DEPARTMENT OF POTABLE WATER SUPPLY,
MINISTRY OF INDUSTRY AND HANDICRAFT (DPWS-MIH)
KINGDOM OF CAMBODIA

PREPARATORY SURVEY REPORT
ON
THE PROJECT FOR
EXPANSION AND IMPROVEMENT OF WATER SUPPLY SYSTEM
IN KAMPOT AND SIHANOUK VILLE
IN
THE KINGDOM OF CAMBODIA

MARCH 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIHON SUIDO CONSULTANTS CO., LTD.
WATER AND SEWER BUREAU, CITY OF KITAKYUSHU

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PREFACE

Japan International Cooperation Agency (JICA) decided to conduct the preparatory survey and entrust the survey to Consortium consist of Nihon Suido Consultants Co., Ltd. and Water and Sewer Bureau, City of Kitakyushu.

The survey team held a series of discussions with the officials concerned of the Royal Government of Cambodia, and conducted a field investigations. As a result of further studies in Japan, the present report was finalized.

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

Finally, I wish to express my sincere appreciation to the officials concerned of the Royal Government of Cambodia for their close cooperation extended to the survey team.

March, 2015

FUWA MASAMI
Director General,
Global Environment Department
Japan International Cooperation Agency

Summary

1. Overview of the Kingdom of Cambodia

(1) Natural Conditions

The total landmass of the Kingdom of Cambodia (hereinafter referred to as Cambodia) is approximately 181,000 km^2 (a little less than the half of Japan's total area). The Mekong River traverses the country from north to south, crossing the boundary with Lao PDR in the north. Tonle Sap Lake and a number of river systems are the dominant features forming the Central Plains which cover three quarters of the country. The Tonle Sap River runs off Tonle Sap Lake and joins with the Mekong River at the capital, Phnom Penh. To the north and northeast, near the boundaries with Viet Nam and Lao PDR, are mountain ranges with dense virgin forests and diverse wildlife. According to the 2013 census, Cambodia has an estimated population of 1,468,000.

Cambodia, lying entirely within the tropics, has a hot and humid climate, which is divided into wet (June to October) and dry (November to May) seasons. Severe heat occurs in the second half of the dry season (February to April) and the day time temperature can rise to 35 to 40°C. The annual average precipitation is 1,584 mm.

(2) Socio Economic Conditions

Cambodia's Gross Domestic Product (GDP) per capita was 1,088 USD in 2014, according to the International Monetary Fund (IMF). This is relatively low in comparison to other countries in the region. Cambodia is still classified as one of the Least Developed Countries, with 36% of the labor force engaged in the primary sector of the economy, 23% and 41% in the secondary and tertiary sectors respectively. During the past ten years, Cambodia has enjoyed much more political stability and territorial unity than previous decades. The country has been experiencing significant economic growth. The average annual growth rate of GDP was > 10% for four consecutive years from 2004 to 2007. Economic growth stalled in 2008 as a result of the worldwide financial crisis, falling to 0.1% in 2009, but recovering to 6.0% in 2010. The integration with the regional and world economies has been strengthening the country's economic condition since the accession to the Association of Southeast Asian Nations (ASEAN) in 1999 and the World Trade Organization (WTO) in 2004.

Although the population below the poverty line has fallen from over 50% in 2004 to around 20% in 2011, Cambodia still has a high percentage of poor people. Poverty reduction continues

to be an important priority. It is understood that comprehensive growth based on diversified industrial activities and productivity improvement is central to the promotion of income opportunities for the poor.

2. Background of the Project

The Royal Government of Cambodia (RGC) is committed to the development of the water supply sector. In February 2003, the National Policy on Water Supply and Sanitation set the goal that “Everyone shall have sustained access to safe water supply and sanitation services and shall live in a clean, healthy and sustainable environment”. The National Strategic Development Plan (NSDP) aims to boost the urban area access to safe water to 80% by 2015. The latest NSDP (2014-2018) states that the access to safe water should be 100% by 2025.

After the civil war, with the support of the government of Japan (GOJ) and other donors, water supply capacity in Phnom Penh and major eight cities such as Siem Reap, has improved with the construction and rehabilitation of water supply facilities and related capacity building for operation and maintenance. The water supply capacities in other cities are still inadequate and not everyone in Cambodia is getting safe and clean water.

In 2006 the Asian Development Bank (ADB) implemented the project to upgrade the water supply systems in 6 provincial capital cities, including Kampot City. In 2003 the World Bank (WB) implemented the upgrade of the water treatment plant in Sihanouk Ville City which is also a provincial capital city. Subsequently, the water distribution system of Sihanouk Ville City was replaced and expanded in 2013 by Japanese Grant Aid. In addition, Japan International Cooperation Agency (JICA) carried out Capacity Building for Water Supply Systems in Cambodia (Phase 2) in 8 cities including Kampot and Sihanouk Ville from 2007 to 2012. Capacity Building for Water Supply Systems in Cambodia (Phase 3) is ongoing to enhance the management capability.

Kampot and Sihanouk Ville benefitted from the infrastructure improvements and technology transfer provided by the GOJ and other donors. Nevertheless, safe water access rate for these two cities is still only 50%, because of insufficient production capacity of the existing facilities and low intake volume in dry season. Therefore, the expansion of water supply facilities in these cities is an urgent matter.

In August 2013, the RGC made a request to the GOJ for Grant Aid for the Project for Expansion

and Improvement of Water Supply System in Kampot and Sihanouk Ville.

After the series of discussions between Cambodian counterparts and Japanese officials held in June 2014, both sides agreed to conduct the project to expand water supply facilities in Kampot. The dredging and bank protection for Preak Tub Lake is dropped because of its limited benefit. Both sides agreed that the development in Sihanouk Ville would be determined after the completion of a water demand projection study up to the year 2030, and a preliminary assessment of potential water sources required to meet the projected water demand. Therefore, this project was formulated for Kampot City only.

The project is implemented with the support of the GOJ to increase access to safe water and improve water supply services by expanding water supply facilities in Kampot City. The project will contribute to a better living environment in Kampot City.

3. Results of the Preparatory Survey and Scope of Project

(1) Results of the Preparatory Survey

JICA dispatched a preparatory survey team to Cambodia twice in 2014 on the dates shown below.

First Assignment in Cambodia:	May 27 to September 24, 2014.
Second Assignment in Cambodia:	December 2 to 18, 2014

The survey team investigated the conditions of the existing water supply systems, social situation, project sites and water quality in Kampot.

The size of the project was determined with due consideration to the requests from the Cambodian side. The basic design, project implementation schedule and the initial cost estimates were prepared, bearing in mind the funding criteria of a Grant Aid project. The Cambodian side agreed to increase the water supply capacity by 7,500 m^3/day in Kampot, thereby raising the water supply ratio in the urban areas to 92% by 2021.

(2) Scope of the Project

1) Construction of Water Supply Facilities

The water supply facilities that would be constructed are as follows:

Intake and Raw Water Transmission Facilities

Facility			Specifications and dimensions
Function	Component	Item	
Raw water intake	Intake Shaft	Main body	Reinforced Concrete Structure Rectangular Shape: W3.00m x L5.70m (inner dimension) Depth 6.55 m (Depth at HWL 6.47 m)
		Intake Pump Room	Reinforced Concrete Structure Rectangular Shape: W4.50 m x L9.00 m x H3.55 m (inner dimension)
		Control Room for Intake Pump	Reinforced Concrete Structure Rectangular Shape: W5.10 m x L4.55 m x H4.00 m(under the beam) (inner dimension) Equipment: Power Receiving Panel, Operating Panel, Switchboard, Secondary Equipment Panel, Generator, Circumference Plumbing of Pump, Overhead Crane
	Intake Pump Facility	Intake Pump	Single Suction Volute Pump 4 sets (Duty 3 sets, Spare1 set)
	Temporary Works	Earth-retaining wall	Soldier pile with lateral lagging L=14.5m, Installation Length L=21.0m Soldier pile with lateral lagging L=13.0m , Installation Length L=13.5m
		Sandbag	3 steps stacking, Length: Foot of Slope L=30m
Raw Water Transmission	Raw Water Transmission Main	Pipe	DIPΦ400、L≒5400 m

Water Treatment Facility

Facility/Equipment			Dimensions and specifications
Function	Component	Item	
Water Treatment Facility	Receiving Well		Reinforced Concrete Structure Internal Dimension: 1.60 m width × 2.30 m length × 4.50 m depth Volume and Detention Time: V=16.56m^3、T=2.89min in dry season (T≧1.5 min) Cascade Aerator; 5steps, Height of a step 30cm
	Rapid Mixing Tank		Reinforced Concrete Structure Gravitational force mixing using a weir Internal Dimension: 1.60 m width × 1.50m length × 3.89 m depth Volume and Detention Time: V=9.3 m^3、T=1.63 min (1<T< 5 min)
	Flocculation Basin		Reinforced Concrete Structure Slow Mixing Method: Vertical channel bands flocculator Internal Dimension: 7.05 m width × 2.80 m length × 4.50 m height + 3.48 m average effective depth Quantity: 2
	Sedimentation Basin		Reinforced Concrete Structure Horizontal-Flow Sedimentation Basin Supernatant Collecting System: Collecting Trough + Submerged Orifice Quantity: 2 Internal Dimension: 7.05 m width × 21.50 m length × 3.78 m average depth

Facility/Equipment			Dimensions and specifications
Function	Component	Item	
			Surface Loading: Q/A=19.0 mm/min (15-30 mm/min) Mean Velocity: V=0.20 m/min (below 0.40 m/min)
	Rapid Sand Filter		Reinforced Concrete Structure Internal Dimension: 2.50 m width × 7.00 m length Quantity: 4 Filter Sand Thickness: 100 cm Underdrain System: Porous Filter Bed Method Filtration Rate: V=117.86 m/day (120-150 m/day) Flow Control: Lower Part Control Method Backwash Method: Simultaneous Backwash Method by Air and Water
	Service Reservoir		Reinforced Concrete Structure using Flat Slab Structure Quantity: 2 Effective Volume: V=1,100 m^3 (550m^3 × 2) Effective Water Depth: H=3.80 m (3-6 m) Detention Time: T=3.5 hours (designed by daily demand fluctuation) Internal Dimension: 10.40 m width × 14.00 m length × 3.80m height
	Elevated Tank		Reinforced Concrete Structure Quantity: 1 Effective Volume: V=300m^3 Internal Dimension: 9.60 m dia ×4.00m depth
	Drainage Basin		Reinforced Concrete Structure Quantity: 2 Effective Volume: V=211 m^3 (105.5 m^3 × 2) Internal Dimension: 4.00 m width × 11.00 m length × 5.60m height + 2.40m depth
	Lagoon		Reinforced Concrete Structure Quantity: 4 Effective Area: A=560 m^2
	Chemical Feeding Facility		Alum, Lime: at Administration Building Chlorine: Chlorine Feeding House (Floor Area 155m^2)
	Emergency Generator		Generator, Equipped with Fuel Tank At Administration Building
	Administration Building		Reinforced Concrete Structure, Three Stories Building, Total Floor Area: 604.4 m^2 Usage: 1st Floor: Staff Room, Workshop, Storage, Emergency Generator Room, Toilet, Chemical Carry-in Room (1-3 Fl. Open Ceiling), laboratory 2nd Floor: Manager Room , Meeting Room, Monitoring Room, Toilet, Chemical Dissolving Tank Room (2-3 Fl. Open Ceiling), Chemical Feeding Pump Room 3rd Floor: Chemical Dissolving Tank Room (2-3 Fl. Open Ceiling) Common: Staircase

Transmission and Distribution Facilities

Facility			Dimensions and specifications
Function	Component	Item	
Transmission Facilities	Transmission Pump	Transmission Pump	Single Volute Pump 2 (1 pump: standby)
		Pump Well	Doubles as Service Reservoir
Distribution Facilities	Service Reservoir (at the Treatment Plant)	Structure	RC Structure, Rectangle, 2 Ground Reservoirs Effective Capacity: V=550 m^3×2 Effective depth: H=3.80 m Water Level: HWL+6.50 m, LWL+2.70 m Foundation: Direct Foundation Doubles as Treated Water Reservoir
	Elevated Tank (at the Treatment Plant)	Structure	RC Structure Effective Capacity: V=300 m^3 Effective depth: H=4.00 m Water Level: HWL+29.00 m, LWL+25.00 m Foundation: Direct Foundation
	Distribution Pump Facilities	Distribution Pump	Single Volute Pump (Large) 3units (1 pump: standby) Low-voltage Inverter Equipment Single Volute Pump (Small) 3units (1 pump: standby) Low-voltage Inverter Equipment
		Pump Well	Doubles as Service Reservoir
	Distribution Pipeline	DIP	Straight Pipe: T type fittings, Thrust Blocking: Restrained joint retainer gland Diameter: φ400A L= 1.7km φ350A L= 6.0km φ300A L= 5.3km φ250A L= 4.6km Total L= 17.6km Bridge-attached Pipe: 4 places Railway Crossings: 1 place River Crossings: 1 place
		HDPE	PE100 Diameter: φ200A L= 7.7km φ150A L= 18.2km φ100A L= 27.9km φ 50A L= 17.3km Total L= 71.1km Pipe attached to Bridge:20 places Railway Crossings: 6 places
	Distribution Flow Monitoring System	Master Station	Monitoring PC, Printer, Receiver, UPS
		Local Station	Electromagnetic Flow Meter GSM Logger＋GSM Transmitter

2) Procurement of Equipment

To achieve adequate water treatment and conduct sound operation and maintenance of the new water supply facilities and to promote service connections for the low income group, the following equipment will be procured under Japanese grant aid:

Category	Name of Equipment/Material	Specifications	Quantity
Equipment for Water Quality Analysis	Jar Tester	Jar tester for six samples having adjust function of mixing intensity (20 - 200min^{-1} digital display)	1set
	Distillation Apparatus	Water purification system (Distillation type) Product capacity: approx. 1.8L/h	1set

	Turbidity Meter	Turbidity meter (digital display direct reading) (0 - 4,000NTU)	1set
	Turbidity Meter	Continuous monitoring meter for treated water	1set
	Laboratory Table	Steel frame laboratory table (3-way tap stainless steel sink / AC220V outlet)	1set
	Residual Chlorine Analyzer	Potable residual chlorine meter (absorption spectrophotometer) (0.00 - 5.00 mg/l)	1set
	Chlorine Continuous Measurement Equipment	Continuous monitoring meter for treated water	1set
	Spectrophotometer	for iron and manganese values	1set
	Uninterruptible Power System (UPS)	Output power capacity：3 kVA	1set
	pH Meter (glass electrode)	Desktop pH meter with electrode（pH 0 - 14）	1set
	pH Meter (BTB)	BTB type simple pH meter （pH 6.0/6.2/6.4/6.6/6.8/7.0/7.2/7.4）	1set
	Portable Conductivity Meter	Portable Conductivity Meter (for Intake Facilities)	1set
	Conductivity Meter	Conductivity Meter (for Water Treatment Plant)	1set
	Reagents	pH4 standard solution, pH7 standard solution, Potassium chloride solution, BTB solution, DPD solution	1set
	Glassware	Beaker, measuring flask, pipette, wash bottle	1set
Tools for Mechanical Equipment	Vibration Checker	Acceleration: 0.02-200 m/s^2, Velocity: 0.3-1,000 mm/s, Displacement: 0.02-100 mm	1set
Equipment and Materials for Service Connections	Socket Fusion Equipment	Diameter 15mm - 63mm for HDPE pipes with a power generator	1set
	Materials and Equipment for Service Connections	Required pipe materials and equipment from the ferrules with saddles on distribution mains (63mm and 110mm in diameter) to water meters (15mm or 20mm in diameter)	900 set

3) Technical Assistance (Soft Component)

Training in the following 3 areas will be provided under the technical assistance (soft component) of this project.

- Operation and maintenance of water treatment facilities
- Operation and maintenance of water transmission and distribution facilities
- Production management (Water supply facility management)

4. Project Implementation Schedule and Project Cost Estimate

(1) Project Implementation Schedule

The project will be implemented over 4 fiscal years. The detailed design will be carried out over 6.5 months during the first fiscal year, followed by the tendering process, which will take about 3.5 months. The final 27 months would be for equipment procurement and construction.

(2) Project Cost Estimate

The total project cost borne by the Cambodian side will be about 783.7 million Cambodia Riel (KHR). The Cambodian side is responsible for land preparation, investigation of land mines and unexploded ordnance, environmental monitoring, contracting process for network connections, for the distribution information system, electrical supply to the new intake facility and the new water treatment plant, bank arrangement, and contracting process for individual service connections.

5. Project Evaluation

(1) Adequacy of the Project

Project Beneficiaries

The water supply facilities in Kampot city will be expanded and the water supply services will be improved by the implementation of this project. The service ratio in the supply area will increase from 47 % in 2013 to 92 % in 2021. By 2021 the population served in Kampot city will increase from the current level of 23,657 to 55,874.

Urgency of Project Implementation

The existing Kampot water supply system is providing water service to only 47% of the population in 2013, because of insufficient production capacity. Therefore, the expansion of water supply facilities in Kampot city is an urgent matter.

Consistency between the Project and Cambodia Planning

The National Strategic Development Plan (NSDP) 2014-2018 sets the water service target of 100% in urban areas by 2025. This project will help Kampot Waterworks achieves this water service ratio. In addition, the project will provide the equipment and materials for house connections for the low income group. The increase in service ratio for the low income group will contribute to poverty reduction which is the most important goal of the NSDP.

Compliance with Japan’s Assistance Policy for Cambodia

Japan’s assistance policy for Cambodia is to support the recipient country in achieving their development goals. “Promotion of Social Development” is a one of priority pillars of this policy. Development of the water supply system promotes social development and is therefore consistent with the policy for Japanese assistance in Cambodia.

(2) Effectiveness

The project is expected to provide the following beneficial outcomes:

Quantitative Effects

The expansion of water supply facilities in Kampot city will result in improvements to the indicators listed in the table below.

No.	Indicator	Baseline Data (Year 2011)	Target (Year 2021) （3 years after completion of the new facilities）
1	Served Population	23,657	55,874
2	Water Supply Capacity (daily average basis)	4,252 m^3/day	10,339 m^3/day
3	Number of Domestic Connections	4,834	11,417

Qualitative Effects

- Maintaining appropriate residual water pressure and increasing water supply capacity will improve water supply services.
- Public health and personal hygiene will improve for residents who switch from using rain water and groundwater to potable water from the supply system. More people will have access to safe water supply and water shortage will be eliminated.
- The replacement of old pipes will reduce leakage in the supply area.
- Promotion of house connections to poor households will improve the access to safe water supply to poor households.

In conclusion, the project will be effective in meeting its goals.

PREPARATORY SURVEY
FOR
THE PROJECT FOR EXPANSION AND IMPROVEMENT OF
WATER SUPPLY SYSTEM
IN
KAMPOT AND SIHANOUK VILLE
IN
THE KINGDOM OF CAMBODIA

FINAL REPORT

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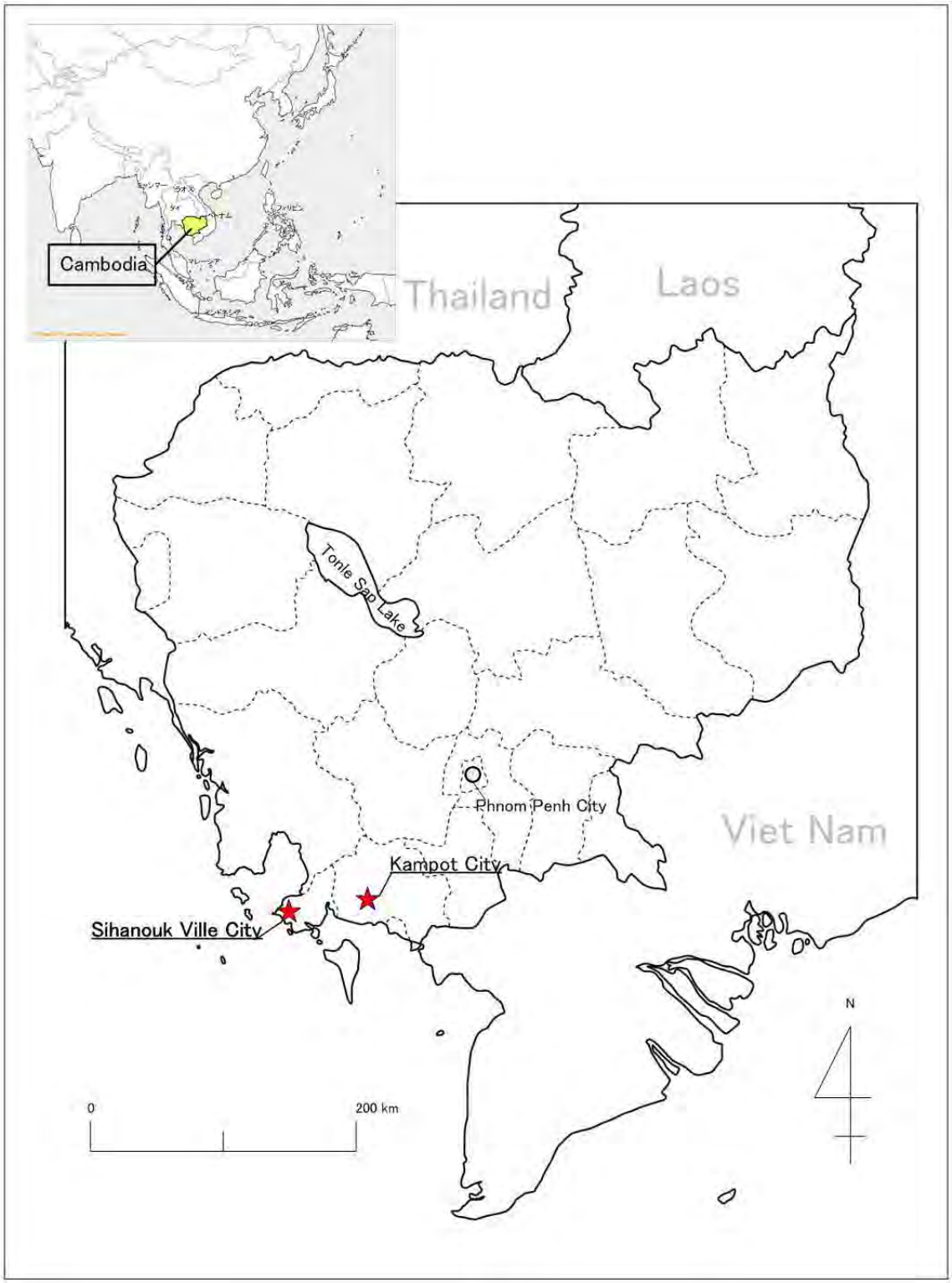
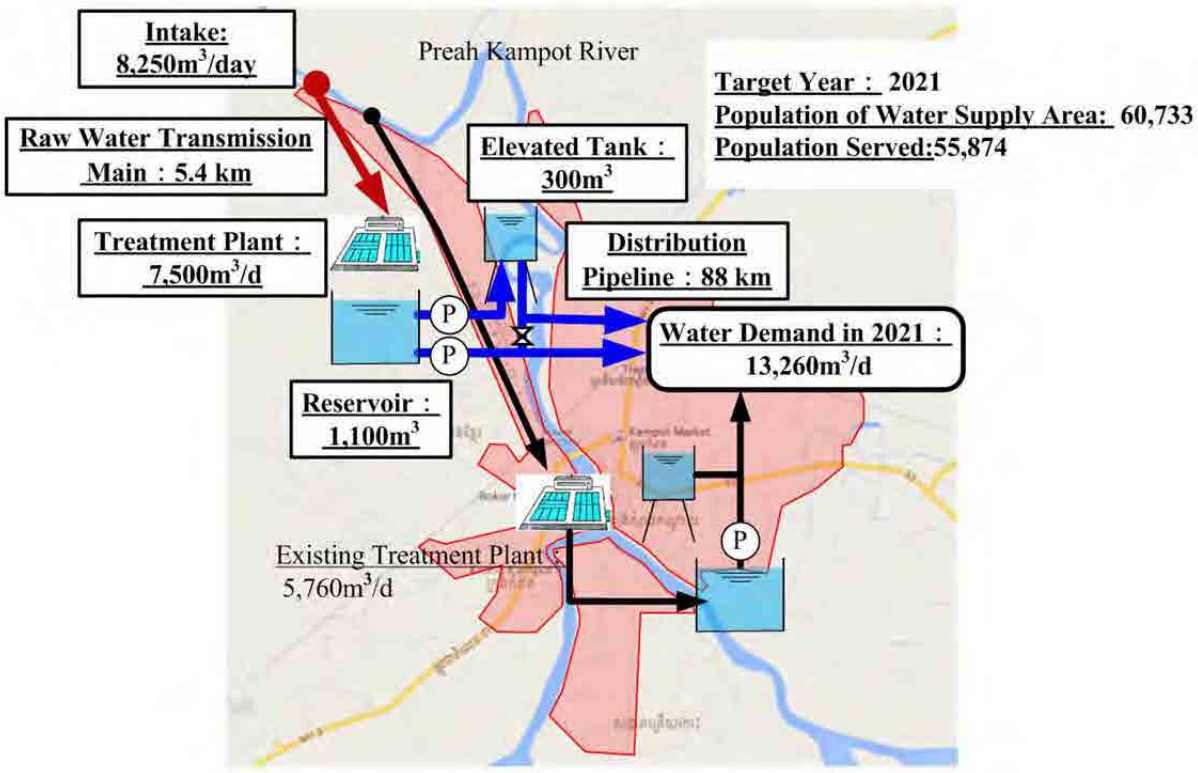


Location Map[1]

[1] According to the series of discussions between Cambodian counterparts and Japanese officials held in June 2014, both sides agreed that the project would include requested components for expansion of water supply facilities for Kampot, but not for Sihanouk Ville.

Project Outline



Perspective of Intake and Water Treatment Facilities

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Abbreviations

ADB	Asian Development Bank
AFD	Agence Française de Développement
APGR	Annual Population Growth Rate
CDC	Council for the Development of Cambodia
CMDGs	Cambodia Millennium Development Goals
DIH	Department of Industry and Handicraft
DIP (DCIP)	Ductile Cast Iron Pipe
DPWS	Department of Potable Water Supply
EDC	Electric du Cambodia
EIA	Environmental Impact Assessment
FS (F/S)	Feasibility Study
GRET	Groupe de Recherche et d'Échanges Technologiques
HDPE	High Density polyethylene
HWL	High Water Level
IEE	Initial Environmental Examination
IEIA	Initial Environmental Impact Assessment
ISO	International Organization for Standardization
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
KPT	Kampot
lpcd (LPCD)	litre per capita day, unit water consumption per day per capita
LWL	Low Water Level
MEK-WATSAN	Mekong Region Water Supply and Sanitation Initiative
MD	Minute of Discussion
MIH	Ministry of Industry and Handicraft
MOE	Ministry of Environment
MOWRAM	Ministry of Water Resources and Meteorology
MP (M/P)	Master Plan
NPRS	National Poverty Reduction Strategy
NRW	Non Revenue Water
NSDP	National Strategic Development Plan
PE	Polyethylene
PPWSA	Phnom Penh Water Supply Authority
PVC	Polyvinyl Chloride Pipe
SEZ	Special Economic Zone
S/V	Supervision
UN	United Nations
WB	World Bank
WTP	Water Treatment Plant

Chapter 1 Background of the Project

1.1 Project Background

The Royal Government of Cambodia (RGC) is committed to the development of the water supply sector. In February 2003, the National Policy on Water Supply and Sanitation set the goal that “Everyone shall have sustained access to safe water supply and sanitation services and shall live in a clean, healthy and sustainable environment”. The National Strategic Development Plan (NSDP), issued in 2006 and reviewed in 2008, aims to boost the urban area access to safe water to 80% by 2015. Latest NSDP (2014-2018) states that the access to safe water should be 100% by 2025.

After the civil war, with the support of the government of Japan (GOJ) and other donors, water supply capacity in the capital city, Phnom Penh, has been improved with the construction and rehabilitation of water supply facilities and related capacity building for operation and maintenance. Finally Phnom Penh has achieved 24-hour water supply, more than 90% of water supply ratio and 6 % of non-revenue water ratio.

On the other hand, the water supply capacities in other cities are still inadequate and not everyone in Cambodia is getting safe and clean water. The GOJ and other donors have implemented projects to upgrade the water supply systems in Kampot City and Sihanouk Ville. Projects have with infrastructure and management aspects. However, only about 50% of residents in Kampot and Sihanouk Ville have access to safe water. Therefore, the expansion of water supply facilities in these cities is an urgent matter.

In August 2013, the RGC made a request to the GOJ for Grant Aid for the Project for Expansion and Improvement of Water Supply Systems in Kampot and Sihanouk Ville, to cope with such circumstances.

According to the series of discussions between Cambodian counterparts and Japanese officials held in June 2014, both sides agreed that the project would include requested components for expansion of water supply facilities for Kampot, but not for Sihanouk Ville. Instead both sides agreed that a water demand projection up to the year 2030 and a preliminary assessment of potential water sources for Sihanouk Ville would be conducted in this preparatory survey and the priority of water supply development would be discussed based on the results of the preparatory survey.

The project is, therefore, implemented with the support of the GOJ to increase access to safe water and improve water supply services by expanding water supply facilities in Kampot City. The project will contribute to a better living environment in Kampot City.

1.2 Natural Conditions

Topographical and line survey, soil investigation and water quality survey described below were carried out to determine the design conditions for the proposed project sites. The existing environmental conditions for the project sites are described in section "**1.3 Environmental and Social Considerations**".

(1) Topographic and Line Survey

Topographic survey

Topographic survey was carried out at the proposed sites for the intake and treatment facilities. At the proposed intake site, a cross sectional survey of the revetments along the Prek Kampot River was included because the angle of the revetment is relatively small and the feature should be considered when studying the design of the intake facility.

Line survey

Line survey was carried out along the proposed main pipeline routes. The project area has a rolling terrain and it is necessary to consider the direct distribution pumping system in order to ensure enough residual water pressure in all parts of the supply area.

(2) Soil Investigation

Proposed river intake site

Hard clay layer with rolling stone (50 or more blows) is located under 1 m.

Proposed treatment plant site

Near the mountain side, hard clay layer (30 or more blows) is located above 6 m, and bed rock (50 or more blows) is located under 6m. Near the road side, hard clay layer (10 to 30 blows) is located under the surface soil.

(3) Water Quality Survey

Water quality survey, pesticide analysis and saltwater intrusion survey were conducted for the raw water from the Prek Kampot River (Refer to **Tables 1.2-1, 1.2-2** and **1.2-3** for the results).

According to the results of raw water quality analysis conducted by the JICA Survey Team and Kampot Waterworks, the characteristics of raw water quality in Prek Kampot River based on are as follows:

- Alkalinity is sometimes insufficient, less than 10, and pH sometimes decreases to 5 based on the record of water quality analysis conducted by the Waterworks.
- Iron and manganese levels are generally within the limits allowed in the water quality

standards, based on the raw water quality analysis conducted by JICA Survey Team. The Waterworks recorded some higher iron and manganese values but these are not at a level that is harmful for human consumption.

- Coliform count is high due to wastewater from the restaurants located in the upstream of the existing water intake. The high coliform count is not a problem because chlorination will be installed in water treatment plant.
- Electrical conductivity, pH, Turbidity, Alkalinity and TDS have decreased as a result of dam operation.
- Color is higher than the water quality standard. However, it is not a problem because it will decrease by the water treatment and meet the water quality standard.
- Pesticide was not detected from the Prek Kampot River on July 14, 2014.

Table 1.2-1 Results of Raw Water Quality Analysis (Prek Kampot River)

No.	Parameter	Unit	June 14, 2014	July 24, 2014	CNDWQS	JNDWQS
1	pH	-	7.21	7.14	6.5 – 8.5	5.8 – 8.6
2	Temperature	^{o}C	27.30	25.80	NV	NV
3	Electrical Conductivity (EC)	µS/cm	9.00	10.18	NV	NV
4	Turbidity	NTU	0.00	3.00	≤5.0	≤2.0
5	Total Dissolved Solid (TDS)	mg/l	5.00	9.10	≤800	≤500
6	Dissolved Oxygen (DO)	mg/l	6.20	6.30	NV	NV
7	Salinity	‰	0.06	0.00	NV	NV
8	Total Suspended Solid(TSS)	mg/l	59.00	44.00	NV	NV
9	Total Alkalinity(as CaCO3)	mg/l	294.00	99.20	NV	NV
10	Total Hardness	mg/l	24.50	58.80	≤300	≤300
11	Chloride (Cl^-)	mg/l	2.03	1.40	≤250	≤200
12	Fluoride (F)	mg/l	0.12	0.12	≤1.5	≤0.8
13	Sulphate (SO_4^{2-})	mg/l	0.84	0.46	≤250	NV
14	Nitrite (NO2)	mg/l	ND	ND	≤3.0	≤0.04
15	Nitrate (NO_3^-)	mg/l	2.15	0.11	≤50	≤10*
16	Ammonium (NH_4)	mg/l	0.10	ND	≤1.5	NV
17	Color	mg/l Pt	40.00	60.00	≤5.0	≤5.0
18	Biochemical Oxygen demand	mg/l	0.57	0.60	NV	NV
19	Chemical Oxygen demand	mg/l	1.98	1.86	NV	NV
20	Total Phosphorus(TP)	mg/l	0.01	0.01	NV	NV
21	Aluminum (Al)	mg/l	0.07	ND	≤0.2	≤0.2
22	Arsenic (As)	mg/l	ND	ND	≤0.05	≤0.01
23	Cadmium (Cd)	mg/l	ND	ND	≤0.003	≤0.003
24	Copper (Cu)	mg/l	ND	ND	≤1.0	≤1.0
25	Chromium (Cr total)	mg/l	0.04	ND	≤0.05	≤0.05
26	Iron (Fe)	mg/l	0.22	0.09	≤0.3	≤0.3
27	Lead (Pb)	mg/l	ND	0.002	≤0.01	≤0.01
28	Manganese (Mn)	mg/l	0.01	0.009	≤0.1	≤0.05
29	Mercury (Hg)	mg/l	0.0003	ND	≤0.001	≤0.0005
30	Zinc (Zn)	mg/l	ND	0.003	≤3.0	≤1.0
31	Total Coliform	MPN/100ml	$1.1x10^3$	$1.1x10^4$	0	NV
32	Escherichia coli (E-Coli)	MPN/100ml	$1.1x10^3$	$2.4x10^3$	0	0

(Conducted by JICA Survey Team, Sampling date; June 14, 2014 and July 24, 2014)
(CNDWQS; Cambodian National Drinking Water Quality Standard (2004), issued by MIME)
(JNDWQS; Japanese National Drinking Water Quality Standard)
(ND; Not detected (lower than detection limit), NV; No value)

The saltwater intrusion survey in Prek Kampot River was conducted by the JICA Survey Team at high tide during the spring tide cycle when the saltwater generally intrudes to its furthest point upstream. Based on the following survey results, the saltwater didn't intrude to the intake station, because the survey was conducted during the rainy season and the discharge volume from the dam was large. However, the saltwater intruded to a point 2km downstream of the existing intake station on 14 June, 2014. Therefore it is likely that saltwater will intrude to just downstream of the intake station during the dry season.

Table 1.2-2 Results of Saltwater Intrusion Survey at Existing Intake Station

	Tide		Discharge from Dam	Water Depth	Chloride Ion	Remark
14 June, 2014	Spring Tide	Low Tide	Overflow	Surface	0 mg/L	Estimated from EC
25 June, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from Pack Test
11 July, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from Pack Test
24 July, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from EC

(The value of Chloride Ion in Cambodian National Drinking Water Quality Standard is 250mg/L.)
(Source: JICA Survey Team)

Table 1.2-3 Results of Saltwater Intrusion Survey at 2km Downstream of Existing Intake Station

	Tide		Discharge from Dam	Water Depth	Chloride Ion	Remark
14 June, 2014	Spring Tide	Low Tide	Overflow	Bottom	9,700 mg/L	Estimated from EC
11 July, 2014	Spring Tide	High Tide	Overflow	Bottom	0 mg/L	Estimated from EC
24 July, 2014	Spring Tide	High Tide	Overflow	Bottom	0 mg/L	Estimated from EC

(Source: JICA Survey Team)

(4) River Flow Measurement Survey

According to the river flow measurements conducted on 22 November 2014, the flow was 2.0 m^3/s at the exit of the spillway of the dam and 3.0 m^3/s at the existing intake point. The result shows that about 1.0 m^3/s of water flow through the riverbed between the two measured points. The riverbed inflow decreases as the dry season approaches. Therefore, the river flow at the existing intake point would be considered to be around 2.0 to 3.0 m^3/s.

1.3 Environmental and Social Considerations

(1) Outline of Project Components that have Environmental and Social Impacts

The project consists of an intake facility, WTP, a distribution reservoir (at WTP site), a transmission pipe and a number of distribution pipes. The planned site for the intake is unoccupied KWW-owned land. The planned site for the WTP is unoccupied privately owned and the land acquisition process was conducted in Oct. 2014. No resettlement actions are required at the proposed intake and treatment plant sites. All pipelines will be installed under public road allowances. There are no resettlement issues.

The intake facility will have pipes which will be built within the river bank and will not occupy any space in the river. Thus, impacts to the river ecosystem should be insignificant. There is no impact to wildlife habitat at other sites and no significant considerations for the ecosystem.

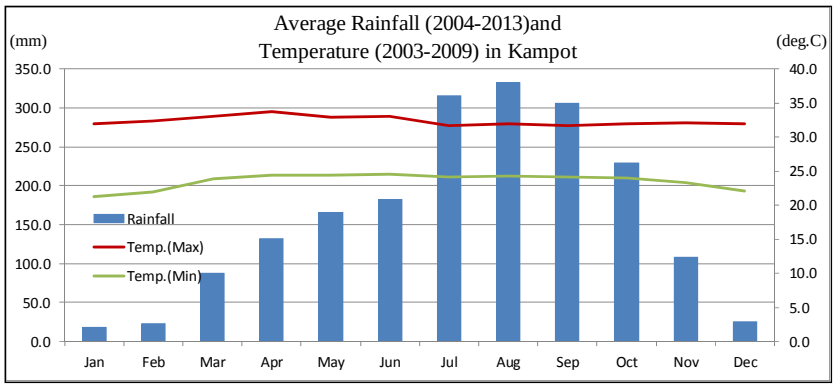
Evaluations by the JPST and stakeholder meetings confirm that there are no significant adverse impacts caused by the project.

The environmental and social considerations check list which summarizes the survey results is shown at the end of this chapter.

(2) Existing Environmental Conditions

(2)-1 Meteorological phenomenon

Kampot has a tropical monsoon climate, with a pronounced rainy season from July through October, a cool dry season from November through February, and a hot dry season in April. The average lowest temperature is 23.5 degree C while average highest is 32.4; and the average rainfall is 1,928 mm. Average precipitations and temperatures in Kampot are shown in **Figure 1.3(2)-1**.

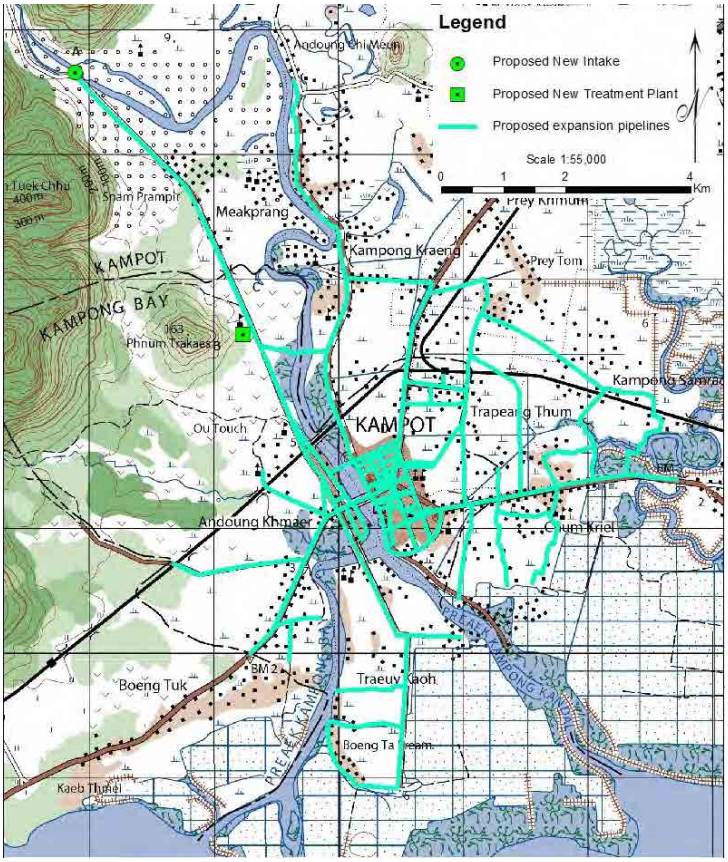


Source: MOWRAM (rainfall) / Statistical Yearbook of Cambodia 2011 (temperature)

Figure 1.3(2)-1 Average Rainfall and Temperature

(2)-2 Geography

Kampot is located at the southern part of Cambodia with the Thailand gulf to the south, a highland to the west and flat land in most other areas. The target area of the project is located on both sides of Prek Kampot River. The area is flat with the highest elevation of only 14 m above sea level. It does not have natural hazards such as steep slopes or unstable soils. Topographical map is shown below.



Source：IEE Report for Expansion and Improvement of Water Supply System Project in Kampot Town

Figure 1.3(2)-2 Topographical Map of the Project Area

The local geology consists of natural levees and alluvial fans with alluvial deposits and coastal plain deposits on the surface and schist, sandstone, colluvial deposits, siltstone, marl, and limestone underground.

(2)-3 Water environment

a. Water quality

Water quality surveys were conducted by JPST and by KWW. The key findings are as followings. (refer to **2.2.2** for the detail)

- Alkalinity descends to 10 or less and pH descends to around 5 during some periods.
- Iron (Fe) can exceed the standard value while Manganese (Mn) can ascend to just below the standard value.
- E-coli values are high because they have a swimming zone and restaurants.

From the viewpoint of water quality management for water supply, the following countermeasures can improve the water quality to a safe level.

- ✓ Lime dosage increases alkalinity and pH.
- ✓ Oxidation lowers Fe and contact filtration lowers Mn.
- ✓ Chlorination disinfects e-coli.

b. Flowrate

The average flow rates in rainy season (at over 100 m^3/sec) of the Prek Kampot River in front of the planned intake site, shown below, are adequate for the planned development. The flow rate is significantly lower (3 m^3/sec) in the dry season (November). The possible impacts to the downstream environment are explained in **2.3.2.(6)**.

Table 1.3(2)-1 Average Flow Rate of Prek Kampot River

No	Date	width M	area m^2	Mean Velocity-m/sec	Flow rate m^3/sec
1	31/07/2014	84.50	260.25	0.606	**157.766**
2	11/08/2014	84.10	245.24	0.570	**139.90**
3	14/11/2014	63.10	-36.62	0.082	**2.986**

Source: JPST

(2)-4 Protected areas

Kampot has a protected area called Preah Monivong National Park (aka; Bokor NP). The Provincial Department of Environment in Kampot explains that they do not have an accurate map showing the border of the park but the project area is located outside of the park and they do not see any problem for the project. Cambodia requires a Buffer Zone around protected areas but the project does not impinge on any Buffer Zones.

(2)-5 Fauna & flora

a. Wildlife

As a result of a survey on fauna in and around the project area, only *Callosciurus finlaysonii* and *Menetes berdmorei* (both are kinds of squirrel) were found. Furthermore, as a result of a household survey, all 104 households answered that they do not have any wild animals in their living area. Thus, it is assumed that the project target area is not located near wildlife habitats and the possibility that the construction gives adverse impacts is low.

b. Fish

After the hydropower dam was constructed, not many kinds of fish can be found in Prek Kampot River and professional fishermen catch fish only in the sea.

Representative fish caught near Kampot are shown in the table below.

Table 1.3(2)-2 Fish found around Kampot

Khmer Name	English Name	Scientific Name
-	Group of Shrimp	-
-	Group of Crab	-
-	Group of Squid	-
-	Group of Oyster	-
Kapi	Asian tiger shrimp	*Penaeus monodon*
Treykamong	Short Mackerel	*Rastrelliger brachysoma*
Trey Koun	Kelee shad	*Hisa Kelee*
Trey Orbtouk	Indian halibut	*Psettodes erumei*
Trey Kantuoy Reong	Bigeye scap	*Selar crumenophthalmus*
Trey Boas Tra	Russell snapper	*Lutjanus russelli*
Trey Chhiem (Krahom)	Malabar blood snapper	*Lutjanus malabaricus*
Trey Phtoung	Aguion needlefish	*Tylosurus acus melanotus*
Trey Kbok	Squaretail mullet	*Ellochelon vaigiensis*
Trey Kdochin	Greater lizardfish	*Saurida tumbil*

Source: Kampot Fisheries Administration Office

c. Vegetation

Land use in Kampot consists of a developed area in the center, paddy fields, crop fields, and riparian forests around the center and paddy fields, salt field and orchards in the suburb. Only vegetation found in the city is riparian forests but also primary forests are found in the national park over 10km away from the city center. (see **Figure 1.3(3)-2**)

(3) Existing Social Conditions

(3)-1 Population and ethnic groups

a. Population

The target area has 5 districts (Sangkat) in the city and 5 districts (commune) outside the city. The population in 2013 is shown below.

Table 1.3(3)-1 Population in the Target Area (2013)

#	Name of Sangkat in Kampot City	Family	Population
1	Kampong Kandal	1431	6828
2	Kampong Bay	1195	5771
3	Traeuy Koh	1373	6426
4	Krang Ampil	944	4542
5	Andong Khmer	2335	11447
#	Name of Commune in Tuek Chhou District	Family	Population
1	Chum Kriel	1797	5447
2	Kampong Kraeng	1434	7023
3	Trapeang Thum	660	3017
4	Mak Prang	1069	5387
5	Prey Khmum	1532	7185
-	Total	13770	63073

Source: Interviews with commune council, Sept. 2014

b. Ethnic groups

Three different ethnic groups can be found in Kampot: Khmer (majority), Islamic and Vietnamese. According tocommune leaders, no discrimination problems are found.

Table 1.3(3)-2 Ethnic Groups in Kampot

Ethnic group	Rate (%)
Khmer	88.7
Islamic (Charm)	11.2
Vietnamese	0.1

Source: Interviews with commune council, Sept. 2014

(3)-2 Socio-economic conditions

a. Outline

The data on the number of households by occupation indicates that "Service" is the most popular but the total of "Agriculture" and "Farming" together is larger. That means farming households are the majority. The total of the table is over 100% because some households have different occupations.

Table 1.3(3)-4 indicates numbers of schools while **Table 1.3(3)-5** indicates numbers of hospitals.

Table 1.3(3)-3 No. of Households by Occupation (Target Area / 2009)

Occupation	%
Service	40.2
Agriculture	32.7
Rice farming	18.7
Fisherman	10.6
Trader	5.5
Transport service provider	3.4
Repairer	2.0
Long-term crops farming*)	1.9
Craft work	1.3
NTFP collection**)	1.0
Furniture crafter, wooden, rattan, vine, bamboo	0.7
Livestock farming	0.5
Metal, aluminium, glass goods producer	0.4
Short-term crops farming***)	0.1
Food stuff producer (noodle, sauce...)	0.1
Other producers, not listed above	0.1
Total	119.3

*) Durian, Mango, Mangostin, Pepper, …etc
**) Green been, Cantaloupe, Watermelon…etc
***) Non Timber Forest Product (NTFP), Bamboo, Rattan, Forest fruits, Wood…etc

Source: Commune database online 2009

Table 1.3(3)-4 Educational Facilities (2013)

#	Name of Sangkat in Project area in Kampot City	Primary School		Secondary School		High School	
		#of school	Student	#of school	Student	#of school	Student
1	Kampong Kandal	4	235	1	1190	No	No
2	Kampong Bay	1	410	1	250	No	No
3	Traeuy Koh	2	731	1	204	No	No
4	Krang Ampil	2	309	1	164	No	No
5	Andong Khmer	3	3860	1	No Data	1	1132
#	Name of Commune in Project area in Tuek Chhou District	Primary School		Secondary School		High School	
		#of school	Student	#of school	#of school	Student	#of school
1	Chum Kriel	1	664	1	189	No	No
2	Kampong Kraeng	4	914	1	277	No	No
3	Trapeang Thum	No	No	No	No	No	No
4	Mak Prang	2	No Data	1	No Data	No	No
5	Prey Khmum	4	1112	1	113	No	No
-	Total	23	8235	9	2387	1	1132

Source: Interviews with commune council, Sept. 2014

Table 1.3(3)-5 Numbers of Health Center (2013)

#	Name of Sangkat in Project area in Kampot City	# of Health Center
1	Kampong Kandal	1
2	Kampong Bay	0
3	Traeuy Koh	1
4	Krang Ampil	1
5	Andong Khmer	0
#	Name of Commune in Project area in Tuek Chhou District	# of Health Center
1	Chum Kriel	2
2	Kampong Kraeng	1
3	Trapeang Thum	0
4	Mak Prang	0
5	Prey Khmum	0

Source: Commune database of Ministry of Planning in 2012

b. Agriculture

Agriculture occupies a large share of all industrial activity in Kampot. **Table 1.3(3)-6** indicates that rice is the main crop in Kampot which is also indicated in **Figure 1.3(2)-7** showing the breakdown of major crops of Kampot.

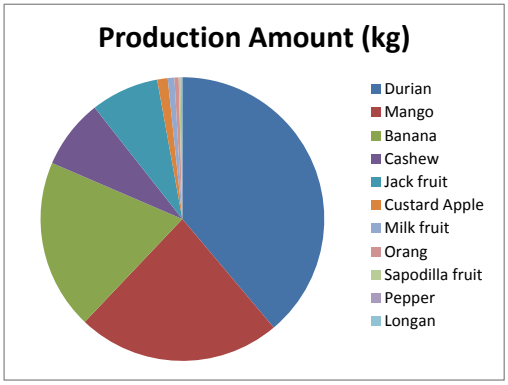
Table 1.3(3)-6 Trend of Yield of Rice in Kampot

Items	**Unit**	**2009**	**2010**	**2011**	**2012**	**2013**
Rice	Ton	398,389	401,453	424,352	437,553	454,245

Source: Department of Agriculture

Table 1.3(3)-7 Major Crops of Kampot (2013)

Products	Amount (kg)
Durian	12,902,800
Mango	7,705,552
Banana	6,430,901
Cashew	2,631,001
Jack fruit	2,572,804
Custard Apple	396,852
Milk fruit	251,430
Orange	157,600
Sapodilla fruit	73,603
Pepper	44,444
Longan	23,294



Source: Department of Agriculture

c. Fishery

Kampot is one of three provinces along the coast in Cambodia. The fishery products are widely distributed all over the country. Major products according to Fisheries Administration Office are shown below.

Table 1.3(3)-8 Major Fishery Products of Kampot (2013)

No.	English	Scientific Name	Yield(ton)
1	Group of small Fish	-	4,812
2	Group of large Shrimp	-	3,987
3	Group of small Shrimp	-	1,509
4	Group of other Crab	-	986
5	Soft Crab	-	635
6	Group of Snail	-	454.2
7	Group of Seaweed	-	446.4
8	Asian tiger shrimp	*Penaeus monodon*	392.3
9	Group of Squid	-	384.5
10	Group of Fish	-	446.4
11	Oyster/mollusk and shell	-	341.3
12	Short Mackerel	*Rastrelliger brachysoma*	112
13	Kelee shad	*Hisa Kelee*	110
14	Indian halibut	*Psettodes erumei*	106
15	Bigeye scap	*Selar crumenophthalmus*	102
16	Russell snapper	*Lutjanus russelli*	91
17	Malabar blood snapper	*Lutjanus malabaricus*	81
18	Aguion needlefish	*Tylosurus acus melanotus*	72
19	Squaretail mullet	*Ellochelon vaigiensis*	71
20	Greater lizardfish	*Saurida tumbil*	70
21	Other	-	7,989.9
-	Total	-	23,199

Source: Fisheries from Fisheries Administration in Kampot 2013

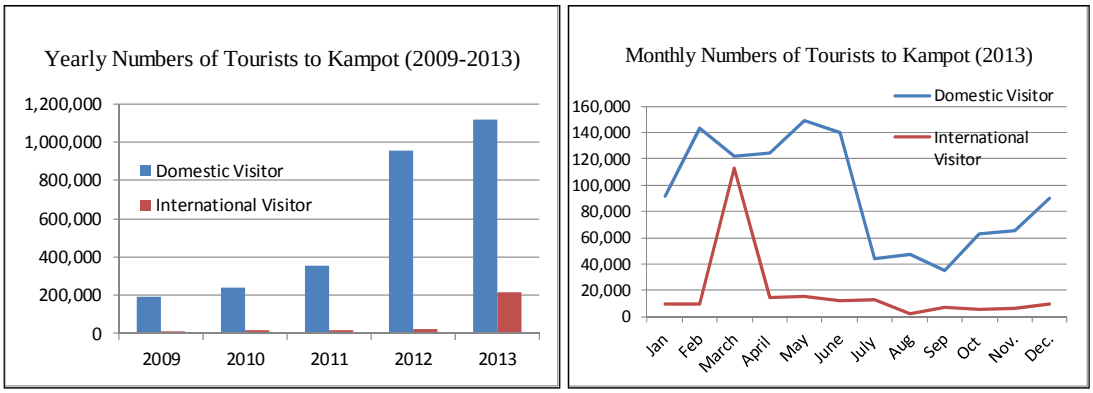
d. Tourism

Kampot has more and more tourists every year with tourism attractions such as pepper and durian as specialties, and salt fields and the national park as unique attractions. The Provincial Department of Tourism intends to improve tourism even more and prepares for city development plans willingly.

Table 1.3(3)-9 Trend of Tourists to Kampot

Month	2009		2010		2011		2012		2013	
	Dom.Visi.	Int.Visi.	Dom.Visi.	Int.Visi.	Dom.Visi.	Int.Visi.	Dom.Visi.	Int.Visi.	Dom.Visi.	Int.Visi.
Jan	10,214	1,526	11,228	1,469	13,230	1,631	49,995	2,300	91,280	9,320
Feb	33,534	1,407	24,838	1,322	39,089	1,692	105,396	2,226	143,349	9,436
March	9,596	1,216	11,038	1,397	12,986	1,703	18,266	1,907	121,886	112,645
April	55,586	1,771	62,617	1,972	85,526	2,038	165,296	2,472	124,482	14,512
May	12,383	974	11,228	1,236	16,845	1,568	92,860	2,139	149,009	15,626
June	11,838	929	10,132	1,125	14,986	1,234	85,163	1,917	139,838	12,049
July	8,796	636	10,645	1,251	14,436	1,334	72,566	1,796	44,119	13,034
Aug	8,686	616	10,212	1,266	11,416	1,125	52,336	1,627	47,334	2,181
Sep	9,266	515	10,436	1,295	10,453	966	41,796	1,568	34,671	7,266
Oct	8,383	484	48,823	1,705	43,294	948	99,541	2,165	63,196	5,237
Nov.	10,338	656	13,110	1,371	39,553	1,261	76,636	1,866	65,595	6,588
Dec.	11,226	836	13,840	1,531	54,115	2,859	93,796	2,989	89,848	9,386
Total	**29,947**	**1,976**	**75,773**	**4,607**	**136,962**	**5,068**	**269,973**	**7,020**	**218,639**	**21,211**

Source: Provincial Department of Tourism in Kampot

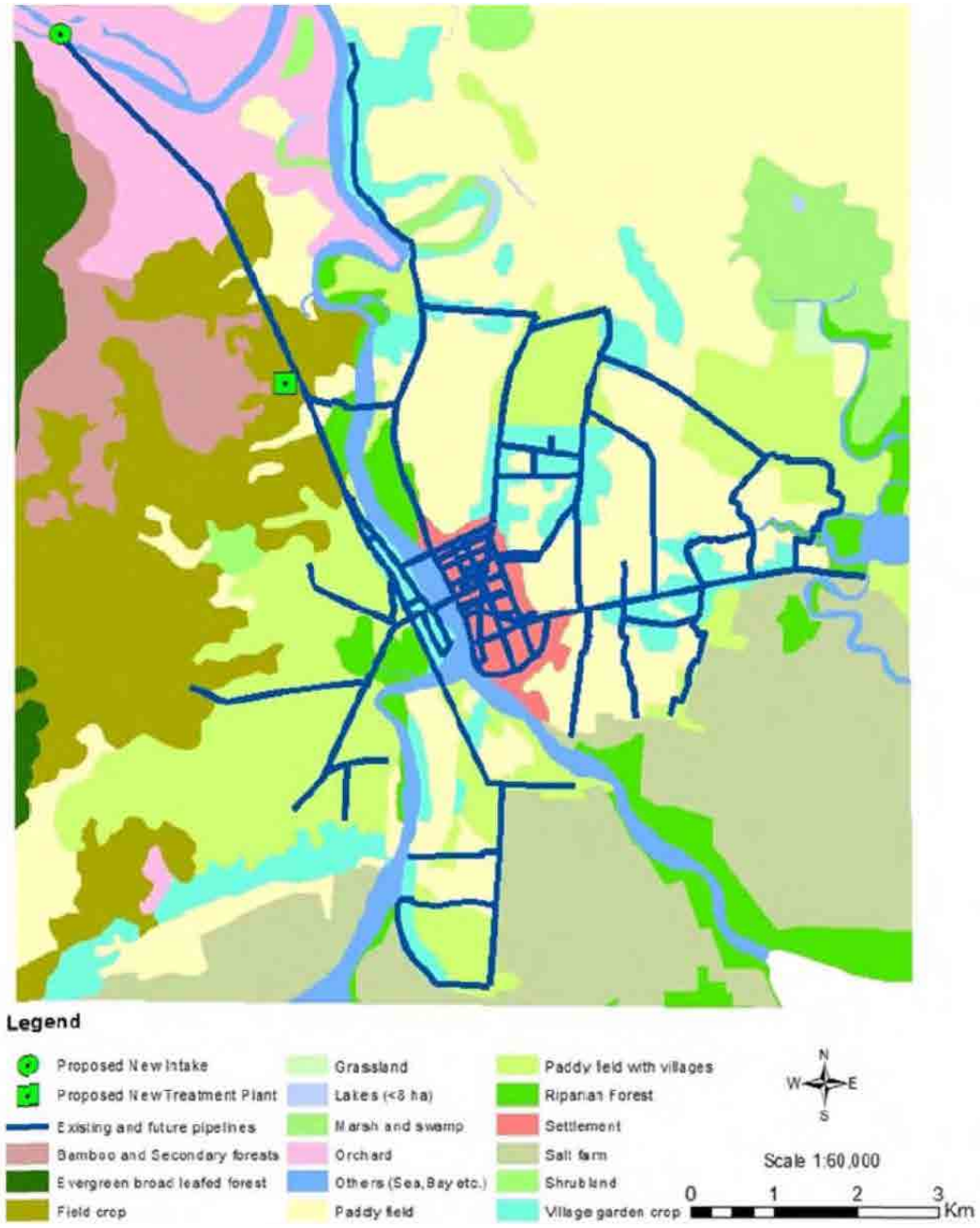


Source: Provincial Department of Tourism in Kampot

Figure 1.3(3)-1 Trend of Tourists to Kampot

(3)-3 Land use

Land use in Kampot consists of developed area in the center, paddy fields, crop fields, and riparian forests around the center and paddy fields, salt field and orchards in the suburb. Only vegetation found in the city is riparian forests but also primary forests are found in the national park over 10km away from the city center. Refer to Figure shown below



Source：IEE Report

Figure 1.3(3)-2 Land Use of Kampot

(3)-4 Water use and Water rights

a. Water use

No major water use is seen around the planned intake facility because of the estuarine water. According to the Fisheries Administration there are no professional fishing activities on the river Office. Furthermore, no concern was heard for future water use in the river at the stakeholder meetings.

b. Water rights

MIH applied to MOWRAM for the approval of the intake of 0.17m^3/sec from Prek Kampot River and MOWRAM replied that MOWRAM had no objection to the request.

(4) Laws and Regulations related to Environmental Consideration.

a. Laws and Regulations related to Environmental Consideration

Laws and Regulations related to Environmental Consideration are described as follows.

1) Constitution (1993)

Article 59 of constitution stipulates that the State shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests and forestry products, wildlife, fish and aquatic resources.

2) Law on environmental Protection and Natural Resource Management (1996)

The law stipulates that the State shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecological system, mines, energy, petrol and gas, rocks and sand, gems, forests and forestry products, wildlife, fish and aquatic resources.

3) Sub-Decree on Environmental Impact Assessment Process (1999)

The sub-decree stipulates EIA system, its processes and target sectors.

4) Sub-Decree on Water Pollution Control (1999)

The sub-decree stipulates criteria of water quality and control method for preventing water pollution.

5) Sub-Decree on Solid Waste Management (1999)

The sub-decree stipulates the scope and proper management method of solid waste.

6) Royal Decree on Creation and Designation of Protected Areas (1993)

The decree stipulates the scope, role and the management method for the projected area.

7) Sub-Decree on Air Pollution Control and Noise Disturbance (2000)

The sub-decree stipulates criteria of air quality, noise & vibration and control method for preventing air pollution.

8) Law on Water Resource Management (2004)

The law stipulates the roles and the responsible organization of water resource management. Article 22 of the law stipulates the regulation on discharge to public water.

b. Necessary Assessment for the Project in Cambodia

The EIA process for the Project is described in above mentioned Sub-Decree on Environmental Impact Assessment Process. According to the Sub-Decree, Water supply projects which cover more than 10,000 people shall conduct IEIA: Initial Environmental Impact Assessment or EIA: Environmental Impact Assessment. IEIA is compatible to IEE: Initial Environmental Examination in JICA Guideline. According to PDoE in Kampot, IEIA shall be conducted for the Project.

c. EIA/IEIA Procedures

The process differs according to the ownership and condition of the Project. The Project is owned by MIH and KWW, therefore, it is categorized as Ministry ownership. The process for this case is described in the following figure.

