PHNOM PENH WATER SUPPLY AUTHORITY (PPWSA)
KINGDOM OF CAMBODIA

THE DATA COLLECTION SURVEY ON WATER SUPPLY SECTOR IN PHNOM PENH CAPITAL CITY

JANUARY 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NIHON SUIDO CONSULTANTS CO., LTD.
WATER AND SEWER BUREAU, CITY OF KITAKYUSHU
CROWN AGENTS JAPAN LTD.
KOEI RESEARCH & CONSULTING INC.

CM
CR(3)
18-001

Exchange Rate（November, 2017）

USD 1.00 ＝ JPY 111.45

USD 1.00 ＝ KHR 4,035

SUMMARY

S.1 Survey Tasks

The main tasks of this survey include the following:

1) Review existing conditions of water supply system in Phnom Penh and Ta Khmau District

- Review the Third Master Plan 2016-2030
- Review existing conditions and future development plan for water supply in Phnom Penh
- Prepare recommendations on cooperation in project implementation

2) Project for Grant -PPP Scheme - “the Project of Construction of Water Treatment System in Ta Khmau District (tentative title)”

- Collect data on the water supply system in Ta Khmau District
- Study applicability of Public Private Partnership (PPP)
- Study types of private sector partnerships (PSP)
- Review legal implications for PPP
- Review environmental and social impacts

3) Japanese loan project of “the Project for Construction of Water Treatment Plant in Bakheng I & II (tentative title)”

- Confirm necessity of the project
- Confirm project scope
- Review environmental and social impacts

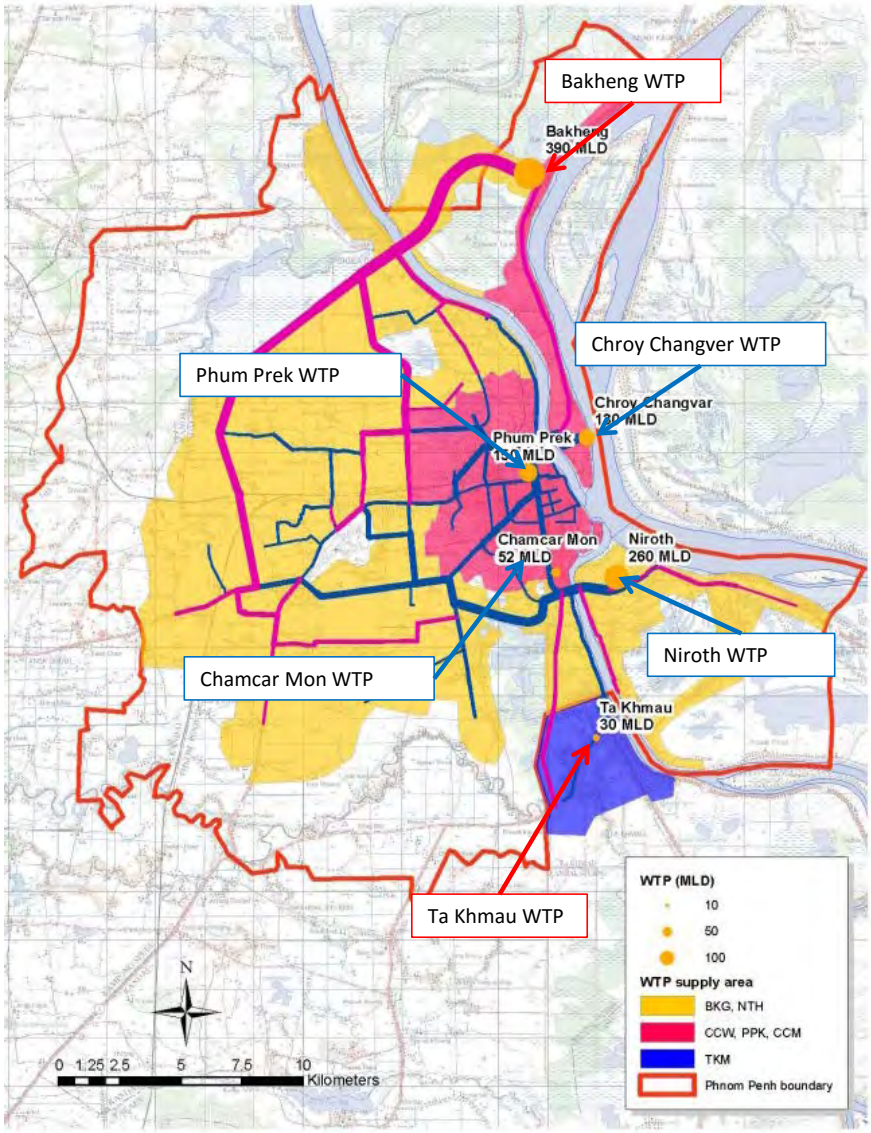
S.2 Current Situation and Third Master Plan for Water Supply in Phnom Penh

Government of Japan (GOJ) and other donors have been supporting the construction and rehabilitation of water supply facilities and capacity building for operation and maintenance in Phnom Penh and other major cities. Government of France (GOF) assisted with the preparation of the water supply master plan - Period of 2016 - 2030 (Third Master Plan 2016-2030), which proposes multi-phased implementation of new facilities (treatment plants and distribution network) as shown in **Figure S.1**.

Surface water resources to the west of the city are limited and not stable. The available water sources are the Mekong, Sap and Bassac rivers east of Phnom Penh. Treatment plants are located in the east. It will therefore be necessary to transmit treated water from the east to the west where demand is growing and distribution pressure is low. The distribution network will need to be improved and expanded.

About 200 km of distribution pipelines will need to be installed every year by 2025 and more than 100 km of pipelines every year from 2026 to 2030. Before the Bakheng WTP comes into

operation in 2025, a lack of water pressure in the western fringe of Phnom Penh would continue. A looping pipeline system is proposed to improve water supply conditions.



Source: Third Master Plan 2016-2030

Figure S.1 Water Supply System in 2030

The Third Master Plan projects the water demand in Phnom Penh will reach about 1.1 million m^3/day by 2030, and proposes the following 4 projects to increase water supply capacity:

(1) Expansion of Chamcar Mon WTP

This is underway with French assistance, to be completed in February 2019. This project is not within the scope of Japanese assistance.

(2) Construction of Ta Khmau WTP

The Third Master Plan proposes to construct the Ta Khmau WTP using Japanese aid. This project is characterized by a high ratio of low income population, originally no PPWSA service,

limited space for construction, and deterioration of raw water quality. It is appropriate to utilize Japanese grant aid for this project because of these challenges.

(3) Construction of Bakheng WTP

The total loan is very large for this project and may require co-funding from Japan and France, similar to the Niroth WTP project. The discussion to finance WTP construction using French loan and selection of consultant has taken place. Japanese loan for intake and distribution facilities should also be considered since Japanese technology has advantages in the following fields:

- High-efficiency pumps: intake pumps made in Japan are used by PPWSA.
- Trenchless technologies: road and Sap River crossings and installation of transmission mains in the city centre, can take advantage of Japanese leading-edge technologies, especially with soft soil conditions.

(4) Rehabilitation of Phum Prek WTP

The Phum Prek WTP was expanded using Japanese Grant Aid and the survey on improving efficiency of WTPs was implemented by the Japanese side from 2014 to 2015. It is logical to use the cooperation scheme of JICA for the rehabilitation of the WTP.

Income and expenditures of PPWSA from 2012 to 2016 continuously secures stable revenue. Although major overhaul of water tariff has not been undertaken, cost reduction was conducted and PPWSA is efficiently managed. It gains enough revenues against expenditure. Regarding financial indicators of PPWSA, Return on Assets (ROA), which shows profitability on assets, is more than 3%. Although this is not high, it is valid earnings ratio as a water-supply corporation. Although the Current Ratio, which shows financial liquidity, greatly decreased in 2016, it is more than 300% remaining high liquidity. Furthermore, Capital Ratio, which shows management stability, is more than 60%, so it is stable. As mentioned above, the current PPWSA performs well financially in general. However, if it does not increase the water tariff in the future, financial situation will become exacerbated with future water facility development.

S.3 Construction of Water Treatment Plant System in Ta Khmau District

S.3.1 Confirmation and Analysis on Concerned Laws and Regulations

Ta Khmau District has been receiving water from PPWSA since 2004. PPWSA subsidizes connections for low income households. PPWSA has to construct a new WTP to deal with the increase in demand in Phnom Penh and to have sufficient capacity to supply water to Ta Khmau District in the future. The use of Japanese Grant Aid can reduce PWWSA’s financial burden for these investments. At the same time, the cooperation will make use of Japanese

know-how and experience in building compact treatment facilities and dealing with deteriorating raw water quality.

S.3.2 Potential project scheme

Since the introduction of the SDGs (Sustainable development target) adopted by the United Nations in October 2015, the ODA trend which can be seen is that ODA is used as a catalyst to promote private investment.

Cambodia has a shortage of infrastructure compared to other Asian countries, Royal Government of Cambodia has been taking steps to improve the investment climate and levels of investment in infrastructure. Comprehensive sector development plans for infrastructure have been prepared, however, most funding for infrastructure is sourced from user fees for services provided by state-owned enterprises and through public sector borrowing on a concessional basis.

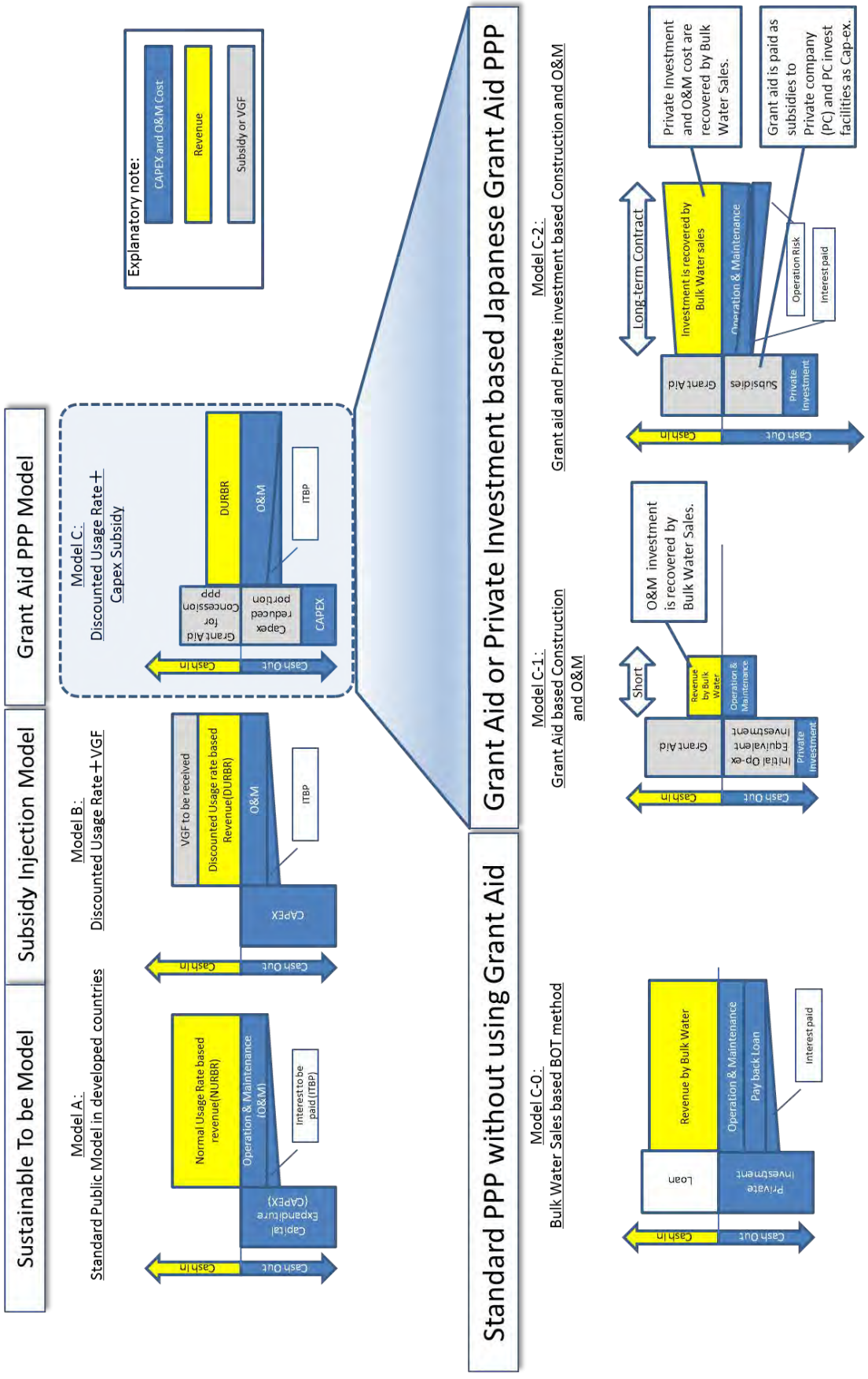
PPP provides a means to improve efficiency and service delivery to users and gain access to new expertise and technology reducing, reducing annual costs of infrastructure to the government, and freeing up the fiscal space. And as a result, the PPP introduction will bring about not only additional sources of funding from private sector and financial institutions which complement traditional sources, but also modern technology and innovation to increase the effectiveness of public service provisions as well as the economy’s competitiveness.

Japanese Grant Aid applicable for Concession project can be used in response to the intention of promoting the infrastructure PPP business in Cambodia.

The Japanese Government will provide the necessary funds for the facilities, equipment and other services necessary for the business, if the financing for the infrastructure business is not sufficient with commercial capital. The funds are paid from the recipient government to the special purpose company (SPC) through the project supervision by JICA.

This research work studied business scopes and business models applicable to this project.

Our conclusion is that Model C-1: Grant Aid based BTO model is the most feasible business model, using the Grant aid money in BTO styled project. (See **Figure S.2**)



Source: JICA Survey Team

Figure S.2 Comparison of Business Models

S.3.3 Financial Analysis of Suggested Project Scheme

Cash flow analysis was conducted based on the following assumptions. The construction period is from 2019 to 2021, and the operation period is from 2022 to 2051 (Operation period of Model C: 2022-2031). The inflation rate during project was 3%[1]. The amount of water production of the new WTP for financial analysis is assumed that it starts from 18,000 m^3/day in 2022 to 30,000 m^3/day in 2037. Non-Revenue Water Rate is 10% based on the Master Plan (revised version in 2017). Results of financial analysis are shown below.

(1) Model A：Sustainable TO-BE Model

The average water tariff is calculated to implement the project (including construction and O&M costs of new Ta Khmau WTP) by self-funding. As a result, since the average water tariff of Model A, which makes FIRR 10%, is 3,567 (KHR/m^3) and the above water tariff is more than thrice of that in 2016 (1,029 KHR/m^3), the tariff in Model A is difficult to apply. Thus, implementing this project by Model A is impossible.

(2) Model B: PPWSA Operation with cash injection from PPWSA

In Model B, in case PPWSA keeps the existing water tariff level with the same conditions of Model A regarding construction, O&M costs and tax, the required amount of cash injection from PPWSA to this project is calculated. The average water tariff in Model B is "946 KHR/m^3" based on the average water tariff of Ta Khmau District in 2016. If a cash injection from PPWSA is applied, the FIRR is 10%. The cash injection every year is KHR 20 billion (around 0.5 billion Yen). The annual cash injection from PPWSA is thrice of amount of water sales from the first year to the fourth year. It becomes less than thrice of amount of water sales later, and the cash injection amount is KHR 20 billion (around 0.5 billion yen), which is extremely expensive. Since the annual cash injection would account for around 8% of total expenditure in 2022, it does not represent a low impact on the finances of PPWSA; therefore, it is difficult to conduct this project by Model B with a large amount of cash injection from PPWSA and the existing water tariff level.

(3) Model C-0: Standard Model not using Grant

The water tariff is a source of profit, and payment of facilities by private investment is covered by the sale of Bulk Water in Model C-0; therefore, a major water tariff increase is required as with Model A. Since it is difficult to implement this project by Model C-1, financial analysis has not been conducted.

(4) Model C-1: Model of Private Operation with Facility Linked Grant by BTO

A private operator conducts construction of WTP, operation and maintenance in Model C-1. A large portion of the construction part is financed by a grant from the Japanese government, and

[1] IMF (2017) "World Economic Outlook Database, October 2017"

small part of that is financed by private company. It sells water (Bulk Water) to PPWSA, and recovers the costs of private investment to WTP and operation and maintenance. The price of Bulk Water from the private operator to PPWSA is "800 KHR/m^3", which is the minimum price based on the minimum private operator's profit although the proposed Bulk Water price was "900 KHR/ m^3" based on market sounding. The average water tariff per user is "946 KHR/m^3", with consideration of social and economic features. As a result of this calculation, the amount of private investment to make the Equity IRR more than 15% (Hurdle Rate) is around 0.9 billion KHR (around 25 million yen) and accounts for 0.6% of whole amount. The Equity IRR is around 15% based on the premise of that full amount of water made by the private operator is bought by PPWSA. Part of the facility financed by private company is owned by the private company. Then, validity of Equity IRR is finally confirmed based on hearing from private investors.

(5) Model C-1 (Option): Model of Private Operation with Facility Linked Grant by BTO (No Private Investment)

As an option of Model C, the following no private investment model is suggested. Construction of the facility is financed by a grant from the Japanese government, and the private operator recovers O&M cost by selling Bulk Water to PPWSA. The price of Bulk Water from the private operator to PPWSA is "800 KHR/m^3", which is based on market sounding. The average water tariff for the user is "946 KHR/m^3". The average recurrent profit margin is 19% and the average current account balance ratio is 124%; therefore, they are valid compared with those of other water supply corporations from home and abroad. In the case of PPWSA, the average current account balance ratio for the past five years is 143%.

(6) Model C-2: Model of Private Investment Recovery using Grant by BOT

Since the grant is supplied as a subsidy (VGF: Viability Gap Fund) payment for the private operator in Model C-2, the grant framework, based on a general E/N template, cannot be applied. In general, the VGF is provided for the project, which the private operator conducts, to keep a self-supporting accounting framework and make it bankable by government financing of part of the cost. It is desirable that the maximum amount of VGF does not exceed half the total cost; therefore, conducting this project by Model C-2 is impossible, so financial analysis has not been conducted.

S.3.4 Confirmation and Analysis on Concerned Laws and Regulations

(1) Public Procurement Law

The Law on Public Procurement of the Kingdom of Cambodia, 2012, promulgated by Royal Decree No. NS/RKM/0112/004 (hereinafter "Procurement Law of Cambodia") shall extend the scope to implement all public procurement transactions in the Kingdom of Cambodia regardless of the source of the resource. However, when a grant aid would be provided by the

government of Japan, the procurement shall be based on “Procurement Guideline for Japanese Grant” by applying Article 3 of the Public Procurement Law of the Kingdom of Cambodia. Since this project includes not only construction but also the operation and maintenance (including possible partial investment to facility development from a private company), which cost would be recovered through water sales to PPWSA. Therefore, it is not clear if Article 3 of the Procurement Law of Cambodia is applicable for this project as a whole. Based on the comments from the locally-based international law firm in Cambodia (hereinafter “Law Firm”), the applicability of Article 3 of the Procurement Law of Cambodia for this case is not described clearly in the concerned laws and regulations in Cambodia; however, there is a high possibility that this project as a whole would be implemented under Article 3 of the Procurement Law of Cambodia. Final confirmation needs to be received from the ministry concerned, i.e. the MEF.

(2) Integral Selection of Private Company

This project would consist of three main contracts, namely: 1) EPC Contract for the construction of Water Treatment Plant (WTP) based on Grant Aid, 2) Lease Contract for private company to use WTP and 3) Bulk Water Purchase Contract. This project is to seek the improvement of service quality, life-cycle cost reduction and appropriate risk transfer to the private company through construction, operation and maintenance by one private company (or consortium) integrally. If those contracts were to be procured separately and select different private companies for different contracts, there runs the risk that the WTP, without much consideration for life-cycle cost, as well as the bulk water supply company, would not take any facility-related risks during the operational period. Also, if those contracts were procured separately, the bulk water purchase agreement is considered separately from the framework of ODA procurement, which might cause non-Japan-tied procurement. Therefore, it is important to make these contracts integrally with one private company (or consortium). E/N or G/A should clearly mention that Contracts 1), 2) and 3) shall be made integrally with one private company (or consortium) in order to apply Article 3 of Procurement Law of Cambodia for Contracts 1) and 2).

(3) Selection Method of Private Company

This PPP project is expected to introduce private know-how and innovation of life-cycle reduction and sustainable water provision. Therefore, a design-build method, in which design and construction would be undertaken by the same company or consortium is recommended. The technology transfer of operation and maintenance, which PPWSA expected from this project, as well as efficient implementation of capacity development are expected to be proposed by a private company. Also, the proposal to retain the quality of the facility after the private company’s operational period should be evaluated. Therefore, it is important to select a private company, not only from the bidding price but also from the technical points of view in

order to introduce private know-how for technology transfer as well as to secure sustainable operation after completion of the private company's operation. It is recommended to utilize a comprehensive evaluation method, which converts financial and technical proposals into a score whereby the private company that achieves the highest total score shall be selected. JICA Guideline Chapter II Section 2.03 (1) describes: "A single-stage two-envelope bidding procedure shall be adopted unless otherwise stated in the G/A or prior agreement with JICA"; however, the applicability of a comprehensive evaluation method is not clearly mentioned and therefore confirmation is required.

(4) Business Permission Procedure

The Ministry of Industry and Handicraft (hereinafter "MIH") Regulation (Prakas) on Procedure for Issuing, Revising, Suspending and Revoking Permit for Water Supply Business, No.461/2014) stipulates the requirement of a water supply business permit including expansion of water supply. Considering the above-mentioned MIH Regulation, PPWSA would be required to acquire a business permit for expansion of water business in Ta Khmau District (Construction and operation of WTP with a capacity of 30,000m^3/day).

Regarding the necessity of a business permit for a private company to conduct this project, there is no such clause in the above-mentioned MIH Regulation. Based on the interview with PPWSA and MIH, this project is conducted within the management of PPWSA; thus, the private company would not be required to get a business permit.

S.3.5 Bid Documents and Contract Forms

To obtain successful result from this project using Japanese Grant Aid for a concession project, all stakeholders such as Japanese Government and JICA, Cambodian Government, PPWSA as implementation agency, and private companies has to collaborate appropriately.

The research team proposes the development of the four contracts templates given below for inclusion in the tender documents as contracts that are necessary to enact this project.

1) EPC Contract for construction of the Water Treatment Plant (hereinafter referred to as "WTP") as the facility to be developed under the project,,

2) WTP lease contract to borrow the facility owned by the implementing agency after completion in nominal price,

3) The bulk water Purchase Contract (including WTP O&M and capacity building operations) to operate and maintain and manage the leased WTP and sell the bulk water to the implementing agency (PPWSA).

4) If necessary, private companies may sign an investment loan Contract and its accompanying direct agreement between the implementation agency (PPWSA) and financial institutions

The research team also analysed the project risk and risk distribution between implementation agency and private companies and proposed key contract terms.

To achieve the successful result, it is necessary to convert the tender documents into a form of comprehensive set for the design construction and operation of the facility. This represents a change from the procurement of goods to the procurement of services we also propose output specification to be used in the tender to allow the private companies budding to submit innovative proposals and evaluate such different proposals fairly.

S.3.6 Important Considerations

(1) Water Intake

- MOWRAM approval
- Suitable water quality

(2) Treatment Capacity, Process, and Construction Site

- Pre-treatment and sludge treatment
- Considerations for facility construction on limited land
- Soil survey

(3) Items to be Conducted by PPWSA

- Distribution network and house connections
- Unexploded ordinances (UXOs)
- Bill collection office relocation

(4) Utilization of the Elevated Tank

(5) Environmental and Social Considerations

(6) Design Build and O&M

(7) Confirmation of Integrated Procurement on Japanese Grant Aid for PPP Project including Bulk Water Purchase Contract

S.3.7 Project Outline

General information and the timeline for the construction of the water treatment system in Ta Khmau District are summarized in **Table S.1**.

Table S.1 Construction of WTP in Ta Khmau District (Draft)

Implementation Agency	Phnom Penh Water Supply Authority (PPWSA)
Project Implementation	BTO (Build, Transfer & Operate) under Japanese Grand Aid-SPC scheme. Japanese company will construct the facilities, transfer these to PPWSA and rent them at a nominal price, operate and maintain these for a certain period of time to recover the initial investment and O/M costs by the sale of bulk water

Facilities	Intake: pumping station, raw water transmission lines Water treatment (30,000 m^3/d): pre-treatment, mixing, coagulation and sedimentation, rapid filtration etc. Distribution: service reservoir, distribution pump, distribution pipeline and flow meter for bulk water measurement Items undertaken by Cambodian side: distribution network
Equipment	Water quality analysis equipment Tools for O & M of mechanical & electrical equipment
Consulting Service	Preparatory Survey for project development, preparation of specification for selection of qualified SPC and monitoring of the operation status of the WTP, facility design at the F/S level and costs estimation for comparing with the proposal by SPC, support for bidding document preparation, bid evaluation and contract procedure, construction monitoring etc.
Schedule	1) From the commencement of the Preparatory Survey to signing contract: about one and a half years 2) Detailed design and construction: approximately 3 years 3) Period of operation and maintenance and supply of bulk water to PPWSA: 10 years

Source; JICA Survey Team

S.4 Project for Construction of Water Treatment Plant in Bakheng (I & II)

S.4.1 Project Scope

The 2030 water demand of 1,093,000 m^3/d cannot be met with the current production capacity of 625,000 m^3/d (see **Table S.2**), even with the addition of Chamcar Mon WTP (52,000 m^3/d) expansion and the new Ta Khmau WTP (30,000 m^3/d). The construction of the Bakheng WTP is necessary (Proposed Bakheng WTP site is shown in **Figure S.3**). The project will be implemented in two stages (Bakheng I and Bakheng II). The project scope is presented in **Table S.3**.

Table S.2 Capacity Summary of WTPs

WTP		Capacity (m^3/d)	Remarks
Existing	1) Phum Prek WTP	150,000	
	2) Chamcar Mon WTP	20,000	
	3) Chroy Changvar WTP	130,000	
	4) Niroth WTP	260,000	
	Sub-total (A)	**560,000**	
New or Expansion	5) Chamcar Mon WTP	32,000	Expanding from 20,000 to 52,000 m^3/d by 2019
	6) Ta Khmau WTP	30,000	Expected by Japanese Aid
	7) Bakheng WTP	390,000	Bakheng I: 195,000 m^3/d by 2022 Bakheng II: 195,000 195,000 m^3/d by 2024
	8) Phum Prek WTP	45,000	Expanding from 1500,000 to 195,000 m^3/d by 2022
	Sub-total (B)	**497,000**	
Ground Total in 2030 (A+B)		**1,057,000**	

Source: Third Master Plan 2016-2030 (Mar. 2017)

Source: JICA Survey Team

Figure S.3 Proposed Bakheng WTP Location

Table S.3 Project Scope of Bakheng WTP

Item	Scope	Construction Period	Remarks
Bakheng I	• Intake, • Raw water transmission main (DN1,800mm, 1.6km), • WTP (195,000 m^3/d), • Treated water transmission mains (DN2,000mm, 7.9km) • Sap River crossing (DN 2,000 mm, pipe bridge)	2019 to 2022	If water demand increases faster than planned prior to tendering for Bakheng I, the total capacity may be increased to 455,000 (=390,000+ 65,000) m^3/d.
Bakheng II	• WTP (195,000 m^3/d)	2023 to 2024	
Total Capacity	390,000 m^3/d		

Source: Technical Feasibility Study Report (Draft Nov. 2017)

As of November of 2017, the F/S for Bakheng WTP project is still in progress. Therefore, the project outlines are summarized based on the update information of the F/S and Third Master Plan 2016-2030.

S.4.2 Information Required for Loan Project

This Data Collection Survey has gathered the basic information for implementing “The Project for Construction of Water Treatment Plant in Bakheng I & II” using Japanese Loan Aid. The Preparatory Survey will confirm the following:

(1) Project Priority and Urgency

“The Project for Construction of Water Treatment Plant in Bakheng I & II”, is essential for improving the water supply situation in Phnom Penh. The F/S for Bakheng I is underway and

the project is expected to be financed by AFD. Phnom Penh will face inadequate water supply, therefore the priority and urgency of the project is high.

(2) Project Outcome and Effectiveness

According to the Third Master Plan, four WTPs will be constructed or expanded by 2030 to meet water demand at that time. New Bakheng WTP, is one of them, and will be constructed in two stages. The capacity of each stage is 195,000 m^3/d (max day). The capacity added by, "The Project for Construction of Water Treatment Plant in Bakheng I & II" is pivotal in meeting the water supply targets for 2030 (total production capacity of 950,000 m^3/d in average or 1,090,000 m^3/d in maximum day, water pressure of 2 bar in all serviced area, NRW of 10%, and total connection of 550,000).

(3) Maturity of the Project

The land for the intake facility and the WTP has already been acquired. The F/S is underway. Therefore, project is sufficiently mature to proceed.

(4) Capability of the Implementing Agency

PPWSA has worked on the Niroth WTP construction with co-financing from Japan and France, and therefore, has the ability to implement the Bakheng WTP project.

(5) Agreements among Stakeholders

IEIA on the Bakheng WTP project is being conducted in parallel with the F/S. Stakeholder consultations will be carried out. The Preparatory Survey will confirm the consensus among stakeholders.

(6) Consideration for Low-income Households

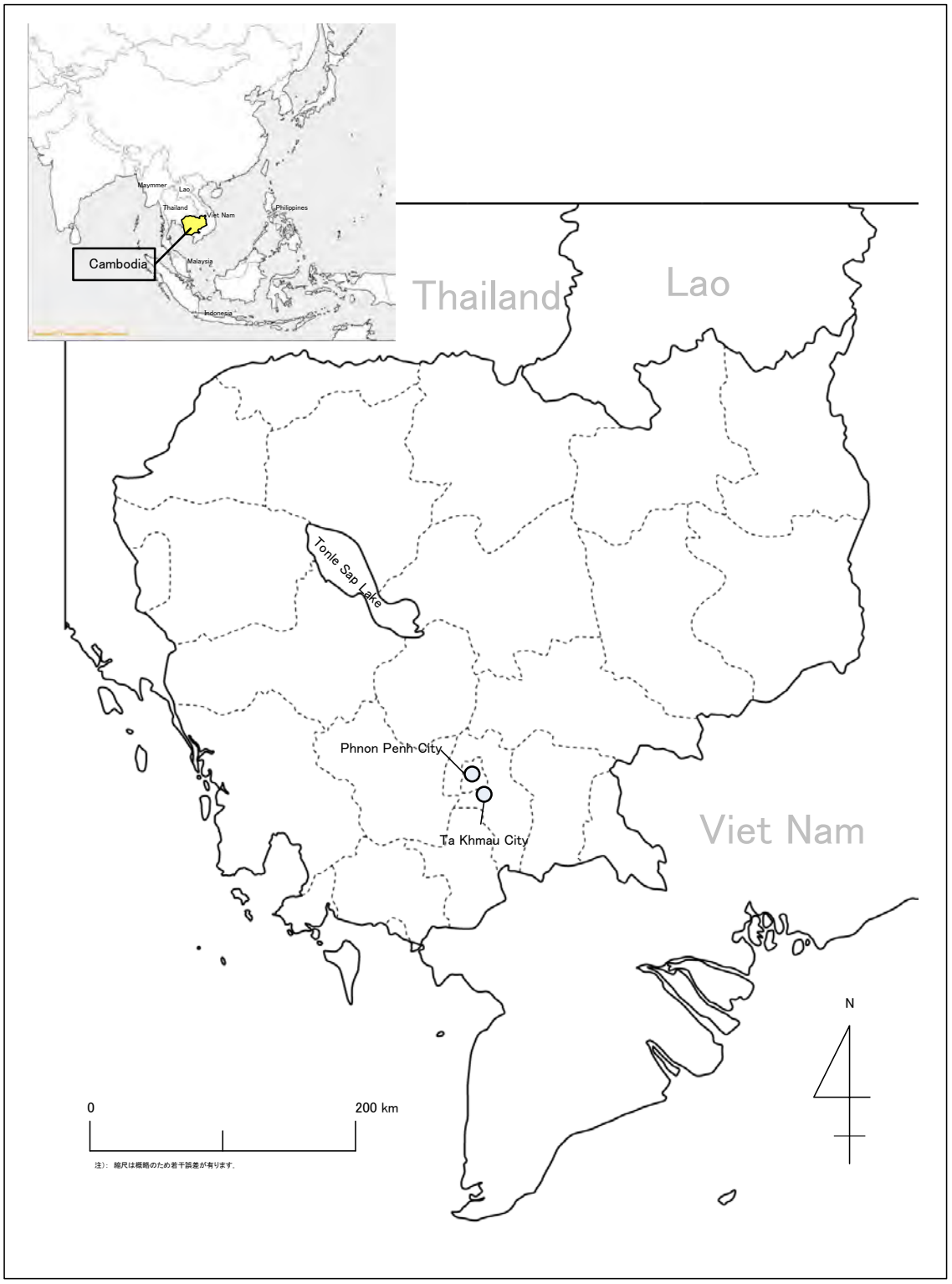
The Third Master Plan aims to improve water supply service for all residents of Phnom Penh by 2030 by supplying treated water to the areas not being served and improving supply situation at existing serviced area. The Preparatory Survey will confirm that low income households will have equal access to the service.

