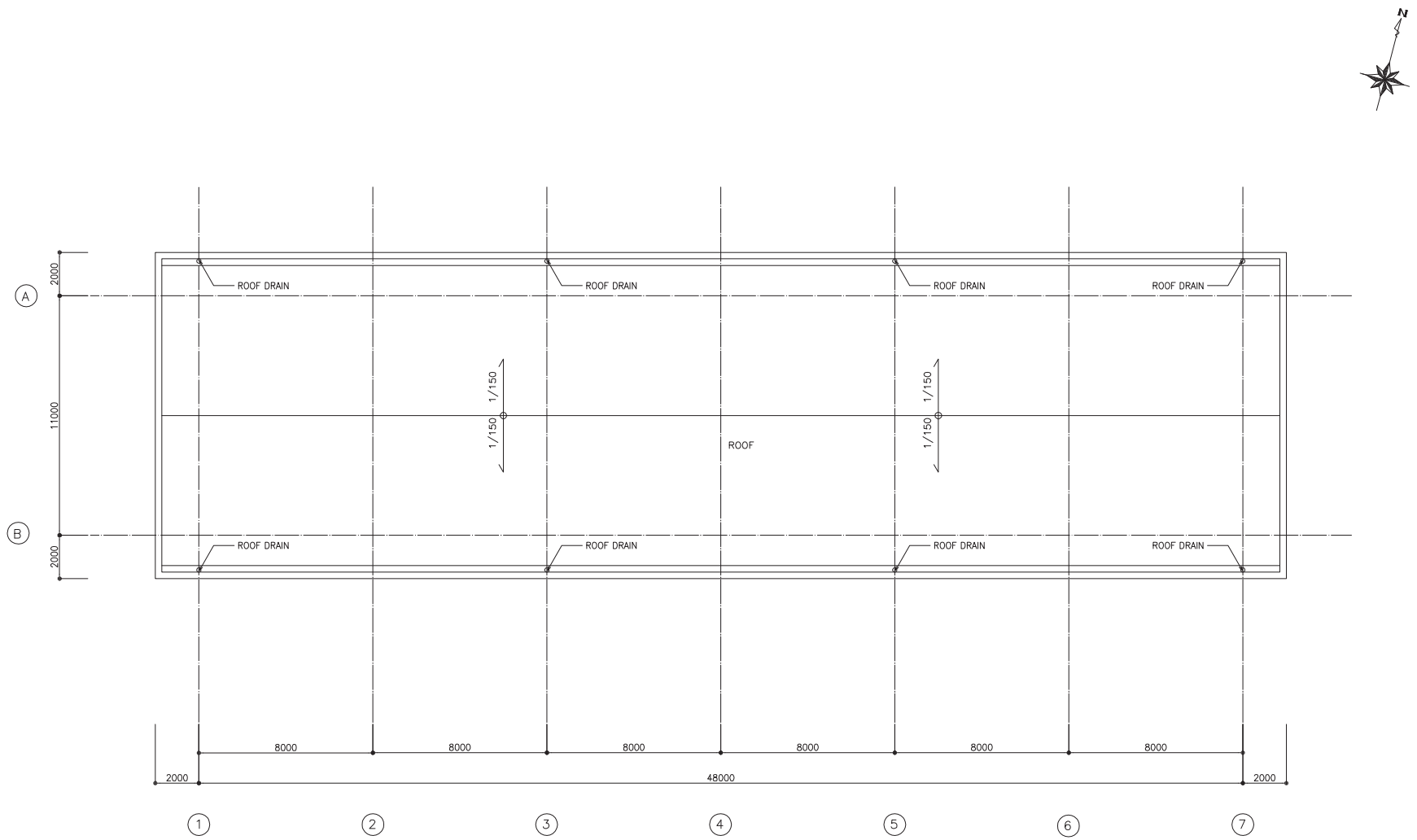
PLAN OF 1ST BASEMENT FLOOR

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟　地下1階平面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDING PLAN OF 1ST BASEMENT FLOOR	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-2	PREPARED BY : NONE
					DATE : JULY 2013



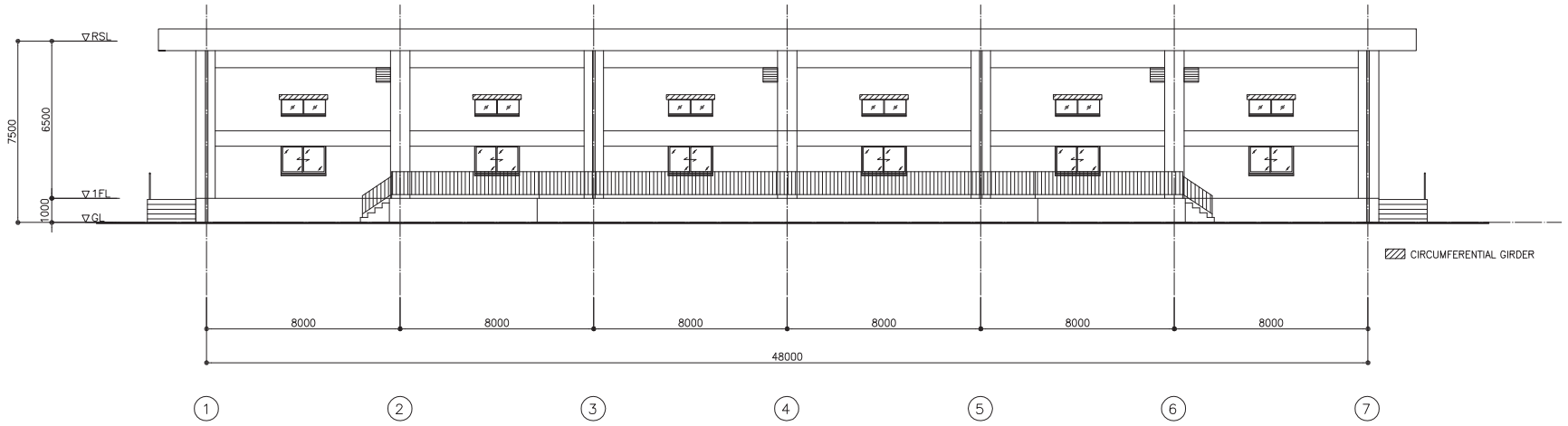
PLAN OF 1ST FLOOR

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟　1階平面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDING PLAN OF 1ST FLOOR	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-3	PREPARED BY : NONE
					DATE : JULY 2013

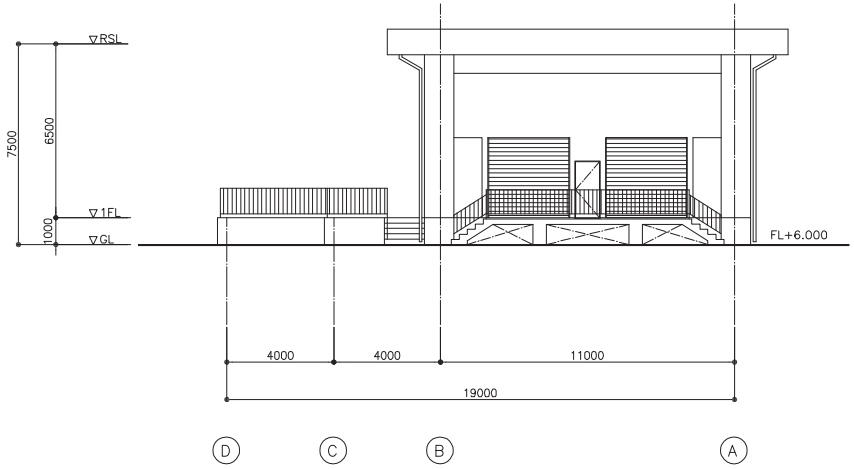


PLAN OF ROOF FLOOR

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟　屋根平面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDING PLAN OF ROOF FLOOR	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG−4	PREPARED BY : NONE
					DATE : JULY 2013