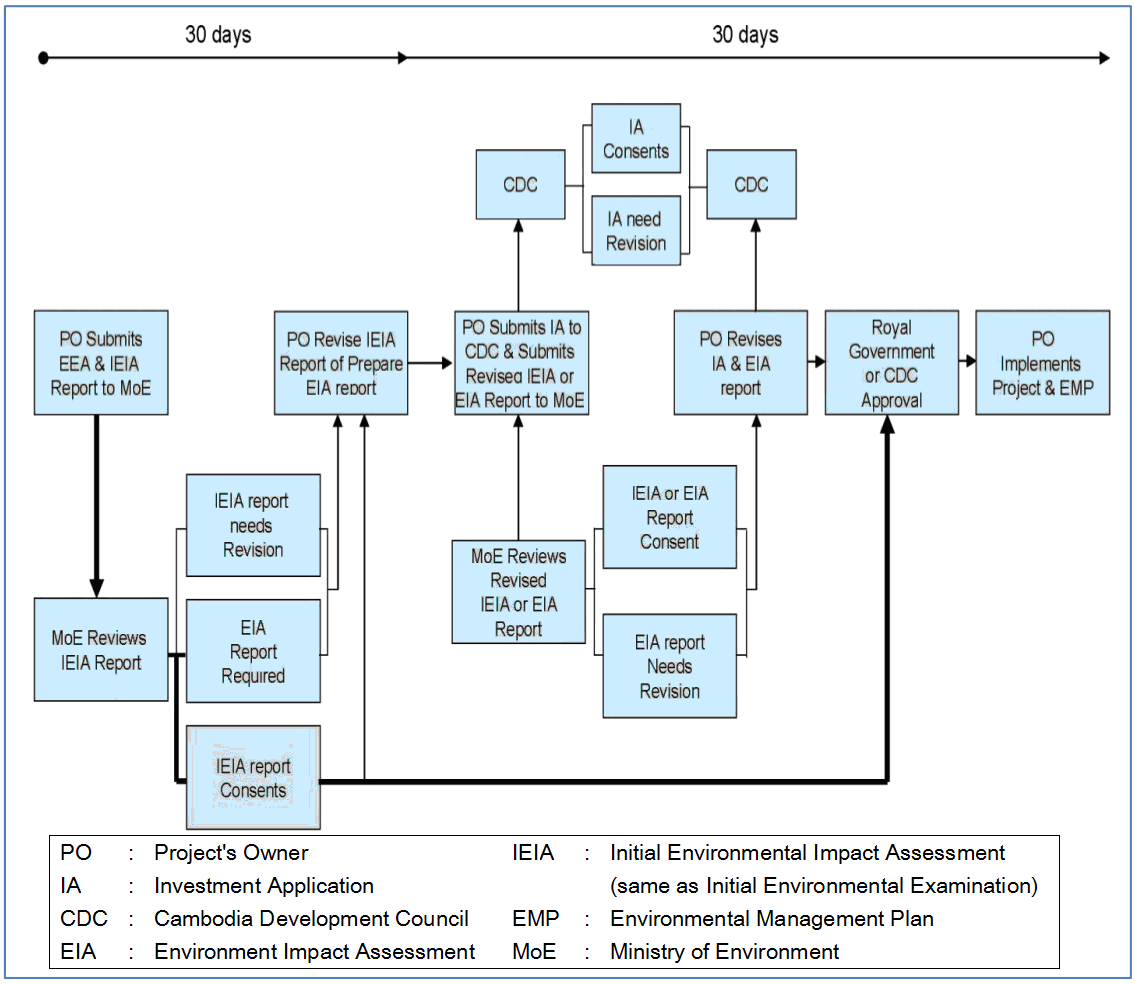


Figure 1.3(4)-1 Flow of EIA/IEIA Process

d. Comparison of Cambodian Laws and Regulations with the JICA Guidelines

The environmental impact assessment process in Cambodia is basically similar to that of JICA guidelines while there is not as much emphasis on “Accident”, “Global warming”, “Employment” and other social considerations in Cambodian laws and regulations. Detailed procedures for land acquisition and resettlement have not been defined yet. Cambodian laws and regulations do not put emphasis on restoring livelihood to previous levels or more.

The result of the comparison between Cambodian laws and regulations with the JICA guidelines is described in the following table.

Table 1.3(4)-1 Comparison of Cambodian Laws and Regulation with the JICA Guidelines

Items No.	JICA Guidelines	Laws & Regulations in Cambodia	Differences	Policy in the Project
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	**Constitution (1993)** **Article 44** Legal private ownership shall be protected by the law. The right to confiscate possessions from any person shall be exercised **only in the public interest** as provided for under law and shall require **fair and just compensation in advance**. **Land Law (2001)** **Article 4** The right of ownership, recognized by Article 44 of the 1993 Constitution, applies to all immovable properties within the Kingdom of Cambodia in accordance with the conditions set forth by this law. **Article 5** No person may be deprived of his ownership, **unless it is in the public interest.** An ownership deprivation shall be carried out in accordance with the forms and procedures provided by law and regulations and after the payment of **fair and just compensation in advance**.	Cambodian laws /regulations do not stipulate avoidance of resettlement and loss of means of livelihood while the JICA guidelines stipulate them.	JICA guideline is applied for this item. (Resettlement is not necessary. No concern is necessary for loss of means of livelihood)
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	**Constitution (1993)** **Article 44** **(as described in 1)** **Land Law (2001)** **Article 5** **(as described in 1)**	There is no line in Cambodian laws /regulations which stipulate minimization of resettlement and loss of means of livelihood while JICA guideline stipulates them.	JICA guideline is applied for this item. (Resettlement is not necessary.)
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	**Constitution (1993)** **Article 44** (Refer to 1) **Land Law (2001)** **Article 5** (Refer to 1) **Expropriation Law (2009)** **Article 4** Expropriation refers to confiscation of ownership of, **with fair and just compensation in advance**, immovable property or the real right to immovable property of a physical person or legal entity or legal public entity, which includes land, buildings, and cultivated plants, and for construction, for rehabilitation or for expansion of public physical infrastructure which is in the national and public interests. **Article 22** Financial compensation given to the property owner and/or rightful owner shall be based on a	Both Cambodian Laws / Regulations and JICA guideline stipulate compensation while no explicit scope for the compensation is given in Cambodian laws /regulations. Also, as described in Section 2, the JICA guidelines the stipulate compensation for loss of means of livelihood while Cambodian laws/regulations stipulate compensation for the property of owner or rightful owner only. In addition to above, the JICA guidelines stipulate the objective of the compensation is that	JICA guideline is applied for this item. (There is no loss of means of livelihood)

Items No.	JICA Guidelines	Laws & Regulations in Cambodia	Differences	Policy in the Project
		market price or replacement price on the date of declaration of the expropriation. The market price or the replacement price shall be determined by an independent committee or agent selected by the Expropriation Committee.	resettled residents can improve or restore their standard of living.	
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	**Expropriation Law (2009)** **Article 22** **(as described in 3)** **Article 23** The owner and/or the rightful owner has the right to compensation for **actual damages** commencing from the last date of declaration of expropriation for which they are entitled to fair and just compensation.	Compensation stipulated by the JICA guidelines include essential costs for recovering livelihood as pre-project conditions while that of the Cambodian laws/regulations is stipulated as "actual damage" without detailed information.	JICA guideline is applied for this item. (Resettlement is not necessary.)
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	**Constitution (1993)** **Article 44** **(as described in 1)** **Land Law (2001)** **Article 5** **(as described in 1)** **Expropriation Law (2009)** **Article 19** The expropriation of ownership of immovable property and real right to immovable property can be exercised only if the Expropriation Committee has paid fair and just compensation to the property's owner and/or rightful owner **in advance**, in accordance with the compensation procedures and principles set out in Section 3 of Chapter 4 of this law.	Both the Cambodian laws/regulations and JICA guidelines stipulate that compensation must be provided prior to displacement while the Cambodian laws/regulations do not stipulate "other kinds of assistance".	JICA guideline is applied for this item. ("Other kinds of assistance" is not necessary because Resettlement is not necessary and there is no loss of means of livelihood)
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	No matching regulation or Laws exists.	Cambodian laws/regulations do not stipulate RAP preparation.	JICA guideline is applied for this item. (Resettlement is not necessary.)
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	**Expropriation Law (2009)** **Article 16** In conducting this survey, the Expropriation Committee shall **arrange** a **public consultation** with the authorities at provincial, district and commune level, the commune councils and village representatives or the communities or persons affected by the expropriation in order to **give them clear and specific information** and to have all opinions from all concerned	Both stipulate holding public consultation with sufficient information while Cambodian laws /regulations do not stipulate RAP preparation.	Cambodian law/regulation is applied for this item however the language and the methods used for conducting consultation follows the JICA guideline as described in item 8. (Resettlement is not necessary.)

Items No.	JICA Guidelines	Laws & Regulations in Cambodia	Differences	Policy in the Project
		parties about the propose for public physical infrastructure project.		
8.	When consultations are held, explanations must be given in a form, manner and language understandable to the affected people. (JICA GL)	**Expropriation Law (2009)** **Article 16** (Refer to 7) *Note: No description exists for manner and language.*	Both stipulate holding public consultation while JICA guideline specifies more detailed manners, especially, accessibility for conducting the consultation.	JICA guideline is applied for this item. (IRC is conducting consultations)
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	**Expropriation Law (2009)** **Article 16** In conducting this survey, the Expropriation Committee shall **arrange** a **public consultation** with the **authorities** at provincial, district and commune level, the commune councils and village **representatives** or the **communities affected** by the expropriation. **Sub-Decree on Environmental Impact Assessment Process (1999)** **Article 1** **Encourage public participation** in the implementation of EIA process and take into account of their conceptual input and suggestion for re-consideration **prior to the implementation** of any project.	Expropriation law stipulates participation of the affected people in public consultation while JICA guideline promotes participation of the affected people in all stages of the project.	JICA guideline is applied for this item. (Stakeholder meetings were held at the planning phase in August, 2014)
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	**Expropriation Law (2009)** **Article 14** A Complaint Resolution Committee shall be established and led by representatives of Ministry of Land Management, Urban Planning and Construction, and representatives of other concerned ministries/institutions shall be involved. The organization and functioning of the Complaint Resolution Committee shall be determined by a separate sub-decree.	Both stipulate establishment of grievance mechanisms. Expropriation law is short on applicability for affected people while JICA guideline specifies more detailed manners, especially, accessibility for conducting the consultation.	JICA guideline is applied for this item. (Grievance mechanism was instituted at the planning phase in August, 2014)
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project	**Expropriation Law (2009)** **Article 16** Before proposing an expropriation project, the Expropriation Committee shall **publicly conduc**t a survey by **recording a detailed description of all rights of the owners and/or rightful owners** to the immovable property and other properties which might be needed for compensation; all other related problems shall be recorded as well.	Both stipulate conduction of precise survey. Expropriation focuses on the rightful property and its owner while JICA guideline following OP4.12 includes affected person who have formal legal rights to land and also affected person who don't have formal legal rights.	JICA guideline following WB4.12 will be applied for this item. (Socioeconomic survey was conducted at the planning phase in August, 2014)

Items No.	JICA Guidelines	Laws & Regulations in Cambodia	Differences	Policy in the Project
	identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)			
12.	Eligibility of benefits includes, the Project Affected Person: PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	**Expropriation Law (2009)** **Article 16** **Owner of immovable property and/or rightful owner** refers to a physical person, private legal person, or public legal entity including a proprietor, possessor and all persons who have rights to land and are affected by the expropriation project. **Article 18** The following are null and void and cannot be made legal in any form whatsoever: - any **entering into possession of public properties** of the State and public legal entities and any **transformation of possession of** private **properties of the State** into ownership rights that was not made pursuant to the legal formalities and procedures that had been stipulated prior to that time, irrespective of the date of the creation of possession or transformation; - any **transformation of a land concession**, into a right of ownership, regardless of whether the transformation existed **before this law came into effect**, except concessions that are in response to social purposes; - any **land concession** which **fails to comply with the provisions** of Chapter 5; - any **entering into possession of properties** in the private property of the State, through any means, that occurs after this law comes into effect.	Expropriation law stipulates "owner of immovable property and rightful owner" as eligible person for compensation while JICA guideline includes PAPs who don't have formal legal rights to land as eligible person.	JICA guideline following WB4.12 will be applied for this item. (It is assumed that the land owner has legal title.)
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	No matching regulation or law exists.	Cambodian laws /regulations do not stipulate any provision of preference to land-based resettlement strategies.	JICA guideline following WB4.12 will be applied for this item. (there is no loss of means of livelihood)
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB	No matching regulation or law exists.	Cambodian laws /regulations do not stipulate provision of support for the transition period.	JICA guideline following WB4.12 will be applied for this item. (Resettlement is

Items No.	JICA Guidelines	Laws & Regulations in Cambodia	Differences	Policy in the Project
	OP4.12 Para.6)			not necessary.)
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	No matching regulation or law exists.	Cambodian laws /regulations do not stipulate particular assistance, care or attention toward vulnerable group.	JICA guideline following WB4.12 will be applied for this item. (Water connections will be provided free of charge to poor households. Attention will be paid to the vulnerable groups)
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	No matching regulation or laws exists.	Cambodian Laws /Regulations do not stipulate preparation of RAP nor ARAP.	JICA guideline following WB4.12 will be applied for this item. (Resettlement is not necessary.)

PAP: Project Affected Person/ People

(5) Comparison of Alternatives

(5)-1 Intake locations

Three alternatives for intake location are considered;

i) At the existing hydropower dam: A hydropower dam is located upstream of Kampot on the Prek Kampot River. Water quality in the reservoir is suitable for potable water supply. However, it is uncertain to be able to get permission from MME and the private management company.

ii) Next to the existing intake facility: The KWW-owned land for the existing intake facility still has enough room for a new intake facility. The planned intake flow rate is $0.17m^3$/sec which is much smaller than the $5.0m^3$/sec minimum discharge of the dam. There are no significant problems for water quality but salt water intrusion should be monitored because some problems have been reported in the past.

iii) Lake Tak Krola: The water quality of the lake has not yet been checked. It is uncertain whether or not MME would approve abstraction from the lake.. There could be impacts to residents that utilize water for irrigation and consultation would be required.

The comparison of alternatives is shown below. Alternative ii) is selected because it presents fewer problems with water rights and does not require land acquisition.

Table 1.3(5)-1 Alternatives Comparison (Intake Facility sites)

	i) Hydropower dam	ii) Close location to the existing intake facility	iii) Lake Tak Krola
Water right	×	○	×
Water source amount	×	○	△
Water quality	○	△	△
Land acquisition	×	○	×
Resettlement	―	―	―
Result of comparison	Rejected	Adopted	Rejected
Conclusive aspect	Water right	Minimum impact	Many concerns

【Legend】 ― : No impact, × : Invalid, △: Less valid / difficult to evaluate, ○ : Valid

(5)-2 WTP sites (including the "without project" option)

Three options are considered;

i) No new WTP: i.e. no project therefore no site required

ii) Constructing the WTP at the existing WTP site: the land is limited so the structure has to be complicated and go vertical, which causes higher cost.

iii) Constructing the WTP at a new site: requires land acquisition but this option is more cost effective.

Comparison of alternatives is shown below Alternative iii) is selected because it provides more space and is more cost effective.

Table 1.3(5)-2 Alternatives Comparison (WTP sites)

	i) Without the project	ii) The existing WTP	iii) New land acquisition
Water source amount	×	△	○
Land area	―	△	○
Construction cost	―	×	△
Land acquisition	―	―	×
Resettlement	―	―	―
Result of comparison	Rejected	Rejected	Adopted
Conclusive aspect	Short of supply	Less effective	Effective

【Legend】 ― : No impact, × : Invalid, △: Less valid / difficult to evaluate, ○ : Valid

(5)-3 River crossing methods

Three alternative methods for crossing the river with distribution pipe are considered;

i) Constructing a new bridge for the pipe: this would likely have many adverse impacts because it would require a new abutment structure in the river.

ii) Utilizing an existing bridge: this method would cost less and make construction easier but the strength of the existing bridges is unknown and difficult to assess.

iii) Crossing under the river bottom: this would be done by pipe jacking which is advanced and expensive but better because it would have no impact to the environment during operation.

The comparison of alternatives is shown below. Alternative iii) is selected because it has the

least environmental impact.

Table 1.3(5)-3 Alternatives Comparison (River Crossing)

	Constructing a new bridge	Utilizing an existing bridge	Crossing under river bottom
Land use (under construction)	×	△	△
Land use (in operation)	×	△	—
Scenery	×	△	○
Approvals	×	△	△
Impacts to the river (under construction)	×	—	—
Impacts to the river (in operation)	×	—	—
Construction cost	×	△	×
Safety (under construction)	△	○	△
Safety (in operation)	△	×	○
Resettlement	—	—	—
Result of comparison	Rejected	Rejected	Adopted
Conclusive aspect	Many impacts	Less safe	Least impact

【Legend】 ー : No impact, × : Invalid, △: Less valid / difficult to evaluate, ○ : Valid

(6) EIA Scoping

Scoping is defined as the process of identifying the content and extent of the environmental information to be submitted to the competent authority under the EIA procedure. Scoping of the water supply facilities and the reasons for the evaluation are shown in the table below.

Table 1.3(6)-1 Scoping

Item	Evaluation	Reason
1 Air pollution	D	No adverse impacts are expected
2 Water pollution	C	Turbidity might be produced during construction of the intake facility
3 Soil pollution	D	No adverse impacts are expected
4 Waste	B	Impacts caused by construction waste (soil, pavement and other) and sludge waste
5 Noise and vibrations	B	Impacts caused by noise and vibration according to construction and transfer
6 Ground subsidence	D	No adverse impacts are expected
7 Offensive odors		
8 Geographical features	B	Impacts caused by building the foundation for the facilities
9 Bottom sediment	D	No adverse impacts are expected
10 Biota and ecosystems	C	Study on fauna and flora is necessary
11 Water usage	C	Study on water usage around the intake facility is necessary
12 Accidents	B	Impacts caused by accidents during construction and operation of WTP
13 Global warming	D	No adverse impacts are expected
14 Land acquisition	B	Land acquisition is necessary
15 Local economies	D	No adverse impacts are expected
16 Land use	B	Impacts caused by dust and turbidity production during construction
17 Social institutions	D	No adverse impacts are expected
18 Existing social infrastructures and services	C	Study on possible impacts to existing social infrastructures and services is necessary

Item	Evaluation	Reason
19 Poor, indigenous, or ethnic people	C	Study on possible impacts to poor, indigenous, or ethnic people is necessary
20 Misdistribution of benefits and damages	C	Study on possible misdistribution of benefits and damages is necessary
21 Local conflicts of interest	D	No adverse impacts are expected
22 Gender		
23 Children's rights		
24 Cultural heritage		
25 Infectious diseases such as HIV/AIDS	B	Long stay of external labor workers is expected and prevention measure of infectious diseases such as HIV/AIDS is necessary

【Evaluation】 A : Large adverse impact is expected, B : Some adverse impact is expected, C : An adverse impact is indistinct, D : No adverse impact is expected

(7) JPST Terms of Reference (TOR) for review of Environmental and Social Impacts

(7)-1 Purpose of the preparatory survey

The purpose of the survey at this preparatory stage is to predict and assess the contents and scale of possible impacts to the natural and social environment by the water supply project which is outline-designed in "Preparatory Survey on The Project for Expansion and Improvement of Water Supply System in Kampot and Sihanoukville".

(7)-2 Items targeted by the JPST survey

In principle, items that received an A, B and C in the scoping table should be reviewed and evaluated. In addition, other items that are identified as the survey proceeds should also be included.

(7)-3 Target areas

Target areas are proposed construction sites and the surrounding areas of the project facilities.

(7)-4 Target periods

Target periods are the stages of planning, execution and operation of the project.

(7)-5 Methodology

a. Scope of work

The information to be collected and the typical countermeasures that will be reviewed by JPST are presented in **Table 1.3(7)-1**.

Table 1.3(7)-1 The Study and Countermeasure associated with the Project

Evalu-ation	No.	Item	Study / Countermeasure	Status
B	4	Waste	・Confirmation of general / special waste reception facilities	Done
			・Consultation with Provincial Dep. of Environment in Kampot	Done
			・Estimate of soil produced and used	DD*)
			・Confirmation of treatment method for construction waste	Done
	5	Noise and vibrations	・Base line survey before construction	Done
			・Study predicted impacts and countermeasures	DD
			・Study of the construction sites and surrounding areas including special facilities such as hospitals, school and so on	Done
			・ Suggestions on low-noise and vibration type machinery for pipe installation.	EMP
			・Suggestions on countermeasures such as reducing noise and vibration of transport of construction materials and so on	EMP
	8	Geographical features	・Minimizing the scale of change to geography caused by building structural foundations at the facilities	Done
	12	Accidents	・Consultation with associated authorities (Provincial Dep. of Labor / Social Affair / Health)	Done
			・Confirmation on existing programs for accidents prevention	Done
			・Suggestions on thorough safety measures during construction	EMP
			・Suggestions on thorough safety measures during operation of the WTP	DD
	14	Land acquisition	・Confirmation on compliance of land acquisition procedure by Inter-ministries Resettlement Committee (IRC) with JICA Guideline	Done
	16	Land use	・Prevention of dust by watering during construction of WTP and so on.	EMP
			・Study on preventing turbidity during construction of the intake facility	Done
	25	Infectious diseases such as HIV/AIDS	・Consultation with associated authorities (Department of Women Affair / Health)	Done
			・Confirmation on existing programs for disease prevention	Done
C	2	Water pollution	・Study on preventing turbidity production under construction of the intake facility	Done
	10	Biota and ecosystems	・Consultation with Provincial Dep. of Environment in Kampot	Done
			・Field surveys for fauna and flora	Done
	11	Water usage	・Consultation with Fishery Administration Office in Kampot	Done
	18	Existing social infrastructures and services	・Consultation with Provincial Dep. of Social Affair	Done
	19	Poor, indigenous, or ethnic people	・Interviews for the existence of (poor / indigenous / ethnic people) to Sangkat / Commune Office	Done
	20	Misdistribution of benefits and damages	・ Consultation with related authorities / Interview surveys with inhabitants by questionnaire / Confirmation in stakeholder meetings	Done

*) DD: will be conducted at the DD stage

b. Prediction and evaluation of the impacts by the project

Prediction and evaluation of the impacts which may be caused by the project should be

conducted for items evaluated as A, B or C in section **(6) EIA Scoping**.

Each item should be re-evaluated as the survey proceeds and the scoping table should be updated accordingly. Subsequently, items with an A and B shall be evaluated in terms of the extent of the impact.

c. Considerations for the Environment Management Plan (EMP) and the Monitoring Plan

In cases where the project causes unavoidable environment impacts, the EMP will identify how to mitigate the extent of the impacts and the monitoring plan will identify what needs to be done by the authorities to ensure that mitigation measures are effectively implemented. For both EMP and the monitoring plan, considerations for executing the items, frequency, organization, necessary reinforcement of the organization and budget should be provided.

d. Stakeholder consultation

The results of the Environmental and Social Consideration study mentioned above shall be presented at a stakeholder consultation and the stakeholders' opinions shall be collected.

(8) Result of Review of Environmental and Social Impacts

The survey results obtained according to the TOR prepared in the previous section are shown below.

Table 1.3(8)-1 Results of the Review of Environmental and Social Impacts

<table>
<tr><th>Item</th><th>Results</th></tr>
<tr><td>Waste</td><td>① General wastes can be accepted by the existing dumping sites. Special wastes such as construction wastes cannot be accepted.
② Construction wastes such as excavated soil, used concrete, used asphalt can be sold for use as land fill.
③ Old asbestos pipes should be left underground because they cannot be accepted by the dumping sites.</td></tr>
<tr><td>Noise and Vibration</td><td>① The results of noise and vibration survey are shown below. The baseline for noise looks high because of hard rain but the values of vibration are low which indicates artificial impacts such as vehicles or facilities are small.
(1) Noise
Survey Point: New Treatment Plant / Sampling date: August 28, 2014
<table>
<tr><th colspan="2" rowspan="2">Survey Period</th><th colspan="4">Noise Level dB(A)</th><th rowspan="2">Remarks</th></tr>
<tr><th>LAeq</th><th>Standard(Leq)</th><th>Lmax</th><th>Lmin</th></tr>
<tr><td rowspan="6">Day</td><td>6:00 - 7:00</td><td>47.5</td><td rowspan="6">70</td><td>66.1</td><td>33.0</td><td></td></tr>
<tr><td>7:00 - 8:00</td><td>46.3</td><td>68.3</td><td>30.2</td><td></td></tr>
<tr><td>10:00 - 11:00</td><td>52.3</td><td>70.5</td><td>42.7</td><td></td></tr>
<tr><td>11:00 - 12:00</td><td>48.3</td><td>67.5</td><td>39.0</td><td></td></tr>
<tr><td>14:00 - 15:00</td><td>41.7</td><td>55.7</td><td>36.9</td><td></td></tr>
<tr><td>15:00 - 16:00</td><td>43.3</td><td>58.7</td><td>32.2</td><td></td></tr>
<tr><td rowspan="2">Evening</td><td>18:00 - 19:00</td><td>52.1</td><td rowspan="2">65</td><td>60.3</td><td>47.1</td><td></td></tr>
<tr><td>19:00 - 20:00</td><td>52.8</td><td>55.4</td><td>48.9</td><td></td></tr>
<tr><td rowspan="4">Night</td><td>22:00 - 23:00</td><td>51.1</td><td rowspan="4">50</td><td>65.4</td><td>48.5</td><td>Hard rain</td></tr>
<tr><td>23:00 - 00:00</td><td>49.1</td><td>59.6</td><td>46.8</td><td>Hard rain</td></tr>
<tr><td>2:00 - 3:00</td><td>47.9</td><td>58.9</td><td>42.4</td><td>Hard rain</td></tr>
<tr><td>3:00 - 4:00</td><td>44.7</td><td>58.3</td><td>39.7</td><td>Hard rain</td></tr>
<tr><td colspan="2">12 hours Average</td><td>48.09</td><td></td><td>62.06</td><td>40.62</td><td></td></tr>
</table>
Survey Point: Proposed New Intake (Pumping Station) / Sampling date: August 28, 2014
<table>
<tr><th colspan="2" rowspan="2">Survey Period</th><th colspan="4">Noise Level dB(A)</th><th rowspan="2">Remarks</th></tr>
<tr><th>LAeq</th><th>Standard(Leq)</th><th>Lmax</th><th>Lmin</th></tr>
<tr><td rowspan="6">Day</td><td>8:00 - 9:00</td><td>60.1</td><td rowspan="6">70</td><td>76.2</td><td>55.3</td><td></td></tr>
<tr><td>9:00 - 10:00</td><td>60.6</td><td>77.2</td><td>55.8</td><td></td></tr>
<tr><td>12:00 - 13:00</td><td>63.2</td><td>78.6</td><td>57.1</td><td></td></tr>
<tr><td>13:00 - 14:00</td><td>61.8</td><td>80</td><td>54.8</td><td></td></tr>
<tr><td>16:00 - 17:00</td><td>61.2</td><td>74.9</td><td>57.8</td><td></td></tr>
<tr><td>17:00 - 18:00</td><td>61.1</td><td>74.6</td><td>56.8</td><td></td></tr>
<tr><td rowspan="2">Evening</td><td>20:00 - 21:00</td><td>62.9</td><td rowspan="2">65</td><td>79.6</td><td>57.6</td><td></td></tr>
<tr><td>21:00 - 22:00</td><td>60.1</td><td>77.4</td><td>57.1</td><td></td></tr>
<tr><td rowspan="4">Night</td><td>24:00 - 01:00</td><td>57.7</td><td rowspan="4">50</td><td>76.4</td><td>53.5</td><td>Hard rain</td></tr>
<tr><td>01:00 - 02:00</td><td>54.6</td><td>72.9</td><td>53.1</td><td>Hard rain</td></tr>
<tr><td>04:00 - 05:00</td><td>60.2</td><td>73.4</td><td>54.3</td><td>Hard rain</td></tr>
<tr><td>05:00 - 06:00</td><td>58.2</td><td>71.5</td><td>54.5</td><td>Hard rain</td></tr>
<tr><td colspan="2">12 hours Average</td><td>60.14</td><td></td><td>76.06</td><td>55.64</td><td></td></tr>
</table>
Survey Point: In front of Samaki Market / Sampling date: August 29, 2014
<table>
<tr><th colspan="2" rowspan="2">Survey Period</th><th colspan="4">Noise Level dB(A)</th><th rowspan="2">Remarks</th></tr>
<tr><th>LAeq</th><th>Standard(Leq)</th><th>Lmax</th><th>Lmin</th></tr>
<tr><td rowspan="3">Day</td><td>8:00 - 9:00</td><td>71.3</td><td rowspan="3">70</td><td>88.7</td><td>59.2</td><td>Exceeded</td></tr>
<tr><td>11:00 - 12:00</td><td>67.5</td><td>85.3</td><td>54.2</td><td></td></tr>
<tr><td>15:00 - 16:00</td><td>69.7</td><td>85.2</td><td>56.6</td><td></td></tr>
<tr><td colspan="2">Average</td><td>69.50</td><td></td><td>86.40</td><td>56.67</td><td></td></tr>
</table>
Survey Point: In front of Andoung Khmer Highschool / Sampling date: August 29, 2014
<table>
<tr><th colspan="2" rowspan="2">Survey Period</th><th colspan="4">Noise Level dB(A)</th><th rowspan="2">Remarks</th></tr>
<tr><th>LAeq</th><th>Standard(Leq)</th><th>Lmax</th><th>Lmin</th></tr>
<tr><td rowspan="3">Day</td><td>9:00 - 10:00</td><td>62.7</td><td rowspan="3">70</td><td>80.6</td><td>36.5</td><td></td></tr>
<tr><td>13:00 - 14:00</td><td>62.4</td><td>81.3</td><td>33.1</td><td></td></tr>
<tr><td>16:00 - 17:00</td><td>62.6</td><td>83.3</td><td>35.8</td><td></td></tr>
</table></td></tr>
</table>

Item	Results

Average	62.57		81.73	35.13	

(2) Vibration

Survey Point: New Treatment Plant / Sampling date: August 28, 2014

Survey Period		Vibration Level dB(A)				Remarks
		LAeq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	**33.5**	65	56.8	13.9	
	7:00 - 8:00	**35.1**		60.5	13.9	
	10:00 - 11:00	**35.1**		60.6	14.8	
	11:00 - 12:00	**26.8**		55.9	14.5	
	14:00 - 15:00	**33.1**		60.4	14.2	
	15:00 - 16:00	**26.4**		52.1	14.3	
Night	18:00 - 19:00	**26.6**	60	54.8	14.2	
	19:00 - 20:00	**21.2**		45.4	13.7	
	22:00 - 23:00	**22.4**		48.6	14.1	
	23:00 - 00:00	**20.8**		48.4	14.3	
	2:00 - 3:00	**30.1**		48.9	13.5	
	3:00 - 4:00	**24.4**		49.3	14.2	
Average		**27.96**		**53.48**	**14.13**	

Survey Point: Proposed New Intake (Pumping Station) / Sampling date: August 28, 2014

Survey Period		Vibration Level dB(A)				Remarks
		LAeq	Standard(Leq)	Lmax	Lmin	
Day	6:00 - 7:00	**46.8**	65	57.9	42.5	
	7:00 - 8:00	**48.2**		60.8	44.8	
	10:00 - 11:00	**49.1**		58.4	45.9	
	11:00 - 12:00	**49.7**		63.2	40.7	
	14:00 - 15:00	**49.2**		60.2	46.7	
	15:00 - 16:00	**48.5**		54.7	45.6	
Night	18:00 - 19:00	**48.5**	60	55.1	46.1	
	19:00 - 20:00	**48.2**		55.4	45.9	
	22:00 - 23:00	**26.4**		45.5	22.8	
	23:00 - 00:00	**29.7**		53.4	22.3	
	2:00 - 3:00	**49.3**		55.7	44.6	
	3:00 - 4:00	**49.6**		58.0	46.9	
Average		**45.27**		**56.53**	**41.23**	

Survey Point: In front of Samaki Market / Sampling date: August 29, 2014

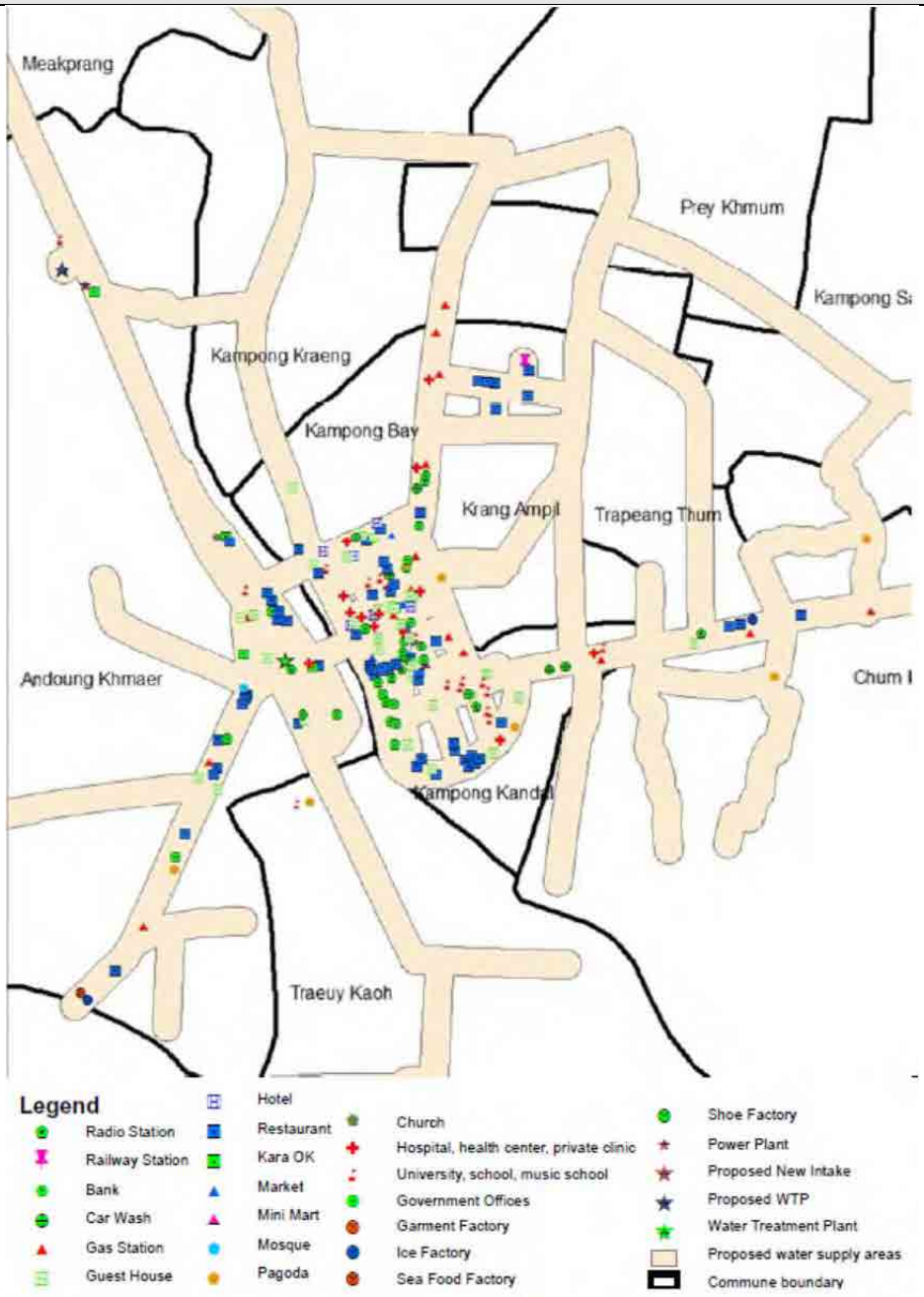
Survey Period		Vibration Level dB(A)				Remarks
		LAeq	Standard(Leq)	Lmax	Lmin	
Day	8:00 - 9:00	**44.5**	65	60.1	34.8	
	11:00 - 12:00	**45.3**		68.5	30.5	
	15:00 - 16:00	**44.7**		61.4	30.4	
Average		**44.83**		**63.33**	**31.90**	

Survey Point: In front of Andoung Khmer Highschool / Sampling date: August 29, 2014

Survey Period		Vibration Level dB(A)				Remarks
		LAeq	Standard(Leq)	Lmax	Lmin	
Day	8:00 - 9:00	**43.6**	65	67.1	13.9	
	11:00 - 12:00	**40.9**		67.8	14.1	
	15:00 - 16:00	**42.5**		72.9	14.1	
Average		**42.33**		**69.27**	**14.03**	

Measured by WE (Water & Energy) Group Co.,Ltd.

② The result of survey on proposed construction sites and the surrounding facilities is shown below.

Item	Results
	 **Facilities in and around the target sites**
Geographical features	① The design of facilities and the construction process are aimed at minimizing geographical impacts.
Accidents	① It was confirmed that the Dep. of Labor / Health have a cooperation system for the construction contractor. ② It was confirmed that the Dep. of Labor / Health have their educational programs for the construction contractor.
Land use	① High turbidity water will be prevented by the intake facility construction on the land in dry season.
Infectious diseases such as HIV/AIDS	① It was confirmed that the Dep. of Health has a cooperation system for the construction contractor. ② It was confirmed that the Dep. of Health has an educational programs for HIV/AIDS

Item	Results
	prevention.
Water pollution	① Turbidity will be prevented by constructing the intake facility above water during the dry season. ② Sludge from the WTP will be introduced into a sludge pond to be separated into sludge and supernatant. Supernatant will go back into the WTP for treatment and discharge will be produced in rare cases.
Biota and ecosystems	① It was confirmed by the Provincial Dep. of Environment that the project will give no significant impacts to biota and ecosystems because the sites are composed of public roads, KWW-owned land and a private land ② Rare kinds of trees were found in the planned intake facility site by the fauna and flora survey.
Water usage	① It was confirmed by the Fisheries Administration Office that the project will give no significant impacts to fisheries because professional fisheries are conducted only in the sea.
Existing social infrastructures and services	① It was confirmed by the Provincial Dep. of Social Affair that the project will give no significant impacts to existing social infrastructures and services.
Poor, indigenous, or ethnic people	① Poor people will be supported by unpaid free of charge household connection plan. ② It was confirmed that no indigenous people inhabit the project area. ③ Ethnic people live in the target area.
Misdistribution of benefits and damages	① It was confirmed by the Provincial Dep. of Social Affair and through the stakeholder meeting that the project will have no significant impacts on account of the misdistribution of benefits and damages.

(9) Prediction and Assessment of Environmental Impacts

The scoping shown in **Table 1.3(6)-1** was updated based on the EIA study items identified in **Table 1.3(8)-1**, The predicted impacts, evaluation results and the mitigation measures are presented in **Table 1.3(9)-1**. The table includes the proposed EMP measure for each item.

Table 1.3(9)-1 Results of Prediction and Evaluation of Impacts

Items	Scoping	Evaluation result	Reason / Mitigation measure
2 Water pollution	C	D	Construction of the intake facility will be above water during the dry season and will not create turbidity in the water. Sludge from the WTP will be introduced into a sludge pond to be separated into sludge and supernatant. The supernatant will go back into the WTP and even rare discharges would only be supernatant. Thus, environment impacts are avoided.
4 Waste	B	B	General waste can be accepted by existing dumping sites. Special waste such as excavated soil, used concrete and used asphalt cannot be accepted by the dumping sites but can be sold for use as land fill. Old pipes made of asbestos cannot be accepted by the dumping sites so should be left underground. Thus, no impacts to the environment are expected. However, it is recommended to monitor the method of handling wastes.
	EMP		Monitoring the waste disposal handling method
5 Noise and vibrations	B	B	Noise and vibration will be caused by construction and transportation activities.
	EMP (also in		Baseline measurement surveys were conducted but only one time during the rainy season for IEE. In the DD stage further baseline measurements and predictions are

	DD)		planned. Mitigation measures such as low-noise / low-vibration type machinery and restrictions on speed of vehicles should be described in the Specifications for the contractor.
8 Geographical features	B	B	Geographical features could be affected by building the foundations for the facilities.
	Design		The design of facilities and the construction process are aimed at minimizing geographical impacts In addition, the area to be affected is limited.
10 Biota and ecosystems	C	B	Rare kinds of trees were found at the planned intake facility site by the fauna and flora survey but are not located near the new intake facility.
	Design		The intake facility was located away from the trees. Thus, it is not necessary to cut them down.
11 Water usage	C	D	The project will have no significant impacts to fisheries because professional fisheries are not conducted in the river.
12 Accidents	B	B	Accidents can happen during construction and operation of the facilities. Construction accidents can be prevented by instruction and programs provided by the Provincial Dep. of Labor. As for the WTP, the design ensures the safety of the structure and manuals ensure the safety of operation and maintenance activities (at DD stage).
	Design /EMP		Design for easy access and equipment repair. Thorough safety management during construction.
14 Land acquisition	B	B	Land acquisition for the WTP was necessary and conducted in accordance with JICA Guidelines.
16 Land use	B	B	Construction could cause dust and turbidity. Dust can be prevented by adequate watering and using covers on hauling vehicles. Construction of the intake facility should not cause turbidity because it will take place on the land during the dry season.
	EMP		Dust countermeasures include watering, covering, etc.
19 Poor, indigenous, or ethnic people	C	D	Poor people will be supported by free of charge house connections. No indigenous people inhabit in the site. Ethnic people live in the target area but they have nothing to do with the priority of water supply planning.
20 Misdistribution of benefits and damages	C	D	No possible adverse impacts are expected. (result of consultation with related authorities / interviews with inhabitants by questionnaire / confirmation in stakeholder meetings)
25 Infectious diseases such as HIV/AIDS	B	B	Long stay of external labor workers is expected and preventative measures for infectious diseases such as HIV/AIDS are necessary.
	EMP		Implementation of a health and hygiene program / Consultation with associated authorities (Department of Women Affair / Health)

【Evaluation】 A：Large adverse impact is expected, B：Some adverse impact is expected,
C：An adverse impact is indistinct, D：No adverse impact is expected

(10) Mitigation Measures and the Cost

a. Mitigation

Based on the results identified in section **(9) Prediction and assessment of environmental impacts** mitigation measures to be taken are shown in the Environmental Management Plan (EMP). The contents should be updated according to modifications made at subsequent stages of the project.

b. Cost

The cost of mitigation measures is included in the construction cost. Therefore, it is not necessary to estimate mitigation cost in terms of Environmental Social Consideration.

Table 1.3(10)-1 Environmental Management Plan (Draft)

No.	Activities	Negative impacts	Mitigation measures	Cost component	Implementation Unit	Supervision Unit
I	**Preparation phase**					
1	Environmental background	Dust	Identify baseline data and parameters to monitor the impact of the project.	Monitoring cost	Contractor / PMU	MoE / MIH / DIH / KWW
2		Noise / Vibration				
II	**Construction phase**					
1	Construction and transfer of materials and waste	Dust	Use watering agents to prevent or reduce dust. Drive construction vehicles slowly with load covers	Construction cost / Monitoring cost	Contractor / PMU	MoE / PDoE / MIH / DIH / PDIH / KWW
2		Noise / Vibration	Drive construction vehicles slowly when transferring the soil. Maximize use of low-vibration & low-noise machineries. Prevent or minimize operation of heavy equipment at night			
3		Worker & public injury	Follow workplace health and safety regulations of Labor Law (No.CS/RKM/0397/01-March13,1997) Utilize sanitary programs. Consult local health authority Use sufficient signage and fencing at construction sites	Construction cost / Monitoring cost	Contractor / PMU	PDoH / PDoL / KWW
4	Construction worker presence, and camp operation	Solid waste and domestic waste pollution	Institute regular solids waste collection and disposal program including placement of disposal bins throughout camp and at all construction sites. Ensure adequate number of latrines at camp cleaned regularly. Temporary latrines maintained at construction sites.	Construction cost / Monitoring cost	Contractor / PMU	MoE / PDoE / MIH / DIH / KWW
5		Worker and public health problems /	Ensure proper hygiene in worker camps. Workers should be tested for	Construction cost /	Contractor / PMU / DPWS (Department	PDoH / PDoL / MIH / DIH /

No.	Activities	Negative impacts	Mitigation measures	Cost component	Implementation Unit	Supervision Unit
		HIV&AIDS prevention	communicable disease. Locate worker camp away from residential areas	Monitoring cost	of Potable Water Supply)	KWW
6		Worker & public safety	Follow workplace health and safety regulations of Labor Law. Sufficient signage and fencing at construction sites			
7	General construction activities	Production of solid wastes	Implement solid waste collection and disposal program. Prepare temporal storage of wastes until being taken.	Construction cost / Monitoring cost	Contractor / PMU	PDoE / MoE / MIH / DIH / KWW
II	**Operation phase**					
1	Operation	Noise / Vibration	Confirmation on Noise / Vibration levels	Monitoring cost	MIH / DIH / KWW	PDoE / MoE
2		Solid waste pollution	Confirmation on Sludge dumping	As above	As above	As above
3		Worker safety	Confirmation on Chlorine management	As above	As above	PDoH / PDoL

(11) Monitoring Plan and the Cost

a. Monitoring

The monitoring plan is shown below. The monitoring plan is necessary for implementing the EMP shown above. The contents should be updated according to modifications made at subsequent stages of the project.

Table 1.3(11)-1 Monitoring plan (Draft)

Summary of Impact / Mitigation	**Monitoring Indicators**	**Location**	**Frequency**	**Responsibility** Supervision / Implementation	**Reporting**
Pre-Construction Phase					
M-1: Noise / Vibration	Decibel (dBa) levels	1 station near Intake site, 1 station near WTP site, 5 stations along pipelines (7st.)	2 times with an interval of 2months or longer	Contractor / PMU / Environmental Specialist (ES)	Monitoring reports prepared quarterly for MoE
Construction Phase					
M-2: Noise / Vibration	Decibel (dBa) levels	1 station near Intake site, 1 station near WTP site, 5 stations along pipelines (7st.)	2/year	Contractor / PMU / ES	Monitoring reports prepared quarterly for MoE
M-3: Dust	Frequency of watering	As above	4/year	As above	As above
M-4: Collection and disposal (excavated solid / construction waste / general waste) and placement of dust bins	Outline of waste (kind and amount) / waste management in the sites and worker camps	The 7stations above and worker camps	2/year	As above	As above
M-5: Labor safety management and signing / fencing	Details of accidents and injuries	The 7stations above	2/year	As above	Monitoring reports prepared 2/year for PDoH / PDoL

Summary of Impact / Mitigation	Monitoring Indicators	Location	Frequency	Responsibility Supervision / Implementation	Reporting
M-6: Health and sanitation for labor workers and the public	Compliance of the program by Department of Health and Labor	The 7stations above and worker camps	2/year	As above	As above
Operation Phase					
M-7: Noise / Vibration	Decibel (dBa) levels	Each station near Intake and WTP site (2 st.)	2/year	MIH / DIH / KWW	PDoE / MoE
M-8: Solid waste pollution	Confirmation on Sludge dumping	1 station at Lagoon	Every month	As above	As above
M-9: Labor safety management	Confirmation on Chlorine management	Chlorine related facilities	2/year	As above	PDoH / PDoL

b. Cost

The cost to execute the monitoring plan is shown below.

Table 1.3(11)-2 The Cost for Monitoring Plan

Item	Station	Time	Unit price (USD/Station/Time)	Cost (USD)
Pre-Construction / Construction Phase				
M-1-1: Noise (baseline)	7*)	2 (for averaging)	1000	2000
M-1-2: Vibration (baseline)	7*)	2 (for averaging)		
M-2-1: Noise (construction phase)	7*)	5 (2/year x 2.5year)	1000	5000
M-2-2: Vibration (construction phase)	7*)	5 (2/year x 2.5year)		
M-3: Dust	7*)	10 (4 /year x 2.5year)	300	3000
M-4: Monitoring collection and disposal (excavated solid / construction waste / general waste) and placement of dust bins	12**)	5 (2/year x 2.5year)	300	1500
M-5: Monitoring labor safety management and signing / fencing	7*)	5 (2/year x 2.5year)	300	1500
M-6: Monitoring health and sanitation for labor workers and the public	36***)	5 (2/year x 2.5year)	400	2000
Overhead cost				4200
Tax				1920
Total				21120
Operation Phase				
M-7: Noise / Vibration	2(Intake & WTP)	5 (2/year x 2.5year)	1500	7500
M-8: Solid waste pollution	1(Lagoon)	15 (6 /year x 2.5year)	0 (by personnel)	0
M-9: Labor safety management	-	5 (2 /year x 2.5year)	0 (by personnel)	0
Tax				750
Total				8250

*) 1 station near Intake site + 1 station near WTP site + 5 stations along pipelines＝7 stations

**) 7stations of *)＋5 stations from worker camps ＝ 12stations

***) 3 habitants for each 7 stations (21 people)＋15 workers as camp residents＝36 people

(12) Stakeholder Meeting

(12)-1 General stakeholder meeting

A stakeholder meeting was held at DIH of Kampot from 8:00 to 11:00 on the 29th August, 2014 Attendees were mainly project affected inhabitants. The majority of comments from the attendees were statements of thanks for the project. Other issues were as following and there were no significant issues or objections.

- Request to announce in advance for disruptions to water supply services.
  ⇒ Prior notice will be given as well as any possible impact from the construction
- Request to explain why Boeng Tuk is not included in the scope of the project despite having an industrial district development plan.
  ⇒ Because the district is far from the WTP and has a low population at present.
- Concern about salt water at the intake like the case in 2006.
  ⇒ Salt water intrusion should not happen if the dam maintains the required amount of minimum flow.
- The project will be funded by a grant. How about house connections?
  ⇒ The project will include the distribution network but not the house connections.
- Necessity of paying for connections for households who are already connected.
  ⇒ Only newly connected households should pay.

Table 1.3(12)-1 General Stakeholder Meeting

Subject	Draft scoping / consultation on proposed survey methods
Time	2014/8/29 8:00～11:00
Venue	Provincial Department of Industry and Handicraft, Kampot
Main issues	- Outline of the project - Draft scoping / consultation on proposed survey methods / conducted survey results - Q & A
Stakeholders	Shown in **Table 1.3(12)-2**

Table 1.3(12)-2 Attendants to the General Stakeholder Meeting

Position	#
Representatives from Communes or upper level municipalities	10
Representatives from Villages	10
Villagers	12
Personnel from KWW / PDoE	6
Total	38

(12)-2 Individual stakeholder meetings

Consultation meetings were held as JPST visited individual authorities. Statements from them were mainly statements of thanks or cooperative opinions. The only significant concern was the fear of salt water intrusion into the intake that they had before.

Table 1.3(12)-3 Summary of Individual Stakeholder Meetings

Date	Name	Position and Organization	Idea, Comments, and Questions
Sept 12, 2014	Mr. Im Sophorn	Office Director of Industry Works, PDIH	Statements of thanks only
Sept 12, 2014	Mr. Sor Samedy	Deputy Chief of Technical Bureau, Kampot Provincial Health Department	Commitment for cooperation for providing instruction and a program.
Sept 12, 2014	Mr. Chan Rith	Deputy Director of Department of Agriculture	Agricultural products are attractive to tourists visiting to Kampot. Water supply is one of the important services for tourism too.
Sept 12, 2014	Mr. Long Sreng	Deputy Director of Department of Environment (responsible for EIA)	No concern about excavated soil due to request from land fillers. General wastes can be accepted by existing dumping sites. It is suggested to leave asbestos pipes underground because they cannot be accepted by the dumping sites.
Sept 12, 2014	Mr. Say Sinol	Director of Department of Tourism	This project is very important for us because it will help our development. A development plan is submitted to the national level and will be approved. The numbers of tourists are increasing and improvement of quality and quantity of water is needed. We would like to request a project for irrigation development, too.
Sept 15, 2014	Ms. Long Savorn	Deputy Director of Department of Labor and vocational training	As for impacts to children, no concern for those that are 14 years old or younger because they cannot work. Children aged 15 to 17 can work but are not allowed to work with heavy loads so the contractor should be careful.
Sept 15, 2014	Ms. Tith Setha	Director of Department of Women Affair	The project will give good influence to women and children because they will have more time to take care of children and the family. Water borne diseases will be reduced. We hope JICA will provide other projects caring for poor people who live far from the town with unsterilized water. We are concerned about salt water distribution that we had before.
Sept 15, 2014	Mr. Sor Sorin	Chief of Fisheries Administration Office	More water supply is needed for better services because we provide sea products to tourists to Kampot and other parts in Cambodia. It is not worried that the project is giving adverse impacts to fisheries because professional fisheries are conducted only in the sea, not in the river. We are concerned about salt water distribution that we had before.
Sept 16, 2014	Mr. Suo Sok	Chief of Administration office in Department of Social Affair	It is not expected that the project gives any adverse impact to the existing social infrastructures or services. Instead, working opportunity increases. We care concerned about poor people having to pay the house connection fee. (Answered that house connections for poor people will be free of charge)

(13) Land Acquisition and Resettlement

(13)-1 Necessity of Land acquisition and resettlement

As mentioned in "**(5) Comparison of alternatives**", land acquisition was conducted because there is not enough space at the existing WTP. The proposed site for the new WTP is located

between the intake and the distribution area, at a relatively higher elevation. Furthermore, no resettlement is necessary, which makes this land an ideal place for the new WTP.

(13)-2 Legal framework for Land Acquisition and Resettlement

Cambodia enacts constitution (1993), Land Law (2001) and Land Acquisition Law (2009).
The outline of these is described as follows.

a. Constitution (1993)

Article 44 secures the right of the land possession of Cambodia people and prohibits the possession by foreign people and company. Article 58 stipulates that the natural resources such as water, river, mine, geology, forest, shore etc. belongs to the state or local authority.

b. Land Law (2001)

Article 4 also secures the right of the land possession of Cambodian people as article 44 of Constitution while Article 5 stipulates that the right is secured except for the benefit for the public purpose.

Article 12 stipulates that the State is the owner of the properties in the territory of the Kingdom of Cambodia enumerated in Article 58 of the 1993 Constitution and of all properties that are escheat, or that are voluntarily given to the State by their owners, or that have not been the subject of due and proper private appropriation or that are not presently being privately occupied.

Article 15 stipulates that the property such as river, lake, structure for public service such as road etc. falls within the public property of the State and public legal entities.

Article 35 stipulates that only the competent authorities may, on behalf of the State and public legal entities, force occupants without title or insufficient titles to vacate the immovable property.

c. Expropriation Law (2009)

Article 1 stipulates the objective of the law, such as defining principle, mechanisms and procedures.

Article 3 stipulates that the law shall be applied to expropriations involving public physical infrastructure projects in the Kingdom of Cambodia not for expropriations investment by partner countries.

Article 5 stipulates the projects subject to EIA/IEIA.

Article 12 to 14 stipulate the expropriation mechanism, such as Expropriation Committee: EC, Expropriation Sub Committee: SEC and Complaint Resolution Committee.

Although, the articles stipulate that the details of the mechanisms and functions shall be defined in sub-decree, the said sub-decree has not been enacted yet.

Article 19 stipulates that the expropriation of the ownership of immovable property and real right to immovable property can be exercised only if the Expropriation Committee has paid fair

and just compensation to the property's owner.
Article 22 stipulates that financial compensation given to the property owner and/or rightful owner shall be based on a market price or replacement price on the date of declaration of the expropriation.

(13)-3 Scale of Land Acquisition and Resettlement

Land acquisition of 0.9 ha was conducted for the WTP but no resettlement was necessary.

(13)-4 Compensation

Land acquisition was conducted with adequate price in accordance with the Cambodian law and JICA Guidelines.

(13)-5 Grievance Mechanism

No grievance mechanism is required because no resettlement is necessary.

(13)-6 Implementation Structure for Land Acquisition and Resettlement

MEF conducted the land acquisition.

(13)-7 Implementation schedule

Negotiation was finalized in September, 2014 and the land acquisition was conducted in October, 2014.

(13)-8 Budget and Financial source

The budget for land acquisition was covered by MEF's financial resources.

(13)-9 Monitoring framework for implementation organization and monitoring form

A monitoring framework and the monitoring form are not required because there is no resettlement.

(13)-10 Stakeholder Meeting

Negotiation between MEF and the land owner was conducted twice and they agreed each other.

(14) Schedule for Environmental and Social Consideration

Field surveys for IEIA were finished in September, 2014. The Draft IEIA Report and the Final Report of the Project will be submitted in March, 2015. The IEIA evaluation process will take approximately 3 months and the outcome is expected by the end of July, 2015.

(15) Others

(15)-1 Monitoring Form (draft)

Monitoring form according to the monitoring plan is shown below. Table numbers are corresponded to the numbers shown in **Table 1.3(11)-1**.

-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.

1) Monitoring Results of Noise / Vibration

Table M-1-1 Results (Noise) **Item: Noise** **Unit: dB(A)**

No.	Date	Measured Value						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Pre-Construction Phase (Baseline)								
1								
2								
Construction Phase								
1								
2								
3								
4								
5								

Table M-1-2 Results (Vibration) **Item: Noise** **Unit: dB(A)**

No.	Date	Measured Value						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Pre-Construction Phase (Baseline)								
1								
2								
Construction Phase								
1								
2								
3								

4								
5								

Table M-1-3 Station

Measured Station	Adopted Standard*)	Detailed location
St.1		
St.2		
St.3		
St.4		
St.5		

***) Refer to Table M-1-3**

Table M-1-4 National Standard Values for Noise (Cambodia)

Type of Area	Standard Value in dB(A)		
	6.00-18.00	18.00-22.00	22.00-6.00
Quiet Areas (Hospital, Library, School, Kindergarten)	45	40	35
Residential Areas (Hotel, Administrative Office, Villa, Flat)	60	50	45
Commercial and Service Areas and Area of multiple businesses	70	65	50
Small industrial factories mingling in residential area	75	70	50

Table M-1-5 National Standard Values for Vibration (Cambodia)

Standard (Leq) Value in dB(A)		
6.00-18.00	18.00-22.00	22.00-6.00
65	60	60

2) Monitoring Results of Dust Pollution

Table M-2-1 Results **Item: Dust** **Mark: "✔" if Watering is done**

No.	Date	Watering Result						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Construction Phase -1st Year								
1								
2								
3								
4								
Construction Phase -2nd Year								
1								
2								
3								
4								
Construction Phase -3rd Year								
1								
2								
3								
4								

Table M-2-2 Station

Observed Station	Detailed location	Remark
St.1		
St.2		
St.3		
St.4		
St.5		

3) Monitoring Results of Waste Management

Table M-3-1 Result as of (Date:_____) Item: Waste Management Mark: "✔" if management is good

Station	Location	Kind of Waste	Whole amount (m^3)	Receiving Dumping Site	Situation of General Waste Management / Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year No. (1 / 2)					
Intake					
WTP					
St. 01					
St. 02					
St. 03					
St. 04					
St. 05					

Table M-3-2 Result as of (Date:_____) Item: Placement of Dust Bins Mark: "✔" if management is good

Station	Placement of Dust Bins	Situation of General Waste Management	Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year ; No. (1 / 2)			
In and around the Worker Camps			
Camp-01			
Camp-02			
Camp-03			
Camp-04			
Camp-05			

4) Monitoring Results of Safety Management

Table M-4 Result as of (Date:_____) **Item: Safety Management** **Mark: "✔" if management is good**

Station	Location	Description of Incident (Injury, Accident and so on)	Situation of Fencing and Other Safety Management / Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year ; No. (1 / 2)			
Intake			
WTP			
St. 01			
St. 02			
St. 03			
St. 04			
St. 05			

5) Monitoring Results of Sanitary Management

Table M-5-1 Result as of (Date:_____) **Item: Sanitary Management** **Mark: "✔" if the item is well conducted**

Interviewee	Items indicated by Sanitary Program				
	i)	ii)	iii)	iv)	Remark (detailed location)
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year No. (1 / 2)					
In and around the Worker Camps					
Camp-01					
Camp-02					
Camp-03					
Camp-04					
Camp-05					
In and around the Construction Sites					
Intake-1					
Intake-2					
Intake-3					

WTP-1					
WTP -2					
WTP -3					
St.1-1					
St.1-2					
St.1-3					
St.2-1					
St.2-2					
St.2-3					
St.3-1					
St.3-2					
St.3-3					
St.4-1					
St.4-2					
St.4-3					
St.5-1					
St.5-2					
St.5-3					

(16) Environmental Checklist

The environmental checklist for the Project is shown below.

Table 1.3(15)-1 Environmental Checklist

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) N (c) N (d) Y	(a)(b) The IEE report is being prepared (September, 2014) and is going to be approved by the end of July, 2015. (c) No conditions added (d) The permission of 0.17m^3/sec for the intake of water supply by appropriate government body is necessary.
	(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) Y (b) Y	(a) By holding the stakeholder meetings, adequate explanation was done and stakeholders agreed the project basically. (b) Comments (such as a request of announcement before water cut / questions of connection fee) were stated but none of them was critical.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternative plans were explained in the stakeholder meeting.
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) Y	(a) There is no possibility to cause air pollution. / For accident prevention, leakage monitoring system will be installed. (b) By utilising closed system (no emission to atmosphere), the chlorine concentrations comply with the standards.
	(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) Y	(a) The close system is adopted and even occasional effluent is designed to be clean after lagoon treatment.
	(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) Y	(a) The country's regulation allows to discharge sludge directly but a sludge lagoon will separate sludge and it will be dried, transferred and sold.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The intake pump will be installed underground and little noise can be produced. The transmission pump will be installed in the WTP site being covered with RC walls and noise will not reach the boundary of the site.
	(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	(a) No groundwater will be exploited.
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) The project sites are all outside of protected areas. No adverse impacts are expected by the project.

	(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) N/A (d) N	(a) The sites were studied but no habitats were found. (b) The intake planned site has a few ecologically valuable trees but the construction does not affect them. (c) As above (d) The upstream dam will release more than intake flow and the amount will be maintained.
	(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) The upstream dam will release more than intake flow and the amount will be maintained.
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? (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?	(a) N (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No resettlement occurs (b) As above (c) As above (d) As above (e) As above (f) As above (g) As above (h) As above (i) As above (j) As above
4 Social Environment	(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) Y (b) N	(a) Construction activities can cause inconvenience to inhabitants but the countermeasures for impact minimization were agreed in the stakeholder meeting. (b) Positive impact such as prevention of ground water exploitation is possible, instead.
	(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) The sites are all within developed lands and no heritage exists there.

	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Intake facility and WTP will locate out of sight from public places.
	(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) N (b) N/A	(a) No indigenous peoples inhabit in the site. No descrimination is recognized among the ethnic groups. (b) As above
	(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 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?	(a) Y (b) Y (c) Y (d) Y	(a) Labor Law, 1997, No. CS/RKM/0397/01 will be complied with. (b) Law as above stipulates safety considerations (c) Adequate program will be held by consultation with the Department of Labor / Health (d) As above
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/A (c) Y (d) Y	(a) Any possible impacts are considered and mitigations are suggested in the EMP (b) The sites were studied but no habitats were found. (c) Construction activities can cause inconvenience to inhabitants and the countermeasures for impact minimization were agreed in the stakeholder meeting. (d) Every construction site can be avoided by bypassing.
5 Others	(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) Y (c) Y (d) Y	(a) The monitoring plan was prepared according to the EMP. (b) The monitoring contents were consulted with the environmental authority. (c) The monitoring plan includes such components. (d) As above
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) N/A	(a) No dams are included as project components and No impacts to the river are expected.
	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) N/A	(a) The project does not have possibility of significant adverse impacts on environment.

1.4 Present Conditions of Project Area

1.4.1 Population

Kampot Province is the eleventh largest province in Cambodia. The province has 8 districts and 97 communes as described in **Appendix–7**. **Table 1.4.1-1** shows the population in Kampot Province as listed in the 1998, 2008 and 2013 census.

Table 1.4.1-1 Population in Kampot Province

	Population*			Annual Population Growth Rate (APGR)	
	1998	2008	2013	1998-2008	2008-2013
Kampot Province	528,405	585,850	611,557	1.04%	0.86%

*: National Institute of Statistics, Ministry of Planning, Cambodia

1.4.2 Water Supply Conditions

Kampot Waterworks is responsible for water supply to urban areas of Kampot Province. **Figure 1.4.2-1** shows the existing water supply area.