THE DATA COLLECTION SURVEY
ON
WATER SUPPLY SECTOR IN PHNOM PENH CAPITAL CITY

FINAL REPORT

Contents

［**Appendices**］



Location Map

Photos

1. Planned Site for Construction of Ta Khmau WTP

1-1: Planned intake site (Nov. 2017)

1-2: Intake site of Ta Khmau WTP (Nov. 2017)

1-3: Low-income house in Ta Khmau District (Nov. 2017)

1-4: Planned cosntruction site for the WTP (Nov. 2017)

2. Bassac River (Raw Water Source for Ta Khmau WTP)

2-1: Sampling for water quality survey (Nov. 2017)

2-2: Pollution sources of Bassac River (Nov. 2017)

3. Planned Construction Site for Bakheng WTP

3-1: Planned intake site (Nov. 2017）

3-2: Planned construction site for the WTP (Nov. 2017）

4. Consultation with Related Organizations

4-1: Consultation with PPWSA for Inception Report
(Nov. 8th, 2017)

4-2 Consultation with MIH for Inception Report
(Nov. 8th, 2017)

4-3: Consultation with PPWSA for Draft Final Report
(Dec. 25 2017）

4-4: Water business opinion exchange meeting
(Dec. 11 2017）

List of Figures

List of Tables

ABBREVIATIONS

AFD	Agence Française de Développement (French Development Agency)
CDC	The Council for Development of Cambodia
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement, Construction
GOF	Government of France
GOJ	Government of Japan
JICA	Japan International Cooperation Agency
JST	JICA Survey Team
IEIA	Initial Environmental Impact Assessment
MIH	Ministry of Industry & Handicraft
MEF	Ministry of Economy and Finance
MOE	Ministry of Environment
MOU	Memorandum of Understanding
MOWRAM	Ministry of Water Resources and Meteorology
NRW	Non-Revenue Water
NSDP	National Strategic Development Plan
PAC	Poly-aluminum Chloride
PAC	Powered Activated Carbon
PDF	Project Development Facility
PPP	Public–Private Partnership
PSP	Private Sector Partnership
PPWSA	Phnom Penh Water Supply Authority
RGC	Royal Government of Cambodia
ROA	Return on Assets
SAFEGE	Société Anonyme Française d'Étude de Gestion et d'Entreprises French Limited Company for the Study of Management and Business
SPC	Special Purpose Company
VFD	Variable Frequency Drive
VGF	Viability Gap Funding
WTP	Water Treatment Plant

1. INTRODUCTION

1.2 Background

The Royal Government of Cambodia (RGC) is committed to the development of water supply. 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 (2014-2018) boosted the target of access to safe water in urban areas from 80% by 2015 to 100% by 2025.

Development of water supply in the country started in the mid-1990s, mainly in the capital city of Phnom Penh. JICA conducted the Study on Phnom Penh Water Supply System in 1993. With the support of the Government of Japan (GOJ) and other donors, water supply capacity in Phnom Penh has improved with the construction and rehabilitation of facilities and capacity building for operation and maintenance. Phnom Penh has a service ratio of over 90 % for 24-hour water supply. Water supply is still inadequate in the surrounding areas because production capacity is not keeping up with the rapid increase in domestic and commercial demand. The expansion of water supply facilities is urgently needed.

Ta Khmau District in Kandal Province south of Phnom Penh has been receiving water supply from Phnom Penh Water Supply Authority (PPWSA) since 2004. There are many low-income households and PPWSA takes measures to provide these with free connections. Ta Khmau District needs a new water treatment plant (WTP) to meet its demand, but the construction cost will be a financial burden to PPWSA because this area is poor. To solve this issue, Kitakyushu Water Service Co., Ltd. (KWS) proposed to PPWSA to apply for funding under the Japanese Grant-Special Purpose Company (SPC) Scheme. This will have the effect of reducing initial investment cost burdens on PPSWA while imparting Japanese knowledge and experience. PPWSA submitted an “Application Form for Grant Aid” to JICA for construction of Ta Khmau WTP based on this proposal.

“Phnom Penh Water Supply Authority Master Plan - Period 2016-2030 (Third Master Plan 2016-2030)” was prepared with the support of the French Government. It calls for: a) construction of new Bakheng WTP; b) extension and rehabilitation of existing WTPs; and c) expansion of services to the south and west of Phnom Penh. The construction of Bakheng WTP is expected to use the Japanese Loan Scheme.

This Data Collection and Analysis Survey will gather the information required for the next JICA Preparatory Survey for the grant aid project - “the Project of Construction of Water Treatment System in Ta Khmau District (tentative title)” and the loan project - “the Project for Construction of Water Treatment Plant in Bakheng I & II (tentative title)”. The information gathering includes discussions with the Cambodian side.

1.3 Survey Tasks

The main tasks include the following:

1) Review existing conditions of water supply system in Phnom Penh and Ta Khmau District

- Review the Third Master Plan 2016-2030
- Review existing conditions and future development plan for water supply in Phnom Penh
- Prepare recommendations on cooperation in project implementation

2) Project for Grant-SPC Scheme - “the Project of Construction of Water Treatment System in Ta Khmau District (tentative title)”

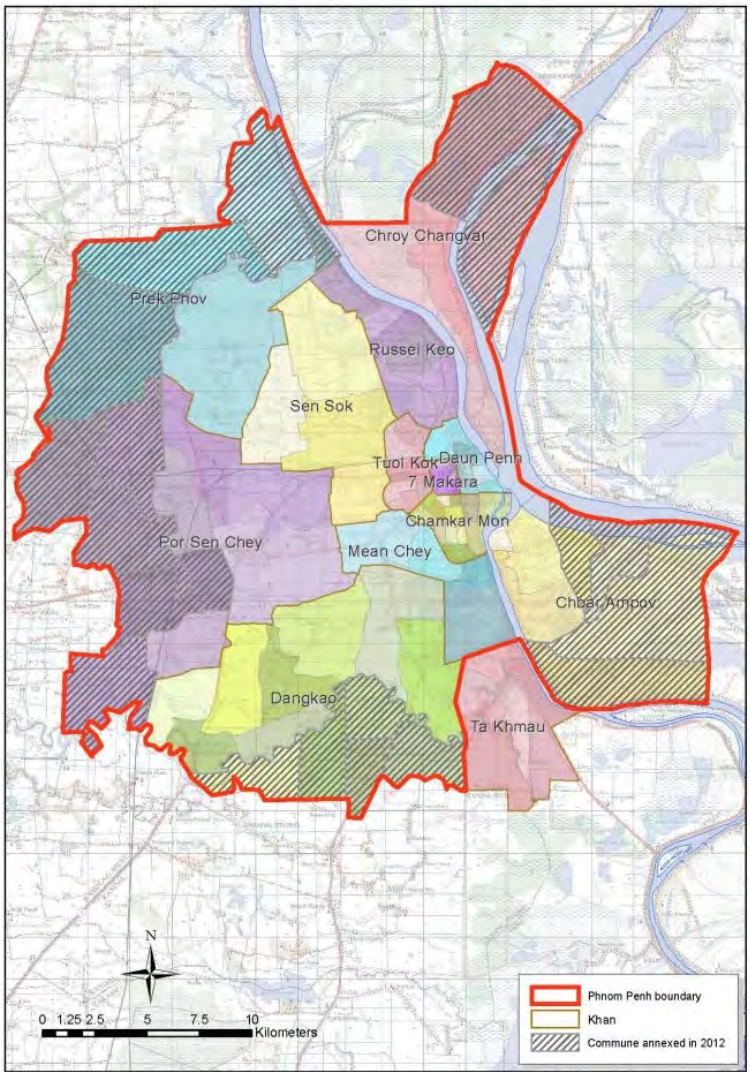
- Collect data on the water supply system in Ta Khmau District
- Study applicability of Public Private Partnership (PPP)
- Study types of private sector partnerships (PSP)
- Review legal implications for PPP
- Review environmental and social impacts

3) Japanese loan project of “the Project for Construction of Water Treatment Plant in Bakheng I & II (tentative title)”

- Confirm necessity of the project
- Confirm project scope
- Review environmental and social impacts

1.4 Survey Area

The survey will cover the PPWSA water supply area which includes Phnom Penh Capital City and Ta Khmau District, located south of Phnom Penh (**Figure 1.4.1**). Phnom Penh Capital City has 12 administrative districts (Daun Penh, 7 Makara, Chamkar Mon, Tuol Kok, Russei Keo, Mean Chey, Dangkao, Por Sen Chey, Sen Sok, Chroy Changvar, Chbar Ampov, Prek Pnov).



Source: Third Master Plan 2016-2030

Figure 1.4.1 Survey Area

1.5 Cambodian Agencies

Cambodian agencies and their responsibilities associated with the project are shown in **Table 1.5.1**.

Table 1.5.1 Agencies Involved in the Project

Role	Agencies
Implementation of the Project	PPWSA: Phnom Penh Water Supply Authority
Jurisdiction for water supply	MIH: Ministry of Industry& Handicraft
Water resource	MOWRAM: Ministry of Water Resources and Meteorology
Environmental and social consideration	MOE: Ministry of Environment
Project funding arrangements	MEF: Ministry of Economy and Finance

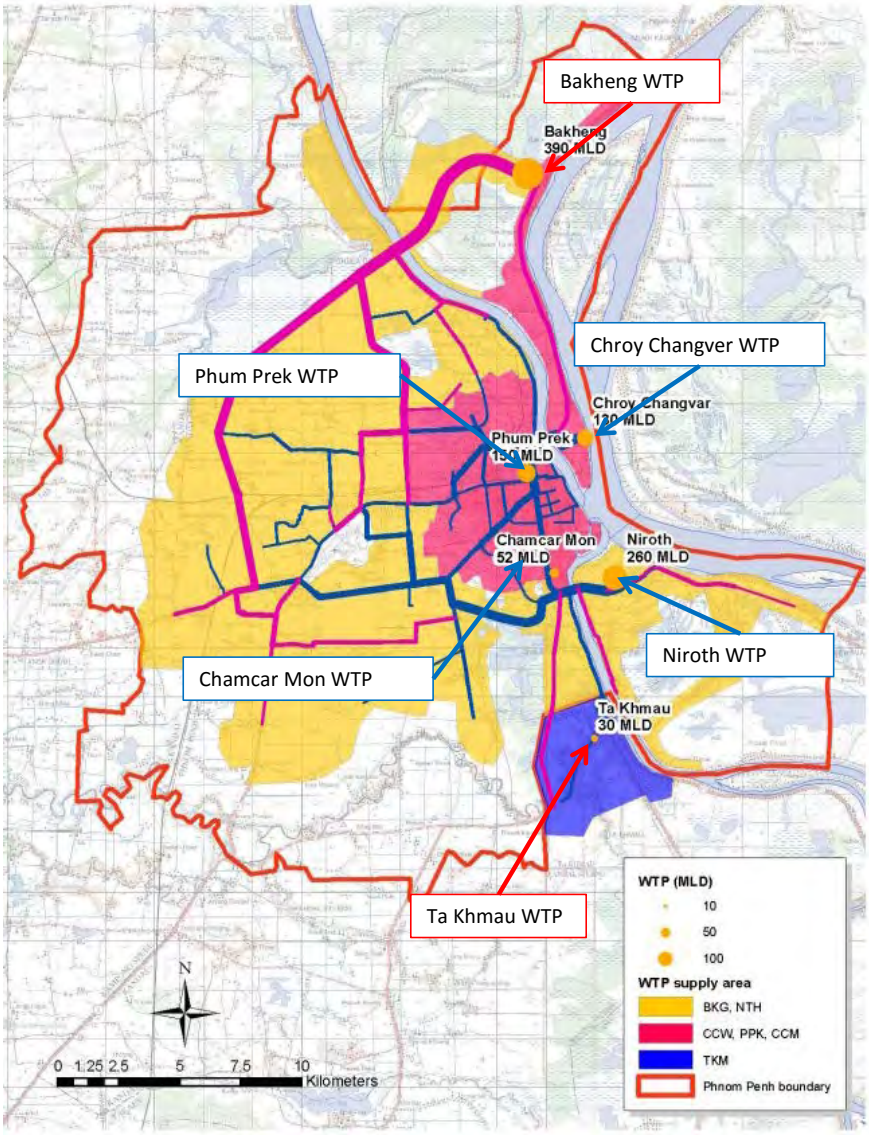
Source: JICA Survey Team

2. WATER SUPPLY IN PHNOM PENH AND PROPOSAL ON COOPERATION

2.1 Review of Master Plan

GOJ and other donors have been supporting the construction and rehabilitation of water supply facilities and capacity building for operation and maintenance in Phnom Penh and other major cities. The French Government assisted with the preparation of the water supply master plan - Period of 2016 - 2030 (Third Master Plan 2016-2030), which proposes multi-phased implementation of new facilities.

Based on the reviewed of the Third Master Plan 2016-2030, the Survey recommends how the cooperation with JICA should proceed.



Source: Third Master Plan 2016-2030

Figure 2.1.1 Water Supply System in 2030

2.1.1 Overview of Current Situation and Development Plan for Water Supply in Phnom Penh

Surface water resources to the west of the city are limited and not stable. The available water sources are the Mekong, Sap and Bassac rivers east of Phnom Penh. Treatment plants are located in the east. It will therefore be necessary to transmit treated water from the east to the west where demand is growing and distribution pressure is low. The distribution network will need to be improved and expanded. About 200 km of distribution pipelines will need to be installed every year to 2025 and more than 100 km of pipelines every year from 2026 to 2030. Before the Bakheng WTP comes into operation in 2025, a lack of water pressure in the western fringe of Phnom Penh would continue. A looping pipeline system is proposed to improve water supply conditions.

The Third Master Plan projects the water demand in Phnom Penh will reach about 1.1 million m^3/day by 2030, and proposes the following 4 projects to increase water supply capacity:

(1) Expansion of Chamcar Mon WTP to Supply the Central Area (by February 2019)

Expansion of the Chamcar Mon WTP was proposed by PPWSA in June 2015 at the early stage of the formulation of the Third Master Plan. There is an urgent need to increase the existing capacity of 20,000 m^3/d (actual only 13,000 m^3/d). The F/S was conducted in 2015, and the construction of a second facility at this location started in 2017. The production capacity will be increased to 52,000 m^3/d.

(2) New WTP (30,000 m^3/d) in Ta Khmau District to Supply the Southern Area

A new WTP to be constructed at Ta Khmau (proposed in 2016) will use water from the Bassac River and will have a capacity of 60,000 m^3/d. Japanese grant aid would be used and the WTP will be operated by a Special Purpose Company (SPC), formed by PPWSA and a Japanese company. It is expected that the WTP can be put into operation by the end of 2021. Because land is limited and there is high level of ammonia nitrogen and organic matter in the raw water, The WTP must be compact (capacity of 30,000 m^3/d), and use a pre-treatment.

(3) New Bakheng WTP (390,000 m^3/d) to Meet 2030 Demand

In addition to the above, the construction of a new Bakheng WTP with a total capacity of 390,000 m^3/d is also proposed in the Third Master Plan. It is expected that construction of Bakheng I would begin in the second half of 2018 and be completed by mid-2022, while Bakheng II is to be completed two years later.

PPWSA purchased 15 hectares in Bakheng for the WTP, as well as a smaller piece of land along the Mekong River for the intake facility. The capacity of Chroy Changva WTP and Niroth WTP is designed for multiples of 65,000 m^3/d. This principle will be followed for Bakheng, because standardization of capacity allows for standardization of equipment simplifying maintenance operations. The construction cost for each individual module is around US 25 million.

(4) Rehabilitation of Phum Prek WTP

Phum Prek WTP was built in 1966 with a production capacity of 100,000 m^3/d. After the war, the

capacity declined to 55,000 m^3/d. Using JICA grant aid, production was restored to its original capacity in 1995 and in 2003, this was expanded to 150,000 m^3/d. Phum Prek WTP faces the issue of high energy consumption associated with pumping. In 2014-2015, a study financed by Japanese aid aimed at decreasing energy consumption in Chamcar Mon and Phum Prek WTPs. The study proposed inverter-controlled systems for treated water pumping stations, replace some transformers and improve power supply at intake facilities. By 2020, it will be 54 years since plant construction, 25 years since its first rehabilitation and 17 years since its expansion. In addition, water quality of the Sap River is deteriorating. Treatment process adjustments are required to cope with further decline of raw water quality. Sustained rehabilitation effort is needed to extend the service life of the facilities at Phum Prek and improve performance.

Production capacity of Phum Prek WTP is expected to be expanded to 195,000 m^3/d to take advantage of its proximity to consumption areas.

2.1.2 Water Demand Projection

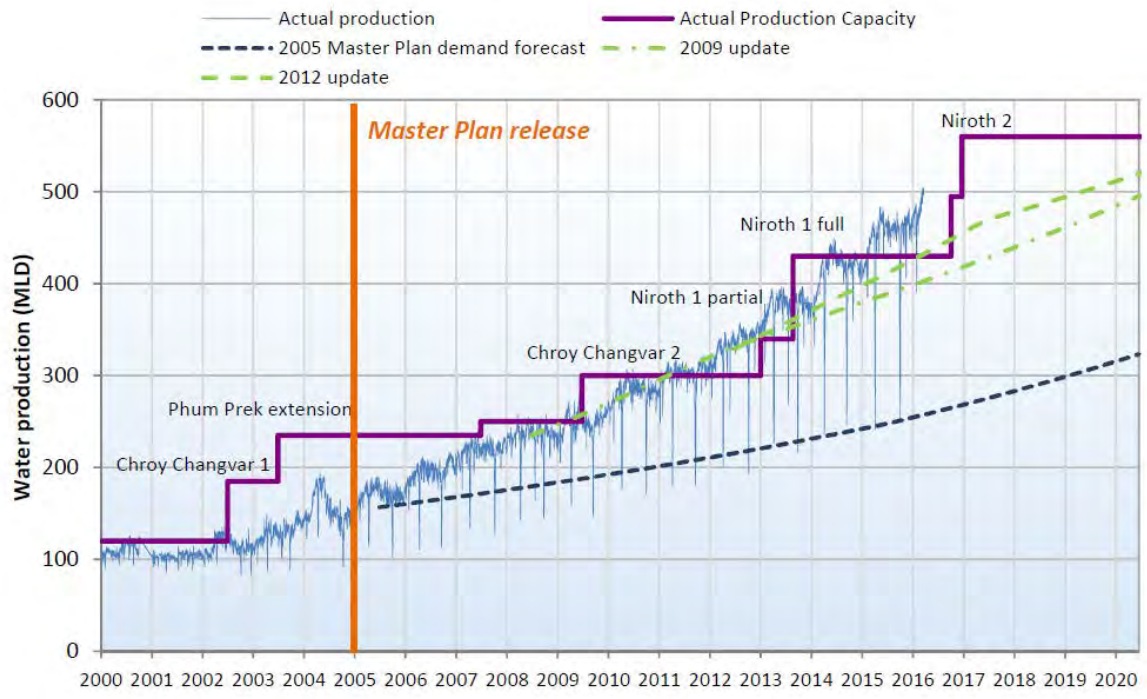
(1) Past Projections

Figure 2.1.2 shows the actual production and water demand projection by JICA (2005) and SAFEGE, French Consultant Company, (2009 and 2012). The Third Mater Plan indicated the following concerns for these projections.

- JICA forecasts, based on population projections, do not reflect actual situations.
- The SAFEGE 2009 forecasts are accurate for the first 4-5 years, but underestimate the actual increase in demand thereafter.
- The SAFEGE 2012 forecasts are higher than those estimated in 2009, but still underestimate actual demand (probably even more so after 2017).

The Third Master Plan explains the reasons for the underestimated demand as follows:

- JICA methodology (2005) based on population projections did not anticipate or account for:
  - urban population explosion currently happening
  - internal migration, i.e. people living, working and consuming water in Phnom Penh, without being registered there.
- SAFEGE methodology (2009 & 2012)
  - It is extremely difficult to forecast based on the length of pipes to be laid yearly over 10 or 15-years. For this reason, the methodology is usually only used for 5-year forecasts, after which demand growth is based on population projection. That is why the 2008 forecasts are accurate until 2012, but underestimate actual demand thereafter.
  - For hydraulic modelling and transmission mains, it is better to forecast water demand at the Sangkat (commune) level. However, this cannot be achieved because it is even harder to forecast accurately the length of pipes to be laid and the connection density to be achieved in each Sangkat for each year.



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.2 Actual Production and Water Demand Forecast (JICA 2005, SAFEGE 2009&2012)

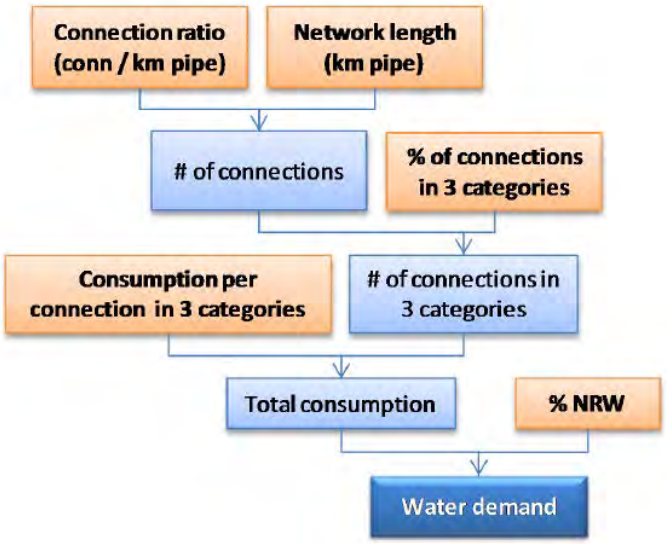
- Estimates of % of administrative connections and consumption per administrative connections are risky and not useful, no real "average" behaviour can be identified when dealing with a smaller number of customers.

(2) Methodology of Water Demand Projection in 2009 and 2012

SAFEGE implemented an alternative methodology in 2009 and 2012 (Niroth I & II F/S), since the water demand projected in 2005 was underestimated. That methodology is based on the following:

- Estimate of development of network length and number of connections/km of pipes, that give the growth in the total number of connections.
- Estimate of the % of domestic, non-domestic and administrative connections, which multiplied by the estimate of total connections gives the number of connection in each category.
- Estimate of the consumption per connection in each category, which multiplied by the number of connections in each category gives the consumption per category.
- Estimate of the NRW rate, which combined with the consumption per category, provides total water demand.

Figure 2.1.3 shows how the methodology works. The parameters to be forecasted are presented in orange coloured boxes, and the results in blue ones.



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.3 Methodology for Water Demand Projection Implemented in 2009 and 2012

(3) Methodology for Water Demand Projection Updated in 2016

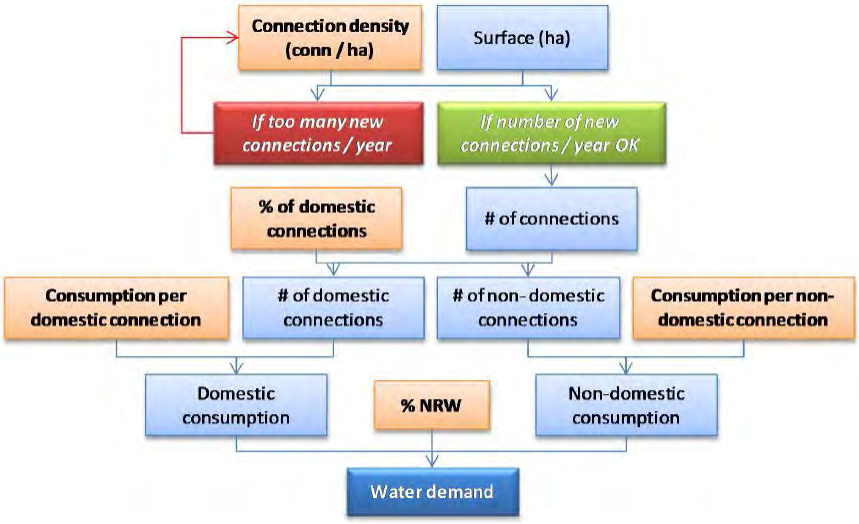
To improve the accuracy of water demand projections, a new methodology was developed in Third Master Plan. It is not based on the length of pipes expected to be laid and connection ratios, but on the connection density (number of connections of any category per hectare of land). The reasons for revising the methodology are as follows:

The connection density can be directly related to the type of urban landscape in each Sangkat. As urban expansion spreads from the central area to the suburbs, it is possible to predict the development of sub-urban areas based on the history of recently developed central areas. There is a “physical reality” for understanding changes to connection density, unlike for the km of pipes to be laid or the number of connections per km of pipe.

Using Monte-Carlo simulation, the water demand predictions are based on forecasts of the following parameters for each Sangkat (including, for each year, expected value and standard deviation):

- connection density (connections / ha)
- % of domestic connections
- daily consumption per domestic and non-domestic connection
- % NRW

In the absence of information, %NRW was assumed to be the same for all the networks. The **Figure 2.1.4** shows how the new methodology works.



Source: Third Master Plan 2016-2030 (Mar. 2017)

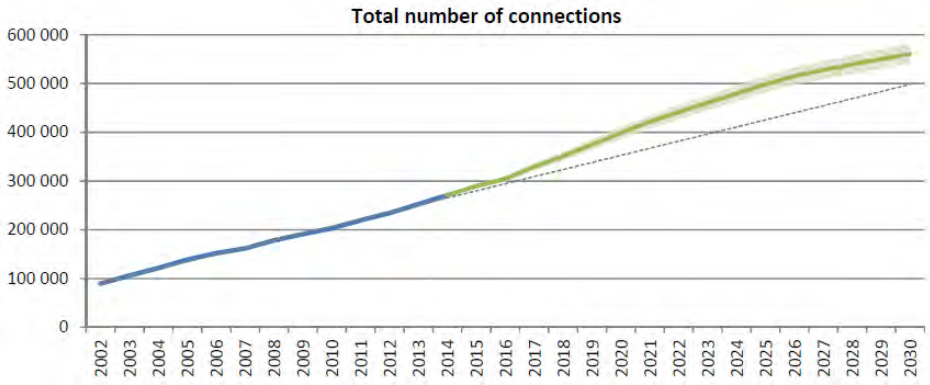
Figure 2.1.4 Methodology for Water Demand Projection Developed in 2016

The methodology was applied to each Sangkat, including ones connected to the network and those yet to be connected. Out of 102 Sangkats around Phnom Penh, Third Master Plan considered 92 would be connected to the network by 2030. That means 92 x 4 = 368 parameters to be forecasted (mean and standard deviation) for the period 2015-2030.

(4) Results of Water Demand Projections in Third Master Plan

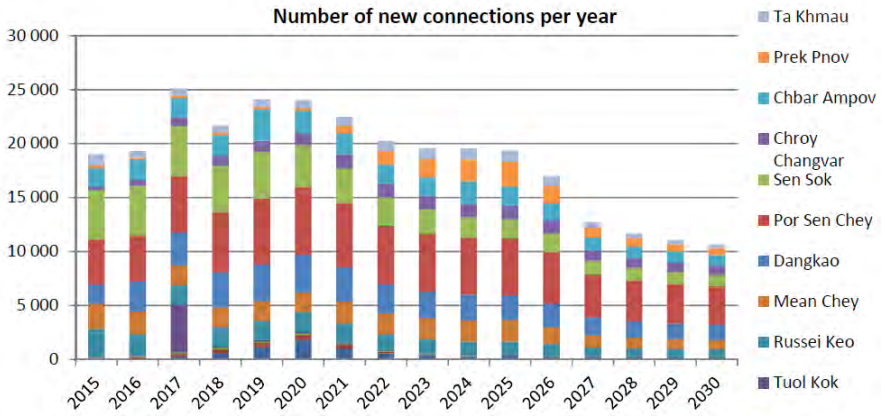
1) Parameters for Water Demand Projection

(a) Number of Connections



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.5 Number of Connections



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.6 Number of New Connections per Year

(b) Other Parameters

Current and forecasted consumptions are summarized in **Table 2.1.1**.

Table 2.1.1 Water Demand Projection in Third Master Plan

Item	Condition	Remark
Consumptions per domestic connection	0.95 m^3/day in 2015 1.03 m^3/day in 2030	Average of 81 communes Average of 92 communes
Consumptions per non-domestic connection	3.50 m^3/day in 2015 3.65 m^3/day in 2030	Ditto
Daily peak factor	1.15	

Source: Third Master Plan 2016-2030 (Mar. 2017)

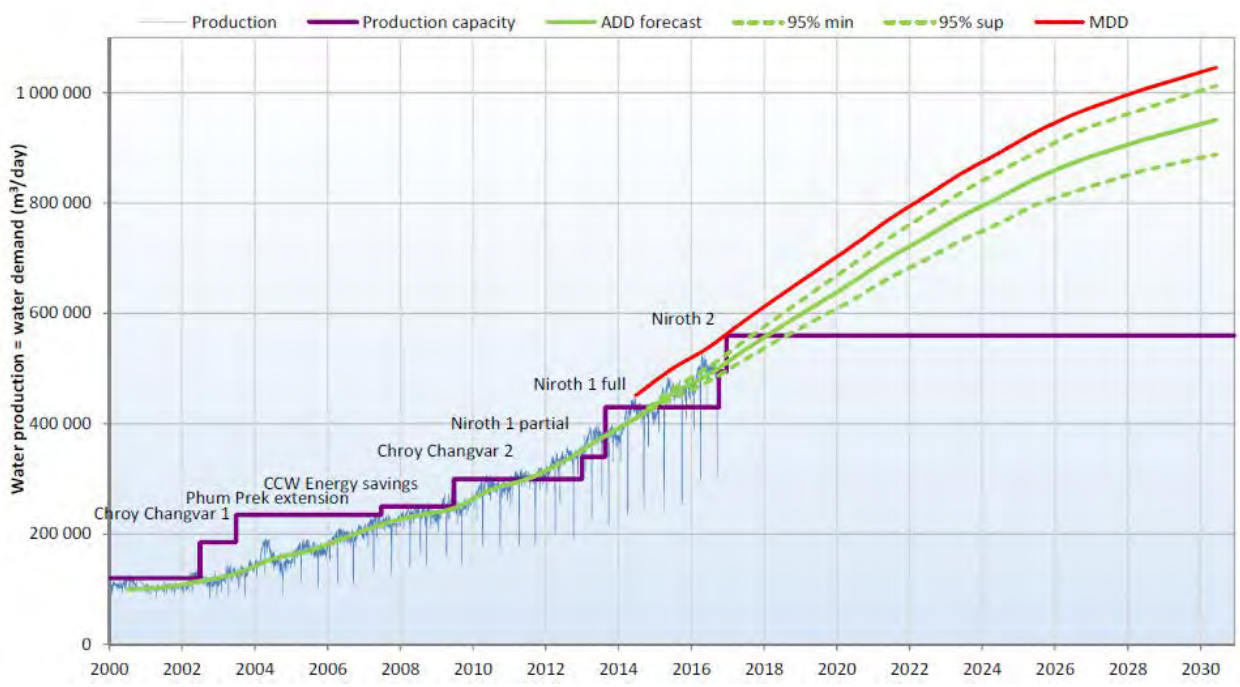
2) Water Demand Projection in Third Master Plan (2017)

Water demand projection in Third Master Plan based on the above parameters is shown in **Table 2.1.2** and **Figure 2.1.7**.

Table 2.1.2 Water Demand Projection in Third Master Plan (2017)

Year	Consumption (m^3/d)	NRW	Average Daily Demand (ADD) (m^3/d)	Maximum Daily Demand (MDD) (m^3/d)	Difference Between ADD and MDD (m^3/d)
2015	417,364	8%	453,656	521,705	68,048
2016	449,721	8%	488,827	562,151	73,324
2017	490,420	8%	533,065	613,025	79,960
2018	523,716	9%	575,513	661,840	86,327
2019	560,876	9%	616,347	708,799	92,452
2020	591,699	10%	657,443	756,060	98,617
2021	630,529	10%	700,587	805,676	105,088
2022	664,460	10%	738,288	849,032	110,743
2023	698,911	10%	776,568	893,053	116,485
2024	728,269	10%	809,187	930,565	121,378
2025	758,750	10%	843,056	969,514	126,458
2026	784,267	10%	871,408	1,002,119	130,711
2027	804,482	10%	893,869	1,027,949	134,080
2028	823,156	10%	914,618	1,051,810	137,193
2029	839,223	10%	932,470	1,072,340	139,870
2030	855,431	10%	950,478	1,093,050	142,572

Source: Third Master Plan 2016-2030 (Mar. 2017)



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.7 Water Demand Projection in Third Mater Plan (2017)

2.1.3 Water Source

(1) Water Source of Bakheng WTP

There are two water source options for Bakheng WTP, Sap River or Mekong River, as shown in **Table 2.1.3**. Mekong River is the recommended water source based on comprehensive studies.

Table 2.1.3 Comparison of Mekong River and Sap River

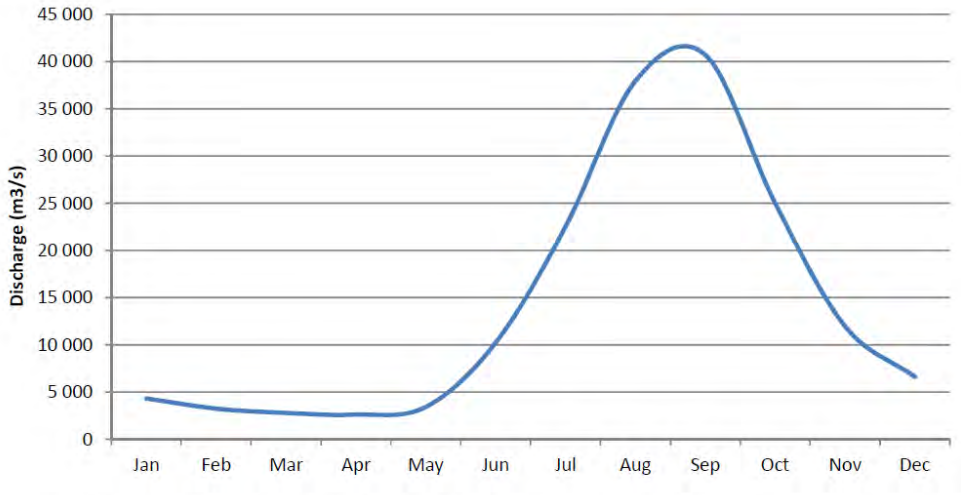
Item	Tonle Sap	Mekong
Quantity of raw water	Good	Excellent
Quality of raw water	Fair	Good
Complexity of treatment	Fair	Good
Perspectives on water quality evolution	Poor	Good
Location	Fair	Poor
Population	Low	Low
River crossing	Tonle Sap	Tonle Sap
Additional costs due to treatment	13.2 M$	-
Additional costs due to pipes	-	24.7 M$
Land price	30 M$	15 M$
Cost difference	**+ 3,5 M$**	

Source: Third Master Plan 2016-2030 (Mar. 2017)

1) Flow Rate of Mekong River

Monthly average flow of the Mekong River at Chroy Changvar station is shown in **Figure 2.1.8**.