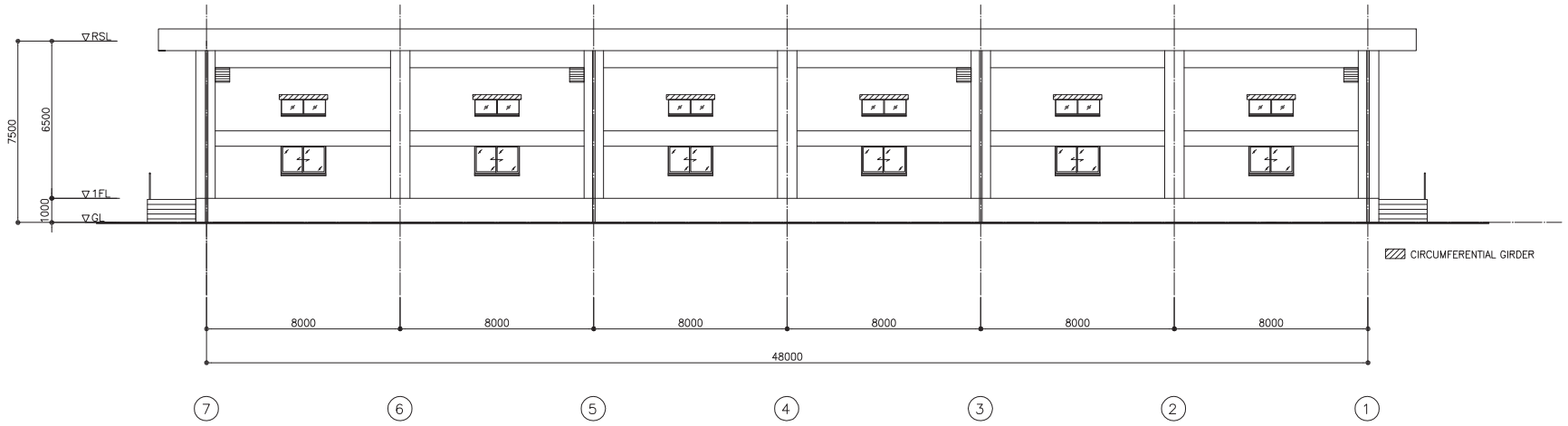


SOUTH ELEVATION

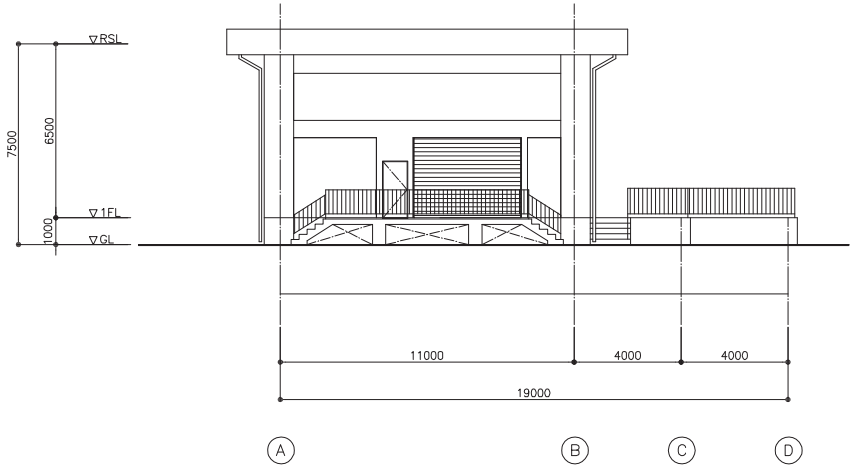


EAST ELEVATION

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟　南、東立面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDING ELEVATION OF SOUTH AND EAST	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-5	PREPARED BY : NONE
						DATE : JULY 2013

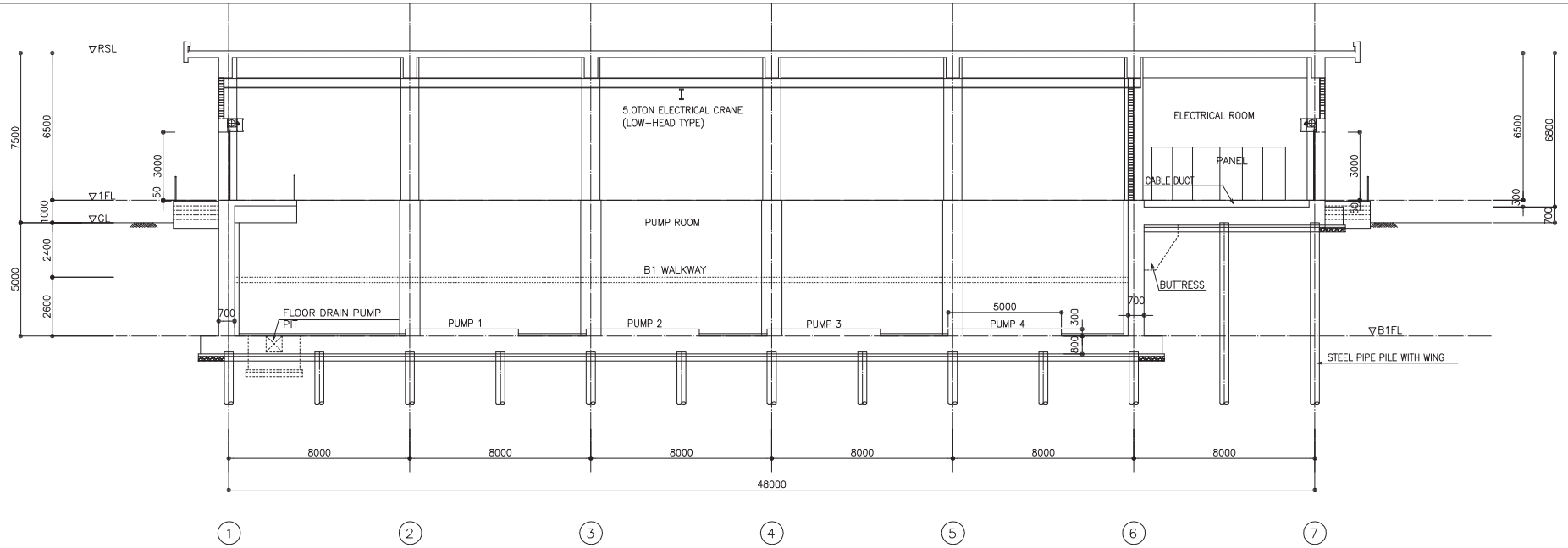


NORTH ELEVATION

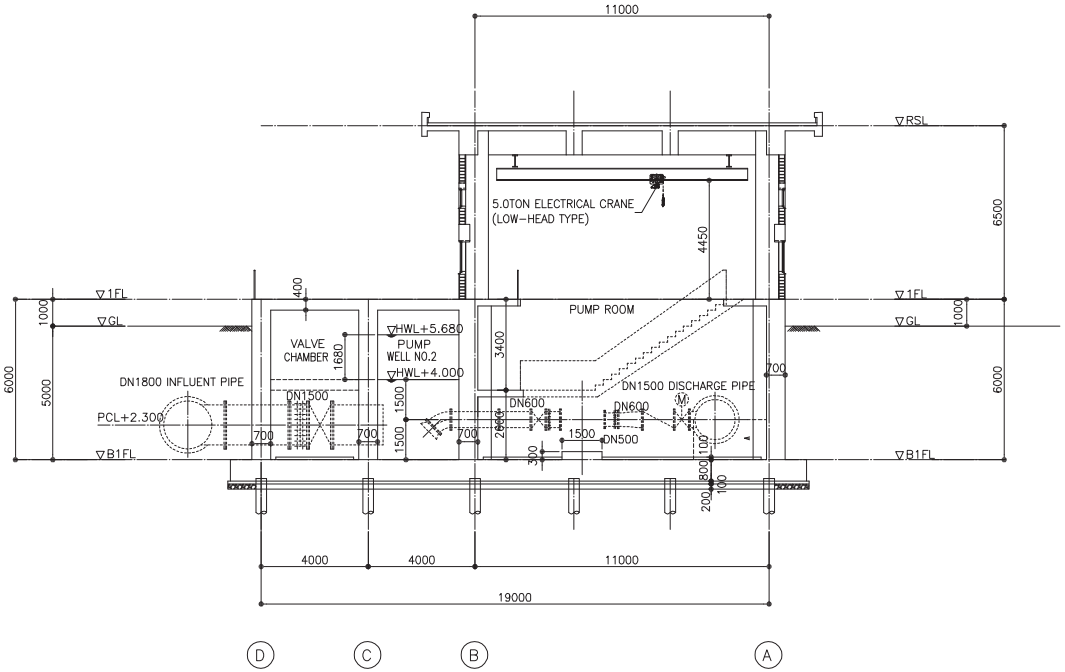


WEST ELEVATION

REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟 北、西立面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDING ELEVATION OF NORTH AND WEST	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-6	PREPARED BY : NONE
					DATE : JULY 2013