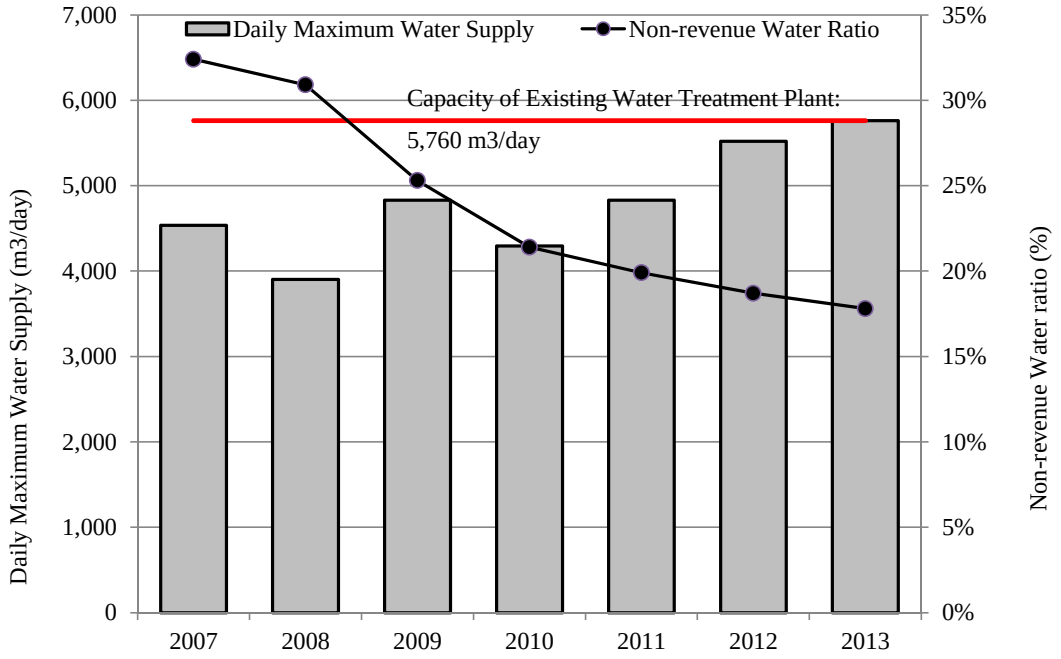
Source: JPST

Figure 1.4.2-1 Existing Water Supply Area

Figure 1.4.2-2 shows the daily maximum water supply and non-revenue water ratios from 2007 to 2013. Production capacity at the existing water treatment plant is 5,760 m^3/day. Daily maximum water supply in 2013 was 5,760 m^3/day which is the same as the plant capacity.

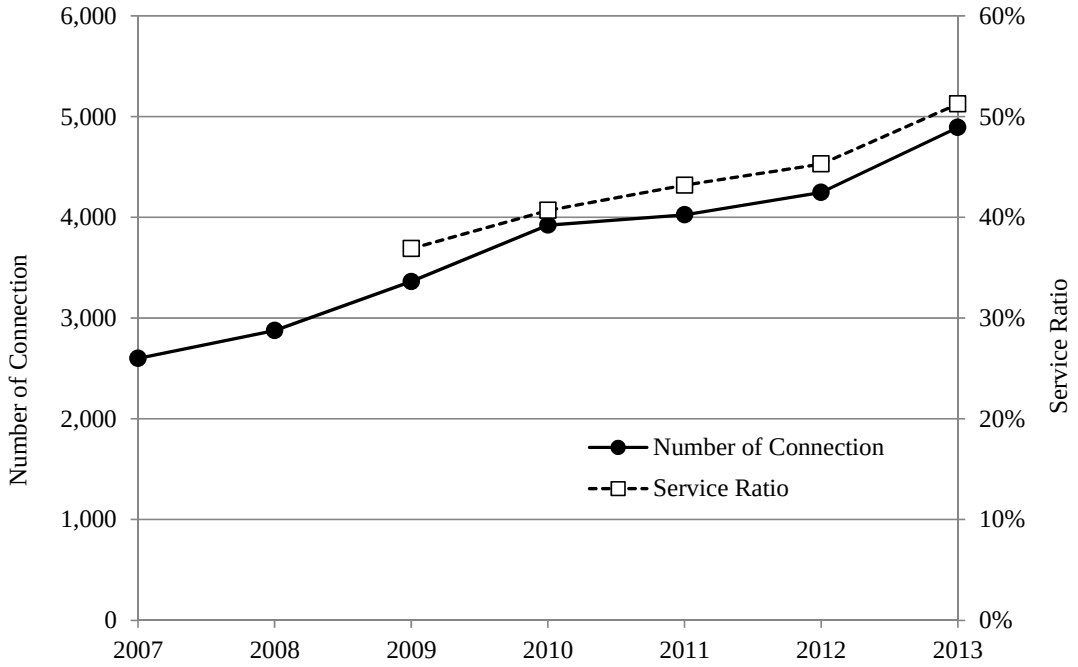
Future water demand will increase and the plant capacity needs to be expanded. **Figure 1.4.2-3** shows the number of connections and service ratios.

General information on Kampot Waterworks is shown in **Appendix-7**.



Source: Technical Cooperation Project Phase 3

Figure 1.4.2-2 Daily Maximum Water Supply and Non-revenue Water Ratios



Source: Technical Cooperation Project Phase 3

Figure 1.4.2-3 Number of Connections and Service Ratios

The water supply capacity in Kampot is inadequate. Only about 50% of the residents in Kampot have access to safe water. Others rely on rain water, groundwater and water vendors for their supply, as shown in **Photo 1.4.2-1**.

	
Usage of Rain Water	Usage of Rain Water

	
Usage of Groundwater	Water from Water Vendor

Photo 1.4.2-1 Alternative Water Sources outside Supply Area (Oct. 2014)

This preparatory survey shows that 4 out of 32 households served by the water supply system have filed a grievance regarding water pressure, and 16 households (50%) would like to have improved water pressure. Households with no water supply are using untreated rain water or groundwater; 66 out of 71 of these households would like to receive safe water from the water supply system. The development and improvement of water services would respond to the needs expressed by many residents in Kampot. The expanded water supply would also improve public health, personal hygiene, and overcome water shortages.

1.4.3 Organization

(1) Ministry of Industry and Handicraft

Sub-Decree No. 575 ANKR-BK, December 2013, assigned the responsibility for urban water supply to the Department of Potable Water Supply (DPWS), under the Ministry of Industry and Handicraft (MIH). **Figure 1.4.3-1** shows the organization of MIH. The implementing and operating agencies are the Department of Industry and Handicraft (DIH) and Kampot Waterworks. The DIH is the local arm of the MIH and Kampot Waterworks operates under the auspice of DIH. Kampot Waterworks will be responsible for the smooth implementation of this Project and for the operation and maintenance of the water supply facilities.

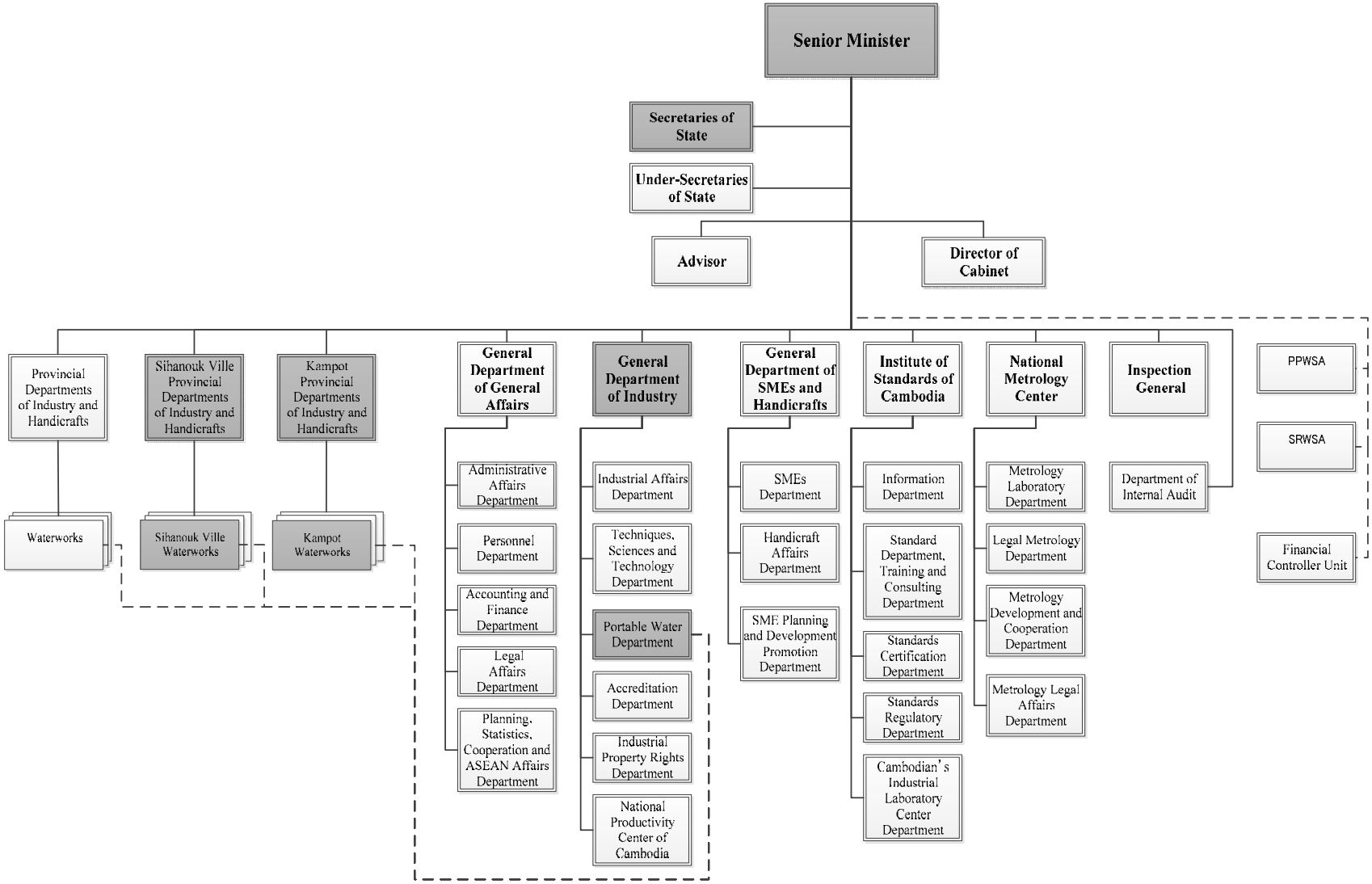


Figure 1.4.3-1 Organization of Ministry of Industry & Handicraft

(2) Kampot Waterworks

Kampot Waterworks has a total of 35 staff as shown in **Table 1.4.3-1** and **Figure 1.4.3-2** including one Director and three Deputy Directors.

Table 1.4.3-1 Staff at Kampot Waterworks in 2014

Function	Responsibilities	Number of Staff
Director	Overall responsibility for the management and operation of the water supply system	1
Deputy Director	Assist the Director, attend meetings in the directors absence, oversee specific departments such as finance and accounting	3
Accounting-Finance	Tariff collection, accounting, inventory control	4
Business	Meter reading, billing, customer management	7
Administration & Planning	General affairs	3
Networks	Service connections, distribution pipelines	9
Technical	O&M of treatment plant and intake, water quality control	8
Total		35

Note: including one chief for each section

The breakdown of the personnel allocated to each of the 3 technical sections is as follows:

- ○ Networks: 9 staff (headed by Deputy Director)
  Chief of Networks: 1, Service Connections: 4, Distribution Pipeline: 4
- ○ Technical (treatment plant and intake): 9 staff (headed by Deputy Director)
  Chief of Technical: 1, Intake: 2, Treatment Plant: 4
- ○ Technical (water quality control): 1 staff (headed by Chief of Technical)

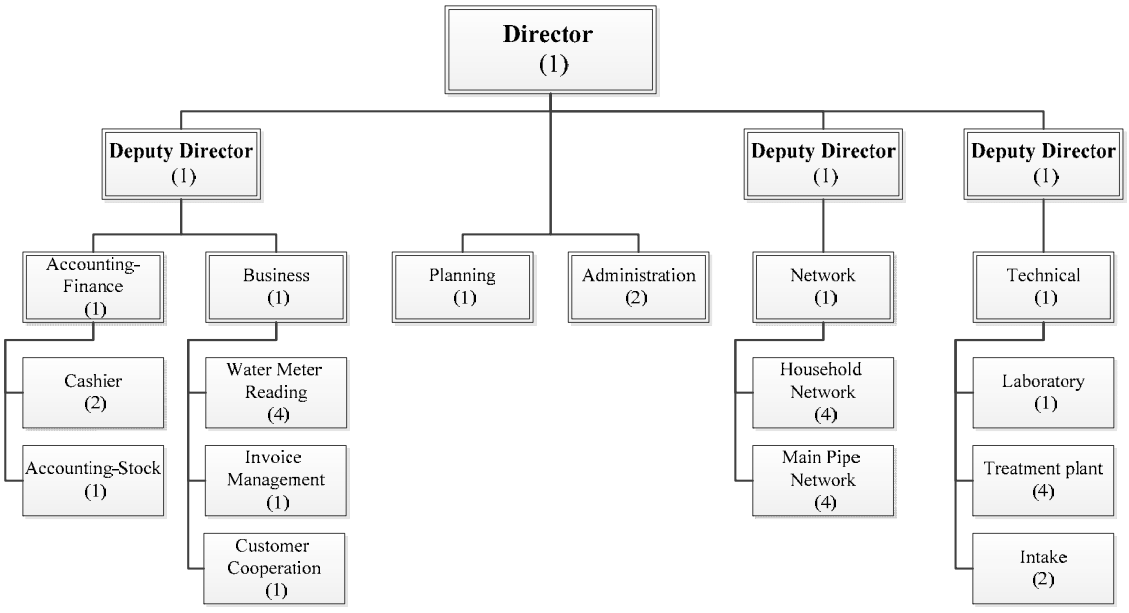


Figure 1.4.3-2 Organizational Structure for Kampot Waterworks

Capacity building for water supply systems in Cambodia (Phase 2) was conducted at eight provincial waterworks, including Kampot Waterworks, by the Japan International Cooperation Agency (JICA). The skill level of the staff at the waterworks increased significantly. It was concluded that "Due to the considerable increase in the capability of the water supply service personnel, which had been exceedingly limiting, it has become possible to provide a safe and stable water supply in the Targeted Provincial Waterworks (TPWs)". Kampot Waterworks has the basic skills required to operate the existing and proposed water treatment plant.

1.4.4 Budget

Kampot Waterworks' financial information for the past 3 years (**Table 1.4.4-1**), shows that it has been operating at a loss if depreciation (asset replacement) costs are included.

Table 1.4.4-1 Financial Condition of Kampot Waterworks (unit: million Riel)

		2011	2012	2013
Revenue	Operating Income	1,577	1,665	1,980
	Water Tariff	1,560	1,650	1,883
	Trust Construction	17	15	97
	Others	0	0	0
	Non-operating Income	69	3	139
	Total	**1,647**	**1,668**	**2,119**
Expenses	Operating Expenses	1,807	1,743	1,929
	Personnel	246	254	207
	Power	503	529	593
	Fuel	47	54	55
	Chemicals	167	178	189
	Repairs	134	42	89
	Depreciation	565	576	640
	Administrative	72	94	82
	Others	73	16	74
	Non-operating Expense	21	17	38
	Others	5	0	0
	Tax	16	17	38
	Total	**1,829**	**1,759**	**1,967**
Profit		**-182**	**-91**	**152**

1.4.5 Existing Facilities

(1) Condition of Existing Intake Facilities

1) Hydraulic and Water Quality Conditions

The existing water intake facility is located approximately 20 km upstream of the mouth of Prek Kampot River. The Kamchay hydroelectric dam is located approximately 1 km upstream of the existing water intake facility and started operating in 2012. The water level and flow volume at the existing water intake point depend on the discharge volume from the upstream hydroelectric dam.

Table 1.4.5-1 Hydraulic and Water Quality Conditions for the Existing Water Intake Facility

	Item	Outline of Hydraulic and Water Quality Condition
1	Flow Volume	・ As indicated in letter (No. 889) from MME dated July 21, 2014, the current minimum discharge volume from the upstream hydroelectric dam is confirmed to be 5.0 m^3/s. ・ However, the current minimum discharge volume estimated on the basis of visual observation by the JICA Survey Team appears to be approximately 1.0 m^3/s. The river flow measurement to confirm the actual minimum discharge volume from the dam at the intake station will be conducted during the dry season by the JICA Survey Team.
2	Water Level	・ The required water level for water intake is maintained by the weir with natural boulders just downstream of the existing intake station. ✓ Water level during minimum flow volume; 2.08 m (water depth at center of stream, 3.3 m; river width, 58m) ✓ Recorded highest water level; 4.78 m (The above data was recorded after the start of dam operation.)
3	Water Quality	・ Iron and Manganese values sometimes become high. ・ Saltwater intrusion was observed in 2002. However, after the weir with natural boulders was constructed downstream of the existing intake station, the saltwater intrusion was not observed. ・ The weir with natural boulders has not been damaged by floods since the installation in 2002.
4	Water Intake Amount	・ After the start of dam operation, a stable water intake of 5,000 m^3/day on average has remained.

Pumping well at riverside

River channel where intake pipe is installed

Photo 1.4.5-1 Existing Water Intake Facility

(a) Flow Volume

The letter (No. 889) from the MME dated July 21, 2014, states that the minimum discharge volume from the upstream hydroelectric dam is 5.0 m^3/s.

However, the JICA Survey Team's visual observation estimated this to be approximately 1.0 m^3/s. The JICA Survey Team conducted river flow measurements to confirm the actual minimum discharge volume from the dam at the intake station during the dry season.

(b) Water Level

The water level during the minimum flow at the existing intake station is estimated from the following water depth data measured during minimum flow and water level data measured at the existing intake station.

Table 1.4.5-2 Water Level in Minimum Flow Volume at Existing Intake Station

	In Minimum Flow Volume June 4, 2014	In Overfolw from Dam June 26, 2014	In Overfolw from Dam July 24, 2014	Remark
Water Depth	0.3 m	-	1.8 m	Mesured by JICA Survey Team
Water Level (water gauge)	-	1.0 m	1.2 m	Mesured by administrator of intake station
Wate Level (Elevation)	-	3.38 m	-	River coross section surveying conducted by JICA Survey Team
Estimated Water Level (Elevation)	2.08 m	-	3.58 m	Estimation result

The following cross sections of the existing and new intake station are based on the results of the river cross section surveying conducted by JICA Survey Team

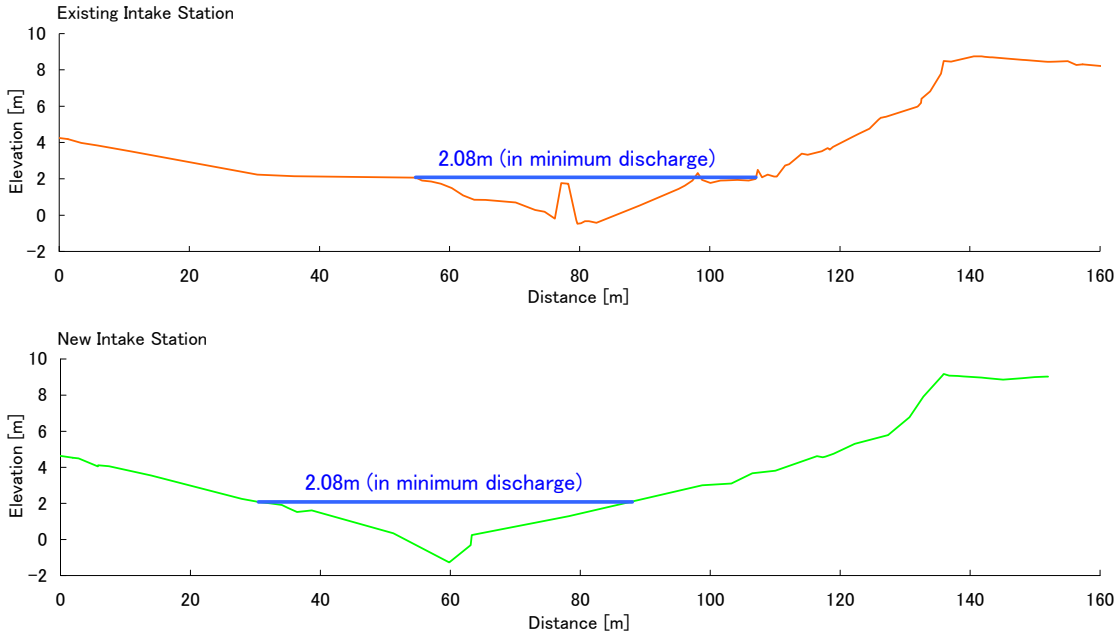


Figure 1.4.5-1 Cross Sections of Existing and New Intake Station

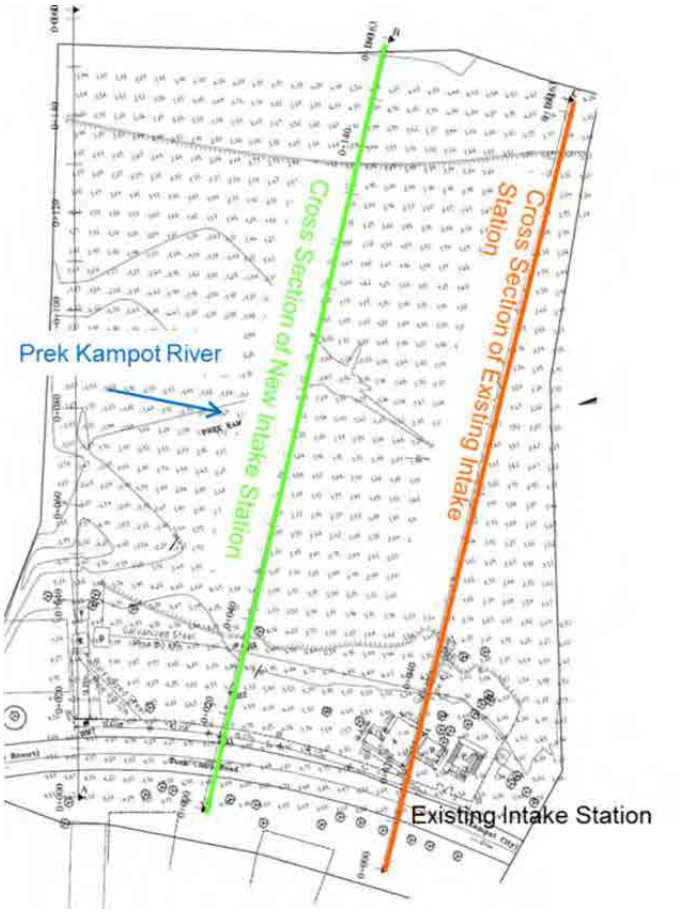


Figure 1.4.5-2 Cross Section Survey Lines of Existing and New Intake Station

The recorded highest and lowest water levels at the intake station are shown in **Table 1.4.5-3** according to the water level data of gauge measured by the administrator of the intake station.

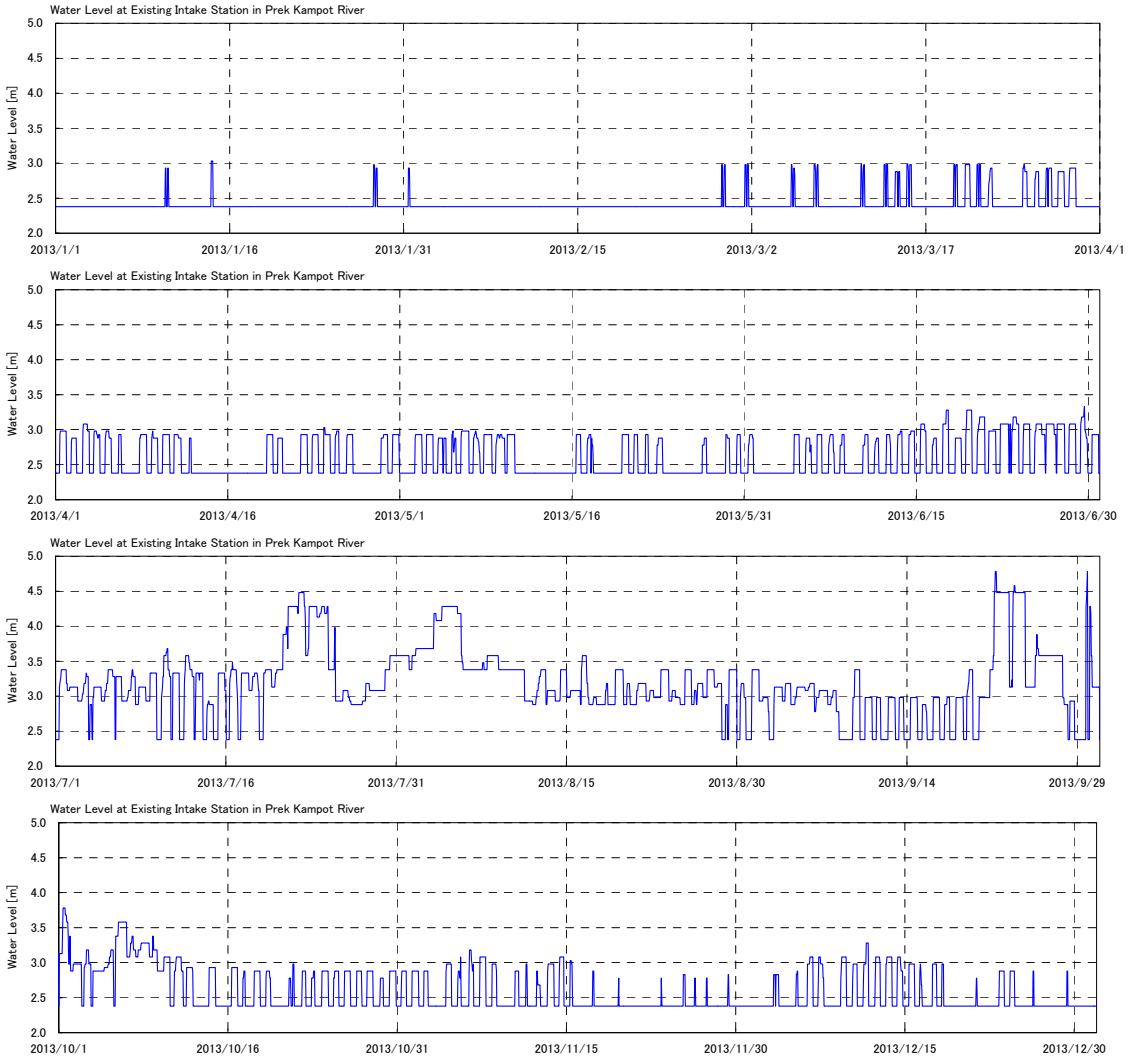
Table 1.4.5-3 Recorded Largest and Lowest Water Levels at Intake Station

	Recorded Largest Water level	Recorded Lowest Water level
Year 2012	4.28 m	2.08 m
Year 2013	4.78 m	2.08 m

Photo 1.4.5-2 Water Gauge at Intake Station

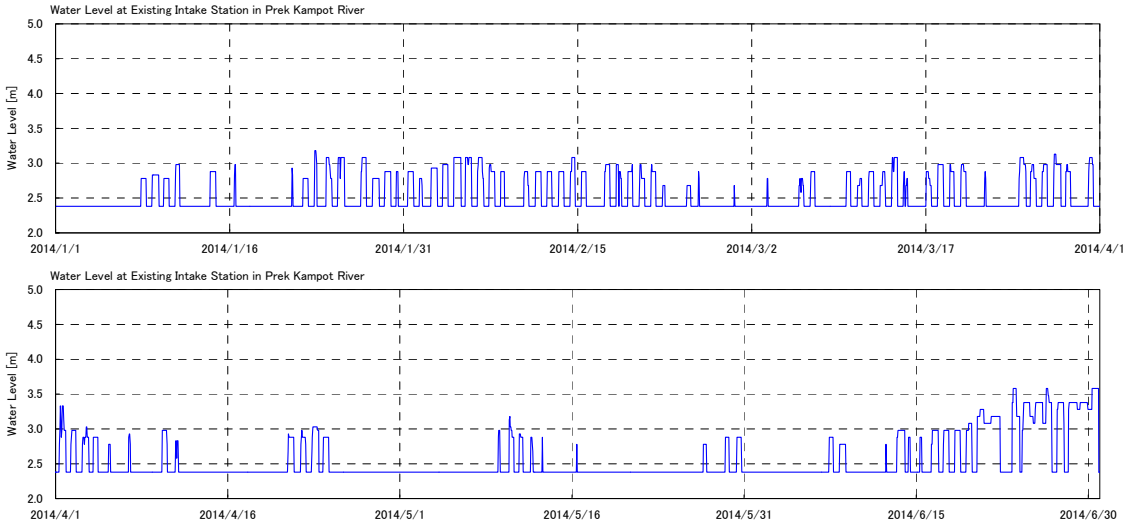
(Source; Kampot Waterworks)
(The water level in the minimum flow volume is not observed and recorded as 2.38 m, because the minimum level of water gauge is 2.38 m.)

Figure 1.4.5-3 Hourly Water Level Data at Intake Station (Year 2012)



(Source; Kampot Waterworks)
(The water level in the minimum flow volume is not observed and recorded as 2.38 m, because the minimum level of water gauge is 2.38 m.)

Figure 1.4.5-4 Hourly Water Level Data at Intake Station (Year 2013)



(Source; Kampot Waterworks)
(The water level in the minimum flow volume is not observed and recorded as 2.38 m, because the minimum level of water gauge is 2.38 m.)

Figure 1.4.5-5 Hourly Water Level Data at Intake Station (Year 2014)

(c) Water Quality

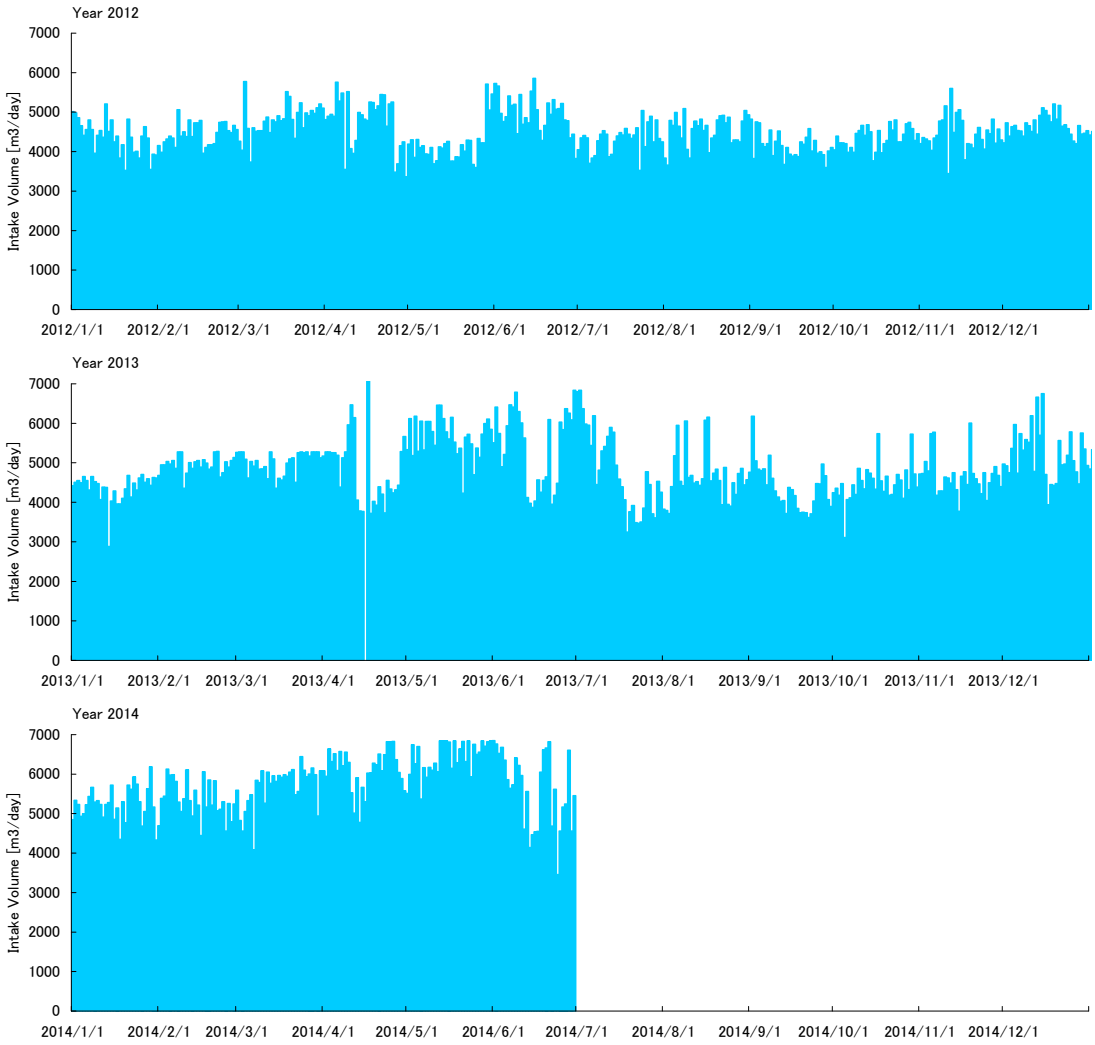
The characteristics of raw water quality at the existing intake station are shown in **Chapter 1.2**.

(d) Water Intake Amount

After the start of dam operation, a stable water intake of 5,000 m^3/day on average has remained according to the record of water intake amount from the existing intake station.

Table 1.4.5-4 Average Water Intake Amount from Existing Intake Station

	Average Water Intake Amount (m^3/day)	Remark
Year 2012	4,499	
Year 2013	4,856	
Year 2014	5,746	January to June

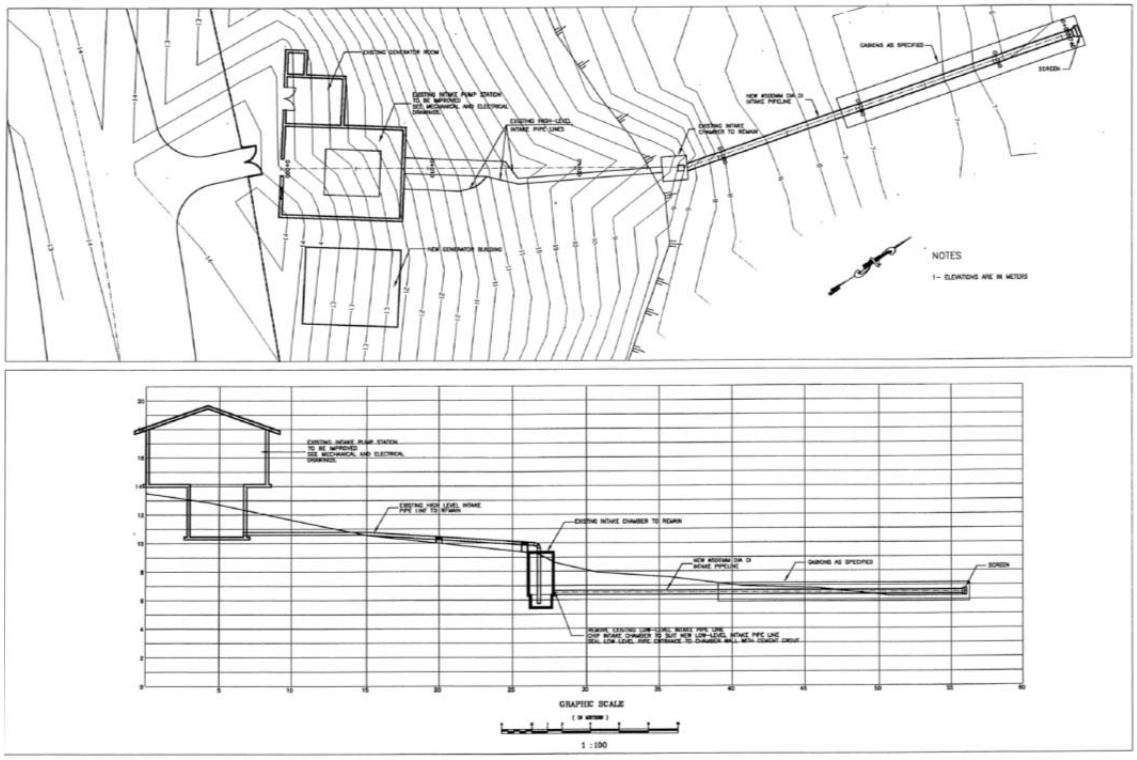


(Source; Kampot Waterworks)

Figure 1.4.5-6 Record of Water Intake Amount from Existing Intake Station

2) Condition of Existing Intake Facilities

An intake pipe conveys water by gravity from the screened intake gate at the bottom of the Pre-Kampot River to pumping wells for pumping to the WTP. Before 2006, water was taken directly from the river bank. As it is difficult to maintain sufficiently high water level at the river bank, in 2006 the “Provincial Towns Improvement Project (ADB)” extended the intake pipe from the intake shaft to the center of the river.



Source: Provincial Towns Improvement Project

Figure 1.4.5-7 Overview of Existing Intake Facilities

An overview of the existing intake facilities is shown in **Table 1.4.5-5**.
The facilities show no obvious signs of deterioration and there are no mechanical or electrical problems. The 5,760 m^3/day of water intake conveyed to the existing water treatment plant is sufficient for the targeted operation.

The other hand, the Existing Facility has the following Problems.

- If discharge from the dam is lower than the minimum required flow rate, the water level in the river will be lower and it becomes difficult to take the required amount of water. This is because the distance between the Low Water Level of Pre Kampot River before the dam was built and the top elevation of the intake pipe is only 5cm.
- It is necessary to rehabilitate the existing facilities because the volume and plane area of the existing pumping well is too small for the capacity of the new project. This would disrupt pumping operations and would jeopardize water supply for the duration of construction activities.

Thus, it will be necessary to construct a new facility for the project.

Table 1.4.5-5 Overview of Existing Intake Facilities

Item	contents	condition
Intake Pipe	・DIP, Diameter:Φ500, Length: 30 m	・Intake pipe conveys water from the center of the river. Pipe inlet has a screen to prevent the entry of large materials that could damage pumps. ・Intake pipe is protected with rock gabion baskets.
Pumping Wells	・Reinforced concrete ・Rectangular shape: W 1.00 m x L 1.00 m x H 3.50 m (inner dimension)	・Volume of intake well is sufficient for flow but capacity could be increased to reduce the number of start-stop cycles. ・There is no trouble for operation of intake.
Intake Pump	・Suction pumps（Φ200）x 3 pumps ・Q=110 m^3/h, H= 37.21 m, P= 22.38 kW	・There is no frequent failure of pumps, but pump does not have extra capacity to handle emergency situations.
Control Room for Intake Pumps	・Reinforced concrete	・The existing structures have no marked deterioration. Durability should not be a problem. ・HWL of Pre-Kampot River has never reached the floor of the control room. ・High water level of Pre-Kampot River has dropped since the construction and operation of the hydro dam. upstream.
Generator Room and Frequency of Power Failures	・Emergency generator ・Reinforced concrete: (floor area 72 m^2)	・Power failures occur about 15 hours a month. ・Each power failure can last a maximum of 5 hours to a minimum of 20 minute.
O&M	・Two staff ・24 hours per day, 7 days a week. ・Tasks include manually switch the pumps on and off and ・Cleaning around the intake facilities and the maintenance of pumps.	

Source: JICA Survey Team

Photo 1.4.5-3 Condition of Existing Facilities

(2) Condition of Existing Raw Water Transmission Main

The existing raw water transmission main to the existing treatment plant is DIP with a diameter is 350mm. It is located along a straight section of road and is approximately 8km long.

The existing facilities structures have not marked deterioration and there is not leakage from pipeline. Therefore, the capacity; 5,760m3/day, of convying water from existing intake to existing water treatment plant is sufficient.

If the existing raw water transmission pipe was used for the design intake flow, the friction head loss would quadruple. The existing pumps would not have the capacity to convey the design flow to the WTP.
Therefore it would be necessary to replace the pumps and transmission pipe and that would result in a disruption in water intake to the treatment plant.

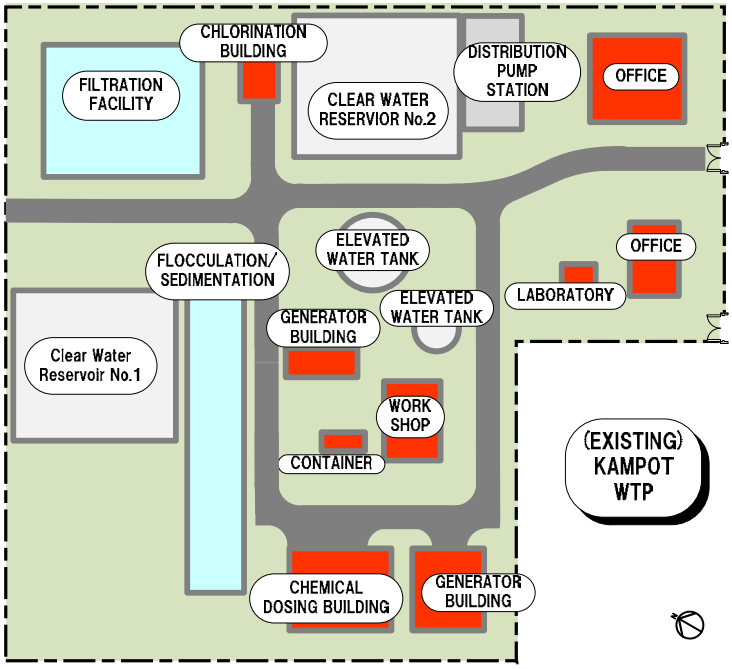
Thus, it will be necessary to construct a new facility for the project.

Source: JICA Survey Team

Figure 1.4.5-8 Overview of Existing Raw Water Transmission Facilities

(3) Condition of Existing Water Treatment Facilities

Existing WTP facility is as follows.
The treatment capacity of the existing water treatment plant; Q = 5,760 m^3/day



Existing WTP facility：
Reciving well, Rapid Mixing Tank,
Flocculation Basin,
Sedimentation Basin
Rapid Sand Filter,
Treated Water Reservoir x 2,
Distribution pump station,
Chemical dosing building,
Chlorination building,
Generator building,
Laboratory,
Administration building

Source: JICA Survey Team

Figure 1.4.5-9　Outline of Existing WTP

（left）Rapid Sand Filter（Right）Treated Water Reservoir

Photo 1.4.5-4　Photo of existing WTP

The Distribution Pump Station and the Treated Water Reservoir were improved and other facilities were constructed under the Provincial Towns Improvement Project in 2006, other than the above facilities, there are elevated tank and small office.

The existing WTP has been operated and maintained with no incidence of extended periods of disrupted water supply or water contamination. In 2015, ADB will replace chlorination equipment and some valves. Therefore, no problem is expected with the existing facilities.

There is not enough space to construct a new WTP at the existing site. A new site for the

planned WTP will be necessary.

Table 1.4.5-6 Overview of Existing WTP Facilities

Item	contents	condition
Receiving Well, Flocculation Basin and Sedimentation Basin	Receiving well - reinforced concrete Quantity: 1, Volume: 390 m^3 Flocculation basin and sedimentation basin - reinforced concrete Quantity: 2 Slow mixing method: vertical channel bands flocculator	・No obvious deterioration or leakage. ・Chemical feeding has improved after the implementation of the Project on Capacity Building for Urban Water Supply System in Cambodia （Phase 2). ・O& M conditions are satisfactory.
Rapid Sand Filter	Reinforced concrete Quantity: 4	・No obvious deterioration or leakage.
Treated Water Reservoir	Reinforced concrete Quantity: 2 Total volume: 2,000 m^3	・One of the two reservoirs was expanded under ADB project. ・No obvious deterioration or leakage.
Distribution Pumping Station	Reinforced concrete Backwash pump × 2, Distribution pump × 4	・There was an incident when the pump start reactor was broken because of some trouble with the motor controller. ・Pump was operating normally but water level indicator and flow meter were not working.
Chemical Dosing Building	Reinforced concrete ・Constructed by ADB project.	・O&M conditions are satisfactory.
Generator Building	Reinforced concrete ・Constructed by ADB project.	・O&M conditions are satisfactory.
Laboratory	Reinforced concrete ・Constructed by ADB project.	・O&M conditions are satisfactory. ・Equipment for water quality analysis are satisfactory and can measure all components required to be tested.
Administration Building	Reinforced concrete ・Constructed by ADB project.	・O&M conditions are satisfactory.
Elevated Tank	Reinforced concrete Quantity: 2 ・High and low elevated tanks. ・Low elevated tank are not in use.	・No obvious deterioration or leakage.
O&M	・Nine staff. ・No reported incident of extended periods of disrupted water supply or water contamination.	

(4) Condition of Existing Transmission and Distribution Facilities

(a) Water Supply Area

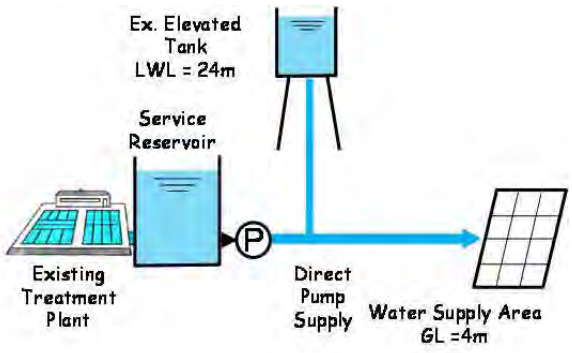
The existing water supply area is shows in **Figure 1.4.5-10**.

Source: JICA Survey Team

Figure 1.4.5-10 Outline of Existing Water Supply Area

(b) Existing Transmission and Distribution Facilities

The Kampot Water Supply distributes treated water using pumps directly and utilizing an existing elevated tank. Outlet pipes from pumped and elevated tank are connected with bypass line; therefore, the function of this elevated tank is that of a surge tank to absorb the pressure change and stock water. An outline of the existing transmission and distribution system is shown in **Figure 1.4.5-11**.

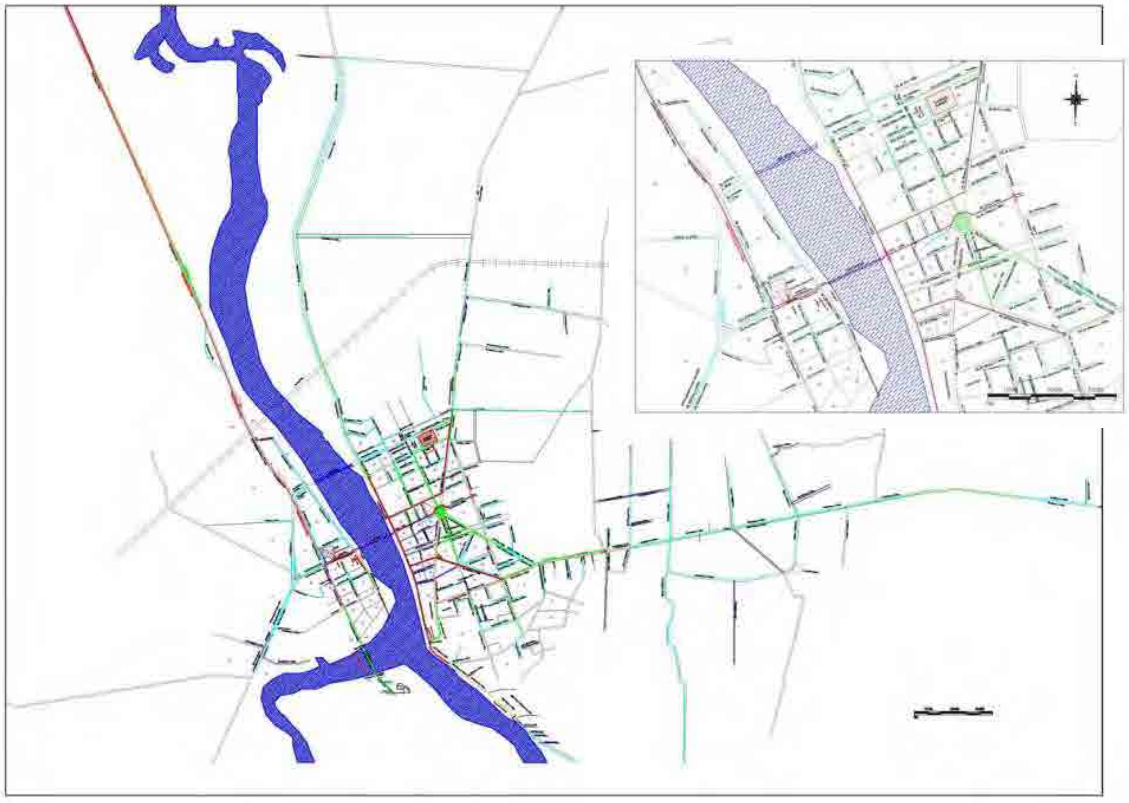


Source: JICA Survey Team

Figure 1.4.5-11 Outline of Existing Transmission and Distribution System

(c) Existing Distribution Network

The existing distribution network is shown in **Figure 1.4.5-12**.



Source: JICA Survey Team

Figure 1.4.5-12 Outline of the Existing Distribution Network

(d) Rehabilitation Pipes

Rehabilitation pipes based on the existing distribution network shows in **Table 1.4.5-7**. Rehabilitation pipes to be replaced are PVC, GI, AC and these lengths are 11km.

Table 1.4.5-7 Rehabilitation Pipes

ND(mm)	Rehabilitation pipes (km)
50	0.9
75	0
100	4.4
150	3.7
200	0.9
250	1.2
300	0
350	0
Total	11.1

Source: JICA Survey Team

1.4.6 The Proposed Site for the New WTP

The proposed site for the new WTP is shown in **Figure 1.4.6-1**.
This site is located between the intake and the distribution area, and the elevation is relatively higher. Exposure of mudstone is detected at the west side of the proposed water treatment plant site. Compacted clayey soil with N value of 20 to 40 at surface layer and sandstone at lower layers are located at the south-east side. Therefore, main structures for the facilities can be built on direct foundations.

Figure 1.4.6-1 The Proposed Site for the New WTP

1.4.7 Power Supply Situation

Power failure sometimes occurs around the new water treatment plant site. Nevertheless, power supply condition is relatively stable and no problem is anticipated in obtaining power supply. Construction of the new treatment plant will not affect the power supply to Kampot city.

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

2.1.1 Overall Goal and Project Objective

The Royal Government of Cambodia (RGC) is committed to the development of the water supply sector. Latest NSDP (2014-2018) states that the access to safe water should be 100% by 2025. With the support of the government of Japan (GOJ) and other donors, water supply capacity in the major cities has improved. On the other hand, the water supply capacities in other cities are still inadequate and not everyone in Cambodia is getting safe and clean water. In 2006 the Asian Development Bank (ADB) implemented the project to upgrade the water supply system in 6 provincial capital cities including Kampot City. However, the existing Kampot water supply system is providing water service to only 47% of the population in 2013, because of insufficient production capacity. Therefore, the expansion of water supply facilities in Kampot city is an urgent matter. Currently, Capacity Building for Water Supply Systems in Cambodia (Phase 3) is ongoing to enhance the management capacity. The project is, therefore, implemented to increase access to safe water and improve water supply services by expanding water supply facilities in Kampot City. The project will contribute to a better living environment in Kampot City.

2.1.2 Project Description

This project to develop the water supply system in Kampot includes: a) construction of water supply facilities, such as intake facilities, raw water conveyance pipelines, treatment facilities and clear water transmission and distribution facilities, b) equipment procurement for water quality control and service connections for poor families, and c) technical assistance for operation and maintenance of water supply facilities constructed by this project. It is anticipated that water supply to 92% of the population in urban areas in Kampot will be achieved by the target year of 2021.

The major components of Japanese assistance are as follows:

(1) Construction of Water Supply Facilities

Water Supply Capacity: 7,500 m^3/day

- Intake Facility, 8,250 m^3/day
  - Intake Pump (4 pumps including 1 stand-by)
- Raw Water Transmission Pipeline, 5.4 km
  - Ductile Cast Iron Pipe, dia.400mm
- Water Treatment Plant, 7,500 m^3/day

- Aerator (1 basin)
- Rapid Mixing Basin (1 basin)
- Flocculation Basin (up-down flow type, 2 basins)
- Sedimentation Basin (2 basins)
- Rapid Sand Filters (4 filter beds)
- Distribution Reservoir (1,100 m^3) and Pumping Station
- Elevated Tank (300 m^3)
- Transmission Pump (2 pumps including 1 stand-by)
- Distribution Pump, Large (3 pumps including 1 stand-by, low-voltage inverter)
- Distribution Pump, Small (3 pumps including 1 stand-by, low-voltage inverter)
- Electrical Facilities, Chemical Feeding Facility
- Administration Building, Chlorine Feeding Building, Sludge Drying Bed (lagoon), Fence, Gate, Others

- Transmission Pipeline (inside treatment plant)
- Distribution Pipeline, 88 km (new pipeline: 77 km, replaced: 11 km)

(2) Equipment Procurement

- Equipment for Water Quality Control
- Equipment for Mechanical Facilities
- Equipment and Materials for Service Connections to poor household

(3) Soft Component (Technical Assistance)

- Operation and Maintenance for Water Treatment Facilities
- Operation and Maintenance of Water Transmission and Distribution Facilities
- Water Supply Facility Management

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

2.2.1.1 Basic Principles

In accordance with the official request from the RGC and the results of the preparatory survey, the water supply system in Kampot will be expanded based on the following design targets and principles.

a. The target year of the project is 2021, three years after the completion of construction.
b. The required increase in water supply capacity is 7,500 m^3/day, based on the water demand projected for 2021 and the existing water supply capacity.
c. Standards to be applied are those widely used in Cambodia by the Phnom Penh Waterworks and those used for the on-going Japanese Grant Aid Project - “The Project for Expansion of Water Supply Systems in Kampong Cham and Battambang”.

Reference to “Design Criteria for Waterworks Facilities” prepared by the Japan Water Works Association will also be made.

d. Equipment procurement is only for the minimum equipment required for the operation and maintenance of the facilities to be constructed in consideration of the official request from the RGC and the equipment that is currently available.
e. In order to increase the water service ratio for the poor, as is the case with the on-going Japanese Grant Aid Project and the projects by other donors, this project also provides equipment and materials to provide service connections for poor families.
f. Local contractors, under the supervision of the Japanese contractor, will be utilized as sub-contractors for the construction of the water supply facilities. There will be appropriate scrutiny of their abilities, company sizes and experience.
g. The implementation schedule is planned with careful consideration of the water level of the river during the wet season and as much as possible, the intake facilities will be constructed during the dry season.
h. The soft component of the project (technical assistance), will train staff at the Kampot Waterworks to conduct the operation and maintenance of the facilities constructed by the project.

2.2.1.2 Environmental Factors

Rainfall

Kampot has a tropical monsoon climate. The wet season is from June to October and the dry season is from November to May. Kampot had an average annual rainfall of 1,926 mm for the period of 2004 to 2013 which is about 1.6 times that of Tokyo. The maximum annual rainfall during the same period was 2,408 mm in 2006. There are many rain-related unworkable days and the construction would be scheduled based on the workable days of the year. Rainfall data between 2004 and 2014 in Kampot area are shown in **Table 2.2.1.2-1** and **Figure 2.2.1.2-1**.

Table 2.2.1.2-1 Kampot Rainfall Records

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2014	5.6	7.0	0.3	148.0	22.8	302.8							487
2013	40.2	5.7	78.2	228.3	62.3	213.9	335.0	166.1	386.5	204.1	221.4	56.8	1,999
2012	100.3	23.0	76.6	85.9	244.2	189.5	189.0	324.2	252.5	202.6	98.4	10.6	1,797
2011	0.6	0.8	89.0	124.6	80.3	301.9	292.8	287.6	439.4	144.2	157.4	30.6	1,949
2010	8.0	116.6	71.0	8.1	50.4	71.9	149.5	300.5	159.1	227.9	169.8	24.6	1,357
2009	0.0	30.8	163.0	108.9	283.5	230.4	422.5	232.7	511.5	176.8	6.8	0.0	2,167
2008	2.8	29.1	218.9	284.0	215.6	120.6	147.3	254.1	414.6	278.8	87.4	71.6	2,125
2007	0.0	3.3	139.6	138.9	84.6	121.8	262.3	446.4	219.9	324.3	69.7	14.5	1,825
2006	12.8	0.0	13.0	177.3	274.1	191.5	629.1	627.9	251.6	198.3	27.1	4.8	2,408
2005	16.8	0.0	18.8	46.9	232.8	136.0	528.2	294.3	260.2	359.3	144.2	38.4	2,076
2004	4.3	18.0	0.0	114.7	128.9	251.5	195.1	391.8	171.0	181.7	102.6	0.0	1,560
AVERAGE	18.6	22.7	86.8	131.8	165.7	182.9	315.1	332.6	306.6	229.8	108.5	25.2	**1,926**
MAXIMUM	100.3	116.6	218.9	284.0	283.5	301.9	629.1	627.9	511.5	359.3	221.4	71.6	**2,408**
MINIMUM	0.0	0.0	0.0	8.1	50.4	71.9	147.3	166.1	159.1	144.2	6.8	0.0	**1,357**

source: MOWRAM

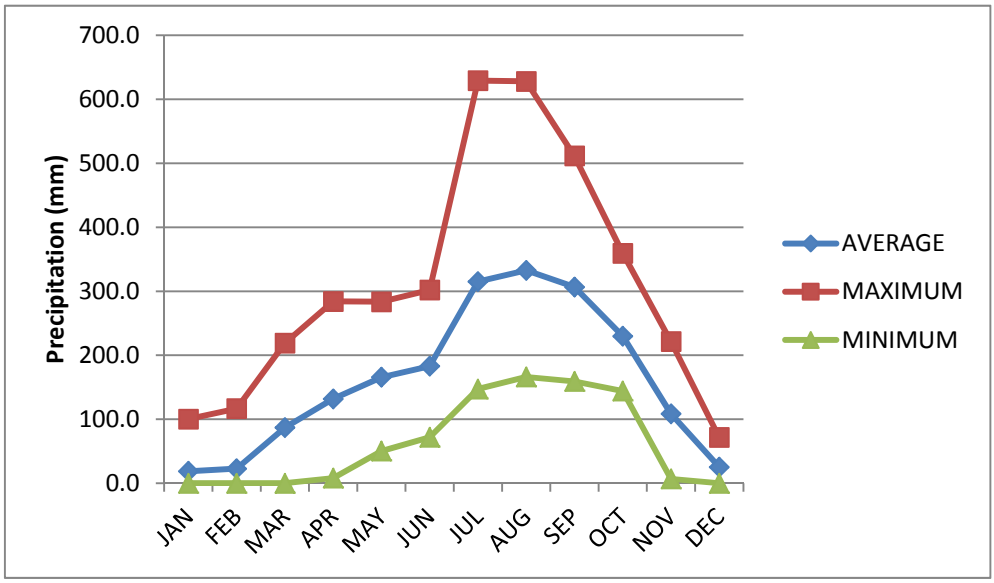


Figure 2.2.1.2-1 Kampot Rainfall Records (2004 through 2013)

Water Flow and Level

The Prek Kampot River is the source of raw water for the existing and new water treatment plants in Kampot. In 2012, Kamchay No.2 Hydroelectric Dam was constructed about 1 km upstream of the intake facilities. Therefore, intake facilities are under the dam discharge flow. Since the construction of intake facility is affected by the water level, it should be implemented during the period of lower water level from November to May, as much as possible.

Topographical and Geological Conditions

The geological strata in Kampot city is composed of Mesozoic sandstone and mudstone as bed rock and recently formed alluvial sediments flow from vicinity high land. Based on bore hole investigations, the area of the proposed intake facility is covered by fine silt with large boulders and composed of weathered sandstone and mudstone at lower layers. Exposure of mudstone is detected at the west side of the proposed water treatment plant site. Compacted clayey soil with N value of 20 to 40 at surface layer and sandstone at lower layers are located at the south-east side. Geological conditions around the proposed location of intake pumping station are rocky conditions with existence of large boulders, and rock excavation using hydraulic hummer is expected. The main structures in the water treatment plant are mostly to be constructed on the mad stone strata or consolidated silty soil strata. Therefore, main structures for the both facilities can be built on direct foundations.

Water Quality

Water quality test results did not detect any toxic substances such as heavy metals and cyanide which are difficult to remove. The water of the Prek Kampot River is safe for use as a source of

raw water for the treatment plants. It is characterized by a low turbidity compared with other sources in other cities in Cambodia.

Although concentrations of iron and manganese are sometimes high, these can be removed by oxidation using aeration, chlorination and contact filtration. Since the Prek Kampot River sometimes contains low alkalinity (below 10) and low pH (about 5) and the existing treatment plant utilizes the lime injection process, the new treatment plants would follow suit. The river contains bacteria which would be dealt with by the disinfection process during treatment.

Water quality data for the design of the chemical feeding facilities are provided by the existing plant which takes the same raw water from the Prek Kampot River. The chemical feed rates applied at the existing plant are used as a reference.

2.2.1.3 Socio Economic Factors

The major industries in Kampot are fishery, salt production and pepper plantation. Recently tourism has emerged as one of the main industries and hotel and resort facilities have been constructed in the downtown and along the Prek Kampot River. Therefore, the project should protect these industries, especially the tourists. Coping with traffic congestion and safety along the roads will be a major concern during pipe installation. Good coordination among relevant agencies regarding pipe installation locations will be critical and essential.

2.2.1.4 Construction and Procurement Factors

Cement is manufactured in Cambodia. K-Cement factory with production capacity of 2,500 ton per day is located close to Kampot. Further, another Chinese funding cement factory (3,800 ton per day) is under construction in Kampot area, which will commence fabrication in the year of 2015. Due to large demand of construction in Cambodia, presently domestic cement production is not enough, and imported cement from Thailand or Vietnam is largely used in the construction industries.
There is no steel mill in Cambodia, and reinforcing bars and structural steel are imported from Thailand and Vietnam, which are available in the market.

Ductile cast iron pipe (DCIP) is not manufactured in Cambodia, but produced in nearby Asian countries, such as Japan, South Korea, Taiwan, Malaysia, China and India. As a reference, Phnom Penh Water Supply Authority (PPWSA) stocks DCIP produced by Saint Gobain SA which is French company that has a factory in China for the Asian region.

High density polyethylene (HDPE) pipe is widely used for small diameters of water supply pipelines in Cambodia, but there is no full-fledged factory for locally made HDPE pipe.

PPWSA procures and stocks HDPE pipes made in Malaysia at present.

Pipe materials are selected in terms of reliability, resistance under pressure, ease of handling, cost, and availability in Cambodia. Pipe materials with larger diameter will be imported from Japan or third countries.

2.2.1.5 Utilization of Local Contractors

Several large local contractors in Cambodia have experience in the construction of treatment plants, river intake facilities, reservoirs and transmission and distribution pipelines. Some local contractors have heavy construction machine and equipment. These local contractors will be sub-contractors under the management of the Japanese contractor. However it will be necessary to pay attention to the availability of capable local contractors, local supervisory staff and skilled works because of a recent increase of construction demands in Cambodia.

2.2.1.6 Operation and Maintenance

Staff at Kampot Waterworks and DIH should be trained to properly manage the new water supply system which will have a capacity more than two times the existing facility. Under the “Soft Component” of the Japanese Grant Aid Project, technical assistance will be provided to build the capability for sound operation and maintenance of the new water supply facilities constructed by this project.

2.2.1.7 Facilities and Equipment to be installed

The water treatment plant is designed to operate with the minimal required mechanical and electrical equipment, to consider the spare parts and chemicals available in the country and to secure the competitiveness of Japanese manufacturers for intake and distribution pumps. Raw water transmission and distribution pipelines are designed to be installed away from paved roads to avoid excessive vehicle load. Depth of pipe installation would conform to Cambodia standards applied by PPWSA in Phnom Penh and the on-going Japanese Grand Aid Project. For road and drain crossings, existing culverts will be used and external concrete protection will be applied where there is no culvert.

2.2.1.8 Construction and Procurement Method and Schedule

Since there are many large boulders at the intake facility site, it is difficult to apply sheet-piling for dry excavation. Instead temporary coffering will be adopted. The construction of the intake facility should be carried out as much as possible during the dry season when the water level of the Prek Kampot River is low. Since a lot of pipes have to be laid during this short time period,

it will be necessary to install multiple sections simultaneously. Therefore, construction supervision must be planned carefully and a sufficient number of inspectors deployed accordingly.