There is significant fluctuation depending on the season. The flow is adequate even at the minimum rate of 2,500 m^3/s, which is equivalent to 216,000,000 m^3/day.



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.8 Mekong River Flow Rate (Monthly Average of 1960-2014)

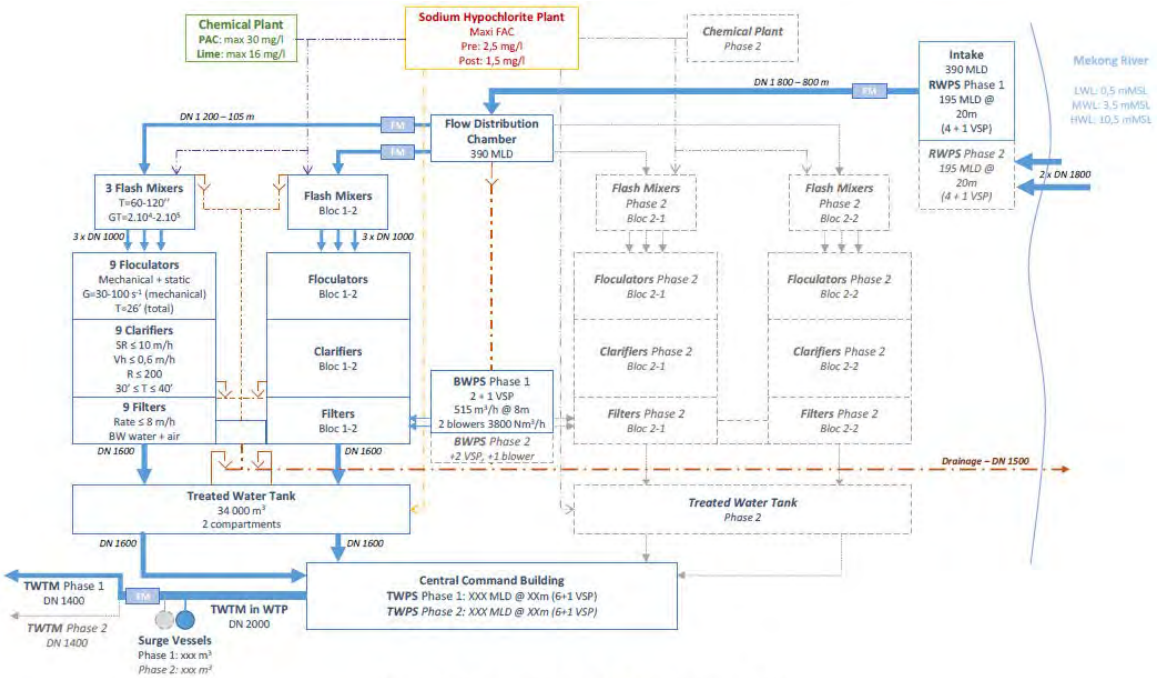
2) Water Quality of Mekong River

Water quality was tested as shown in **Table 2.1.4.** Rapid filtration method is recommended for the Bakheng WTP as shown in **Figure 2.1.9**.

Table 2.1.4 Water Quality Comparison of Mekong River and Sap River

		Overall		Dry season		Rainy season	
		Mekong	Tonle Sap	Mekong	Tonle Sap	Mekong	Tonle Sap
Physical	Temperature	28.7 (22.4 - 32.6)	28.8 (23.8 - 32.8)	28.4	28.6	29.1	29
	pH	7.8 (6.8 - 8.6) *[increasing trend]*	7.2 (6.6 - 8.4)	8	7.1	7.6	7.3
	Turbidity	113 (9 - 913)	111 (8 - 1003)	32	78	205	150
	DO	6.8 (4 - 9.4)	5.3 (0.7 - 8.1)	7.2	4.9	6.4	5.8
	Colour	26 (0 - 132)	43 (5 - 264)	10	42	45	44
Mineral	Conductivity	148 (60 - 226)	106 (61 - 233)	170	92	121	123
	Total hardness	60 (24 - 96)	40 (16 - 88)	69	33	51	48
	Mg hardness	19 (3 - 56)	14 (4 - 36)	21	13	16	14
Chemical	Organic matter	10 (0.8 - 57)	18 (4 - 42) *[increasing trend]*	7	21	14	16
	Ammonia	0.13 (0 - 0.48)	0.37 (0 - 1.63)				
	Iron	0.26 (0 - 3.4) *[increasing trend]*	0.6 (0 - 6.4) *[increasing trend]*				
	Manganese	0.02 (0 - 0.2?)	0.03 (0 - 0.12)				
Bacterio	Faecal Coliforms	7.10^2 (0 - 3.10^4)	7.10^3 (20 - 2.10^5)	581	4800 *≈ 1000 at intake site*	755	9800 *≈ 13 000 at intake site*

Source: Third Master Plan 2016-2030 (Mar. 2017)



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.9 Water Treatment Process for Bakheng WTP

Chroy Changvar and Niroth WTPs take raw water from the Mekong River, with no problems in terms of water quality. It expected that this water source is acceptable for the Bakheng WTP.

(2) Water Source for Ta Khmau WTP

The Third Master Plan proposes to use water from the Bassac River for the Ta Khmau WTP. The flow rate and water quality is as follows:

1) Flow Rate

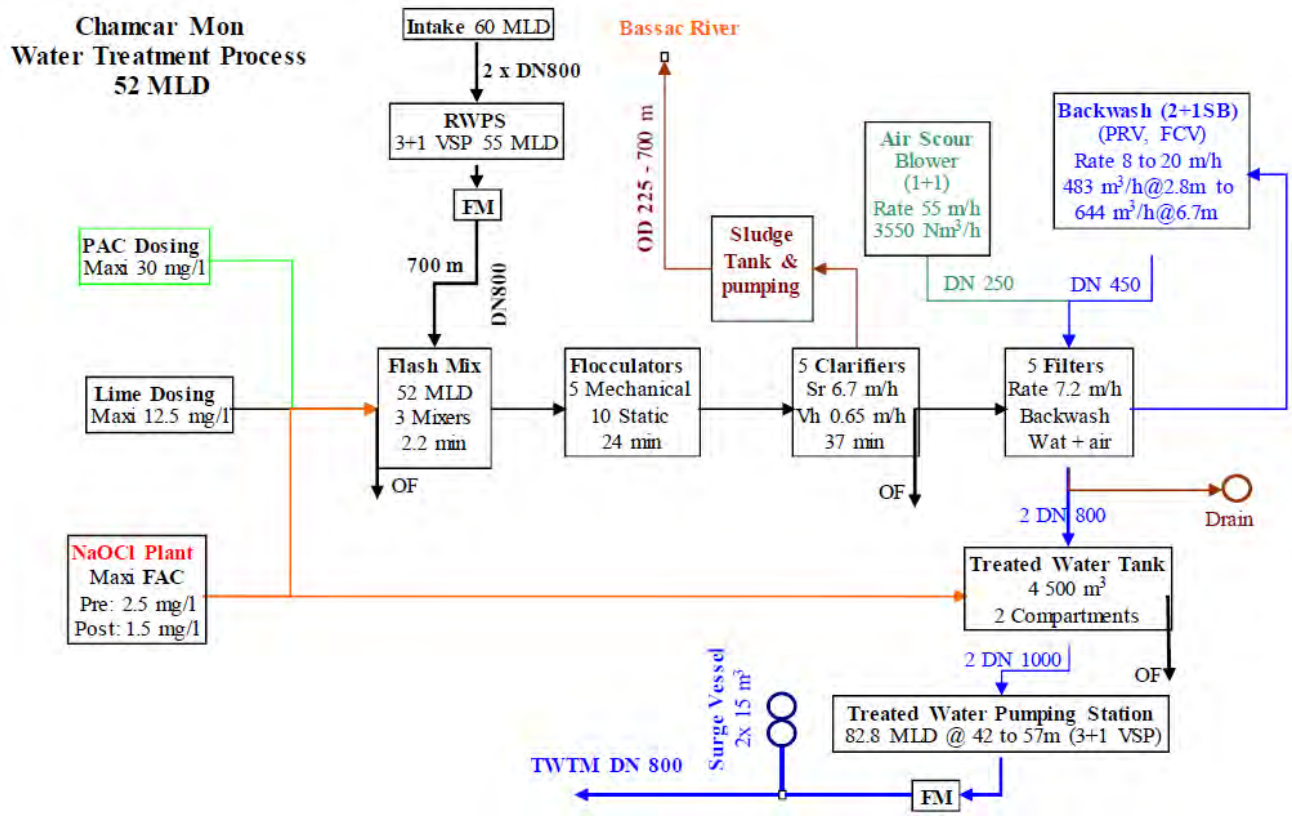
- Flow in dry season is low - 40 m^3/s in April.
- The Chamcar Mon (52,000 m^3/d) and Ta Khmau WTPs (60,000 m^3/d) will consume almost 3% of the flow in dry season.
- Further abstraction is not feasible

2) Water Quality

- Water quality deteriorates towards the south of the city because of urban contamination.
- A treatment process significantly more complex and costly than what is currently implemented, will be required.

3) Proposed Treatment Process

The proposed treatment process for the Chamcar Mon WTP using water from the Bassac River is shown in **Figure 2.1.10**.



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.1.10 Proposed Treatment Process for Chamcar Mon WTP

2.1.4 Financial Issues

The Financial Internal Rate of Return (FIRR) of Chamcar Mon WTP and Bakheng WTP based on the following tariff increase is shown below.

- Gradual increase: It increases from above 1,000 to 1,700 KHR/m^3 between 2019 and 2024.
- Stepwise increase: It increases to 1,700 KHR/m^3 in 2020.

Table 2.1.5 FIRR Based on the Recommended Tariff

Project	Gradual Increase	Stepwise Increase
Chancar Mon WTP	5.0%	5.7%
Bakheng WTP	2.0%	2.0%

Source: The Third Master Plan 2016-2030 (Mar. 2017)

The FIRR of Chamcar Mon WTP is higher than the cost of the capital PPWSA (2.2%), and that of Bakheng WTP is lower than the cost of the capital PPWSA; therefore, Bakheng WTP is not financially viable if a subsidy is not given. Since the financial analysis of the two projects is based on the above tariff increase, it could relate to a decrease of the FIRR of Chamcar Mon WTP so that the recommended tariff increase is not implemented.

The investment amount of the Master Plan is around USD 500 million based on the 2016 price. 32% of that is investment from PPWSA and 68% is loan. Because the tariff increase is affected by policy,

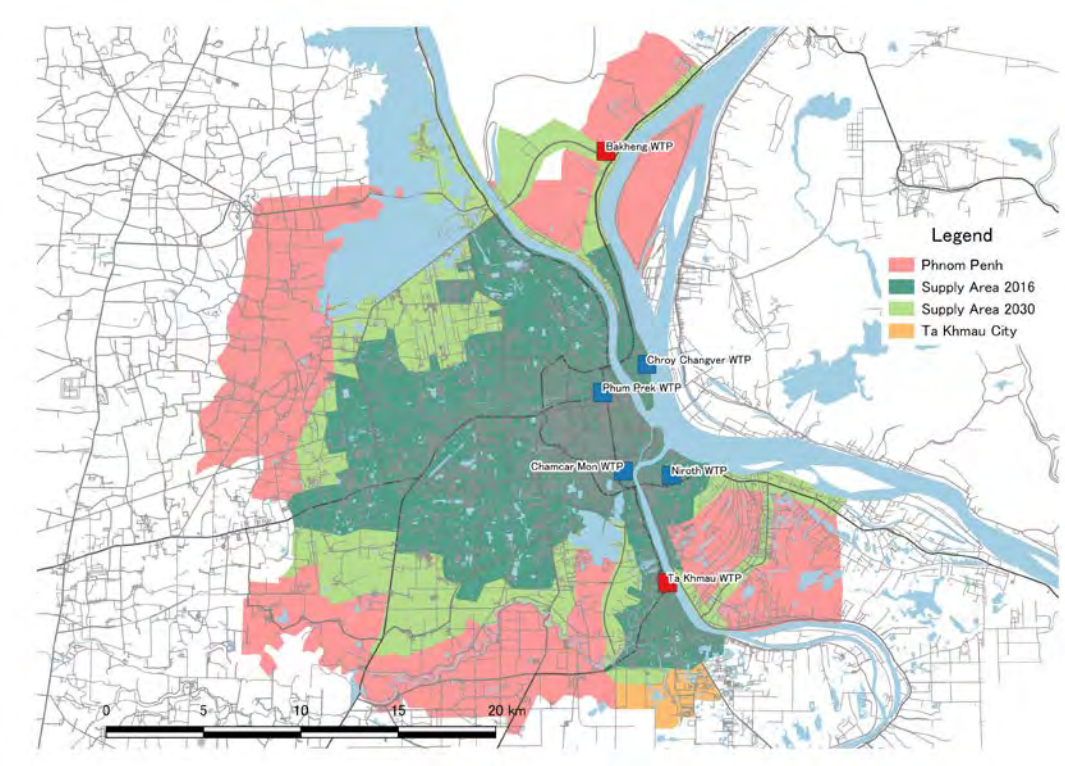
no tariff increase makes investment of the two projects difficult. Validity of investment is required after consideration of the risks of the tariff increase.

2.2 Current Situation and Plan for Phnom Penh Water Supply

2.2.1 Water Supply Area and Connection Numbers

(1) Water Supply Area

Current and future supply area is shown in **Figure 2.2.1**.



Source: Third Master Plan 2016-2030

Figure 2.2.1 Water Supply Area

(2) Connection Numbers

The connection numbers are shown in **Table 2.2.1**. The Third Master Plan estimates that the total number of connections will be 550,000 in 2030.

Table 2.2.1 Connection Numbers

	2012	2013	2014	2015	2016
Number of metered connections	234,225	252,315	270,812	289,024	310,835
Number of annual connections	-	18,090	18,497	18,212	21,811

Source: PPWSA

2.2.2 Non-Revenue Water, Water Tariff, and Billing Rate

(1) Non-Revenue Water and Billing Rate

The current NRW and billing Rate of PPWSA are shown in **Table 2.2.2**. NRW has been on the rise over the last five years, but is still lower than 10%. The NRW increase can be attributed to (a) pressure

increase at pumping stations due to the expansion of the supply area, and (b) aging of the distribution network. PPWSA must deal with NRW control in the future.

Table 2.2.2 Non-Revenue Water and Billing Rate

	2012	2013	2014	2015	2016
Billing ratio	93.37%	92.29%	91.86%	91.56%	90.99%
NRW ratio	6.63%	7.71%	8.14%	8.44%	9.01%

Source: PPWSA

(2) Water Tariff Structure

The current water tariff structure is shown in **Table 2.2.3**. Although the tariffs for domestic, commercial, autonomous state authorities and retailers depend on the quantity of consumption, that for government institutions & distributors and landlords is fixed. The average water tariff in 2016 was 1,029 (KHR/m^3), and that of Ta Khmau District is 946 (KHR/m^3)[2].

Table 2.2.3 Current Water Tariff System

Category of Customer	Qty of water used (m^3/month)	Tariff (KHR/m^3)
Domestic	0-3m^3	400
	4-7m^3	500
	8-15m^3	770
	16-50m^3	1,010
	Over 50m^3	1,270
Government institutions &distributors	Without consideration of Qty	1,030
Commercial, Autonomous State Authorities and Retailers	0-100m^3	950
	101-200m^3	1,150
	201-500m^3	1,350
	Over 500m^3	1,450
Landlord	Without consideration of Qty	700

Source: PPWSA (2017) "2Q 2017 Report"

The "Clean Water for Low-Income Families" program, in place since from 1999, has the following features:

a) Payment by instalment policy: payment periods of 12, 17 and 22 months can be chosen by users based on their financial capacity,

b) 20% discount on connection fee,

c) Subsidy covering 30%, 50% and 70% of the connection fee. In 2015, PPWSA provided 887 connections and a subsidy of KHR 197,841,600 (USD 49,460). 200 households in Ta Khmau District received subsidy in 2015, and 22.6% (885) of the new connections were subsidized.

2.2.3 Financial Situation of PPWSA

According to **PPWSA's income** and expenditures from 2012 to 2016 continuously secured stable revenue. Although a major overhaul of water tariff has not been undertaken, cost reduction was conducted and PPWSA is efficiently managed. It gains enough revenue against expenditure. Profit

[2] PPWSA (2017)

after tax in 2012 was around KHR 34 billion; this increased from 2013 to 2015 by 13-19%. It decreased by 6% in 2016 and was KHR 50 billion.

Table 2.2.4 PPWSA's income and expenditures from 2012 to 2016 continuously secured stable revenue. Although a major overhaul of water tariff has not been undertaken, cost reduction was conducted and PPWSA is efficiently managed. It gains enough revenue against expenditure. Profit after tax in 2012 was around KHR 34 billion; this increased from 2013 to 2015 by 13-19%. It decreased by 6% in 2016 and was KHR 50 billion.

Table 2.2.4 Income and Expenditures of PPWSA (KHR'000)

	31 Dec.2016	31 Dec. 2015	31 Dec. 2014	31 Dec. 2013	31 Dec. 2012
Total revenue	198,179,874	191,348,246	156,542,849	151,580,207	135,119,518
Total expense	-140,710,401	-136,705,608	-111,891,271	-100,047,277	-92,427,831
Operating profit	57,469,473	54,642,638	44,651,578	51,532,930	42,691,687
Finance income	20,193,599	33,210,466	23,067,802	8,592,122	6,728,848
Finance costs	-17,071,783	-19,869,858	-11,663,042	-12,038,249	-6,528,582
Profit before income tax	60,591,289	67,983,246	56,056,338	48,086,803	42,891,953
Income tax expense	-10,159,170	-14,051,176	-10,051,811	-9,341,274	-8,470,992
Profit for the year	50,432,119	53,932,070	46,004,527	38,745,529	34,420,961

Source : PPWSA "Financial Statements" (2012-2016)

The following **Table 2.2.5** shows the financial indicators of PPWSA. Return on Assets (ROA), which shows profitability on assets, is more than 3%. Although this is not high, it shows a valid earnings ratio as a water-supply corporation. Although the Current Ratio, which shows financial liquidity, greatly decreased in 2016, it is more than 300% remaining high liquidity. Furthermore, Capital Ratio, which shows management stability, is more than 60% so it is stable.

Table 2.2.5 Financial Indicators of PPWSA

	31 Dec.2016	31 Dec. 2015	31 Dec. 2014	31 Dec. 2013	31 Dec. 2012
ROA (Return on Assets)	3.9%	4.3%	3.9%	3.5%	3.4%
Current Ratio	331%	472%	541%	447%	413%
Capital Ratio	63%	63%	63%	63%	66%

Source: PPWSA "Financial Statements" (2012-2016)

As mentioned above, the current PPWSA generally performs well financially. At this time, there is no big problem. However, if it does not increase the water tariff in the future, the financial situation will become exacerbated with future water facility development. The impact of the water supply facility improvement in Ta Khmau City, which is extremely unprofitable, on the financial situation of PPWSA is evaluated by cash flow, and profit and loss (PL) statements, in the financial analysis of **Chapter 3**.

2.2.4 Analysis of Energy Efficiency, Technology Level, Chemical Consumption, and Environmental Load of Each Water Treatment Plant

Water treatment plants consume electricity and chemicals and discharges sludge. Electricity is a significant cost that accounts for approximately 23% of the total operating cost (including fixed costs and variable expenses)

The 2016 energy efficiency and chemical consumption in the four WTPs were calculated and compared based on records obtained from PPWSA and the average daily treated water quantity shown in **Table 2.2.6**.

Table 2.2.6 Treated Water Quantity in 2016 (Daily Average)

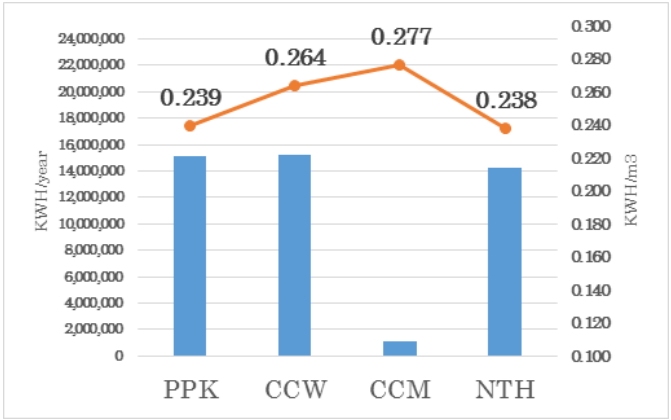
Water Treatment Plant	Phum Prek (PPK)	Chroy Changvar (CCW)	Chamcar Mon (CCM)	Niroth (NTH)
Treated Water Quantity (m^3/d, daily average)	173,005	157,933	11,150	164,076

Source: PPWSA

(1) Energy Efficiency

The yearly and unit electricity consumption (kWh/m^3) of each WTP is shown in **Figure 2.2.2**. Chamcar Mon WTP with the lowest capacity has a small annual consumption but the highest unit value of 0.277 kWh/m^3. Niroth WTP is a new facility completed in 2014 to supply water to the Ta Khmau District. Because of its high efficiency pumps, it is the most energy efficient of the WTPs.

In the Third Master Plan, electricity consumption in 2015 was analysed and the results are like those of this survey.



Source: ICA Survey Team

Figure 2.2.2 Annual and Unit Electricity Consumption (2016)

Source: ICA Survey Team

Figure 2.2.3 Daily Average Production of each WTP and Unit Electricity Consumption

The change in yearly and unit electricity consumption over the last five years for each WTP is shown in **Figure 2.2.3**. The trend in energy efficiency is as follows:

- Phum Prek WTP shows improved unit consumption since 2014, due to the introduction of a solar power generation system in July 2013.
- Chroy Changvar WTP production has been increasing year by year, with corresponding increase in electricity consumption. Part of the increase in electricity consumption is thought to be caused by aging of facilities and inefficient operation.
- Chamcar Mon WTP has high unit electricity consumption. Energy efficiency should improve with the new facility under construction.
- The water supply volume of Niroth WTP has been increasing every year since its commissioning in 2014. The unit power consumption also increases but at a low rate.
- When Niroth WTP no longer supplies water to the Ta Khmau District, more efficient operation becomes possible and improvement of energy efficiency is expected.

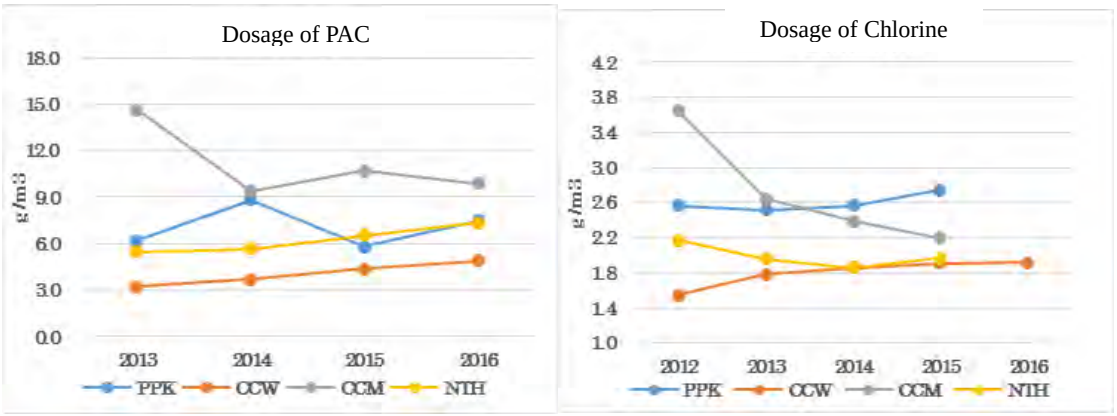
(2) Water Quality Testing Capability

All WTPs are operated directly by PPWSA to provide 24-hour water supply. Daily operating situation and water quality analysis are recorded, and the records are managed at PPWSA's headquarters in the Phum Prek WTP. Each WTP has a water quality testing laboratory, with instruments such as jar test, turbid meter, pH meter, and conductivity meter. Water quality analysis requiring other specialized analytical techniques, are carried out as required at the Phum Prek WTP.

Kitakyushu City water engineers have been working with PPWSA for a long time in Capacity Building for Water Supply System in Cambodia (Phase 1) supported by JICA. PPWSA's technical capability is high and they are capable of producing water meeting drinking water quality standards.

(3) Chemical Consumption

Alum was used as a coagulant until 2012, and lime for pH adjustment. After 2013 all WTPs switched to PAC, and pH adjustment became unnecessary. Lime has not been used since. Generally, chlorine gas is used for disinfection. In 2016 Phum Prek WTP started manufacturing its own a sodium hypochlorite on-site using electrolysis. PPWSA plans to sequentially switch other WTPs to on-site sodium hypochlorite generation. The amount of chemicals used depend on the pollution load of the water source. **Figure 2.2.4** shows the change in injection rate of PAC and chlorine at each WTP.



Source: ICA Survey Team

Figure 2.2.4 PAC and Chlorine Injection Rate at each WTP

Chemical usage comparison for the WTPs is as follows.

- PAC injection rate at Chamcar Mon WTP tends to be higher than other WTPs because the Bassac River is more polluted than the Mekong and Sap rivers.

- Ta Khmau WTP will take water from the Bassac River, downstream from the Chamcar Mon WTP intake. More chemicals may be needed at the Ta Khmau WTP.

- Chemical use is increasing at all WTPs because river pollution is worsening year by year.

(4) Environmental Impact

Environmental impact is analyzed based on 2013 to 2016 data obtained from PPWSA. The calculation method is described in the Ministry of Health, Labor and Welfare *"Guide on Environmental Measures in Water Supply Project of Japan (July 2009)"*.

Table 2.2.7 Data Categories

Category	Parameter	Unit	Remarks
Water Quantity	Intake	m^3/year	2013～2016 (4 year)
	Water supply volume	m^3/ year	Same as above
	Effective water volume	m^3/ year	Same as above
Energy	Electricity Consumption	kWh/ year	Electricity：0.6413kgCO_2/kWh
	Renewable energy	kWh/ year	Solar Power (Phum Prek WTP)
Chemical	Chemical usage	kg/year	PAC: 0.170mgCO_2/t Chlorine: 0.894mgCO_2/t
	Chemical injection rate	mg/L	Chemical usage/Intake Amount
Sludge		DS-t/year	Mekong River：113NTU Sap River：111NTU Bassac River：105NTU

Source: ICA Survey Team

The analysis results are shown in **Table 2.2.8**. The 2013 and 2016 data show an improving trend for both electricity consumption and CO2 emissions per m3 of water supply volume. This can be attributed to the introduction of solar power at the Phum Prek WTP in 2013. The renewable energy use overall is not large. PPWSA is considering the introduction of a large scale solar power system, utilizing the vacant space at one of the WTPs. Further improvement is expected if this is implemented.

Table 2.2.8 Environmental Impact Analysis

Category	item	Unit	Environmental Impact		Difference	
			2013	2016	Absolute value	Evaluation
Energy saving, CO_2 saving	Electricity Consumption per 1m^3	kWh/m^3	0.255	0.247	0.008	Improved
	CO_2 emissionsper1m^3	g-CO2/m^3	164	159	5	Improved
	Renewable energy utilization rate	%	0	2.4	2.4	Improved
Resource circulation	Effective utilization rate of sludge	%	0	0	0	Not improved
Sound water circulation	Production loss rate	%	96.7	96.5	-0.2	Worsened

Source: ICA Survey Team

There is no wastewater treatment facility in any of the four existing WTPs. Backwash water is directly released to the river, with no re-utilization. However, the production loss rate of 96.5% can be evaluated as effective.

2.2.5 Demand Forecast

The water demand forecasts in the Third Master Plan 2016 - 2030 are not based on population projections, because it is very difficult to account for non-registered population. Forecasts are based on the following parameters at the Sangkat level (92 of 102 Sangkats plan to receive water supply from PPWSA), as summarized in in **Table 2.2.9**:

1) connection density (connections /ha);

2) % of domestic connections;

3) daily consumption per domestic and non-domestic connection, and

4) % NRW

Table 2.2.9 Summary of Water Demand Forecast

Item	2016	2030	Remarks
Number of serviced Sangkat (commune)	81	92	
Connection	310,000	550,000	Including Sangkat outside Phnom Penh City
Connection density, connections/ha	0.02-290[1)] 41.0[2)]	0.3-270 38.8	Serviced area is increased by 2030.
Domestic connecting rate, %	2-97.3 80.75	63-92 79.75	Ditto
Unit domestic consumption, m^3/connection	0.52-1.70 0.94	0.52-1.80 1.02	Ditto
Unit non-domestic consumption, m^3/connection	0.98-34.86 4.19	0.9-20 3.19	The proportion of large consumers decreases in 2030.
Service ratio, %	75	?	No projection population data
Total consumption, m^3/d	449,721	855,431	
NRW, %	8	10	
Daily average water demand, m^3/d (A)	488,827	950,478	
Daily max water demand, m^3/d (B)	560,000	1,090,000	Peak factor: 1.15

Note: 1) Minimum and maximum values
2) Average values.
Source: Third Master Plan 2016-2030 (Mar. 2017)

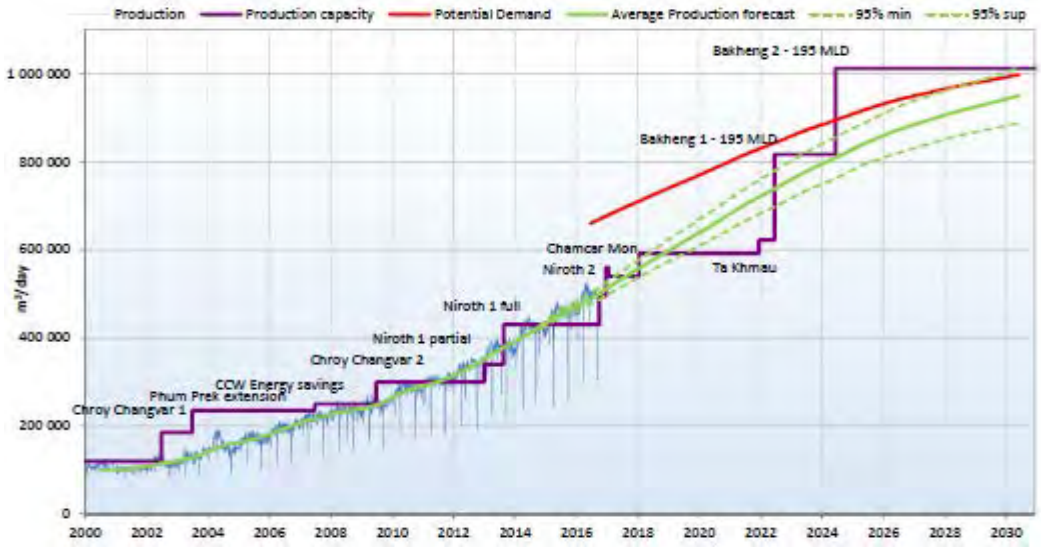
Daily maximum water demand in 2030 is estimated to be around 1,090,000 m^3/d. The current production capacity is only 560,000 m^3/d. Capacity expansion is required to meet 2030 demand as shown in **Table 2.2.10**.

Table 2.2.10 Production Capacity Expansion Plan

WTP		Capacity (m^3/d)	Remarks
Existing	1) Phum Prek WTP	150,000	
	2) Chamcar Mon WTP	20,000	
	3) Chroy Changvar WTP	130,000	
	4) Niroth WTP	260,000	
	Sub-total (A)	**560,000**	
New or Expansion	5) Chamcar Mon WTP	32,000	Expanding from 20,000 to 52,000 m^3/d by 2019
	6) Ta Khmau WTP	60,000	Finally, Third Master Plan proposed 30,000 m^3/d.
	7) Bakheng WTP	390,000	Bakheng I: 195,000 m^3/d by 2022 Bakheng II: 195,000 195,000 m^3/d by 2024
	8) Phum Prek WTP	45,000	Expanding from 1500,000 to 195,000 m^3/d by 2022
	Sub-total (B)	**527,000**	
Ground Total in 2030 (A+B)		**1,087,00≈ 1,090,00**	

Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.2.5 shows the water demand forecast and the production capacity expansion plan.



Source: Third Master Plan 2016-2030 (Mar. 2017)

Figure 2.2.5 Water Demand Forecast and Production Capacity Expansion Plan

2.2.6 Water Source

(1) Relevant Laws and Regulations

Laws and regulations relevant to water resources management and intake are summarized in **Table 2.2.11**. Water diversion and abstraction will require the approval from MOWRAM.

Table 2.2.11 Laws and Regulations Related to Water Resources Management and Intake

No.	Law and Regulation	Description
1	Law on Environmental Protection and Natural Resource Management (1996)	As the principal law on environmental protection, the law provides for a national environment policy, national and regional environment plans, assessment of impact on the environment of projects and activities, management of natural resources, monitoring etc.
2	Sub-decree No. 27 on Water Pollution Control (1999)	This Sub-decree regulates activities that cause pollution in public water areas to sustain good water quality so that the protection of human health and the conservation of biodiversity are ensured.
3	Law on Water Resources Management (2007)	This Law gives MOWRAM responsibility for resource management and water allocation.

Source: JICA Survey Team

(2) Intake Plan

Current and future plan for raw water sources and intake capacity for each WTP are shown in **Table 2.2.12**.