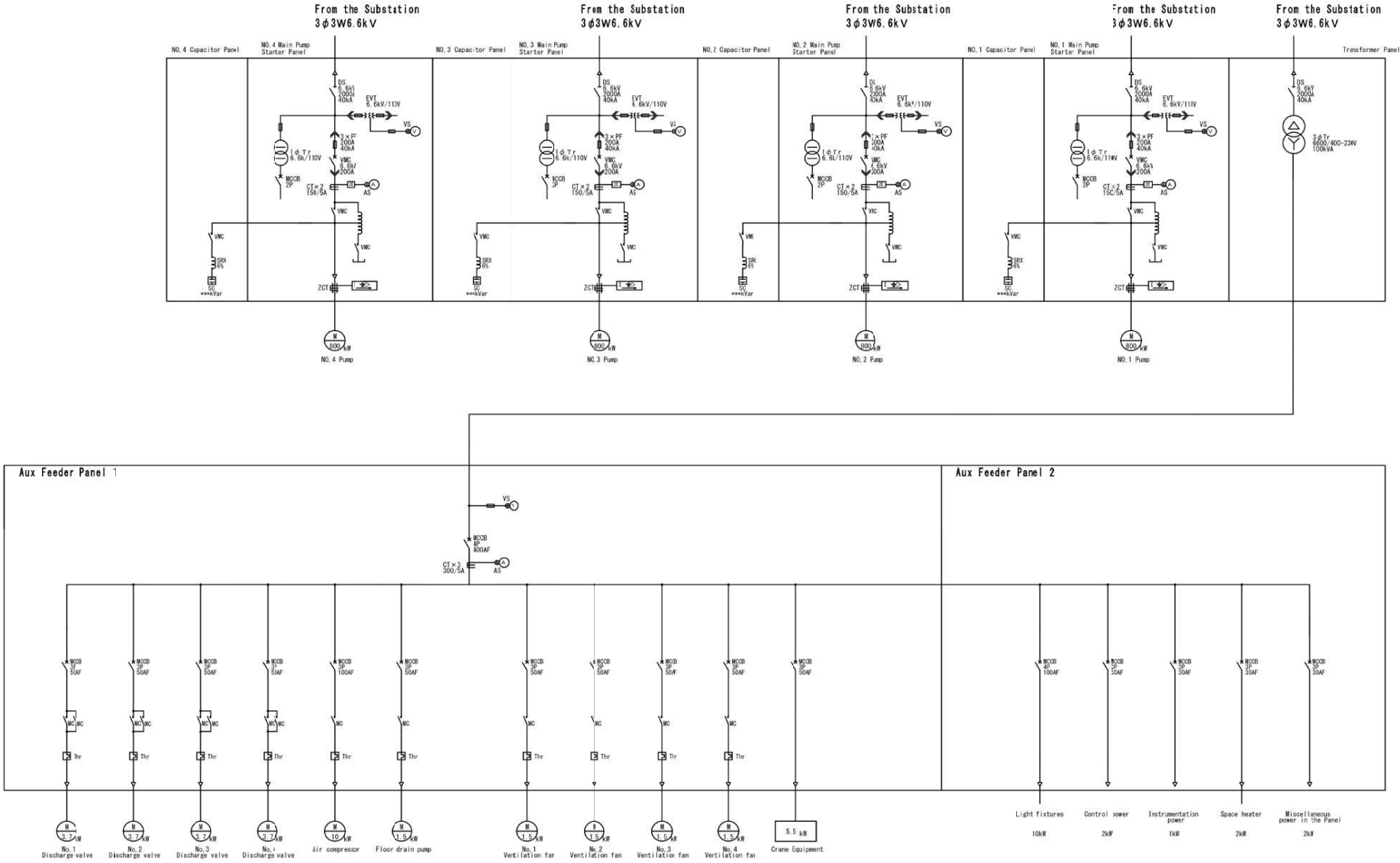


SECTION A – A

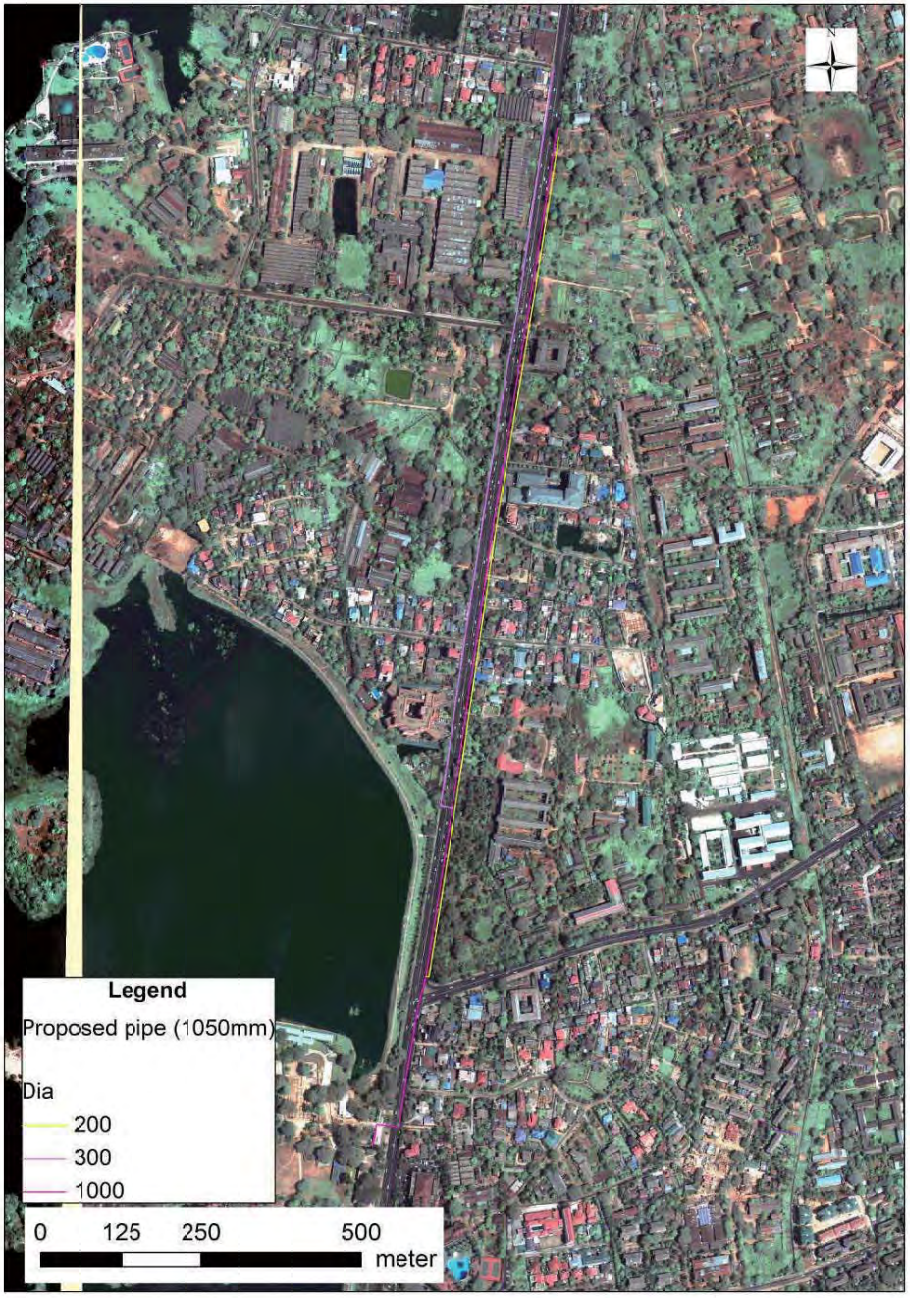


SECTION B – B

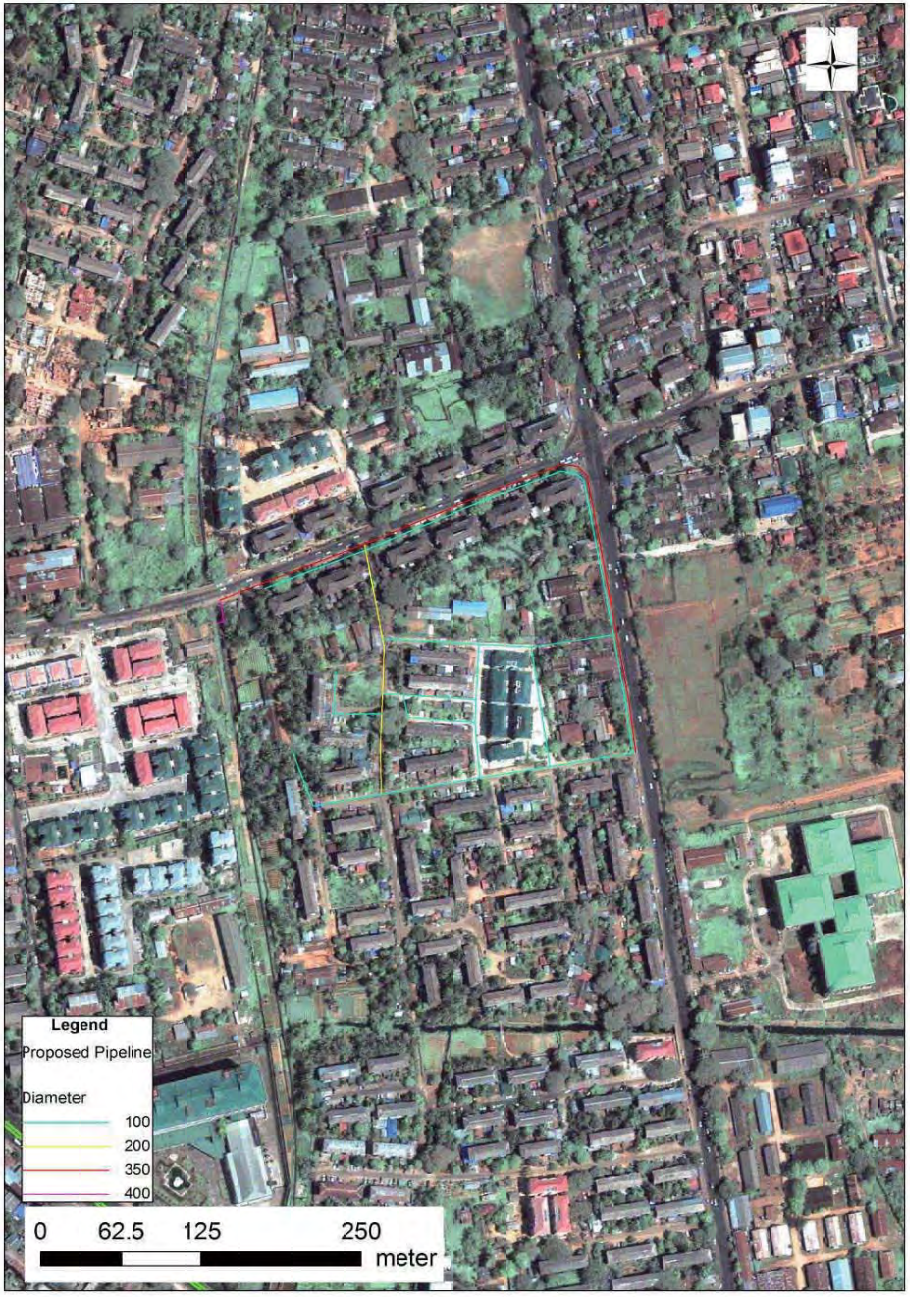
REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ニャウフナッピン第一期浄水場送配水ポンプ棟送配水ポンプ棟　断面図 NYAUNGHNAPIN FIRST PHASE WATER TREATMENT PLANT PUMP STATION BUILDINGSECTION	SCALE : S=1:200	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-7	PREPARED BY : NONE
					DATE : JULY 2013



REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA	JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : 単線結線図 ELECTRICAL SINGLE LINE DIAGRAM	SCALE : NONE	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-8	PREPARED BY : NONE
						DATE : JULY 2013



REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : コカイン配水池からの外口径1,050mm配水管平面図 PLANE OF DISTRIBUTION PIPELINE WITH OUTER DIA. 1,050mm FROM KOKINE SERVICE RESERVOIR	SCALE : NONE	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-9	PREPARED BY : NONE
					DATE : JULY 2013



REMARKS :	THE PREPARATORY SURVEY ON THE PROJECT FOR URGENT IMPROVEMENT OF WATER SUPPLY SYSTEM IN YANGON CITY IN THE REPUBLIC OF THE UNION MYANMAR	JICA JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	TITLE : ヤンキンタウンシップ内パイロットエリア配水管平面図 PLANE OF DISTRIBUTION PIPELINE IN PILOT AREA IN YANKIN TOWNSHIP	SCALE : NONE	APPROVED BY : NONE
	YANGON CITY DEVELOPMENT COMMITEE (YCDC) THE REPUBLIC OF THE UNION MYANMAR	TEC INTERNATIONAL CO., LTD. JAPAN		DRAWING NO. : DWG-10	PREPARED BY : NONE
					DATE : JULY 2013

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

This project will be implemented in accordance with the framework of Japan's grant aid scheme. Following approval by the Governments of Myanmar and Japan, the Exchange of Notes (E/N) will be signed to initiate the actual implementation process of the project. Subsequently, Yangon City Development Committee (YCDC); the implementation agency of the Government of Myanmar, will conclude a contract with a Japanese consultant and construction company, and the detail design and construction work will be implemented.

Considering the framework of grant aid and the content of construction of facilities, the construction plan will be formulated for the project to which aid is applicable, in accordance with the basic guidelines below.

(1) Project Implementing Entity

The responsible organization in Myanmar for the implementation of this project will be the Yangon City Development Committee (YCDC). The department responsible for water supply and sanitation sectors in YCDC is the section in charge.

(2) Consultant

The Japanese consultant company will conclude an agreement with the project-implementing agency of the Government of Myanmar, and will perform the detail design and construction supervision. The consultant will also prepare the tender documents, examine the tenderer's qualifications, and assist in the tendering work for selecting the contractor by open tender. After the start of construction of the facilities, the consultant will supervise the construction from an objective standpoint and also ensure that the grant aid is being appropriately utilized.

(3) Contractor