2.2.2 Basic Plan

2.2.2.1 Water Demand Projection

(1) Supply Area

The future water supply area in Kampot, shown in **Figure 2.2.2.1-1,** was determined based on the existing plan of Kampot Waterworks, consultations with staff at the waterworks, the supply area for the GRET Project, the supply area for the previous JICA study and the field survey by the JPST,

Figure 2.2.2.1-1 Future Water Supply Area in Kampot

(2) Population and Growth Rate

The population in Kampot Province listed in the 1998, 2008 and 2013 population census is shown in **Table 2.2.2.1-1**, (source: Spatial Distribution and Growth of Population, Analysis of CIPS Results Report No.2, Cambodia Inter-Censal Population Survey 2013, National Institute of Statistics, Ministry of Planning, Cambodia, December 2013).

Table 2.2.2.1-1 Population in Kampot Province

	Population			Annual Growth rate	
	1998	2008	2013	1998-2008	2008-2013
Kampot Province	528,405	585,850	611,557	1.04%	0.86%

*: National Institute of Statistics, Ministry of Planning, Cambodia

source: National Institute of Statistics, Ministry of Planning, Cambodia

The future water supply area consists of 10 communes in 2 districts and the 1998 and 2008 population census data for each commune is listed in **Table 2.2.2.1-2**. Two communes, Kampong Kraeng and Makprang, however, do not include all villages in the future water supply area. **Table 2.2.2.1-3** shows the 1998 and 2008 population data for each commune affected by the project.

Table 2.2.2.1-2 Population and Growth Rate in 10 Communes

		1998	2008	APGR
0707	**Tuek Chhou**			
070702	Chum Kriel	5,531	5,834	0.53%
070703	Kampong Kraeng*	6,142	6,426	0.45%
070704	Kampong Samraong	2,784	2,896	0.40%
070709	Makprang*	4,910	5,104	0.39%
070719	Trapeang Thum	2,436	2,769	1.29%
0708	**Krong Kampot**			
070801	Kampong Kandal	8,146	8,285	0.17%
070802	Krrang Ampil	4,156	4,632	1.09%
070803	Kampong Bay	6,613	6,376	-0.36%
070804	Andoung Khmer	9,127	10,923	1.81%
070805	Traeuy Kaoh	5,084	6,151	1.92%
	Total	54,929	59,396	0.78%

source: National Institute of Statistics, Ministry of Planning, Cambodia

Table 2.2.2.1-3 Population and Growth Rate in Future Water Supply Area

		1998	2008	APGR
0707	**Tuek Chhou**			
070702	Chum Kriel	5,531	5,834	0.53%
070703	Kampong Kraeng	4,790	5,011	0.45%
070704	Kampong Samraong	2,784	2,896	0.40%
070709	Makprang	2,638	2,742	0.39%
070719	Trapeang Thum	2,436	2,769	1.29%
0708	**Krong Kampot**			
070801	Kampong Kandal	8,146	8,285	0.17%
070802	Krrang Ampil	4,156	4,632	1.09%
070803	Kampong Bay	6,613	6,376	-0.36%
070804	Andoung Khmer	9,127	10,923	1.81%
070805	Traeuy Kaoh	5,084	6,151	1.92%
	Total	51,304	55,619	0.81%

source: National Institute of Statistics, Ministry of Planning, Cambodia

The total population of the 10 communes in the future water supply area was 51,304 in 1998

and 55,619 in 2008. The average annual population growth rate was calculated to be 0.81%, much lower than the national average of 2.24% and the provincial average of 1.04%.

(3) Population in the Future Water Supply Area

The 2013 census population data for each commune has not been released yet, therefore it was projected by the JPST as shown in **Table 2.2.2.1-4** based on the data in **Tables 2.2.2.1-1 and 2.2.2.1-3**.

Table 2.2.2.1-4 Projected Population by Commune in 2013

District/Commune	Population			Annual Growth Rate	
	1998*	2008*	2013**	1998-2008*	2008-2013**
Tuek Chhou					
Chum Kriel	5,531	5,834	5,955	0.53%	0.41%
Kampong Kraeng	4,790	5,011	5,098	0.45%	0.34%
Kampong Samraong	2,784	2,896	2,939	0.40%	0.29%
Makprang	2,638	2,742	2,782	0.39%	0.29%
Trapeang Thum	2,436	2,769	2,917	1.29%	1.04%
Krong Kampot					
Kampong Kandal	8,146	8,285	8,329	0.17%	0.11%
Krrang Ampil	4,156	4,632	4,839	1.09%	0.88%
Kampong Bay	6,613	6,376	6,268	-0.36%	-0.34%
Andoung Khmer	9,127	10,923	11,756	1.81%	1.48%
Traeuy Kaoh	5,084	6,151	6,651	1.92%	1.57%
Total	51,304	55,619	57,533	0.81%	0.68%

*: National Institute of Statistics, Ministry of Planning, Cambodia

**: projected by JPST

Based on the growth rate mentioned in previous paragraphs, the future population for the target year of 2021 is estimated as shown in **Table 2.2.2.1-5**.

Table 2.2.2.1-5 Future Population for Each Commune in the Supply Area

		2013	2014	2015	2016	2017	2018	2019	2020	2021
0707	**Tuek Chhou**									
070702	Chum Kriel	5,955	5,979	6,003	6,026	6,049	6,072	6,095	6,118	6,141
070703	Kampong Kraeng	5,098	5,114	5,131	5,148	5,164	5,180	5,196	5,212	5,228
070704	Kampong Samraong	2,939	2,947	2,955	2,964	2,972	2,979	2,987	2,995	3,002
070709	Makprang	2,782	2,790	2,797	2,805	2,812	2,819	2,827	2,834	2,841
070719	Trapeang Thum	2,917	2,947	2,977	3,007	3,038	3,069	3,100	3,131	3,162
0708	**Krong Kampot**									
070801	Kampong Kandal	8,329	8,337	8,344	8,351	8,358	8,364	8,370	8,376	8,381
070802	Krrang Ampil	4,839	4,880	4,922	4,965	5,007	5,049	5,092	5,135	5,177
070803	Kampong Bay	6,268	6,246	6,224	6,201	6,178	6,156	6,132	6,109	6,086
070804	Andoung Khmer	11,756	11,929	12,104	12,281	12,459	12,640	12,823	13,008	13,195
070805	Traeuy Kaoh	6,651	6,755	6,860	6,966	7,074	7,183	7,294	7,406	7,519
	Total	57,533	57,924	58,317	58,713	59,112	59,513	59,917	60,324	60,733
	APGR	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%	0.68%

source: JPST

Some areas of the two communes, Kampong Kraeng and Kampong Samraong, have not water supply services at present. Accordingly, the population projections for these two communes for the target year of 2021 are adjusted as shown in **Table 2.2.2.1-6** (see **Appendix-7**).

Table 2.2.2.1-6 Future Population in the Supply Area

		2013	2014	2015	2016	2017	2018	2019	2020	2021
0707	**Tuek Chhou**									
070702	Chum Kriel	5,955	5,979	6,003	6,026	6,049	6,072	6,095	6,118	6,141
070703	Kampong Kraeng	879	882	885	888	2,433	3,237	5,196	5,212	5,228
070704	Kampong Samraong	0	982	1,970	2,964	2,972	2,979	2,987	2,995	3,002
070709	Makprang	2,782	2,790	2,797	2,805	2,812	2,819	2,827	2,834	2,841
070719	Trapeang Thum	2,917	2,947	2,977	3,007	3,038	3,069	3,100	3,131	3,162
0708	**Krong Kampot**									
070801	Kampong Kandal	8,329	8,337	8,344	8,351	8,358	8,364	8,370	8,376	8,381
070802	Krrang Ampil	4,839	4,880	4,922	4,965	5,007	5,049	5,092	5,135	5,177
070803	Kampong Bay	6,268	6,246	6,224	6,201	6,178	6,156	6,132	6,109	6,086
070804	Andoung Khmer	11,756	11,929	12,104	12,281	12,459	12,640	12,823	13,008	13,195
070805	Traeuy Kaoh	6,651	6,755	6,860	6,966	7,074	7,183	7,294	7,406	7,519
	Total	50,375	51,726	53,085	54,453	56,381	57,569	59,917	60,324	60,733

source: JPST

(4) Service Ratio and Population Served

The NSDP says that the target service ratio (the rate of access to safe water) in urban areas should increase to 80 % in 2015 and 100 % in 2025. Therefore the project has assumed a target service ratio of 92% for the target year of 2021.

As shown below, the population served in the target year 2021 is 55,874.

55,874 (population served in the target year 2021) = 60,733 (population in service area in the target year 2021) * 92% (service ratio in the target year 2021)

(5) Per Capita Water Consumption

The average family size is 4.89, calculated from the total population (59,396) and number of households (12,137) in the year 2008. The average water consumption per household can be calculated from the total domestic water consumption and the number of domestic connections. Based on the average family size and the average water consumption per household, the per capita water consumption is calculated as shown in **Table 2.2.2.1-7**.

Table 2.2.2.1-7 Per Capita Water Consumption in Kampot

		2008	2009	2010	2011	2012	2013
Domestic Consumption	m3/day	1,847	2,050	2,525	2,543	2,791	3,205
Domestic Connections	nos.	2,802	3,309	3,700	3,968	4,188	4,834
Unit Population per Household	person	4.89	4.89	4.89	4.89	4.89	4.89
Served Population	person	13,712	16,194	18,107	19,419	20,495	23,657
Per Capita Water Consumption	lpcd	134.7	126.6	139.5	131.0	136.2	135.5

source: Kampot Waterworks

In Cambodia, there are no standards or guidelines related to water supply planning and design. The previous Japanese Grant Aid Project, the Project on Replacement and Expansion of Water

Distribution System for Pursat, Sihanouk Ville and Battambang, used 125 to 140 lpcd for per capita water consumption and the on-going Japanese Grant Aid Project, the Project for Expansion of Water Supply Systems in Kampong Cham and Battambang, used 150 lpcd for Kampong Cham and 120 lpcd for Battambang. Therefore for the project in Kampot the future per capita consumption is set at 130 lpcd.

(6) Domestic Water Demand

Based on the actual data from Kampot Waterworks, **Table 2.2.2.1-8** shows the breakdown of water consumption by category. Domestic water consumption is about 85 % of total water consumption. This water consumption ratio is applied to the calculations for demand projections.

Table 2.2.2.1-8 Breakdown of Water Consumption in Kampot

Consumption (billed)		2008	2009	2010	2011	2012	2013	Total
Domestic	m^3/day	1,847	2,050	2,525	2,543	2,791	3,205	14,961
Commercial	m^3/day	103	170	127	223	98	120	841
Public	m^3/day	283	228	247	286	340	359	1,744
Total	m^3/day	2,233	2,448	2,899	3,052	3,229	3,684	17,546
Ratio of Domestic	%	82.7%	83.7%	87.1%	83.3%	86.4%	87.0%	**85.3%**

source: Kampot Waterworks

(7) Tourist Demand

Future water demand projections for Kampot should take into account the tourist demand, because water consumption for tourism has been increasing rapidly with a sharp rise in the number of tourists to Kampot. Based on the actual data on the number of tourists to Kampot from Kampot Waterworks, approximately 120 million tourists visited Kampot from home and abroad in 2013. Considering past number of tourists to Kampot and Sihanouk Ville, the number of tourists to Kampot[1] is estimated as shown in **Figure 2.2.2.1-2**.

[1] based on the discussion with Cambodian side at Kampot Waterworks in June 2014

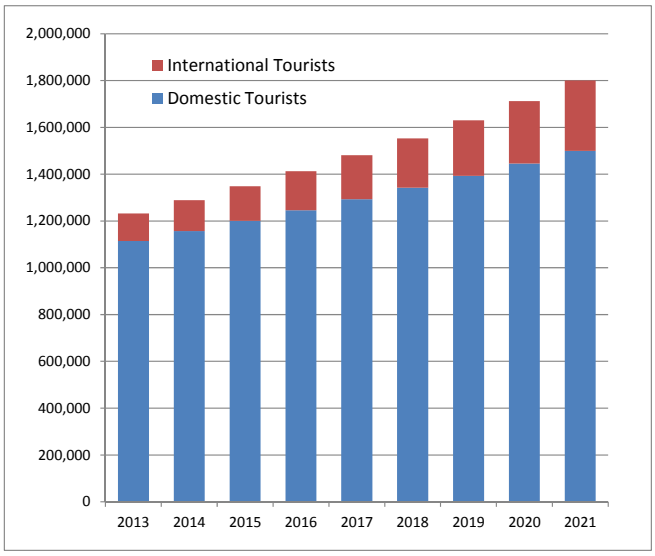


Figure 2.2.2.1-2 Future Number of Tourists to Kampot

source: JPST

In order to project the tourism consumption, the water consumption per tourist and the length of stay were assumed as shown in **Table 2.2.2.1-9** by reference to figures in other cities.

Table 2.2.2.1-9 Consumption per Tourist and Length of Stay

	Consumption (lpcd)	Length of Stay (days)
Domestic Tourist	130	2.0
Foreign Tourist	267	2.5

source: JPST

Based on the consumption per tourist and length of stay mentioned above, future consumption for tourism in Kampot for the target year of 2021 is estimated as shown in **Table 2.2.2.1-10** and **Figure 2.2.2.1-3**. Kampot Waterworks does not have a separate tariff classification for tourism. Tourism consumption, which is estimated at 1,008 m^3/day in 2013, was therefore included in the domestic consumption tariff category. The tourism consumption identified in the future water demand projections is therefore only the incremental demand.

Table 2.2.2.1-10 Tourist Consumption

		2013	2014	2015	2016	2017	2018	2019	2020	2,021
Consumption by Domestic Tourist	m^3/day	794	824	855	887	921	956	992	1,030	1,068
Consumption by Foreign Tourist	m^3/day	214	241	271	305	343	386	434	488	549
Total Consumption by Tourist	m^3/day	1,008	1,065	1,126	1,193	1,264	1,342	1,426	1,517	1,617
Tourist Consumption included in Domestic Consumption	m^3/day	1,008	1,015	1,022	1,029	1,036	1,043	1,050	1,057	1,064
Additional Consumption for Tourist	m^3/day	0	50	105	164	228	299	376	460	553

source: JPST

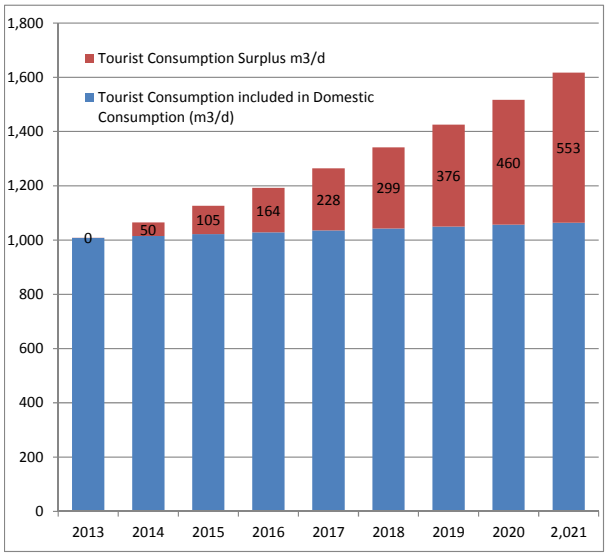


Figure 2.2.2.1-3 Tourist Consumption

source: JPST

(8) Leakage Ratio

The NRW (non-revenue water) ratio of Kampot Waterworks was about 18% in 2013. The level is relatively low and is expected to be maintained in future. Since there is no data showing the ratio of leakage to NRW in Cambodia, the leakage ratio is assumed based on past experience in other developing countries.

Usually when the NRW ratio is high (e.g. around 50%), the components of NRW that are not leakage (i.e. meter error, illegal usage, etc.) are also high. Typically leakage would account for 50% of NRW.

However, when the NRW ratio has been lowered by implementing some NRW reduction activities, the reduction of the other NRW components is usually more than the reduction of leakage. This results in a higher ratio of leakage to NRW. Therefore, the leakage ratio to NRW

used in the demand projection for Kampot, where the NRW ratio is currently low, was assumed to be 75%. As shown in **Table 2.2.2.1-11**, the target leakage ratio in 2021 is set at 12% with an assumption that the NRW ratio will remain as high as the current NRW ratio in the future.

Table 2.2.2.1-11 Leakage Ratio in Kampot

	2013*	2014	2015	2016	2017	2018	2019	2020	2021
NRW Ratio（%）	17.8%	17.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%	16.0%
Leakage Ratio（%）	13.4%	12.8%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%

*: Kampot Waterworks

(9) Daily Peak Factor

According to the water distribution data for 2008 to 2013, the average peak factor (ratio of daily maximum to daily average) was calculated at 78 % as shown in **Table 2.2.2.1-12**. In this projection, the daily peak factor is set at 78%.

Table 2.2.2.1-12 Peak Factor in Kampot

			2008	2009	2010	2011	2012	2013	Average
Day Average Demand		m^3/day	3,317	3,278	3,712	3,809	3,971	4,482	
Day Maximum	amount	m^3/day	3,903	4,829	4,294	4,830	5,520	5,760	
	day	-	23-Feb	6-Dec	7-May	13-Mar	13-May	13-May	
Rate of Loading		-	85.0%	67.9%	86.5%	78.9%	71.9%	77.8%	78.0%

source: Kampot Waterworks

(10) Daily Maximum Water Demand

Factors described above, the daily average water demand and the daily maximum water demand are projected as shown in **Table 2.2.2.1-13**. Daily maximum water demand in 2021 is estimated at 13,260 m^3/day. Since the capacity of the existing water treatment plant is 5,760 m^3/day, the necessary incremental water treatment plant capacity will be 7,500 m^3/day. The relationship between the water demand and the supply capacity is shown in **Figure 2.2.2.1-4**. As shown in **Figure 2.2.2.1-4**, the water supply capacity will be more than the demand, once the project is completed in 2018. Before that, however, the capacity is below the demand.

Table 2.2.2.1-13 Water Demand up to 2021 in Kampot

		2013	2014	2015	2016	2017	2018	2019	2020	2021
Population in Service Area	person	50,375	51,726	53,085	54,453	56,381	57,569	59,917	60,324	60,733
Service Ratio in Service Area	%	47.0%	50.5%	53.8%	56.9%	63.7%	70.8%	76.2%	83.8%	92.0%
Population Served	person	23,657	26,104	28,550	30,997	35,891	40,785	45,679	50,572	55,872
Per Capita Consumption	/day/perso	135	130	130	130	130	130	130	130	130
Domestic Consumption	m3/day	3,205	3,393	3,712	4,030	4,666	5,302	5,938	6,574	7,263
Number of Domestic Connection	no.	4,834	5,334	5,834	6,334	7,334	8,334	9,334	10,334	11,417
Increase of Domestic Connection	no.	646	500	500	500	1,000	1,000	1,000	1,000	1,083
Ratio of Domestic Comsumption	%	87.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
Non-domestic Consumption	m3/day	479	599	655	711	823	936	1,048	1,160	1,282
Total Consumption	m3/day	3,684	3,992	4,367	4,741	5,489	6,238	6,986	7,735	8,545
Tourist Consumption	m3/day	0	50	105	164	228	299	376	460	553
Total Consumption + tourist	m3/day	3,684	4,043	4,471	4,905	5,718	6,537	7,362	8,195	9,098
Leakage Ratio	%	13.4%	12.8%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%	12.0%
Day Average Demand	m3/day	4,252	4,633	5,081	5,573	6,497	7,428	8,366	9,313	10,339
Rate of Loading		77.8%	78.0%	78.0%	78.0%	78.0%	78.0%	78.0%	78.0%	78.0%
Day Max. Demand	m3/day	5,464	5,941	6,515	7,146	8,331	9,524	10,727	11,941	13,257
Existing Capacity	m3/day	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760	5,760
Capacity needed by the Project	m3/day	-296	181	755	1,386	2,571	3,764	4,967	6,181	7,497

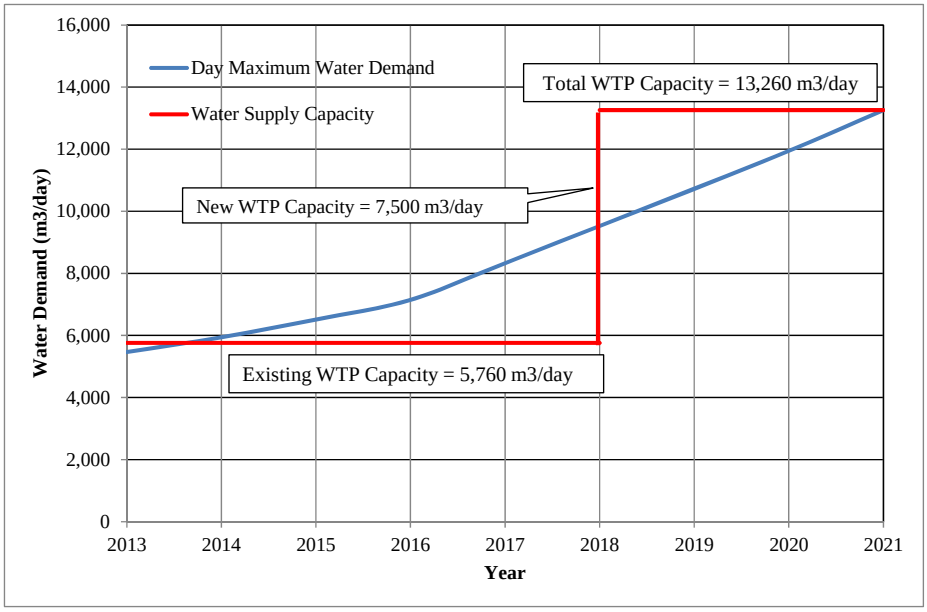


Figure 2.2.2.1-4 Relationship between Water Demand and Supply Capacity in Kampot

2.2.2.2 Plan for New Water Sources

(1) Selection of Water Source

The existing water intake in Prek Kampot River for Kampot Waterworks can be affected by low water level and saltwater intrusion when the discharge from the upstream hydroelectric dam is reduced especially during the dry season. Therefore the upstream reservoir at Kamchay hydroelectric dam (operated by Chinese private company) and the Tak Krola Lake were surveyed as potential new water sources in addition to the Prek Kampot River near the existing intake.

Figure 2.2.2.2-1 Candidate Water Sources in Kampot City

1) Upstream Hydroelectric Dam Reservoir

The Kamchay hydroelectric dam is located approximately 1 km upstream of the existing water intake and started operation in 2012. The water volume is sufficient and stable enough to be a new water source but it is difficult to get permission from the dam operator and MME for water intake and construction of an intake facility. Furthermore, it would not be easy to operate a new intake facility in the upstream hydroelectric dam reservoir, because access would be through private land and a new intake facility would be separated from the existing intake facility.

2) Prek Kampot River near Existing Intake

Based on letter (No. 889) from MME dated July 21, 2014, the current minimum discharge volume from the upstream hydroelectric dam is confirmed to be 5.0 m^3/s which is enough for the required water intake amount (0.17 m^3/s) including the existing water intake amount. Moreover, there are no factors that contribute to raw water quality problems in the existing intake. However, there is the possibility of saltwater intrusion at the intake especially during the dry season. Therefore, the saltwater intrusion survey in Prek Kampot River was conducted by the JICA Survey Team.

3) Tak Krola Lake

Tak Krola Lake approximately 14 km east of the center of Kampot City is the reservoir for irrigation managed by MOWRAM. It's unclear if MOWRAM would give permission for a new water intake, because it would be necessary to make an adjustment to existing irrigation use. Moreover, there is the potential for contamination of the water source from the inflow of pesticide and chemicals.

Photo 2.2.2.2-1 Candidate Water Sources in Kampot City

Upstream Hydroelectric Dam Reservoir

Tak Krola Lake

Current Minimum Discharge from Upstream Hydroelectric Dam

Prek Kampot River
(Existing Intake Facility)

Prek Kampot River near the existing intake is selected for the appropriate water source based on the following evaluation results.

Table 2.2.2.2-1 Evaluation of Candidate Water Sources in Kampot City

Water Sources / Items	Upstream Hydroelectric Dam Reservoir	Prek Kampot River near Existing Intake	Tak Krola Lake
Water Right	× It's difficult to get the permission from the dam operator.	○ It's necessary to get the permission from MOWRAM.	△ It's unclear if MOWRAM would give permission.
Water Volume	× It's difficult to get the permission from the dam operator.	○ Minimum discharge volume from the dam is enough for water intake.	△ It's necessary to conduct a detailed survey to determine how much water resources could be available.
Water Quality	○ No factors that cause the problem for raw water quality.	○ It's unlikely that saltwater intrude to intake station based on the saltwater intrusion survey.	△ It's necessary to confirm the pollution by pesticide and chemicals.

Land for Intake Facility	× It's difficult to get the permission from the dam operator.	○ Land for intake facility was already acquired next to existing water intake facility.	× It's necessary to acquire land for the intake facility.
Evaluation	×	○	×

(○ : Adequate, × : Inadequate, Δ : Adequacy can't be determined at this time)

(2) Required Water Intake Amount

The required water intake amount for the existing and new water supply from Prek Kampot River is calculated to be 0.17 m^3/s as shown in **Table 2.2.2.2-2**.

Table 2.2.2.2-2 Required Water intake amount from Prek Kampot River

No.	Item	Amount	Unit	Remark
A	Existing WTP Capacity	5,760	m^3/day	
B	New WTP Capacity	7,500	m^3/day	
C	Total Water Supply	13,260	m^3/day	
D	Total Intake Amount	14,590	m^3/day	C*1.1
E	Required Minimum Discharge Volume for Water Supply	0.17	m^3/s	

(3) Minimum Discharge Volume from the Dam

Based on letter (No. 889) from MME dated July 21, 2014, the current minimum discharge volume from the upstream hydroelectric dam is confirmed to be 5.0 m^3/s which is enough for the required water intake amount (0.17 m^3/s) including the existing water intake amount.

Table 2.2.2.2-3 Discharge Volume from the Dam

Number of Unit	Discharge Volume
0	5 m^3/s
1	60 m^3/s
2	120 m^3/s
3	180 m^3/s

(Source; Letter (No. 889) from MME dated July 21, 2014)

The JICA Survey Team conducted river flow measurements on November 22, 2014, when the discharge and overflow of Kamchay hydroelectric dam are not observed in the dry season. The measurements are as follows: 2.0 m^3/s at the exit of the spillway of the dam and 3.0 m^3/s at the existing intake point. The minimum discharge from the Kamchay hydroelectric dam is 2.0 m^3/s at any time. The riverbed inflow between the exit of the spillway of the dam and the existing intake point is 1.0 m^3/s. This meets the planned intake flow rate of 0.17 m^3/s.

Table 2.2.2.2-4 Water Level and Flow of the Existing Intake Station at the Minimum Discharge Volume

Date	Water Depth at Water Gauge	Water Level of Water Gauge	Discharge Volume	Remarks
Jun. 4, 2014	0.3 m	- 0.3 m	-	Discharge volume is small at the end of dry season.
Nov. 22, 2014	0.56 m	- 0.04 m	3.0 m^3/s	Discharge volume is large at the beginning of dry season.

source: JPST

Table 2.2.2.2-5 Flow of the Spillway of the Dam at the Minimum Discharge Volume

Date	Maximum Water Depth	Discharge Volume	Remarks
Nov. 22, 2014	0.92 m	2.0 m^3/s	Power Generation was ongoing. No overflow was observed.

source: JPST

(4) Raw Water Quality

The results of raw water quality analysis conducted by the JICA Survey Team on June 14, 2014 and July 24, 2014 are shown in **Table 2.2.2.2-6**.

Table 2.2.2.2-6 Results of Raw Water Quality Analysis (Prek Kampot River)

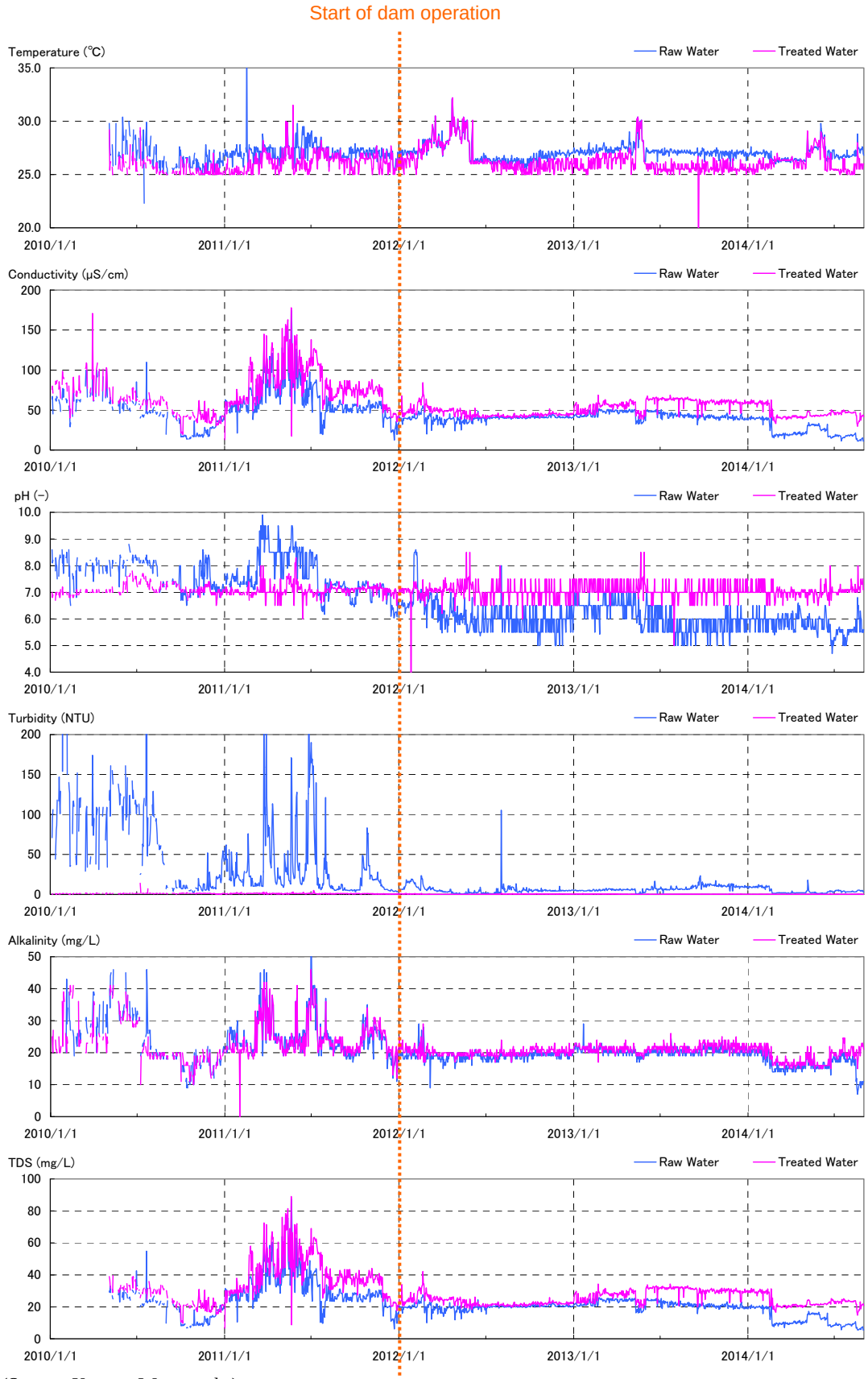
No.	Parameter	Unit	June 14, 2014	July 24, 2014	CNDWQS	JNDWQS
1	pH	-	7.21	7.14	6.5 – 8.5	5.8 – 8.6
2	Temperature	^{o}C	27.30	25.80	NV	NV
3	Electrical Conductivity (EC)	µS/cm	9.00	10.18	NV	NV
4	Turbidity	NTU	0.00	3.00	≤5.0	≤2.0
5	Total Dissolved Solid (TDS)	mg/l	5.00	9.10	≤800	≤500
6	Dissolved Oxygen (DO)	mg/l	6.20	6.30	NV	NV
7	Salinity	‰	0.06	0.00	NV	NV
8	Total Suspended Solid(TSS)	mg/l	59.00	44.00	NV	NV
9	Total Alkalinity(as CaCO3)	mg/l	294.00	99.20	NV	NV
10	Total Hardness	mg/l	24.50	58.80	≤300	≤300
11	Chloride (Cl^-)	mg/l	2.03	1.40	≤250	≤200
12	Fluoride (F)	mg/l	0.12	0.12	≤1.5	≤0.8
13	Sulphate (SO_4^{2-})	mg/l	0.84	0.46	≤250	NV
14	Nitrite (NO2)	mg/l	ND	ND	≤3.0	≤0.04
15	Nitrate (NO_3^-)	mg/l	2.15	0.11	≤50	≤10*
16	Ammonium (NH_4)	mg/l	0.10	ND	≤1.5	NV
17	Color	mg/l Pt	40.00	60.00	≤5.0	≤5.0
18	Biochemical Oxygen demand	mg/l	0.57	0.60	NV	NV
19	Chemical Oxygen demand	mg/l	1.98	1.86	NV	NV
20	Total Phosphorus(TP)	mg/l	0.01	0.01	NV	NV
21	Aluminum (Al)	mg/l	0.07	ND	≤0.2	≤0.2
22	Arsenic (As)	mg/l	ND	ND	≤0.05	≤0.01
23	Cadmium (Cd)	mg/l	ND	ND	≤0.003	≤0.003
24	Copper (Cu)	mg/l	ND	ND	≤1.0	≤1.0
25	Chromium (Cr total)	mg/l	0.04	ND	≤0.05	≤0.05
26	Iron (Fe)	mg/l	0.22	0.09	≤0.3	≤0.3
27	Lead (Pb)	mg/l	ND	0.002	≤0.01	≤0.01
28	Manganese (Mn)	mg/l	0.01	0.009	≤0.1	≤0.05
29	Mercury (Hg)	mg/l	0.0003	ND	≤0.001	≤0.0005
30	Zinc (Zn)	mg/l	ND	0.003	≤3.0	≤1.0
31	Total Coliform	MPN/100ml	$1.1x10^3$	$1.1x10^4$	0	NV
32	Escherichia coli (E-Coli)	MPN/100ml	$1.1x10^3$	$2.4x10^3$	0	0

(Conducted by JICA Survey Team, Sampling date; June 14, 2014 and July 24, 2014)
(CNDWQS; Cambodian National Drinking Water Quality Standard (2004), issued by MIME)
(JNDWQS; Japanese National Drinking Water Quality Standard)
(ND; Not detected (lower than detection limit), NV; No value)

According to the results of raw water quality analysis conducted by the JICA Survey Team and Kampot Waterworks, the characteristics of raw water quality in Prek Kampot River based on are as follows:

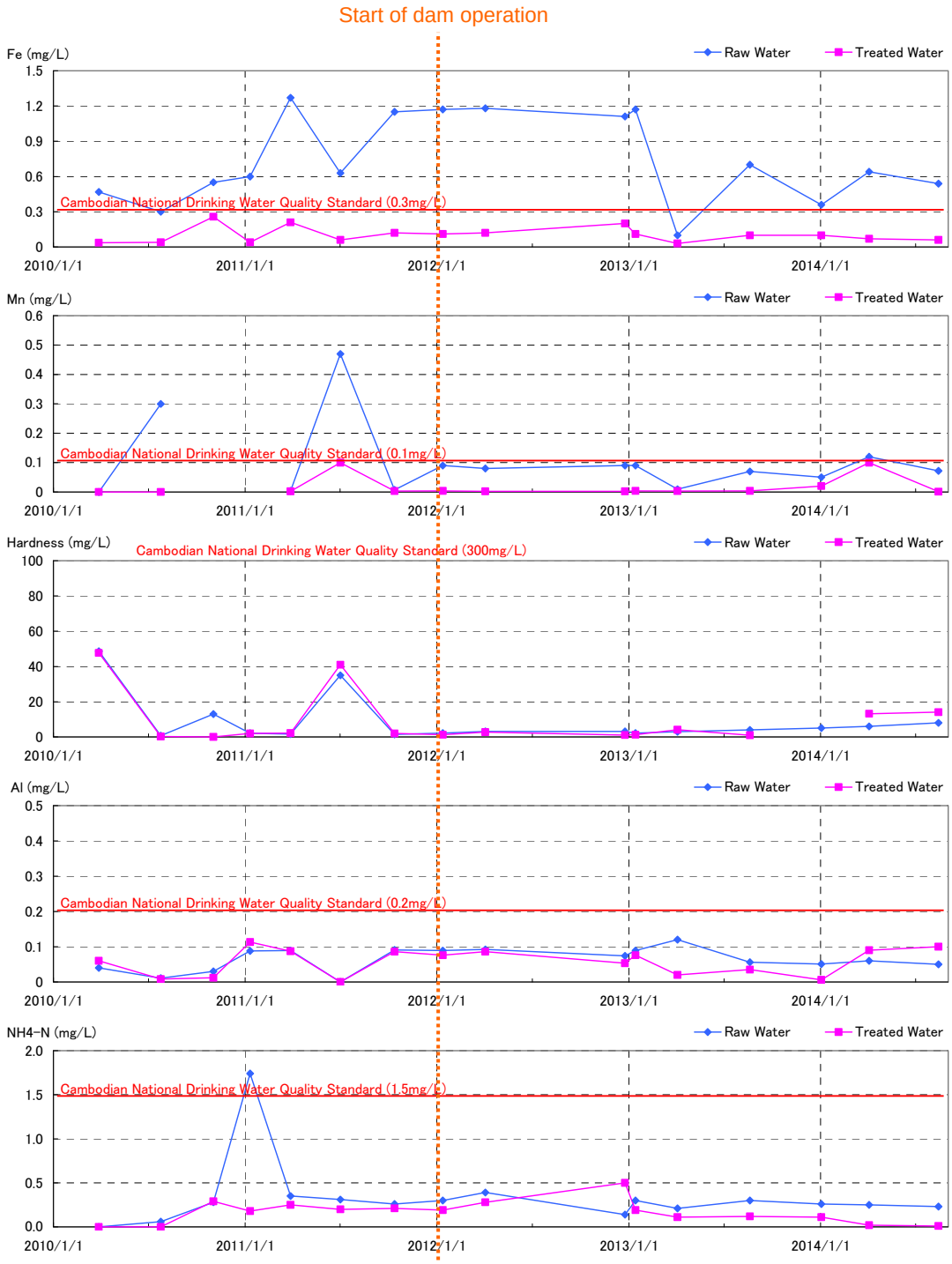
- Alkalinity is sometimes insufficient, less than 10, and pH sometimes decreases to 5 based on the record of water quality analysis conducted by the Waterworks.
- Iron and Manganese values are low based on the raw water quality analysis conducted by JICA Survey Team, but the iron value sometimes becomes high and the manganese value is also close to the standard according to the record of water quality analysis conducted by the Waterworks. However, those high values are not harmful to human.

- Coliform count is high due to wastewater from the restaurants located in the upstream of the existing water intake. The high coliform count is not a problem because chlorination will be installed in water treatment plant.
- Electrical conductivity, pH, Turbidity, Alkalinity and TDS have decreased as a result of dam operation.
- Pesticide was not detected from the Prek Kampot River.



(Source; Kampot Waterworks)

Figure 2.2.2.2-2 Water Quality of Raw Water and Treated Water (1)



(Source; Kampot Waterworks)

Figure 2.2.2.2-3 Water Quality of Raw Water and Treated Water (2)

(5) Evaluation of Saltwater Intrusion

The saltwater intrusion survey in Prek Kampot River was conducted by the JICA Survey Team at high tide during the spring tide cycle when the saltwater generally intrudes to its furthest point upstream.

Based on the following survey results, the saltwater didn't intrude to the intake station, because the survey was conducted during the rainy season and the discharge volume from the dam was large. However, the saltwater intruded to a point 2km downstream of the existing intake station on 14 June, 2014. Therefore it is likely that saltwater will intrude to just downstream of the intake station during the dry season.

Table 2.2.2.2-7 Results of Saltwater Intrusion Survey at Existing Intake Station

	Tide		Discharge from Dam	Water Depth	Chloride Ion	Remark
14 June, 2014	Spring Tide	Low Tide	Overflow	Surface	0 mg/L	Estimated from EC
25 June, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from Pack Test
11 July, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from Pack Test
24 July, 2014	Spring Tide	High Tide	Overflow	Surface	0 mg/L	Estimated from EC

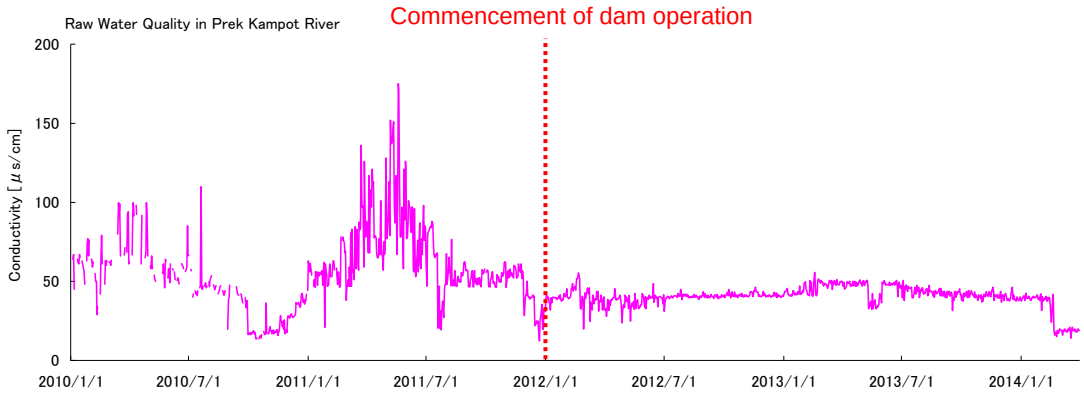
(The value of Chloride Ion in Cambodian National Drinking Water Quality Standard is 250mg/L.)
(Source: JICA Survey Team)

Table 2.2.2.2-8 Results of Saltwater Intrusion Survey at 2km Downstream of Existing Intake Station

	Tide		Discharge from Dam	Water Depth	Chloride Ion	Remark
14 June, 2014	Spring Tide	Low Tide	Overflow	Bottom	9,700 mg/L	Estimated from EC
11 July, 2014	Spring Tide	High Tide	Overflow	Bottom	0 mg/L	Estimated from EC
24 July, 2014	Spring Tide	High Tide	Overflow	Bottom	0 mg/L	Estimated from EC

(Source: JICA Survey Team)

Saltwater has never yet intruded to the existing intake station after the start of dam operation based on the past record of raw water quality conducted by Kampot Waterworks. Moreover, after the start of dam operation, the conductivity (chloride ion) decreased as a result of stable discharge from the upstream hydroelectric dam during the dry season.



(Source; Kampot Waterworks)

Figure 2.2.2.2-4 Electrical Conductivity of Raw Water in Prek Kampot River

There is a weir with natural boulders just downstream of the existing intake station, which was installed by Kampot Waterworks in 2002 when the saltwater intrusion at the existing intake station was observed. The weir with natural boulders (minimum elevation; 2.0m) is higher than high tide level (0.90m) and prevents saltwater from intruding further upstream. Therefore, there is likely to be no salt water intrusion problem at the existing intake station.

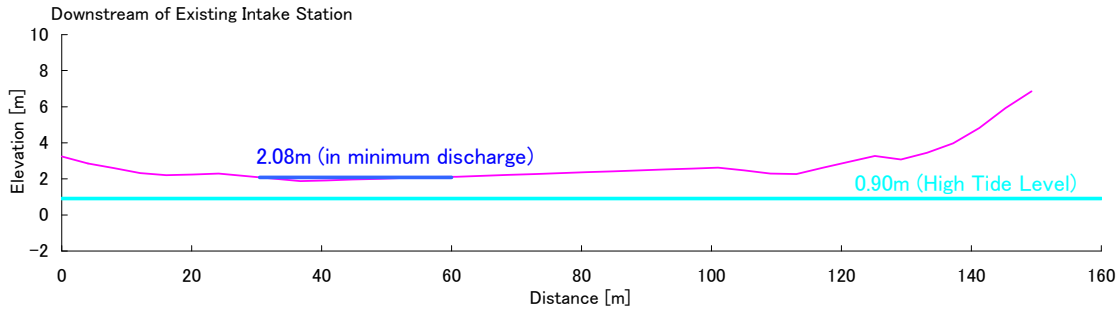


Figure 2.2.2.2-5 Cross Section of Just Downstream of Existing Intake Station

The weir with natural boulders has withstood floods and has not been damaged since it was installed in 2002. The weir with natural boulders is reinforced with sandbags every dry season by Kampot Waterworks.

Moreover, the dam operation decreases the probability of erosion of the natural weir as a result of lower and more regulated flood discharges.

The possibility of saltwater intrusion to the intake station is summarized as follows:

- The saltwater is likely to intrude to just downstream of the intake station especially during the dry season.
- The weir with natural boulders (minimum elevation; 2.0m) located downstream of the

existing intake station is higher than the high tide level (0.90m) and prevents the saltwater from intruding to the intake station.

- The natural weir has not been damaged by flooding since its installation in 2002.
- The dam operation decreases the probability of erosion of the weir because the dam regulates the flood discharge.
- It is important to continuously monitor saltwater intrusion by measuring conductivity at the intake station especially during the dry season.
- If saltwater intrusion is observed at the intake station, it is necessary to take the raw water carefully based on the tidal level and salinity concentration.

Photo 2.2.2.2-2 Weir with Natural Boulders Located Downstream of the Existing Intake Station

	
Weir with Natural Boulders (June, 2014)	Reinforcement of weir with sandbags conducted by Kampot Waterworks (Feburualy, 2011)

(6) Analysis of Impact on Downstream Environment by the Water Intake

1) Potential of Impact

The new water intake amount is 0.09 m^3/s. It would be necessary to determine if the additional intake from the Prek Kampot River would cause a decrease of discharge downstream and in turn have impacts on the downstream river environment and the existing river water utilization.

The minimum discharge volume from the upstream hydroelectric dam, as stated in the letter (No. 889, July 21, 2014) from MME, is 5.0 m^3/s. The river flow measurements taken on November 22, 2014 was 2.0 m^3/s at the exit of the spillway of the dam and 3.0 m^3/s at the existing intake. The result shows a 1.0 m^3/s riverbed water inflow between the exit of the spillway of the dam and the existing intake. The riverbed water inflow decreases as the dry season approaches. The river flow at the existing intake is considered to be around 2.0 to 3.0 m^3/s.

The additional intake of 0.09 m^3/s from the Prek Kampot River may have the following impacts on the downstream environment:

- Increase in the distance of saltwater intrusion
- Increase of salinity and decrease of DO as a result of the saltwater intrusion, especially at the river bottom
- Impact on ecosystem and fishing industry as a result of the change in water quality
- Impact on the existing river water utilization, ship transportation, and tourism

2) Saltwater Intrusion Distance

The saltwater intrusion survey shows that the Prek Kampot River is forming a weakly mixed saltwater wedge. The length of the saltwater wedge was estimated using the following formula (Source: Hydraulics Formulas).

$$L = \frac{H}{2\bar{f}_i}\left(\frac{1}{5}F_{d0}^{-2} - 2 + 3F_{d0}^{2/3} - \frac{6}{5}F_{d0}^{4/3}\right)$$

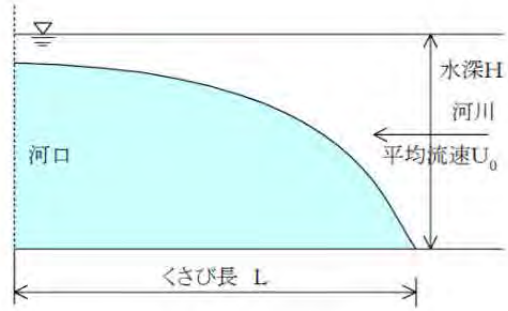


Figure 2.2.2.2-6 Estimation of Saltwater Intrusion Distance

The result of the calculation is shown in **Table 2.2.2.2-9**. The saltwater intrusion distance would increase by 2.0 km in the upstream direction. A weir made of natural gravel is constructed at the immediate downstream of the existing intake. The top of the weir is 2.0 m high, and is higher than the crest of the high tide in the spring (0.90 m). Therefore, saltwater will not intrude as long as the weir is maintained.

Table 2.2.2.2-9 Change in Saltwater Intrusion Distance after Additional Intake

	Intake Amount	Minimum Discharge Immediately Downstream of the Intake Point	Saltwater Intrusion Distance
Current Status	0.08 m^3/s	1.92 m^3/s	20.0 km
After Additional Intake of 0.09m^3/s	0.17 m^3/s	1.83 m^3/s	22.0 km

3) Impacts on Downstream Environment as a Result of Additional Intake

Impacts on downstream environment and the existing river water utilization are summarized in **Table 2.2.2.2-10.**

Table 2.2.2.2-10 Impacts on Downstream Environment

	Item	Impact
1	River Water Quality	· Saltwater will not intrude past the weir constructed immediately downstream of the existing intake. · Saltwater may intrude downstream of the weir. Increase of salinity and decrease of DO, especially at the river bottom is expected. However, the change will be within the range of normal fluctuations (salinity: 0 to 18,000 mg/L, DO: 3.0 to 6.3 mg/L). Therefore, impact on river water quality is not expected. · DO at the river bottom is around 3.0 mg/L. Anaerobic condition will not develop.
2	River Water Ecosystem	· The change of river water quality is within the range of normal fluctuations. Saltwater may intrude. However, the change in salinity is not more than that observed with the ebb and flow of the tide. Therefore, impact on the river water

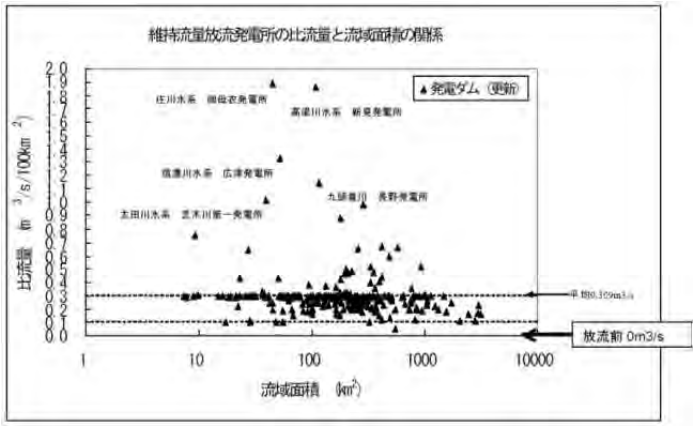
	Item	Impact
		ecosystem is not expected.
3	Fishing Industry	· There is no fishing industry downstream of the intake. Since the impact on the river water ecosystem is not expected, neither will there be any impact on fishing industry.
4	Water Utilization	· There is no water intake for drinking or agricultural use downstream of the intake.
5	Ship Transportation	· There is heavy ship traffic. However, water level downstream of the intake is affected more by tidal change than by the additional intake. Therefore, impact on ship transportation is not expected.
6	Tourism	· Kampot attracts many tourists. Water level downstream of the intake is affected by tidal change. Impact on tourism by the additional intake is not expected.

In conclusion, there is no expected impact on the downstream environment and the existing river water utilization, as a result of the additional intake of 0.09 m^3/s.

4) Evaluation of Maintenance Flow

According to the Guidelines for Power Generation published in Japan, the river maintenance flow should be approximately 0.1 to 0.3 m^3/s per 100 km^2 of basin area.

The basin area of the Kamchay hydroelectric dam is 2,443 km^2. The river maintenance flow should be within 2.4 to 7.2 m^3/s.



Source: Guidelines for Power Generation

Figure 2.2.2.2-7 Relationship between Basin Area and River Maintenance Flow

The minimum discharge volume of 5.0 m^3/s, from the upstream hydroelectric dam, stated in the letter (No. 889, dated July 21, 2014) from the MME, falls within the acceptable range. The JICA Survey Team river flow measurements, showing the river flow at the existing intake point to be around 2.0 to 3.0 m^3/s, are within the range mentioned in the guideline.

2.2.2.3 Plan for Water Intake Facilities

(1) Selection of Intake System and Site for the Proposed New Intake Facility

(a) Intake Site

The existing Intake Site is shown in **Figure 2.2.2.3-1**. The New intake Site is located next to existing Intake Facility.

Source: JICA Survey Team

Figure 2.2.2.3-1 Intake Site

(b) Study of Intake System

The intake system for the new intake facility has to be selected in consideration of several factors such as the annual fluctuation of water level at Pre-Kampot River, workability, and impact to the surrounding areas.

1) Site Condition

- Water level of Pre-Kampot River is affected by outflow rate from upstream dam.
- River width is around 50m at the intake site at minimum flow rate.
- Boats cannot pass through the weir located downstream of the intake site.
- The bank slope is gentle slope. The distance from the road to the edge of the water is around 30m. The vertical drop from the road to the water is around 10m.
- The soil condition at the intake point has been established by doing a borehole survey. A layer of boulder stones has been identified at approximately 4m below the surface.

2) Intake System

In general, options for the type of intake system include intake weir, intake tower, floating, intake gate, intake shaft with horizontal Pipe and inclined intake pipe.

The following methods are rejected. Intake weir and intake tower are comparatively expensive

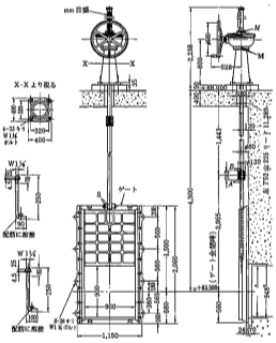
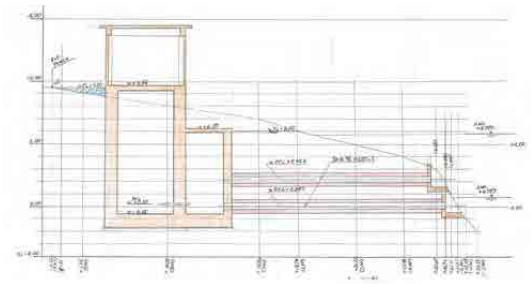
and therefore not suitable. A floating intake has does not fit river conditions and would not provide for a stable intake of water. The inclined intake pipe would require too much maintenance.

The following two plans are based on the existing intake system and are considered feasible.
Plan A: Intake Gate in the River
Install an intake gate in the river to convey water to an intake well where it will be pumped up.

Plan B: Intake Shaft with Horizontal Pipe
Install an intake shaft at the river bank with a pipe to convey water by gravity flow to an intake shaft where it will be pumped up.

Table 2.2.2.3-1 shows the options for the Intake System.

Table 2.2.2.3-1 Selection of Intake System

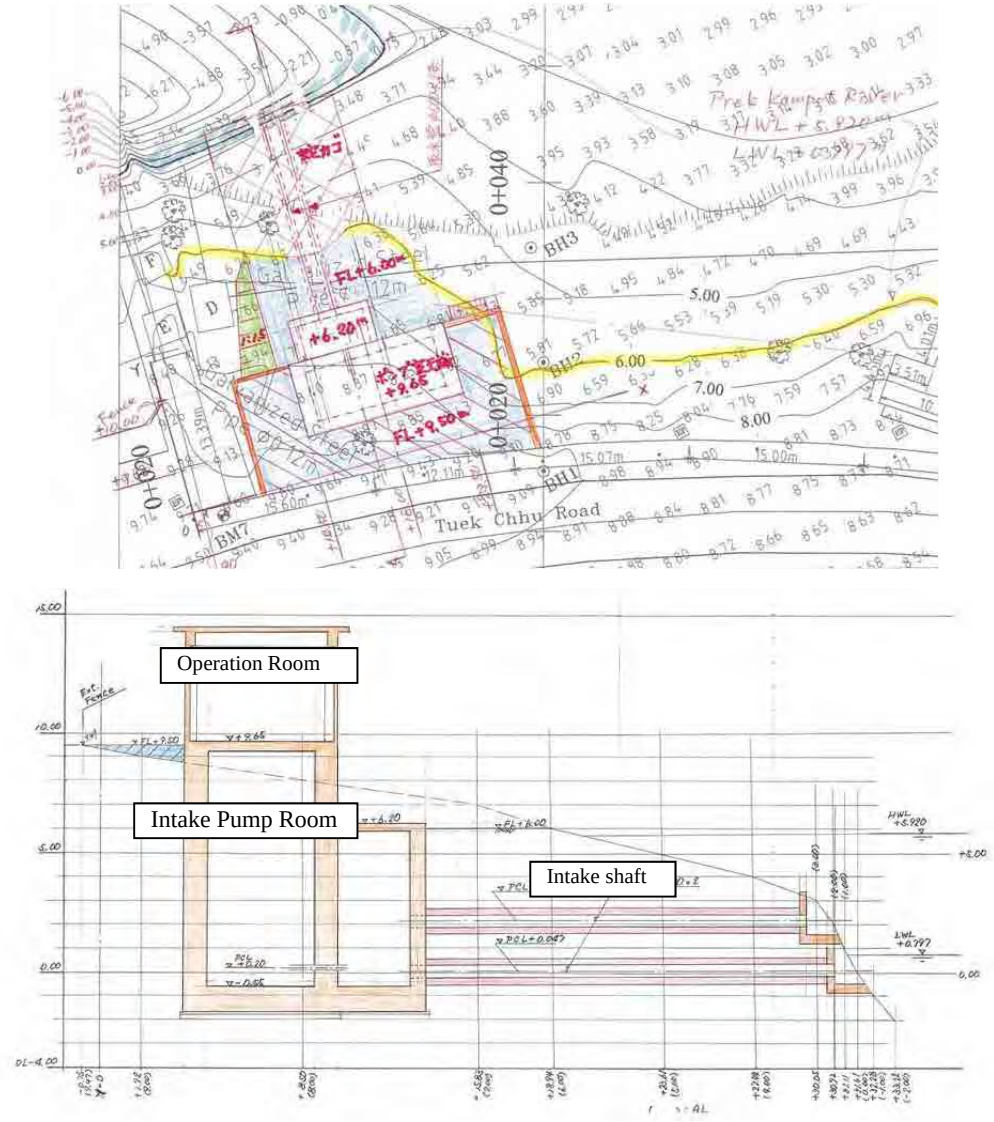
	Plan A: Intake Gate in River	Plan B：Intake Shaft with Horizontal Pipe
Photo（Ex.）		
Figure（Ex.）		
Estimated facilities and construction type	・Portal concreate structure ・Intake gate ・Foundation works：Spread foundation ・Operation room ・Revetment works (Gabion works) ・Single suction volute pump ・Electro-mechanical equipment ・Temporary works	・Intake shaft ・Foundation works：Spread foundation ・Operation room ・Revetment works (Gabion works) ・Single suction volute pump ・Electro-mechanical equipment ・Temporary works
Overview of facilities	・An intake gate in the river to convey water to an intake shaft where it will be pumped up.	Install an intake structure at the river bank with a pipe to convey water by gravity flow to an intake shaft (well) where it will be pumped up.
Intake	・When river flow and water levels are stable, water	・The intake shaft must be deeper than the probable low

	Plan A: Intake Gate in River	Plan B：Intake Shaft with Horizontal Pipe
performance	intake is stable. ・A sediment pit is needed at the intake gate.	water level. ・A discharge sediment pit is needed at the intake shaft.
Workability	・Installation of an intake gate at water'sedge is needed. ・Excavation is needed at water's edge to install the intake gate with temporary works such as sheet pipe or sandbag during construction.	・Installation of an intake shaft inside the bank is needed. ・Excavation of the river bank is needed to install intake shaft and horizontal intake pipes.
Environment	・A wide area of excavation is needed at the bank. ・No hindrance to boat transport.	・An excavation is needed at the river bank. ・No hindrance to boat transport.
O&M	・Intake pumps need regular maintenance. ・Maintenance is required to remove the accumulation of sediment and debris at the intake.	・Intake pumps need regular maintenance. ・Maintenance is required to remove the accumulation of sediment and debris at the intake.
Economic efficiency	・Construction cost will be expensive.	・Construction cost will be low.
Implementation record	・There are records of construction in Cambodia.	・There are records of construction in Cambodia.

Note: The photos and figures of intake system in the table are shown as examples.
Source: JICA Survey Team

Both plans can provide a stable performance however both need regular maintenance to clean the surroundings of the water inlet to prevent intake failure due to the accumulation of sediment and debris. Plan A can control intake gate and Plan B can select intake pipe depend on water level.
The cheapest and more environmentally friendly option is Plan B because the excavation volume is less than Plan A.
Therefore, Plan B "intake shaft with horizontal pipe" is recommended for the Project.

The details of the Plan B "Intake Shaft with Horizontal Pipe" are presented in **Figure 2.2.2.3-2** and summarized as follows.
The intake shaft will require a deep excavation. Site conditions require that a part of excavation work be carried out by driving sheet piles into the bedrock. An operations room will be constructed on top of the intake shaft to house the electro-mechanical equipment for the pump, the pump chain hoist, and the slurry discharge pump for sediment removal. The intake pipes from the shaft to the water can be installed using open-cut excavation. A revetment is required to protect the river bank from erosion. In addition, for operation and maintenance, a slurry pit is installed for trapping sediment at the bottom of the intake shaft.



Source: JICA Survey Team

Figure 2.2.2.3-2 Intake Shaft with Horizontal Pipe

(2) Type of Raw Water Pump

The raw water pump can be one of the following types: horizontal shaft type, vertical shaft type, or submersible motor type. **Table 2.2.2.3-2** shows the comparison of the three types of pumps. After examination, the horizontal shaft type is recommended because it is the easiest to maintain. This type of the pump has also been used at the existing raw water pump station.

Table 2.2.2.3-2 Comparison of Intake Pump Types

	Horizontal Shaft Type	Vertical Shaft Type	Submersible Motor Type
Advantages	· Less corrosion, easy maintenance because the parts are above the water. · No submerged bearings · Both driver and pump are inexpensive.	· Less potential for cavitation because the impeller is in the water. · Requires a small area for installation · Automation is easy because there is no priming.	· Less potential for cavitation because the impeller is in the water. · Requires a small area for installation and building structure can be simple. · Automation is easy because there is no priming. · Noise is minimal since the motor is underwater.
Disadvantages	· Requires large area for installation · Requires priming for start-up.	· Potential for corrosion because the main part is underwater. · Relatively difficult to disassemble and repair · Pump are submerged in the water. For maintenance they have to be pulled out. · Requires high crane lifting height · More expensive than horizontal shaft type.	· Life of the motor is shorter compared to non submersible pump. · Requires regular maintenance for leakage inspection. · Expensive · There is little track record of implementation of this type in Cambodia, especially, for drinking purposes.
Others	· Total excavation volume is smaller compared to installations in Kampong Cham and Battambang where the excavation depth is around 20m.	· This type was adopted in Kampong Cham and Battambang.	

(3) Electrical and Control Facilities

· New power receiving facilities will be installed.

· An emergency generator will be required.

Recent operational record shows that the frequency of power failure is 3-8 times a month, the duration of power outages is between 20 minutes and 5 hours. The existing generator is running frequently. Therefore, it is necessary to install an emergency generator at the new facility.

· Lightning protection will be installed at each building to prevent lightning damage

2.2.2.4 Plan for Raw Water Transmission Main

(1) Planning Condition for New Raw Water Transmission Main

(a) Design Intake Flow

Design intake flow is the design maximum daily water supply in the target year (2021) plus 10% for conveyance and treatment losses.

・Design intake flow ＝ 7,500m^3/day x 1.1＝8,250 m^3/ day

(b) Water Level Condition

Based on the results of discussions with WWs and a review of historical records for measurements taken near the planned site, water level conditions are set as follows.

i) Intake Water Level

Water level condition is determined as follows based on existing facility's water level.