Table 2.2.12 Current and Future Plan for Intake

WTP	Raw Water Source	Intake Capacity	Remarks
Phum Prek	Sap River	156,000 m^3/d	Existing intake
Chroy Changvar	Mekong River	140,000 m^3/d	Existing intake
Chamcar Mon	Bassac River	60,000 m^3/d	Planning intake (to be operated from 2019)
Niroth	Mekong River	270,000 m^3/d	Existing intake
Ta Khmau	Bassac River	33,000 m^3/d	Planning intake (to be operated from 2020)
Bakheng	Mekong River	406,000 m^3/d	Planning intake (to be operated from 2022, and 2024)
Total		**1,065,000** m^3/d	

Source: JICA Survey Team, Third Master Plan 2016-2030, and Technical Feasibility Study Report (Draft version of Nov. 2017)

The minimum flows of the Sap, Mekong and Bassac rivers at 500 m^3/s, 2,600 m^3/s and 40 m^3/s, respectively, are adequate for the required raw water intake.

(3) Raw Water Quality

Raw water quality in the Sap, Mekong and Bassac rivers are described in **Table 2.2.13**.

Table 2.2.13 Raw Water Quality

Parameter		Cambodia Drinking Water Standard	Sap River[a)]	Mekong River[b)]	Bassac River[c)]
Physical	1. Temperature (C^0)	-	23.8 - 32.8[1)] 28.8[2)]	22.4 - 32.6 28.7	25.0 - 31.5 28.5
	2. pH	6.5-8.5	6.6 - 8.4 7.2	6.8 - 8.6 7.8	7.0 - 8.3 7.7
	3. Turbidity (NTU)	5	8 - 1,000 111	9 - 913 113	7 - 972 105
	4. DO (mg/L)	- (>5[3)])	0.7 - 8.1 5.3	4.0 - 9.4 6.8	6.1 - 8.4 7.5
	5. Color (TCU)	5	5.3 - 80 25	0 - 132 26	5.3 - 80 25
Mineral	6. Conductivity (μs/cm)	-	61 - 233 106	60 - 226 148	76 - 281 165
	7. Total Hardness	300	16 - 88 40	24 - 96 60	32 - 118 68
Chemical	8. Organic Matter (mg/L)	-	4 - 42 18	0.8 - 57 10	7.1 - 22 13
	9. Ammonia nitrogen (mg/L)	1.5	0 - 1.63 0.37	0 - 0.48 0.13	0.10 - 1.81 0.59
	10. Iron (mg/L)	0.3	0 - 6.4 0.6	0 - 3.4 0.26	0.09 - 1.95 0.67
	11. Manganese (mg/L)	0.1	0 - 0.12 0.03	0 - 0.2? 0.02	0.02 - 0.06 0.03
Biological	12. E. Coli (cfu/100mL)	0	0 - $3*10^3$ $7*10^2$	0 - $3*10^4$ $7*10^2$	0 - $3*10^3$ $7*10^2$

Note: 1) Minimum and maximum values
2) Average values.
3) Japanese environmental standards for rivers (Class B, the lowest level of the water source for water supply)

Source: a) Third Master Plan 2016-2030 (Raw water quality of Phum Prek WTP)
b) Third Master Plan 2016-2030 (Raw water quality of Chroy Chanvar WTP)
c) JICA Survey Team based on the information provided by PPWSA (Raw water quality of Chamcar Mon WTP, 2016)

Water quality in the Sap and Bassac rivers is poor compared to that of the Mekong River. The main issue is high concentration of ammonia nitrogen and organic matter from sewage discharge.

2.2.7 PPPs in Cambodia

In Cambodia, the government-operated water service is mainly provided in Capital city of Phnom Penh and other major provincial cities, and other area such as the suburbs of the major cities, cities and villages, the water supply business is conducted by private companies. There are more than 100 private water supply companies in Cambodia, however, there is no water law, so the water supply business is mainly provided by the private water companies without formulation of a legal system. The Ministry of Industry and Handicraft (MIH) issue Prakas (Ordinance) on Procedure for issuing, revising, Suspending and revoking Permit Supply Business in 2014, and clarified that the water service company will be licensed for 20 years if they meet a certain standard, In fact, there are several private

water suppliers, who have been doing water business in various places since 2015, have been already approved.

Through the interview with the PPWSA, it was found that Sihanoukville Water Supply Authority (SWSA) has been obtaining bulk water from a private company since 2009, because its only raw water source from Preak Tup Lake is insufficient during the dry season. Through the negotiation between SWSA and private company, it is agreed that the private company manages and operates Kbal Chhay Dam and the nearby water treatment plant and supplies 10,000 m^3 of treated water per day to Sihanouk Ville Water Authority. However, such agreement with the private company or project detail is not publicly opened, they may supply water as verbal agreement basis.

To the extent studied in this survey, only mentioned case of Sihanoukville city was confirmed as PPP classified Bulk water supply project. However, the water supply business is listed as one of the potential PPP projects being studied in Cambodia, and officially reported the possibility of the BOT style Bulk Water trading project. In 3.2 Applicable project scheme, PPP related background, objectives, business contents, financial structure, position of participating companies etc. are summarized and explained.

2.3 Japanese Cooperation

After the civil war, water supply in Phnom Penh improved with the support of the Japanese government and other donors. 90% of the city receives 24-hour water supply, and non-revenue water is only at 8%. The next goal is to boost the access to safe water in urban areas to 80% by 2015 based on “Rectangular Strategy Phase III” and “The National Strategic Development Plan (NSDP: 2009-2013)”, and 100% by 2025 based on the latest NSDP (2014-2018).

According to the “JICA Country Analysis Paper”, “*Promotion of Social Development*” is a priority. It is recognized that the need for water supply and sewerage infrastructure is especially high. In the Japanese government “Country Assistance Policy for Cambodia” issued in July 2017, the improvement of urban living environment (including water supply) and quality of life, is given high priority. The Japanese government supports Cambodian water supply development in the following projects:

- Technical Cooperation: “The Project on Capacity Building for Urban Water Supply System in Cambodia (Phase 3) (2012-2017)” to strengthen the capacity of 8 targeted provincial waterworks to manage water supply stably and sustainably.
- Japanese ODA Loan: “Siem Reap Water Supply Expansion Project” (7,161 million yen, and loan agreement signed in March 2012).
- Japanese Grant Aid: “The Project for Expansion of Water Supply System in Kampot” (2,985 million yen, and loan agreement signed in June 2012).

Like the above cooperation frameworks, the four projects proposed in the Third Master Plan can be implemented with Japanese assistance as follows:

(1) Expansion of Chamcar Mon WTP

This is underway with French assistance, to be completed in February 2019. This project is not within the scope of Japanese assistance.

(2) Construction of Ta Khmau WTP

The Third Master Plan proposes to construct the Ta Khmau WTP using Japanese aid. This project is characterized by a high ratio of low income population, originally no PPWSA service, limited space for construction, and deterioration of raw water quality. It is appropriate to utilize Japanese grant aid for this project because of these challenges.

(3) Construction of Bakheng WTP

The total loan is very large for this project and may require co-funding from Japan and France, similar to the Niroth WTP project. The discussion to finance WTP construction using French loan and selection of consultant has taken place. Japanese loan for intake and distribution facilities should also be considered since Japanese technology has advantages in the following fields:

- High-efficiency pumps: intake pumps made in Japan are used by PPWSA.
- Trenchless technologies: road and Sap River crossings and installation of transmission mains in the city centre, can take advantage of Japanese leading-edge technologies, especially with soft soil conditions.

(4) Rehabilitation of Phum Prek WTP

The Phum Prek WTP was expanded using Japanese Grant Aid and the survey on improving efficiency of WTPs was implemented by the Japanese side from 2014 to 2015. It is logical to use the cooperation scheme of JICA for the rehabilitation of the WTP.

3. CONSTRUCTION OF WATER TREATMENT SYSTEM IN TA KHMAU DISTRICT

3.1 Background Information on Ta Khmau District

3.1.1 Economic and Financial Situation

GDP per capita in Cambodia was KHR 5,117,697 (USD 1,269.9) [3] in 2016. Cambodia is one of the lower middle income countries. Average economic growth from 1994 to 2015 was high at about 7.4%[4]. In 2014, the average per capita monthly disposable income was KHR 681,000 in Phnom Penh (1.6 times higher than other cities) and KHR 435,000 in other urban centres, including Ta Khmau District. The average per capita monthly spending was KHR 622,000 in Phnom Penh (1.4 times higher than other cities[5]) and KHR 457,000 in other cities. The difference in financial conditions between Phnom Penh and other cities is significant.

Table 3.1.1 Average per Capita Disposable Income and Spending

Item	Average per capita disposable income (2014) (KHR)	Average per capita spending (2014) (KHR)
Whole Country	331,000	371,000
Phnom Penh City	681,000	622,000
Other Urban	435,000	457,000
Other Rural	265,000	321,000

Source : National Institute of Statistics, Ministry of Planning Phnom Penh, Cambodia (2015) "Cambodia Socio-Economic Survey 2014 National"

Poverty rate in Cambodia decreased from 47.8% in 2007 to 13.5%[6] in 2014. Ta Khmau District is the capital of Kandal Province, and its poverty rate was 16.0% in 2013, much higher than the 9.8% (2015) in Phnom Penh[7]. The primary sector accounts for 32% of the whole economy in Cambodia, and agriculture is the main industry. The secondary and third sectors are 22% and 38% of the economy. Textile and footwear for export are the main industries in the secondary sector, and tourism is central to the third sector[8].

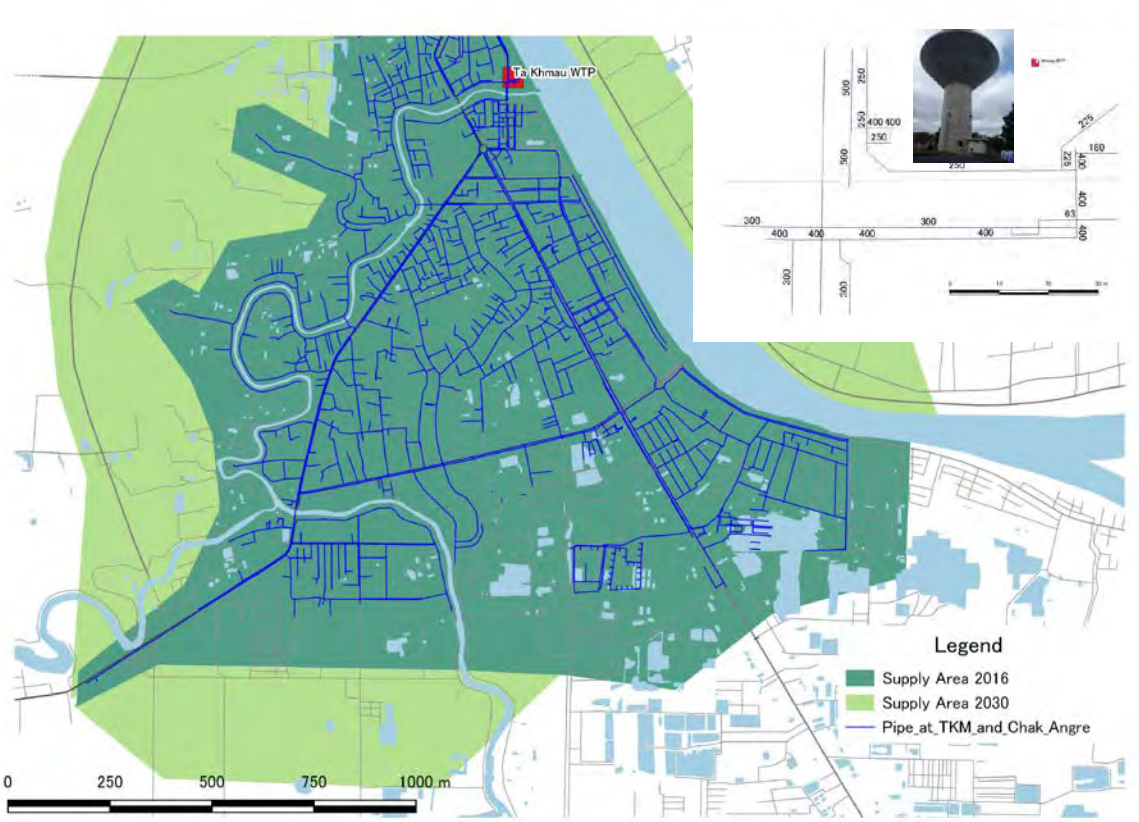
There were 41,000 business enterprises in Kandal Province in 2011, 8% of the whole country. [As comparison, Phnom Penh has twice as many business enterprises, 96,000, and accounts for 19%[9] of the country.] Annual sales in Kandal Province is KHR 3,123 billion (USD 775 million), 6.1% of the country. The size of the individual business enterprise is relatively small[10]. The average per capita

[3] The World Bank (2017) "World Bank national accounts data"
[4] The World Bank (2017) "The World Bank in Cambodia, Overview"
[5] National Institute of Statistics, Ministry of Planning Phnom Penh, Cambodia (2015) "Cambodia Socio-Economic Survey 2014 National"
[6] The World Bank (2017) "The World Bank in Cambodia, Overview"
[7] Ministry of Planning (2015) "Identification of Poor Household"
[8] Council for Development of Cambodia
[9] National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia (2012) "Economic Census of Cambodia 2011 National Report (Revised) on FINAL CENSUS RESULTS"
[10] National Institute of Statistics, Ministry of Planning, Phnom Penh, Cambodia (2012) "Economic Census of Cambodia 2011 National Report (Revised) on FINAL CENSUS RESULTS"

health expenditure of Kandal Province is the lowest in Cambodia (KHR 52,390 or US$13 in 2010), 8% of Phnom Penh (US$167)

3.1.2 Water Supply Area and Population Projection

Planned water supply area, population and water demand projection for 2030 is given in **Figure 3.1.1** and **Table 3.1.2**.



Source: JICA Survey Team

Figure 3.1.1 Planned Water Supply Area in Ta Khmau District

Table 3.1.2 Population and Water Demand Forecast for Ta Khmau District

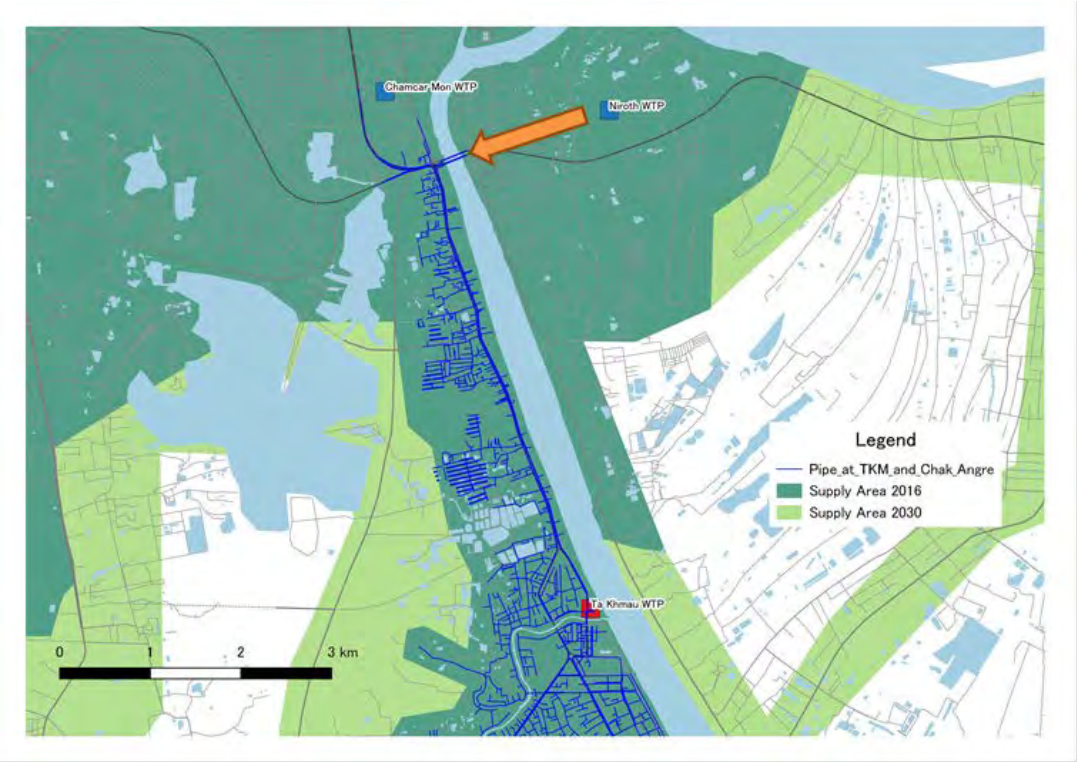
Item	Current (2015)	Target Year (2030)	Remarks
Population (person)	76,738	119,555	Third M/P: no population data for 2030
Pop. Served (person)	48,305	119,498	Connections in Third M/P 2015: 11,600 2030: 22,200
Service Ratio (%)	63%	99.9%	
Consumption (m^3/day)	11,440	22,420	Third M/P: 22,000 m^3/d in 2030
NRW (%)	8%	8%	Third M/P: 10%
Average demand (m^3/day)	12,400	24,300	Third M/P: 24,500
Peak factor	1.2	1.2	Third M/P: 1.15
Maximum demand (m^3/day)	14,880	29,200	Third M/P: 28,200

Source: PPWSA (Application Form for Grant Aid) and the Third Master Plan 2016-2030
M/P: Master Plan

3.1.3 Water Supply Situation

(1) Current and Future Supply

Since Ta Khmau District was transferred to PPWSA in 2004, drinking water in Ta Khmau has been mainly supplied by the Chamcar Mon WTP. The expansion of Chamcar Mon WTP started in October 2017, and will be completed in February 2019. Until then and with the completion of the Niroth II WTP, drinking water will be supplied by Niroth WTP via a 500 mm diameter transmission main as shown in **Figure 3.1.2**.



Source: JICA Survey Team

Figure 3.1.2 Water Supply Transmission Main to Ta Khmau District

Table 3.1.3 indicates that recent water consumption and house connections in the Ta Khmau District have increased. It is expected that water demand will continue to increase to 2030.

Table 3.1.3 Current Consumption in Ta Khmau District

	2011	2012	2013	2014	2015
Population (person)	67,662	70,500	71,497	74,273	76,738
Pop. Served (person)	35,810	37,415	38.905	43,880	48,305
Service Ratio (%)	53	53	54	59	63
Consumption (m^3/day)	7,739	7,869	8,945	10,226	11,440

Source: PPWSA

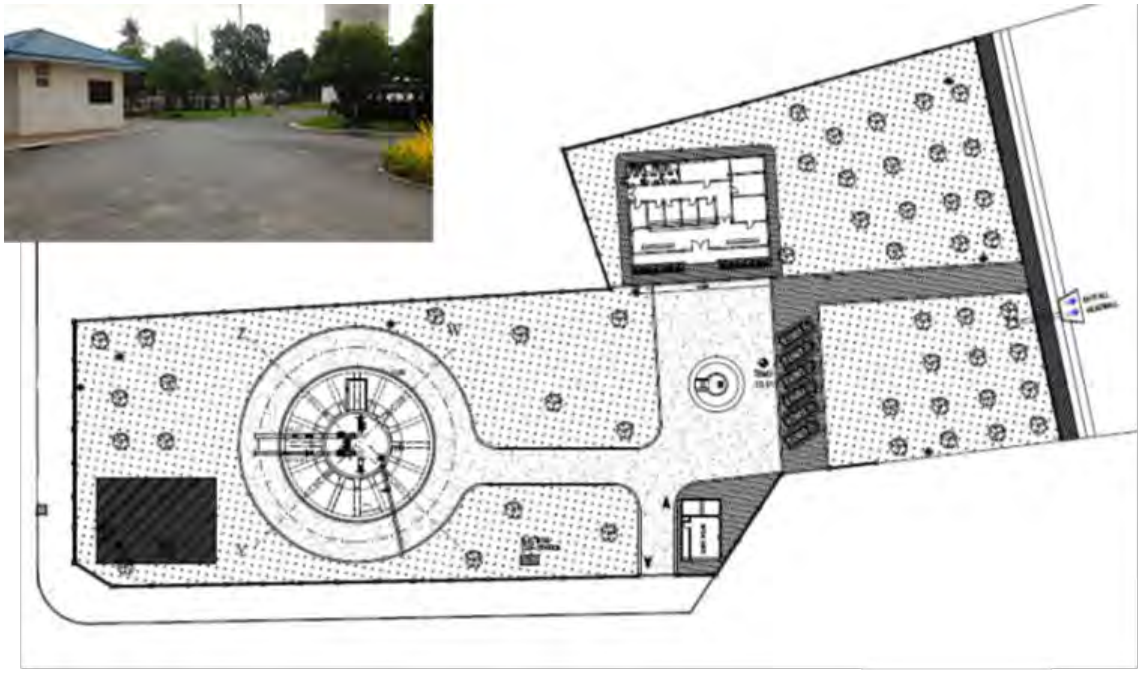
When the Ta Khmau WTP is completed, treated water will be supplied not only to Ta Khmau District but also to the south part of Phenom Penh.

(2) Ta Khmau WTP

1) Existing Facility

There is an elevated tank and buildings housing the water distribution centre and bill collection office at the site for the Ta Khmau WTP.

The site plan is shown in **Figure 3.1.3**.



Source: JICA Survey Team

Figure 3.1.3 Ta Khmau WTP Site

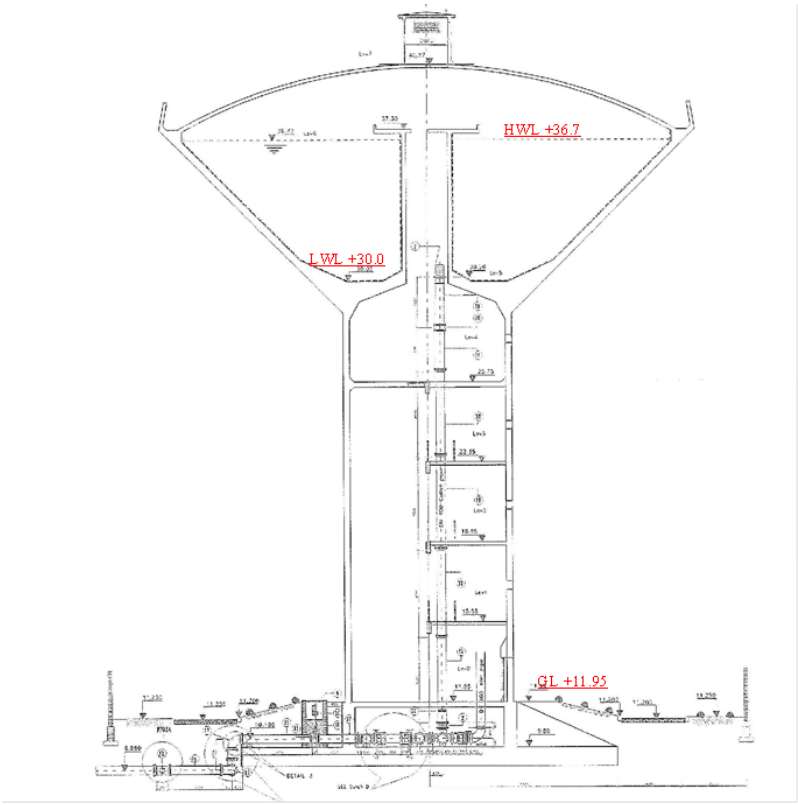
Key characteristics of the elevated tank at the Ta Khmau WTP are shown in **Table 3.1.4**.

Table 3.1.4 Key Characteristics of Elevated Tank at Ta Khmau WTP

	Volume (m^3)	Invert (mASL)	Overflow (mASL)
Ta Khmau Reservoir	1,410	30	36,7

Source: JICA Survey Team

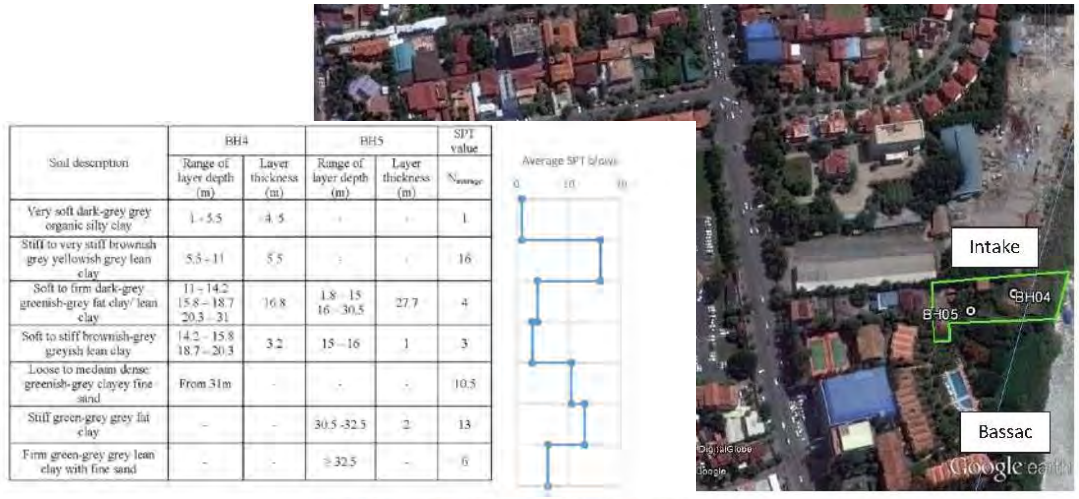
The elevated tank has a capacity of 1,410 m^3, the inflow water level is +30 mASL (ground level is about + 11 m) and the overflow pipe level is +36.7 m, and the effective water depth is about 6m.



Source: JICA Survey Team

Figure 3.1.4 Elevated Tank Structure at Ta Khmau WTP

The elevated tank has a 10 m pile foundation (**Figure 3.1.5**). Geological survey of the Chamcar Mon WTP intake shows that the soil condition is like that of Ta Khmau. Therefore, pile foundation may be necessary for the new Ta Khmau WTP to be built at this site.



Soil description	BH4		BH5		SPT value
	Range of layer depth (m)	Layer thickness (m)	Range of layer depth (m)	Layer thickness (m)	$N_{average}$
Very soft dark-grey grey organic silty clay	1 - 5.5	4.5	-	-	1
Stiff to very stiff brownish grey yellowish grey lean clay	5.5 - 11	5.5	-	-	16
Soft to firm dark-grey greenish-grey fat clay/ lean clay	11 - 14.2 15.8 - 18.7 20.3 - 31	16.8	1.8 - 15 16 - 30.5	27.7	4
Soft to stiff brownish-grey greyish lean clay	14.2 - 15.8 18.7 - 20.3	3.2	15 - 16	1	3
Loose to medium dense greenish-grey clayey fine sand	From 31m	-	-	-	10.5
Stiff green-grey grey fat clay	-	-	30.5 -32.5	2	13
Firm green-grey grey lean clay with fine sand	-	-	≥ 32.5	-	6

Source: Feasibility Study of Rehabilitation and Extension of Chamcar Mon WTP

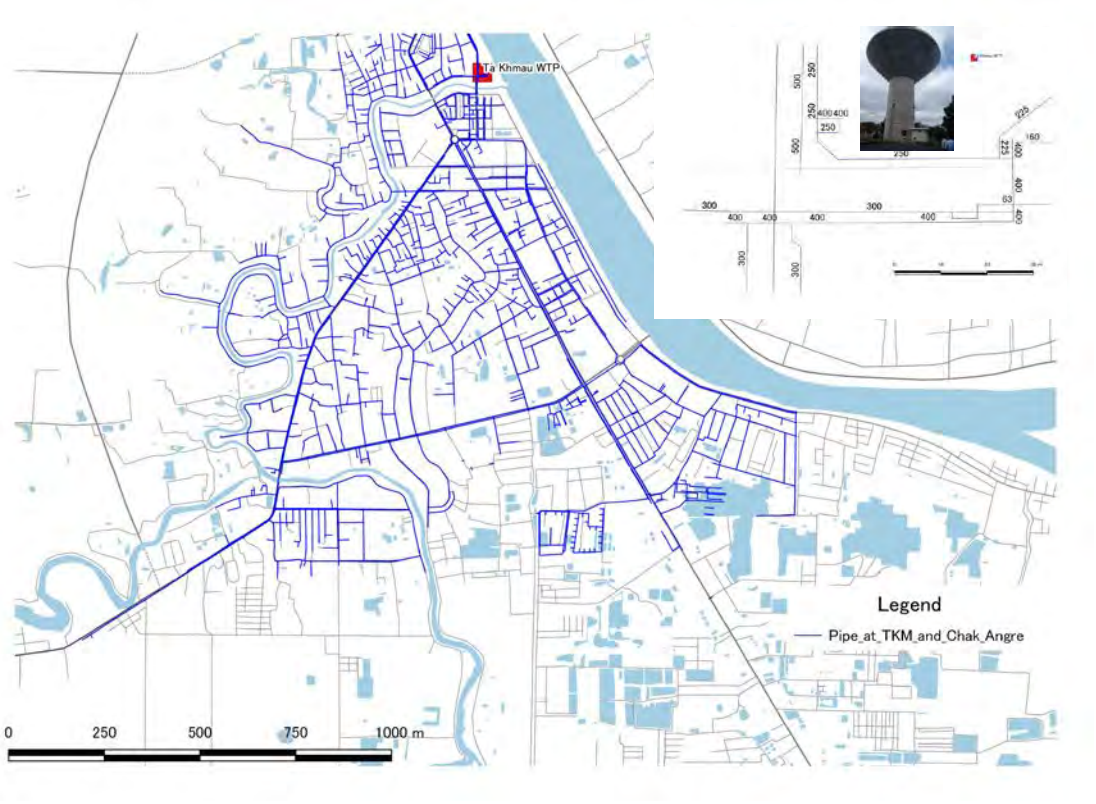
Figure 3.1.5 Results of Geological Survey at Chamcar Mon WTP Intake

2) Distribution Network

As shown in **Figure 3.1.2**, treated water is transferred from Phnom Penh to the elevated tank via a 500 mm transmission main. Two 300 mm distribution pipelines connect the elevated tank to the distribution network in the Ta Khmau District. During peak hours low pressure in the transmission main may occur, and water may be directly distributed to the Ta Khmau District, bypassing the elevated tank.

PPWSA has a central monitoring system at the Phum Prek WTP to control distribution. Flow meter and water pressure gauge are installed at the entrance of the elevated tank for monitoring and recording every 15 minutes.

Current distribution network in the Ta Khmau District is shown in **Figure 3.1.6**.



Source: JICA Survey Team

Figure 3.1.6 Current Distribution Network in Ta Khmau District

3.1.4 Necessity of Ta Khmau WTP

Ta Khmau District has been receiving water from PPWSA since 2004. PPWSA subsidizes connections for low income households. PPWSA has to construct a new WTP to deal with the increase in demand in Phnom Penh and to have sufficient capacity to supply water to Ta Khmau District in the future. The use of Japanese Grant Aid can reduce PWWSA's financial burden for these investments. At the same time, the cooperation will make use of Japanese know-how and experience in building compact treatment facilities and dealing with deteriorating raw water quality.

(1) Low Income Households

As shown in **Table 3.1.5**, the proportion of users requiring subsidies for water supply in Ta Khmau District is twice that of Phnom Penh.

Table 3.1.5 Subsidized Connections in Phenom Penh and Ta Khmau

	Total Connections	Low-income Connections	% of Total
Phnom Penh Capital City	300,244	33,373	11.1%
Ta Khmau	10,591	2,511	23.7%

Source: JICA Survey Team based on the data provided by PPWSA.

(2) Japanese Know-how and Experience

In general, 1 to 1.5 ha is required for a 30,000 m^3/d WTP. The site for the construction of Ta Khmau WTP is only 0.3 ha (**Figure 3.1.7**) and irregular (not rectangular) in shape. Japan has valuable experience in building multi-level WTPs in limited spaces.

Source: JICA Survey Team

Figure 3.1.7 Available Area for Construction of Ta Khmau WTP

(3) Pre-treatment

Pollution in the Bassac River, is worsening year by year. Pre-treatment is necessary to remove ammonia nitrogen and organic contaminants in the raw water. Biological oxidation, pre-chlorination and activated carbon absorption are typically used. Upward-flow Bio Contact Filtration (U-BCF), a biological oxidation method, used in some Japanese WTPs since 2000, is effective.

This pre-treatment can be applied to Niroth and Chamcar Mon WTPs which are located downstream of Phnom Penh and may face similar raw water problems. Through this project, PPWSA can accumulate the experience of pre-treatment for use at other WTPs.

(4) Third Master Plan 2016-2030

The WTP will be constructed in the southern part of Phnom Penh to supply the Ta Khmau District. This will allow Niroth and Chamcar Mon WTPs to focus on and improve the supply to the southern and western areas of Phnom Penh.

Water demand projection of Ta Khmau District in the Third Master Plan is summarized in **Table 3.1.6**.

Table 3.1.6 Water Demand Projection of Ta Khmau District in Third Master Plan

		2015	2020	2025	2030
Consumption	m^3/day	11,668	14,854	19,556	21,966
NRW	%	8%	10%	1%	10%
Leakage Amount	m^3/day	1,015	1,650	2,173	2,441
Average Demand	m^3/day	12,683	16,504	21,729	24,407
Peak factor		1.15	1.15	1.15	1.15
Maximum Demand	m^3/day	14,585	18,980	24,988	28,068

Source: The Third Master Plan 2016-2030

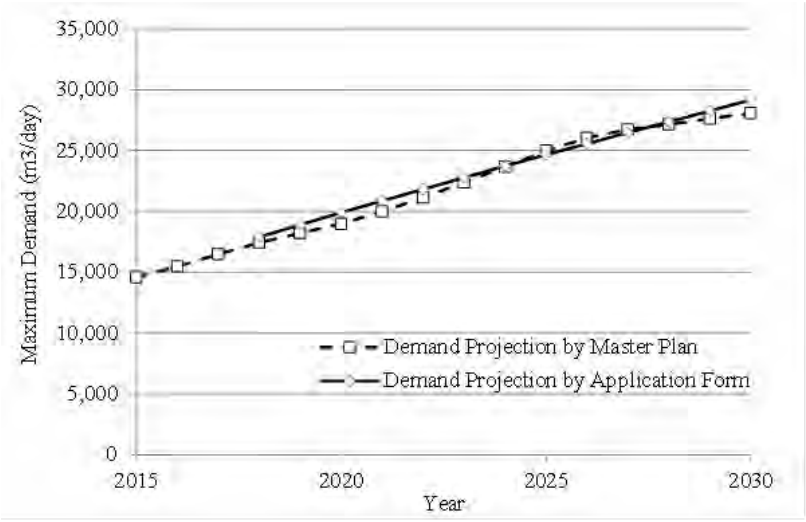
In addition, water demand projection of Ta Khmau District in "Application Form for Grant Aid from Japan" is shown in **Table 3.1.7**.