In accordance with the framework of Japan's grant aid scheme, the Japanese contractor selected through open tendering will carry out the construction of facilities. As the construction work is to be performed at a remote site quite different from the social environment and social background in Japan, the contractor is required to possess adequate capability to complete the work overseas. Furthermore, since this project requires the use of locally-procured materials and equipment, and work in congested urban areas, the contractor shall be adequately aware of the local market, local labor laws, the geography of the place, and the local customs and acceptable practices.

The contractor will maintain a proper communication system even after handing over the facilities after completion of the project since after sales services such as response to breakdowns and procurement or replacement parts will be necessary during maintenance and management after completion of the project.

2-2-4-2 Implementation Conditions

The precautions to be taken related to the formulation of the construction plan are as given below.

(1) Construction Plan considering Rainy Season

The annual rainfall of Yangon is approximately 2,300mm. Most of rainfall is observed during the rainy season from May to October, while almost no rainfall is observed during dry season from October to April. Interruption of pipe laying work is expected by water flowing into the excavated trench in rainy season. Therefore, trench work in rainy season shall be carried out with care and consideration shall be given to include drainage equipment and drainage method.

(2) Pipe Laying Work

The routes for pipe laying include main roads and service roads where the traffic is busy; thus, third-party safety measures, measures against effects of traffic, and measures against existing buried objects become important. Considerations are necessary for preventing any adverse effects on the activities of the local industries and businesses as far as possible. Trenchless technique by lead-pipe jacking method is utilized for the crossing of Kabar Aye Pagoda Street, heavily-trafficked main road, considering influence to the traffic.

In order to advance the construction work smoothly, careful attention should be paid to such arrangements, as explanations on the construction to the neighboring people as well as applications for permission from the governmental authorities to the construction, and these activities should be finished up before the construction starts. In regard to locations for pipe laying, there is a need to check up on existing situations of the construction sites and on the existing data, when the construction starts, and to re-verify the locations by trial excavation, as required.

As volume of pipe materials is considerable, those materials should be procured on divided lot basis, in consideration of available storage space at site. Especially ductile cast iron pipes are imported, thus, those materials should be timely ordered so that there is no trouble in obtaining storage sites and there would be no interruption in construction work because of materials-shortage, under constant checking up of both progress of construction and volume of stocks.