Water level at the intake shaft:

・HWL: 5.920m

・LWL: 0.797m

ii) Discharge Water Level

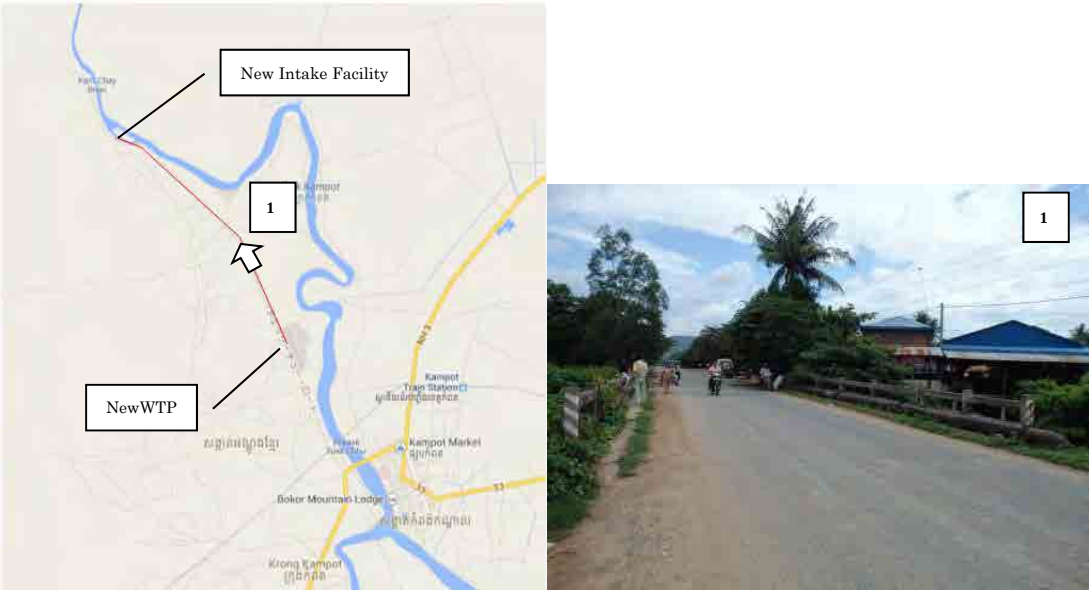
・Water level at the receiving well of the water treatment facility: 10.4m

(c) Raw Water Transmission Main Route

The planned raw water transmission main route is approximately 5,400m along a straight section of road to the south of the access road to the intake point. It is the shortest route to the water treatment plant. The raw water transmission main will be connected to the receiving well in the water treatment plant via the approach road.

Almost all sections on the route are asphalt-paved roads. The approach road to the treatment plant is unsurfaced. In some sections of the proposed route there are small shops on both sides that will be affected by construction. Shop owners need to be informed about the project.

Figure 2.2.2.4-1 shows the raw water transmission main route.



Source: JICA Survey Team

Figure 2.2.2.4-1 Raw Water Transmission Main Route

(2) Diameter

(a) Calculation Formula for Diameters

The Hazen-Williams Formula is used to calculate the pipe flow velocity and friction head loss.

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

Where , H : friction head loss (m)

C : Coefficient of velocity（C = 110 is used for the conduit as a whole, including the loss in bends.）

D : Diameter (m)

Q : Flow (m^3/s)（Design intake flow: 8,250 m^3/day）

L : Length of pipeline (m)（Raw Water Transmission Main: 5,400m）

Table 2.2.2.4-1 below summarizes the relationship between diameter of raw water transmission main and velocity for the minimum design intake flow.

Table 2.2.2.4-1 Diameter of Raw Water Transmission Main and Velocity with the Minimum Flow Rate

Diameter (mm)	Velocity(m/s)
Φ200	3.039 m/s
Φ250	1.945 m/s
Φ300	1.351 m/s

Diameter（mm）	Velocity(m/s)
Φ350	0.992 m/s
Φ400	0.760 m/s
Φ450	0.600 m/s
Φ500	0.486 m/s
Φ600	0.338 m/s
Φ700	0.248 m/s

Source: JICA Survey Team

The minimum velocity (V=0.3m/s) needs to be secured to prevent the deposition of suspending sand in the pipe. The table above shows that diameters less than φ600 are needed to secure the minimum velocity.

(b) Conditions for Economical Diameter

The following costs are considered to determine the specifications for the raw water transmission main and the diameter.

a) Initial Cost
- Cost of pumps
- Cost of Raw Water Transmission Main

b) Cost for O&M
- O&M cost for pump (2% of initial costs)）
- O&M cost for pipelines (1% of initial costs)
- Energy cost for public water supply entity (850R/kwh)

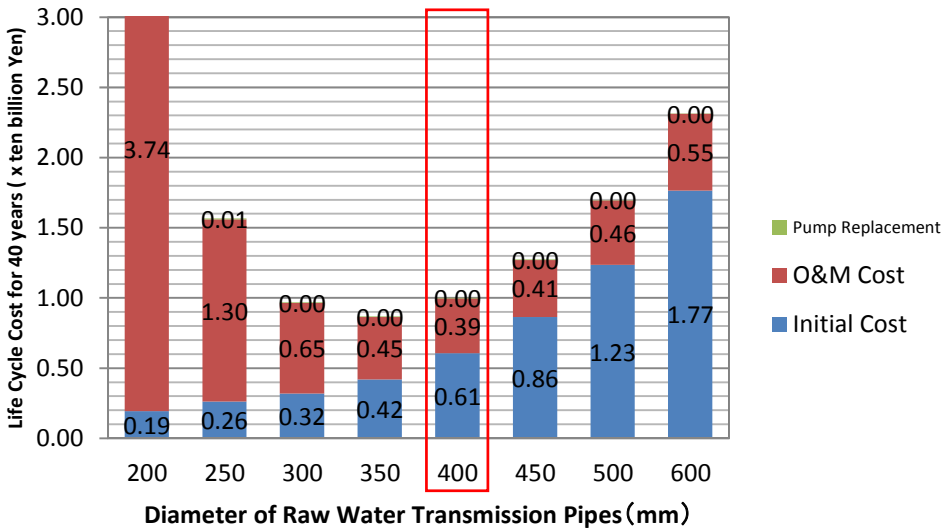
c) Replacement Cost
- Replacement Cost for pumps is estimated based on a pump life of 22 years. The cost for replacement is the cost incurred by replacement taking the discount rate at the time of replacement into account to calculate the present value. The discount rate is calculated by the following formula:

Discount Rate = $1/(1+r)^n$; where, r: Interest Rate (=4%), n: Operation Years

d) Others
- The initial costs are calculated by annual expense ratio (cost ratio for 1 year) during the life cycle (40 years). The annual expense ratio is calculated by the following equation:
  Annual expense ratio = r/(1-(1+r)-n), where, r: Interest Rate (=4%), n: Operation Years
- The O&M cost is the present value of the annual O&M cost taking the discount rate as well as annual expense ratio into account.

(c) Diameter of Raw Water Transmission Main

Figure 2.2.2.4-2 below shows the estimated costs.



Note: the ratio of the value for expenses accured of annual cost for Φ400
Source: JICA Survey Team

Figure 2.2.2.4-2 Relationship between Diameter of Raw Water Transmission Main and Annual Operating Cost

The figure above shows that the initial costs are the sum of pump and pipeline construction costs. Costs for pumps become smaller with larger diameter raw water transmission main since pipeline loss becomes less, but the construction costs are higher for the laying of pipelines. Considering these factors, the initial costs will slightly increase when the diameter of raw water transmission main becomes larger.

The cost for O&M is the sum of the costs for maintenance of pumps and pipelines and the power supply. The smaller the diameter, the higher the cost of the pumps becomes. Similarly, the smaller the diameter, the higher the power supply becomes. Based on minimizing total costs φ350 and φ400 pipeline is comparatively the least expensive.

A pipeline with a diameter of φ400 provides economically the most advantageous for O&M costs. Therefore, a φ400 pipeline is selected for the raw water transmission main.

(3) Materials for Raw Water Transmission Main

Potential materials considered for the raw water transmission are as follows.

- Ductile Cast Iron Pipe
- High Density Polyethylene Pipe
- Coated Steel Pipe for Water Service

The comparison between various types of water supply pipes is given in the following table

Table 2.2.2.4-2 Comparison of Pipe Materials

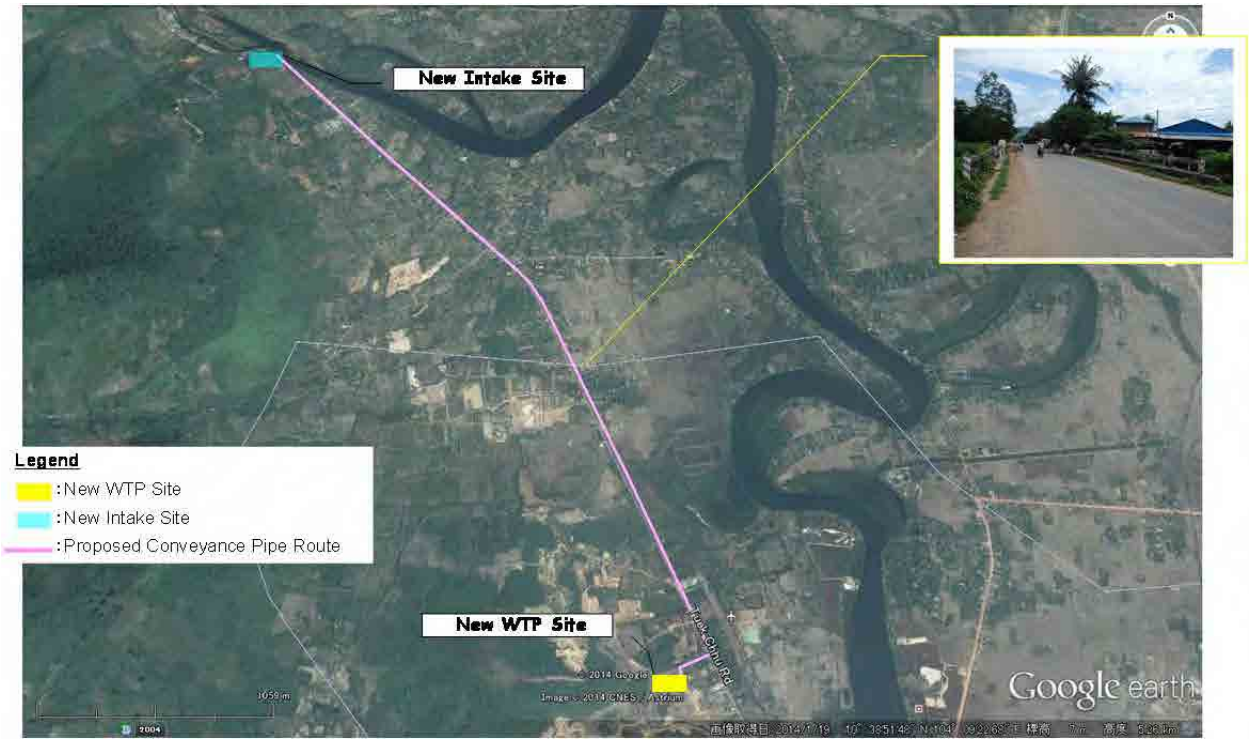
Criteria	Ductile Cast Iron Pipe (DIP)	High Density Polyethylene Pipe (HDPE)	Coated Steel Pipe for Water Service (STW)
Durability	・Strong and corrosion resistant. ・Weak against shock.	・Excellent corrosion resistance. Ultra-violet rays resistant.	・Strong against shock but easily corroded when the surface protection is damaged and spot welded for pipes of less than diameter 700mm.
Workability	・Workable with the push-in type fittings.	・Light and high workability. ・The applicable size of butt welding machine in Cambodia is up to φ200mm.	・It takes time and skills for welding joints.
Implementation result	・Many applications with pipelines larger than φ250mm or more in Cambodia.	・φ200mm is generally used in Cambodia.	・Minimal usage in Cambodia.
O&M	・Many applications with pipelines larger than φ250mm. ・Easy procurement of spare parts with a wide market.	・Accessibility of spare parts may be limited since the use of φ250mm or more is minimal.	・Repair needs time since there are not many users.
Others	・Within allowable bending angles of the pipes; pipes can be laid along the ground. Pipes can come apart if too much pressure is applied.	・Pipes are flexible and can be laid along the ground.	・Pipes joints are welded and pipe can be laid along the ground..
Selected	○		

Source: JICA Survey Team

Based on the comparison above, ductile cast iron pipe (DIP) should be used for pipelines with more than φ250mm diameter since there are many similar applications of this type in Cambodia. Polyethylene (PE) pipe has seen minimal applications for pipelines larger than φ250mm and the availability of spare parts is not well established. Furthermore, the waterworks has no joint fusion machine for repairs. Although coated steel pipe for water service (STW) is equivalent to ductile cast iron pipe (DIP) in terms of price, they should not be used for the project due to difficulties with workability and the skill needed for the welding work.

(4) Raw Water Transmission Main Arrangement Plan

Based on the above discussion, the raw water transmission main is designed as shown in **Figure 2.2.2.4-3**.



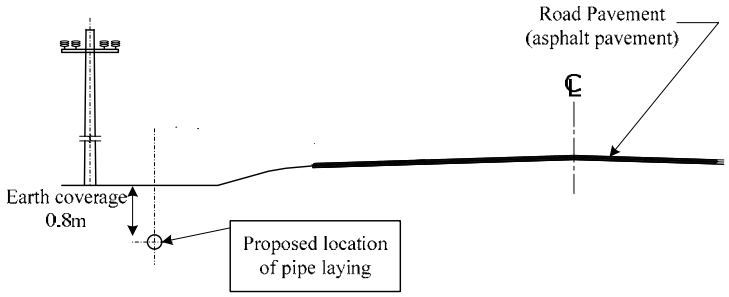
Source: JICA Survey Team

Figure 2.2.2.4-3 Raw Water Transmission Main Design

(5) Design Criteria for Raw Water Transmission Main

(a) Pipe Installation Location

Almost all sections along the proposed route are two lane asphalt-paved roads. The approach road to the treatment plant is unsurfaced. Therefore, the pipeline will be placed along the roadside to prevent damaging the asphalt surface.



Source: JICA Survey Team

Figure 2.2.2.4-4 Installation Location of Pipeline

(b) Excavation and Backfilling

Earth cover over the pipe is set to 0.8m at roadside. Pipe trenches must be supported by steel

sheet piles. Pipe trenches are less than 3m deep therefore lightweight steel sheet piles can be used. The top 20cm of the pipe trench will be backfilled with sand.

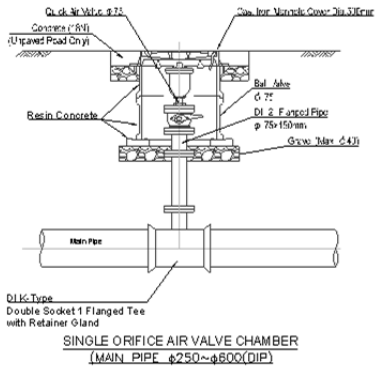
(c) Appurtenant Structures

a) Sluice Valves

Sluice valves are installed at approximately 2km intervals to isolate sections of the raw water transmission main for maintenance. Sluice valves are typically located at the high points, at drain out locations and wherever pipes are attached to a bridge.

b) Air Valves

The function of the air valve is to discharge air accumulated inside the pipe and to allow air into the pipe when draining. Air valves make for a smoother operation and improved flow. Air valves are always located at high points in the pipeline where air accumulates. An example of air valve is shown in **Figure 2.2.2.4-5**.



Source: JICA Survey Team

Figure 2.2.2.4-5 Example of Air Valve

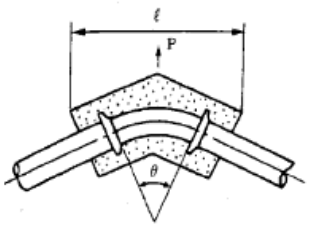
c) Drainage Facility

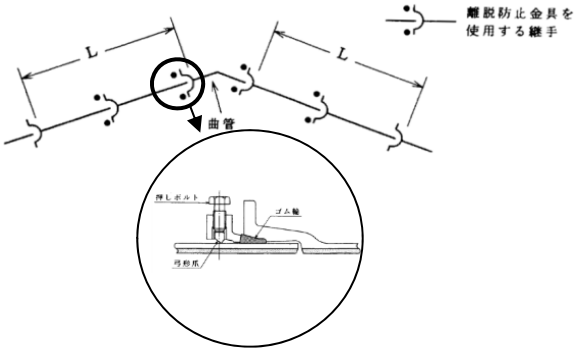
Drainage facilities on a pipeline are required to wash out the impure substances accumulated when the pipe is installed and to discharge turbid water from the pipes when there is an emergency. The installation location shall be set at the lowest portion of the pipeline near the river or drainage canal.

d) Protection of Deformed Pipes

Thrust blocks or restrained joint fittings shall be installed at all bends, changes in direction and valves, since these will be affected by the uneven force of water pressure. An example of a thrust block is shown in **Figure 2.2.2.4-6** and an example of a restrained joint fitting is shown in **Figure 2.2.2.4-7**.

Thrust blocks are commonly used but they are not appropriate in this Project because they take several days to install and that would have a negative impact on road traffic. The use of restrained joint fittings is preferred.





Source: JICA Survey Team

Figure 2.2.2.4-6 Example of Thrust Block

Figure 2.2.2.4-7 Example of Restrained Joint Fitting

(6) Components and Specification for Intake Facility

Components and specification for intake facility are shown in **Table 2.2.2.4-3**.

Table 2.2.2.4-3 Components and Specification for Intake Facility

Facility			Specifications and dimensions
Function	Component	Item	
Raw water intake	Intake Shaft	Main body	Reinforced Concrete Structure Rectangular Shape: W3.00m x L5.70m (inner dimension) Depth 6.55 m (Depth at HWL 6.47 m)
		Intake Pump Room	Reinforced Concrete Structure Rectangular Shape: W4.50 m x L9.00 m x H3.55 m (inner dimension)
		Control Room for Intake Pump	Reinforced Concrete Structure Rectangular Shape: W5.10 m x L4.55 m x H4.00 m(under the beam) (inner dimension) Equipment: Power Receiving Panel, Operating Panel, Switchboard, Secondary Equipment Panel, Generator, Circumference Plumbing of Pump, Overhead Crane
	Intake Pump Facility	Intake Pump	Single Suction Volute Pump 4 sets (Duty 3 sets, Spare1 set)
	Temporary Works	Earth-retaining wall	Soldier pile with lateral lagging L=14.5m, Installation Length L=21.0m Soldier pile with lateral lagging L=13.0m , Installation Length L=13.5m
		Sandbag	3 steps stacking, Length: Foot of Slope L=30m
Raw Water Transmission	Raw Water Transmission Main	Pipe	DIPΦ400、L≒5400 m

2.2.2.5 Plan for Water Treatment Facilities

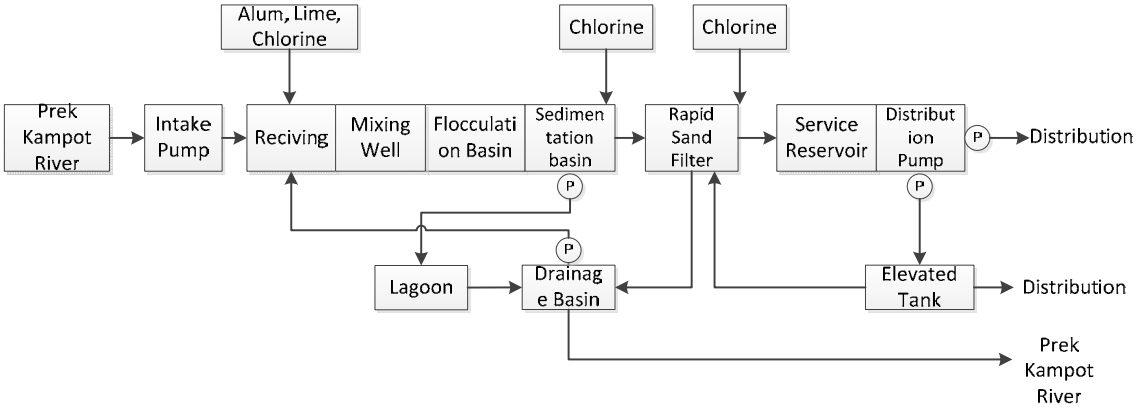
(1) Treatment Process

The treatment process was designed to achieve operational and energy efficiency, as well as for ease of operation and maintenance. In other words, the integrated operation of the components of the treatment process (such as sedimentation, filtration and disinfection) would be efficient and effective.

The key factors to consider in designing the treatment process are the quality of the raw water, the desired quality of the treated water, the quantity of water to be treated, and the level of technology required for proper operation and maintenance. The conventional treatment process (coagulation – sedimentation – rapid sand filtration), similar to that used at the existing Phum Prek plant in Phnom Penh and other plants in Cambodia, is deemed most appropriate. The chemical feeding system uses aluminium sulfate for coagulant, lime for pH and alkalinity adjustment and chlorine gas for disinfection.

In addition, an intermediate chlorination system treats the manganese. The intermediate chlorination system maintains the chlorine residual concentration at the sand filter and promotes the oxidation of manganese at the surface of the sand filter. Filter sand is coated by insoluble manganese oxide. The intermediate chlorination issued for manganese oxidation at the surface of sand filter.

Figure 2.2.2.5-1 shows the treatment process flow chart.



Source: JICA Survey Team

Figure 2.2.2.5-1 Water Treatment Process

(2) Details of Each Component of the Treatment Process

(a) Mixing Well

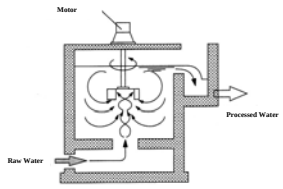
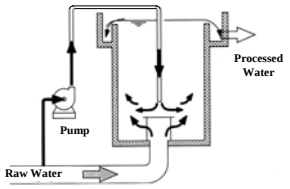
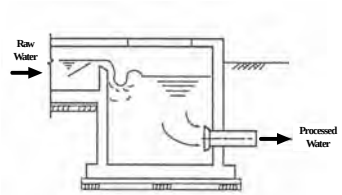
There are three stages to the coagulation-sedimentation process: mixing, flocculation and sedimentation. Thorough and rapid mixing of the raw water with the added coagulants is

necessary to promote coagulation of the fine particles to form flocs.

The three mixing methods listed below (and see **Figure 2.2.2.5-2**) were considered:

a. Mechanical mixing
b. Mixing using pumps
c. Gravitational force mixing using a weir

The gravitational force mixing method is preferred because of the minimum operation and maintenance requirements. The existing treatment plants in Phnom Penh also use this method. This is a well-established method widely used at other plants outside of Cambodia.

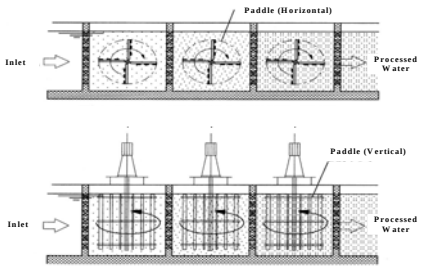
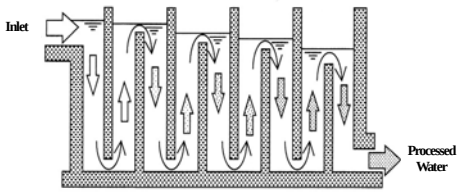
Mechanical Mixing	Mixing using Pump	Gravitational force mixing using a weir
		

Source: JICA Survey Team

Figure 2.2.2.5-2 Types of Mixing Method

(b) Flocculation Basin

It is proposed that the flocculation basin will be a vertical baffled channel type. The mechanical agitation type basin is not recommended because of its operation and maintenance requirements. **Figure 2.2.2.5-3** shows the vertical baffled channel type basin and the mechanical agitation type basin. The existing plants in Cambodia also use the baffled channel type. This is a well-established method widely used at other plants outside of Cambodia.

Mechanical Agitation (Flocculator)	Baffled Channel
	

Source: JICA Survey Team

Figure 2.2.2.5-3 Types of Flocculation Basin

(c) Sedimentation Basin

The efficiency of the sedimentation basin (E) is determined using the following equation:

$$E = vo / (Q / A)$$

where A : horizontal area of the sedimentation basin
Q : flow rate into the sedimentation basin
vo : velocity of floc sedimentation
Q / A : overflow rate (surface loading)

The above equation indicates that the efficiency of the sedimentation basin can be improved by:

1. Increasing the area of the sedimentation basin;
2. Increasing the velocity of floc sedimentation; or
3. Decreasing the flow rate into the sedimentation basin.

The different types of sedimentation basins can be classified according to the above variables, as shown in **Table 2.2.2.5-1**. The "conventional type, uni-flow sedimentation basin" is recommended for this project. This is a well-established method widely used at other plants outside of Cambodia.

Table 2.2.2.5-1 Improved Settling Performance Provided by Different Type of Sedimentation Basin

Horizontal flow sedimentation basin	Conventional type – uni-flow sedimentation basin		decreased flow rate into the sedimentation basin
	Multi-layer sedimentation basin	Dual layer	increased area of sedimentation basin
		Triple layer	
	Inclined plate/pipe sedimentation basin	Horizontal flow type	
		Up-flow type	
Suspended solid contact type sedimentation basin	Slurry circulation type suspended solid contact type sedimentation basin		increased velocity of floc sedimentation
	Sludge blanket type sedimentation basin		
	Combined type of above types		

Source: JICA Survey Team

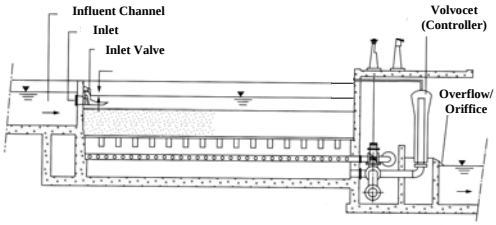
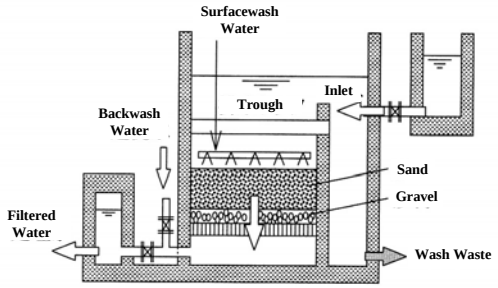
(d) Rapid Sand Filtration Basin

The rapid sand filtration basin is the final turbidity removal step in the water treatment process. The following two types of filtration basins were considered for this project (see **Figure 2.2.2.5-4**):

a. Rapid sand filtration, air scouring type
b. Standard rapid sand filtration type

The standard rapid sand filtration type is not recommended because it requires relatively high level of technical knowledge to adjust the volume of water being filtered, as well as for other operational control. The rapid sand filtration, air scouring type is simple to operate, uses less

backwash water and is used at existing plants in Cambodia. Staff would have the expertise to operate and maintain the system. Therefore, the rapid sand filtration, air scouring type is recommended as the preferred option for this project.

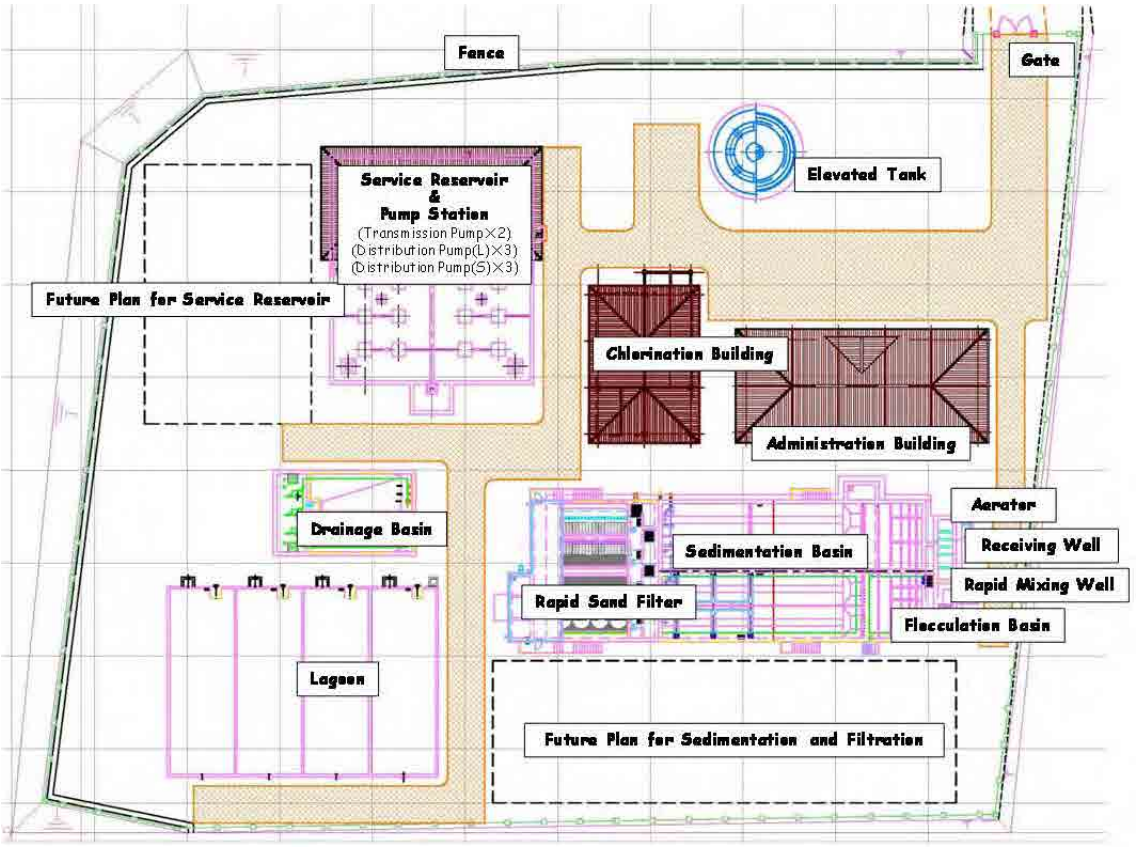
Air Scouring Type	Standard Type
	

Source: JICA Survey Team

Figure 2.2.2.5-4 Types of Rapid Sand Filtration Basin

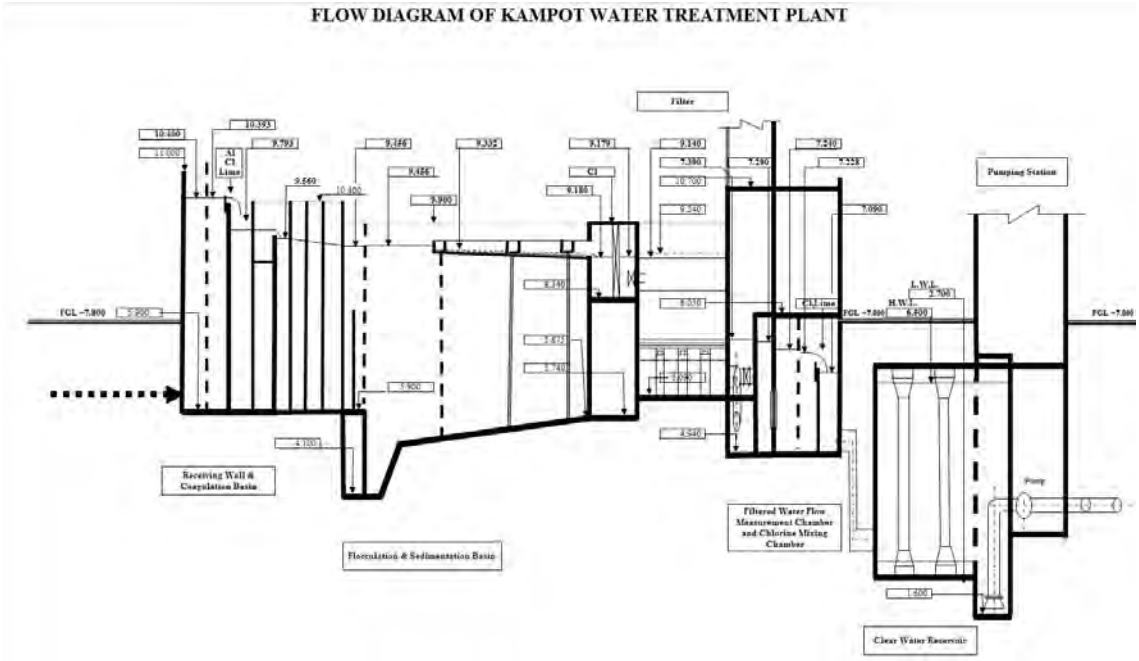
(3) Layout of Treatment Facility

The layout of the proposed water treatment facilities of Kampot is shown in **Figures 2.2.2.5-5**. The flow diagram of the proposed water treatment facilities of Kampot is shown in **Figures 2.2.2.5-6**.



Source: JICA Survey Team

Figure 2.2.2.5-5 Layout of Kampot Water Treatment Plant



Source: JICA Survey Team

Figure 2.2.2.5-6 Flow Diagram of Kampot Water Treatment Plant

(4) Design for Other Components of the Treatment Facilities

(a) Design for Sludge Treatment and Wastewater Discharge

Sludge from the sedimentation basin will be treated and disposed of in the following manner in compliance with discharge standards:

・During washing of the basin, the supernatant of the basin which is of low turbidity will be discharged to the Pre-Kampot River.

・Settled sludge and high turbidity water is pumped to a sludge drying bed.

・Supernatant of the drying bed will be discharged to the river and the dried sludge will be disposed of at a pre-determined location.

Backwash water from the filtration basin will be retained at the wastewater basin and discharged by pump to the nearby river in a control manner to avoid releasing large volumes of wastewater in a short period of time. Supernatant from the sludge drying bed and wastewater basin can return to the receiving well, if the supernatant still has high turbidity.

The route for the wastewater discharge pipe is show in **Figures 2.2.2.5-7**.

Backwash water from the filtration basin will be retained at the wastewater basin and discharged by pump to the nearby river in a control manner to avoid releasing large volumes of wastewater in a short period of time. Especially, supernatant of the sludge drying bed and wastewater basin can return to the receiving well, if the supernatant still has high turbidity.

Wastewater discharge pipe route show in **Figures 2.2.2.5-7**.

Source: JICA Survey Team

Figure 2.2.2.5-7 Wastewater Discharge Pipe Route

(b) Distribution Pumping Facilities

A foot valve will be installed at the suction of the distribution pump rather than a complicated

vacuum pump system.

(c) Electrical and Control Facilities

· New power receiving facilities will be installed.

· An emergency generator will be required.

Recent operational record shows that the frequency of power failure is 3-8 times a month, the duration of power outages is between 20 minutes and 5 hours. The existing generator is running frequently. Therefore, it is necessary to install an emergency generator at the new facility.

· Lightning protection will be installed at each building to prevent lightning damage

(d) Yard Piping and Landscaping

Inter-connecting pipelines of appropriate diameters will be installed between treatment facilities.

Maintenance roads will be constructed around the treatment facilities.

The land for the planned WTP is a vacant site and has no fence or gate to prevent entry. Considering the public safety, the potential for property loss and risk of terrorism, a fence and gate will be constructed for improved security..

(5) Design for Components of the Water Treatment Facility

Table 2.2.2.5-2 shows the components of the water treatment facility planned for Kampot.

Table 2.2.2.5-2 Components and Specification for Water Treatment Facility

Facility/Equipment			Dimensions and specifications
Function	Component	Item	
Water Treatment Facility	Receiving Well		Reinforced Concrete Structure Internal Dimension: 1.60 m width × 2.30 m length × 4.50 m depth Volume and Detention Time: V=16.56m^3、T=2.89min in dry season (T≧1.5 min) Cascade Aerator; 5steps, Height of a step 30cm
	Rapid Mixing Tank		Reinforced Concrete Structure Gravitational force mixing using a weir Internal Dimension: 1.60 m width × 1.50m length × 3.89 m depth Volume and Detention Time: V=9.3 m^3、T=1.63 min (1<T< 5 min)
	Flocculation Basin		Reinforced Concrete Structure Slow Mixing Method: Vertical channel bands flocculator Internal Dimension: 7.05 m width × 2.80 m length × 4.50 m height + 3.48 m average effective depth Quantity: 2
	Sedimentation Basin		Reinforced Concrete Structure Horizontal-Flow Sedimentation Basin Supernatant Collecting System: Collecting Trough + Submerged Orifice Quantity: 2 Internal Dimension: 7.05 m width × 21.50 m length × 3.78 m average depth Surface Loading: Q/A=19.0 mm/min (15-30 mm/min)

Facility/Equipment			Dimensions and specifications
Function	Component	Item	
			Mean Velocity: V=0.20 m/min (below 0.40 m/min)
	Rapid Sand Filter		Reinforced Concrete Structure Internal Dimension: 2.50 m width × 7.00 m length Quantity: 4 Filter Sand Thickness: 100 cm Underdrain System: Porous Filter Bed Method Filtration Rate: V=117.86 m/day (120-150 m/day) Flow Control: Lower Part Control Method Backwash Method: Simultaneous Backwash Method by Air and Water
	Service Reservoir		Reinforced Concrete Structure using Flat Slab Structure Quantity: 2 Effective Volume: V=1,100 m^3 (550m^3 × 2) Effective Water Depth: H=3.80 m (3-6 m) Detention Time: T=3.5 hours (designed by daily demand fluctuation) Internal Dimension: 10.40 m width × 14.00 m length × 3.80m height
	Elevated Tank		Reinforced Concrete Structure Quantity: 1 Effective Volume: V=300m^3 Internal Dimension: 9.60 m dia ×4.00m depth
	Drainage Basin		Reinforced Concrete Structure Quantity: 2 Effective Volume: V=211 m^3 (105.5 m^3 × 2) Internal Dimension: 4.00 m width × 11.00 m length × 5.60m height + 2.40m depth
	Lagoon		Reinforced Concrete Structure Quantity: 4 Effective Area: A=560 m^2
	Chemical Feeding Facility		Alum, Lime: at Administration Building Chlorine: Chlorine Feeding House (Floor Area 155m^2)
	Emergency Generator		Generator, Equipped with Fuel Tank At Administration Building
	Administration Building		Reinforced Concrete Structure, Three Stories Building, Total Floor Area: 604.4m^2 Usage: 1st Floor: Staff Room, Workshop, Storage, Emergency Generator Room, Toilet, Chemical Carry-in Room (1-3 Fl. Open Ceiling), laboratory 2nd Floor: Manager Room , Meeting Room, Monitoring Room, Toilet, Chemical Dissolving Tank Room (2-3 Fl. Open Ceiling), Chemical Feeding Pump Room 3rd Floor: Chemical Dissolving Tank Room (2-3 Fl. Open Ceiling) Common: Staircase

2.2.2.6 Plan for Transmission and Distribution Facilities

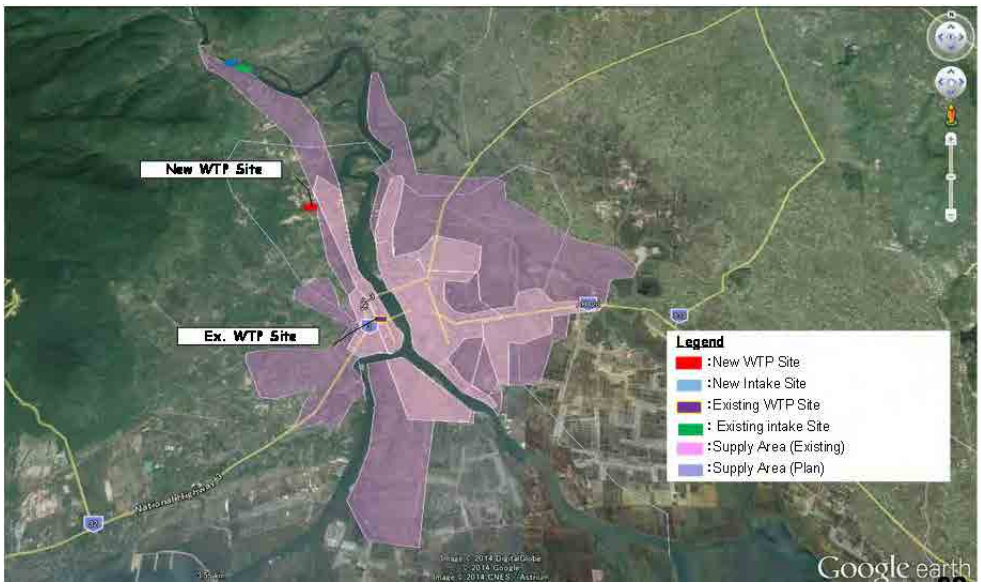
(1) Distribution System Study

(a) Planed Water Supply Area

The existing water supply area and the planned water supply area are shown in **Figure 2.2.2.6-1**.

The plan for transmission and distribution facilities was developed based on the "Water Master Plan", which was formulated under The Project on Capacity Building for the Water Supply System in Cambodia Phase 2 and other related project plans.

In addition to "Master Plan", three villages; Snam Prampir、Mark Prang、Kampong Krong, are included in the planned water supply area because these three village have similar population densities to other expansion areas.



Source: JICA Survey Team

Figure 2.2.2.6-1 Outline of the Water Supply Area

(b) Study for Distribution System

a) Study for Distribution System

The following three alternatives are considered for supplying water from the planned WTP.

Plan A: Gravity flow

Plan A is gravity flow from an elevated tank located at the planned WTP. The ground level of the planned WTP is 7.8m. The elevation of elevated tank needs to be more than 50m to provide

sufficient residual pressure at the limit of the expanded water supply area. Construction of such a high elevated tank is difficult therefore Plan A is not recommended.

Plan B: Pumped distribution

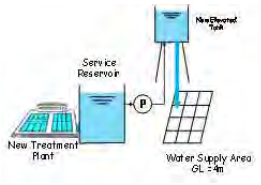
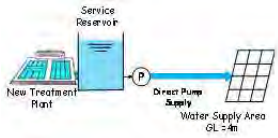
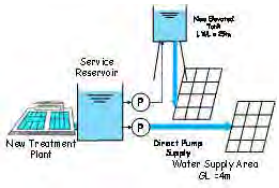
Plan B is to pump from the planned WTP to the expanded distribution area. This plan does not require the construction of an elevated tank but pumps operation is required.

Plan C: Pumped distribution and Gravity flow

Plan C is a combination of gravity flow with pumping. This plan is distribution of water to the limit of the expanded water supply area by pumping and to the part of area by gravity flow using an elevated tank.

The comparison of distribution system alternative is presented as follows.

Table 2.2.2.6-1 Comparison of Distribution System

	Plan A : Gravity flow	Plan B: Pumped distribution	Plan C: Pumped distribution and Gravity flow
Outline			
Elevated tank	Elevated tank (height 50m)	No elevated tank	Elevated tank (height 30m)
	×	○	○
Pump	Transmission pump	Distribution pump	Distribution pump
	○	△	△
Ease of operation	Management of water level needed for elevated tank only. However, water level monitoring by staff is necessary.	The control depends on water demand.	The control depends on water demand.. Management of water level needed for elevated tank Distribution system is similar to the existing WTP. Elevated tank can also be used as backwash storage for rapid sand filter.
	○	△	○
Land acquisition	No land acquisition	No land acquisition	No land acquisition (inside the planned WTP)
	○	○	○
Economic efficiency	Construction cost will be expensive.	Construction cost will be low but O&M is higher than Plan C	Construction cost will be low
	×	○	○
Overall evaluation	×	△	○

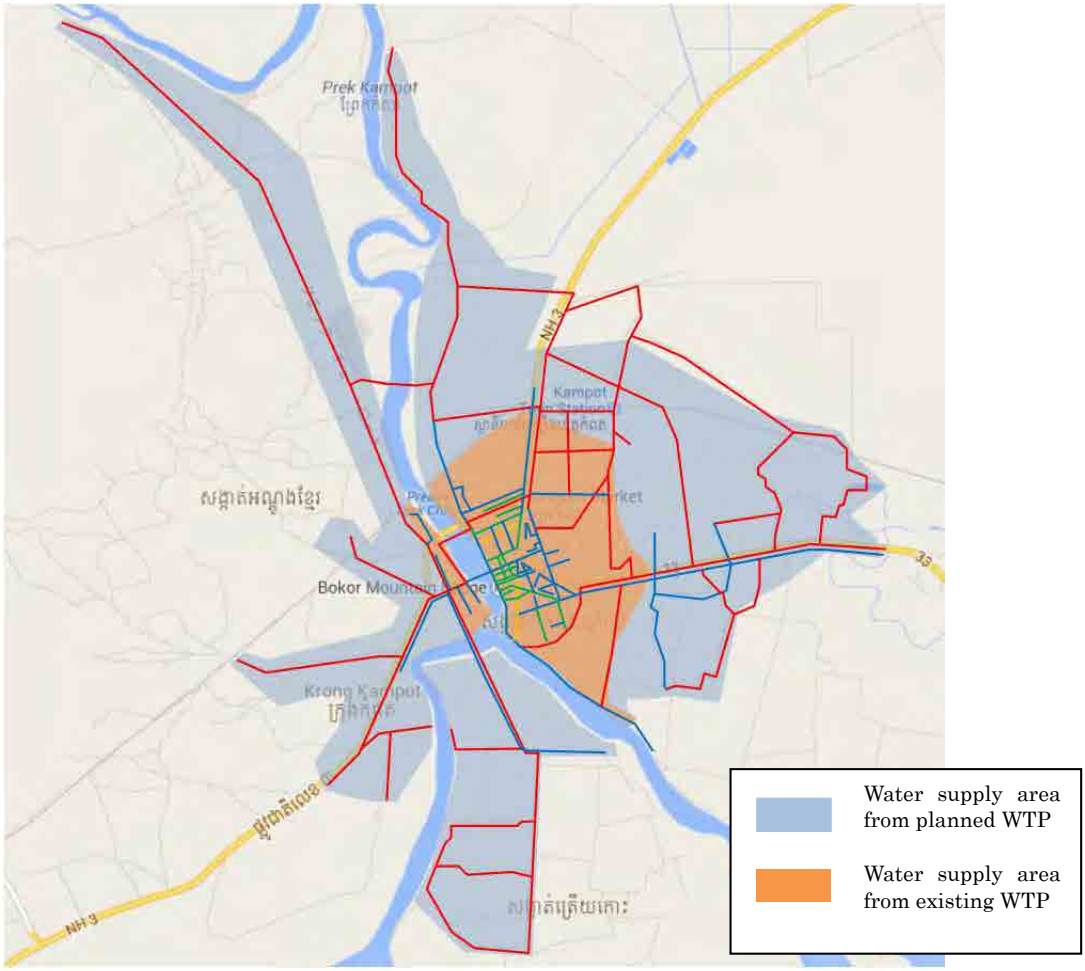
Source: JICA Survey Team

Plan C is adopted because it has an economic advantage, there is no need for land acquisition to build the new elevated tank and elevated tank can be used as backwash storage for rapid sand filter.

b) Study for Water Supply Area

The supply pressure from the existing WTP will be low since the designed distribution flow and supply area will be expanded by a factor of three. Therefore, the expansion area will be supplied by the proposed WTP.

The ground elevation of the designed water supply area is almost flat, between 3m and 4m. The designed water supply area for the existing and new treatment plants is shown in **Figure 2.2.2.6-2**.

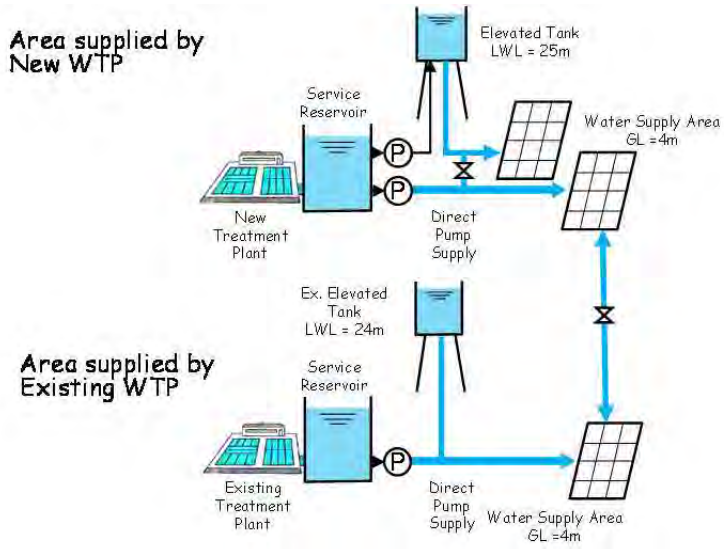


Source: JICA Survey Team

Figure 2.2.2.6-2 Design Water Supply Area

As shown in **Figure 2.2.2.6-2**, the water supply area is divided into two areas; water supply area in the central city from existing WTP and water supply area in the expansion area from the proposed WTP.

The expansion area will be supplied mainly by pumping; however a part of the expansion area will be supplied from an elevated tank. An outline of the Kampot system is shown in **Figure 2.2.2.6-3**.

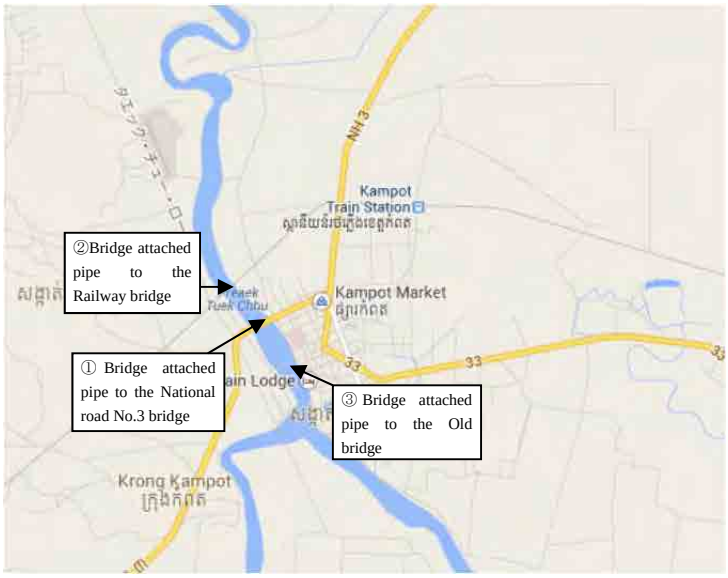


Source: JICA Survey Team

Figure 2.2.2.6-3 Outline of Kampot system

(c) Study for River Crossing

The following three alternatives based on site conditions are considered for crossing the river and these are shown in **Figure 2.2.2.6-4**.



Source: JICA Survey Team

Figure 2.2.2.6-4 Outline of Crossing River Location

① Bridge for National road No.3

Electric cables have already been attached on the upstream side. However, the main distribution pipe can be attached on the downstream side of the bridge.

② Railway bridge

The main distribution pipe can be attached on the upstream side and downstream side of the railway bridge. As there is no access road from the main road to the railway bridge, it would be difficult to install the distribution piping to the railway bridge.

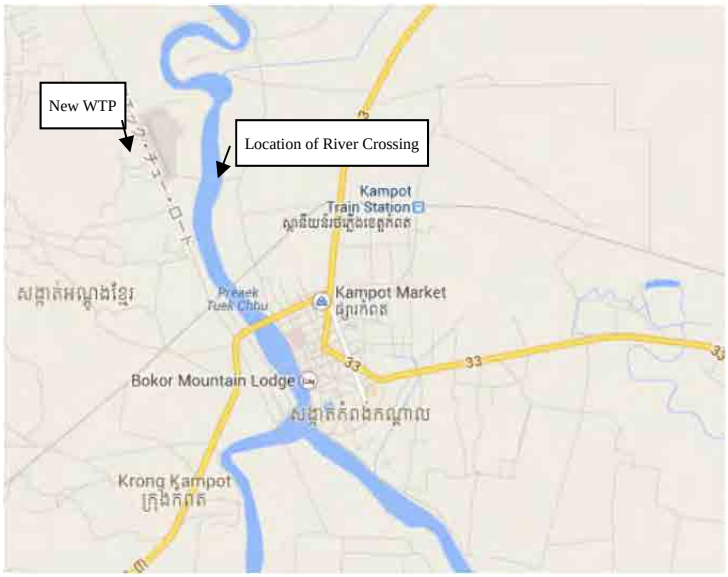
③ Old bridge

Existing distribution pipes have been attached on the upstream side of the old bridge. The old bridge is ageing and is already unable to handle any traffic. Therefore, it is not wise to install more pipes on the old bridge.

Thus, the only feasible location for crossing the river is to use the bridge for National road No.3. It is difficult to attach two water main lines to the bridge structure; distribution pipe from the existing WTP, distribution pipe from the planned WTP. The distribution pipe from the existing WTP will attached to the National road No.3 bridge in this project.

The method for crossing the river with the distribution pipe from the new WTP is considered in the following section.

The river crossing location for distribution pipes from the planned WTP is shown in **Figure 2.2.2.6-5**. This location is close to the planned WTP and has an access road to the riverside.



Source: JICA Survey Team

Figure 2.2.2.6-5 Outline of River Crossing Location

i) Site Conditions at Proposed River Crossing Location

Site conditions at the river crossing location are shown in **Figure 2.2.2.6-6**.

Source: JICA Survey Team

Figure 2.2.2.6-6 Site Condition at Proposed River Crossing Location

- The proposed river crossing site is located to the southeast of the planned WTP.
- Construction vehicles can access the riverside.
- The site has brush on both sides of the road.
- To the East of the site there is a guesthouse and to the south there is a vacant land.
- The soil condition at the river crossing site has been examined. The borehole survey has identified a layer of clay.
- Fishing boats come and go in the morning and evening, excursion boats go in the evening.

ii) Study for River Crossing Method

Potential River Crossing Methods are as follows.

Crossing river method
- Inverted siphon
  - Open Cut Method
- Tunnel
  - Pipe Jacking Method
  - Shield Method
- Water Pipe Bridge

The following two plans are considered because open cut method is generally adopted for small scale construction in rivers.

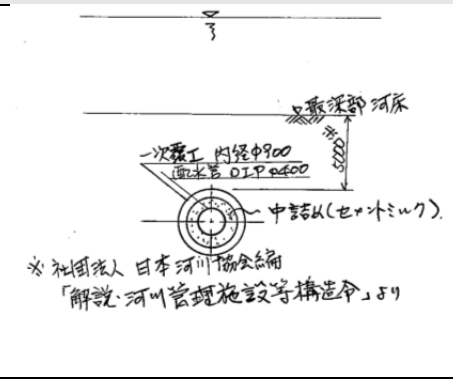
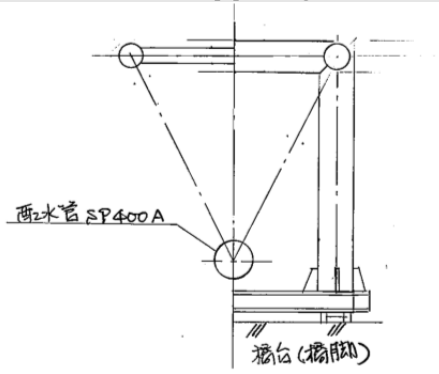
A：Tunnel (Pipe Jacking Method, Shield Method)

Construct temporary vertical shaft on both sides of the river. Bore between vertical shafts and construct tunnel (casing pipe). Water pipes are installed in tunnel (casing pipe).

B：Water pipe bridge

Construct bridge abutments and bridge pier on both sides of the river and in the middle for long spans. Water pipes are installed on bridge abutments and bridge piers.

Table 2.2.2.6-2 Comparison of River Crossing Methods

	A：Tunnel	B：Water pipe bridge
Figure（Ex.）		
Estimated facilities and construction type	Segment; L≒300m Distribution pipe; L≒300m Fill in Cement grouting vertical shaft: lining plate×2, chemical grouting	Water pipe：inverted triangle steel truss bridge 30.0m/span×10span Substructure：bridge abutment; Foundation works, 2 place bridge pier; Foundation works, 9 place
Impact	No impact against river. No hindrance to boat transport.	It needs to construct structure with temporary pier and sheet piles. After construction there are piers in the river. Boat transport is hindered during the construction period and after construction.
Construction scale	Small scale	Large scale (most of the works are underwater)
O&M	None	Repaint External coating for water pipes.
Economic efficiency	Construction cost will be low.	Construction cost will be expensive.

Source: JICA Survey Team

In the above comparison, tunnelling is selected as the preferred method for the following

reasons.

- A pipe bridge would hinder boat traffic during and after construction. A pipe bridge would significantly change the visual landscape.
- Exposed water pipes would need to recoat for rust prevention.
- Tunnelling is more cost effective than a pipe bridge.

(d) Network Calculation

The purpose of this project is to expand the water supply system to improve the water supply coverage ratio while utilizing existing facilities as much as possible. However, after this project, , the distributed amount of water and the water supply area itself will be increased by a factor of three. It is therefore difficult to secure more than 150kPa of residual pressure at peak demand in the fringe and suburb water supply areas even if a new distribution main is prepared. Therefore, to give first priority to achieving the target water supply coverage ratio of 92% in 2021, the water pressure (minimum dynamic pressure) that should be ensured is as shown in **Table 2.2.2.6-3**.

Table 2.2.2.6-3 Planned Daily Minimum Dynamic Water Pressure

At peak demand	
Urban area and Dis main	100kPa and up
Suburb area	50kPa and up
At average demand	
Urban area and Dis main	150kPa and up
Suburb area	100kPa and up

Source: JICA Survey Team

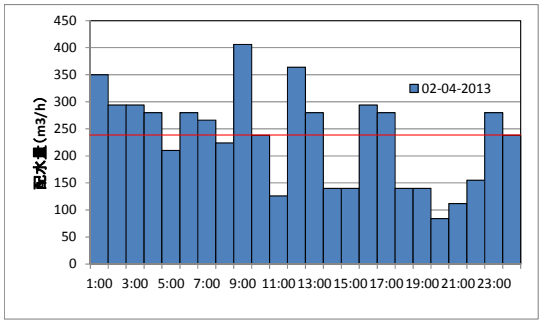
Hourly Factor

Only the Phnom Penh Water Supply Authority (PPWSA) has measured hourly factors in Cambodia and the measurements are taken in the downtown area of Phnom Penh. Thus it is hard to use it as a reference as the circumstances of water demand are very different between Phnom Penh and Kampot.

Therefore, for estimating the hourly factor for Kampot, the regression formula is utilized to establish the relationship between daily supply amount and hourly factor of Japanese waterworks in “The Design Criteria for Water Supply Facilities” published by the Japan Waterworks Association.

The result of comparisons between the regression formula and hourly factors estimated from the distribution record at the existing WTP in Kampot indicates that an hourly factor of 1.69 is appropriate for this project.

Table 2.2.2.6-4 Hourly Factor

	Item	Kampot
The Design Criteria for Water Supply Facilities	Regression formula (daily amount and hourly factor)	K=2.6002×（Q／24）$^{-0.0628}$ (K : Hourly factor, Q : Daily supply amount)
	Planned maximum daily supply （2021）	13,260m^3／day
	Hourly factor: K	1.75
		Hourly maximum amount ÷ Hourly average amount
Water Supply record of Kampot WWs	Hourly factor: K	
		Hourly maximum amount ÷ Hourly average amount 1.69 (=406÷240)

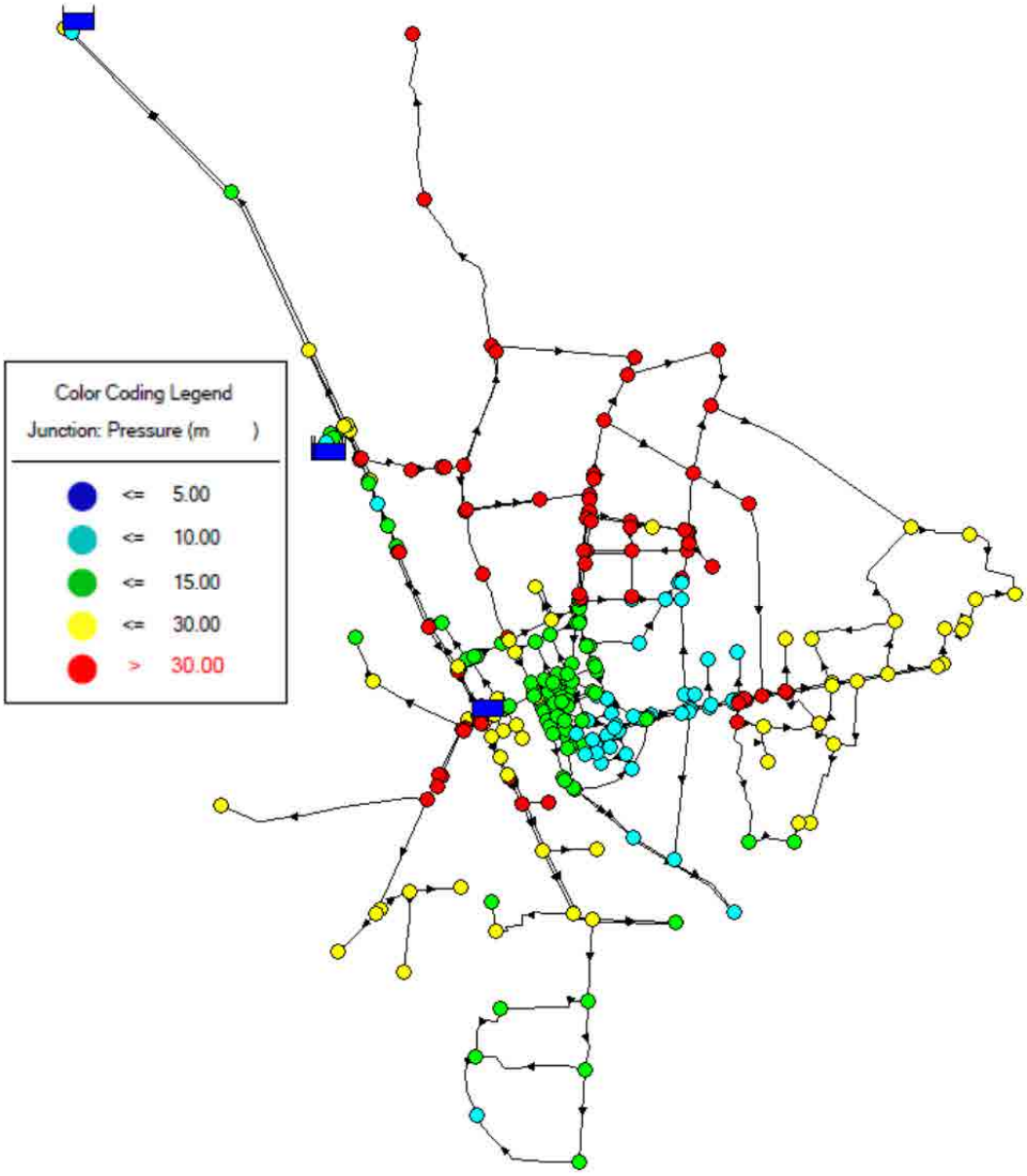
Source: JICA Survey Team

Network Calculation

The Network calculation was calculated by EPANET ver 2.0 with the above conditions.

- Hazen-Williams formula
  $H = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$
  Where
  H: Friction Head Loss (m)
  C: Coefficient of flow velocity
  D: Internal diameter of pipe (m)
  Q: Flow rate (m^3/s)
  L: Length (m)

The effective pressure at the peak demand of the designed water supply area in Kampot is shown in **Figure 2.2.2.6-7**. By this project, the effective pressure in the downtown area of Kampot will be improved.