Table 3.1.7 Water Demand Projection of Ta Khmau District in the Application Form

		2018	2020	2025	2030
Consumption	m^3/day	13,749	15,292	18,952	22,416
Leakage Ratio	%	8%	8%	8%	8%
Leakage Amount	m^3/day	1,100	1,223	1,516	1,793
Average Demand	m^3/day	14,849	16,515	20,468	24,209
Rate of Loading		1.20	1.20	1.20	1.20
Maximum Demand	m^3/day	17,891	19,897	24,661	29,168

Source: The Third Master Plan 2016-2030

Water demand projection in Third Master Plan is based on connection growth while water demand projection in the Application Form is based on population growth. Although the projection methods are different, the results are not significantly different as shown in **Figure 3.1.8**. The water demand in 2030 at two projection methods is about 28,000 to 29,000 m^3/d. Therefore, it is considered that the capacity of 30,000 m^3/d is appropriate for Ta Khmau WTP.

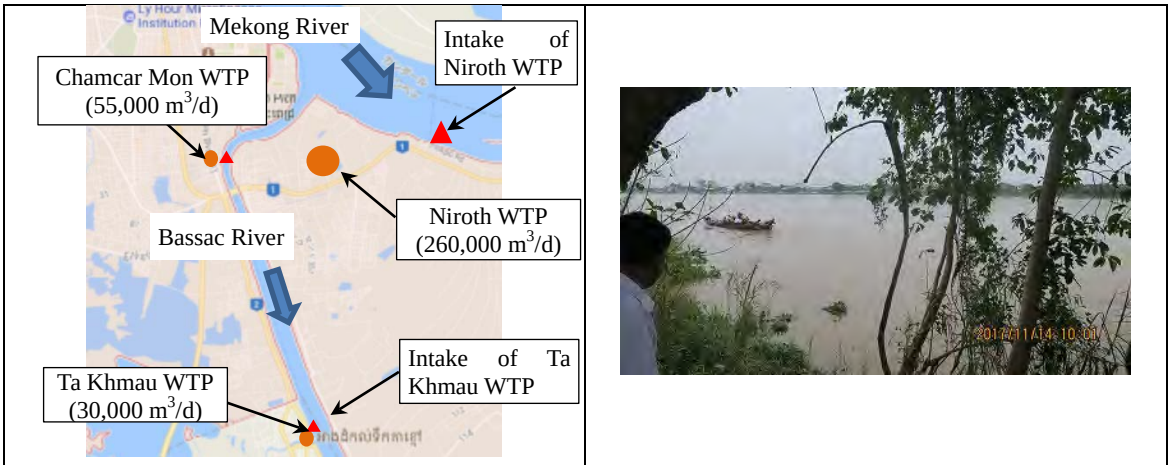


Source: JICA Survey Team

Figure 3.1.8 Comparison of Water Demand Projection

3.1.5 Water Source

The water source for Ta Khmau WTP is the Bassac River as shown in **Figure 3.1.9**.



Current and Future Water Source | Proposed Raw Water Source (Bassac River)

Source: Third Master Plan 2016-2030

Figure 3.1.9 Raw Water Source

The Bassac River is a tributary of the Mekong River. It starts from Phnom Penh and flows south to the Vietnamese border.

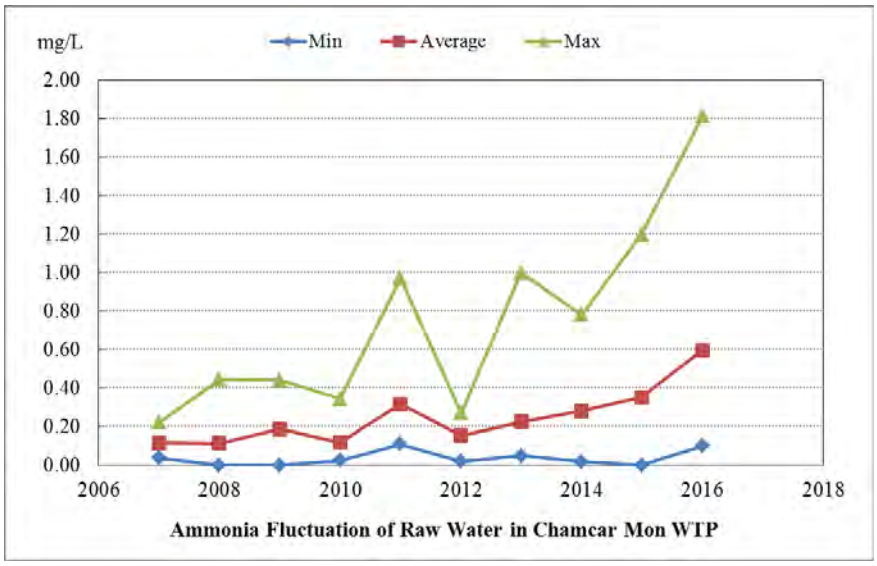
Table 3.1.8 summarizes water use and minimum flow of the Bassac River, the proposed intake capacity and approvals required for intake.

Table 3.1.8 Water Use and Low Flow of Bassac River Table

WTP	Raw Water Source	Minimum Flow of the River	Intake Capacity	Intake Ratio to Minimum Flow	Intake Approval
Ta Khmau WTP	Bassac River	40 m^3/s[1)]	33,000 m^3/d	0.95%	PPWSA to seek from MOWRAM
Chamcar Mon WTP	Bassac River		20,000 m^3/d[2)] 60,000 m^3/d[3)]	0.58%[2)] 1.74%[3)]	Approval from MOWRAM

Note: 1) Monthly average in April.
2) Capacity by 2016.
3) Planning capacity (from 2019)
Source: JICA Survey Team and Third Master Plan – Period 2016-2030

Currently there are no other water intake facilities along the Bassac River other than that of Chamcar Mon WTP. Intake quantity of Ta Khmau WTP will be less than 1% of the flow in dry season. There should be limited impact on downstream water use. However, as mentioned in **Section 2.2.6**, attention must be paid to raw water quality, especially for ammonia nitrogen and organic matter. **Figure 3.1.10** shows the overall increase in ammonia nitrogen in the raw water at Chamcar Mon WTP over the last 10 years. High ammonia nitrogen concentration in raw water could result in high pre-chlorine consumption.

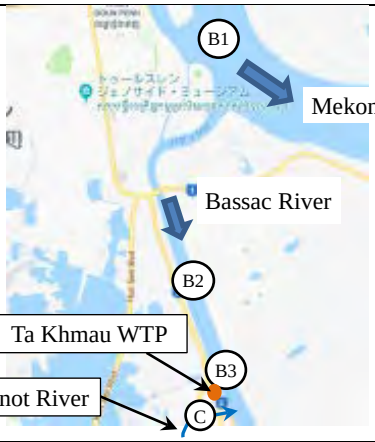


Source: JICA Survey Team based on the information provided from PPWSA (details are shown in **Appendix 9**.)

Figure 3.1.10 Ammonia Nitrogen Fluctuation in Raw Water at Chamcar Mon WTP (Bassac River)

This is caused by wastewater disposal and storm-water runoff. Because the intake facility of the Ta Khmau WTP will be located about 6 km downstream of the intake facility of the Chamcar Mon WTP, the Ta Khmau WTP may face the risk of high level of ammonia nitrogen in raw water. Therefore, it is necessary to investigate the use of pre-treatment to reduce pre-chlorine consumption and the risk from disinfection by-products (DBPs).

A simplified water quality survey along the river was conducted by JICA Survey Team. Sampling locations are given in **Figure 3.1.11** and the results are presented in **Table 3.1.9**.



Sampling Location

Pack Test (upper: NH_4-N, lower: COD)

Source: JICA Survey Team

Figure 3.1.11 Sampling Locations

Table 3.1.9 Results of Field Water Analysis

Parameter	Unit	B1 (0 km)	B2 (6 km)	B3 (9 km)	C (Prek Thnot River)	Remarks
Temperature	C^0	29.0	29.2	29.1	29.0	
pH	-	6.8	7.0	7.1	7.2	
Conductivity	µs/cm	70	70-80	70-80	200	
Turbidity	NTU	40	34	27	110	
COD_{Mn}	mg/L	8	8	8	>8	Pack test method
NH_4-N	mg/L	0.2	0.2	0.2	2	Pack test method

Source: JICA Survey Team

Although ammonia nitrogen concentration at the Ta Khmau intake (B3) is low (0.2 mg/L) compared to that of the Chamcar Mon WTP (0.59 mg/L), COD_{Mn} concentration is relatively high (around 8 mg/L). In addition, very high concentration (2 mg/L) of ammonia nitrogen is detected at the Prek Thnot River where it flows into the Bassac River 100 m downstream of the Ta Khmau intake.

3.2 Potential Project Schemes

3.2.1 Trend of PPP and Procurement of infrastructure in developing countries

After the shift from the MDGs to SDGs in January 2016, infrastructure-related objectives (health, education, water & sanitation, energy, infrastructure, industrialization, innovation, sustainable cities, means of implementation, etc.) have set up. However, ODA investment amount is not sufficiently enough to cover the huge capital necessary for developing countries, private investment is emphasized, and ODA is now expected to play as a role of the catalyst for the promotion of private investment. In addition, the quality and efficiency of public services are increasing through the effective use of the technological and efficiency efforts of private companies. By procuring both the facility construction and the operation and the maintenance management business, improvement of the quality of facilities and its performance guarantees are also promoted in addition to reducing the life cycle costs, including both construction and maintenance costs.

3.2.2 PPP policy in Cambodia reflecting the trend of international PPP business

After the financial crisis in 2008, Foreign Direct Investment (FDI) has risen and the Cambodian economy is recovering significantly. However, corruption, regulatory uncertainty, high-cost unstable supply energy, political instability and inadequate logistical environment are cited as a major constraint for companies. The financial sector, which is linked to the dollar economy, can only fund short-term finance with high interest rate and is further constrained by the absence of interbank-markets. Cambodia has a shortage of infrastructure compared to other Asian countries, and further investment is being sought to increase competitiveness in Cambodia. Industrialization and urbanization are rising rapidly, and demand for new infrastructure and related services is increasing. Although Royal government's investment plan for infrastructure is clearly stated in the long-term sector development plan, the total investment in Cambodia's infrastructure is estimated at 12 billion to 16 billion dollars from 2013 to 2022, but in fact, as the demand for public investment in the water sector is expected, infrastructure investment has become state-driven type.

The Royal Government of Cambodia has been taking steps to improve the investment climate and levels of investment in infrastructure. Comprehensive sector development plans for infrastructure have been prepared, but implementation is constrained by institutional weaknesses and limited borrowing capacity. Most funding for infrastructure is sourced from user fees for services provided by state-owned enterprises (SOEs), and through public sector borrowing on a concessional basis. SOEs have limited capacity to borrow due to the lack of availability of long-term debt in local financial markets. The amount of public sector borrowing is limited by the size of the country’s tax base, which is low and does not reflect the demand for infrastructure facilities and services. In December 2011, all public-sector debt, by law, was sourced on a concessional basis, and there was no commercial debt program. Government and official development assistance (ODA) funding resources are insufficient to meet Cambodia’s large infrastructure funding needs. To date, the Royal Government has not sought less concessional ODA from sources such as the International Bank for Reconstruction and Development (IBRD) and ordinary capital resources of the Asian Development Bank (ADB) to meet its large infrastructure investment needs due to concerns about its borrowing capacity.

Public–private partnership (PPP) can help the government meet this financing gap by stimulating private sector investment and financing for infrastructure. PPP provides a means to improve efficiency and service delivery to users and gain access to new expertise and technology, reducing annual costs of infrastructure to the government, and freeing up the fiscal space. Recognizing these factors, the ADB country partnership strategy (CPS) 2011–2013, endorsed by the Board in July 2011, calls for PPPs to be “actively sought in all areas of operations.” The CPS provides an undertaking for ADB to carry out a PPP assessment in 2011 to identify the potential for PPPs in the Cambodia Program. Consequently, a joint PPP assessment mission was fielded by ADB and Agence Française de Développement (AFD) on 22–31 August 2011 to investigate the potential for PPPs in Cambodia, to assess the level of “PPP readiness” in the country, and to identify potential measures and opportunities to expand PPP. In this way, it is understood that the system design of the PPP business in Cambodia is advanced by ADB and AFD.

A PPP is a genuine partnership between the public and private sectors, in which risks are allocated between the two parties to create a risk profile whereby risks attached to economically important projects for the government have an acceptable credit profile for financiers. These partnership arrangements can be reinforced through the provision of "government support" to make projects "bankable." While the mobilization of private sector capital is often a primary motivation for governments to use PPPs, it is critical that these projects, and the associated levels of government support, are economically sustainable over the long term, and represent a least-cost solution for the government.

The basic idea for the institutional design of such a Cambodian PPP business was outlined in July 2012, study entitled "Assessment of Public-Private Partnerships in Cambodia Constraints and Opportunities", and it is thought that the PPP business is maintained while complying with this idea. The basic concept defined for the water sector will be described below.

The PPP policy paper for public investment project Management 2016-2020, mentioned that private sector involvement will bring about additional sources of funding, knowledge, knowhow, and modern technology to the public sector which allows the sector to develop and manage the operation of public infrastructure investment projects in a more innovative and effective manner to respond to increasing needs of the people, which aligns with the Royal Government's policies and vision. The Royal Government is developing PPP short-term measures as well as medium and long-term measures for the PPP approach. This progress will be described later.

3.2.3 Policy Paper on PPP for Public Investment Project Management 2016-2020

This policy Paper is composed of the following four parts.

Part 1: Policy documents on PPP for public investment project management 2016-2020
Part 2: Institutional capacity and Human Resource development plan for management of Public investment projects through public Private partnership.
Part 3: Decisions on establishment of the Inter-ministerial committee for steering the Implementation of Policy on Public Private partnership.
Part 4: Technical working group on Formulation of the Policy Paper on Public Private Partnerships for Public investment Project Management 2016-2020

The Royal Government has promoted and encouraged private sector to participate in public infrastructure investments by setting out policy and legal instruments and other necessary measures to strengthen and widen partnerships with all partners as reiterated.

The Vision of PPP for Public Investment Project Management is decided as follows;

By the end of 2020, the Royal Government has to fully develop and implement a comprehensive and interlinked system in accordance with the international standards in order to manage public investment through PPPs. The system shall also contribute to enhancing the management of risks associated with contingent liabilities that may arise from the implementation of public investment projects through PPPs. Achieving this vision will bring about not only additional sources of funding from private sector and financial institutions which complement traditional sources, but also modern technology and innovation to increase the effectiveness of public service provisions as well as the

economy's competitiveness.

Definition of the PPP is as follows;

PPP is an investment agreement between the state and one or more private partners to restore, build, repair, maintain and/or manage the operation of public infrastructure or other economic productivity enhancement sectors or to provide public services within a certain period of time by which the private party shall invest, bear risks and receive benefits in accordance with the provisions stipulated in the concession contract.

Many Countries in the world have developed solid, clear and comprehensive legal and policy framework, institutional mechanism, financial support mechanism and institutional capacity and human resources. Specifically in the financial Support mechanism, two types of special funds, such as "Project Development Facility (PDF)", and "Viability Gap Funding (VGF)" have been established and managed by the Ministry of Finance of many countries.

Through the interview with the MEF (Ministry of Economy and Finance), who created the policy document for the short-term measures, we found that these short-term works are progressing smoothly, and the items described as a medium-and long-term measures will start after 2020.

The possibility of the problems and business related to the water field described in assessment of public-private Partnerships in Cambodia Constraints and opportunities described above are as follows.

Water Sector :

The water sector is being impacted by rapidly intensifying urbanization. The urban sector accounts for 20% of the population and approximately 50% of GDP. By 2020, the urban population is expected to account for 30% of the population and may account for 70% of GDP. Phnom Penh Capital City dominates the urban sector, accounting for 55% of the urban population, and it currently attracts about 80% of investments and 21,800 immigrants per year. There are significant regional disparities, with more than 76% of residents in Phnom Penh Capital City having access to piped water supply compared to the national average of 42%. Private companies (or small-scale providers) provide access to water supply for a further 10% of the urban population. Wastewater treatment plants exist in Phnom Penh Capital City, Preah Sihanouk, Siem Reap, and Svay Rieng. Additional small-scale systems exist at health facilities at various locations in Cambodia. In areas without coverage, wastewater is discharged directly to the subsoil or via open drainage channels to surface water, or using various forms of on-site sanitation facilities.

The water sector in Cambodia is highly decentralized, with the national ministries MIME and the MRD retaining authority over water sector policy and approval of major projects, while the local government agencies are responsible for the water supply services in their respective jurisdictions. There is no independent regulator in place to oversee tariff adjustments. While the system is expanding, investment is constrained by difficulties in accessing sufficient funds to increase coverage and improve services. There are also institutional challenges impacting the system following the government's comprehensive decentralization and deconcentration reform program. The Strategic Framework for Decentralization and Deconcentration Reforms of 2005 gives legal responsibility to provinces, districts, and commune councils to administer their affairs, including the preparation of development plans and the oversight and evaluation of projects.

The government considers improved access to water supply and sanitation to be a prerequisite for poverty reduction. MIME and the MRD jointly prepared the National Policy on Water and Sanitation in February 2003. A sector strategy for urban and rural water supply and sanitation (2010–2028) has recently been prepared which estimates the amount of investment required in the sector up to 2028 is $19 billion.

In March 2010, MIME finalized its action plan for 2009–2013, focusing on three programs: (i)

facilitating PPPs, (ii) strengthening the management of publicly owned water supply agencies, and (iii) integrating urban water supply with urban environmental management. Considering the large investment needs in the sector, expansion of the local private sector is seen by the government as being essential in both rural and urban areas. There is a bulk water project in Preah Sihanouk and more than 300 small-scale private water supply operators are registered, but capacity is low, operating costs are high, and service delivery is poor. Effective regulation is required to facilitate investment from the private sector.

The MRD is presently scaling up its efforts to increase private sector involvement in rural water supply and sanitation, and Phnom Penh Capital City has some small-scale community-based solid waste management projects, but much more could be done in this area.

In terms of future potential for ADB and AFD PPP-related activities in the water sector, there appear to be large project development opportunities, particularly in the area of bulk water using BOT structures.

Quoted from "Assessment of PPP in Cambodia Constraints and Opportunities."

3.2.4 Japanese Grant Aid for PPP project

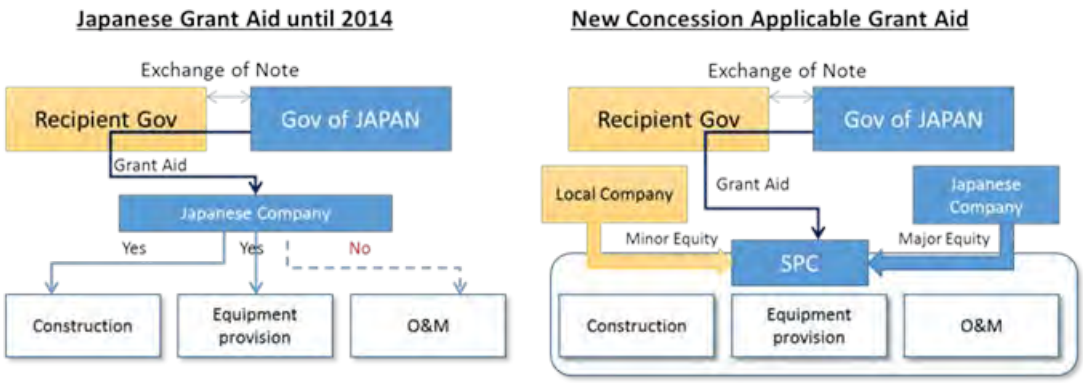
In the past, infrastructure development was generally performed by the government as public works projects, as economic development assistance projects, or as MDBs funded projects, however in the large cities of Southeast Asian countries with extremely high population increase and remarkable population inflows to those cities, the actual demand for infrastructure development greatly exceeds planned new infrastructure supply based on the conventional measures.

One method to solve this problem is utilization of private investment. However, from the viewpoint of private investment based on the economic profitability, a low usage fee rate for public services in developing countries often stands as a barrier for the business establishment. Besides, considering the disposable income per capita in developing countries, such usage fee for public services must be within the users' expenditure level.

From the viewpoint of promoting the improvement of public infrastructure, a developing country government should guarantee the profitability of private investors through VGF or through reducing investors' initial investment using donor grant aid.

Japanese Grant Aid can be used for the concession project for infrastructure which is constructed and operated by the Japanese company since 2014; we call this Japanese Grant aid as "Grant Aid for the Project for Grant-PPP Scheme". Such Grant Aid is useful for an infrastructure project, which can produce a big social benefit in case such project is implemented.

Until 2014 Japanese Grant Aid could be used only for the construction of infrastructure facilities for operation by the local implementation agency or local operators after handing-over such facilities to the local implementation agency.

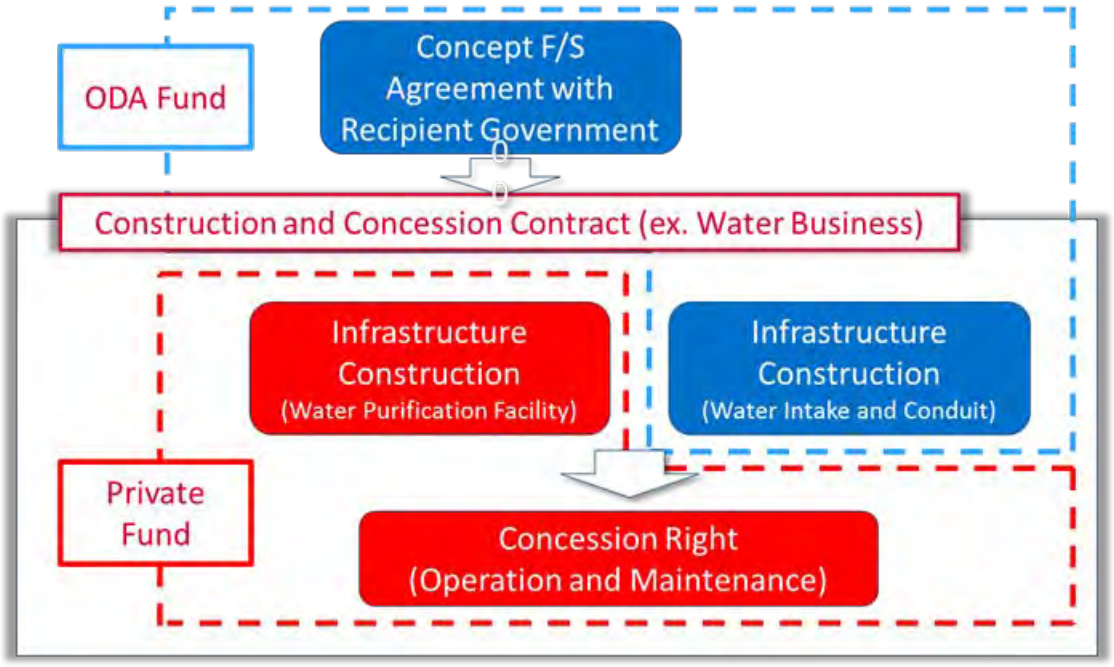


Source: JICA Survey Team

Figure 3.2.1 Japanese Grant Aid Scheme

Grant Aid for the Project for Grant-PPP Scheme provides grant aid money to the recipient government to construct such above-mentioned infrastructure facilities through the management of JICA or a procurement agent. The recipient government retains the ownership of the facilities; however, such facilities can be used by the Japanese investor / operator with a nominal value, which means the capital investment cost will be reduced in the amount of the such grant aid amount.

The following chart shows at typical scheme of the Japanese Grant Aid for PPP project.



Source: JICA Survey Team

Figure 3.2.2 The Typical Scheme of the Japanese Grant Aid for PPP Project

(1) Purpose of the Project

In developing countries, public and private partnerships are being promoted, and it is expected that the private companies will take advantage of the technology and know-how they have to manage their

business over the medium to long term. Through Grant Aid PPP scheme in public works, Japan's excellent technology and know-how can be used where private companies are involved in comprehensive implementation of facility construction and operation and maintenance.

(2) Business Structure

1) Outline of the business

In the case of the infrastructure business undertaken by the developing countries, if financing is not sufficient with commercial capital, the Japanese Government will provide the necessary funds for the facilities, equipment and other services necessary for the business. The funds are paid from the recipient government to the special purpose company (SPC) which carries out the business through the developing country.

2) Research phase (survey - prior to business implementation)

a. prior to the request from the recipient country, a private company proposes the business model to such Government. The Recipient Government examines the proposal and request to Japanese Government.

b. In the survey, the concept of business will be confirmed while incorporating the ideas of private companies. Depending on the maturity of the proposal of the private sector, it may be necessary to conduct both a survey and a business appraisal to reinforce the proposal of a private company, and only to review the business feasibility. In the business feasibility study, competitiveness and fairness will be confirmed through the market soundings.

c. From Japan, the results of the survey will be handed over to the Governments of developing countries. In such case, the recipient government and the Government of Japan will prepare a document (MOU, etc.) to agree the results of the survey (business concept, bid documents, etc.) and secure the involvement of the other party.

d. Exchange of Notes (E/N) will be concluded based on the normal procedures. The main contractor will provide facilities development and the O&M services paid for from Japanese Grant Aid fund, is assumed to be the Special Purpose Company (SPC) represented by Japanese company. The tax exemption shall be applicable to the products and services provided by Japanese Grant Aid funds, and the details shall be determined in consultation with the government of Cambodia.

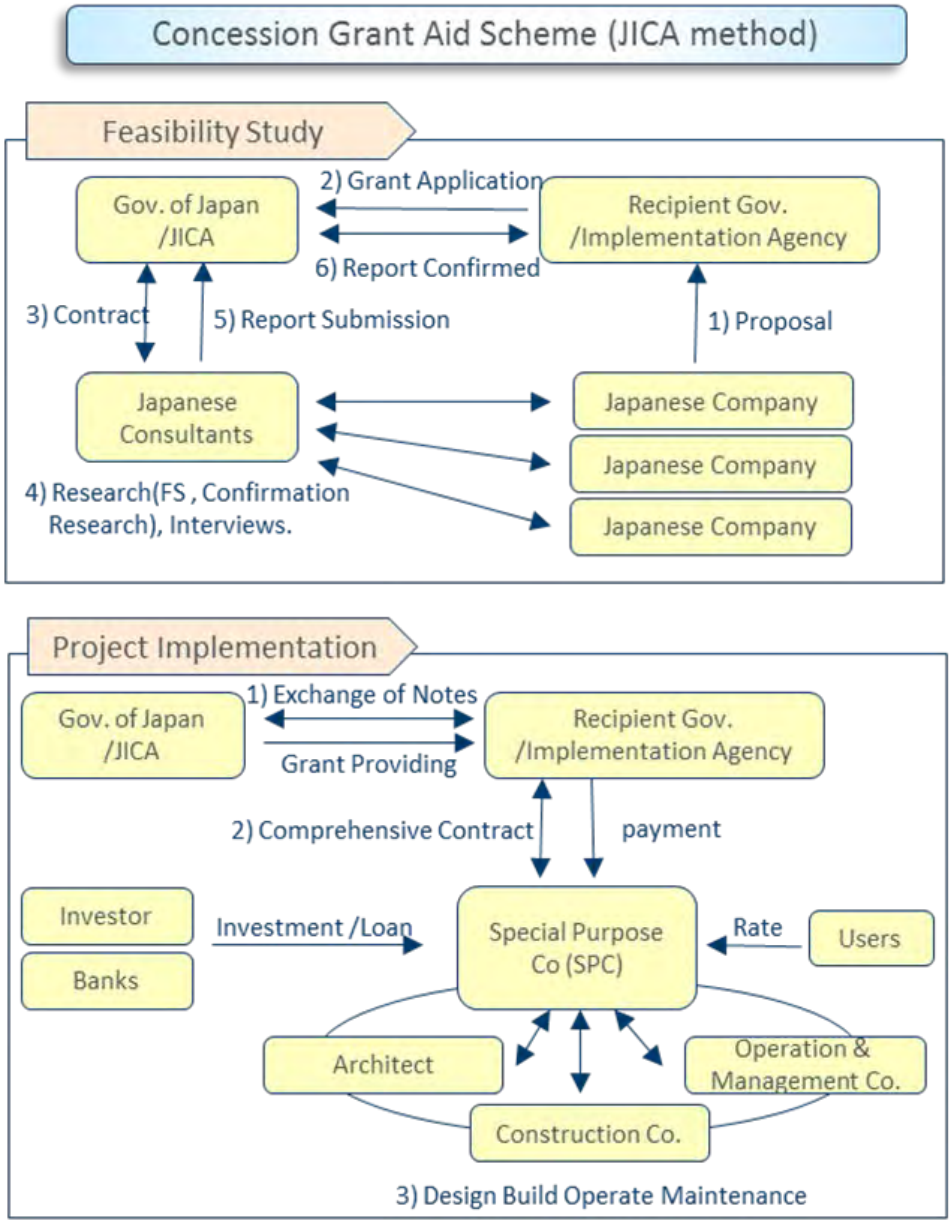
e. Japanese Grant Aid fund will be provided.

3) Project Implementation Phase

a. The developing country procures the business according to the business concept agreed by the two countries. Competition and fairness shall be ensured by the use of general competitive bidding.

b. The SPC will operate the business over the medium to long term construction and operation & maintenance.

c. Japanese Grant Aid money is remitted to SPC as the payment for the procurement of products and services related to the project.



Source: JICA Survey Team

Figure 3.2.3 Business Structure

3.3 Identification of the Scope of Project

3.3.1 Background of this Project

This is a project to develop a water treatment plant in the Ta Khmau district, located 11 kilometers south of Phnom Penh by utilizing the Japanese Grant Aid scheme.

Background information of this project is as follows.

a. In recent years, water demand has increased due to the increase in population and commercial facilities in the area around Phnom Penh Capital City. By 2030, it is forecast that additional facilities will be needed for an average of some 500,000 m^3/day, and thus improving the water supply capacity of PPWSA is an urgent need.

b. In Ta Khmau District, the main source of the public water supply used to be the well water and public water supply service taking raw water from the Bassac River, Population explosion and the detection of arsenic contamination in multiple wells has markedly increased water demand. Royal Government of Cambodia instructed PPWSA to connect the water distribution pipe of Ta Khmau directly with Phnom Penh's water supply district and water supply through PPWSA has been provided since 2004. With the change of the water supplier to PPWSA, ownership of water supply facilities and land have been transferred from the Ta Khmau District to PPWSA.

c. The Ta Khmau District is a region with many low-income residences in the metropolitan area, and PPWSA is trying to take measures such as exemptions of water connection to the low-income residence.

d. Ta Khmau District, south of Phnom Penh Capital City, is located at downstream of the Bassac River. The quality of intake water from Bassac River is poor compared with the quality of the water intake at upstream of the Mekong River in the northern part of Phnom Penh Capital City. This results in high purification costs.

e. Moreover, the land owned by PPWSA in Ta Khmau District for the construction of a Water Treatment Plant (WTP) is relatively narrow with 0.3 ha.

In order to perform advanced water purification in narrow land, application of Japanese Grant Aid PPP scheme is studied.

3.3.2 Identification of the Scope of this Project

According to the PPWSA's Third Master Plan- Period 2016-2030, only summary information of the Ta Khmau project plan was given as follows;

Capacity of Ta Khmau WTP is expected to be 30,000 m^3/d, Start the construction early 2018 to be completed in the end of 2019. The WTP will be operated by a SPC formed by PPWSA and a Japanese company.

In Cambodia, there are cases where some private WTPs are being managed by private enterprises such as Sihanoukville, we recognize that majority of investments, cost factors such as operation, maintenance and interest expenses, and the collection of usage fees were operated as a public utility company.

However, as the PPP method is being standardized globally, even in developing countries, if the burden of Viability Gap can be eliminated by an appropriate subsidy to the private investor, it is

possible to introduce a mechanism that allows the private sector to access funds for the public infrastructure investment and this same private investor can take the business risk.

The following illustration shows the business scope options when implementing water utility business using PPPs.

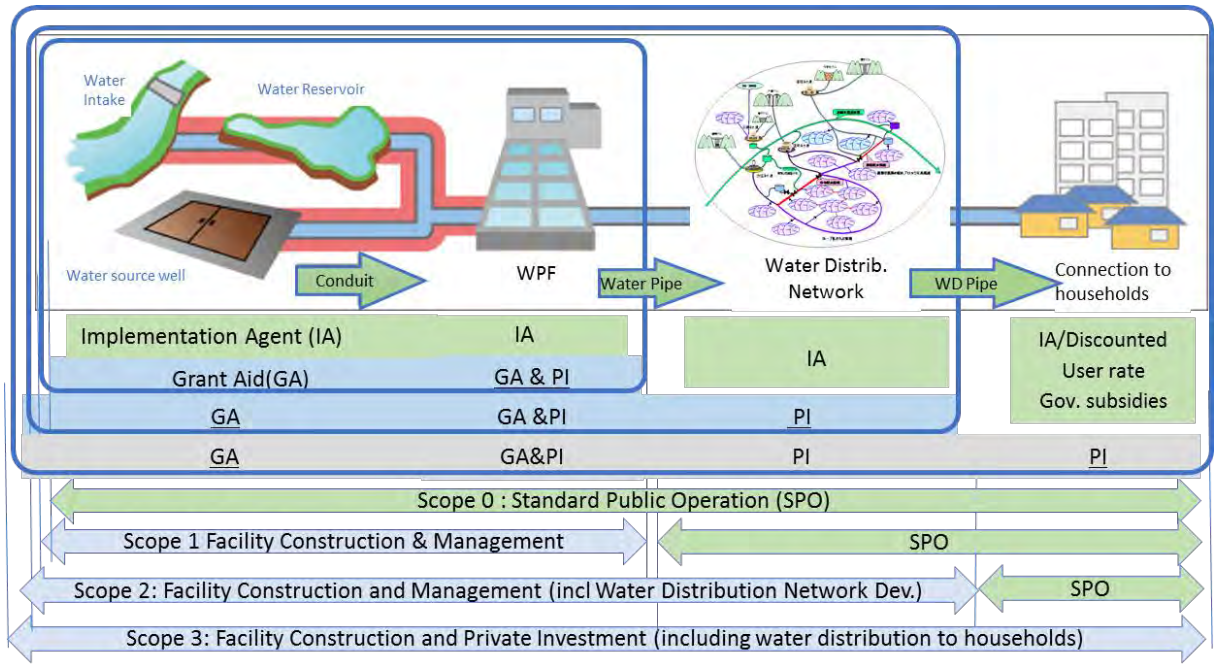
Scope 0: Public project with no PPP elements, where the water taken from a river is sent to the water treatment plant via a water conduit, the water is purified, purified water is transferred to the water distribution plant, and water is supplied from here to each home via the water supply network. PPWSA will carry out the entire task of providing water supply. The business model anticipates that a reduced user fee will be applied, and that government subsidies are provided to the public company.