2-2-4-3 Scope of Works

The scope of works by Japan and by Myanmar is shown in Table 2-13.

Table 2-13 Demarcation of Construction Works of Facilities between Two Countries

Construction/Procurement & Installation	Japan	Myanmar
1. To secure land		●
2. To clear, level and reclaim the site when needed		●
3. To construct gates and fences in and around the site		●
4. To construct the parking lot	●	
5. To construct roads		
(1) Within the site	●	
(2) Outside of site		●
6. To construct the building	●	

Construction/Procurement & Installation	Japan	Myanmar
7. To provide facilities for the distribution of electricity, water supply		
(1) Electricity		
a. The distributing line to the site		●
b. The drop wiring and internal wiring within the site	●	
c. The main circuit breaker and transformer	●	
(2) Water supply		
a. The city water distribution main to the site	●	
b. The supply system within the site (receiving and/or elevated)		●
(3) Drainage		
a. The city drainage system (for storm, sewer and others) to the site		●
b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
(4) Gas supply		
a. The city gas main to the site		●
b. The gas supply within the site	●	
(5) Telephone System		
a. The telephone trunk line to the main distribution frame / panel (MDF) of the building		●
b. The MDF and the extension after the frame / panel	●	
(6) Furniture and Equipment		
a. General furniture		●
b. Project equipment	●	
8. To bear the following commissions to a bank of Japan for the banking services based upon the B/A		
(1) Advising commission of A/P		●
(2) Payment commission		●
9. To ensure prompt unloading and customs clearance at the port of disembarkation in recipient country		
(1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
(2) Tax exemption and custom clearance of the products at the port of disembarkation		●
(3) Internal transportation from the port of disembarkation to the project site	●	
10. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
11 .To except Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
12. To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant Aid		●
13. To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the construction of the facilities as well as for the transportation and installation of the equipment		●

2-2-4-4 Construction Supervision Plan

This Project will be implemented by the system of the Japanese cooperation of grant aid. The Consultant will carry out detail design, construction supervision and soft component for implementation of the Project.

(1) Detail Design

The consultant makes detail design, prepares the tender documents, and prepares the documents required for the project implementation.

(2) Tender

The consultant will assist YCDC so that a tender-bidding may be carried out fairly and smoothly.

(3) Construction Supervision

The consultant will carry out, assisting YCDC, such works as instructions/supervisions of contractors, focusing on progress-control and quality-control through staff-meetings before the start of construction, factory-inspections of materials/machines, witnessing of transportation at the local site, inspections of construction works as well as equipment installations when they are installed, trial operations, completion inspections and so on. The Consultant will share the responsibility for completing the construction of the facilities complying with the required qualities and specifications within the construction schedule prescribed in G/A.

2-2-4-5 Quality Control Plan

The consultant dispatches the staff as a resident supervision engineer, prepares construction supervision guideline based on quality control plan, and implements quality control, progress control and safety/environmental control. The main items of quality control for site construction are described below.

- Concreting work: Material test (aggregate/cement), Mixing test, Strength test and Slump test
- Reinforcement: Tensile test and Bending test (factory shipment certificate)
- Pipe laying work: Hydraulic pressure test
- Road work：Material test, Density test and Asphalt test
- Mechanical work: Installation inspection and Actual operation test
- Electrical work: Insulation resistance test and Sequence interlock test

2-2-4-6 Procurement Plan

In this project, materials and equipment are procured from Myanmar, third countries and Japan. The scheduled procurement countries of main materials and equipment procured in the project are shown in Table 2-14.

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Table 2-14 Procurement Plan for Main Materials and Equipment

	Myanmar	Japan	Third Country
Cement	○		
Aggregate	○		
Reinforcing bars	○		
Fuel (gasoline/diesel)	○		
Form work materials	○		
Ductile cast iron pipe		○	○
u-PVC pipe	○		
HDPE pipe	○		
Painted Steel pipe		○	○
Valves		○	○
Water meter		○	○
Screw steel pipe pile with toe wing		○	
Base course	○		

Asphalt	○		
Scaffolding and support materials	○		
Sheet pile and earth retaining materials		○	○
Mechanical equipment (pump)		○	○
Electrical equipment (panel)		○	○
Monitoring and instrumentation		○	○

Materials and equipment procured from third countries and Japan will be unloaded at Thilawa port and transported over land to the site. Thilawa port is the international port which was newly developed in Thilawa district which is located on the east coast of Yangon River and 25km south of Yangon city. Construction materials are unloaded mainly at Thilawa port since Thilawa port has more serviceable facilities and bigger ships can enter port compared to Yangon port. It takes about a week to arrange for custom clearance at Thilawa port. Distance from Thilawa port to the stock yard at Yankin Township is about 35km, while distance to Nyaunghnapin First Phase WTP is about 66km.

2-2-4-7 Operational Guidance Plan

The contractor implements the operational guidance regarding the facilities constructed in the project. The instruction will be carried out based on the operation and maintenance manual in English before handing over the facilities. Engineers of the contractor will implement the instruction regarding pumps and monitoring system after trial operation and adjustment. Contents of the operational guidance for the facilities are summarized in Table 2-15.

Table 2-15 Contents of Operational Guidance

Facility	Content of Guidance
Pump Station in Nyaunghnapin First Phase WTP	・ Instruction of operating pumps (normal and abnormal conditions) ・ Handling of incidental facilities (valves, instrumentation, panels etc.) ・ Inspection and repair of mechanical equipment (pumps, valves etc.) ・ Inspection and repair of electrical equipment (operating panels, transformer etc.) ・ Inspection and repair of instrumentation (level meter, flow meter etc.) ・ Inspection and maintenance of pump suction well
Water Distribution Pipeline in Yankin township	・ Instruction on operation of monitoring system ・ Instruction on inspection and repair of monitoring system ・ Instruction on maintenance work (inspection, dismantling and repair) for valves (isolation valve, air valve, drain valve)

The instruction and training on operation of the monitoring system are given by the contractor. Furthermore the instruction on water distribution control of the distribution pipeline network is given through the soft component.

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

(1) Study Guideline for Soft Component Plan

If this grant aid Project is implemented, water supply system which can apply effective Non-Revenue Water Control is completed. The characteristic of this water supply system is described below.

1) Distribution system is restructured and distribution zones are made clearly, then, distribution water pressure is able to be controlled appropriately
2) It is possible to manage water supply pressure.
3) Water flow meters are installed in the inlet of each distribution zone and it is possible to monitor distribution water flow and manage the system.

Currently water supply has been implemented based on the YCDC's experience; however, by Grant Aid Project, distribution system is restructured and distribution zones are made clearly, then, distribution water pressure is able to be controlled appropriately. Additionally, tabulation and analysis of distribution water flow by using obtained data from distribution facilities and equipment and understanding of Non-Revenue Water (NRW) by comparison to other data have not been implemented and it is necessary to improve skills for understanding of distribution condition appropriately. In this regard, the acquisition of basic technology toward to improvement of NRW is targeted.

(2) Necessity of Introducing Soft Component

1) Problems in Non-Revenue Water management and water distribution management

The problems in non-revenue water management and water distribution management for the target zones are described below.

a) Since the water transmission and distribution system is not appropriate, non-revenue water management and distribution management are not effective.
b) Water distribution management skills are lacking.
- Water distribution data management skills are lacking.

Of the above, a) will be improved by construction of facilities (hard component) in Japanese grant aid project. b) is likely to remain as a topic for improvement; therefore, it will be supported by soft components for improving the skills. Causes of lack of water distribution management skills include inability to manage distribution pressures in distribution zone, inability to adopt preventive measures for water leakage, and inability to propose and implement plans for non-revenue water management. Furthermore, as a consequence, other causes include inappropriately high supply pressure, frequent leakage accidents, existence of unsatisfactory water supply areas, high leakage ratio and non-revenue water ratio, inability to distribute water fairly. Finally, sound development of the water supply works is being hindered.

2) Necessity and role of soft component

In this project, new water transmission and distribution system will be built. However, the implementation effects of this plan cannot be demonstrated continuously and to the maximum extent if daily distribution control of each water distribution zone, management and utilization of water distribution data, periodic renewal of distribution pipeline network data, maintenance and renewal of appropriate distribution networks are not continuously implemented. The existing technical skills of

Department of water supply and sanitation in YCDC are not sufficient for implementing such work continuously. Therefore, the staff of the implementing organizations in Myanmar (Department of water supply and sanitation in YCDC) should be trained and their water distribution management skills should be upgraded.