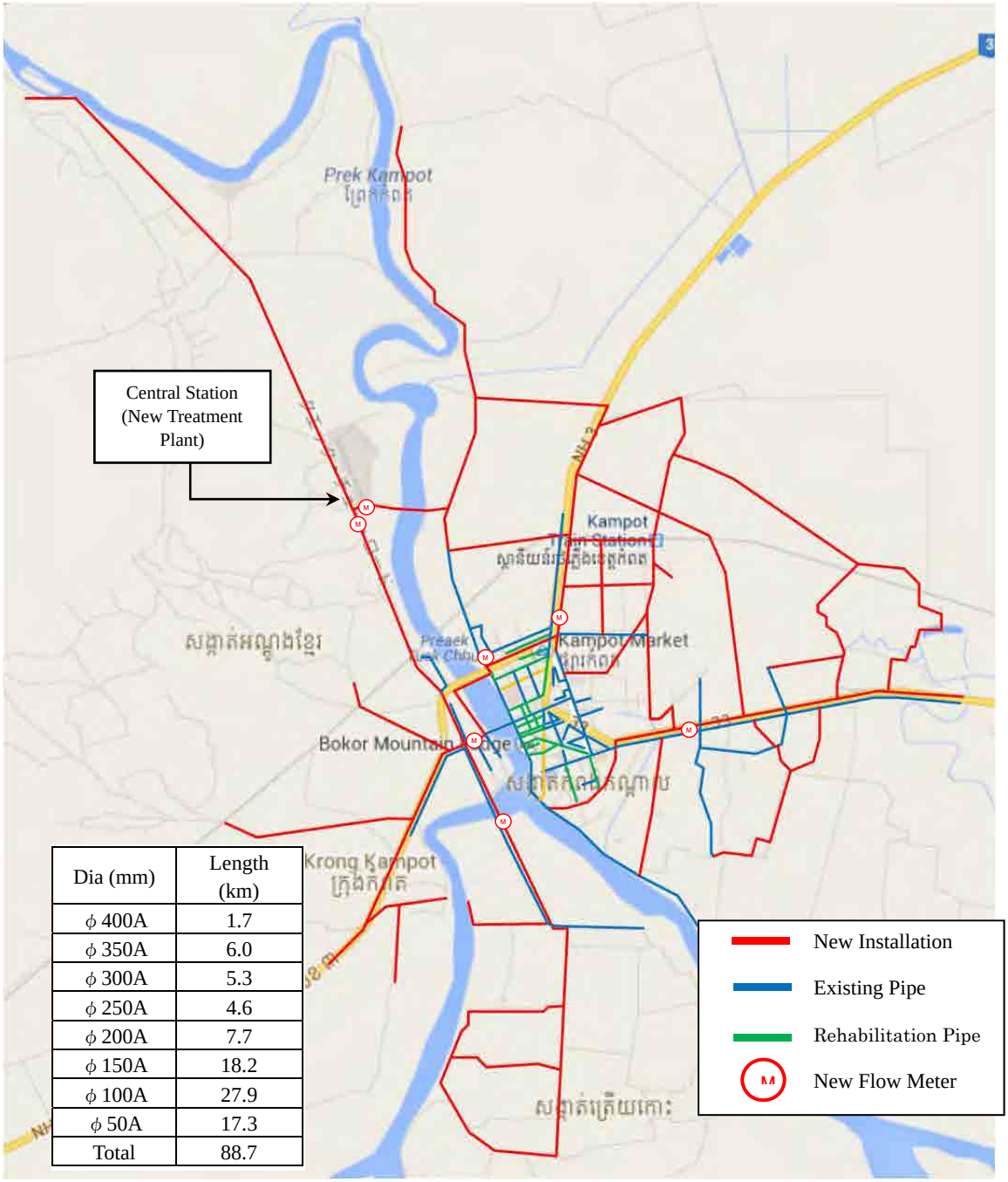


Source: JICA Survey Team

Figure 2.2.2.6-7 Effective Pressure at Peak Demand in Kampot

(e) Transmission and Distribution Pipe Arrangement Plan

Based on the results of network calculations for the distribution and transmission network, pipes are designed as shown in **Figure 2.2.2.6-8**.



Dia (mm)	Length (km)
ϕ 400A	1.7
ϕ 350A	6.0
ϕ 300A	5.3
ϕ 250A	4.6
ϕ 200A	7.7
ϕ 150A	18.2
ϕ 100A	27.9
ϕ 50A	17.3
Total	88.7

Source: JICA Survey Team

Figure 2.2.2.6-8 Transmission and Distribution Pipe Design

(2) Materials for Transmission and Distribution Pipe

The materials proposed for transmission and distribution pipes are as follows.

・Ductile Cast Iron Pipe

・High Density Polyethylene Pipe

The comparison between various pipe materials is given in the following **Table 2.2.2.6-5.**

Table 2.2.2.6-5 Comparison of Pipe Materials

Piping Materials	Ductile Cast Iron Pipe (DIP)	High Density Polyethylene Pipe (HDPE)
Durability	・Strong and corrosion resistant. ・Weak against shock.	・Excellent corrosion resistance. ・Ultra-violet rays resistant.
Workability	・Workable with the push-in type fittings.	・Light and high workability. ・The applicable size of butt welding machine in Cambodia is up to φ200mm.
Implementation result	・Many applications with pipelines larger than φ250mm or more in Cambodia..	・Many applications with pipelines larger smaller than φ200mm is generally used in Cambodia.
O&M	・Easy procurement of spare parts with a wide market.	・Accessibility of spare parts may be limited since the use of φ250mm or more is minimal.
Others	・Within allowable bending angles of the pipes; pipes can be laid along the ground. Pipes can come apart if too much pressure is applied.	・Pipes are flexible and can be laid along the ground.
Selected	○ (250mm or more)	○ (200mm or less)

Source: JICA Survey Team

Taking into consideration previous experience in Cambodia, the materials utilized for transmission and distribution pipes are as follows.

- φ250mm or more diameter pipeline: Ductile Cast Iron Pipe (DIP)
- φ200mm or less diameter pipeline: High Density Polyethylene Pipe (HDPE)

However, in special situations, such as for water pipe bridges and exposed pipes, steel pipe is recommended because it can be installed with comparative flexibility.

(3) Distribution Flow Monitoring System

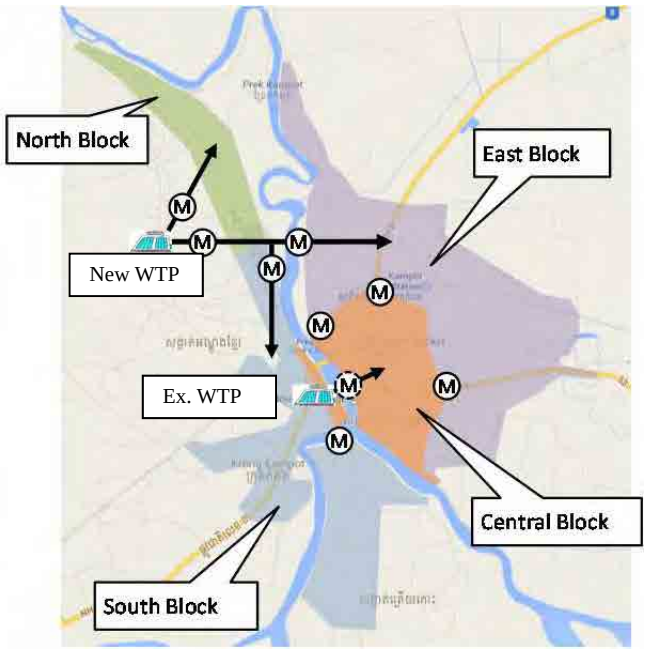
The installation of a distribution flow monitoring system is recommended for the purpose of understanding the distribution flow, centralizing the flow data management and for efficient operation and Non-Revenue Water reduction. As of 2014, water supply projects have been conducted in Battambang, Kampong Cham and two other provincial cities by JICA. This project will install the same monitoring system as current ongoing projects for the following reasons.

The electromagnetic flow meters and the local stations will be installed at the inlet point of the each block, and transfer the flow data to the central station located in the new treatment plant. The technical homogenization and cheap procurement of spare parts through group purchasing are expected results from the installation of multiple stations at the same system. The system operators are then able to cooperate mutually with other utilities.

(4) Block Distribution System

The intent of the block distribution system is to divide the water supply area into several appropriately sized areas. The advantages of this system are equalization for supply pressure and proper pressure, advanced water supply management such as distribution flow measurement, water loss management, and limitation of the effect of accident damage. The boundaries of the block distribution areas are decided in consideration of the existing pipe network and geographical features such as roads, rivers, etc, in the way that the existing system can be fully utilized.

The water supply area is divided into 4 blocks by the Pre-Kampot River and the border of the water supply area, between the new and existing treatment plants, because the water supply area in Kampot is flat. The block distribution system is shown in **Figure 2.2.2.6-9**.



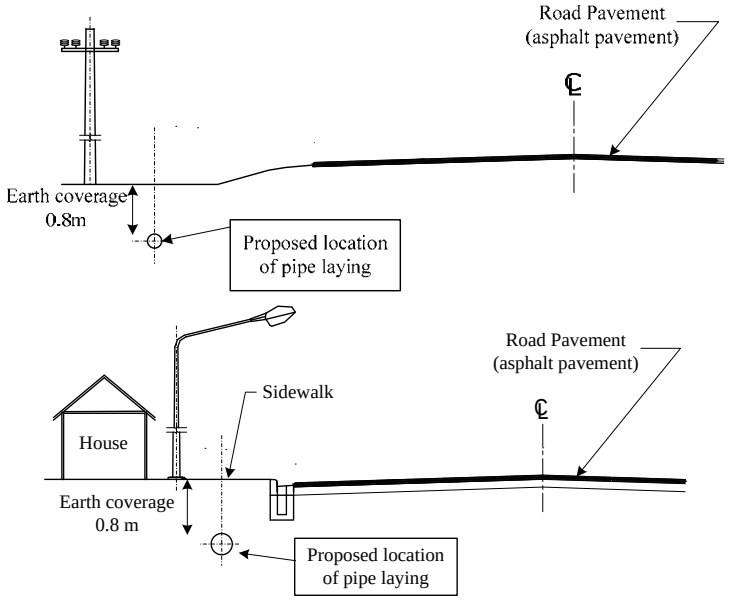
Source: JICA Survey Team

Figure 2.2.2.6-9 Block Distribution Area in Kampot

(5) Design Criteria for Distribution Facilities

(a) Pipe Installation Location

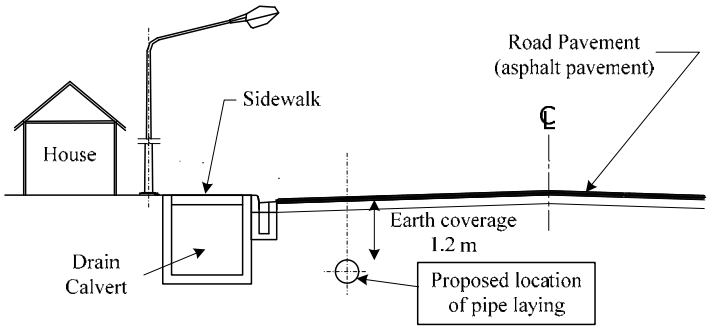
The majority of transmission and distribution pipelines are planned to be installed along the side of a road. The installation of pipelines under the sidewalk or road shoulder was decided after consultation with Kampot WWs. The preferred installation location is shown in **Figure 2.2.2.6-10**.



Source: JICA Survey Team

Figure 2.2.2.6-10 Preferred Installation Location of Pipeline

Underground facilities such as drainage, cable, will sometimes interfere and there will not be enough space for pipe installation along the shoulder. In these cases pipe will be installed under the asphalt road. This is shown in **Figure 2.2.2.6-11.**



Source: JICA Survey Team

Figure 2.2.2.6-11 Pipe Installation Location under Asphalt Road

(b) Excavation and Backfilling

The specifications for excavation and backfilling follow the standards set by the Phnom Penh Water Supply Authority and the past construction records of Kampot waterworks. In principal, in the case of laying pipe under a road, the earth cover is 1.2m, and in the case of laying pipe under sidewalk or a road shoulder, the earth cover is 0.8m.

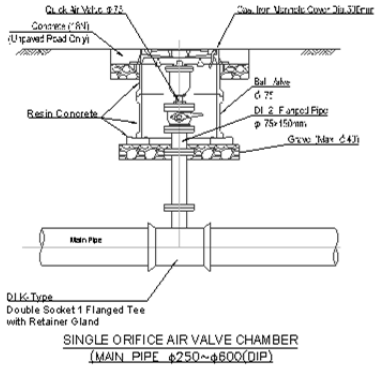
(c) Appurtenant Structures

a) Sluice Valves

Sluice valves are installed for drainage and maintenance. Sluice valves are also installed before and after the inverted siphon, at drain out locations and where pipes are attached to a bridge.

b) Air Valve

The function of the air valve is to discharge air accumulated inside the pipe and to allow air into the pipe when draining. Air valves make for a smoother operation and improved flow. Air valves are always located at high points in the pipeline where air accumulates. An example of air valve is shown in **Figure 2.2.2.6-12**.



Source: JICA Survey Team

Figure 2.2.2.6-12 Example of Air Valve

c) Drainage Facility

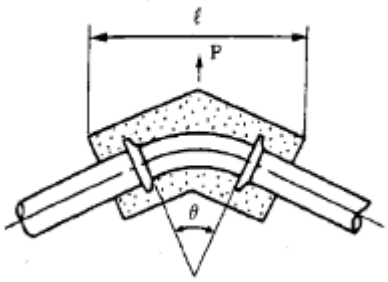
Drainage facilities on a pipeline are required to wash out the impure substances accumulated when the pipe is installed and to discharge turbid water from the pipes when there is an emergency. The installation location shall be set at the lowest portion of the pipeline near the river or drainage canal.

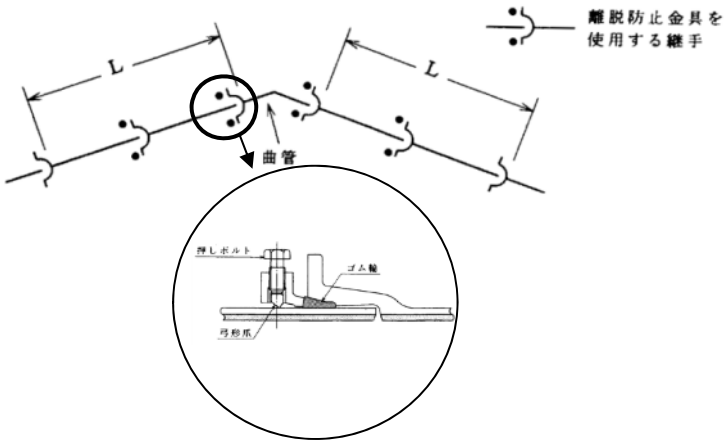
d) Protection of Deformed Pipes

Thrust blocks or restrained fittings shall be installed at all bends, changes in direction and valves, since these will be affected by the uneven force of water pressure. An example of a thrust block is shown in **Figure 2.2.2.6-13** and an example of restrained joint fitting is shown in **Figure 2.2.2.6-14**.

Thrust blocks are commonly used but they are not appropriate in this case because they take

several days to install and that would have a negative impact on road traffic. The use of restrained joint fittings is preferred.





Source: JICA Survey Team

Figure 2.2.2.6-13 Example of Thrust Block

Figure 2.2.2.6-14 Example of Restrained Joint Fitting

c) Railway Crossing

Water distribution piping in the Kampot network area will have to cross the railway. The technical options were discussed with WWs, and it was decided to use a concrete casing pipe installed under the railway crossing by the pipe jacking method. The concrete casing pipe will protect the distribution pipe.

(6) Others

(a) Transmission and Distribution Pump

A direct pump supply system is recommended for the eastern and southern water supply area and a gravity flow system from the elevated tank is recommended for the expanded water supply area near the raw water pump station. The distribution pump and transmission pump for the elevated tank are installed in the pumping station located in front of the service reservoir. As for the distribution pumps for the eastern and southern water supply area, variable frequency drives which enables the pumps to be controlled automatically, smoothly and operate with high efficiency will be installed for power-saving and reduced labor costs.

(b) Generator

Recent operational record shows that the frequency of power failure is 3-8 times a month, the duration of power outages is between 20 minutes and 5 hours. To cope with the power outage, generator will be installed at the new WTP. The capacity of the generator shall be 300kVA to

supply water of 240m^3/h even at power outage. Considering the frequency of refill, fuel tank shall have the capacity to operate generator around 18 hours, in the same manner as the existing WTP.

(c) Service Reservoir Capacity

The designed maximum water supply amount of the existing water treatment plant is 5,760 m^3/day, and the designed average water supply amount is 240 m^3/hour. The minimum required capacity of the existing service reservoir is 788 m^3 which is sized to guarantee 3.3 hours the designed average water supply amount. The total required capacity of the new service reservoir is 1,400 m^3 which will guarantee a 4.5 hour. Service reservoir will be 1,100 m^3 and elevated tank will be 300 m^3.

(7) Components and Specification of the Transmission and Distribution system

Components and specification of the transmission and distribution system are shown in **Table 2.2.2.6-6**.

Table 2.2.2.6-6 Components and Specification of the Transmission and Distribution System

Facility			Dimensions and specifications
Function	Component	Item	
Transmission Facilities	Transmission Pump	Transmission Pump	Single Volute Pump 2 (1 pump: standby)
		Pump Well	Doubles as Service Reservoir
Distribution Facilities	Service Reservoir (at the Treatment Plant)	Structure	RC Structure, Rectangle, 2 Ground Reservoirs Effective Capacity: V=550 m^3×2 Effective depth: H=3.80 m Water Level: HWL+6.50 m, LWL+2.70 m Foundation: Direct Foundation Doubles as Treated Water Reservoir
	Elevated Tank (at the Treatment Plant)	Structure	RC Structure Effective Capacity: V=300 m^3 Effective depth: H=4.00 m Water Level: HWL+29.00 m, LWL+25.00 m Foundation: Direct Foundation
	Distribution Pump Facilities	Distribution Pump	Single Volute Pump (Large) 3units (1 pump: standby) Low-voltage Inverter Equipment Single Volute Pump (Small) 3units (1 pump: standby) Low-voltage Inverter Equipment
		Pump Well	Doubles as Service Reservoir
	Distribution Pipeline	DIP	Straight Pipe: T type fittings, Thrust Blocking: Restrained joint retainer gland Diameter: φ400A L= 1.7km φ350A L= 6.0km φ300A L= 5.3km φ250A L= 4.6km Total L= 17.6km Bridge-attached Pipe: 4 places Railway Crossings: 1 place River Crossings: 1 place
		HDPE	PE100 Diameter: φ200A L= 7.7km φ150A L= 18.2km φ100A L= 27.9km

			φ 50A L= 17.3km Total L= 71.1km Pipe attached to Bridge:20 places Railway Crossings: 6 places
	Distribution Flow Monitoring System	Master Station	Monitoring PC, Printer, Receiver, UPS
		Local Station	Electromagnetic Flow Meter GSM Logger＋GSM Transmitter

Source: JICA Survey Team

2.2.2.7 Plan for Procurement of Equipment

Based on the request from GOC and the discussion with the Cambodian counterparts (10th June and 19th August, 2014), a list of required equipment was identified as described in the following sections.

Table 2.2.2.7-1 Equipment Procurement listed in M/D and the Technical Notes

Item		Discussion on 10th June, 2014 (listed items in M/D)	Discussion on 19th August, 2014 (listed items in Technical Notes)
Procurement of Equipment	Equipment for Water Quality Analysis	Optical analyzer, Distillation apparatus, Reagents, Glassware, pH meter, Turbidity meter, UPS, Others	Jar Tester, Distillation Apparatus, Turbidity Meter, Laboratory Table, Residual Chlorine Analyzer, Uninterruptible Power System (UPS), pH Meter (glass electrode), pH Meter (BTB), Portable Conductivity Meter (for Intake), Conductivity Meter (for Treatment Plant), c, Reagents and Glassware
	Tools for Electrical and Mechanical Maintenance	Electroscope, Vibration checker, Torque wrench, Earth checker, Insulation checker, Database system for maintenance, Other tools	Vibration Checker (Electroscope, Torque wrench, Earth checker, Insulation checker, Other tools are provided as spare parts and tools for mechanical and electrical facility stated in Specification of Construction Works.)
	Distribution Management Tools	Leakage locating equipment, Pipe locator, Pipe laying, Pipe network information system	- Leak detection equipment had already provided by Technical Cooperation Project - Pipe Network Information System is to be included in construction (this work).
	Equipment and Materials for Service Connections to Poor HH	(Provision of necessary materials such as water meters, fittings and pipes will be considered in the Survey in order to assist the expansion of water supply to the poor families.)	Socket Fusion Equipment (1 set), Materials and Equipment for Service Connections (900 sets)

(1) Equipment for Water Quality Analysis

The provision of the minimum equipment for water quality analysis required for the O&M of the new water treatment plant is planned.

In the discussion on 19th August, 2014, the Cambodian counterparts requested that the

equipment for water quality analysis should follow the standard laboratory equipment list provided by ADB. Therefore items that are on the ADB list and not already installed in Kampot Waterworks lab have been identified for procurement as shown in **Table 2.2.2.7-2**. The jar tester, residual chlorine analyzer, turbidity meter, glassware, distillation apparatus, pH meter and conductivity meter will be provided, because they are frequently used daily for the operation of the water treatment process and required for the implementation of the training component of the project. Spectrophotometer will be also provided for daily measurement of iron and manganese values. On the other hand, oven (for TDS) and material for microbiological examination used only one time per week or four times per year are already installed at the existing water treatment plant lab and can be shared with the new treatment plant.

Table 2.2.2.7-2 Standard Laboratory Equipment List provided by ADB and Installation Condition in Existing Water Treatment Plant

Equipment List provided by ADB	Remark	Installation Condition in Existing Water Treatment Plant
Jar Tester		Already installed (can't be shared with the new water treatment plant)
Residual Chlorine Analyzer	Including reagent	
Turbidity Meter		
Glassware		
Distillation Apparatus		
pH Meter		
Conductance Meter		
Spectrophotometer	Including reagent	
Oven (for TDS)		Already installed (can be shared with the new water treatment plant)
Material for Microbiological Examination	Incubator, Sterilizer	

(2) Tools for Electrical and Mechanical Maintenance

The vibration checker will be provided under the project for O&M of the pumping equipment to be installed.

The electroscope, torque wrench, earth tester and insulation resistance tester are required for O&M but will be provided by the construction contractor as spare parts and tools for mechanical and electrical facilities stated in Specifications for Construction Works.

(3) Distribution Management Tools

The leak detection and locating equipment and pipe locator requested by GOC will not be provided under the project, because they were already provided through the Japanese Technical Cooperation Project and used/kept under good conditions in the existing water treatment plant.

The pipe network information system will be included in the construction works for Distribution Flow Monitoring System.

(4) Equipment and Materials for Service Connections for Poor HH

In the discussion on 19th August, 2014, the Cambodian counterparts requested the Japanese side to assist with the individual house connection for poor households by the providing materials such as water meters, fittings and pipes, similar to the ongoing JICA grant aid projects and MEK-WATSAN projects of UN-Habitat. It was also confirmed that the provision of the materials for poor households would be included in the Preparatory Survey and the Cambodian side would bear the cost for installation works thereof.

The number of connections for which materials will be provided was estimated based on the data from "Identification of Poor Household Program" which is being implemented by the Ministry of Planning in Cambodia since 2008 with the help of UNICEF, Germany and Australia. In Kampot, 7 of the 10 communes targeted for future water supply in this project are covered by the data from "Identification of Poor Household Program" (**Table 2.2.2.7-3**). The number of poor households supplied by this project is calculated as shown in **Table 2.2.2.7-4**.

Table 2.2.2.7-3 Ratio of Poor Households and Number of Equipment to be Provided

District	Commune	Results of the Study by the Ministry of Planning *			Number of the Households supplied by this project	Number of Connections to be provided
		Household Number	Poor Household Number	Ratio of Poor Households		
Tuek Chhou	Chum Kriel	1038	144	13.9%	-	-
Tuek Chhou	Kampong Kraeng	1134	235	20.7%	-	-
Tuek Chhou	Kampong Samraong	585	121	20.7%	-	-
Tuek Chhou	Meakprang	622	101	16.2%	-	-
Tuek Chhou	Trapeang Thum	607	60	9.9%	-	-
Krong Kampot	Andoung Khmer	1178	161	13.7%	-	-
Krong Kampot	Traeuy Kaoh	1326	141	10.6%	-	-
Total		6490	963	14.8%	6,014	900

*Source; Ministry of Planning, Cambodia, 2012

Table 2.2.2.7-4 Number of Households supplied by the Project

Item	Unit	Kampot
Day Maximum Demand	m^3/day	7,500
Day Maximum Factor	—	0.78
Day Average Demand	m^3/day	5,850
Leakage Ratio	%	12%
Total Consumption	m^3/day	5,148
Ratio of Domestic Consumption	%	85%
Tourist Consumption	m^3/day	553
Day Average Domestic Consumption	m^3/day	3,823
Per Capita Consumption	Lpcd	130
Population Served	Person	29,406
Family Size	Person	4.89
Number of Households	Nos	6,014
Ratio of Poor Households	%	14.8%
Number of Poor Households by this project	Nos	890

Based on the above estimate, equipment and materials will be provided for service connections to 900 poor households. Socket fusion equipment for HDPE pipes will be also provided since it is required for making service connections.

The equipment and materials to be provided are based on the standard composition of those, because there are no existing technical problems on service connections in Kampot Waterworks in terms of leakage prevention. Therefore, there are no technical problems in the Project of grant aid, because the existing method of service connections conducted by Kampot Waterworks will be followed. The staff for water supply will be assured through the change of organization and the increase of personnel.

After the installation, the material and equipment for service connection will belong to the customer. However waterworks will maintain those material and equipment. All the materials after water meter are procured and installed by customers. At the service connection work, one concrete box to cover water meter is included as a burglary preventive measure.

Table 2.2.2.7-5 shows the plan for equipment provision in this project based on the considerations described above.

Table 2.2.2.7-5 Outline of the Plan for Equipment Provision

Category	Name of Equipment/Material	Specifications	Quantity
Equipment for Water Quality Analysis	Jar Tester	Jar tester for six samples having adjust function of mixing intensity (20 - 200min^{-1} digital display)	1set
	Distillation Apparatus	Water purification system (Distillation type) Product capacity: approx. 1.8L/h	1set
	Turbidity Meter	Turbidity meter (digital display direct reading) (0 - 4,000NTU)	1set
	Turbidity Meter	Continuous monitoring meter for treated water	1set
	Laboratory Table	Steel frame laboratory table (3-way tap stainless steel sink / AC220V outlet)	1set
	Residual Chlorine Analyzer	Potable residual chlorine meter (absorption spectrophotometer) (0.00 - 5.00 mg/l)	1set
	Chlorine Continuous Measurement Equipment	Continuous monitoring meter for treated water	1set
	Spectrophotometer	for iron and manganese values	1set
	Uninterruptible Power System (UPS)	Output power capacity：3 kVA	1set
	pH Meter (glass electrode)	Desktop pH meter with electrode（pH 0 - 14）	1set
	pH Meter (BTB)	BTB type simple pH meter （pH 6.0/6.2/6.4/6.6/6.8/7.0/7.2/7.4）	1set
	Portable Conductivity Meter	Portable Conductivity Meter (for Intake Facilities)	1set
	Conductivity Meter	Conductivity Meter (for Water Treatment Plant)	1set
	Reagents	pH4 standard solution, pH7 standard solution, Potassium chloride solution, BTB solution, DPD solution	1set
	Glassware	Beaker, measuring flask, pipette, wash bottle	1set

Tools for Mechanical Equipment	Vibration Checker	Acceleration: 0.02-200 m/s^2, Velocity: 0.3-1,000 mm/s, Displacement: 0.02-100 mm	1set
Equipment and Materials for Service Connections	Socket Fusion Equipment	Diameter 15mm - 63mm for HDPE pipes with a power generator	1set
	Materials and Equipment for Service Connections	Required pipe materials and equipment from the ferrules with saddles on distribution mains (63mm and 110mm in diameter) to water meters (15mm or 20mm in diameter)	900 set

Remark; Electroscope, torque wrench, earth checker and insulation checker will be provided under the construction contract as spare parts and tools for mechanical and electrical facilities. Requirements will be identified in Technical Specifications for Construction Works. The equipment for the Distribution Flow Monitoring System, Turbidity Continuous Measurement, and Chlorine Continuous Measurement will also be provided under the construction contract.

2.2.3 Outline Design Drawings

Selected schematic design drawings are provided in **Appendix-7**. The drawing list of the schematic design is shown in **Table 2.2.3-1**.

Table 2.2.3-1 List of Outline Design Drawings

No.	Facility	Drawing Title	Dwg No.
1.	General (G)	General Layout	G1
2.	Intake (I)	Raw Water Pump Station General Plan	KI-1
		Raw Water Pump Station Facilities Structure	KI-2
3.	Raw Water Transmission Main(R)	Route of Raw Water Transmission Main	KD-2, KD-3, KD-4
4.	Treatment Facility (T)	Water Treatment Plant General Plan	KT-1
		Flow Diagram of Kampot Water Treatment Plant	KT-2
		Water Treatment Facilities Structure (1)	KT-3
		Water Treatment Facilities Structure (2)	KT-4
		Water Treatment Facilities Structure (3)	KT-5
		Water Treatment Facilities Structure (4)	KT-6
		Water Treatment Facilities Structure (5)	KT-7
		Water Treatment Facilities Structure (6)	KT-8
		Water Treatment Facilities Structure (7)	KT-9
		Service Reservoir and Pumping Station Structure (1)	KT-10
		Service Reservoir and Pumping Station Structure (2)	KT-11
		Elevated Tank Structure	KT-12
		Drainage Basin Structure (1)	KT-13
		Drainage Basin Structure (2)	KT-14
		Lagoon Structure (1)	KT-15
		Lagoon Structure (2)	KT-16
5.	Transmission and Distribution Facility (D)	Location Map for Distribution Pipe Line	KD-1
		Distribution Pipe Plan (1)	KD-2
		Distribution Pipe Plan (2)	KD-3
		Distribution Pipe Plan (3)	KD-4
		Distribution Pipe Plan (4)	KD-5
		Distribution Pipe Plan (5)	KD-6
		Distribution Pipe Plan (6)	KD-7
		Distribution Pipe Plan (7)	KD-8
		Distribution Pipe Plan (8)	KD-9
		Distribution Pipe Plan (9)	KD-10
		Distribution Pipe Plan (10)	KD-11
		Distribution Pipe Plan (11)	KD-12
		Distribution Pipe Plan (12)	KD-13
		Distribution Pipe Plan (13)	KD-14
		Distribution Pipe Plan (14)	KD-15
		Distribution Pipe Plan (15)	KD-16
		Distribution Pipe Plan (16)	KD-17
		Typical Drawing for Pipe Laying (1)	TYP-1
		Typical Drawing for Pipe Laying (2) Sluice Valve	TYP-2
		Typical Drawing for Pipe Laying (3) Installation of Air Valve and Washout	TYP-3
		Typical Drawing for Pipe Laying (4) Connecting	TYP-4
		Typical Drawing for Pipe Laying (5) Connecting	TYP-5
		Typical Drawing for Pipe Laying (6) Connecting	TYP-6
		Typical Drawing for Pipe Laying (7) Connecting	TYP-7
		Typical Drawing for Pipe Laying (8) Connecting	TYP-8
		Typical Drawing for Pipe Laying (9) Bridge Attached Pipe	TYP-9
		Typical Drawing for Pipe Laying (10) Water Flow Meter Chamber	TYP-10
		Typical Drawing for Pipe Laying (11) 15mm Water Meter with Clamp Saddle for HDPE Main Pipe	TYP-11
		Typical Drawing for Pipe Laying (12) 20mm Water Meter with Clamp Saddle for HDPE Main Pipe	TYP-12

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

(1) Organization for Project Implementation

The project will be executed according to the scheme for Japanese Grant Aid. After the Exchange of Note between the two governments, the Royal Government of Cambodia (RGC) will select the consultant and contractor who must be Japanese corporations for the implementation of the project. **Figure 2.2.4.1-1** shows the conceptual organization of the project.

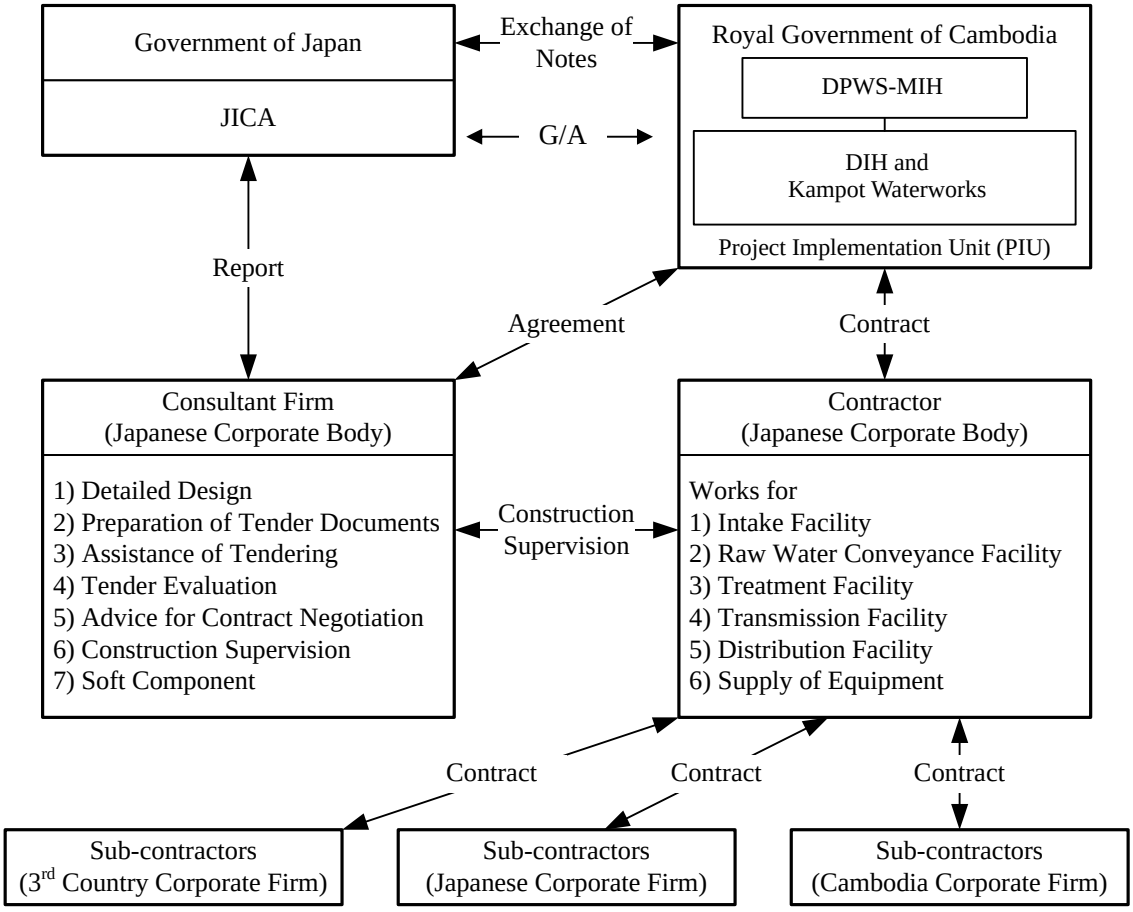


Figure2.2.4.1-1 Organization for Project Implementation

(2) Implementing Agency

The executing agency is DPWS-MIH: Department of Potable Water Supply, Ministry of Industry & Handicraft. The implementing and operating agencies are Department of Industry & Handicraft (DIH), and the Waterworks in Kampot Provinces. DIH is a local agency of MIH and

the Waterworks operate under the auspice of DIH. Kampot Waterworks is responsible for the smooth implementation of the Project, operation and maintenance of the water supply facilities. Cooperation and coordination between DPWS-MIH and DIH is indispensable.

(3) Consulting Firm

The detailed design and construction supervision for the works financed by the Japanese side will be carried out by a Japanese consulting firm.

(4) Construction Contractor

The contractor carrying out the construction financed by the Japanese side should also be a Japanese corporation. The contractor would carry out mainly civil construction of raw water intakes, raw-water transmission, water treatment, treated-water transmission and distribution facilities, as well as procurement of equipment. The company must be a general construction company that has sufficient capacity and experience and is capable of dispatching qualified engineers, procuring construction materials and heavy machinery necessary for the undertaking.

(5) Japanese Experts

It is necessary to dispatch Japanese engineers with specialized expertise in the construction of treatment facilities, installation of electrical and mechanical equipment, conducting test operations and testing the water tightness of structures and pipelines. The following engineers are needed to be dispatched as Japanese experts:

- One representative in charge of overall construction work
- Site Manager for each site
- Civil Engineers
- Architects
- Pipeline Engineers
- Mechanical Engineers
- Electrical Engineers

2.2.4.2 Implementation Conditions

The following conditions would apply to the implementation of the project at construction sites:

- Extra effort will be devoted to coordination and information sharing because there are a number of parties involved. The Cambodian side, the construction contractor, the consultant and the related donor organizations would meet regularly to review progress. Other means of communications will also be used. .
- The consultant would share information with the involved parties continuously and deploy one project manager and one resident engineer on site to ensure smooth implementation of the project.

- The construction contractor would also deploy one representative and one site manager on site.
- The consultant and the construction contractor would have offices set up at appropriate locations.
- Consultations with the Cambodian side would be required since the coordination with the national and state governments is indispensable for approvals of IEE, water rights, construction of intake facilities, seeking permissions for occupancy of roads, etc.
- It is recommended that construction of intake facilities be executed between November and June when the water level is low. Works should not be conducted between July and October when the water level is higher, unless the water can be blocked. During the first dry season of the contract period, temporary water coffers should be constructed. Then excavation and concrete placing can follow.
- Total length of pipes for raw water transmission, clear water transmission and distribution will be approximately 93 km. The main sites are urban areas with busy roads, commercial and residential areas. Accordingly, the pipe installation would require special considerations for safety and to minimize disruption of traffic and daily activities in the area.
- Residents should receive water even during the construction period because the project is only expanding existing facilities. Should water shutdowns be required, it is necessary to announce the shutdown period and warn residents of possible turbidity in the water, to obtain their understanding and cooperation.
- The Cambodian side shall assure the safety of the construction work sites from landmines and unexploded ordinance (UXO) by submitting the official report to the JICA Cambodia Office by the commencement of the construction work
- The construction will be done in the day time. In case night-time construction cannot be avoided, for example during pipe laying work in the area of markets, restaurants, offices, etc., consultation with the Cambodian side will be required.
- Materials and equipment will be procured locally. If this is not possible, procurement from Japan or third countries would be considered sequentially.
- Materials for service connections to be provided by the Japanese side should be products manufactured in neighboring countries and sold in Cambodia. These are likely already used by the Waterworks for existing pipes.

2.2.4.3 Scope of Work

The Japanese side will be responsible for the construction of the facilities. The Cambodian side will take care of the storage of the procured equipment (especially materials for service connections) and installation of service connections between distribution pipes and households.

Details of the obligations of the Cambodian side are described in **Chapter 2.3**.

2.2.4.4 Consultant Supervision

(1) Detailed Design

Detailed site surveys including line survey and spot detail survey of distribution facilities and cost quotations for local products will be conducted in Cambodia at the start of the detailed design. After the site surveys in Cambodia, the detailed design will be carried out in Japan and comparison between estimated costs of the outline design and detailed design will be studied. Based on the comparison, the detailed design is finalized and tender documents are prepared for the approval of the Cambodian side. Schedule of the detailed design is shown in **Table 2.2.4.4-1**. Total period of the detailed design is expected to be 6.5 months.

For the detailed design, in addition to the project manager, engineers will be assigned to be in charge of 1) intake facility, 2) treatment facility, 3) transmission and distribution facility, 4) mechanical equipment, 5) electrical equipment, 6) architecture, 7) implementation schedule and cost estimates, and 8) tender documents.

(2) Tendering Process

Announcement of tender and prequalification and distribution of tender documents will be conducted after the approval of the tender documents. The schedule and the flow chart of the tendering process are shown in **Table 2.2.4.4-1** and **Figure 2.2.4.4-1** respectively. The consultant will act as the agent for the Cambodian side in this process. It will take 4.0 months from the announcement of Pre-Qualification (PQ) to the awarding of the contract and approval by the Ministry of Foreign Affair, Japan.

Table 2.2.4.4-1 Schedule of Detailed Design and Tender Works

Month	1	2	3	4	5	6	7	8	9	10	11
Detailed Design											
Consultant Agreement/ Verification by GOJ											
Site Survey											
Site Survey by sub-contractor											
Detailed Design in Japan											
Preparation of Tender Documents											
Approvals of Tender Documents by GOC											
Tendering											
Pre-qualification											
Tendering (Distribution of Tender Documents, Tender Opening, Evaluation)											
Contract/ Approval by GOJ											

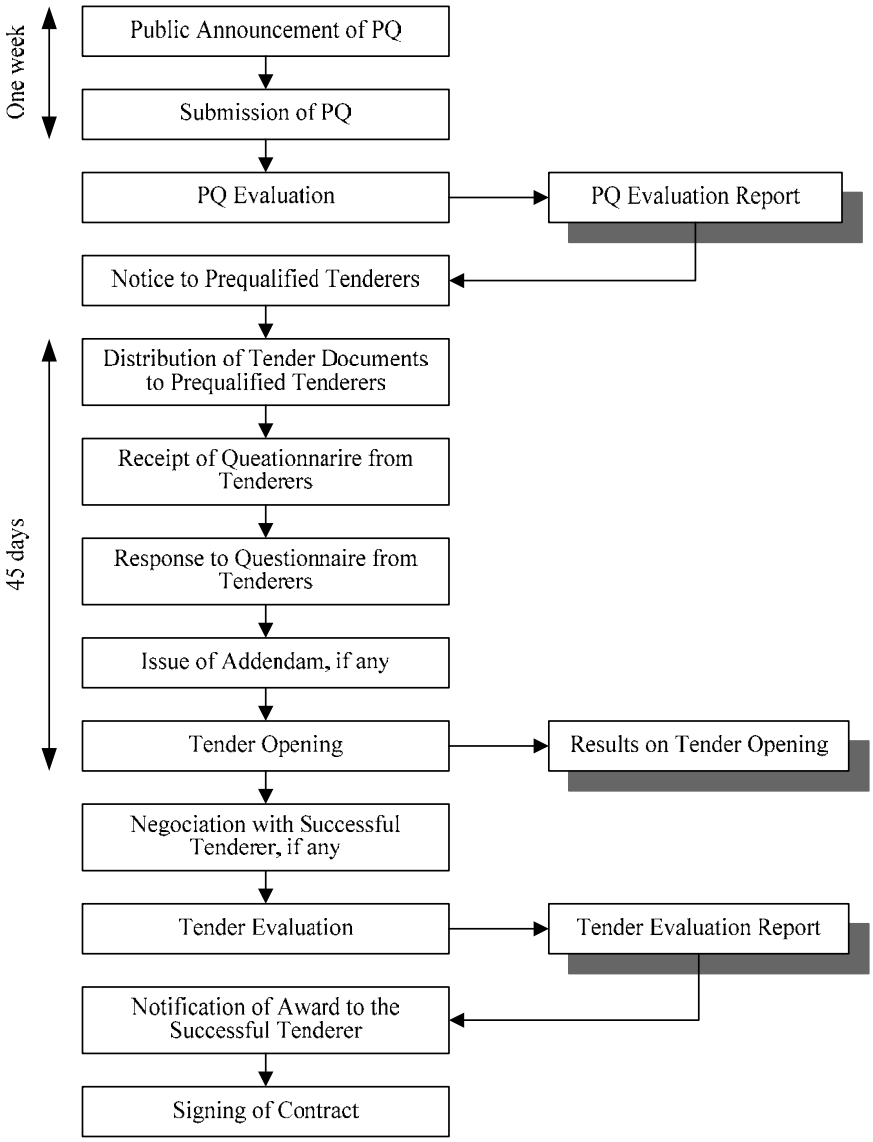


Figure 2.2.4.4-1 Flow of Tender Process

(3) Construction Supervision

The selected consultant will perform the following supervisory work:

- Check and approve shop drawings,
- Inspect major equipment and materials at the factories before shipping,
- Supervise construction activities,
- Inspect completed structures,
- Test facility operations and evaluate performance,
- Inspect the procured equipment,
- Report on construction progress to Japanese and Cambodian sides,
- Safety guidance on the construction work and supervision of the construction quality
- Advise on work to be carried out by the Cambodia side,
- Technical assistance (capacity building) on operation and maintenance of the facilities,

- Assist the Cambodian side on the necessary procedures and responsibilities in the execution of the Japan's Grant Aid project.

In order to supervise the activities throughout the construction period, it is necessary to deploy one resident engineer from the start of construction to the commissioning of the facilities. In addition, various specialists (as listed below) are required for on-site supervision of the construction of the different facilities as described in details below.

Project Manager

The major scope of work for the Project Manager is as follows:

- Prior to the commencement of construction, confirm obligations of each party, scope of the project, and implementation schedule, by holding meetings with Cambodian agencies, consultants and contractors.
- Confirm satisfactory completion of the work.
- Assist the Cambodian side in the handover of the facility.

Resident Engineer

The resident engineer will supervise all the work especially in the aspect of quality control and progress to assist and provide instruction to the contractors. The engineer will also prepare monthly progress reports to the Japanese and Cambodian sides. The major scope of work of the resident engineer is as follows:

- Maintain tender documents, drawings, standards, specifications, results of surveys and soil investigations, and documents prepared and submitted by the contractors.
- Check and approve construction schedule/plan and shop drawings.
- Inspect and approve materials and equipment for the project.
- Inspect and approve construction work executed by the contractors.
- Monitor and manage the progress of the project.
- Inspect safety provisions.
- Hold periodical or ad-hoc meetings with the Cambodian side, consultants, and contractors.
- Check and approve as-built drawings.
- Assist with the work which should be executed by the Cambodian side.
- Check shop drawings, supervise construction activities as well as test procedures, provide instruction and advice

Specialists

The following specialists will be assigned as required and they will also provide technology transfer during the testing period.

a. Civil Engineer (for intake/raw water transmission facilities)

Check shop drawings, supervise construction activities as well as test procedures, provide instruction and advice concerning intake/transmission facilities.

b. Civil Engineer (treatment facilities)

Check shop drawings, supervise construction activities as well as test procedures, provide instruction and advice concerning treatment facilities.

c. Civil Engineer (transmission/distribution facilities)

Check shop drawings, supervise construction activities as well as test procedures, provide instruction and advice concerning transition/distribution facilities.

d. Architect

Check shop drawings, supervise installation of electrical equipment as well as test procedures, provide instruction and advice concerning architectural facilities.

e. Mechanical Specialist

Check shop drawings, supervise installation of mechanical equipment as well as test procedures, provide instruction and advice concerning mechanical equipment/facilities.

f. Electrical Specialist

Check shop drawings, supervise installation of electrical equipment as well as test procedures, provide instruction and advice concerning electrical equipment/facilities.

g. Specialist for procurement of equipment

Check approval procedure, supervise the procurement of equipment and provide instruction and advice.

2.2.4.5 Quality Control Plan

Quality control during construction consists largely of ensuring conformance to planning decisions and the technical specifications in the original design. The major items to be scrutinized are listed in **Table 2.2.4.5-1** together with indicators, control methods, and standards to be adopted. In principle, JIS or other equivalent International Standards will be followed for quality control.

Table 2.2.4.5-1 Major Work Items and Methods for Quality Control

Category	Material/ Equipment	Control	Method of Control	Applicable Standards	Frequency of Test	Records	Remarks
Pump Facilities	Pump	Conform to the Standards	Observation Shop-Drawing Test Report	JIS B 8301 JIS B 8302	When Received Factory Inspection	Record Test Result Table Approval Drawings	In the presence of Consultant
Pipe Material	Ductile Cast Iron Pipe	Conform to the Standards	Shop-Drawing	JIS G 5526 JIS G 5527	For each pipe laying section	Approval Drawings	
		Type	Observation		For each type、when received	Record	In the presence of Consultant

Category	Material/ Equipment	Control	Method of Control	Applicable Standards	Frequency of Test	Records	Remarks
Pipe Laying Work	Joint	Joint Condition	Observation	－	During the course of Jointing Work	Report	In the presence of Consultant
			Pressured Leakage Test	No leakage observed	For each pipe laying section	Test Result Table	In the presence of Consultant
			Ultra Sonic Test		At one time for every 10 joints	Test Result Table	
Concrete Material	Reinforcing Bars	Type of Re-bar (deformed, round)	Observation	JIS G 3112 JIS G 3117	When received for each type		In the presence of Consultant
		Conform to the Standards	Test Report			Test Result Table	
	Cement	Type of Cement	Observation	JIS R 5210	When received.	Record	In the presence of Consultant
		Conform to the Standards	Test Report			Test Result Table	
	Water	Piped Water or Clear River Water	Observation	－	When mixed	Concrete Mixture Table	In the presence of Consultant
		Water Quality (River Water)	Water Quality Test	JIS A 5308 Appendix 9	Before mixture design	Test Result Table	
	Aggregates	Maximum diameters of Aggregates	Observation	Reinforced Concrete: 25mm	When Received.	Record	In the presence of Consultant
		Grain Size	JIS A 1102	JIS A 5005	Before mixture design	Test Result Table	
	Concrete Mixture	Conform to the Standards	Test Report	JIS A 6201-6207	When received	Test Result Table	When necessary.
	Storage of Materials	Place and Storage Conditions	Observation	－	When necessary.	Report	In the presence of Consultant
Concrete Placing Work	Concrete Design Mixture (Major Structures)	Test Mixture	Confirmation of Quality	28 day strength:21N/mm^2 Slump:10.0±2.5cm Air Content:±1.5% W/C Ratio: less than 65% (less than 55% for water retaining structure) Cement: more than 270kg/m^3	1 time before placing	Test Result Table	In the presence of Consultant
	On-site Concrete Mixture	Water Content of Small Aggregate Surface	JIS A 1111, 1125	－	Each mixing	Test Result Table	In the presence of Consultant
		Grain Size of Aggregate	JIS A 1102	JIS A 5005	When received	Test Result Table	
		Temperatures of Water and Aggregates	Temperature Measurement	－	Each mixing	Test Result Table	In the presence of Consultant

Category	Material/ Equipment	Control	Method of Control	Applicable Standards	Frequency of Test	Records	Remarks
		Water and Cement Volumes		Error: less than1%			
	Slump	Conform to the Specifications	JIS A 1101	10.0±2.5cm	Each placing	Test Result Table	In the presence of Consultant
	Air	Conform to the Specifications	JIS A 1128	±1.5%	Each placing	Test Result Table	In the presence of Consultant
	Compressive Strength	Laboratory	―	Approval of Consultant	Prior to the test	―	
		Sampling	JIS A 1132	7day Strength: 3 pcs 28day strength: 3pcs	Every 50m^3 placing or 1 time per day 1time for one consecutive placing work	―	In the presence of Consultant
		Conform to the Specifications	JIS A 1108	Design Strength= 21 N/mm^2	Every 50m^3 placing or 1 time per day 1time for one consecutive placing work	Test Result Table	
	Leakage Test (Reservoir and others)	Conform to the Specifications	Water Level Measurement, Observation	No water level draw-down after 24 hours	After the structure is constructed	Test Result Table	In the presence of Consultant

2.2.4.6 Procurement Plan

(1) Procurement of Materials and Equipment

Construction materials and equipment for the Project will be procured in Cambodia, Japan or other countries, according to the following considerations. Quality of materials and equipment should conform to the requirements.

- For local materials and equipment, quality and capacity of supply should be at the acceptable level
- Easy operation and maintenance taking into account availability of spare parts
- Appropriate price
- Availability of after-sale service

Local procurement in Cambodia is preferable. Almost all materials for construction works are available in Cambodia and have appropriate quality. But, procurement from Japan or other countries is considered when materials or equipment cannot be procured in Cambodia, especially for mechanical and electrical equipment and pipe materials. Pipe materials, not available in Cambodia and being the larger part of the project cost, would be procured from neighboring ASEAN and OECD countries where the price is lower.

Equipment and materials for service connections should be procured in Cambodia, because those will be needed on a long term basis even after the project is complete. The procurement plan for construction materials is shown in **Table 2.2.4.6-1**.

Table 2.2.4.6-1 Procurement Plan for Construction Materials

Name of Materials	Source of Procurement			Remarks
	Cambodia	Japan	Third Countries	
1. Construction Materials				
Ready Mix Concrete, Sand, Gravel, Cement, Steel Bar	○			
Formwork Wooden Plate, Wood	○			
Steel Sheet Pile and H-shape Steel Pile	○			
Pre-stressed Concrete Pile	○			
Galvanized Steel Plate	○			
Paints, Lubricant, Fuel	○			
Water Stops	○			
Filter Sand	○			
Scaffolding and Support	○			
2. Mechanical and Electrical Equipment				
Pumps		○		
Overhead traveling crane		○		
Water Treatment Equipment including Chemical Feeding Equipment		○		
Electrical Equipment and Panels		○		
Lighting equipment, Cables and Cable Conduits	○			
Instrumentation and Control Devises		○		
Air Conditioner, Inter Phone, etc.	○			
Distribution Flow Monitoring System		○		
3. Pipe Materials				
Pipe Material (DIP)			○	Malaysia, etc
Pipe Material (HDPE), Fittings	○		○	Malaysia, etc
4. Equipment Procurement				
Water Quality Testing Equipment and Mechanical Maintenance Tool		○		
Equipment for Service Connections	○			

(2) Transportation Plan

Equipment procured in Japan and other countries will be transported to Sihanoukville by marine transportation. After import custom clearance, it will be transported to stock yards in Kampot by truck. The truck route to Kampot is approximately 100 km via Route 4 and 3, and takes around 2 hours. The transportation routes are shown in **Figure 2.2.4.6-1**.

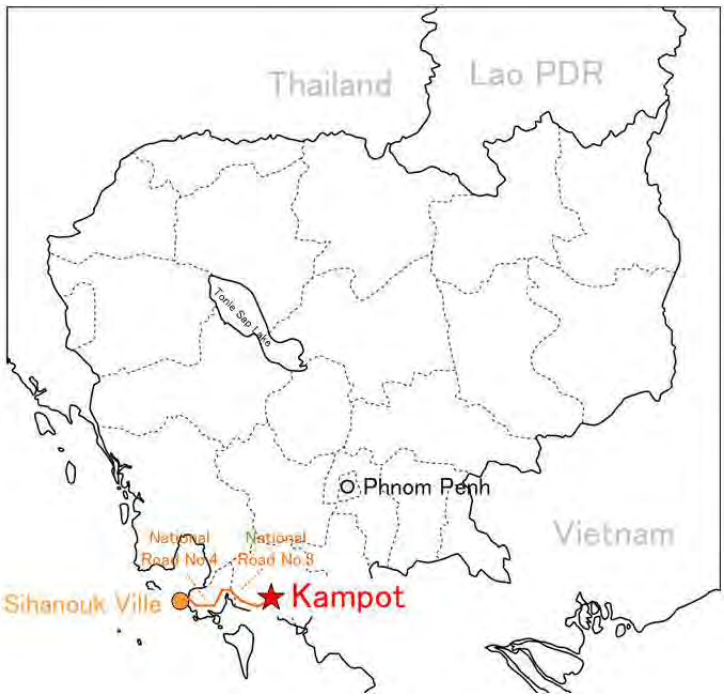


Figure 2.2.4.6-1 Routes for Transportation

2.2.4.7 Operation Guidance Plan

(1) Guidance Items

Guidance items required for the operation and management of the new and existing water supply facilities are shown below.

- Operation and maintenance plan (new facilities)
- Management plan for the new facility
- Management plan for the existing facilities
- Long-term maintenance and renewal plan of the new facility
- Operational management of the new and existing facilities combined
- Dealing with the increased customers base
- Personnel management

The following training will be provided for the above mentioned items.

- Management guidance (soft component) to be implemented under the project
- Instruction for the operation and maintenance of the equipment provided by contractor
- Project on Capacity Building for Urban Water Supply Systems in Cambodia

The relationship between the guidance items and the training components are shown in **Table 2.2.4.7-1**. Planning for the training, the evaluation, and supplementary classes will be provided under the management guidance to ensure effective training. Operation guidance and initial

operation instructions for individual facilities and mechanical and electrical equipment will be carried out by the contractor at the time of delivery of the facility.

Table 2.2.4.7-1 Guidance Items and Training Components

Guidance Items	Management Guidance (Soft Component)	Contractor	Capacity Building Project
Operation and maintenance of the new facility	○	◎	-
Operation and management plan for the new facility management	◎	-	-
Long-term maintenance and renewal plan of the new facility	○	-	◎
Combined operation management with the new and the existing facilities	◎	-	-
Dealing with Customers to be increased	○	-	◎
Management plan of the new and the old facilities	○	-	◎
Personnel management	○	-	◎

◎: Main, ○: Sub (evaluation and supplementary classes)

(2) Guidance by the Capacity Building Project

To carry out the above guidance items, method to assume the operation and maintenance man-hours in accordance with the facility expansion, and the guidance to support the residents of the new water supply area as an item of business plan shall be implemented during the period of the capacity building project. These are part of the capacity building project goals. Therefore, it is assumed that the training within the framework by the planned dispatched experts can be carried out. Capacity building project (phase 3) is scheduled to end in November 2017, before the construction of the new facility is completed. It is expected that the human resources which are necessary for management the water supply system will have been developed by that time.

2.2.4.8 Soft Component (Management Guidance) Plan

The project on the capacity building for water supply systems in Cambodia (phase 2) was conducted in eight targeted provincial waterworks including Kampot Waterworks by the Japan International Cooperation Agency (JICA). As a result, the skill level of the staff at the waterworks increased dramatically, and at the end of the project it was concluded that "Due to the considerable increase in the capability of the water service personnel, which had been exceedingly limiting, it has become possible to provide a safe and stable water supply in the Targeted Provincial Waterworks (TPWs)". Therefore Kampot Waterworks has the basic skills required to operate the existing water treatment plant.

The project will expand the treatment capacity and the distribution network and Kampot Waterworks by a factor of approximately 2.3. Kampot Waterworks should reorganize its management including operation and maintenance for new facilities, acquire enough operation and maintenance skills for new facilities, and strengthen the management of the waterworks to be expanded. However, it is difficult for the Waterworks to cope with these issues by themselves. To tackle these issues soft component will be conducted and new standard operational procedure (SOP) for each facility will be prepared. Therefore, the need for this component is very high.

The purpose of the component in this project is that Kampot Waterworks continuously operate and maintain the new facilities with the existing facilities and provide safe water to the people, which meets the water quality standards. In order to achieve this purpose, it is necessary for the Cambodian counterparts to allocate the required number of staff with enough basic knowledge and skills for waterworks before commencement of this component to operate and maintain the new facilities.

Therefore, the following three soft components should be implemented in this project. However, the contents of the training implemented by the project on the capacity building for water supply systems in Cambodia (phase 2) will be reviewed only.

(1) Operation and maintenance of water treatment facilities

In order to produce clean water at the new water treatment plant, the training for operation and maintenance of water treatment facilities will be carried out during the project. New O&M staff must be properly trained to ensure that the facility would be operated consistently in an efficient manner.

(2) Operation and maintenance of water transmission and distribution facilities

Distribution block management will be introduced in the project. Staff will be trained for distribution flow control, water leakage management and accident response.

(3) Production management (Water supply facility management)

Necessary training for sound management such as inventory control of consumable chemicals and sludge disposal plan will be carried out in order to produce clear water sustainably. Through the training, staffs waterworks can improve their performance for management of the treatment plant effectively.

The implementation schedule is as shown in **Table 2.2.4.8-1**.

Table 2.2.4.8-1 Implementation Schedule of Soft Component

			30	31	32	33	34	35	36	37	38	39	40	41	M/M	
															Cambodia	Japan
Japanese Consultants	Water Treatment Operation and Maintenance Consultants	Water Treatment		0.2	0.767								1.233		2.000	0.200
		Water Quality										0.1	0.767		0.767	0.100
	Distribution Operation and Maintenance Consultant			0.1	0.533								0.767		1.300	0.100
	Production Mangement Consultant											0.1	1.233		1.233	0.100
															5.300	0.500
Local Consultants	Water Treatment Operation and Maintenance Consultants	Water Treatment			0.767								1.233		2.000	0.000
		Water Quality											0.767		0.767	0.000
	Distribution Operation and Maintenance Consultant				0.533								0.767		1.300	0.000
															4.067	0.000
Local Assistants	Interpriter / Support (Water Treatment)				1.267								1.733		3.000	0.000
	Interpriter / Support (Distribution)				1.033								0.767		1.800	0.000
	Interpriter / Support (Production Management)												1.733		1.733	0.000
															6.533	0.000
Report					△ Progress Report									△ Final Report		

2.2.4.9 Implementation Schedule

The implementation schedule is shown in **Figure 2.2.4.9-1**. The detailed design period will be about 6.5 months, pre-qualification and tendering period will be about 3.5 months, and procurement and construction will be 27 months.

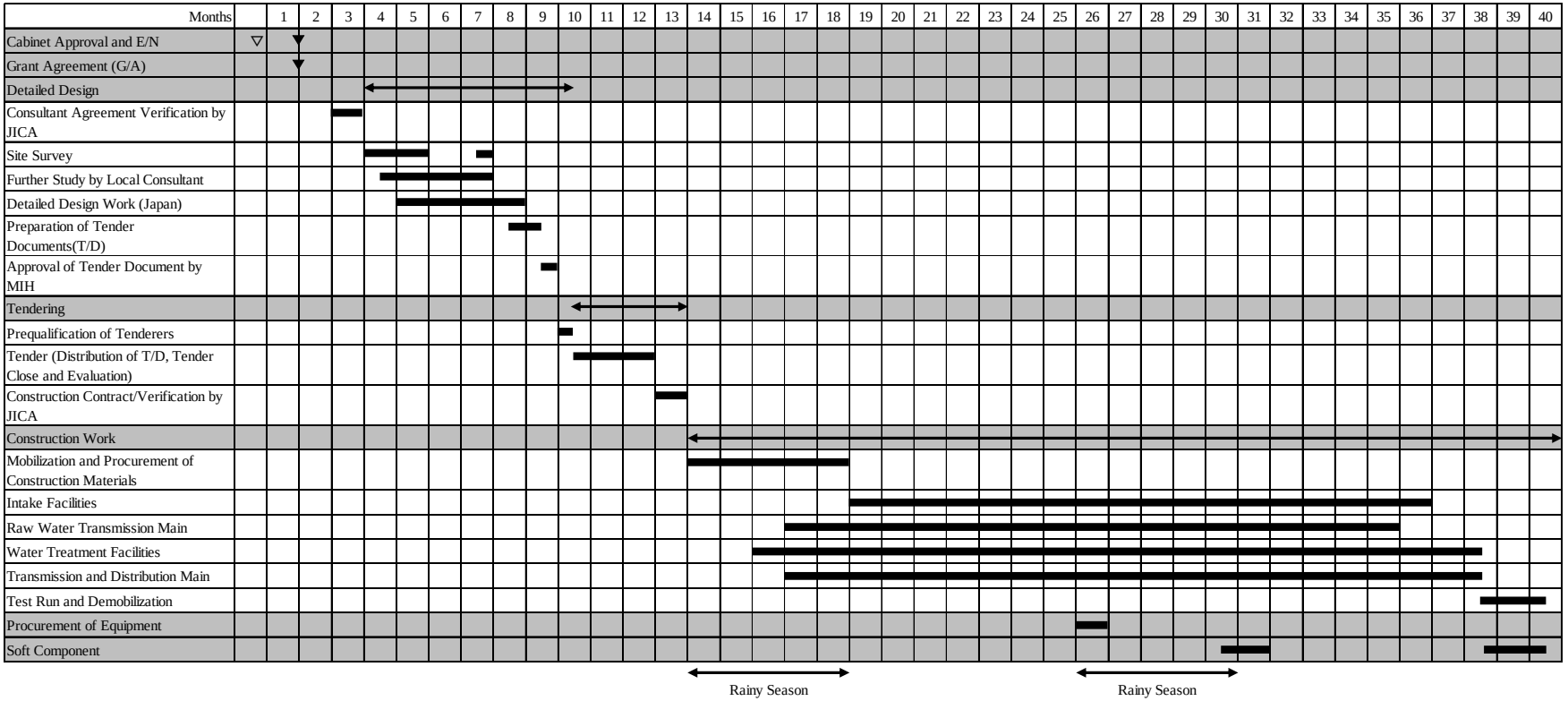


Figure 2.2.4.9-1 Implementation Schedule

2.3 Obligations of Recipient Country

2.3.1 Land Acquisition for Water Treatment Plant and Land Preparation

The land required for the new water treatment plant has been identified by the Cambodian side and the Ministry of Economy and Finance has already acquired it. There is no illegal resident and the existing building and this land has never been utilized as agricultural or forest land. Therefore there is no problem to use this land for the proposed treatment facility (see **Photo 2.3.1-1**). The Cambodian side should, however, level the land for the construction of the treatment facility after the land has been acquired.