Scope 0: A model which excludes private operator's participation at any stage. This is very similar to the current scope of PPWSA's operation.

Scope 1: PPP method can be used through grant aid programme used to construct a water purification facility. The project period is shorter than the service life of the facility; it is ten years.

Scope 2: Utilizing Grant Aid money funds as per scope 1 but additionally including the expansion of the water distribution network by private investment. The operation and maintenance service of the Water Treatment Plant and Investments in the expansion of the water distribution network will be recovered by the sale of bulk waters to PPWSA. Water supply to each household is implemented as a public utility operation as same as in Scope 1.

Scope 3: The scope or the project maintained by private investment is the same as Scope 2, which utilizes Japanese Grant aid money, but private investment is extended to connection of water pipe to individual residence and the fee collection service is also included. In this case, in addition to the sales of the bulk water to the PPWSA explained in the above-mentioned Scope 2, SPC will receive a service charge from the users and should there be a viability gap, a subsidy from Cambodian government to allow the SPC to do reasonably profitable business.



Source: JICA Survey Team

Figure 3.3.1 Potential Project Scope of Water Business using Grant Aid and Private Investment

Interview with PPWSA has confirmed that the scope of business in this project and the demarcation of the public and private roles were confirmed to be the Scope 1; construction of water treatment facility by utilizing Grant Aid money and operation.

3.4 Study and Proposal of Business Model

In this project, the following business models are considered.

(1) PPWSA is the business operator

1) PPWSA will charge the user to recover investment cost, this is a sustainable to-be model,

2) PPWSA will recover the amount of investment that cannot be recovered by the existing user fee by Additional Investment.

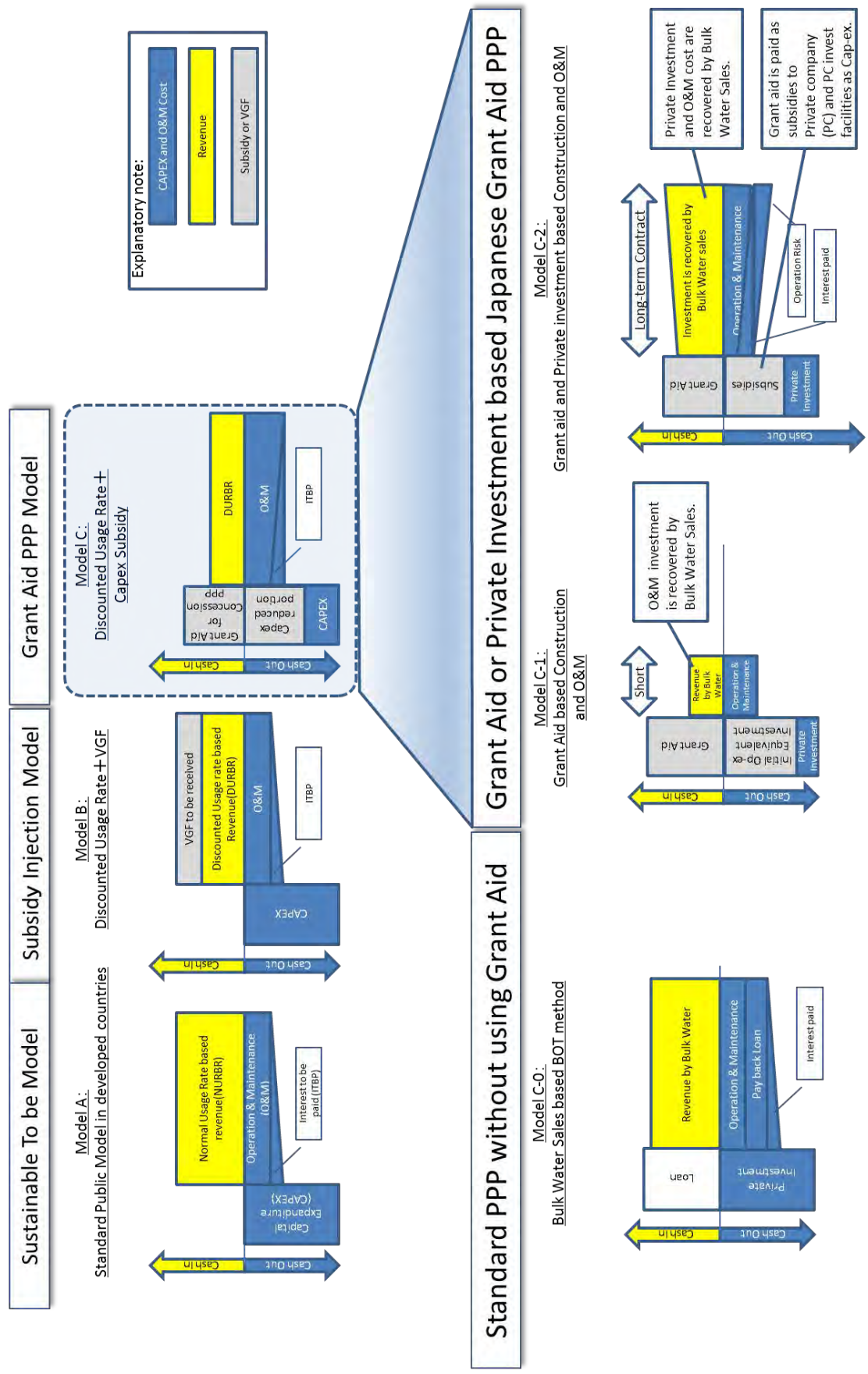
(2) PPP business model sells bulk water to PPWSA

1) PPP business model; Private firm invests in facilities, and sells bulk water to PPWSA,

(3) PPP model using Japanese Grant Aid for Concession business

1) BTO style business model; SPC constructs the facility using Grant Aid and same SPC operates the facility,

2) Grant Aid used as a subsidy to the business operator, and a BOT style project invested and operated by same private investor.



Source: JICA Survey Team

Figure 3.4.1 Comparison of Business Models

Figure 3.4.1 presents a comparison of these five business models.

1) Sustainable to be model (Model A)

This is sustainable to-be model that envisages users paying sufficient fee to recover initial investment.

2) Sustainable with Additional fund from PPWSA (The model B)

Additional funds during the time of operation are required; it is difficult to recover the investment in the facilities through water charges levied from people with low disposable income. Therefore, in order to be able to take a profit from the business, the additional funds must be invested voluntarily.

3) The standard PPP scheme without using Grant Aid money (model 0),

The investment of the facilities maintained by private company is covered by the bulk water sales, which is described in the Cambodian PPP policy paper.

4) Facility development and Operational model using BTO Method (Model C-1) used Japanese Grant Aid Money

The facility will be developed by using Japanese Grant Aid money, and transfer the ownership of the facility transferred to the implementation agency (PPWSA) after completion of the facility development. If the method of setting the price applied to the lease to a third party of the assets owned by the implementation agency (PPWSA) is specified by domestic law and Ordinance, in order to reduce the substantial initial investment cost, which is the purpose of this business scheme, it is desirable to agree to clarify the source of funding for the necessary maintenance of the asset and repairs. In this model, the asset is transferred to the implementation agency (PPWSA), therefore the BTO method is applicable as the asset will be operated by private companies responsible for the design build and operation of the facility. The operating expenses and profit of the business will be recovered through means of a bulk water purchase agreement with the implementation agency (PPWSA). The existing E/N template can be used without modification for this project.

5) The private investment recovery model (model C-2)

Grant Aid money is used as subsidies to Japanese company made by the Cambodian government. The project style will be BOT, because Japanese company will retain the ownership during the business operation period. The private investment, and operating expenses and operating profit are recovered by bulk water sale. However, this is a business model is not considered applicable under the existing E/N templates.

Table 3.4.1 Consideration of the Business Models

Models	Applicability of Japanese Grant Aid	WTP build by private investment	Others build by private investment	Payment Mechanism
Model C-0		WTP of 30,000 m^3/d	Other Facilities	User fees will be the source of fund to pay the contractor.
Model C-1	WTP of 30,000 m^3/d	－	－	Operation cost and profit recovered by bulk water sales.
Model C-2	Subsidies to Japanese companies	WPF of 30,000 m^3/d	Other Facilities	Private investment and operating expenses recovered by bulk water sales.

Source：JICA Survey Team

Through the interview with Japanese companies in Phnom Penh Capital City, we found that water purification facilities built and maintained based on these requirements have to use Grant Aid funds because they cannot be recovered through existing user fees.

a) The land owned by PPWSA has limited space, it is difficult to obtain other appropriate land in a short period of time.

b) In order to produce 30,000 m^3/d in the limited sized land, the water purification facility has to utilize Japanese advanced technology.

c) Due to the poor water quality obtained from the southern side of Phnom Penh Capital City, it is necessary to develop facilities that are accompanied by processes such as pre-treatment utilizing advanced Japanese technology.

3.5 Financial Analysis of Suggested Project Scheme

3.5.1 Project Period, Construction Cost and O&M Cost

Cash flow analysis was conducted, based on the above-mentioned project scheme. The construction period is from 2019 to 2021 and the operation period is from 2022 to 2051 (Operation period of Model C: 2022-2031). The inflation rate during the project was 3%[11]. Construction costs are shown below. Land acquisition was already conducted, and the cost for new land acquisition will not be required. The above conditions are common conditions for all models of financial analysis. The price level year of the following construction costs is 2017.

Table 3.5.1 Construction Costs of New Ta Khmau WTP

Item		Cost（KHR million)	Cost（Yen million)
Facility	Intake Facility	33,894	936
	Water Purification Facility	93,209	2,574
Equipments	Instrument for Water Quality	404	11
Soft components		6,456	178
Design/ Management		13,316	368
Total		147,278	4,068

Source：PPWSA (2017) “Application Form for Grant Aid from Japan

The O&M cost in financial analysis is based upon the amount of maximum daily water production (30,000 m^3/day). Furthermore, if water production is less than 30,000 m^3/day, the O&M cost will increase. (Price level year for the following O&M cost is 2022.)

Table 3.5.2 O&M Cost of New Ta Khmau WTP

Amount of Maximum Daily Water Production	15,000 m^3/day	20,000 m^3/day	30,000 m^3/day
Item	Cost (KHR/m^3)	Cost (KHR/m^3)	Cost (KHR/m^3)
Electricity costs	238	234	230
Salaries[12]	202	151	101
Raw materials for water treatment	61	61	61
Repairs and maintenance	205	156	107
Other expenses	56	42	27

[11] IMF (2017) “World Economic Outlook Database, October 2017”

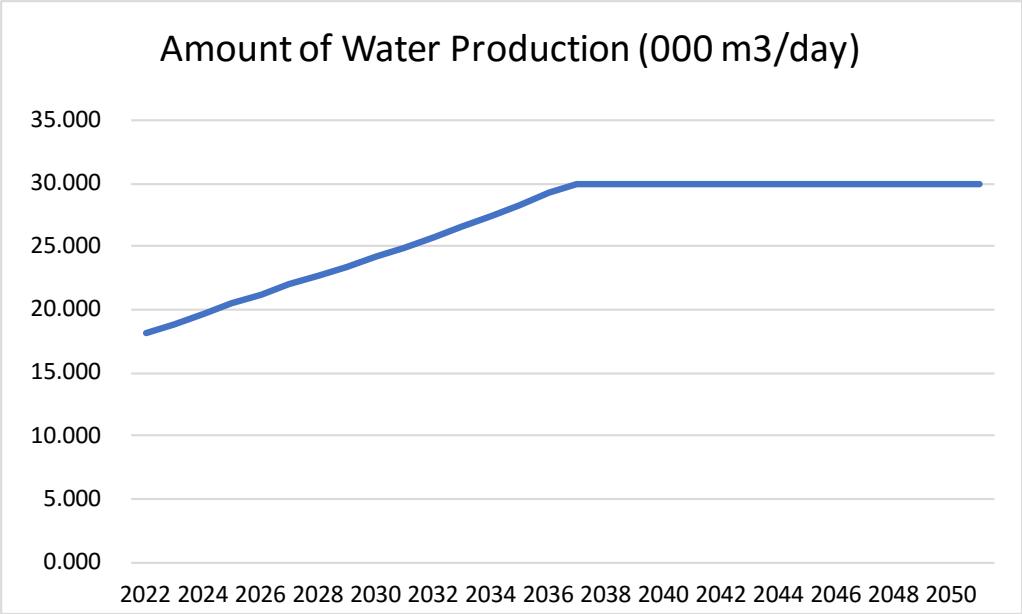
[12] Since salaries accrues regardless of water production, salaries are constant expenses.

Amount of Maximum Daily Water Production	15,000 m^3/day	20,000 m^3/day	30,000 m^3/day
Total	762	644	526

The above O&M cost is the minimum estimate of O&M cost. Therefore, it could be revised if additional costs are considered.
Source：JICA Survey Team

3.5.2 Amount of Water Production

The amount of water production of the new WTP for financial analysis is shown below. It is assumed that it starts from 18,000 m^3/day in 2022 to 30,000 m^3/day in 2037. The Non-Revenue Water Rate is 10% based on the Master Plan (revised version in 2017).



Source：PPWSA (2010) "Application Form for Grant Aid from Japan"

Figure 3.5.1 Water Production

3.5.3 Tax

Regarding tax, VAT for construction costs, which are financed by grant, is to be exempted. However, O&M costs are considered not to be exempted. Therefore, VAT for O&M costs is calculated in financial analysis. It is considered that VAT for O&M will be paid by PPWSA (it is covered by the payment for Bulk Water from PPWSA to a private operator in Model C). It needs to be reconfirmed in the next preparatory survey.

If the project is classed as a Qualified Investment Project (QIP[13]), tax exemption on Tax on Profit is applied (Trigger year + three years－Priority Period). Regarding the priority period, it is 0 year(s) if the investment amount is cheaper than USD 5 million. The priority period is one year if the investment amount is from USD 5 to 20 million. The priority period is two years if the investment amount is more than USD 20 million and classified as a QIP.

Since private investment in this project is less than USD 5 million, the priority period is 0 year(s). If an operation profit is gained in the first year, it is classed as the 'Trigger year'. That year and the remaining three years (three years＋priority period 0 years) could be the period of tax exemption.

[13] See "3.6.3" to be described.

Regarding a profit tax exemption, if the contents of the project are objectified in the next preparatory survey, it is required to be confirmed with CDC.

Pre-condition of Taxation for financial analysis is shown in **Table 3.5.3**.

Table 3.5.3 Precondition of Taxation

Items	Assumptions	Remarks
Tax on Profit	20%	QIPs are entitled to profit tax exemption. Profit tax exemption is composed of the "Trigger period"+ three years + priority period. If it is profitable in the first year of operation and the amount of investment is less than USD 5 million, the total years of the Trigger period (one year) + three years + priority period (0 years) amounts to four.
VAT	10%	Tax refund for initial investment (construction cost) would be possible.

Source：JETRO (2014) "Explanation of Cambodia Law of Taxation", "Law on Investment of the Kingdom of Cambodia (1994)", "Law on Amendment to the Law on Investment (2003)"

3.5.4 Exchange Rate

The exchange rate for financial analysis is shown in **Table 3.5.4**.

Table 3.5.4 Exchange Rate

Exchange Rate (JPY/USD)	111.45
Exchange Rate (KHR/USD)	4,035

Source：Bank of Japan (November, 29, 2017), National Bank of Cambodia (November 29, 2017)

3.5.5 Common Terms of Model A and Model B

Common terms regarding financing and others of Model A and Model B are shown in **Table 3.5.5**.

Table 3.5.5 Common Terms of Model A and Model B

Implementation Agency	PPWSA
Financing	Yen Loan：Interest Rate 1.0% +On-lending fee 6%=7.0%
Period of grace	10 years
Financial Internal Rate of Return (FIRR)	10%[14]

Source：JICA Survey Team

3.5.6 Results of Financial Analysis of Each Model

(1) Model A：Sustainable TO-BE Model

The average water tariff is calculated to implement the project (including construction and O&M costs of the new Ta Khmau WTP) by self-funding. As a result, the average water tariff, which makes FIRR 10%, is shown in **Table 3.5.6**.

Table 3.5.6 Average Water Tariff of Model A

Item	Cost (KHR/m^3)	Cost (Yen/m^3)
Average Water Tariff	3,567	99

Source：JICA Survey Team

The PL and cash flow of the project in Model A are shown below. Since the average water tariff was

[14] Since total rate of interest rate of financing (7.0%) and risk premium (3%) is 10%, making FIRR 10% is set as one of common terms.

1,029 (KHR/m^3) in 2016 and the water tariff above is more than thrice that of 2016, the tariff in Model A is difficult to apply; thus, implementing this project by Model A is impossible.

Table 3.5.7 PL and Cash Flow of New WTP in Ta Khmau District (Model A)

(KHR 000)

1. Profit and Loss Statement

	2019	2020	2021	1 2022	2 2023	3 2024	4 2025	5 2026	6 2027	7 2028	8 2029	9 2030	10 2031	11 2032	12 2033
Operating Income															
Amount of Water Production (000m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117	9,407	9,706
NRW (Non-Revenue Water) Rate				10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Amount of Water Sold (000 m3)				5,948	6,208	6,471	6,724	6,969	7,217	7,462	7,708	7,953	8,206	8,466	8,736
Average Water Tariff of Water (KHR/m3)				3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567
Total Operating Income				21,215,878	22,145,083	23,082,490	23,983,573	24,857,706	25,742,384	26,617,689	27,492,993	28,367,126	29,269,051	30,199,653	31,159,843
Operating Cost															
Depreciation				-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,631,358	-2,631,358	-2,631,358	-2,631,358	-2,631,358	-2,631,358
Electricity costs				-1,519,808	-1,633,963	-1,754,223	-1,877,385	-2,004,184	-2,137,778	-2,276,782	-2,422,201	-2,574,191	-2,735,718	-2,907,380	-3,089,814
Salaries, wages and related expenses				-1,103,484	-1,136,588	-1,170,686	-1,205,806	-1,241,980	-1,279,240	-1,317,617	-1,357,146	-1,397,860	-1,439,796	-1,482,990	-1,527,479
Raw materials for water treatment				-401,618	-431,784	-463,564	-496,110	-529,617	-564,920	-601,653	-640,081	-680,245	-722,929	-768,292	-816,501
Repairs and maintenance				-705,808	-758,822	-814,672	-871,869	-930,755	-992,797	-1,057,351	-1,124,885	-1,195,470	-1,270,484	-1,350,205	-1,434,929
Other operating expenses			-1,057,096	-183,722	-197,521	-212,059	-226,947	-242,275	-258,425	-275,228	-292,807	-311,180	-330,707	-351,458	-373,511
Total Operating Cost			-1,057,096	-6,643,022	-6,887,261	-7,143,785	-7,406,699	-7,677,395	-7,961,742	-8,159,989	-8,468,478	-8,790,305	-9,130,992	-9,491,684	-9,873,593
Gross Operating Profit			***-1,057,096***	***14,572,856***	***15,257,821***	***15,938,705***	***16,576,874***	***17,180,311***	***17,780,642***	***18,457,700***	***19,024,515***	***19,576,821***	***20,138,059***	***20,707,970***	***21,286,250***
Non-Operating Cost															
Interest Expense	-1,460,502	-2,903,478	-5,824,481	-8,745,485	-8,745,485	-8,745,485	-8,745,485	-8,745,485	-8,745,485	-8,745,485	-8,745,485	-8,308,211	-7,870,937	-7,433,662	-6,996,388
Front End Fee	-250,372	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income before Tax	***-1,710,874***	***-2,903,478***	***-6,881,578***	***5,827,371***	***6,512,336***	***7,193,220***	***7,831,389***	***8,434,826***	***9,035,157***	***9,712,215***	***10,279,030***	***11,268,610***	***12,267,122***	***13,274,307***	***14,289,862***
Tax on Profit	0	0	0	0	0	0	0	-1,686,965	-1,807,031	-1,942,443	-2,055,806	-2,253,722	-2,453,424	-2,654,861	-2,857,972
VAT				-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984	-537,734	-571,476
Net Income after Tax	***-1,710,874***	***-2,903,478***	***-6,881,578***	***5,546,275***	***6,210,127***	***6,868,768***	***7,484,158***	***6,377,177***	***6,832,734***	***7,348,670***	***7,775,226***	***8,538,779***	***9,307,714***	***10,081,712***	***10,860,414***

2. Cashflow

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Cashflow from Operating Cashflow															
Net Income after Tax	-1,710,874	-2,903,478	-6,881,578	5,546,275	6,210,127	6,868,768	7,484,158	6,377,177	6,832,734	7,348,670	7,775,226	8,538,779	9,307,714	10,081,712	10,860,414
Depreciation	0	0	0	2,728,583	2,728,583	2,728,583	2,728,583	2,728,583	2,728,583	2,631,358	2,631,358	2,631,358	2,631,358	2,631,358	2,631,358
Cash Flows from Investment Activity															
Capital Investment	-52,082,233	-53,644,700	-55,934,613		0	0	0	0	0	0	0	0	0	0	0
Cashflow from Financial Activities															
Government Portion	7,363,875	7,363,875	7,363,875		0	0	0	0	0	0	0	0	0	0	0
Disbursement	41,728,625	41,728,625	41,728,625		0	0	0	0	0	0	0	0	0	0	0
Repayment	0	0	0	0	0	0	0	0	0	0	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775
Net Cashflow	***-4,700,607***	***-7,455,678***	***-13,723,691***	***8,274,858***	***8,938,710***	***9,597,351***	***10,212,741***	***9,105,760***	***9,561,316***	***9,980,028***	***4,159,809***	***4,923,362***	***5,692,297***	***6,466,295***	***7,244,996***
Opening Balance	0	-4,700,607	-12,156,285	-25,879,976	-17,605,118	-8,666,408	930,942	11,143,683	20,249,443	29,810,759	39,790,787	43,950,597	48,873,959	54,566,256	61,032,551
Closing Balance	-4,700,607	-12,156,285	-25,879,976	-17,605,118	-8,666,408	930,942	11,143,683	20,249,443	29,810,759	39,790,787	43,950,597	48,873,959	54,566,256	61,032,551	68,277,547

Cashflow for FIRR															
CAPEX	-52,082,233	-53,644,700	-55,934,613												
OPEX			-1,057,096	-3,914,439	-4,158,679	-4,415,203	-4,678,117	-4,948,813	-5,233,160	-5,528,631	-5,837,120	-6,158,947	-6,499,634	-6,860,326	-7,242,235
Tax on Profit	0	0	0	0	0	0	0	-1,686,965	-1,807,031	-1,942,443	-2,055,806	-2,253,722	-2,453,424	-2,654,861	-2,857,972
VAT	0	0	0	-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984	-537,734	-571,476
Income				21,215,878	22,145,083	23,082,490	23,983,573	24,857,706	25,742,384	26,617,689	27,492,993	28,367,126	29,269,051	30,199,653	31,159,843
Net Cashflow for FIRR	-52,082,233	-53,644,700	-56,991,709	17,020,343	17,684,195	18,342,836	18,958,226	17,851,245	18,306,801	18,725,514	19,152,069	19,478,348	19,810,009	20,146,733	20,488,160
FIRR	10.0%														

3. Financing Schedule

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Opening Balance	0	41,478,253	83,206,878	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	118,688,728	112,441,953	106,195,178	99,948,403
Disbursement	41,728,625	41,728,625	41,728,625												
Interest	1,460,502	2,903,478	5,824,481	8,745,485	8,745,485	8,745,485	8,745,485	8,745,485	8,745,485	8,745,485	8,745,485	8,308,211	7,870,937	7,433,662	6,996,388
Repayment											6,246,775	6,246,775	6,246,775	6,246,775	6,246,775
Front End Fee	250,372														
Closing Balance	41,478,253	83,206,878	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	124,935,503	118,688,728	112,441,953	106,195,178	99,948,403	93,701,627

13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
10,015	10,333	10,662	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
9,013	9,300	9,596	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855
3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567	3,567
32,150,562	33,172,781	34,227,501	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785
-2,631,358	-2,631,358	-2,631,358	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173
-3,283,696	-3,489,743	-3,708,720	-3,923,248	-4,040,946	-4,162,174	-4,287,039	-4,415,650	-4,548,120	-4,684,563	-4,825,100	-4,969,853	-5,118,949	-5,272,517	-5,430,693	-5,593,614	-5,761,422	-5,934,265
-1,573,304	-1,620,503	-1,669,118	-1,719,191	-1,770,767	-1,823,890	-1,878,607	-1,934,965	-1,993,014	-2,052,804	-2,114,389	-2,177,820	-2,243,155	-2,310,449	-2,379,763	-2,451,156	-2,524,690	-2,600,431
-867,736	-922,185	-980,051	-1,036,741	-1,067,843	-1,099,879	-1,132,875	-1,166,861	-1,201,867	-1,237,923	-1,275,061	-1,313,313	-1,352,712	-1,393,293	-1,435,092	-1,478,145	-1,522,489	-1,568,164
-1,524,969	-1,620,658	-1,722,352	-1,821,981	-1,876,640	-1,932,939	-1,990,927	-2,050,655	-2,112,175	-2,175,540	-2,240,806	-2,308,030	-2,377,271	-2,448,590	-2,522,047	-2,597,709	-2,675,640	-2,755,909
-396,949	-421,857	-448,328	-474,261	-488,489	-503,143	-518,238	-533,785	-549,798	-566,292	-583,281	-600,779	-618,803	-637,367	-656,488	-676,183	-696,468	-717,362
-10,278,011	-10,706,304	-11,159,926	-11,508,595	-11,777,858	-12,055,198	-12,340,859	-12,635,090	-12,938,147	-13,250,296	-13,571,810	-13,902,969	-14,244,063	-14,595,390	-14,957,256	-15,329,979	-15,713,883	-16,109,304
21,872,552	***22,466,477***	***23,067,575***	***23,644,190***	***23,374,927***	***23,097,587***	***22,811,926***	***22,517,695***	***22,214,638***	***21,902,489***	***21,580,975***	***21,249,816***	***20,908,722***	***20,557,395***	***20,195,529***	***19,822,806***	***19,438,902***	***19,043,481***
-6,559,114	-6,121,840	-5,684,565	-5,247,291	-4,810,017	-4,372,743	-3,935,468	-3,498,194	-3,060,920	-2,623,646	-2,186,371	-1,749,097	-1,311,823	-874,549	-437,274	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15,313,438	***16,344,638***	***17,383,010***	***18,396,899***	***18,564,910***	***18,724,844***	***18,876,458***	***19,019,501***	***19,153,718***	***19,278,843***	***19,394,604***	***19,500,719***	***19,596,899***	***19,682,847***	***19,758,255***	***19,822,806***	***19,438,902***	***19,043,481***
-3,062,688	-3,268,928	-3,476,602	-3,679,380	-3,712,982	-3,744,969	-3,775,292	-3,803,900	-3,830,744	-3,855,769	-3,878,921	-3,900,144	-3,919,380	-3,936,569	-3,951,651	-3,964,561	-3,887,780	-3,808,696
-607,335	-645,444	-685,945	-725,623	-747,392	-769,814	-792,908	-816,695	-841,196	-866,432	-892,425	-919,198	-946,774	-975,177	-1,004,432	-1,034,565	-1,065,602	-1,097,570
11,643,415	***12,430,266***	***13,220,463***	***13,991,896***	***14,104,537***	***14,210,062***	***14,308,258***	***14,398,906***	***14,481,779***	***14,556,643***	***14,623,258***	***14,681,378***	***14,730,746***	***14,771,101***	***14,802,172***	***14,823,680***	***14,485,520***	***14,137,215***

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
11,643,415	12,430,266	13,220,463	13,991,896	14,104,537	14,210,062	14,308,258	14,398,906	14,481,779	14,556,643	14,623,258	14,681,378	14,730,746	14,771,101	14,802,172	14,823,680	14,485,520	14,137,215
2,631,358	2,631,358	2,631,358	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	-6,246,775	0	0	0
8,027,998	***8,814,849***	***9,605,046***	***10,278,294***	***10,390,934***	***10,496,460***	***10,594,656***	***10,685,304***	***10,768,176***	***10,843,041***	***10,909,656***	***10,967,775***	***11,017,144***	***11,057,499***	***11,088,570***	***17,356,853***	***17,018,693***	***16,670,388***
68,277,547	76,305,545	85,120,394	94,725,439	105,003,733	115,394,668	125,891,128	136,485,784	147,171,087	157,939,264	168,782,304	179,691,960	190,659,736	201,676,880	212,734,378	223,822,948	241,179,801	258,198,494
76,305,545	85,120,394	94,725,439	105,003,733	115,394,668	125,891,128	136,485,784	147,171,087	157,939,264	168,782,304	179,691,960	190,659,736	201,676,880	212,734,378	223,822,948	241,179,801	258,198,494	274,868,881

-7,646,653	-8,074,946	-8,528,568	-8,975,422	-9,244,685	-9,522,025	-9,807,686	-10,101,917	-10,404,974	-10,717,123	-11,038,637	-11,369,796	-11,710,890	-12,062,217	-12,424,083	-12,796,806	-13,180,710	-13,576,131
-3,062,688	-3,268,928	-3,476,602	-3,679,380	-3,712,982	-3,744,969	-3,775,292	-3,803,900	-3,830,744	-3,855,769	-3,878,921	-3,900,144	-3,919,380	-3,936,569	-3,951,651	-3,964,561	-3,887,780	-3,808,696
-607,335	-645,444	-685,945	-725,623	-747,392	-769,814	-792,908	-816,695	-841,196	-866,432	-892,425	-919,198	-946,774	-975,177	-1,004,432	-1,034,565	-1,065,602	-1,097,570
32,150,562	33,172,781	34,227,501	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785	35,152,785
20,833,887	21,183,463	21,536,386	21,772,360	21,447,727	21,115,977	20,776,900	20,430,273	20,075,871	19,713,461	19,342,802	18,963,648	18,575,742	18,178,822	17,772,619	17,356,853	17,018,693	16,670,388

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
93,701,627	87,454,852	81,208,077	74,961,302	68,714,527	62,467,752	56,220,976	49,974,201	43,727,426	37,480,651	31,233,876	24,987,101	18,740,325	12,493,550	6,246,775
6,559,114	6,121,840	5,684,565	5,247,291	4,810,017	4,372,743	3,935,468	3,498,194	3,060,920	2,623,646	2,186,371	1,749,097	1,311,823	874,549	437,274
6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775	6,246,775
87,454,852	81,208,077	74,961,302	68,714,527	62,467,752	56,220,976	49,974,201	43,727,426	37,480,651	31,233,876	24,987,101	18,740,325	12,493,550	6,246,775	0

Source：JICA Survey Team

(2) Model B: PPWSA Operation with cash injection from PPWSA

In Model B, in case PPWSA keeps the existing water tariff level with the same conditions of Model A regarding construction, O&M costs and tax, the required amount of cash injection from PPWSA to this project is calculated.

The average water tariff in Model B is "946 KHR/m^3" based on the average water tariff of Ta Khmau District in 2016. If a cash injection from PPWSA is applied, the FIRR is 10%. The cash injection every year is KHR 20 billion (around 0.5 billion Yen).

Table 3.5.8 Average Water Tariff and Cash Injection from PPWSA in Model B

Item	Cost	
Average Water Tariff	946 (KHR/m^3)	26 (Yen m^3)
Annual cash injection from PPWSA	20 (billion KHR)	0.5 (billion Yen)

Source：JICA Survey Team

The PL and cash flow of New WTP in Ta Khmau District (Model B), and Comparison of Operating Profits of PPWSA (Model B and Not Compiled with Ta Khmau WTP) are shown below. The annual cash injection from PPWSA is thrice of water sales from the first to the fourth year. It becomes less than thrice, and the cash injection amount is KHR 20 billion (around 0.54 billion yen), which is extremely expensive. Since the annual cash injection would account for around 8% of total expenditure in 2022, it does not represent a low impact on the finances of PPWSA; therefore, it is difficult to conduct this project by Model B with a large amount of cash injection from PPWSA and the existing water tariff level.