Moreover specifically, a system of distribution zoning, and recording and transmitting of the distribution amount (including water pressure to some extent) to Department of water supply and sanitation in YCDC or related office will be constructed. This system is to be used to support transfer of technology so that non-revenue water and distribution management including leakage management can be effectively implemented.

3) Objectives of soft component

The objectives of soft component are to upgrade skills in Department of water supply and sanitation in YCDC for distribution management.

4) Output of soft component

The outputs and activities of soft component are shown below. Through this soft component, YCDC will be able to analyze distribution data which is obtained in real time by monitoring system installed, and calculate non-revenue water mount. Meanwhile the sustainability of distribution condition will be improved by construction of new water supply facilities as a hardware countermeasure. As a result of it, the adequate water distribution management can be achieved.

Output1: Hydraulic conditions of water transmission and distribution systems can be better understood.
- Analysis and utilization of distribution data

Output2: Water transmission and distribution data can be utilized in managing water distribution management and non-revenue water management.
- Using the data in water distribution management and non-revenue water management

5) Confirmation of Achievement

Table 2-16 shows confirmation method of achievement of soft component. The number of target trainees is 10 from YCDC south region sales office, Yankin Township office and pipeline management sector (east), and the technical support will be given to trainees and the goal is that all trainees pass all performance indicators.

a) Distribution management data

In the field of distribution management data, firstly, water flow, pressure and residual chlorine data collected by the installed monitoring system are checked. Moreover, it is checked if trainees understood that importance of monitoring system and operation and maintenance of its work. According to the result of tabulation, it is checked if trainees can understand the variety of daily distribution condition. The acquisition level of utilization method of distribution network model formulated by consultant and its

simulation method is checked and case study which is assumed the case that installed pipe is replaced, is conducted and the result of distribution network formulation is examined.

b) Distribution management

Distribution data tabulated in the b) and the charged water amount collected daily (Metered water) is compared and it is judged if trainees can calculate non-revenue water amount. The collection method of data is also judged.

Table 2-16 Confirmation method of output of soft component

Field	Output	Confirmation items of achievement
Distribution management data	Hydraulic conditions of water transmission and distribution is understood.	Trainees can understand the importance of monitoring work on operation and maintenance. Trainees can collect, tabulate, analyze and chart the required distribution data appropriately. Trainees can understand the result of tabulation
Distribution management	Distribution data is utilized for distribution management and non-revenue water control.	Trainees can calculate non-revenue water amount by comparison between distribution data and charged water amount (Metered water).

6) Activities of soft component

Table 2-17 shows the contents of the detailed activity.

Table 2-17 Contents of the detailed activity for soft component

No.	Items	Input	
		Japanese side	No. of trainees for Myanmar side
1)	Preparation		
①	Domestic preparation (1 expert)		
D-1	Preparation of transfer of technology plans	1 man×1 day＝1 man-day	―
D-2	Test preparation, questionnaire preparation, training text (draft) Preparations	1 man×4 days＝4 man-day	―
	Passage	1 man ×1 day＝1 man-day	―
②	Implementation preparations and introductory technical briefing (1 expert)		
②-1	Training room establishment, C/P meeting, implementation preparations, briefing preparations	1 man×4 days＝4 man-day	2men×4 days＝8 man-day CE andACE
②-2	Selection of trainees (pre-test training, questionnaire, evaluation, selection)	1 man×3 days＝3 man-day	2 men×3 days＝6 man-day
②-3	Implementation briefing	1 man×1 day＝1 man-day	20 men×1 day＝20 man-day
Sub total		**14 man-day**	**34 man-day**
2)	Water distribution management data (Distribution management expert 1)		
①	Analysis and utilization of water distribution data		
①-1	Purpose of collection of distribution water data and introduction of its equipment, and explanation of	1 man×2 days＝2 man-day	10 men×2 days＝20 man-day

No.	Items	Input	
		Japanese side	No. of trainees for Myanmar side
	normal and abnormal data (Explanation of water flow meter, water pressure gauge and residual chlorine meter (class))		
②-2	Collection of water distribution data (Explanation of data collection method of water flow transferred to monitoring equipment and data acquisition method (class and practice))	1 man×3 days＝3 man-day	10 men×3 days＝30 man-day
③-3	Analysis and utilization of water distribution data (Analysis of variety of hour, day and season for water flow and water pressure collected (class and practice))	1 men×2 days＝2 man-day	10 men×2 days＝20 man-day
Sub total		**7 man-day**	**70 man-day**
3)	Water distribution management (Distribution management expert1)		
①	Using data for water distribution management and non-revenue water control (Explanation of management for water flow and water pressure based on evaluation result of distribution water and analysis of non-revenue water comparing with collected water tariff data (class and practice))	1 man×2 days＝2 man-day	10 men×2 days＝20 man-day
Sub total		**2 man-day**	**20 man-day**
4)	General report (1 expert)		
①	Technology transfer seminar		
①-1	Technology transfer seminar preparations	1 man×2 days＝2 man-day	10 men×2 days＝20 man-day
①-2	Technology transfer seminar	1 man×1 day＝1 man-day	20 men×1 day＝20 man-day
②	Preparation of reports and provision of manual		
②-1	Soft component evaluation	1 man×1 day＝1 man-day	―
②-2	Preparation and submission of general report	1 man×1 day＝1 man-day	―
Sub total		**5 man-day**	**40 man-day**
	Passage	**1 man-day**	―
Total		**29 man-day**	**164 man-day**

To ensure that the training is successful, the trainees need to have appropriate knowledge beforehand. YCDC and Japanese consultant must select the trainees carefully. The following are the necessary conditions for selection of trainees:

① Should have experience in water distribution management
② Should be familiar with basic operations of the computer
③ Should be familiar with basic operations of basic software (MS-Excel and MS-Word)
④ Should be able to devote adequate time for training (at least 3 hours per day)
⑤ Should have interest in the training program

Since there is no training room in YCDC, it is necessary to ensure training space in the Yankin Township office or YCDC. YCDC bears travelling expense to the training place and daily allowance, if necessary.

7) Procurement method of implementation resources of soft component

In this soft component, distribution management experts (Japanese consultant) are dispatched for 1.13 months in the total and the training will be implemented by the type of direct support. The necessary qualifications of water distribution management expert to be dispatched to Myanmar are as below.

a) Has fully understood pipeline network hydraulics
b) Can establish transmission and distribution operation plan
c) Has the skills to manage training programs to Myanmar's side experts

The expert shall have language ability to communicate with Myanmar expert in addition to hydraulics knowledge and experience regarding establishment of transmission and distribution operation plan and understand the problems on operation and maintenance of transmission and distribution system in developing countries.

Moreover, as this soft component is implemented after the project work such as design in Japan, construction and construction supervision is completed, it is adequate that the experts belonging to Japanese consultant, who has the proper technology obtained through construction stage, implements the soft component. . Staff assignment plan is shown in Table 2-18.

Table 2-18 Staff Assignment Plan

Field	No. of persons	Belonging to	Description
Water distribution management experts	1	Japan	The water distribution management technology of Japan is to suit the technical level of the trainees and conditions on site. The following items are to be implemented: ・ Preparation of text for training, implementation of training ・ Preparation and evaluation of tests and homework reports ・ Provision of various formats ・ Implementation of seminars ・ Data collection, editing and modeling ・ Evaluation

8) Soft component implementing stages

The construction work of the facilities under this Project will be implemented in 15 months. The implementation of the soft component will require distribution amount and water pressure data measured in the planned facilities. Accordingly, the soft component will be implemented after facilities for which data can be collected are completed. The monitoring system can transmit distribution water flow and pressure data measured in DMA to the central monitoring station and the all staff in charge of the monitoring system are trained on the operation method of the computer system by Japanese supplier in OJT. The number of required man-days shown in the table of detailed activity plan is as given below. The implementation plan is shown in Table 2-19, while the detailed activity plan is shown in Table 2-20.