Photo 2.3.1-1 Proposed Land for New Water Treatment Plant

2.3.2 Approval of Intake from the River

The new intake station for the Project is located near the existing intake station in Prek Kampot River. MIH obtained a letter from MOWRAM on approval of intake from the river (The required water intake amount is 0.17 m^3/s including the existing water intake amount).

Based on the letter (No. 889) from MME dated July 21, 2014, the current minimum discharge volume from the upstream hydroelectric dam is confirmed to be 5.0m^3/s.
However, the current minimum discharge volume estimated by visual confirmation of JICA Survey Team is approximately 1.0 m^3/s. Therefore, the river flow measurement for the current minimum discharge volume from the dam and at intake station was conducted in dry season by JICA Survey Team.

2.3.3 Transmission of Electricity to the New Intake Facility and Water Treatment Plant

The Japanese side explained to the Cambodian side that Japanese Grant Aid will provide and install the transformers at the sites of the new intake facility and water treatment plant. However,

the Cambodian side has to construct the power transmission facilities to the transformers. Kampot Waterworks is having talks with Electric du Cambodia (EDC), especially for construction of power transmission facility to new water treatment plant.

2.3.4 Land Acquisition Procedure for Pipeline Routes

The land acquisition procedure for transmission and distribution pipes is different between the laying under local roads and the laying under national roads, bridges or railways. Each procedure is as described below.

(1) Land Acquisition Procedure under National Roads, Bridges and Railways

The waterworks in Kampot have to file an application with the Department of Industry & Handicraft (DIH) for the processing of land acquisition procedures to obtain approval from the Ministry of Public Works and Transportation (MPWT) and shall contain information on the construction site and the construction method. MPWT shall inform the Department of Public Works and Transportation (DPWT) about the construction of pipes after the approval of the application from MIH.

The land acquisition procedure for pipe-laying under national roads, bridges and railways is as shown in **Figure 2.3.4-1**.

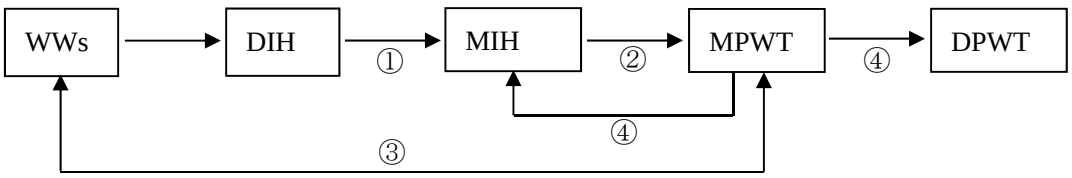


Figure 2.3.4-1 Land Acquisition Procedure under National Roads, Bridges and Railways

① The waterworks shall provide the following information to MIH through DIH.

・Information on national road, bridge and railway affected by pipe laying.
・Pipe laying location
・Construction Method

② MIH shall file an application for pipe laying with the above information to MPWT.

③ MPWT shall ask waterworks directly about unknown matters including improvement of the above construction application.

④ MPWT shall recognize the application of MIH and issue a cooperation request to DPWT.

(2) Land acquisition procedure under local roads

The waterworks of Kampot have to file an application with the Department of Industry & Handicraft (DIH) for the processing of land acquisition procedures to obtain approval from the Provincial Government. The Provincial Government shall inform the Department of Public Works and Transportation (DPWT) about the construction of pipes which shall contain information on the construction site and the construction method.

The land acquisition procedure for the pipe laying under local roads is as shown in **Figure 2.3.4-2**.

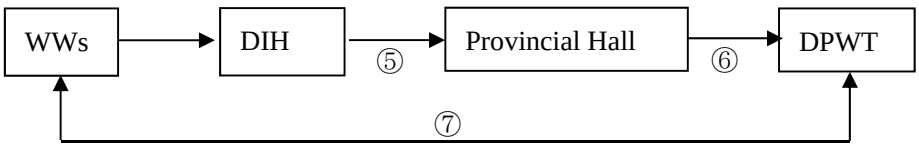


Figure 2.3.4-2 Land Acquisition Procedure under Local Roads

⑤ The waterworks shall file an application with DIH for the processing of land acquisition procedures to obtain approval from the Provincial Government and shall contain the following information:

・Information of local road affected by pipe laying.
・Pipe laying location
・Construction Method

⑥ The Provincial Government will then inform DPWT about the pipe-laying which shall contain the above information.

⑦ DPWT shall ask waterworks directly about unknown matters including improvement of the above construction application. Waterworks will then provide detailed information on the construction work to DPWT one week before the commencement of construction work.

To commence the works, the Waterworks companies shall ask the Provincial Government to launch a project committee and shall also issue a cooperation request to every authority.

2.3.5 Individual Service Connections

The facilities installed downstream of the distribution mains, such as service pipes and water meters shown in **Figure 2.3.5-1,** are installed by the waterworks at the customer's request. The typical size of service pipe and water meter is 25 mm and 15 mm in diameter, respectively. Larger service pipes and water meters are required for those customers using a large amount of water. The materials and equipment costs and their installation costs (connection fee) are borne by the customers.

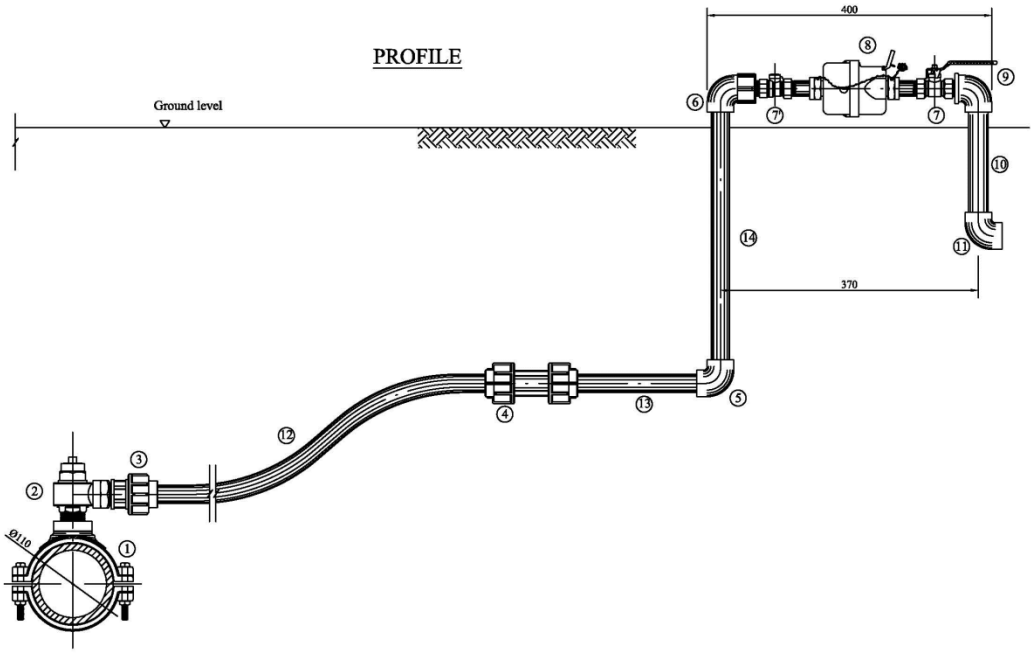


Figure 2.3.5-1 Typical Drawing of an Individual Service Connection in Cambodia

The connection of service pipes, the procurement and installation of water meters are required for new applicants for service connections. This task will be implemented by the technical personnel of the waterworks at the expense of the new applicants. The current number of service connections in Kampot Waterworks (2009 to 2012) is about 220 to 510. **Table 2.3.5-1** shows the projected number of new connections per year for achieving the target water supply ratio.

Table 2.3.5-1 Schedule of Additional Service Connection

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021
Number of Connections (nos/year)	646	500	500	500	1,000	1,000	1,000	1,000	1,083

source: JPST

In order to increase service connections among low income groups, the provision of service

connection materials (i.e. water meters, service pipes and other accompanying items) is included in this project. The installation costs of the connections will be covered by the Cambodian side.

2.3.6 Investigation of Land Mines and Unexploded Ordnance

According to the Cambodian Mine Action Center (CMAC), a governmental organization, which has been instrumental in demining and removing unexploded ordnance in Cambodia, approximately 4,500 km^2 land is contaminated by land mines and unexploded ordnance as shown in **Figure 2.3.6-1** and only 500 km^2 land has been cleared by 2014. There is the possibility of finding land mines and unexploded ordnance in the Kampot area. Therefore, the Cambodian side should take the following measures during project implementation.

- execute a search for land mines and unexploded ordnance in the project sites before commencement of construction works
- demining and removing unexploded ordnance detected during search and during construction
- prior arrangements and discussions on the above among parties concerned

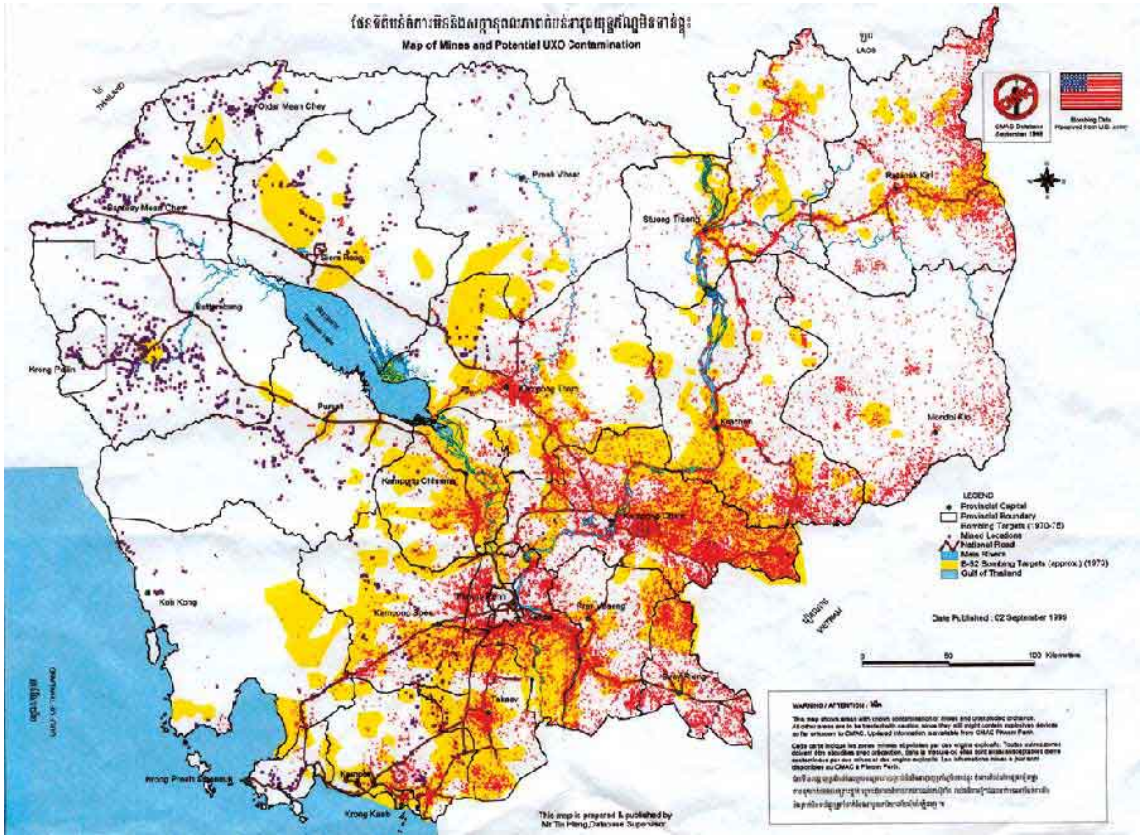


Figure 2.3.6-1 Map for Area Contaminated by Land Mines and Unexploded Ordnance (source: CMAC)

Proposed intake and treatment facilities and distribution pipeline routes for the project are located at the areas that need to be verified for land mines and unexploded ordnance and cleared.

It is possible to search and demine the proposed treatment plant site and intake site before commencement of the construction works. For the pipeline routes, verification activities can begin after the alignment routes are fixed through the digging of test pits after commencement of the construction works. To confirm the methodology and schedule of investigation of land mines and unexploded ordnance with CMAC and other agencies concerned is indispensable.

2.3.7 Environmental and Social Considerations

The progress of environmental and social consideration activities such as IEIA (Initial Environmental Impact Assessment) and RAP (Resettlement Action Plan) is as mentioned below.

- Field surveys for IEIA were completed in September, 2014. The draft IEIA report (English version) is being prepared and will be submitted to MIH in March, 2015. It usually takes 60 working days (approximately 3 months) for IEIA evaluation. Then another month or more may be required for responding to comments. Therefore, the evaluation outcome will be known by the end of July, 2015.
- The Cambodian side has acquired the land for the planned WTP following the appropriate process required by the Cambodian laws. There is no significant difference between JICA Guideline and the Cambodian laws and no problem is expected. No resettlement is required.

2.3.8 Others

In addition to the above, the following components are designated as the responsibilities of the Cambodian side for the implementation of this project.

- Establishment of Project Implementation Unit (PIU) organized by MIH, DIH and Kampot Waterworks
- Budgeting for the project components for which the Cambodian side is responsible
- Bank arrangements
- Procedure of tax exemption
- Contracting process of network connection for the distribution information system
- Increasing the number of personnel in the waterworks, optimization of personnel distribution and training

- Stock management of procured materials and equipment and proper O&M of the constructed facilities
- Continuously acquiring and accumulating the values of the indicators set for project monitoring.

2.4 Project Operation Plan

2.4.1 Organization after Completion of the Project

The agency responsible for urban water supply is the Department of Potable Water Supply (DPWS), under the Ministry of Industry and Handicraft (MIH). The implementing and operating agencies for water supply facilities are the Department of Industry and Handicraft (DIH) and Waterworks in Kampot Province. For this project, the Kampot Waterworks will be responsible for the smooth implementation of the Project and for the operation and maintenance of the water supply facilities.

In order to operate and maintain the existing and new facilities, it is recommended to increase the number of staff to 67 in total by the target year of 2021 as shown in **Table 2.4.1-1**. MIH is considering a reorganization of provincial waterworks beginning in 2015, in which case the organization plan in **Table 2.4.1-1** should be revised at that time.

Table 2.4.1-1 Proposed Staff Number for future Kampot Waterworks

Name of Section	Work Allocation	Existing Staff as of 2014 (A)	Staff to be required (B)	Proposed Staff in 2021 (A+B)
Director	Director	1	-	1
Deputy Director	Assistant to Director	3	-	3
Accounting-Finance	tariff collection, accounting, inventory control	4	+3	7
Business	meter reading, billing, customer management	7	+6	13
Administration & Planning	general affairs	3	-	3
Networks	service connections, distribution pipelines	9	+9	18
Technical	O&M of treatment plant and intake, water quality control	8	+14	22
Total		**35**	**+32**	**67**

Note: including one chief for each section

Recommended number of staff for future waterworks is based on the following conditions.

a. Accounting-Finance and Business

The number of staff (except the chief of each section) is increased to correspond to the 2.3-fold increase in the number of service connections:.

Accounting-Finance: from 4 to 7

Business: from 7 to 13

b. Networks

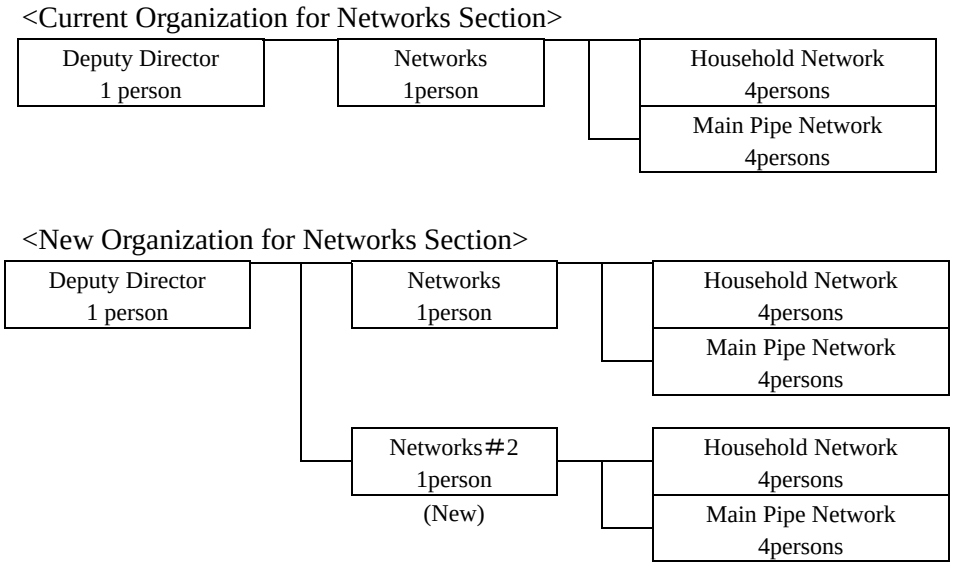
In order to increase the service ratio and realize the benefit of the facility expansion project, approximately 1,000 new connections should be installed every year from 2017. In addition, work volumes for data analysis will increase with the introduction of a new distribution monitoring system. The proposed number of staff is as follows;

Proposed number of staff from the perspective of number of connections

There is just over a two-fold increase in the number of connections. Assuming one team can install 3 connections a day and work 200 days a year, two teams would be needed to make 1,000 new connections in a year. Existing staff will be fully occupied with replacing customer meters in the existing service area therefore it is estimated that an equal number of staff will be required for the new expanded service area. Therefore, the waterworks will need to double staff to 18 persons from the current 9.

Proposed number of staff from the perspective of pipeline length

The existing number of staff is 9 for 79 km of pipelines. In 2021 pipeline length will be 155 km, so that 18 staff in 2021 is considered to be reasonable.



Note: Distribution data analysis is handled by 1 staff each of Main Pipe Network.

Figure 2.4.1-1 Organization for Networks Section

c. Technical (Intake station and water treatment plant)

After implementation of the project, the technical section has to operate the existing and the new water treatment plants effectively. The new intake station will be operated from the new treatment plant by remote control, thus one (1) staff will be enough for the new intake station.

The new plant will be operated by 4 teams on a three-shift basis. One team consists of two (2) operators. Three mechanical and electrical staff will be provided during the daytime for maintenance work. Therefore, a total eleven (11) staff are required to operate the new plant. When the operator has day off, maintenance staff supports his shift. The production management between new and existing plants will be done at the new plant. Thus, the production management staff will be stationed at the new plant.

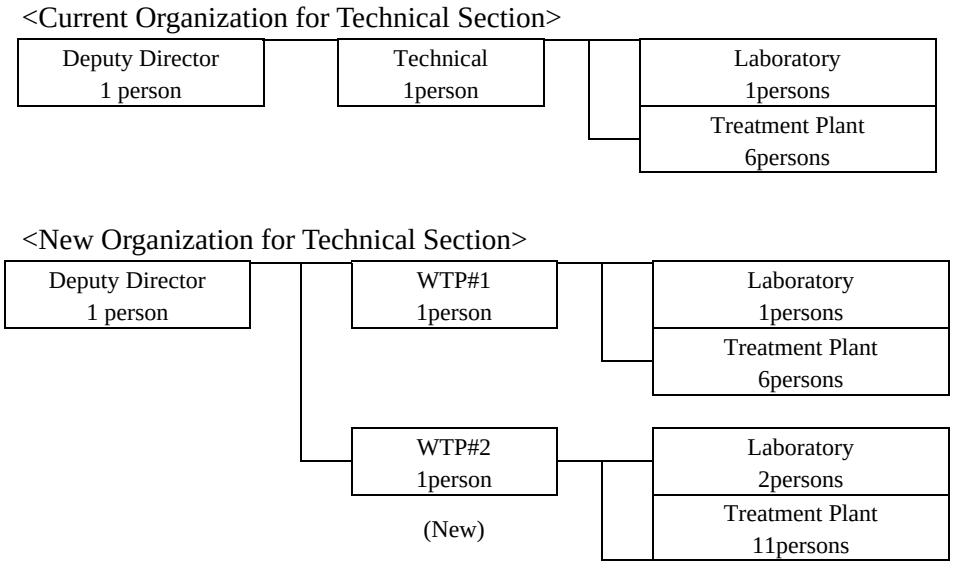
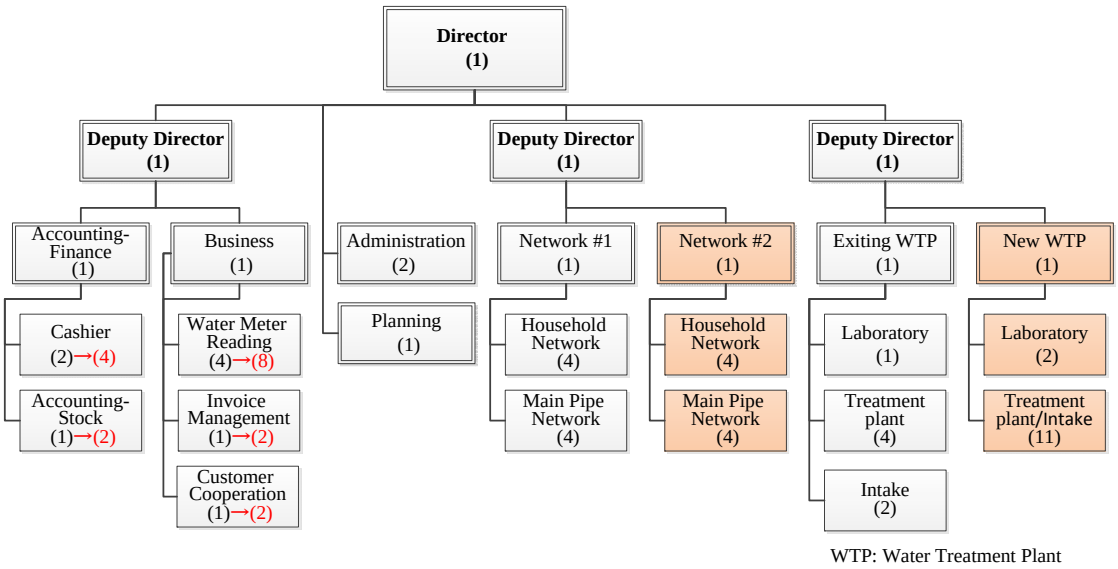


Figure 2.4.1-2 Organization for Technical Section

d. Technical (Water quality analysis)

Water quality at customer taps must be sampled for every 2,500 houses. There are 4 sampling points at present. Therefore, four (4) sampling points will be added for approximately 6,000 new connections by the target year of 2021. The laboratory at each water treatment plant is responsible for water quality control and checking water quality in the distribution system at these 8 points.



WTP: Water Treatment Plant

Figure 2.4.1-3 Organization Chart for Kampot Waterworks

2.4.2 Project Maintenance Plan

Upon implementation of the project, the proposed operation and maintenance requirements are shown in **Table 2.4.2-1**.

Table 2.4.2-1 Contents of Operation and Maintenance

Work Contents	Frequency	Remarks
■Intake Station		
－Intake pump	Daily	Instruction from WTP
－Operation record	Daily	Pump and electric facilities
－Cleaning	Every 3 months	Screen
－Accident response	Need	Coordination
■Water Treatment Plant		
●Water quality analysis		
－Essential analytical items	Daily	Temperature, pH, Turbidity, Residual Chlorine, etc.
－Daily record of water quality	Daily	
－Important analytical items	Every 3 months	AL, NH_4, etc.
－Jar test	Weekly	When raw water turbidity increasing
－Residual Chlorine in tap water	Twice/month	Several points
－Monthly record of water quality	Monthly	
●Water Treatment		
－Intake pump operation	Daily	Instruction of Intake station
－Condition of coagulation	Daily	
－Dosing rate of Alum	Daily	Result of Jar test, Condition of flock
－Dosing rate of Lime	Daily	pH measurement
－Dosing rate of chlorine	Daily	Residual chlorine (pre and post)
－Charging of chlorine gas tank	Need	
－Sedimentation basin operation	Weekly	

Work Contents	Frequency	Remarks
－Cleaning Sedimentation basin	Yearly	
－Discharging pump operation	Daily	
－Lagoon operation	Daily	Water content
－Sludge conveyance	Monthly	
－Filtration basin operation	Daily	
－Washing filter sand	Daily	
－Measurement of sand layer	Yearly	
－Quality of filter sand	Yearly	Effective size, Uniformity Coefficient
－Monitoring water level	Daily	Sedimentation, Filtration, Reservoir, etc.
－Cleaning reservoir	Yearly	
－Recording daily operation	Daily	
●Electrical and mechanical facilities		
－Routine maintenance check	Daily	Thermometer, vibration meter
－Washing chemical pipe	Daily	
－Minor fault repairing	Daily	
－Regular check of pump and motor	Yearly	
－Regular check of chemical equip.	Yearly	
－Regular check of motor valve	Yearly	
－Regular check of rapid mixing	Yearly	
－Regular check of level gage	Every 6months	Sedimentation, filtration, reservoir
－Insulation and earth test	Yearly	Electrical facilities
●Others		
－Cleaning	Daily	
－Security duties	Daily	
■Transmission and Distribution		
●Distribution pump operation		
－Pump operation	Daily	
－Recording pump operation	Daily	
－Operation daily schedule	Daily	
－Operation monthly schedule	Monthly	
●Distribution flow monitoring system		
－Record and analysis of water flow	Daily	
－Implementation of leakage survey	Monthly	
－Water pressure	Monthly	at the end of network
■Stock Management		
●Maintenance duties		
－Making annual operation plan	Yearly	2 WTPs
－Chemical stock management	Daily	Alum, Lime, Chlorine
－Sludge treatment plan	Daily	

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

(1) Project Cost borne by Cambodia Side

Total Project Cost borne by the Cambodia by 2021 side is estimated at about 783.7 million Cambodia Riel (KHR). **Table 2.5.1-1** shows its breakdown.

Table 2.5.1-1 Project Cost borne by Cambodia Side

Items	Contents	KHR (million)
Land Preparation for WTP	Land leveling for WTP	80.94
Survey of UXO and land mines	Assure the safety of the construction sites from UXO and land mines	446.89
Environmental Consideration	Environmental Monitoring for Air, Water, Noise and Vibration (2018-2021)	30.53
Information System	Contracting process of broadband LAN connection for the distribution information system.	8.14
Electricity Supply	Transmission of electricity to the new intake facilities and WTPs	81.67
Bank Charge	Bank arrangement for the project	98.90
Connection Fee	Installation of connection equipment for poor households	36.63
	Total	783.7

KHR 1 = 0.025 yen

(2) Conditions for Cost Estimates

1) Date of Estimates: As of August, 2014

2) Exchange Rate: US$ 1 = 102.87 yen
KHR 1 = 0.025 yen
(Average exchange rate between May 2014 and July 2014)

3) Period of Construction: Total: 36 months
Detailed Design: 6.5 months
PQ and Tendering: 3.5 months
Construction/Procurement: 26.0 months

4) Others: The Project should be implemented in accordance with the procedures of Japan's Grant Aid Scheme.

2.5.2 Operation and Maintenance Cost

2.5.2.1 Assumptions for O&M Cost Estimates

Operation and maintenance cost will be calculated depending on the assumptions shown in **Table 2.5.2-1** including income in the target year.

Table 2.5.2-1 Condition of O&M cost

Item	Condition
Revenue	
Water Tariff	1,400 Riel/m^3
Expense	
Personnel expense	Staff number: 59 in total (up to 2019) Staff number: 67 in total (2020-) Increase rate of salary*: 3.04%/year
Chemical cost	Alum: Unit cost: 44.76 Riel/m^3 Lime: Unit cost: 8.43 Riel/m^3 Chlorine: Unit cost: 98.38 Riel/m^3 Note: Based on the record for the existing plant
Power and fuel	Main power: Electricity (High Voltage) Electrical consumption: 441.25 Riel/m^3
O&M cost	Existing pipe: 534,727 Riel/km (including the cost of the monitoring system) New pipe: no cost by 2021 because of new pipes Existing electrical and mechanical facilities: the same cost as the current O&M cost New electrical and mechanical facilities: 2.3 times the existing O&M cost Note: Based on the failure rate curve
Depreciation	Pipe: 50 years Architecture: 50 years Mechanical equipment: 20 years Electrical equipment: 15 years Note: Based on the depreciation system of Phnom Penh Water Supply Authority (PPWSA). Residual value: 10%
Office articles	7% of total expense, based on the past performance
Tax	1.6% of total expense, based on the current situation

Note: Inflation rate: 3.04%, IMF-World Economic Outlook Database (Oct, 2014)

2.5.2.2 Operation and Maintenance Costs

(1) Cash Flow Forecast including Depreciation

Assuming the existing water tariff of 1,400 Riel/m^3, the cash flow forecast indicates that Kampot Waterworks will be operating at a loss (in the red) if depreciation costs are included as shown in **Table 2.5.2-2** (profit & loss sheet) and **Table 2.5.2-3** (breakdown of expenses).

Table 2.5.2-2 Profit and Loss Sheet

	Income			Expense	Summary	
Year	Annual consumption (Dome) (m3)	Annual consumption (Non Dome) (m3)	Annual sales (Riel)	Total Expense /year (Riel)	Year Profit/Loss Include Dep(Riel)	Year Profit/Loss Exclude Dep(Riel)
2015	1,354,880	239,075	2,231,537,000	2,672,710,066	-441,173,066	564,975,934
2016	1,470,950	259,515	2,422,651,000	2,847,363,239	-424,712,239	581,436,761
2017	1,703,090	300,395	2,804,879,000	3,107,684,902	-302,805,902	703,343,098
2018	1,935,230	341,640	3,187,618,000	3,526,002,188	-338,384,188	667,764,812
2019	2,167,370	382,520	3,569,846,000	3,819,155,361	-249,309,361	756,839,639
2020	2,399,510	423,400	3,952,074,000	4,219,469,365	-267,395,365	738,753,635
2021	2,650,995	467,930	4,366,495,000	4,674,913,567	-308,418,567	697,730,433

Table 2.5.2-3 Expense Sheet

	Expense								
Year	Operation Cost(Riel)							Depreciation	Tax(Riel)
	Electricity +Fuel	CL2	ALM	LIME	Maintenance	Salary	Admini		
2015	869,215,000	193,709,000	83,018,000	16,604,000	60,395,000	213,767,000	187,089,705	1,006,149,000	42,763,361
2016	982,328,000	218,926,000	93,825,000	18,765,000	62,231,000	220,266,000	199,315,427	1,006,149,000	45,557,812
2017	1,144,960,000	262,982,000	112,707,000	22,541,000	64,123,000	226,962,000	217,537,943	1,006,149,000	49,722,958
2018	1,320,914,000	309,807,000	132,774,000	26,555,000	66,072,000	360,495,000	246,820,153	1,006,149,000	56,416,035
2019	1,500,584,000	359,536,000	154,087,000	30,817,000	68,081,000	371,454,000	267,340,875	1,006,149,000	61,106,486
2020	1,721,126,000	412,402,000	176,744,000	35,349,000	122,079,000	382,746,000	295,362,856	1,006,149,000	67,511,510
2021	1,968,727,000	471,754,000	202,180,000	40,436,000	123,239,000	460,386,000	327,243,950	1,006,149,000	74,798,617

(2) Proposed Water Tariff

The proposed water tariff structure shown in **Table 2.5.2-4** is an increasing block tariff. The tariff for the first block is set at a very low rate with the objective to protect poor households that are assumed to consume less water than non-poor households. For low income groups the Phnom Penh Water Supply Authority sets the threshold for the first block to 7 m^3 per month per

connection.

Table 2.5.2-4 Proposed Water Tariff Structure

Class	Fee (Riel/m^3)
Domestic Less than 7 m^3/month	900
Domestic More than 7 m^3/month	1,800
Business	1,800

Table 2.5.2-5 Cash Flow Forecast Summary

	Income			Expense	Summry	
Year	Annual consumption (Dome) (m3)	Annual consumption (Non Dome) (m3)	Annual sales (Riel)	Total Expense /year (Riel)	Year Profit/Loss Include Dep(Riel)	Year Profit/Loss Exclude Dep(Riel)
2015	1,354,880	239,075	2,428,068,600	2,672,710,066	-244,641,466	761,507,534
2016	1,470,950	259,515	2,635,986,600	2,847,363,239	-211,376,639	794,772,361
2017	1,703,090	300,395	3,051,822,600	3,107,684,902	-55,862,302	950,286,698
2018	1,935,230	341,640	3,468,315,600	3,526,002,188	-57,686,588	948,462,412
2019	2,167,370	382,520	3,884,151,600	3,819,155,361	64,996,239	1,071,145,239
2020	2,399,510	423,400	4,299,987,600	4,219,469,365	80,518,235	1,086,667,235
2021	2,650,995	467,930	4,750,939,800	4,674,913,567	76,026,233	1,082,175,233

If the waterworks adopts the proposed tariff structure, cash flow will become positive (in the black) from 2020 which is 2 years after the completion of the project.

The average water consumption per household is 19.9 m^3/month, therefore the average water charge per household would be 29,520 Riel/month. This price is approximately 3 % of average income per household of 880,000 Riel/month which was obtained from the results of a social survey conducted during this preparatory survey. Therefore, it is possible for customers to pay this amount.

This cash flow forecast and proposed water tariff structure are only estimated for the project. The actual water tariffs should be based on the long-term development plan and financial plan. Advice for setting proper water tariffs is part of the scope of work for “the Project on Capacity Building for Urban Water Supply System (Phase 3)”. Therefore, the proposed cash flow forecast should be shared with the capacity building project and with MIH for their future reference.

Chapter 3 Project Evaluation

3.1 Preconditions

Preconditions and responsibilities by the Cambodian side for project implementation are described in "**Chapter 2-3 Obligations of Recipient Country**". The key conditions are as follows.

Water Intake Permissions

The current laws and regulations in Cambodia do not specify who issues water rights for the rivers and there is no water management being exercised at this time. The MOWRAM will start to manage the water resources in the near future. MIH obtained permission from the MOWRAM to take water from the Prek Kampot River for this project.

Investigation of Land Mines and Unexploded Ordnance

The Cambodian side would assure that all construction sites (for intake station, water treatment plant and distribution pipeline routes) are free from land mines and unexploded ordnance. An official report on the safety of the construction sites should be submitted to the Japanese side before the commencement of the construction phase.

Approval of IEIA Report

According to Article 7 of Sub-Decree on Environmental Impact Assessment and the comments of the MOE, the Project Owner, the MIH, shall prepare and submit an IEIA report and a pre-feasibility study report to the MOE for approval. Japanese side will support the preparation of the IEIA report and will submit the final report of this preparatory survey as the pre-feasibility study report for IEIA approval in March 2015. The MIH understands this procedure and will obtain the approval from the MOE by the end of July 2015.

Electric Transmission Lines to the New Intake Facilities and Water Treatment Plants

Japanese Grant Aid will provide and install the transformers at the new intake station and water treatment plant. The Cambodian side will construct the power transmission facilities to the transformers.

Right of Way for Pipelines

Water distribution pipes will be installed along public roads. Therefore, land acquisition for pipe laying will not be required, but permission of pipe installation should be obtained from the Ministry of Public Works and Transportation for national roads and from the Provincial Government for local roads.

3.2 Necessary Inputs by Recipient Country

Installation of Service Connections

The Japanese side will install the distribution pipelines. At the customers' request the Kampot Waterworks will install the service pipes from the distribution pipelines and the water meters. The materials, equipment and installation costs (connection fee) are borne by the customers.

Staff Increase

It is necessary for the Kampot Waterworks to increase the number of staff for the operation and maintenance of the new water supply facilities constructed by the Japanese Grant Aid. The appropriate staff complement should be allocated one year before the completion of construction so that they can be trained under the technical assistance component of the project.

3.3 Important Assumptions

The desired project outcomes can only be achieved if the following assumptions remain true:

- Serious natural disaster will not occur.
- Serious deterioration of the economy will not occur.
- Demographics in the project area will not change unexpectedly.
- The existing treatment capacity will be maintained.

3.4 Project Evaluation

3.4.1 Adequacy of the Project

Project Beneficiaries

The water supply facilities in Kampot city will be expanded and the water supply services will be improved by the implementation of this project. The service ratio in the supply area will increase from 47 % in 2013 to 92 % in 2021. By 2021 the population served in Kampot city will increase from the current level of 23,657 to 55,874.

Urgency of Project Implementation

The existing Kampot water supply system is providing water service to only 47% of the population in 2013, because of insufficient production capacity. Therefore, the expansion of water supply facilities in Kampot city is an urgent matter.

Consistency between the Project and Cambodia Planning

The National Strategic Development Plan (NSDP) 2014-2018 sets the water service target of 100% in urban areas by 2025. This project will help Kampot Waterworks achieves this water

service ratio. In addition, the project will provide the equipment and materials for house connections for the low income group. The increase in service ratio for the low income group will contribute to poverty reduction which is the most important goal of the NSDP.

Compliance with Japan's Assistance Policy for Cambodia

Japan's assistance policy for Cambodia is to support the recipient country in achieving their development goals. "Promotion of Social Development" is a one of priority pillars of this policy. Development of the water supply system promotes social development and is therefore consistent with the policy for Japanese assistance in Cambodia.

3.4.2 Effectiveness

The project is expected to provide the following beneficial outcomes:

(1) Quantitative Effects

The expansion of water supply facilities in Kampot city will result in improvements to the indicators listed in **Table 3.4.2-1**.

Table 3.4.2-1 Quantitative Effects

No.	Indicator	Baseline Data (Year 2011)	Target (Year 2021) (3 years after completion of the new facilities)
1	Served Population	23,657	55,874
2	Water Supply Capacity (daily average basis)	4,252 m^3/day	10,339 m^3/day
3	Number of Domestic Connections	4,834	11,417

(2) Qualitative Effects

- Maintaining appropriate residual water pressure and increasing water supply capacity will improve water supply services.
- Public health and personal hygiene will improve for residents who switch from using rain water and groundwater to potable water from the supply system. More people will have access to safe water supply and water shortage will be eliminated.
- The replacement of old pipes will reduce leakage in the supply area.
- Promotion of house connections to poor households will improve the access to safe water supply to poor households.

In conclusion, the project will be effective in meeting its goals.

Appendix -1 Member List of the Survey Team

1. Leader
   Mr. Eiji IWASAKI
   Deputy Director General (for Water Resources and Disaster Management), Global Environment Department, JICA HDQs

2. Senior Advisor on Water Resources
   Mr. Kenji NAGATA
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5. Chief Consultant/ Water Supply Planning Specialist
   Mr. Takehiko OGA
   Global Engineering Department 1, Nihon Suido Consultants

6. Deputy Chief Consultant/Mechanical and Electrical Equipment Specialist
   Mr. Naoto TAKATOI
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7. Water Source Specialist
   Mr. Tatsuya TOBE
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8. Water Supply Facility/Equipment Designer (Intake/Raw Water Conveyance Facility)
   Mr. Takashi OKAMOTO
   Global Engineering Department 1, Nihon Suido Consultants

9. Water Supply Facility/Equipment Designer (Water Treatment Facility)/Operation and Management Specialist
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   International Project Division, International Project Department,
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10. Water Supply Facility/Equipment Designer (Transmission/Distribution Facility 1)
    Mr. Hideharu KIKUCHI
    Global Engineering Department 1, Nihon Suido Consultants

11. Water Supply Facility/Equipment Designer (Transmission/Distribution Facility 2)
    Mr. Takahiro NAKATA
    Global Engineering Department 1, Nihon Suido Consultants

12. Construction and Procurement Planning/Cost Estimation Specialist
    Mr. Koichi MATSUBARA
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13. Environmental and Social Considerations Specialist
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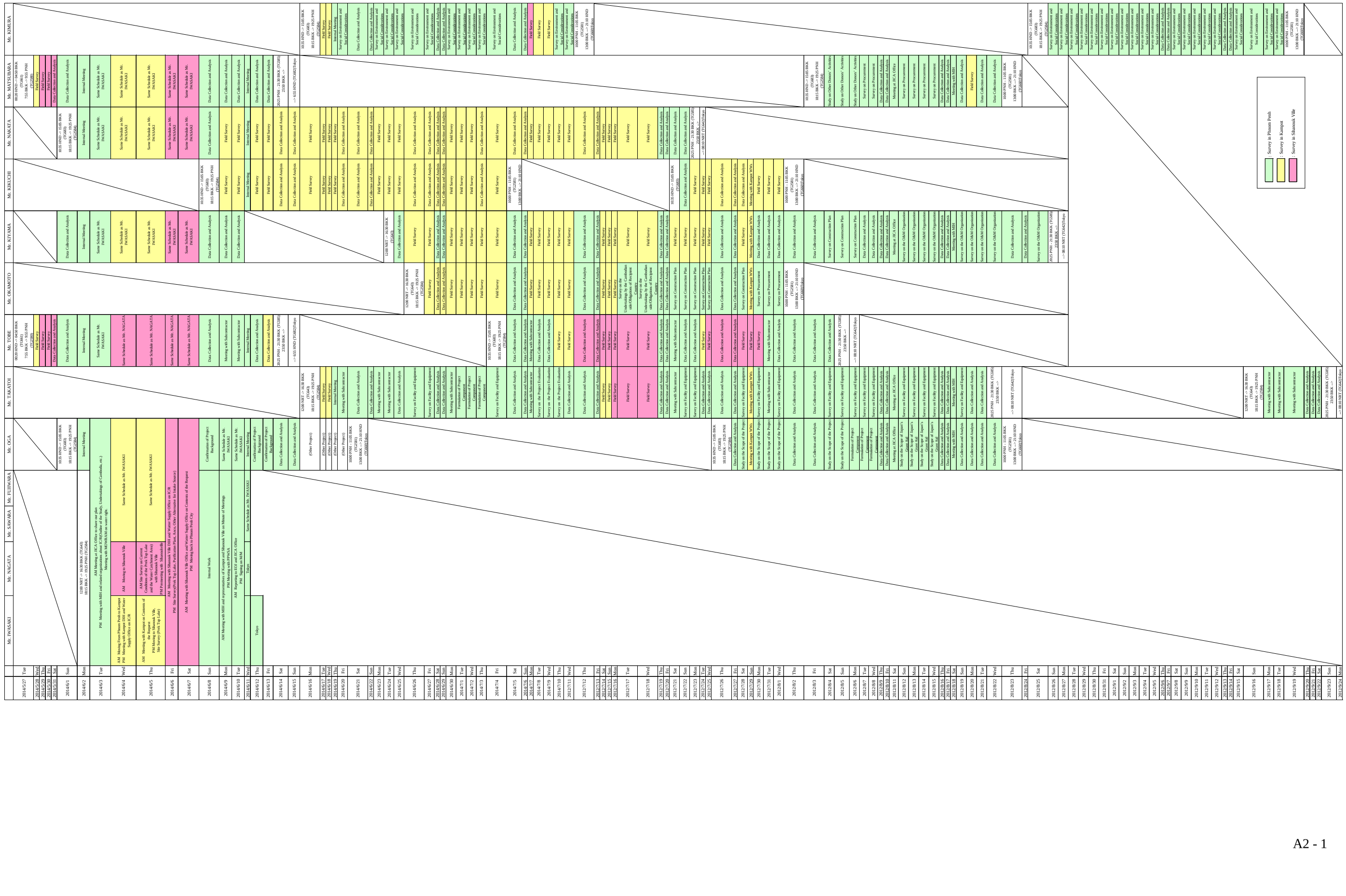
Appendix -2　Survey Schedule

(1) Survey Schedule for the First Work in Cambodia



(2) Survey Schedule for the Second Work in Cambodia

			Mr. IWASAKI	Mr. NAGATA	Mr. SAWARA	Mr. FUJIWARA	Mr. OGA	Mr. TAKATOI	Mr. KIYAMA	Mr. MATSUBARA	Mr. KIMURA
	2014/12/2	Tue						11:45 NRT- 16:45 BKK (TG643) 18:20BKK-19:35 PNH(TG584)			
	2014/12/3	Wed						Preparation of Draft Final Report (Khmer)			
	2014/12/4	Thu									
	2014/12/5	Fri									
	2014/12/6	Sat					11:45 NRT- 16:45 BKK (TG643) 18:20BKK-19:35 PNH(TG584)	Internal Work	11:45 NRT- 16:45 BKK (TG643) 18:20BKK-19:35 PNH(TG584)		
1	2014/12/7	Sun	11:45 NRT- 16:45 BKK (TG643) 18:20BKK-19:35 PNH(TG584)				Internal Work	Internal Work	Internal Work	10:45 HND- 15:45 BKK (TG683) 18:20BKK-19:35 PNH(TG584)	
2	2014/12/8	Mon	Courtesy call on MIH Explanation and Discussion on the Draft Outline Design								
3	2014/12/9	Tue	AM Meeting with MIH on the Minute of Meetings PM Meeting with Mr. Ek Son Chan								
4	2014/12/10	Wed	AM Internal Meeting at JICA Office PM Making a report								
5	2014/12/11	Thu	AM Site Survey in Kompong Cham PM Reporting to EOJ	Tokyo	AM Site Survey in Kompong Cham PM Reporting to EOJ		AM Internam Work PM Reporting to EOJ				
6	2014/12/12	Fri	AM Meeting with JICA staff and experts of the technical project PM Reporting to JICA Office 20:35 PNH - 21:40 BKK (TG585) 23:15 BKK -->		Same Schedule as Mr. IWASAKI	Same Schedule as Mr. IWASAKI 20:35 PNH - 21:40 BKK (TG585) 23:55 BKK -->	AM Internam Work PM Reporting to JICA Office	AM Internam Work PM Reporting to JICA Office 20:35 PNH - 21:40 BKK (TG585) 23:55 BKK -->	AM Internam Work PM Reporting to JICA Office	AM Internam Work PM Reporting to JICA Office	AM Internam Work PM Reporting to JICA Office 20:35 PNH - 21:40 BKK (TG585) 23:15 BKK -->
7	2014/12/13	Sat	--> 6:55 HND (TG682)Tokyo		keep staying in Phnom Penh for a next mission	--> 08:10 NRT (TG642)Tokyo	Internam Work	--> 08:10 NRT (TG642)Tokyo	Internam Work	Internam Work	--> 6:55 HND (TG682)Tokyo
	2014/12/14	Sun					Internam Work		Internam Work	Internam Work	
	2014/12/15	Mon					Internam Work		(Other Project)	Internam Work	
	2014/12/16	Tue					(Other Project)		(Other Project)	Internam Work	
	2014/12/17	Wed					(Other Project)		(Other Project)	(Other Project)	
	2014/12/18	Thu					(Other Project)		(Other Project until 23rd)		

Appendix -3 List of Parties Concerned in the Recipient Country

Ministry of Industry & Handicraft (MIH)

- H.E. CHAM Prasidh — Senior Minister
- H.E. EK Sonn Chan — Secretary of State
- TAN Soviddhya — Advisor to H.E. Senior Minister, MIH
  Director, Department of Potable Water Supply
- TAN Sokchea — Deputy Director General, General Deparment of Industry
- SOM Sethy — Deputy Director, Department of Potable Water Supply
- SOCHETTRA Tang — Deputy Director, Department of Potable Water Supply
- SOM Kunthea — Office chief, Department of Potable Water Supply
- SRENG Sokvung — Secretary of H.E. EK Sonn Chan, Department of Potable Water Supply

Ministry of Water Resources and Meteorology (MOWRAM)

- PONH SACHAK — Director General of Technical Affairs

Department of Industry and Handicraft in Kampot

- SOK Kimchoeun — Director

Department of Industry and Handicraft in Sihanouk Ville

- PRAK Prakat — Director

DoWRAM in Kampot

- CHAN Dara — Director

DoWRAM in Sihanouk Ville

- AING Chandara — Director

Kampot Water Works

- BUN Chankong — Director
- NUN Vanny — Deputy Director
- TY Kean — Deputy Director

Sihanouk Ville Water Works

- PRAK Prakat — Director
- LY Seng — Deputy Director
- PRAK Samprathna — Deputy Director
- CHUON Chetha — Deputy Director

Phnom Penh Water Supply Authority

- SIM SITHA — Director General
- VISOTH CHEA — Deputy Director General, Company Secretary

Ministry of Environment, Department of Kampot Province Environment

- SUY THEA — Director

Appendix -4

MINUTES OF DISCUSSIONS ON THE PREPARATORY SURVEY FOR THE PROJECT FOR EXPANSION AND IMPROVEMENT OF WATER SUPPLY SYSTEM IN KAMPOT AND SIHANOUK VILLE IN THE KINGDOM OF CAMBODIA (signed on 10 June, 2014)

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
FOR
THE PROJECT FOR EXPANSION AND IMPROVEMENT OF WATER SUPPLY SYSTEM IN KAMPOT AND SIHANOUK VILLE IN THE KINGDOM OF CAMBODIA

In response to the request from the Royal Government of Cambodia (hereinafter referred to as "RGC"), the Government of Japan decided to conduct a Preparatory Survey on the Project for Expansion and Improvement of Water Supply System in Kampot and Sihanouk Ville (hereinafter referred to as "the Project") and entrusted the survey to the Japan International Cooperation Agency (hereinafter referred to as "JICA").

JICA sent to Cambodia the Preparatory Survey Team (hereinafter referred to as "the Team"), which is headed by Mr. IWASAKI Eiji, Deputy Director General, Global Environment Department, JICA, and is scheduled to stay in the country from 02 June 2014 to 11 June 2014.

The Team held discussions with the officials concerned of RGC. In the course of discussions and field surveys, both sides confirmed the items described in the Attached sheets. The Team will proceed to further work and prepare the Preparatory Survey Report.

Phnom Penh, 10 June 2014

岩崎 英二

IWASAKI Eiji
Leader
Preparatory Survey Team
Japan International Cooperation Agency

CHAM Prasidh
Senior Minister
Ministry of Industry & Handicraft

ATTACHMENT

1. Title of the Project

The title of the Project is "The Project for Expansion and Improvement of Water Supply System in Kampot and Sihanouk Ville."

2. Objective of the Project

The objective of the Project is to improve the access to safe water in the cities of Kampot and Sihanouk Ville through the expansion and improvement of water supply system including construction of a new water treatment plant and water distribution systems.

3. Responsible and Implementing Agency

3-1) The Responsible Agency is Ministry of Industry & Handicraft (hereinafter referred to as "MIH").

3-2) The Implementing Agencies are the Department of Potable Water Supply as the Project Management Unit, and Kampot and Sihanouk Ville Waterworks as the Project Implementation Unit.

3-3) The organization chart of MIH and Provincial Departments of Industry & Handicraft (hereinafter referred to as "DIH") is described in **Annex 1**.

4. Target Cities of the Preparatory Survey

The target cities of the preparatory survey are Kampot and Sihanouk Ville.

5. Items requested by RGC

After series of discussions between the Cambodian side and the Team (hereinafter referred to as "both sides"), items of the request were confirmed by both sides as below.

5-1) The items of the request in Kampot are shown in **Annex 2**.

5-2) The items of the request in Sihanouk Ville will be further examined based on the results of the preparatory survey.

6. Japan's Grant Aid Scheme

6-1) The Cambodian side understands the Japan's Grant Aid Scheme explained by the Team, as described in **Annex 3**.

6-2) The Cambodian side will take the necessary measures, as described in **Annex 4**, for smooth implementation of the Project, as a condition for the Japanese Grant Aid to be implemented.

7. Schedule of the Preparatory Survey

7-1) The consultant members of the Team will conduct the preparatory survey in Cambodia until September 2014.

7-2) JICA will prepare the draft preparatory survey report in English and dispatch a mission in order to explain its contents to the Cambodian side around December 2014.

7-3) In case that the contents of the report are accepted in principle by the Cambodian side, JICA will finalize the report and send it to the Cambodian side around February 2015.

7-4) The Cambodian side understands that execution of the preparatory survey does not necessarily imply the Japanese Government's commitment to the project implementation.

8. Other Relevant Issues

8-1) Discussion on the Project Components

<Kampot>

(1) Water Treatment Plant

(a) Capacity of New Water Treatment Plant

Both sides agreed that the capacity of the new Water Treatment Plant (hereinafter referred to as "WTP") was around 6,500m^3/day, and the final capacity will be decided through the preparatory survey.

(b) Land for the New WTP

Both sides mutually understood that the existing premises was not large enough to construct the new WTP, and the Cambodian side should acquire land for the new WTP considering future expansion. Considering efficient operation and maintenance of WTP, the Team suggested that the location of the new WTP be selected somewhere in between the proposed intake site and the city.

(c) Schedule for the Land Acquisition

Both sides agreed that required procedure for the acquisition of the land should be so processed that topographical and geotechnical investigation for completing the plant design could be started by the middle of July 2014 at the latest. The Team explained that Japanese side would need the completion notice of the land acquisition from the Cambodian side by December 2014.

(2) Water Intake Facility

(a) Required Water Intake Amount

Both sides confirmed that the required water intake amount for the existing and the new WTP was around 0.16m^3/s.

(b) Location of Intake

Both sides agreed the most suitable and feasible location of the new water intake facility should be around the existing intake location based on the site observation by both sides.

(c) Permission of Water Intake

i) The Team requested MIH to confirm, by the end of July 2014, the current minimum discharge with Ministry of Mines and Energy (hereinafter referred to as "MME"), and to agree with MME on the minimum discharge including the required water intake amount of around 0.16m^3/s without producing any negative impact to the downstream.

ii) The Team requested MIH to secure permissions from MOWRAM for intake amount at the agreed location by the end of August 2014.

iii) The Team also requested MIH to obtain approval from local government bodies for the intake facility construction at the agreed locations by the end of February 2015 after the submission of a draft Outline Design Report of the preparatory survey.

(d) Permission on the land use for water intake

Both sides understood that the Team needed to confirm in writing from MIH official rights to use the land for Water Intake etc. by the end of June 2014.

(3) Weir

The Cambodian side reported there was complaints from the customers about the change of taste which was caused by salt water intrusion in 2002 (Complaints were not recorded and water quality was not tested). After 2002, Kampot Waterworks has taken preventive measures such as making the instant weir in dry season.

The Team explained and the Cambodian side understood that there was not enough evidence for the occurrence of salt water intrusion such as the date it was occurred, duration of the incident, and Chloride concentration, and therefore not to include the construction of weir in the Project.

The Cambodian side requested and the Japanese side agreed to continue studying possibility of salt intrusion at the point of the intake facility in this preparatory survey. Both sides recognized the importance of the water quality monitoring activities which is needed to justify the necessity of the future construction of the weir.

(4) Pipe Network and Monitoring System

Both sides confirmed that the request regarding pipelines included expansion for 55km and 3 additional villages, and replacement for 13km. The Team explained to examine for the eligibility for the Project. Both sides agreed that the Team would design water distribution monitoring system (including flow meter) for the comprehensive pipeline after confirming necessity and effectiveness of it in the preparatory survey.

(5) Others discussed

(a) Both sides agreed that the Cambodian side take necessary measures for the land acquisition of Elevated Tank and/or pumping station if needed.

(b) The Cambodian side agreed to provide background information or referential document regarding tourism visits to the Japanese side.

<Sihanouk Ville>

(1) Dredging of the Lake

The Team explained and the Cambodian side understood that the dredging of the Prek Tup Lake was considered as a part of routine operation and maintenance work of the Waterworks, and therefore that it could not be included in the Grant Aid Project. The Cambodian side requested that the on-going technical cooperation project on Capacity Building for Water Supply System (Phase 3) would assist the Waterworks to conduct a public awareness campaign on the environmental protection of the Prek Tup Lake.

(2) Pipe Network

The Team explained and the Cambodian side understood that the pipe network component was suspended. Both side understood the decision to support the pipe network components will be considered after the completion of the preliminary assessment.

(3) Contents of the Preparatory Survey

Both sides confirmed that the Team would conduct a water demand projection study for Sihanouk Ville up to the Year 2030, and the preliminary assessment of potential water sources as listed below to meet the projected water demand. In this regards, both sides agreed that the water demand projection should be made for the area to be supplied by the Waterworks in the future. Both sides agreed that the priority of water supply development would be discussed based on the results of the preparatory survey.

(a) Prek Tup Lake (including bathymetric survey)
(b) Kbal Chhay Dam
(c) Stung Hav Hun Sen Spillway
(d) Botkorki Reservior (Ou Chomna Dam)
(e) Groundwater

(4) Further Discussion

Both side understood that further study was necessary for developing overall pictures of the water supply system in Sihanouk Ville when new water sources would be found based on the preliminary assessment. Both sides also understood that if RGC needs the Grant Aid Project to realize the study, a new official request from RGC will be required.

8-2) Provision of Data from the Cambodian side

Both sides confirmed that MIH would assist the Team to obtain hydrological and meteorological data in each target city which have been recorded by Ministry of Water Resources and Meteorology upon request from the Team.

8-3) Target Year of the Project

The Team explained that the target year should be set at 3 years after the completion of the Project, because the Japanese Grant Aid is deemed to be provided to meet urgent and short-term needs of the recipient country.

8-4) Collaboration with JICA Technical Cooperation

Both sides confirmed that the collaboration between the on-going technical cooperation project on Capacity Building for Water Supply System (Phase 3) and this preparatory survey should be maintained.

8-5) Social and Environmental Considerations

(1) Both sides confirmed that the Team would assist RGC to conduct the Initial Environmental Impact Assessment (IEIA) for the project under the laws and regulations of Cambodia.

(2) The Team explained that the environmental and social considerations studies would be conducted according to JICA's Guidelines for Environmental and Social Considerations in order to examine the mitigation measures of impacts and monitoring plan during/after the implementation.

8-6) Tax exemption

The taxes including Value Added Tax (VAT), custom duty, and any other taxes and levies in Cambodia which is to be arisen from the Project activities will be exempted by the Cambodian side. MIH will take any procedures necessary for the tax exemption with the Ministry of Economy and Finance of Cambodia at its responsibility.

8-7) Overlapping with other projects

Both side confirmed that the on-going / proposed projects by other donor agencies, NGO, and Cambodian official organization(s) should be carefully investigated to avoid overlapping with the Project. The Cambodian side agreed to provide necessary information on related projects.

8-8) Individual House Connections for Poor Families

The Cambodian side requested the Japanese side to assist the individual house

connection for poor households through the provision of the materials such as water meters, fittings and pipes. Both sides confirmed that MIH would provide data of poor families and/or criteria used for the identification for poor families. As for individual house connections, both sides agreed that necessity of provision of the materials such as water meters, fittings and pipes will be considered in the Survey in order to assist the expansion of water supply to the poor families. Both sides also confirmed that Cambodian side will bear the cost for installation works thereof.

8-9) Ensuring the land for construction of new water supply facilities

Both sides agreed that the Cambodian side would clear the site completely including removing any remaining underground structures for ensuring the land to construct new water supply facilities before the commencement of the Project.

Annex-1 Organization Chart of MIH, DIH, and each Waterworks.

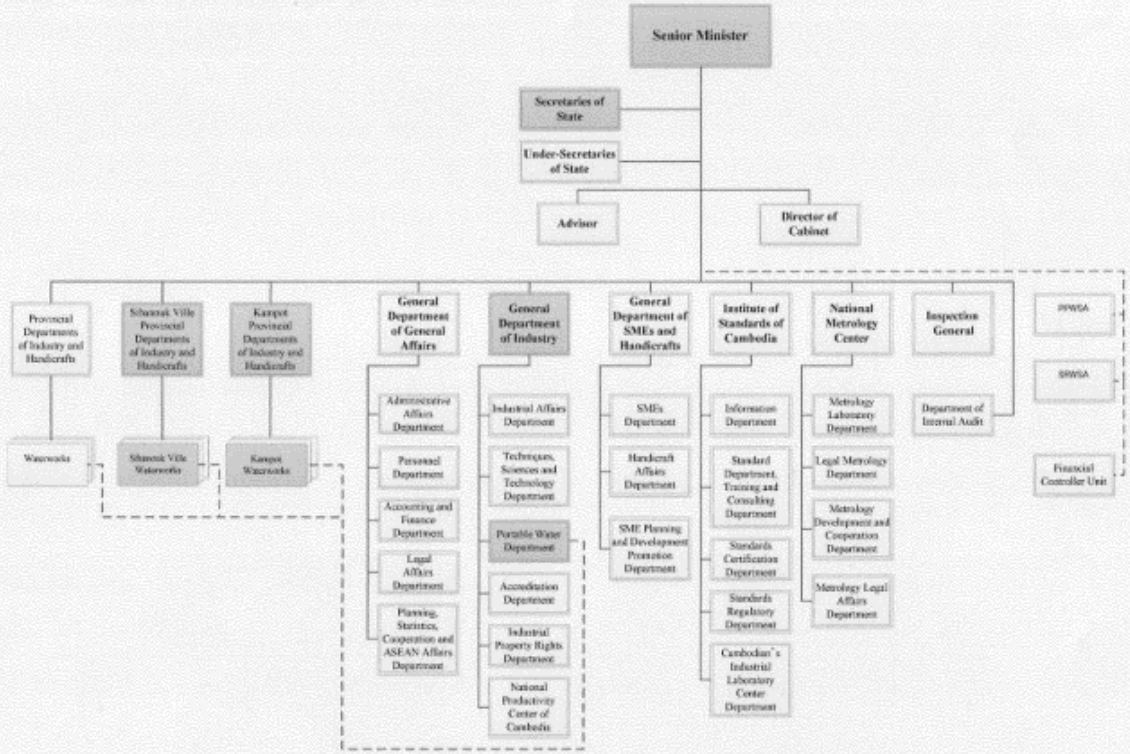


Figure 1-1: Organization of Ministry of Industry & Handicraft

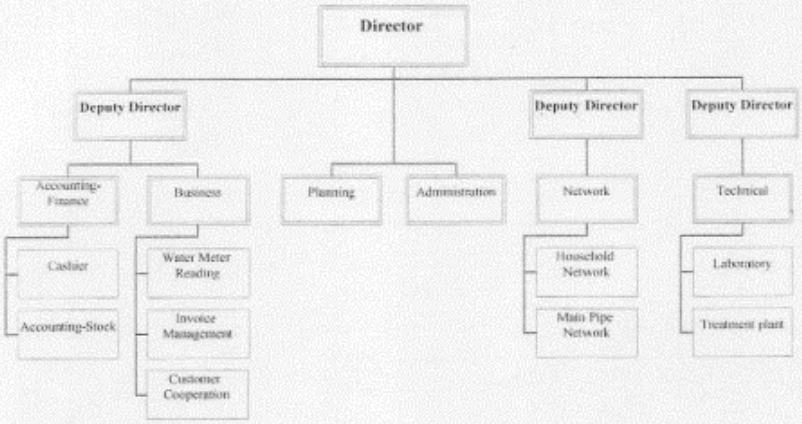


Figure 1-2: Organization of Kampot Waterworks

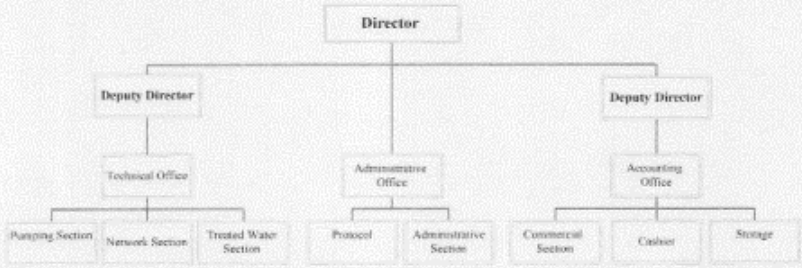


Figure 1-3: Organization of Sihanouk Ville Waterworks

Annex-2 Expected items requested by the Government of the Cambodia

Table: Confirmed Components of the Project

Item		Components confirmed	
		Kampot City	Sihanouk Ville City
Facility	Dredging and bank protection	-	**not to be included in the preparatory survey**
	Intake Facility	Intake pump station	-
	Raw water transmission	Intake to WTP	-
	Water treatment plant	Capacity: 6,000~6,500m3/day **(exact figure to be confirmed in the preparatory survey)**	-
	Clear water transmission	WTP to elevated tank	-
	Elevated tank	1 unit	-
	Expansion of distribution Network	New Network: **55 km + α(for 3 villages to be newly supplied)** Rehabilitation: **13 km (exact figure to be confirmed in the preparatory survey)**	**not to be included in the preparatory survey**
	Water distribution flow Monitoring system	1 Ls	**not to be included in the preparatory survey**
Equipment **(exact items to be confirmed in the preparatory survey)**	Water quality analysis	Optical analyzer, Distillation apparatus, Reagents, Glassware, pH meter, Turbidity meter, UPS, Others	-
	Maintenance tools - electrical and mechanical	Electroscope, Vibration checker, Torque wrench, Earth checker, Insulation checker, Database system for maintenance, Other tools	-
	Distribution management tools	Leakage locating equipment, Pipe locator, Pipe laying, Pipe network information system	-
Others		Detailed Design, Construction Supervision, Soft Component	**Preliminary Assessment in the Preparatory Survey (Study for Water Demand Projection and Potential Water Sources)**

Annex-3: Japan's Grant Aid Scheme

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

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

1. Grant Aid Procedures

The Japanese Grant Aid is supplied through following procedures:

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

2. Preparatory Survey

(1) Contents of the Survey

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

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

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

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

(2) Selection of Consultants

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

(3) Result of the Survey

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

3. Japan's Grant Aid Scheme

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

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

(2) Selection of Consultants

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

(3) Eligible source country

Under the Japanese Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased. When JICA and the Government of the recipient country or its designated authority deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country. However, the prime contractors, namely, constructing and procurement firms, and the prime consulting firm are limited to "Japanese nationals".