Table 3.5.9 PL and Cash Flow of New WTP in Ta Khmau District (Model B)

(KHR 000)

1. Profit and Loss Statement

				1	2	3	4	5	6	7	8	9	10	11	12
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Operating Income															
Amount of Water Production (000m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117	9,407	9,706
NRW (Non-Revenue Water) Rate				10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Amount of Water Sold (000 m3)				5,948	6,208	6,471	6,724	6,969	7,217	7,462	7,708	7,953	8,206	8,466	8,736
Average Water Tariff of Water (KHR/m3)				946	946	946	946	946	946	946	946	946	946	946	946
Water Sale (KHR 000)				5,626,639	5,873,072	6,121,681	6,360,656	6,592,484	6,827,108	7,059,247	7,291,385	7,523,213	7,762,412	8,009,216	8,263,866
Cash Injection from PPWSA				19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087	19,977,087
Total Operating Income				25,603,726	25,850,159	26,098,768	26,337,743	26,569,571	26,804,196	27,036,334	27,268,473	27,500,300	27,739,499	27,986,303	28,240,954
Operating Cost															
Depreciation				-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,728,583	-2,631,358	-2,631,358	-2,631,358	-2,631,358	-2,631,358	-2,631,358
Electricity costs				-1,519,808	-1,633,963	-1,754,223	-1,877,385	-2,004,184	-2,137,778	-2,276,782	-2,422,201	-2,574,191	-2,735,718	-2,907,380	-3,089,814
Salaries, wages and related expenses				-1,103,484	-1,136,588	-1,170,686	-1,205,806	-1,241,980	-1,279,240	-1,317,617	-1,357,146	-1,397,860	-1,439,796	-1,482,990	-1,527,479
Raw materials for water treatment				-401,618	-431,784	-463,564	-496,110	-529,617	-564,920	-601,653	-640,081	-680,245	-722,929	-768,292	-816,501
Repairs and maintenance				-705,808	-758,822	-814,672	-871,869	-930,755	-992,797	-1,057,351	-1,124,885	-1,195,470	-1,270,484	-1,350,205	-1,434,929
Other operating expenses			-1,057,096	-183,722	-197,521	-212,059	-226,947	-242,275	-258,425	-275,228	-292,807	-311,180	-330,707	-351,458	-373,511
Total Operating Cost			-1,057,096	-6,643,022	-6,887,261	-7,143,785	-7,406,699	-7,677,395	-7,961,742	-8,159,989	-8,468,478	-8,790,305	-9,130,992	-9,491,684	-9,873,593
Gross Operating Profit			***-1,057,096***	***18,960,704***	***18,962,898***	***18,954,983***	***18,931,044***	***18,892,176***	***18,842,453***	***18,876,345***	***18,799,994***	***18,709,996***	***18,608,507***	***18,494,619***	***18,367,360***
Non-Operating Cost															
Interest Expense	-1,549,446	-3,079,736	-6,271,596	-9,559,211	-9,559,211	-9,559,211	-9,559,211	-9,559,211	-9,559,211	-9,559,211	-9,559,211	-9,081,251	-8,603,290	-8,125,330	-7,647,369
Front End Fee	-273,668	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Income before Tax	***-1,823,114***	***-3,079,736***	***-7,328,692***	***9,401,493***	***9,403,687***	***9,395,772***	***9,371,833***	***9,332,965***	***9,283,242***	***9,317,134***	***9,240,783***	***9,628,745***	***10,005,217***	***10,369,290***	***10,719,991***
Tax on Profit	0	0	0	0	0	0	0	-1,866,593	-1,856,648	-1,863,427	-1,848,157	-1,925,749	-2,001,043	-2,073,858	-2,143,998
VAT				-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984	-537,734	-571,476
Net Income after Tax	***-1,823,114***	***-3,079,736***	***-7,328,692***	***9,120,398***	***9,101,478***	***9,071,320***	***9,024,602***	***7,095,689***	***7,031,202***	***7,032,606***	***6,944,629***	***7,226,887***	***7,498,190***	***7,757,698***	***8,004,517***

2. Cashflow

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Cashflow from Operating Cashflow															
Net Income after Tax	-1,823,114	-3,079,736	-7,328,692	9,120,398	9,101,478	9,071,320	9,024,602	7,095,689	7,031,202	7,032,606	6,944,629	7,226,887	7,498,190	7,757,698	8,004,517
Depreciation	0	0	0	2,728,583	2,728,583	2,728,583	2,728,583	2,728,583	2,728,583	2,631,358	2,631,358	2,631,358	2,631,358	2,631,358	2,631,358
Cash Flows from Investment Activity															
Capital Investment	-52,082,233	-53,644,700	-55,934,613		0	0	0	0	0	0	0	0	0	0	0
Cashflow from Financial Activities															
Government Portion	7,363,875	7,363,875	7,363,875		0	0	0	0	0	0	0	0	0	0	0
Disbursement	44,269,898	45,597,995	46,965,935		0	0	0	0	0	0	0	0	0	0	0
Repayment	0	0	0	0	0	0	0	0	0	0	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008
Net Cashflow	***-2,271,574***	***-3,762,566***	***-8,933,495***	***11,848,980***	***11,830,060***	***11,799,902***	***11,753,185***	***9,824,271***	***9,759,784***	***9,663,964***	***2,747,979***	***3,030,237***	***3,301,540***	***3,561,048***	***3,807,867***
Opening Balance	0	-2,271,574	-6,034,140	-14,967,635	-3,118,655	8,711,405	20,511,307	32,264,492	42,088,763	51,848,547	61,512,511	64,260,490	67,290,728	70,592,267	74,153,315
Closing Balance	-2,271,574	-6,034,140	-14,967,635	-3,118,655	8,711,405	20,511,307	32,264,492	42,088,763	51,848,547	61,512,511	64,260,490	67,290,728	70,592,267	74,153,315	77,961,183
Cashflow for FIRR															
CAPEX	-52,082,233	-53,644,700	-55,934,613												
OPEX			-1,057,096	-3,914,439	-4,158,679	-4,415,203	-4,678,117	-4,948,813	-5,233,160	-5,528,631	-5,837,120	-6,158,947	-6,499,634	-6,860,326	-7,242,235
Tax on Profit	0	0	0	0	0	0	0	-1,866,593	-1,856,648	-1,863,427	-1,848,157	-1,925,749	-2,001,043	-2,073,858	-2,143,998
VAT	0	0	0	-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984	-537,734	-571,476
Income				25,603,726	25,850,159	26,098,768	26,337,743	26,569,571	26,804,196	27,036,334	27,268,473	27,500,300	27,739,499	27,986,303	28,240,954
Net Cashflow for FIRR	-52,082,233	-53,644,700	-56,991,709	21,408,191	21,389,272	21,359,114	21,312,396	19,383,482	19,318,996	19,223,175	19,135,198	18,939,496	18,732,838	18,514,386	18,283,244
FIRR	10.0%														

3. Financing Schedule

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Opening Balance	0	43,996,231	89,594,226	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	129,732,153	122,904,145	116,076,137	109,248,129
Disbursement	44,269,898	45,597,995	46,965,935												
Interest	1,549,446	3,079,736	6,271,596	9,559,211	9,559,211	9,559,211	9,559,211	9,559,211	9,559,211	9,559,211	9,559,211	9,081,251	8,603,290	8,125,330	7,647,369
Repayment											6,828,008	6,828,008	6,828,008	6,828,008	6,828,008
Front End Fee	273,668														
Closing Balance	43,996,231	89,594,226	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	136,560,161	129,732,153	122,904,145	116,076,137	109,248,129	102,420,121

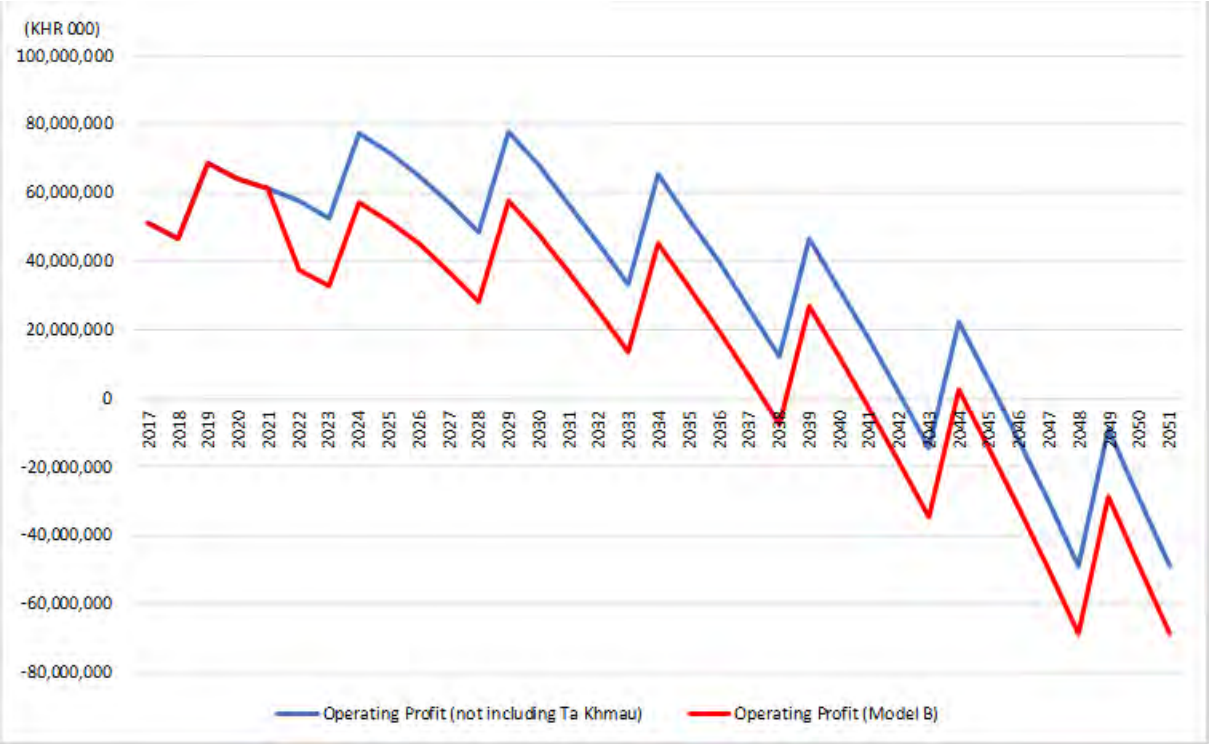
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
10,015	10,333	10,662	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950	10,950
10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
9,013	9,300	9,596	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855	9,855
946	946	946	946	946	946	946	946	946	946	946	946	946	946	946	946	946	946
8,526,614	8,797,715	9,077,437	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830	9,322,830
19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522	19,911,522
28,438,136	28,709,237	28,988,958	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352
-2,631,358	-2,631,358	-2,631,358	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173	-2,533,173
-3,283,696	-3,489,743	-3,708,720	-3,923,248	-4,040,946	-4,162,174	-4,287,039	-4,415,650	-4,548,120	-4,684,563	-4,825,100	-4,969,853	-5,118,949	-5,272,517	-5,430,693	-5,593,614	-5,761,422	-5,934,265
-1,573,304	-1,620,503	-1,669,118	-1,719,191	-1,770,767	-1,823,890	-1,878,607	-1,934,965	-1,993,014	-2,052,804	-2,114,389	-2,177,820	-2,243,155	-2,310,449	-2,379,763	-2,451,156	-2,524,690	-2,600,431
-867,736	-922,185	-980,051	-1,036,741	-1,067,843	-1,099,879	-1,132,875	-1,166,861	-1,201,867	-1,237,923	-1,275,061	-1,313,313	-1,352,712	-1,393,293	-1,435,092	-1,478,145	-1,522,489	-1,568,164
-1,524,969	-1,620,658	-1,722,352	-1,821,981	-1,876,640	-1,932,939	-1,990,927	-2,050,655	-2,112,175	-2,175,540	-2,240,806	-2,308,030	-2,377,271	-2,448,590	-2,522,047	-2,597,709	-2,675,640	-2,755,909
-396,949	-421,857	-448,328	-474,261	-488,489	-503,143	-518,238	-533,785	-549,798	-566,292	-583,281	-600,779	-618,803	-637,367	-656,488	-676,183	-696,468	-717,362
-10,278,011	-10,706,304	-11,159,926	-11,508,595	-11,777,858	-12,055,198	-12,340,859	-12,635,090	-12,938,147	-13,250,296	-13,571,810	-13,902,969	-14,244,063	-14,595,390	-14,957,256	-15,329,979	-15,713,883	-16,109,304
18,160,125	***18,002,933***	***17,829,032***	***17,725,757***	***17,456,494***	***17,179,154***	***16,893,493***	***16,599,262***	***16,296,205***	***15,984,055***	***15,662,542***	***15,331,383***	***14,990,289***	***14,638,962***	***14,277,096***	***13,904,373***	***13,520,469***	***13,125,048***
-7,169,408	-6,691,448	-6,213,487	-5,735,527	-5,257,566	-4,779,606	-4,301,645	-3,823,685	-3,345,724	-2,867,763	-2,389,803	-1,911,842	-1,433,882	-955,921	-477,961	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10,990,717	***11,311,485***	***11,615,545***	***11,990,230***	***12,198,928***	***12,399,548***	***12,591,848***	***12,775,578***	***12,950,481***	***13,116,292***	***13,272,739***	***13,419,540***	***13,556,407***	***13,683,041***	***13,799,135***	***13,904,373***	***13,520,469***	***13,125,048***
-2,198,143	-2,262,297	-2,323,109	-2,398,046	-2,439,786	-2,479,910	-2,518,370	-2,555,116	-2,590,096	-2,623,258	-2,654,548	-2,683,908	-2,711,281	-2,736,608	-2,759,827	-2,780,875	-2,704,094	-2,625,010
-607,335	-645,444	-685,945	-725,623	-747,392	-769,814	-792,908	-816,695	-841,196	-866,432	-892,425	-919,198	-946,774	-975,177	-1,004,432	-1,034,565	-1,065,602	-1,097,570
8,185,238	***8,403,744***	***8,606,491***	***8,866,561***	***9,011,751***	***9,149,825***	***9,280,570***	***9,403,767***	***9,519,189***	***9,626,602***	***9,725,766***	***9,816,435***	***9,898,352***	***9,971,256***	***10,034,876***	***10,088,934***	***9,750,773***	***9,402,468***

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
8,185,238	8,403,744	8,606,491	8,866,561	9,011,751	9,149,825	9,280,570	9,403,767	9,519,189	9,626,602	9,725,766	9,816,435	9,898,352	9,971,256	10,034,876	10,088,934	9,750,773	9,402,468
2,631,358	2,631,358	2,631,358	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173	2,533,173
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	-6,828,008	0	0	0
3,988,588	***4,207,094***	***4,409,841***	***4,571,726***	***4,716,916***	***4,854,990***	***4,985,735***	***5,108,932***	***5,224,354***	***5,331,767***	***5,430,931***	***5,521,600***	***5,603,517***	***5,676,421***	***5,740,041***	***12,622,107***	***12,283,946***	***11,935,641***
77,279,301	81,267,889	85,474,983	89,884,824	94,456,550	99,173,465	104,028,455	109,014,190	114,123,122	119,347,476	124,679,243	130,110,174	135,631,774	141,235,291	146,911,712	152,651,753	165,273,859	177,557,805
81,267,889	85,474,983	89,884,824	94,456,550	99,173,465	104,028,455	109,014,190	114,123,122	119,347,476	124,679,243	130,110,174	135,631,774	141,235,291	146,911,712	152,651,753	165,273,859	177,557,805	189,493,447
-7,646,653	-8,074,946	-8,528,568	-8,975,422	-9,244,685	-9,522,025	-9,807,686	-10,101,917	-10,404,974	-10,717,123	-11,038,637	-11,369,796	-11,710,890	-12,062,217	-12,424,083	-12,796,806	-13,180,710	-13,576,131
-2,198,143	-2,262,297	-2,323,109	-2,398,046	-2,439,786	-2,479,910	-2,518,370	-2,555,116	-2,590,096	-2,623,258	-2,654,548	-2,683,908	-2,711,281	-2,736,608	-2,759,827	-2,780,875	-2,704,094	-2,625,010
-607,335	-645,444	-685,945	-725,623	-747,392	-769,814	-792,908	-816,695	-841,196	-866,432	-892,425	-919,198	-946,774	-975,177	-1,004,432	-1,034,565	-1,065,602	-1,097,570
28,438,136	28,709,237	28,988,958	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352	29,234,352
17,986,005	17,726,550	17,451,336	17,135,261	16,802,490	16,462,603	16,115,388	15,760,625	15,398,086	15,027,538	14,648,742	14,261,450	13,865,407	13,460,350	13,046,010	12,622,107	12,283,946	11,935,641

2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048
102,420,121	95,592,113	88,764,105	81,936,097	75,108,088	68,280,080	61,452,072	54,624,064	47,796,056	40,968,048	34,140,040	27,312,032	20,484,024	13,656,016	6,828,008
7,169,408	6,691,448	6,213,487	5,735,527	5,257,566	4,779,606	4,301,645	3,823,685	3,345,724	2,867,763	2,389,803	1,911,842	1,433,882	955,921	477,961
6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008	6,828,008
95,592,113	88,764,105	81,936,097	75,108,088	68,280,080	61,452,072	54,624,064	47,796,056	40,968,048	34,140,040	27,312,032	20,484,024	13,656,016	6,828,008	0

Source：JICA Survey Team

Table 3.5.10　Comparison of Operating Profits of PPWSA (Model B and Not Compiled with Ta Khmau WTP）



Source：JICA Survey Team

(3)　Model C-0: Standard Model not using Grant

The water tariff is a source of profit, and payment of facilities by private investment is covered by the sale of Bulk Water in Model C-0; therefore, a major water tariff increase is required as with Model A. Since it is difficult to implement this project by Model C-1, financial analysis has not been conducted.

(4)　Model C-1: Model of Private Operation with Facility Linked Grant by BTO

A private operator conducts construction of WTP, operation and maintenance in Model C-1. A large portion of the construction part is financed by a grant from the Japanese government, and a small part of that is financed by a private company. It sells water (Bulk Water) to PPWSA, and recovers the costs of private investment to WTP, and operation and maintenance. The price of Bulk Water from the private operator to PPWSA is "800 KHR/m^3", which is the minimum price based on the minimum private operator's profit. The average water tariff per user is "946 KHR/m^3", with consideration of social and economic features. As a result of this calculation, the amount of private investment to make the Equity IRR more than 15% (Hurdle Rate) is shown in **Table 3.5.11** with the following grant amount.

Table 3.5.11 Amount of Construction Cost of Grant and Private Investment in Model C-1

Item	Cost (KHR 000)	Cost (Yen 000)	Rate
Grant Amount	146,379,293	4,043,116	99.4%
Private Investment Amount	898,207	24,809	0.6%
Total	147,277,500	4,067,925	100%

Source：JICA Survey Team

The private investment amount is around 0.9 billion KHR (around 25 million Yen) and accounts for 0.6% of the whole amount. The Equity IRR is around 15% based on the premise that the full amount of water made by the private operator is bought by PPWSA (demand risks are taken by PPWSA). Part of the facility financed by the private company is owned by the private company. The validity of the Equity IRR is then finally confirmed, based on hearing from private investors. The PL and cash flow of the project in Model C-1 are shown below. Comparison of operating profits of PPWSA with and without this project (which is shown in Model B) is not shown in Model C because there is no big difference between the operating profits with project or without the project.

It is assumed that the amount of water sold will be 18,000 m^3/day in 2022 and will increase to 30,000 m^3/day in 2037 in the financial analysis. If the amount of water sold increases, private investment increases; therefore, the possibility of private investment needs to be examined when the amount of water sold each year is decided.

Table 3.5.12 PL and Cash Flow of New WTP in Ta Khmau District (Model C-1)

(KHR 000)

1. Profit and Loss Statement

	2019	2020	2021	1 2022	2 2023	3 2024	4 2025	5 2026	6 2027	7 2028	8 2029	9 2030	10 2031
Operating Income													
Amount of Water Production (000m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117
NRW (Non-Revenue Water) Rate				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Amount of Water Sold (000 m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117
Price of bulk Water Sale (KHR/□)				800	800	800	800	800	800	800	800	800	800
Total Operating Income				5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786
Operating Cost													
Depreciation				-113,273	-113,273	-113,273	-113,273	-113,273	-113,273	-16,048	-16,048	-16,048	-16,048
Electricity costs				-1,519,808	-1,633,963	-1,754,223	-1,877,385	-2,004,184	-2,137,778	-2,276,782	-2,422,201	-2,574,191	-2,735,718
Salaries, wages and related expenses				-1,103,484	-1,136,588	-1,170,686	-1,205,806	-1,241,980	-1,279,240	-1,317,617	-1,357,146	-1,397,860	-1,439,796
Raw materials for water treatment				-401,618	-431,784	-463,564	-496,110	-529,617	-564,920	-601,653	-640,081	-680,245	-722,929
Repairs and maintenance				-705,808	-758,822	-814,672	-871,869	-930,755	-992,797	-1,057,351	-1,124,885	-1,195,470	-1,270,484
Other operating expenses			-1,057,096	-183,722	-197,521	-212,059	-226,947	-242,275	-258,425	-275,228	-292,807	-311,180	-330,707
Total Operating Cost			-1,057,096	-4,027,712	-4,271,951	-4,528,475	-4,791,389	-5,062,085	-5,346,432	-5,544,679	-5,853,168	-6,174,995	-6,515,682
Gross Operating Profit	***0***	***0***	***-1,057,096***	***1,259,240***	***1,246,557***	***1,223,633***	***1,185,267***	***1,132,403***	***1,068,516***	***1,088,393***	***998,028***	***894,033***	***778,104***
Non-Operating Cost													
Interest Expense													
Front End Fee													
Net Income before Tax	***0***	***0***	***-1,057,096***	***1,259,240***	***1,246,557***	***1,223,633***	***1,185,267***	***1,132,403***	***1,068,516***	***1,088,393***	***998,028***	***894,033***	***778,104***
Tax on Profit	0	0	0	0	0	0	0	-226,481	-213,703	-217,679	-199,606	-178,807	-155,621
VAT				-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984
Net Income after Tax	***0***	***0***	***-1,057,096***	***978,145***	***944,348***	***899,181***	***838,036***	***535,239***	***459,421***	***449,613***	***350,425***	***239,118***	***116,499***

2. Cashflow

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Cashflow from Operating Cashflow													
Net Income after Tax	0	0	-1,057,096	978,145	944,348	899,181	838,036	535,239	459,421	449,613	350,425	239,118	116,499
Depreciation	0	0	0	113,273	113,273	113,273	113,273	113,273	113,273	16,048	16,048	16,048	16,048
Cash Flows from Investment Activity													
Capital Investment	-317,636	-327,165	-1,017,552										
Cashflow from Financial Activities													
Equity Injection	317,636	327,165	2,074,648										
Net Cashflow	***0***	***0***	***0***	***1,091,417***	***1,057,620***	***1,012,453***	***951,308***	***648,512***	***572,693***	***465,661***	***366,473***	***255,166***	***132,547***
Opening Balance	0	0	0	0	1,091,417	2,149,038	3,161,491	4,112,799	4,761,311	5,334,004	5,799,665	6,166,138	6,421,304
Closing Balance	0	0	0	1,091,417	2,149,038	3,161,491	4,112,799	4,761,311	5,334,004	5,799,665	6,166,138	6,421,304	6,553,851

Cashflow for Equity IRR													
Net Income after Tax	0	0	-1,057,096	978,145	944,348	899,181	838,036	535,239	459,421	449,613	350,425	239,118	116,499
Depreciation	0	0	0	113,273	113,273	113,273	113,273	113,273	113,273	16,048	16,048	16,048	16,048
Equity Injection	-317,636	-327,165	-2,074,648	0	0	0	0	0	0	0	0	0	0
Net Cashflow for Equity IRR	-317,636	-327,165	-3,131,744	1,091,417	1,057,620	1,012,453	951,308	648,512	572,693	465,661	366,473	255,166	132,547
Equity IRR	15.0%												

Cashflow for PPWSA													
Income													
Water Sale (KHR 000)	0	0	0	5,626,639	5,873,072	6,121,681	6,360,656	6,592,484	6,827,108	7,059,247	7,291,385	7,523,213	7,762,412
Expenditure													
Water Purchase from SPC	0	0	0	5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786
Operating Profit	***0***	***0***	***0***	***339,687***	***354,564***	***369,573***	***384,000***	***397,996***	***412,160***	***426,175***	***440,189***	***454,185***	***468,626***

Source：JICA Survey Team

(5) Model C-1 (Option): Model of Private Operation with Facility Linked Grant by BTO (No Private Investment)

As an option of Model C, the following no private investment model is suggested. Construction of the facility is financed by a grant from the Japanese government, and the private operator recovers O&M cost by selling bulk water to PPWSA. The price of Bulk Water from the private operator to PPWSA is "800 KHR/m^3", which is based on market sounding. The average water tariff for the user is "946 KHR/m^3". The PL and cash flow of the project in Model C-1 (Option) are shown below.

The average recurrent profit margin is 19% and the average current account balance ratio is 124%; therefore, they are valid compared with those of other water supply corporations from home and abroad. In the case of PPWSA, the average current account balance ratio for the past five years is 143%.

Table 3.5.13 PL and Cash Flow of New WTP in Ta Khmau District (Model C-1, Option)

(KHR 000)

1. Profit and Loss Statement

	2019	2020	2021	1 2022	2 2023	3 2024	4 2025	5 2026	6 2027	7 2028	8 2029	9 2030	10 2031	
Operating Income														
Amount of Water Production (000m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117	
NRW (Non-Revenue Water) Rate				0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Amount of Water Sold (000 m3)				6,609	6,898	7,190	7,471	7,743	8,019	8,291	8,564	8,836	9,117	
Price of bulk Water Sale (KHR/□)				800	800	800	800	800	800	800	800	800	800	
Total Operating Income				5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786	
Operating Cost														
Depreciation				0	0	0	0	0	0	0	0	0	0	
Electricity costs				-1,519,808	-1,633,963	-1,754,223	-1,877,385	-2,004,184	-2,137,778	-2,276,782	-2,422,201	-2,574,191	-2,735,718	
Salaries, wages and related expenses				-1,103,484	-1,136,588	-1,170,686	-1,205,806	-1,241,980	-1,279,240	-1,317,617	-1,357,146	-1,397,860	-1,439,796	
Raw materials for water treatment				-401,618	-431,784	-463,564	-496,110	-529,617	-564,920	-601,653	-640,081	-680,245	-722,929	
Repairs and maintenance				-705,808	-758,822	-814,672	-871,869	-930,755	-992,797	-1,057,351	-1,124,885	-1,195,470	-1,270,484	
Other operating expenses			-1,057,096	-183,722	-197,521	-212,059	-226,947	-242,275	-258,425	-275,228	-292,807	-311,180	-330,707	
Total Operating Cost			-1,057,096	-3,914,439	-4,158,679	-4,415,203	-4,678,117	-4,948,813	-5,233,160	-5,528,631	-5,837,120	-6,158,947	-6,499,634	
Gross Operating Profit	***0***	***0***	***-1,057,096***	***1,372,513***	***1,359,829***	***1,336,905***	***1,298,539***	***1,245,675***	***1,181,788***	***1,104,441***	***1,014,076***	***910,081***	***794,152***	
Non-Operating Cost														
Interest Expense														
Front End Fee														
Net Income before Tax	***0***	***0***	***-1,057,096***	***1,372,513***	***1,359,829***	***1,336,905***	***1,298,539***	***1,245,675***	***1,181,788***	***1,104,441***	***1,014,076***	***910,081***	***794,152***	
Tax on Profit	0	0	0	0	0	0	0	-249,135	-236,358	-220,888	-202,815	-182,016	-158,830	
VAT				-281,096	-302,209	-324,452	-347,231	-370,683	-395,392	-421,101	-447,997	-476,109	-505,984	
Net Income after Tax	***0***	***0***	***-1,057,096***	***1,091,417***	***1,057,620***	***1,012,453***	***951,308***	***625,857***	***550,039***	***462,452***	***363,263***	***251,956***	***129,338***	

2. Cashflow

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Cashflow from Operating Cashflow														
Net Income after Tax	0	0	-1,057,096	1,091,417	1,057,620	1,012,453	951,308	625,857	550,039	462,452	363,263	251,956	129,338	
Depreciation	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cash Flows from Investment Activity														
Capital Investment	0	0	-680,572											
Cashflow from Financial Activities														
Equity Injection	0	0	5,430,686											
Net Cashflow	***0***	***0***	***3,693,018***	***1,091,417***	***1,057,620***	***1,012,453***	***951,308***	***625,857***	***550,039***	***462,452***	***363,263***	***251,956***	***129,338***	
Opening Balance	0	0	0	3,693,018	4,784,436	5,842,056	6,854,509	7,805,818	8,431,675	8,981,713	9,444,165	9,807,428	10,059,385	
Closing Balance	0	0	3,693,018	4,784,436	5,842,056	6,854,509	7,805,818	8,431,675	8,981,713	9,444,165	9,807,428	10,059,385	10,188,722	
Cashflow for PPWSA														
Income														
Water Sale (KHR 000)	0	0	0	5,626,639	5,873,072	6,121,681	6,360,656	6,592,484	6,827,108	7,059,247	7,291,385	7,523,213	7,762,412	
Expenditure														
Water Purchase from SPC	0	0	0	5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786	
Operating Profit	***0***	***0***	***0***	***339,687***	***354,564***	***369,573***	***384,000***	***397,996***	***412,160***	***426,175***	***440,189***	***454,185***	***468,626***	
Current Profit	0	0	-1,057,096	1,372,513	1,359,829	1,336,905	1,298,539	1,245,675	1,181,788	1,104,441	1,014,076	910,081	794,152	
Total Operating Income	0	0	0	5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786	**Average**
Recurrent Profit Margin				***26%***	***25%***	***23%***	***22%***	***20%***	***18%***	***17%***	***15%***	***13%***	***11%***	19%
Total Operating Cost	0	0	-1,057,096	-3,914,439	-4,158,679	-4,415,203	-4,678,117	-4,948,813	-5,233,160	-5,528,631	-5,837,120	-6,158,947	-6,499,634	
Total Operating Income	0	0	0	5,286,952	5,518,508	5,752,108	5,976,656	6,194,488	6,414,948	6,633,072	6,851,196	7,069,028	7,293,786	**Average**
Current Account Balance Ratio				***135%***	***133%***	***130%***	***128%***	***125%***	***123%***	***120%***	***117%***	***115%***	***112%***	124%

Source：JICA Survey Team

(6) Model C-2: Model of Private Investment Recovery using Grant by BOT

Since the grant is supplied as a subsidy (VGF: Viability Gap Fund) payment for the private operator in Model C-2, the grant framework, based on a general E/N template, cannot be applied. In general, the VGF is provided for the project, which the private operator conducts, to keep a self-supporting accounting framework and make it bankable by government financing of part of the cost. It is

desirable that the maximum amount of VGF does not exceed half the total cost; therefore, conducting this project by Model C-2 is impossible, so financial analysis is not implemented.

3.5.7 Sensitivity Analysis

1) Construction Cost

Construction cost is affected by the price of materials and any delay in the construction period. **Table 3.5.14** and **Table 3.5.15** show results of sensitivity analysis regarding the increase and decrease in construction cost.

Table 3.5.14 Results of Sensitivity Analysis (Construction Cost) [15]

Model	Item	20% decline	10% decline	Base Case	10% increase	20% increase
Model A	FIRR	12.3%	11.0%	10.0%	9.1%	8.3%
Model B	FIRR	12.6%	11.1%	10.0%	9.0%	8.1%
Model C-1	Equity IRR	16.9%	15.9%	15.0%	14.1%	13.3%

Source：JICA Survey Team

Table 3.5.15 Results of Sensitivity Analysis (Construction Cost, FIRR of 10% is fixed)

Model	Item	20% decline	10% decline	Base Case	10% increase	20% increase
Model A	Average Water Tariff of Water (KHR/m^3)	3,039	3,289	3,567	3,839	4,105
Model B	Annual Cash Injection from PPWSA (billion KHR)	16	18	20	22	24

Source：JICA Survey Team

2) O&M Cost

The O&M cost is affected by salaries, the price of electricity, chemicals and other factors. **Table 3.5.16** and **Table 3.5.17** show results of sensitivity analysis regarding the increase and decrease in O&M cost.

Table 3.5.16 Results of Sensitivity Analysis（O&M Cost） [16]

Model	Item	20% decline	10% decline	Base Case	10% increase	20% increase
Model A	FIRR	10.6%	10.3%	10.0%	9.6%	9.3%
Model B	FIRR	10.7%	10.3%	10.0%	9.6%	9.2%
Model C-1	Equity IRR	42.0%	30.3%	15.0%	Incalculable	Incalculable
Model C-1 (Option)	Average of Recurrent Profit Margin	35%	27%	19%	11%	3%
	Average of Current Account Balance Ratio	155%	138%	124%	113%	103%

Source：JICA Survey Team

[15] Average water tariff of Model A and cash injection from PPWSA are fixed.
[16] Ibid

Table 3.5.17 Results of Sensitivity Analysis（O&M cost, FIRR of 10% is fixed）

Model	Item	20% decline	10% decline	Base Case	10% increase	20% increase
Model A	Average Water Tariff of Water (KHR/m^3)	3,400	3,484	3,567	3,666	3,755
Model B	Annual Cash Injection from PPWSA (billion KHR)	19	19	20	21	21

Source：JICA Survey Team

3) Water Production

If water production starts from 30,000 m^3/day, income increases. The following table shows results of sensitivity analysis regarding water production (Base Case starts from 18,000 m^3/day).

Table 3.5.18 Results of Sensitivity Analysis（Water Production）[17]

Model	Item	Base Case	Water Production starts from 30,000 m^3/day
Model A	FIRR	10.0%	13.3%
Model B	FIRR	10.0%	10.4%
Model C-1	Equity IRR	15.0%	47.5%
Model C-1 (Option)	Average of Recurrent Profit Margin	19%	25%
	Average of Current Account Balance Ratio	124%	134%

Source：JICA Survey Team

Table 3.5.19 Results of Sensitivity Analysis（Water Production, Model A&B=FIRR 10%, ModelC-1=Equity IRR15% are fixed）

Model	Item	Base Case	Water Production starts from 30,000 m^3/day
Model A	Average Water Tariff of Water (KHR/m^3)	3,567	2,896
Model B	Cash Injection from PPWSA (billion KHR)	20	19
Model C-1	Amount of Private Investment (billion KHR)	0.99	4.6

Source：JICA Survey Team

4) Price of Bulk Water

The Bulk Water price is affected by the contents of the contract between PPWSA and the private operator. **Table 3.5.20** shows results of sensitivity analysis regarding the increase and decrease in the Bulk Water price.