- No. of actual work days: 29 days (domestic preparations 5 days x 1 person = 5 man-days, on-site 24 days x 1 person = 24 man-days)
- Equivalent man-months: Domestic preparation time: 0.47 MM X 1 persons = 0.47MM, dispatch period: 1.13MM x 1 person=1.13 MM (24 days x (7/5) 1persons=34 man-days, 34/30=1.13MM)

Table 2-19 Implementation Plan of Soft Component

No	Activities	Japan	In Myanmar 1st month	In Myanmar 2nd month
1)	Preparations			
①	Domestic preparations			
②	Implementation preparations and introductory technical briefing			
2)	Water distribution management data			
①	Analysis and utilization of water distribution data			
3)	Water distribution management			
	Using data for water distribution management and non-revenue water control			
4)	General report			
①	Technology transfer seminar			
②	Preparation of reports and provision of manual			

Table 2-20 Detailed Activity Plan

Main items	No.	Activity / Days	Total days	Domestic 1 2 3 4 5	1st month 1 2 3 4 5 6 7 8 9 #	2nd month #	Remark
1) Preparation							
	1)	Preparation					
	①	Domestic preparation (1 expert)					
	D-1	Preparation of transfer of technology plans	1				
	D-2	Test preparation, questionnaire preparation, training text (draft) preparations	4				
		Moving	1				
	②	Implementation preparations and introductory technical briefing (1 expert)					
	②-1	Training room establishment, C/P meeting, implementationpreparations, briefing preparations	4				
	②-2	Selection of trainees (pre-test training, questionnaire, evaluation, selection)	3				pre-test training, questionnaire
	②-3	Implementation briefing	1				Technical transfer plan report
		Sub total	14				
3) Water distribution management data							
	3)	Water distribution management data (Distribution management expert1)					
	①	Analysis and utilization of water distribution data					
	①-1	Introduction of purpose of collection of distribution water data and its equipment, and explanation of normal and abnormal data	2				
	①-2	Collection of water distribution data	3				
	①-3	Analysis and utilization of water distribution data	2				
		Sub total	7				
4) Water distribution management							
	4)	Water distribution management (Distribution management expert1)					
	①	Using data for water distribution management and non-revenue water control					
	①-1	Distribution control by using of water flow meter and pressure gauge	2				
		Sub total	2				
5) General report							
	5)	General report (1 expert)					
	①	Technology transfer seminar					
	①-1	Technology transfer seminar preparations	2				
	①-2	Technology transfer seminar	1				
	②	Preparation of reports and provision of manual					
	②-1	Soft component evaluation	1				
	②-2	Preparation and submission of general report	1				General report
		Sub total	5				
Moving							
		Moving	1				
		Total	29				

9) Outcomes

The following reports and outcomes are to be prepared and submitted:

Report & Outcomes	Description	Timing
Transfer of technology plan (in English)	Description, achievement target, detailed schedule, implementation method, etc. of soft component	At the start
Completion Report (in English with Japanese summary)	General report including description of transfer of technology, results of upgrading skills, training evaluation, transfer of technology manual and photo	At completion
Distribution data collection	Input distribution data	At completion
Manuals (in English and language of Myanmar)	Distribution data input and management manual	At completion
Others	Teaching records, outputs, training texts	At completion

10) Duties of Myanmar side

a) Feasibility

The department of water supply and sanitation in YCDC has realized the importance of operation and maintenance with utilizing of monitoring equipment in the future. Therefore, sustainability of this duty is basically secured. Moreover, this realization has been had by a chief engineer and a deputy chief engineer level; therefore, this realization is shared with staffs in south sales office, Yankin Township office and pipe management sector (east) who are the target trainees.

b) Factors causing obstacles and its countermeasures

The factor causing obstacles is reassignment of trainees. The countermeasure is to request to hold trainees in the same sector. However, in case that it is difficult to find time for additional working time due to daily duty, recommendation to YCDC is made so that trainees can be appointed as responsible persons for implementation of monitoring system operation.

c) Continual activities

In order to achieve the objectives of Soft Component, YCDC shall submit monthly distribution management report to decision maker based on the obtained contents.

2-2-4-9 Implementation Schedule

This Project is divided into two procurement lots consisting of the rehabilitation of pumping station in Nyaunghnapin First Phase WTP and renewal of distribution pipeline from Kokine reservoir to Mayangon Township, and the rehabilitation of water distribution pipeline in the pilot area in Yankin Township. Each lot is implemented as a single year project. The implementation schedule expected currently is shown in figure below.