(4) Necessity of "Verification"

The Government of the recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by JICA.

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

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

In the implementation of the Grant Aid Project, the recipient country is required to undertake such necessary measures as Annex 4.

(6) Proper Use

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

(7) Export and Re-export

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

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account under the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). JICA will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

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

(9) Authorization to Pay (A/P)

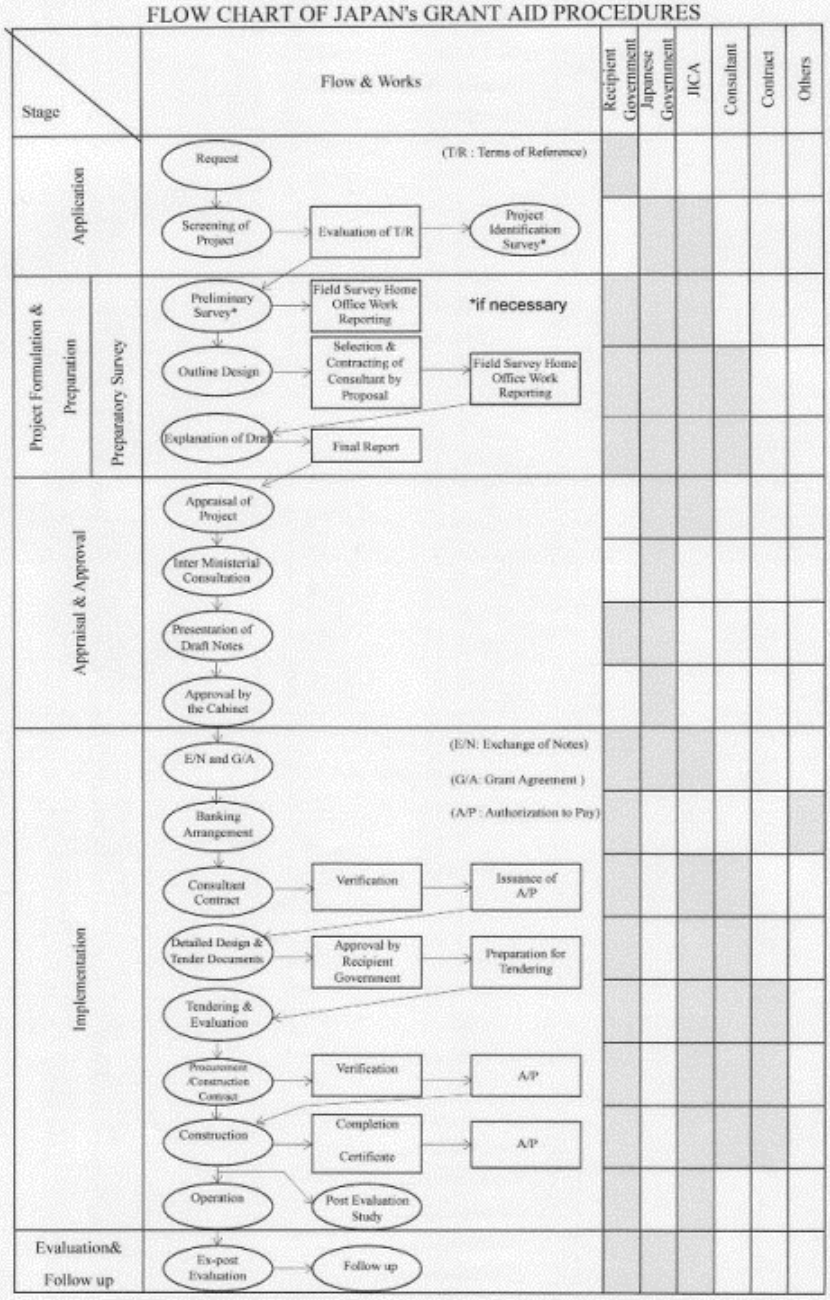
The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions paid to the Bank.

(10) Social and Environmental Considerations

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

Attachment for Annex-3

FLOW CHART OF JAPAN's GRANT AID PROCEDURES



Annex-4: Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure [a lot] / [lots] of land necessary for the implementation of the Project and to clear the [site] / [sites];		●
2	To ensure prompt unloading and customs clearance of the products at ports of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Internal transportation from the port of disembarkation to the project site	(●)	(●)
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be borne by the Authority without using the Grant		●
4	To accord Japanese physical persons and / or physical persons of third countries whose services may be required in connection with the supply of the products and the services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
5	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
7	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
8	To give due environmental and social consideration in the implementation of the Project.		●

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

MINUTES OF DISCUSSIONS ON THE PREPARATORY SURVEY FOR THE PROJECT FOR EXPANSION AND IMPROVEMENT OF WATER SUPPLY SYSTEM IN KAMPOT AND SIHANOUK VILLE IN THE KINGDOM OF CAMBODIA (EXPLANATION OF THE DRAFT REPORT) (signed on 9 December, 2014)

MINUTES OF DISCUSSIONS
ON
THE PREPARATORY SURVEY
FOR
THE PROJECT FOR EXPANSION AND IMPROVEMENT OF WATER SUPPLY SYSTEM
IN KAMPOT AND SIHANOUK VILLE
IN THE KINGDOM OF CAMBODIA
(EXPLANATION OF THE DRAFT REPORT)

In response to the request from the Royal Government of Cambodia, the Government of Japan decided to conduct a preparatory survey on the Project for Expansion and Improvement of Water Supply System in Kampot and Sihanouk Ville (hereinafter referred to as "the Project") and entrusted the survey to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). Therefore JICA sent the first preparatory survey team on the Project to the Cambodia from 2 June 2014. Through discussions, field surveys, and technical examination of the study results in Japan, JICA prepared a draft final report of the survey.

In order to explain and to consult with the Royal Government of Cambodia on the project components of the draft final report, JICA dispatched to the Cambodia the Draft Final Report Explanation Team (hereinafter referred to as "the Team"), headed by Mr. IWASAKI Eiji, Deputy Director General, Global Environment Department, JICA from the 7th to the 9th of December 2014.

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

Phnom Penh, 9 December 2014

岩崎英二

IWASAKI Eiji
Leader
Preparatory Survey Team
Japan International Cooperation Agency

CHAM Prasidh
Senior Minister
Minister of Ministry of Industry & Handicraft

ATTACHMENT

1. Component of the Draft Final Report

The Cambodian side agreed and accepted in principle the project components on the draft final report explained by the Team. The Project sites map and component of the Project are respectively shown in **Annex-1** and **Annex-2**.

2. Japan's Grant Aid Scheme

The Cambodian side understood the Japan's Grant Aid Scheme and the necessary measures to be taken by the Royal Government of Cambodian (hereinafter referred to as "RGC") as explained by the Team and described in the Annex 3 and the Annex 4 of the Minutes of Discussion signed by both sides on 10 June 2014.

3. Submission of the Final Report

JICA will complete the final report in accordance with the confirmed items and send it the RGC by March 2015. The both sides agreed that all the reports would be prepared in both languages of English as original and Cambodian as translation. In case of any discrepancy in interpretation, the English text shall prevail.

4. Title of the Project

Both sides confirmed that the title of the Project changed from "The Project for Expansion and Improvement of Water Supply System in Kampot and Sihanouk Ville" to "The Project for Expansion and Improvement of Water Supply System in Kampot". The title is subject to the approval of the both governments.

5. Responsible and Implementing Agency

5-1) The Responsible Agency is Ministry of Industry and Handicraft (hereinafter referred to as "MIH").
5-2) The Implementing Agency is the Departments of Industry & Handicraft of Kampot Province (hereinafter referred to as "Kampot DIH").

6. Other Relevant Issues

6-1) Project Cost Estimate and Fairness

The Team explained to the Cambodian side the estimated project cost as attached in **Annex-3**. Both sides confirmed that this cost estimate is provisional and would be examined further by the Government of Japan for its final approval. Furthermore, both sides confirmed that this project cost estimate is confidential, and should never be duplicated in any forms or released to

any other parties until the relevant contracts are awarded by RGC, in order to secure fairness of tender procedure.

6-2) Necessary Budget to be covered by the Cambodian Side

The Team explained necessary project cost to be covered by the Cambodian side, and necessary annual operation and maintenance cost as attached in **Annex-4**. The Cambodian side agreed to secure necessary budget every year from the start of the Project.

In addition, the Team explained the result of the cost estimate for O&M would be crucial information which contribute to improve financial status of Kampot Waterworks (Kampot Waterworks is a water supply operation body under Kampot DIH) as stated on page 5-2 of the Draft Report in English. The Cambodian side agreed to keep strengthening the management capacity of the Kampot Waterworks in consultation with the Project on Capacity Building for Urban Water Supply System (Phase 3) (hereinafter referred to as "the JICA technical cooperation project").

6-3) Undertakings of the Cambodian Side

The Team explained to the Cambodian side its undertakings as listed in **Annex-5**, and the Cambodian side understood and agreed to execute them. The following items are to be emphasized:

1) **Assignments of Necessary Staff and Development of New Division**

Kampot DIH shall assign a sufficient number of appropriate personnel with basic knowledge of the water supply for operation and maintenance of the new water supply system in the reorganized divisions or units of Kampot Waterworks as shown in **Annex-6** by the commencement of the soft components.

2) **Mines and Unexploded Ordnance**

The Cambodian side shall assure the safety of the construction work sites from landmines and unexploded ordnance (UXO) by submiting the official report to the JICA Cambodia Office by the commencement of the construction work.

3) **Installation of Connecting Equipment for Poor Households**

The Cambodian side shall secure the budget of fiscal year from 2017 to 2021 for the installation of house connections to 900 poor households for free by using the house connection materials provided by the Project for poverty alleviation purposes in principle. Both sides confirmed that progress of the installation would be monitored annually by filling the form attached in **Annex-7** (this annex form will be duly confirmed by both sides at the stage of signing of Grant Agreement).

4) **Power Supply in Kampot**

TBC.

The Cambodian side shall arrange that Kampot Waterworks receive sufficient power supply to the new intake and the water treatment plant by the commencement of the construction work.

5) **Individual Service Connections**

The Cambodian side shall increase customer base through public campaign to local residents to promote the safe water access and to increase the revenue.

6-4) Technical Assistance ("Soft Component" of the Project)

Both sides confirmed that soft components on the following three topics would be implemented in the Project for proper operation and maintenance of the new facilities which would be constructed by the Project.

-Operation and maintenance of water treatment facilities
-Operation and maintenance of water transmission and distribution facilities
-Water supply facility management

Furthermore, the Team explained and the Cambodian side understood that since these soft components would be scheduled to start about one year before the completion of construction of the facilities as shown in the Table 2.5.8-1 of the Draft Report in English, the staff members to operate the new facilities should be allocated in advance with enough basic capacity to participate in trainings of the soft components.

6-5) Layout Plan of the Water Treatment Plant

The Cambodian side shared information that there was a plan of new roads along the new water treatment plant site, and requested that it should be taken into account at the stage of the detail design of the Project. The Team agreed to it.

6-6) Replacement of Existing Old Pipes

The Cambodian side proposed to the Team to consider the rehabilitation of all the old pipes as first priority. The team agreed to take this into account at the stage of the detail design of the Project as long as revision would not affect the cost of the Project nor change the scope of the Project such as the number of the service population and the capacity of the water treatment.

6-7) Environmental and Social Considerations

Both sides confirmed Environmental and Social considerations issues as follows:

1) Environmental Guidelines and Environmental Category

JICA Guidelines for Environmental and Social Considerations (April 2010) (hereinafter referred to as 'the Guidelines') is applicable for the Project. The Project is categorized as B[1] because

[1] Category B: Proposed projects are classified as Category B if their potential adverse impacts on the environment and society are less adverse than those of Category A projects. Generally, they are site-specific; few if any are irreversible; and in most cases, normal mitigation measures can be designed more readily.
http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf

the Project is not located in a sensitive area, nor has it sensitive characteristics, nor falls it into sensitive sectors under the Guidelines, and its potential adverse impacts on the environment are not likely to be significant.

2) IEIA

The Cambodian side will prepare and submit Initial Environmental Examination (IEE) / Initial Environmental Impact Assessment (IEIA) report and a pre-feasibility study report to Ministry of Environment (MOE) immediately and obtain their approval by the end of July 2015.

3) Environmental Checklist

Environmental and Social considerations including major impacts and mitigation measures for the Project are summarized in the Environmental Checklist attached as **Annex-8.** The Cambodian side confirmed they would inform JICA of any major changes which might affect environmental and social considerations made for the Project by revising the checklist in a timely manner.

4) Land Expropriation and Resettlement

The Project will not involve any land expropriation nor involuntary resettlement. With regard to the land acquisition for the water treatment plant, both side confirmed that the price of the acquired land was appropriate based on the document provided by the Ministry of Economy and Finance and the information collected in this study.

5) Monitoring for Environmental and Social Considerations

Results of environmental monitoring will be provided to JICA as a part of Project Progress Report by filing in the Monitoring Form attached as **Annex-9** on a quarterly basis during construction, provided that there is no outstanding issue regarding the environmental and social considerations during operation of the Project.

In case JICA finds that there is a need for improvement in a situation with respect to environmental considerations after the agreed monitoring period, JICA may request to extend the period of monitoring and reporting until JICA confirms the issues have been properly addressed.

The Cambodian side agreed to disclose the monitoring results to local project stakeholders and in the MIH office in accordance with Cambodian relevant laws. The Cambodian side agreed that JICA would also disclose the same results on its website. When third parties request further information, JICA may disclose it, subject to approval by MIH.

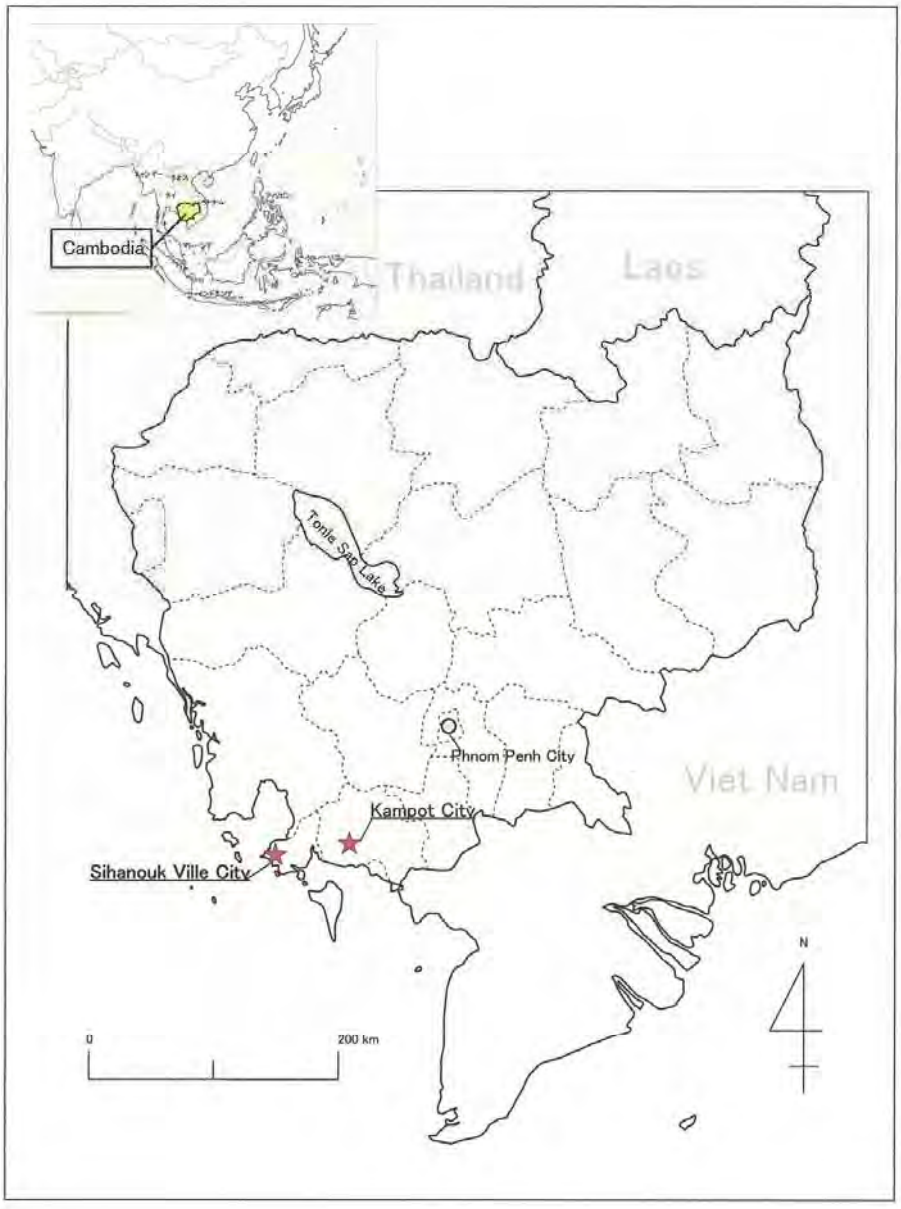
7) **Confirmation of Water Intake**

Both sides agreed that MIH would obtain the confirmation in writing from the Ministry of Water Resources and Meteorology (MOWRAM) that the Kampot Waterworks took the required water intake amount of $0.17m^3/s$ (= current water intake amount of $0.08m^3/s$ +

additional water intake amount of 0.09m^3/s) by the end of December 2014.

Annex- 1 Project Sites Map
Annex- 2 Components of the Project
Annex- 3 Estimated Cost borne by the Japanese and the Cambodian Side
Annex- 4 Estimated Operational and Maintenance Cost borne by the Cambodian Side
Annex- 5 Major Undertakings by the Cambodian Side
Annex- 6 New Organization Chart of Kampot Waterworks
Annex- 7 Monitoring Form (as an attachment of Record of Discussion) for Progress of the Construction Work
Annex- 8 Environmental Checklist
Annex- 9 Monitoring Form for Environmental and Social Considerations

Annex- 1 Project Sites Map



Annex- 2 Components of the Project

	By Japan Grant Aid	By Cambodia Side
1. Constructions		
(1) Water Intake Facilities	- Intake Facility:8,250 m^3/day - Intake Pumps	- Electricity Supply Line
(2) Raw Water Transmission Pipeline	- Intake to WTP (DIPφ400mm, L≒5.4km)	
(3) Water Treatment Plant	- Treatment Facility:7,500 m^3/day - Aerator - Rapid Mixing Basin - Flocculation Basin - Sedimentation Basin - Rapid Filtration Basin - Distribution Reservoir and Pumping Station - Elevated Tank - Transmission Pumps - Distribution Pumps, Large - Distribution Pumps, Small - Electrical Facilities, Chemical Feeding Facility - Generator for backup - Operation Building, Sludge Drying Bed (lagoon), Fence, Gate, Others	- Electricity Supply Line
(4) Treated Water Transmission Pipeline	- Inside Treatment Plant	
(5) Treated Water Transmission and Distribution Main	- WTP to Service Areas (L≒88.6km) (DIPφ400A L= 1,657m) (DIPφ350A L= 6,029m) (DIPφ300A L= 5,295m) (DIPφ250A L= 4,586m) (HDPEφ200A L= 7,673m) (HDPEφ150A L=18,221m) (HDPEφ100A L= 27,923m) (HDPEφ 50A L=17,258m) - Distribution Flow Monitoring System	
(6) Service Connections		- Service Connection(6,083 households from 2015 to 2021)
2. Procurements		
(1)Procurement of the Equipment	-Equipment for Water Quality Control (Jar tester, Distillation Apparatus, Turbidity Meter, Laboratory Table, Residual Chlorine Analyzer, Uninterruptible Power System (UPS), pH Meter (glass electrode), pH Meter (BTB), Potable Conductivity Meter (for Intake), Conductivity Meter (for Treatment Plant), Spectorophotometer, Reagents, Glassware) -Equipment for Mechanical Facilities (Vibration Checker) -Equipment and Materials for Service Connections to poor household (Socket Fusion Equipment, Materials and Equipment for Service Connections, 900sets)	
3. Soft Components		
(1)Technical assistance	- Operation and Maintenance of Water Treatment Facilities - Operation and Maintenance of Water Transmission and Distribution Facilities - Water Supply Facility Management	

Annex- 3 Estimated Cost borne by the Japanese and the Cambodian Side

Project Components by Japan Grant Aid

This part is closed due to confidentiality.

Project Components by Cambodia Government

Total Project Cost borne by Cambodia Government: approximately 783 Million Riel

Items	Contents	Estimated Cost	
		KHR (million)	Yen (million)
Land Preparation for WTP	Land for new water treatment plant should be leveled for the construction.	80.94	2.04
Investigation of Land Mines and UXO	Proposed intake and treatment plant sites and pipeline routes should be verified for land mines and UXO and cleared.	446.89	11.29
Environmental Consideration	Environmental Monitoring for Air, Water, Noise and Vibration (2018-2021)	30.53	0.77
Information System	Contracting process of network connection for the distribution information system	8.14	0.21
Electricity Supply	Transmission of electricity to the new intake station and new water treatment plant	81.64	2.06
Service Connections	Kampot Waterworks will install service connections for poor households	36.63	0.93
Bank Charge	Bank arrangement for the project	98.90	2.50
	Total	783.70	19.80

KHR (Cambodia Riel) 1 = 0.025yen

Annex- 4 Estimated Operational and Maintenance Cost borne by the Cambodian Side

Operation and Maintenance

Estimated annual O&M costs, depreciation and tax of Kampot Waterworks from 2018 to 2021

(Unit: 1,000 KHR)

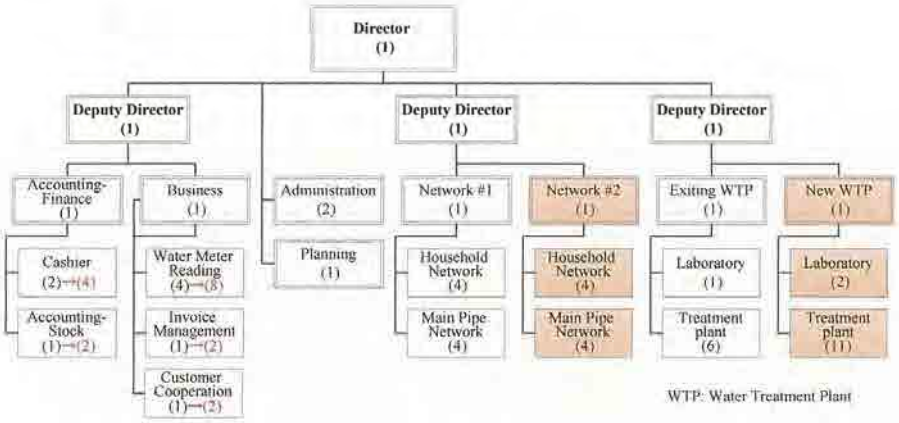
Item	Estimated Costs			
	2018	2019	2020	2021
Personal Expense	382,549	394,178	406,161	485,247
Chemical Cost	469,136	544,440	624,495	714,370
Power & Fuel Cost	1,320,914	1,500,584	1,721,126	1,969,727
Repair Cost	66,072	68,081	122,079	123,239
Administrative Cost	248,509	269,081	297,156	329,148
Depreciation	1,006,149	1,006,149	1,006,149	1,006,149
Tax	56,802	61,504	67,921	75,234
Total Expense	3,550,131	3,844,017	4,245,087	4,702,114

Annex- 5 Major Undertakings by the Cambodian Side

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	to secure a lot land necessary for the implementation of the Project and to clear the sites;		●
2	To ensure prompt unloading customs clearance of the products at port of disembarkation in the recipient country and to assist internal transportation of the products		
	1) Marine (Air) transportation of the Products from Japan to the recipient country	●	
	2) Internal transportation from the port of disembarkation to the project site	(●)	(●)
3	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the products and the services be exempted.		●
4	To accord Japanese physical persons of third countries whose services may be required in connection with the supply of the products and services such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
5	To ensure that the Facilities and the products be maintained and used properly and effectively for the implementation of the Project		●
6	To bear all the expenses, other than those covered by the Grant, necessary for the implementation of the Project		●
7	To bear the following commissions paid to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
8	To give due environmental and social consideration in the implementation of the Project.		●

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

Annex- 6 New Organization Chart of Kampot Waterworks



WTP: Water Treatment Plant

Annex- 7 Monitoring Form (as an attachment of Record of Discussion) for Progress of the Construction Work

Record of Discussions (DRAFT)

With reference to the Grant Agreement between the Japan International Cooperation Agency (hereinafter referred to as "JICA") and the Royal Government of Cambodia (hereinafter referred to as "RGC") dated < signing date of G/A > concerning the Japan's grant assistance for < title of the Project >, the representatives of JICA and of RGC wish to record the following:

1. With regard to the Article 10 (1) (f) and (2) of the said Grant Agreement, the representative of JICA stated that:

(a) RGC will submit to JICA annual progress reports on the construction work utilizing the materials and/or equipment procured under the said grant, for which RGC is responsible, by filling in the form attached hereto until all the construction work is completed; and

(b) RGC will submit to JICA a final report upon completion.

2. The representative of RGC stated that RGC has no objection to the statement by the representative of JICA referred to above.

Phnom Penh, Day Month 2015

IZAKI Hiroshi	**********
Chief Representative	**********
JICA Cambodia Office	Ministry of Economy and Finance
	(In principle, same signer as G/A)

[Progress / Completion] Report submitted on ○○○

1. Outline of the Project

(1) Name of Country: the Royal Government of Cambodia

(2) Name of the Project:

(3) Date of the Grant Agreement: ** ***** 2015

(4) Name of the Executing Organization: Ministry of Industry and Handicraft (hereinafter referred to as "MIH").

2. General Situation (how the equipment and/or materials procured under the Japan's Grant Assistance are used in general)

3. Detailed Explanation

equipment and/or materials;	How they are being used;	In case they haven't been used as planned	
		Reason for it; (Please specify the reason such as budgetary problems and problems in employing appropriate staffs etc.)	Measures to be taken to redress the situation;
Materials for Service Connections for Poor Households			

4. Progress of the Construction Work done by MIH

Project site	Current situation	In case the work is delayed		Planned completion date	Any other problems;
		Reason for delay;	Measures to be taken to redress the situation;		

5. Photos (please attach photos showing the progress of the construction work or the overall view of the facilities constructed by MIH.)

Annex- 8 Environmental Checklist

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) N (c) N (d) Y	(a)(b) The IEE report is being prepared (September, 2014) and is going to be approved by July, 2015. (c) No conditions added (d) The permission of 0.17m3/sec for the intake of water supply by appropriate government body is necessary.
	(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) Y (b) Y	(a) By holding the stakeholder meetings, adequate explanation was done and stakeholders agreed the project basically. (b) Comments (such as a request of announcement before water cut / questions of connection fee) were stated but none of them was critical.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternative plans were explained in the stakeholder meeting.
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) Y	(a) There is no possibility to cause air pollution. / For accident prevention, leakage monitoring system will be installed. (b) By utilising closed system (no emission to atmosphere), the chlorine concentrations comply with the standards.
	(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) Y	(a) The close system is adopted and even occasional effluent is designed to be clean after lagoon treatment.
	(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) Y	(a) The country's regulation allows to discharge sludge directly but a sludge lagoon will separate sludge and it will be dried, transferred and sold.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) The intake pump will be installed underground and little noise can be produced. The transmission pump will be installed in the WTP site being covered with RC walls and noise will not reach the boundary of the site.
	(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	(a) No groundwater will be exploited.
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) The project sites are all outside of protected areas. No adverse impacts are expected by the project.

	(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) N/A (d) N	(a) The sites were studied but no habitats were found. (b) The intake planned site has a few ecologically valuable trees but the construction does not affect them. (c) As above (d) The upstream dam will release more than intake flow and the amount will be maintained.
	(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) The upstream dam will release more than intake flow and the amount will be maintained.
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? (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?	(a) N (b) N/A (c) N/A (d) N/A (e) N/A (f) N/A (g) N/A (h) N/A (i) N/A (j) N/A	(a) No resettlement occurs (b) As above (c) As above (d) As above (e) As above (f) As above (g) As above (h) As above (i) As above (j) As above
4 Social Environment	(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) Y (b) N	(a) Construction activities can cause inconvenience to inhabitants but the countermeasures for impact minimization were agreed in the stakeholder meeting. (b) Positive impact such as prevention of ground water exploitation is possible, instead.
	(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) The sites are all within developed lands and no heritage exists there.

	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) Intake facility and WTP will locate out of sight from public places.
	(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) N (b) N/A	(a) No indigenous peoples inhabit in the site. No descrimination is recognized among the ethnic groups. (b) As above
	(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 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?	(a) Y (b) Y (c) Y (d) Y	(a) Labor Law, 1997, No. CS/RKM/0397/01 will be complied with. (b) Law as above stipulates safety considerations (c) Adequate program will be held by consultation with the Department of Labor / Health (d) As above
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/A (c) Y (d) Y	(a) Any possible impacts are considered and mitigations are suggested in the EMP (b) The sites were studied but no habitats were found. (c) Construction activities can cause inconvenience to inhabitants and the countermeasures for impact minimization were agreed in the stakeholder meeting. (d) Every construction site can be avoided by bypassing.
5 Others	(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) Y (c) Y (d) Y	(a) The monitoring plan was prepared according to the EMP. (b) The monitoring contents were consulted with the environmental authority. (c) The monitoring plan includes such components. (d) As above
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) N/A	(a) No dams are included as project components and No impacts to the river are expected.
	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) N/A	(a) The project does not have possibility of significant adverse impacts on environment.

Annex- 9 Monitoring Form for Environmental and Social Considerations

(1) Monitoring Results of Noise / Vibration

Table M-1-1 Results (Noise)

Item: Noise

Unit: dB(A)

No.	Date	Measured Value						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Pre-Construction Phase (Baseline)								
1								
2								
Construction Phase								
1								
2								
3								
4								
5								

Table M-1-2 Results (Vibration)

Item: Noise

Unit: dB(A)

No.	Date	Measured Value						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Pre-Construction Phase (Baseline)								
1								
2								
Construction Phase								
1								

2								
3								
4								
5								

Table M-1-3 Station

Measured Station	Adopted Standard*)	Detailed location
St.1		
St.2		
St.3		
St.4		
St.5		

***) Refer to Table M-1-3**

Table M-1-4 National Standard Values for Noise (Cambodia)

Type of Area	Standard Value in dB(A)		
	6.00-18.00	18.00-22.00	22.00-6.00
Quiet Areas (Hospital, Library, School, Kindergarten)	45	40	35
Residential Areas (Hotel, Administrative Office, Villa, Flat)	60	50	45
Commercial and Service Areas and Area of multiple businesses	70	65	50
Small industrial factories mingling in residential area	75	70	50

Table M-1-5 National Standard Values for Vibration (Cambodia)

Standard (Leq) Value in dB(A)		
6.00-18.00	18.00-22.00	22.00-6.00
65	60	60

(2) Monitoring Results of Dust Pollution

Table M-2-1 Results **Item: Dust** **Mark: "✔" if Watering is done**

No.	Date	Watering Result						
		Intake site	WTP site	Pipeline site				
				St.1	St.2	St.3	St.4	St.5
Construction Phase -1st Year								
1								
2								
3								
4								
Construction Phase -2nd Year								
1								
2								
3								
4								
Construction Phase -3rd Year								
1								
2								
3								
4								

Table M-2-2 Station

Observed Station	Detailed location	Remark
St.1		
St.2		
St.3		
St.4		
St.5		

(3) Monitoring Results of Waste Management

Table M-3-1 Result as of (Date:_____) **Item: Waste Management** **Mark: "✔" if management is good**

Station	Location	Kind of Waste	Whole amount (m^3)	Receiving Dumping Site	Situation of General Waste Management / Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year No. (1 / 2)					
Intake					
WTP					
St. 01					
St. 02					
St. 03					
St. 04					
St. 05					

Table M-3-2 Result as of (Date:_____) **Item: Placement of Dust Bins** **Mark: "✔" if management is good**

Station	Placement of Dust Bins	Situation of General Waste Management	Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year ; No. (1 / 2)			
In and around the Worker Camps			
Camp-01			
Camp-02			
Camp-03			
Camp-04			
Camp-05			

(4) Monitoring Results of Safety Management

Table M-4 Result as of (Date:_____) **Item: Safety Management** **Mark: "✔" if management is good**

Station	Location	Description of Incident (Injury, Accident and so on)	Situation of Fencing and Other Safety Management / Remark
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year ; No. (1 / 2)			
Intake			
WTP			
St. 01			
St. 02			
St. 03			
St. 04			
St. 05			

(5) Monitoring Results of Sanitary Management

Table M-5-1 Result as of (Date:_____) **Item: Sanitary Management** **Mark: "✔" if the item is well conducted**

Interviewee	Items indicated by Sanitary Program				
	i)	ii)	iii)	iv)	Remark (detailed location)
Construction Phase - □ 1st Year / □ 2nd Year / □ 3rd Year No. (1 / 2)					
In and around the Worker Camps					
Camp-01					
Camp-02					
Camp-03					
Camp-04					
Camp-05					
In and around the Construction Sites					
Intake-1					
Intake-2					
Intake-3					
WTP-1					
WTP -2					

WTP -3					
St.1-1					
St.1-2					
St.1-3					
St.2-1					
St.2-2					
St.2-3					
St.3-1					
St.3-2					
St.3-3					
St.4-1					
St.4-2					
St.4-3					
St.5-1					
St.5-2					
St.5-3					

PREPARATORY SURVEY
FOR
THE PROJECT FOR
EXPANSION AND IMPROVEMENT OF
WATER SUPPLY SYSTEM
IN KAMPOT AND SIHANOUK VILLE
IN
THE KINGDOM OF CAMBODIA

SOFT COMPONENT PLAN
(TECHNICAL ASSISTANCE PLAN)

MARCH 2015

1. CAPACITY BUILDING FOR KAMPOT WATERWORKS

1-1. Background

This project is to expand the water service in Kampot City which is one of the important development areas along the coast in Cambodia. The Government of the Kingdom of Cambodia (GOC) constructed the existing water treatment plant which has a capacity of 5,760 m^3/day, using an Asia Development Bank (ADB) loan. This water treatment plant does not have sufficient production capacity, leaving Kampot City with only 47% access to safe water.

The GOC made an official request to the Government of Japan (GOJ) under the Japanese Grant Aid scheme, for "The Kampot Province Water Supply Expansion Project in the Kingdom of Cambodia", aiming to supply safe water to approximately 2.3 times more customers. The operational and management staff of the Kampot Waterworks will have to acquire new capabilities to operate, maintain and manage the expanded facilities and provide service to a broader customer base.

1-2. Existing Management Framework and Technical Level at Kampot Waterworks

(1) Management Framework

Kampot Waterworks of the Department of Potable Water Supply (DPWS), under the Ministry of Industry and Handicraft (MIH), is responsible for water supply in Kampot. Current staff assignment at Kampot Waterworks is described in **Table 1-1**.

Table 1-1 Current Staff Assignment of Kampot Waterworks

Department	Area of Responsibility	Number of Staff
Accounting-Finance	Tariff Collection, Accounting, Stock Management	4
Business	Meter Reading, Billing, Customer Management	7
Administration & Planning	Administration	3
Networks	Water Supply Pipes, Distribution Mains	9
Technical	O&M of Water Treatment Plant, Water Quality Management	8

(2) Technical Level

Japan International Cooperation Agency (JICA) conducted capacity building for water supply systems in Cambodia (TA Phase 2) from 2007 to 2012 in eight targeted provincial waterworks, including Kampot Waterworks. The training covered the following areas:

- Water quality analysis
- Maintenance of intake and water treatment facility

- Pipe construction method
- Distribution expansion plan
- Distribution network and maintenance

Standard Operation Procedures (SOPs) were prepared as at the end of the training. The skill level of the staff at the waterworks increased dramatically. It was concluded that "Due to the considerable increase in the capability of the water service personnel, which had been exceedingly limited, it has become possible to provide a safe and stable water supply in the Targeted Provincial Waterworks (TPWs)". The TPWs have the basic skills required to operate their respective water treatment plants.

(3) Current Technical Assistance to Kampot Waterworks

TA Phase 3 was initiated in 2013 to provide training on financial soundness, rehabilitation plan formulation, and human resources development. TA Phase 3 training would provide Kampot Waterworks with the basic ability to operate autonomously as a public utility similar to the Phnom Penh Water Supply Authority.

1-3. Specific Training Needs at Kampot Waterworks

In coordination with the training under TA Phase 3, Kampot Waterworks staff would need to acquire the technical know-how to operate the new facilities as well as manage the efficient and integrated operation of the old and new facilities as one system.

(1) Overall Challenges

Kampot Waterworks will serve 2.3 times more customers as a result of the expansion of the facilities. Kampot Waterworks would need to upgrade its management plan and Operation and Maintenance (O&M) procedures for running the expanded system. It is critical that its staff be able to undertake the following priority tasks.

i) Management Planning

- To plan for the management of the integrated operation of the new and old facilities.

ii) O&M Planning

- To allocate staff for the new facilities which include intermediate chlorine injection (for manganese treatment), backwash, chlorine safety system and VVVF systems for pumps.

- To develop an integrated O&M plan for the new and old facilities.
- To deal with the increase in customer connections.

iii) O&M Activities

- To establish the O&M procedures for new systems such as intermediate chlorine injection (Mn treatment), backwash, chlorine safety system and VVVF systems for pumps.

iv) Human Resources Management Planning

- To have the appropriate staff complement for the integrated operation and maintenance of the expanded facility.

v) Long-term Management Planning for System Rehabilitation

- To set tariffs with appropriate depreciation to facilitate future expansion.

(2) Approach to Develop the Required Capabilities

Kampot Waterworks does not have the human resources required to undertake the above tasks. The MIH has limited resources to provide the necessary assistance. TA Phase 3 would help develop the required administrative management capabilities. Technical know-how such as the operating procedures and settings for machinery would be obtained from the contractors, directly under the expansion project.

(3) Capacity Building for Each Priority Task

i) Management Planning

- Covered by this SOFT COMPONENT PLAN

ii) O&M Planning

- To formulate the management plan for the integrated facilities (with the assistance under TA Phase 3).
- Technical Assistance component of the expansion project would provide the assistance in the analysis of the work volume of each employee, work allocation and proposal to change work allocation. Technical Assistance also covers the planning required to promote more customer connections.

iii) O&M Activities

- The contractor and consultants engaged for technical instructions and the Technical

Assistance would provide instructions on O&M activities, with particular focus on the formulation and revision of Standard Operational Procedures (SOPs).

iv) Human Resources Management Planning

- The plan to increase the number of staff is covered in the main report under the outline design of the project.

v) Long-term Management Planning for System Rehabilitation

- The Technical Assistance component would help Kampot Waterworks staff set future tariffs with appropriate depreciation and revenue to meet future demand for expansion. Assistance for long-term management planning will be implemented by TA Phase 3. The consultants engaged for the Technical Assistance component would help with developing the information on costs and revenue.

1-4. Necessity for Technical Assistance in Capacity Building

Kampot Waterworks staff do not have adequate capability to operate and manage the expanded water supply system and develop the SOPs for the new facilities.

1-5. Components of Technical Assistance

Technical Assistance would be delivered in the following 3 areas.

(1) Operation and maintenance of water treatment facilities

This would cover intake facilities, water treatment plant and transmission facilities. The training also includes appropriate chemical dosing, backwash and chlorine leakage alarm and neutralization equipment.

(2) Operation and maintenance of water transmission and distribution facilities

Distribution block management would be introduced. Staff would be trained on distribution flow control, water leakage management and accident response. The training would also include flow management and leakage control under block distribution used in the new system.

(3) Production management (Water supply facility management)

This covers the training on unit cost calculation, stock management, promotion of water connection, follow-up of SOP, and management of equipment provision.

2. OBJECTIVE OF CAPACITY BUILDING

Kampot Waterworks staff would acquire the capability to operate and maintain the expanded facilities to provide customers with safe water, which meets water quality standards.

3. CAPACITY BUILDING OUTCOMES

Kampot Waterworks staff would acquire the following capabilities in the 3 main areas of responsibility in the water supply system:

(1) Operation and maintenance of water treatment facilities

1) Improved capability to treat water.
2) Improved capability to operate and maintain mechanical and electrical equipment.
3) Improved capability to analyze water quality.

(2) Operation and maintenance of water transmission and distribution facilities

1) Improved capability to operate distribution pumps.
2) Improved capability to operate the flow monitoring system.

(3) Production management (water supply facility management)

1) Improved capability to operate and maintain water treatment facilities.
2) Proper management of equipment provision.
3) Continuous increase in customer connections.

4. EVALUATION OF CAPACITY BUILDING OUTCOMES

It is important to determine if the training has provided the necessary improvement in staff capabilities. **Table 4-1** shows the process for assessing the successful delivery of this training component.

Table 4-1 Evaluation of Training Outcomes

Area of Responsibility	Outcome	Indicator	Output/Deliverable
Operation and Maintenance of Water Treatment Facilities	Improved capability to treat water	1. SOP review completed. 2. Daily recording of operational activities in the prescribed format. 3. Ability to accurately determine the optimal dosing volume of chemicals according to the raw water quality. 4. Meeting the target set for turbidity of the settled water. 5. Meeting the target set for residual chlorine in the treated water. 6. Appropriate control of the filter washing process. 7. Appropriate control of the sludge treatment process.	1. Relevant SOPs 2. Daily operation record 3. Chemical dosing record 4. Settled water turbidity record 5. Treated water residual chlorine record 6. Filter washing record 7. Sludge treatment record
	Improved capability to operate and maintain mechanical and electrical equipment	1. SOP review completed . 2. Conducting regular checks of mechanical and electrical equipment based on SOPs. 3. Record book based on SOPs prepared. 4. Channel of communication with relevant manufactures established to ensure immediate contact can be made in case of breakdowns.	1. Relevant SOPs 2. Record of daily routine maintenance 3. Record of routine maintenance 4. Manufactures' contact list and check list in the event of breakdowns.
	Improved capability to analyze water quality	1. SOP review completed. 2. Ability to analyze water quality based on SOPs. 3. Parameters for water quality analysis analyzed and recorded at the frequency designated in the SOPs. 4. Result of water quality analysis submitted to the MIH based on SOPs.	1. Relevant SOPs 2. Record of water quality analysis 3. Record of water quality analysis 4. Annual report of water quality analysis
Operation and Maintenance of Water Transmission and Distribution Facilities	Improved capability to operate the distribution pump	1. SOP review completed. 2. Record of distribution flow and pressure data prepared daily in the prescribed format. 3. Distribution flow data analyzed based on SOPs. 4. Ability to operate accident preventing valves based on SOPs.	1. Relevant SOPs 2. Record of distributed flow and pressure 3. Report of analysis 4. Report of valve operation
	Improved capability to operate the flow monitoring system	1. SOP review completed. 2. Ability to operate the system based on SOPs. 3. Record of maintenance prepared. 4. Channel of communication with relevant manufactures established.	1. Relevant SOPs 2. Record of distributed flow data 3. Record of maintenance 4. Manufactures' contact list
Production Management (Water Supply Facility Management)	Improved capability to operate and maintain water treatment facilities	1. SOP review completed. 2. Ability to calculate unit cost based on SOPs. 3. Efficient control of the inventory of chemicals and consumable items. 4. Appropriate management of equipment provision. 5. Increased number of customer connections.	1. Relevant SOPs 2. Unit cost calculation sheet 3. Stock management list 4. Equipment management list 5. Number of water connections 6. Operational Plan (such as sludge treatment plan)

Area of Responsibility	Outcome	Indicator	Output/Deliverable
		6. Management of all activities based on SOPs.	
	Public Campaign	1. Implementation of promotion activities to increase customer. 2. Implementation of water saving activities. 3. Implementation of water source preservation activities.	1. Report on promotion activities 2. Report on water saving activities 3. Report on water source preservation activities

5. TRAINING ACTIVITIES

The training for operation and maintenance of the water treatment facilities will be mainly conducted for the staff in charge of water treatment. The training for operation and maintenance of water transmission and distribution facilities will be mainly conducted for the staff in charge of distribution management. The training for production management will be conducted for the director and deputy director of TPWs and chiefs with the authority to administer the operation of treatment plant.

The training will be carried out at the new WTP in Battambang and Kampong Cham, to be completed in the near future by JICA Grant Aid. The training personnel required and the assigned tasks are as follows.

(1) Japanese consultants, responsible for

- general overview of each training module
- overall management of the training course
- SOPs
- preparation of training materials
- training evaluation
- support for the local consultants
- training components which require advanced expertise

(2) Local consultants, responsible for

- providing relevant experience in Cambodia
- on-site training
- preparation of training materials in Khmer

(3) Local assistants, responsible for

- arranging documents
- preparing materials in Khmer
- coordination with C/P

Locations for training are as follows.

(1) Operation and maintenance of water treatment facilities

1st step: Battambang or Kampong Cham province (dry season)

2nd step: Kampot province (rainy season)

(2) Operation and maintenance of water transmission and distribution facilities

1st step: Battambang or Kampong Cham province (dry season)

2nd step: Kampot province (rainy season)

(3) Production management (Water supply facility management)

Kampot province (any season)

The training plan is shown in **Table 5-1.**

Table 5-1 Training Plan

Area of Responsibility	Outcomes	Training Contents	Input
Operation and maintenance of water treatment facilities	Improved capability to treat water is	1. Preparation of SOPs 2. Setting up record keeping format 3. Proper chemical dosing 4. Turbidity measurement 5. Residual Chlorine measurement 6. Filtration washing process 7. Revision of the SOPs	Japanese consultants (The 1st step) Water treatment: 0.967M/M (The 2nd step) Water treatment: 1.233M/M Water quality: 0.867M/M Local consultants (The 1st step) Water treatment: 0.767M/M (The 2nd step) Water treatment: 1.233M/M Water quality: 0.767M/M Local assistants (The 1st step) 1.267M/M (The 2nd step) 1.733M/M
	Improved capability to operate and maintain mechanical and electrical equipment	1. Preparation of SOPs 2. Operation of mechanical and electrical equipment 3. Setting up the record keeping format 4. Preparing the contact list of manufactures	
	Improved capability to analyze the water quality	1. Preparation of SOPs 2. Water quality analysis 3. Setting up the record keeping format	
Operation and maintenance of water transmission and distribution facilities	Improved capability to operate the distribution pump	1. Preparation of SOPs 2. Setting up the distribution record 3. Data analysis 4. Response to accident 5. Operation of distribution pump	Japanese consultants (The 1st step) 0.633M/M (The 2nd step) 0.767M/M Local consultants (The 1st step) 0.533M/M (The 2nd step) 0.767M/M Local assistants (The 1st step) 1.033M/M (The 2nd step) 1.767M/M
	Improved capability to operate the flow monitoring system	1. Preparation of SOPs 2. Setting up the record keeping format 3. Preparation of the operation manual	
Production management (Water supply facility management)	Improved capability to operate and maintain water treatment facilities	1. Preparation of SOPs 2. Unit cost calculation 3. Stock management 4. Sludge treatment plan 5. Management of all SOPs	Japanese consultants (The 2nd step) 1.333M/M Local assistants (The 2nd step) 1.733M/M
	Public campaign	1. Promotion activities 2. Water saving activities 3. Water source preservation activities	

The manning schedule is shown in **Figure 5-1**.

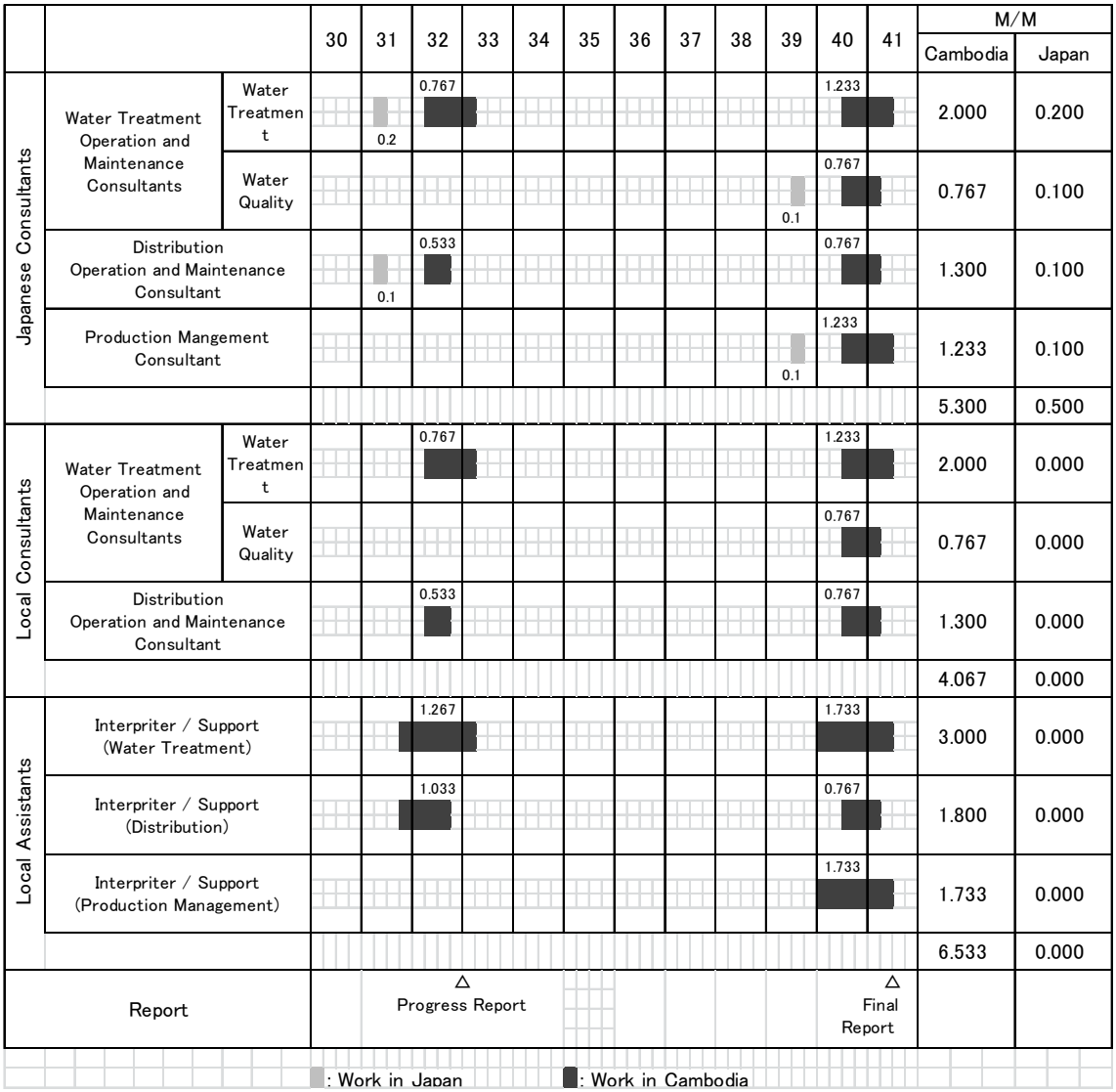


Figure 5-1 Manning Schedule

6. RESOURCES REQUIRED TO DELIVER THE TRAINING

Four Japanese experts will be dispatched. The staff at the Phnom Penh Water Supply Authority (PPWSA), Battambang and Kampong Cham will be utilized as the local consultants. They work with direct pump supply and flow monitoring at the Phum Prek water treatment plant and have the skill required to operate the new facilities.

(1) Japanese consultants

The officials in regional governments in Japan are knowledgeable in water utility management and plant operation. The man months (M/M) required from the experts in each operational

specialty are as follows.

1) Operation and maintenance of water treatment facilities

1st step:	0.967M/M (water treatment)
2nd step:	1.233M/M (water treatment)
	0.867M/M (water quality)

2) Operation and maintenance of water transmission and distribution facilities

1st step:	0.633M/M
2nd step:	0.767M/M

3) Production management (Water supply facility management)

2nd step:	1.333M/M

(2) Local consultants

1) Operation and maintenance of water treatment facilities

1st step:	0.767M/M (water treatment) from BTB or KMC
2nd step:	1.233M/M (water treatment) from BTB or KMC
	0.767M/M (water quality) from PPWSA

2) Operation and maintenance of water transmission and distribution facilities

1st step:	0.533M/M (water treatment) from PPWSA
2nd step:	0.767M/M (water treatment) from PPWSA

7. IMPLEMENTATION SCHEDULE

The implementation schedule is shown in **Figure 7-1**.

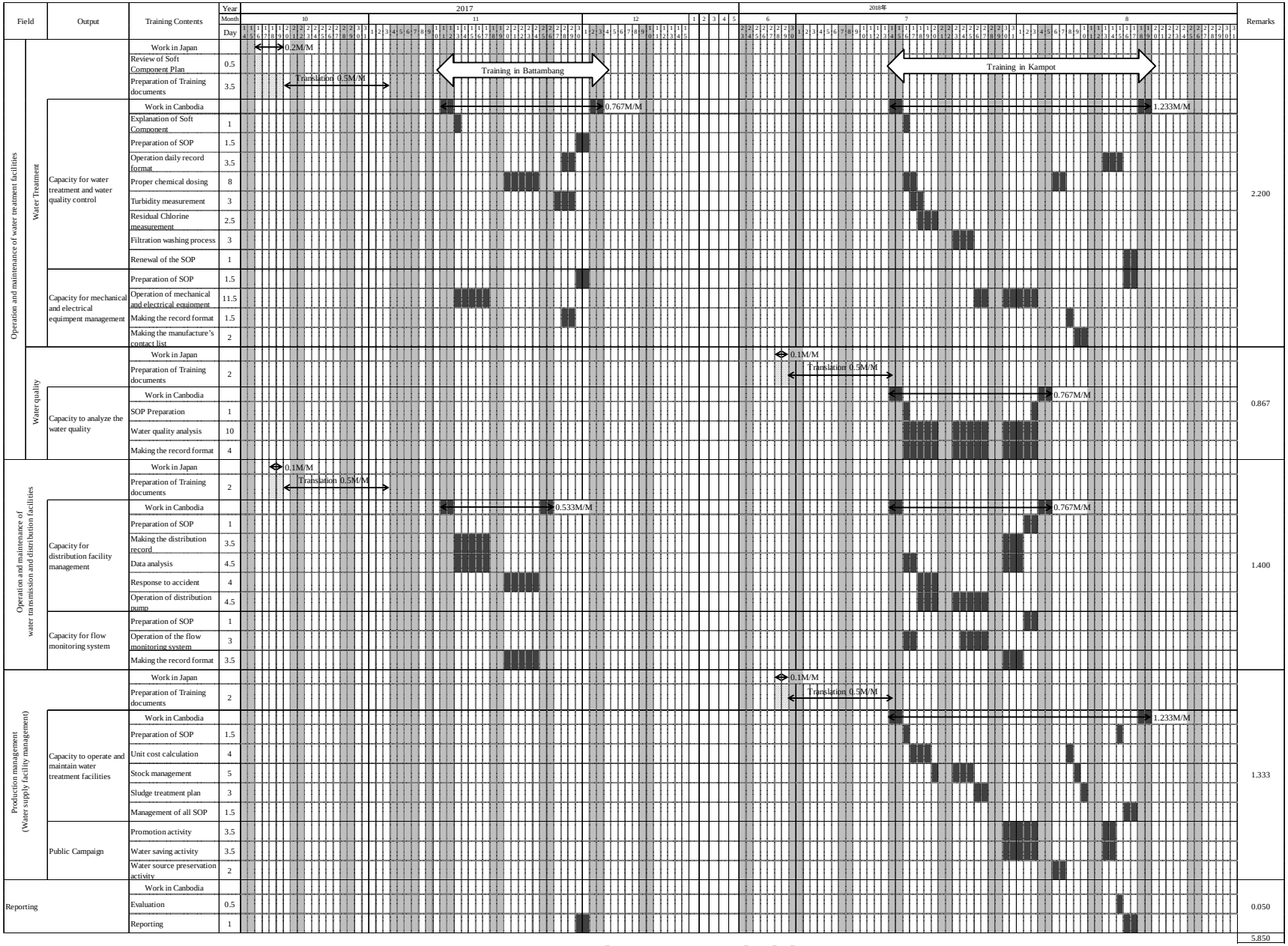


Figure 7-1 Implementation Schedule

8. DELIVERABLE

The deliverables are summarized in **Table 8-1**.

Table 8-1 Deliverables

Schedule for Submission	Deliverables
In the middle of the project	Progress Report Training documents Others
At the end of the project	Final report Training documents Various SOPs as needed Various record formats as needed (Operation record) Achievement and Evaluation (mini-exam)

The report on capacity building will be prepared based on the Soft Component Guide Line (the third edition).

9. EXPENSE FOR CAPACITY BUILDING

Table 9-1 Expense for Capacity Building

Items	JPY (x1,000)	RIEL		USD		Total JPY (x1,000)
		RIEL	JPY (x1,000)	USD	JPY (x1,000)	
Direct Labor Cost	4,756					4,756
Direct Expense	3,797			49,926	5,135	8,933
Overhead	6,087					6,087
Total	14,641			49,926	5,135	19,776

10. RESPONSINBILITY OF RECIPIENT COUNTRY

(1) Responsibility of Recipient Country

The Cambodian side needs to secure and deploy enough personnel by the end of June 2017, one year before the completion of the construction of the facilities.

If the deployment of the addition personnel cannot be achieved, the training will be implemented for the existing staff that will operate and maintain the new plant.

OJT should be carried out at the new facilities which will be completed 2 months before operation is scheduled to begin. It is important to ensure that there is no delay in the construction schedule.

(2) Coordination with TA Phase 3

The capacity building under the Technical Assistance component of the expansion project focuses on training Kampot Waterworks staff for the operation and management of the expanded facilities. This effort would be coordinated with the TA Phase 3 being carried out by JICA from November 2012 to November 2017.

Appendix -6 Other Relevant Data (List of Collected Data)

No.	Name	Figure Book・Video Map・photo etc	Original ・Copy	Issuing institution	The date of issue
1	Overview on Urban Water Supply Sector in the Kingdom of Cambodia	Book	Original	MIME	2012
2	Extension of Water Supply and Sanitation in Kampot Downtown Project of UN-HABITAT, Community-based Water Suply and Sanitation Project, Output Under the Cooperation Agreement between UN-HABITAT and Kampot Water Supply Utility, Report on Development, Trial and Establishment of “Revolving Fund” Mechanism for Water Supply and Cost Sharing Modalities a Agreed with Community	Book	Copy	UN-HABITAT	2010
3	Reports from Database of Poor Households, Identification of Poor Households Program	CD-R	Original	Ministry of Planning	2012
4	The Study on National Integrated Strategy of Coastal Area and Master Plan of Sihanouk Ville for Sustainable Development	Book (PDF)	Copy	JICA	2010
5	Rainfall Records 2004-2014 (Kampot)	Soft Copy (Excel)	Copy	MOWRAM	2004-2014
6	Rainfall Records 2004-2014 (Sihanouk Ville)	Soft Copy (Excel)	Copy	DOWRAM	2004-2014
7	Records of Water Intake Amount from Existing Intake Station 2013-2014 (Kampot)	Hard Copy	Copy	Kampot Waterworks	2013-2014
8	Water Level Data at Existing Intake Station 2012-2014 (Kampot)	Hard Copy	Copy	Kampot Waterworks	2012-2014
9	Water Quality Records 2010-2013 (Kampot)	Soft Copy (Excel)	Copy	Kampot Waterworks	2010-2013
10	Water Quality Records 2010-2014 (Sihanouk Ville)	Soft Copy (Excel)	Copy	Sihanouk Ville Waterworks	2010-2014
11	Hydrological Data on Prek Tup Lake 2009-2014 (Water Intake Amount and Water Level)	Soft Copy (Excel)	Copy	Sihanouk Ville Waterworks	2009-2014
12	Water Supply Records 2010-2013 (Sihanouk Ville)	Hard Copy	Copy	Sihanouk Ville Waterworks	2010-2013
13	Topographic Map Data	Soft Copy (GIS)	Copy	JICA Cambodia Office	1999
14	Layout Drawing on Existing Distribution Pipeline	Soft Copy (CAD)	Copy	Kampot Waterworks	2014
15	Survey Map on Existing Distribution Pipeline	Soft Copy (CAD)	Copy	Kampot Waterworks	2014
16	Population Data 2012 (Kampot)	Soft Copy (Excel)	Copy	Kampot Waterworks	2013
17	Population Data 2013 (Kampot)	Soft Copy (Excel)	Copy	Kampot Waterworks	2014
18	Existing Facility Drawings	Book	Copy	Kampot Waterworks	2002
19	Population Data 2007-2013 (Sihanouk Ville)	Soft Copy (Excel)	Copy	Sihanouk Ville Waterworks	2008-2014