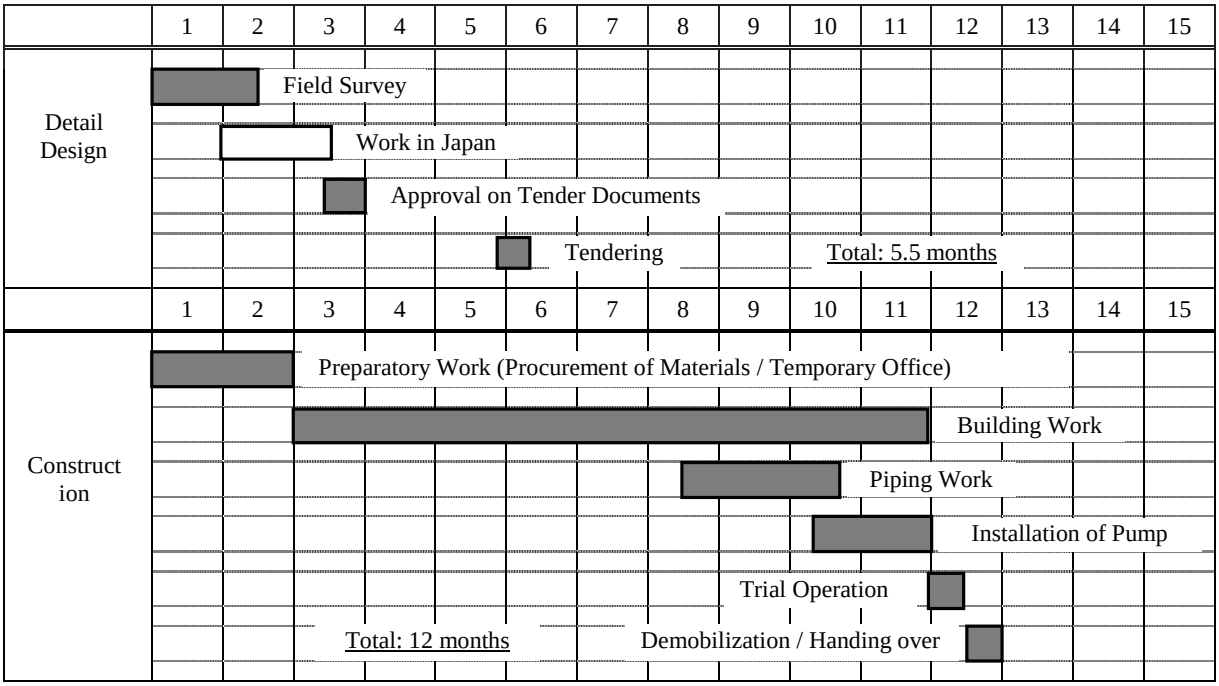

Figure 2-12　Implementation Schedule（Lot-1）

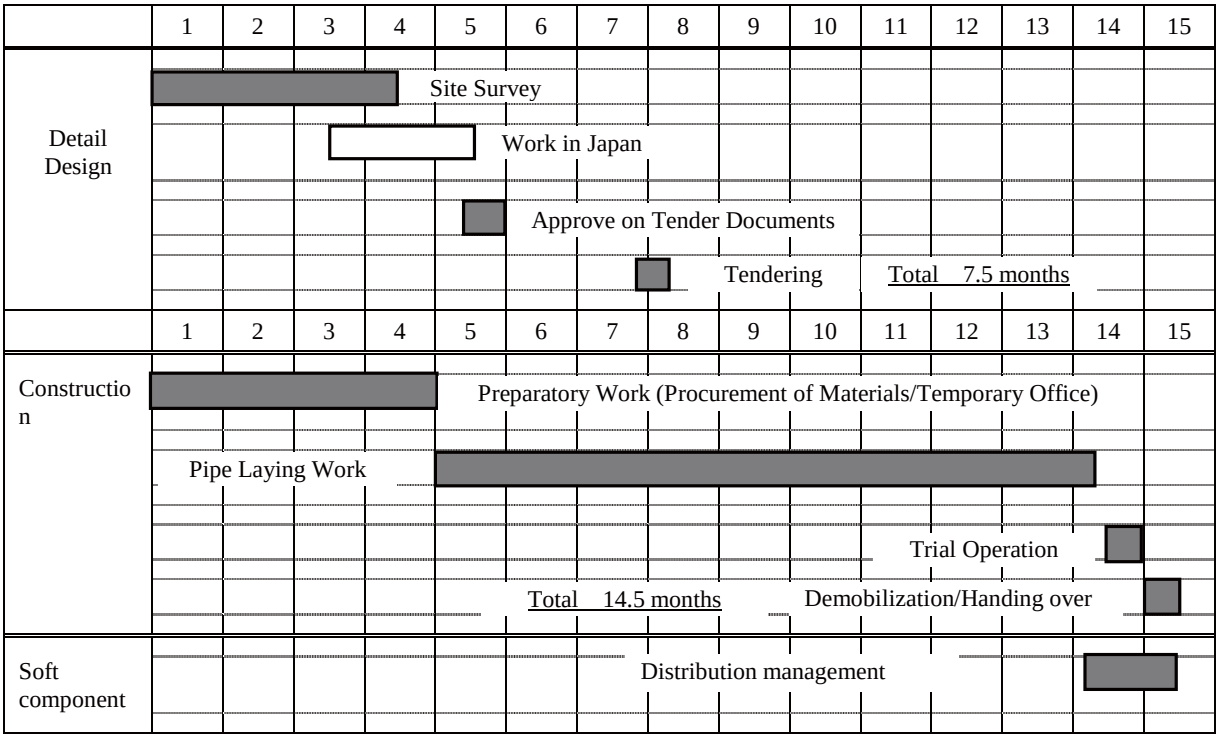

Figure 2-13　Implementation Schedule（Lot-2）

2-3 Obligations of Recipient Country

2-3-1 General Works

The general works to be done by Myanmar side are as follows;

① To provide data and/or documents necessary for the Project
② To secure safety for the project site and to provide general safety information
③ To make payment of commission for Banking Arrangements (B/A) and Authorization to Pay (A/P)
④ To carry out prompt unloading and custom clearance at the port of disembarkation in Myanmar for materials and equipment to be procured under this Project
⑤ To exempt Japanese nationals from custom duties, internal taxes and other fiscal levies which may be imposed in Myanmar with respect to the supply of the products and services under the verified contract
⑥ To bear all the expenses other than those to be borne by the Grant Aid and to secure YCDC engineers required to implement this Project

2-3-2 Particular Works for Project

The particular works for the Project to be done by Myanmar side, but not limited to, are as follows;

① To follow the procedure necessary inside YCDC to secure the material storage area in Yankin township (YCDC site)
② To follow the procedure necessary inside YCDC to get permission of using the public road in Yankin township and to notify it to the police office
③ To follow the procedure to get permission of use for communication system of the monitoring system in Yankin township
④ Allowance and Transportation fee of participants of Soft Component

2-4 Project Operation Plan

This Project is to renew the existing facilities. Accordingly the following operation and maintenance works for the facilities renewed can be done in the same way as the existing one;

① Operation and monitoring of the pump for Nyaunghnapin first phase WTP pump station
② Water distribution management for water transmission/distribution pipeline to Mayangon and water distribution pipeline in the pilot area in Yankin township

Currently the staffs of Nyaunghnapin 1st phase WTP do operation and maintenance work for the pump station. Therefore Nyaunghnapin 1st phase WTP has personnel and technical level capable of the maintenance work including pump failure cause determination, pump dismantling, pump assembling, pump adjusting, etc. As the renewed pump has the same type and capacity as the existing one and the operation and maintenance guidance is given the said staffs by the pump manufacturer's

engineer during the installation of the renewed pump, the said staffs can do operation and maintenance work subsequently and smoothly.

Meanwhile water distribution management work for water transmission/distribution pipeline to Mayangon and the existing water distribution facilities in Yankin township is done by the water distribution department, the south region sales office and Yankin township management office. They have personnel sufficient for the existing routine work.

DMA establishment and the monitoring work for water distribution data are added newly under this Project. This is installation of basic technology toward to improve NRW for activities in the pilot area and staffing and skills are sufficient even if new technology is added. Furthermore, it is expected that YCDC can do sustainable maintenance management work continuously by upgrading capability on the water distribution management by the soft component implemented under this Project

By the reason of the above, the operation and maintenance management for the facilities renewed can be made under the existing personnel and organization sufficiently

2-5 Project Cost Estimation

2-5-1 Estimated cost born by Myanmar Side

The costs borne by Myanmar side are estimated to be 21 thousand USD. The costs borne by Myanmar side are shown in Table 2-21.

Table 2-21 Cost Summary born by Myanmar Side

Total Estimated Cost: Approximately 21 thousand USD

Cost Item	Estimated Cost (USD)
Banking Arrangement (B/A) and Authorization to Pay(A/P) commission	21,458
Allowance and Transportation fee of participants of Soft Component	0.0

(1) Estimate Condition

1) Estimated date：March 2013
2) Exchange rate：1 US$＝89.71 yen
3) Construction period：The period of detail design and construction work is as per the implementation schedule
4) Others：Cost estimate is made in accordance with accuracy of Japanese Grant Aid Assistance.

2-5-2 Operation and Maintenance Cost

The difference of the operation and maintenance cost between the renewed facilities and the existing one when this Project is implemented is shown below.

① Nyaunghnapin First WTP Pump Station

Manpower cost: No change
Electrical power cost: No change (Pump capacity and motor output are the same: 800 kW)
Repair cost: As the facilities renewed is new, it is slightly cheaper than the existing one.
Depreciation cost: it is not required in YCDC's annual account, because the operation and maintenance cost for water supply system is included in the general account budget of the city.

② Water Transmission/Distribution Pipeline to Mayangon and the Existing Water Distribution Facilities in Yankin Township

Manpower cost: No change
Electrical power cost: No change (Electrical power consumption can be ignored because of little)
Repair cost: No change
Depreciation cost: it is not required in YCDC's annual account, because the operation and maintenance cost for water supply system is included in the general account budget of the city.

YCDC includes the annual operation and maintenance cost for the water supply and sewerage system in the budget in a lump. The actual cost in year 2011/2012 is approximately 4,467 million Kyat. As it is expected that this budget is not changed even if this Project is implemented, there is no problem for the budget.

CHAPTER 3 PROJECT EVALUATION

3-1 Preconditions

The tax exemption to the Grant Aid Project in Myanmar is implemented by the method of duty exemption letter. YCDC shall communicate with relevant organizations and take procedure of tax exemption without any delay.

3-2 Necessary Inputs by Recipient country

In this Project, DMA is set in the distribution network in Yankin Township and monitoring system using computer system is installed. The appropriate YCDC staff with skills regarding computer knowledge is dispatched for operation of monitoring system

3-3 Important Assumptions

The items mentioned below are considered as important assumptions regarding Project impact expression and sustainability.

- The policy regarding water sector in Myanmar is not changed
- The portion of foreign currency in this Project is 30%. Currently, the exchange rate is rapidly fluctuated and the implementation of the Project is difficult situation in the case that the trend of depreciation of yen is continued.

3-4 Project Evaluation

(1) Relevance

The project is expected to contribute to the improvement of living environment of inhabitants through improvement of water supply conditions due to urgent rehabilitation of water supply system required in Yangon city where rapid economic development is expected. The appropriateness of Project is high in order to meet two out of three (3) Japanese Assistance Policy for Myanmar (April 2012), that is; “Assistance for the improvement of the lives of the citizenry” and “Assistance for the improvement of the infrastructure system required for sustainable economic growth”.

(2) Effectiveness

・Quantitative Effects

The water supply condition is improved by implementation of the Project as shown below.

Index	Base Year (2011)	Target Year (2016)
The period of water supply (hr./day) (650 thousand persons to be supplied water from the Pump Station in Nyaunghnapin First Phase Water Treatment Plant	16.5	24
The period of water supply (hr./day) (50 thousand persons to be supplied water from Kokine Reservoir to Mayangone Township)	16.5	24
Water leakage ratio in Yankin Township (%)	50	10

・Qualitative Effects

The accident of water pipeline bursting is expected to decrease by renewal of 1000mm ϕ water distribution pipeline from Kokine reservoir. Accordingly, the traffic blockage decreases and traffic jam is reduced.