Table 3.5.20 Results of Sensitivity Analysis (Bulk Water Sales Price)

Model	Item	20% decline	10% decline	Base Case	10% increase	20% increase
Model C-1	Equity IRR	Incalculable	Incalculable	15.01%	32.7%	46.4%
Model C-1 (Option)	Average of Recurrent Profit Margin	-1%	10%	19%	26%	32%
	Average of Current Account Balance Ratio	99%	111%	124%	136%	149%

Source：JICA Survey Team

3.6 Confirmation and Analysis on Concerned Laws and Regulations

3.6.1 Public Procurement, PPP, Concession Law

[17] Average water tariff of Model A and cash injection from PPWSA are fixed.

(1) Public Procurement Law

The purpose of the Law on Public Procurement of the Kingdom of Cambodia, 2012, promulgated by Royal Decree No. NS/RKM/0112/004 (hereinafter "Procurement Law of Cambodia") is to ensure that the process of public procurement for procuring goods, civil works, repairs, engaging of services and engaging of consultancy services shall be done with transparency, accountability, fairness, effectiveness, quality, equality/equity, economy and with timeliness as well as to ensure that the public procurement system shall be uniform across the Kingdom of Cambodia. According to Article 3 of the Procurement Law of Cambodia, the law shall extend the scope to implement all public procurement transactions in the Kingdom of Cambodia regardless of the source of the resource except for:

(i) Procurement transactions under the financing project by the development partners which shall be implemented in accordance with the guiding principles and procedures as provided in the financing agreement. If the agreement did not determine any guiding principles and procedures, the process of such procurement shall be implemented in accordance with the provisions of this Law;

(ii) Any procurement affecting secrets in the national defense sector and public security shall require an approval/decision from the Prime Minister;

(iii) Granting other concessions of state shall be implemented in accordance with the law and particular provisions. We believe that the project for the Japanese Grant Aid PPP project may fall under exception (i) above; however, we will need to consult further with the relevant officials at the Ministry of Economy and Finance (MEF) on this point due to the ambiguity of the wording in the law.

When a grant aid would be provided by the government of Japan, the procurement shall be based on "Procurement Guideline for Japanese Grant" by applying Article 3 of Public Procurement Law of Kingdom of Cambodia.

However, this project includes not only construction but also the operation and maintenance (including possible partial investment to facility development from a private company), which cost would be recovered through water sales to PPWSA. Therefore, it is clear if Article 3 of the Procurement Law of Cambodia is applicable for this project as a whole.

Based on the comments from the locally-based international law firm in Cambodia (hereinafter "Law Firm[18]"), the applicability of Article 3 of the Procurement Law of Cambodia for this case is not described clearly in the concerned laws and regulations in Cambodia; however, there is a high possibility that this project as a whole would be implemented under Article 3 of the Procurement Law of Cambodia. Final confirmation needs to be received from the ministry concerned, i.e. the MEF.

[18] TMI Sohgoh Ltd. TMI Sohgoh Law Firm's Phnom Penh Office, one of the largest law firms in Japan (more than 300 lawyers) http://www.tmi.gr.jp/global/office/se-asia/phnom-penh.html

(2) Procurement on Japanese Grant Aid

The grant aid by the government of Japan shall be based on Exchange of Notes (hereinafter "E/N") between Japan and the recipient country. Grant Agreement (hereinafter "G/A") shall be made based on the E/N. E/N and G/A usually describe that the products and/or services purchased for Japanese Grant Aid shall be from Japanese nationals. Japanese nationals are usually defined as "Japanese physical persons or Japanese juridicial persons controlled by Japanese physical persons"; in other words, the procurement for a Japanese grant aid project is basically done by Japan-tied.

In general, G/A describes the "Procurement Guideline for the Japanese Grant (hereinafter "JICA Procurement Guideline") as the procurement guideline for a Grant Aid project; in other words, "the guiding principles and procedures as provided in the financing agreement" described in Article 3 of the Procurement Law of Cambodia is considered to correspond with the JICA Procurement Guideline.

(3) Concession Law

The Law on Concession, 2007, promulgated by Royal Decree No. NS/RKM/1007/027 (hereinafter "Concession Law") is the basic law for PPP in the Kingdom of Cambodia. The purpose of this Law is to promote and facilitate the implementation of private finance in the Kingdom of Cambodia in order to ensure the public interest and the fulfilment of the national economic and social objectives.

"Concession" in the law means any act attributable to the state whereby a competent institution entrusts to a private third party the total or partial implementation of an Infrastructure Project for which that institution would normally be responsible and for which the third party assumes a major part of the construction and/or operating risks, or receives a benefit by way of compensation from government revenue or from fees and charges collected from users or customers. Such acts of the state will henceforth be considered as a "concession" under this Law regardless of the legal name used for the act (Article 3 of Concession Law). Concession contracts in relation to infrastructure facility providing direct or indirect services to the general public may be entered into by the relevant institutions in the following sectors, such as water supply and sanitation etc. (Article 5 of Concession Law).

It can be interpreted that the project conducted under Japanese Grant Aid for PPP project can be regarded as a concession under Article 3, so it would be necessary to comply with this law.

Regarding the relationship with the Procurement Law of Cambodia, Concession Law stipulates that, "The contracting institution shall select the Concessionaire through international or national bidding procedures, by negotiated procedure according to the circumstances. The selection of the Concessionaire shall be carried out in accordance with the procedures provided for in the Sub-Decree (Concession Law, Article 11). However, based on the law firm, Sub-Decree of the law has not been issued and in reality, the law has been applied with wide interpretation. Therefore, there is a high possibility that Concession Law would be applied to this project; however, no Sub-Decree has been issued regarding Concession Law and at least for procurement, Article 3 of Procurement Law of Cambodia is most likely to be applied to this project (Final confirmation shall be required from MEF).

When Concession Law is applied, permission from the Council for Development of Cambodia (CDC) is required (Concession Law, Article 8). However, based on the interview with the MEF, permission needs to be acquired from the MEF but not from the CDC.

(4) Integral Selection of Private Company

As shown in **Figure 3.6.1**, this project would consist of three main contracts, namely: 1) EPC Contract for the construction of Water Treatment Plant (WTP) based on Grant Aid, 2) Lease Contract for private company to use WTP and 3) Bulk Water Purchase Contract.

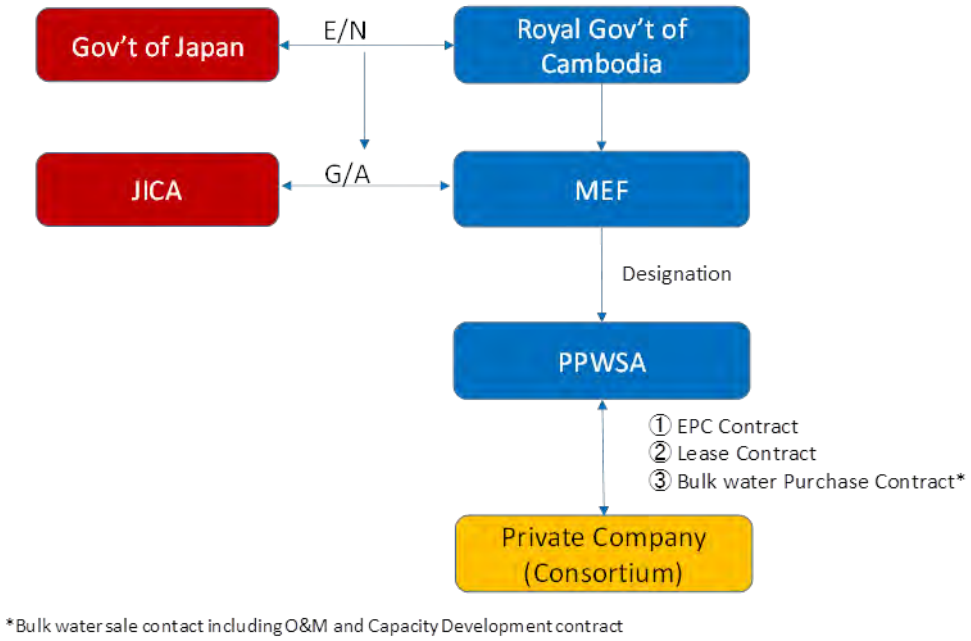
Regarding Contract 1) above, this would be based on E/N between the Government of Japan and Royal Government of Cambodia, and G/A between JICA and MEF. After G/A is signed, it is recommended that actual procurement and contractual activity be designated to PPWSA.

Regarding Contract 2), this is the contract to lease the WTP, which was constructed under contract 1) from PPWSA to private company. Based on the interview with PPWSA, the ownership of WWTP, which is provided through Grant Aid usually transfers from MEF to PPWSA after completion of construction as in-kind investment. Regarding the lease fee, it is recommended to lease without charge because the lease fee would be charged on top of the bulk water purchase price; therefore, there would be no merit for PPWSA. Possible conflict with other laws and regulations needs to be studied in the later stage.

For Contract 2), the bulk water purchase agreement is similarly made between PPWSA and the private company by selling bulk water produced by private company to PPWSA.

This project is to seek the improvement of service quality, life-cycle cost reduction and appropriate risk transfer to the private company through construction, operation and maintenance by one private company (or consortium) integrally. If those contracts were to be procured separately and select different private companies for different contracts, there runs the risk that the WTP, without much consideration for life-cycle cost, as well as the bulk water supply company, would not take any facility-related risks during the operational period. Also, if those contracts were procured separately, the bulk water purchase agreement is considered separately from the framework of ODA procurement, which might cause non-Japan-tied procurement.

Therefore, it is important to make these contracts integrally with one private company (or consortium). E/N or G/A should clearly mention that Contracts 1), 2) and 3) shall be made integrally with one private company (or consortium) in order to apply Article 3 of Procurement Law of Cambodia for Contracts 1) and 2).



Source: JICA Study Team

Figure 3.6.1 Example of Contractual Relation of the Project

(5) Selection Method of Private Company

This PPP project is expected to introduce private know-how and innovation of life-cycle reduction and sustainable water provision. Therefore, a design-build method, in which design and construction would be undertaken by the same company or consortium is recommended. The technology transfer of operation and maintenance, which PPWSA expected from this project, as well as efficient implementation of capacity development are expected to be proposed by a private company. Also, the proposal to retain the quality of the facility after the private company's operational period should be evaluated.

Therefore, it is important to select a private company, not only from the bidding price but also from the technical points of view in order to introduce private know-how for technology transfer as well as to secure sustainable operation after completion of the private company's operation. It is recommended to utilize a comprehensive evaluation method, which converts financial and technical proposals into a score whereby the private company that achieves the highest total score shall be selected.

Based on JCA Procurement Guideline, the following two selection methods are stipulated:

(i) A single-stage two-envelope bidding procedure

(ii) Two-Stage bidding

The above two methods are not comprehensive evaluation methods. JICA Guideline Chapter II Section 2.03 (1) describes: "A single-stage two-envelope bidding procedure shall be adopted unless otherwise stated in the G/A or prior agreement with JICA"; however, the applicability of a comprehensive evaluation method is not clearly mentioned and therefore confirmation is required.

3.6.2 Business Permission Procedure

The Ministry of Industry and Handicraft (hereinafter "MIH") Regulation (Prakas) on Procedure for Issuing, Revising, Suspending and Revoking Permit for Water Supply Business (No.461/2014) stipulates the requirement of a water supply business permit including expansion of water supply. Considering the above-mentioned MIH Regulation, PPWSA would be required to acquire a business permit for expansion of water business in Ta Khmau District (Construction and operation of WTP (30,000m^3/day).

Regarding the necessity of a business permit for a private company to conduct this project, there is no such clause in the above-mentioned MIH Regulation. Based on the interview with PPWSA and MIH, this project is conducted within the management of PPWSA; thus, the private company would not be required to get a business permit.

3.6.3 Other Concerned Laws/Regulations

Laws/Regulations which might affect this project are reviewed as follows;

(1) Public Financial System Law

The Law on the Public Financial System dated 20th May, 2008, which is promulgated by Royal Decree No. NS/RKM/0508/016 refers to the law that plans annual state revenue and expenditure regulations pertaining to the financial system and payments used to perform roles, and to undertake programs and responsibilities of ministries/institutions at the national and sub-national levels in compliance with the provisions of the Constitution and the law on public financial system, and regulations on financial system determined by law. There is no specifically concerned article, which might affect this project as Japanese Grant Aid for PPP grant project.

(2) Law on Water Resources Management

The general purpose of the Law on Water Resources Management of the Kingdom of Cambodia dated 29th June, 2007, which is promulgated by Royal Decree No. NS/RKM/0607/016 is to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people.

This Law determines:

- the rights and obligations of water users;

- the fundamental principles of water resources management; and

- the participation of users and their associations in the sustainable development of water resources.

There is no description for PPP or cooperation with private companies within this law.

(3) MIH Regulation on Water Tariff Determination Mechanism

The MIH Regulation (Prakas) No. 069 dated 4th March, 2016 on the Water Tariff Determination Mechanism has divided the water tariff determination mechanism into two methods:

Method 1: Cash Flow Method - This method is used to calculate converting the cash flow of the water service provider into real value (basic year) to determine the water tariff. This provision refers to water service supplier type “A”, which supplies water to more than 2,001 connections.

Method 2: Annuity Method - This method is to set the average water tariff equal to the income of the water service provider, divided by the amount of planned water sold. This provision refers to water service supplier type “B”, which supplies water to equal or less than 2,000 connections.

The MIH shall be the only one who has rights to determine the water tariff for those water service providers. According to the meetings with PPWSA on 8th November, 2017 and 14th November, 2017, the PPWSA mentioned that the tariff determination for PPWSA was under the jurisdiction of the Council Ministers of Cambodia and that the above-mentioned methods will not apply for PPWSA. However, the sub-decree mentioned by PPWSA has not yet been found and further confirmation shall be required.

(4) Investment Law

There is no restriction on foreign investment including the maximum ratio of share for the water supply sector. The Qualified Investment Project (QIP) is entitled to profit tax exemption. Profit tax exemption is composed of the “Trigger period” + three years + Priority Period (Maximum total: nine years). The clean water supply project with an investment capital of more than USD 500,000 is irrigable above-mentioned profit tax exemption (Article 15 of Sub Decree No. 111 ANK/BK dated 27th September, 2005 on the Implementation of the Law on the Amendment to the Law on Investment of the Kingdom of Cambodia). It is not clearly mentioned in the concerned laws and regulation weather the grant-aid value would be considered as part of investment capital mentioned above.

(5) Tax Regulations

The following are the tax regulations. There are no critical tax regulations, which affect this project:

- Prakas No. 559 of MEF
- Prakas No. 002 MEF on Implementation of Advance Ruling on Tariff Classification, Customs Valuation and Origin of the Goods
- Instruction No 345 GDCE on Implementation of Advance Ruling on Tariff Classification
- Instruction No 346 GDCE on Implementation of Advance Ruling on Customs Valuation
- Instruction No 2175 GDCE on Implementation of Advance Ruling on Origin of the Goods

(6) Foreign Exchange Law

Any foreign exchange operations and, in general, any operations carried out between residents and non-residents are subject to the present law when they relate to:

- payments for commercial transactions;
- transfer; or

- capital flows, including investment.

There shall be no restrictions on foreign exchange operations through book entry including purchases and sales of foreign exchange on the foreign exchange market, transfers, all kinds of international settlements and capital flows in foreign or domestic currency, between Cambodia and the rest of the world or between residents and non-residents. However, such operations shall be undertaken solely through authorized intermediaries (Article 5 of Law on Foreign Exchange dated 22nd August, 1997, which is promulgated by Royal Decree No. CS/RKM/0897/03). In addition, there is no foreign exchange restriction for Japanese Yen in Cambodia.

(7) Law on Expropriation

'Expropriation' refers to confiscation of ownership of, with fair and just compensation in advance, immovable property or the real right to immovable property of physical persons or legal entities or legal public entities, 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 (Law on Expropriation dated on 26th February, 2010, which is promulgated by Royal Decree No. NS/RKM/0210/003). Any expropriation of land needs to follow this Law on Expropriation.

(8) Law on Accounting and Auditing

The purpose of this law is to govern accounting and auditing with effectiveness, transparency and reliability in the Kingdom of Cambodia. According to Article 3 of the Law on Accounting and Auditing dated 11th May, 2016, which is promulgated by Royal Decree No. NS/RKM/0416/006, this law shall apply to public institutions, enterprises, not-for-profit entities, accountants and auditors. Since PPWSA is a state-owned company this law shall be applied.

(9) Employment of Foreigner

The Ministry of Labor Regulation, 2001, No.161 based on Law on Labor, 1997, promulgated through Royal Decree No. CS/RKM/0397/01 described the conditions on employment of foreigners. The employment of foreigners is permitted only if there are no alternative human resources in Cambodia in terms of occupational ability. When the company employs foreigners, an application needs to be submitted to the Ministry of Labor and the maximum percentage of the foreigners' employment is 10% of the total number of those employed by the company. When there is a permit from the Ministry of Labor, the number of foreigners' employment percentage could be more than 10%.

3.6.4 Outline of Market Sounding and Questionnaire Survey

The study team conducted the interviews with Japanese companies and financial institutions, which locate their branch company or representative office in Phnom Penh in order to hear their opinions on this project. Also, the questionnaire survey was conducted in "Water Business Public Meeting -Public Private Partnership thorough Water Treatment Facility Development in Cambodia-"on December 11th in Tokyo. The following are the summary of the opinions from private companies:

(1) Project Scheme

- "Take or Pay" method, in which PPWSA shall pay the contracted amount regardless of their willingness to buy the water if the water is ready to provide.
- Bulk water tariff should be adjusted based on inflation.
- If there is a government guarantee for the payment of bulk water purchase agreement, it would be easier to enter the contract with PPWSA.
- JICA should continuously involve the operation of project. JICA should consider to inject equity to SPC.
- Consortium with local company should be admitted. This is difficult to deal with especially acquiring a permit from the government only by a Japanese company.

(2) Operation and Maintenance Concept

- One Japanese staff would be allocated and control the new WTP. Usually Japanese staff is not required but it should be considered given the importance of technology transfer to PPWSA.
- The treatment of staff in WTP after the operation and maintenance by a private company should be considered. The staff in WTP should be continuously employed by PPWSA after the project period ends.

(3) Method of Private Company Selection

- If only price competition, the company, which proposes the lowest price with minimum quality facility might be selected. If high quality facility and equipment, such as those made in Japan are involved, the technical proposal should also be evaluated.
- If only the water PPP experience in overseas is considered in the evaluation, the competition would be very limited. The water PFI experience in Japan should also be considered.

(4) Permission

- It should be clarified if PPWSA would conduct EIA or not.
- Water right(s) should be secured by PPWSA in advance.

(5) Tax

- Tax treatment during the operational period should be clarified by the public side.
- VAT for water sales might not be added; however, it is considered that the private company (Special Purpose Company (SPC)) needs to pay tax.

(6) Other Requirement

- Distribution pipeline development plan should be clarified.
- The assets purchase from public sector and compensation of lost profit should be guaranteed.

(7) Financial Market

- The financial market in Cambodia is still not mature. Japanese financial institutions only have their representative office in Cambodia and cannot conduct banking business (except through a subordinate company in Cambodia). Usually Japanese companies get finance through group company finance or approach to off-shore market(s).
- In Cambodia, USD has the role of key currency and around 90% of deposits are done using USD. The government of Cambodia is promoting Cambodian riel (KHR) utilization. The policy seems to be unchanged in the short term but changing the key currency would have a significant impact on the Cambodian economy, especially with regard to foreign companies. Tax needs to be paid by KHR.

3.7 Bid Documents and Contract Forms

Considering the potential contracting parties such as Japanese government, Cambodian government, PPWSA as Implementation Agency, the Japanese companies, and the financial institution, possible contracts in model A, model B, model C-1 and model C-2 are listed in **Table 3.7.1**.

Table 3.7.1 Contracting Parties of Each Model

	VGF	Grant Aid	EPC contract	WTP lease contract	WTP M&O Contract	Bulk water purchase contract	Investment loan contract	Specific features
Model A Standard Sustainable To-Be Model	-	-	PPWSA - contractor	-	-	-	-	It can be feasible if sufficient MDBs loans to RGC are available.
Model B Low water usage rate + VGF	PPWSA - RGC	-	PPWSA - Contractor	-	-	-	-	VGF must be paid by RGC to PPWSA
Model C-0			SPC - Contractor	-	SPC - PPWSA	SPC - PPWSA	SPC - banks	
Model C1 Grant Aid BTO Model	-	GoJ - RGC	JPC - PPWSA	JPC - PPWSA	JPC - PPWSA	JPC - PPWSA	JPC - banks	Standard Japanese Grant Aid scheme can be used
Model C2 Grant Aid BOT Model	JPC - PPWSA	GoJ - RGC	JPC - Contractor	—	JPC - PPWSA	JPC - PPWSA	JPC - banks	New Japanese Grant Aid scheme must be developed.

Source：JICA Survey Team

3.7.1 Contract Forms Necessary for the Execution of the Business

Considering implementation forms including the availability of grant aid, the five business models described above have been considered, and depending on each business models, the contract forms varies.

In this section, we will explain the model C-1, which is the most feasible business model, using the Grant Aid money in BTO styled project.

Model C-1 uses Japanese Grant aid money, so the contracting parties are Japanese government, Cambodian government, PPWSA (Implementation Agency), and Japanese companies.

First of all, a source of funds is required to realize the business, and this fund would be Japanese Grant Aid. In order to use this Grant aid money, an Exchange of Notes (E/N) will be signed by the two governments, agreeing to grant aid money, and the Grant Agreement (hereinafter referred to as "G/A") will be concluded between JICA and implementation agency (PPWSA), which is specifically empowered to use this grant aid money by the Cambodian Government. The E/N and G/A defines the purpose of use, amount of money, and the conditions of the usage of the grant aid money.

In order to use Japanese Grant aid money, a consultant in the fields of finance, legal and technical domain will be selected by JICA through a competitive request for proposals exercise to create tender documents which necessary the project implement. Prior to the conclusion of E/N, such development of tender documents draft has to be conducted by JICA. After the signature of the G/A the Consultants who conduct the preparatory investigations and formulation of the tender documents are normally recommended to the implementation agency (PPWSA) as consultants to support the project procurement and this is done by a letter of recommendation issued by JICA. The research team proposes the development of the four contracts templates given below for inclusion in the tender documents as contracts that are necessary to enact this project.

1) EPC Contract for construction of the Water Treatment Plant (hereinafter referred to as "WTP") as the facility to be developed under the project,

2) WTP lease contract to borrow the facility owned by the implementing agency after completion in nominal price,

3) The bulk water Purchase Contract (including WTP O&M and capacity building operations) to operate and maintain and manage the leased WTP and sell the bulk water to the implementing agency (PPWSA).

4) If necessary, private companies may sign an investment loan Contract and its accompanying direct agreement between the implementation agency (PPWSA) and financial institutions

These business contracts, contract for development of the facilities necessary for the business, contract for the lease of such facilities and contract of the operation of the facilities, are co-related and mutually interdependent. Therefore, we propose that these contracts will be signed with the private companies at the same time at the selection stage when the involvement of the Japan government is critical.

3.7.2 Risks Associated with Implementation of Business Model

During the field survey of this project, team member interviewed local Japanese companies and specifically sought to establish the risks that Japan companies envisioned.

There is no significant difference between the business risks that Japanese companies highlight, and the risks (economic & market risks, and political & social risks) that should be covered by standard PPP contracts, however reflecting the peculiarities of the grant aid money finance, there is the additional risk of nonfulfillment of the contract by the implementation Agency.

The business risks in the **Table 3.7.2** is after signing the contracts, therefore the risk arising from changing the bidding conditions, the risk of changing the scope of business, and all other risks before signing the contracts are not included here.

As the concept of risk sharing in this report, a risk is not defined as a loss or a negative factor as described in "the guidance of the third-party consignment" issued by Water Supply Div., Health Service Bureau, the Ministry of Health, Labour and Welfare. We recognize "risk" as a future uncertainty that can be both positive and negative (almost evenly), which is usually recognized in the financial science. With such definition, assignment of the works with corresponding risks is demarcated to the person who can best manage such risk. The total cost of the risk will be reduced by outsourcing such risk management to the person who can manage better than previous risk taker, and such new risk taker will manage such transferred risk with minimal cost by risk preventing method or risk mitigation method to obtain profit from such risk management works.

When calculating the risk cost, an often-used method is that of calculation from the product of the probability of the risk and the impact of such risk.

The following table summarizes the risk category, description of risks, direct consequence of the risks, work assignment demarcation, and risk share between the implementation agency and private companies. It is assumed that the one who manages the risk best can manage such risk in the appropriate manner. However, in accordance with the contents of the risks entrusted to the private sector, it is desirable to agree in advance that the risk which the private operators cannot control, should be the responsibility of the implementation agency.

Table 3.7.2 Business Risks, Work Demarcation and Risk Distribution

Risk Category	Description of Risks	Direct Consequence of the Risks	Work Demarcation	Risk Share	
				Implementation Agency	Private Companies
Commissioning risk	The risk that the infrastructure will not receive all approvals to satisfy an output specification, such as expected changes in legislation which allow for a specific output specification not materializing.	Additional ramp-up cost, cost of maintaining existing infrastructure, or providing a temporary alternative solution, where this leads to a delay in the provision of the service.	It is the private company's responsibility to complete the facility development and transfer the ownership to the implementation agency. If the implementation agency delays the commissioning schedule without any reason, it is responsible of implementation agency.		○

Risk Category	Description of Risks	Direct Consequence of the Risks	Work Demarcation	Risk Share	
				Implementation Agency	Private Companies
Construction risk	The risk that the construction of the assets required for the project are not completed on time, within budget, or to specification.	Additional raw materials and labor costs, cost of maintaining existing infrastructure, or providing a temporary alternative solution where this leads to ta delay in the provision of the service.	It is the private company's responsibility to complete the construction of the facility within the budget.		○
Demand(usage) risk	The risk that the actual demand for a service is lower than planned.	Reduced revenue.	The risk arising from demand fluctuation cannot be taken by private companies, therefore the responsibility of such fluctuation is taken by the implementation agency.	○	
Design risk	The risk that the proposed design will be unable to meet the performance and service requirements in the output specification	Cost of modification, redesign costs.	It is the private company’s responsibility to design the facility to be functioned for its purpose.		○
Environmental risk	The risks that the project could have an adverse environmental impact, which affects project costs not foreseen in the environmental impact assessment.	Additional costs incurred to rectify an adverse environmental impact on the project incurred from the construction or operation of the project or pre-existing environmental contamination.	It is the private company’s responsibility to design, build, and operate in a way that does not adversely affect the environment within the agreed conditions.		○
Financial risk	The risk that the private sector over-stresses a project through inappropriate financial structuring.	Additional funding costs for increased margins or unexpected refinancing costs.	In this project, refinancing is not required because there is no private financing.	—	—
Force majeure risk	An act occasioned by an unanticipated, unnatural or natural disaster, such as war, earthquake, or flood, of such magnitude that it delays or destroys the project and cannot be mitigated.	Additional costs to rectify.	Neither party can take on the responsibility for the events of force majeure, However the necessary actions have to be taken by either party, and they will not claim for compensation from each other.	○	○
Industrial relations risk	The risk that industrial relations issues will adversely affect construction costs, timetable and service delivery.	Increased employee costs, lost revenue, or additional expenditure during delay in construction or service provision (post-construction)	Private companies can foresee short-term risks associated with their industry, consequently such risks have to be taken by the private companies.		○
Latent defect risk	The risk that an inherent defect exists in the structure being built or equipment used, which is not identified up front and which will inhibit provision of the required service.	Cost of new equipment or modification to existing infrastructure.	If there is a defect in the facilities provided by the implementation agency, such responsibility should be taken by the implementation agency, unless other conditions are agreed separately.	○	△

Risk Category	Description of Risks	Direct Consequence of the Risks	Work Demarcation	Risk Share	
				Implementation Agency	Private Companies
Operating risk (Service upper-performance)	The risks associated with the daily operation of the project, including an unexpected change in operating cons over budget	Increased operating costs or reduced revenue over the project term.	The cost fluctuation related to the operation is the responsibility of the private companies, however if such cost fluctuation, for example, energy or other utility costs, is not under the control of the private companies, such responsibility has to be taken by the implementation agency through the adjustable method such as metered rate system.	△	○
Performance risk	The risk that the operator will not perform to the specified service level, such as the Water Resources Department permitting offtake of less than required demand.	Cost of failing to comply with performance standards.	The underperformance operation in a given condition is the responsibility of private companies, however the deterioration of the quality of the water source, etc., which are not under the control of private companies are the responsibility of the implementation agency.	△	○
Change in law risk	The risk that the current regulatory regime will change materially over the project or produce unexpected result.	Cost of complying with new regulations	Changes of the laws directly related to the project is the responsibility of the implementation agency, however, modifications of the general laws which are applicable to all industry such as change of VAT and income tax are the responsibility of the private companies.	○	△
Residual value risk	The risk relating to differences from the expected realizable value of the underlying assets at the end of the project.	Lower realizable value for underlying assets at the end of the project term.	It is the responsibility of the private companies if the residual value of the facility is decreased because of the private companies' bad operation. However if the causes of asset value decrease are due to ground subsidence and deterioration of the surrounding environment, such value decreases are the responsibility of the implementation agency.	△	○
Technology obsolescence risk	The risk that the technology used will be unexpectedly superseded during the term of the project and will not be able to satisfy the requirements in the output specification.	Cost of replacement technology.	If the implementation agency requires new technology during the durable life of the facilities, such requirement is the responsible of the implementation agency. On the other hand, if private companies voluntarily invest new technology to improve the efficiency of the operation, such self-proposed new technology is under the responsibility of the private companies.	○	○

Risk Category	Description of Risks	Direct Consequence of the Risks	Work Demarcation	Risk Share	
				Implementation Agency	Private Companies
Upgrade risk	The risk associated with the need for upgrading the assets over the term of the project to meet performance requirements.	Additional capital cost required to maintain specified service.	Industry-standard upgrades are the responsibility of the private companies. Any specific upgrade request which was not included in the initial technical specification, is under the responsibility of the implementing agency.		○
Nonfulfillment of the contract Risk	The risk of nonfulfillment of the contract to pay the compensation fee for the received bulk water to the private companies by the convenience of the implementation agency.	Generation of negative cash flows due to the lack of business income as a result of nonfulfillment of the compensation fee payment by the implementation agency or receivables to the implementation agency becomes bad debts	Nonfulfillment of the contract by the off-taker may be covered by an insurance (such insurance has to be confirmed). JICA may participate the project through capital investment to the SPC of the private companies, or in addition, JICA may invest to PPWSA to manage the project operation to prevent occurring this risk.	—	—

Source: JICA Survey Team

The quantification of these risks will vary depend on the contract clauses which are to be accordance with the concrete technical specification, the detailed quantification measures should be developed during subsequent feasibility study stage.

3.7.3 Review and Set up of Key Contract Terms (term sheet)

In the four business contracts described above 1) WTP EPC contract, 2) WTP lease contract, 3) WTP O&M and bulk water purchase contract, 4) Loan contract and its direct agreement, the first three contract has to be integrated in the tender documents. The integration of the contract is necessary because there is a correlation between the construction of facilities and the operation of the facilities, and it is essential to manage investment and management appropriately. In addition, although the term sheet of the 4th loan contract is not listed here because it is a contract between the investor and the financial institution, it is important that all these contracts be signed simultaneously.

Volume I: The Tender

Letter of Invitation

i Instructions to Tenderers

ii Tender Data

(a) Tender Security Form
(b) List of Tenderer/Companies (SPC)
(c) Tenderer/Manufacturer's Information Form
(d) Manufacturer’s Authorisation Form
(e) List of Subcontractors
(f) Subcontractor’s Information Form
(g) Tenderer’s Project Organization
(h) Key Professional Staff
(i) Curriculum Vitae (CV) for Proposed Professional Staff
(j) Detailed Design Proposal Form
(k) Detailed Work Plan and Program Proposal Form
(l) Detailed Operation, Maintenance Plan Form
(m) Sample Form for Programme

(n) Tenderer’s Financial Proposal
(o) Price Schedules
(p) Summary of Alternative Bid

Volume II: The Contract
EPC Contract
1. GENERAL PROVISIONS
2. THE EMPLOYER
3. THE EMPLOYER'S ADMINISTRATION
4. THE CONTRACTOR
5. DESIGN
6. STAFF AND LABOUR
7. PLANT, MATERIALS AND WORKMANSHIP
8. COMMENCEMENT, DELAYS AND SUSPENSION
9. TESTS ON COMPLETION
10. TAKING-OVER
11. DEFECTS LIABILITY
12. VARIATIONS AND ADJUSTMENTS
13. CONTRACT PRICE AND PAYMENT
14. TERMINATION BY THE Employer
15. SUSPENSION AND TERMINATION BY THE CONTRACTOR
16. RISK AND RESPONSIBILITY
17. INSURANCE
18. FORCE MAJEURE
19. CLAIMS, DISPUTES AND ARBITRATION
20. COMPLIANCE
21. REPRESENTATIONS AND WARRANTIES

Special Clauses
1. The Employer’s Requirements:
2. Schedule of Payments
3. Schedule of Performance Guarantees
4. Forms of Security

Part 1 Form of Performance Security
Part 2 Form of Advance Payment Guarantee
5. Tests on Completion 92
6. Programme

Part 1 Form of Initial Programme
Part 2 Programme Specification

7 Insurance Requirements
8 Form of Collateral Warranty
9 Form of Subcontractor Acknowledgment and Consent
10 Form of Statement
11 The Contractor’s Representative
12 Approvals to be obtained by The Employer
13 [Interface Schedule]
14 Defects Liability Period

Lease Contract
1. Definitions and Interpretation
2. Demise
3. Rent
4. Lessee’s Covenants
5. Lessor’s Covenants
6. Alienation
7. Term and Termination
8. Assignment
9. Notices
10. Governing Law

11. Disputes
12. Geranral
13. Intention to be bound

O&M and Bulk water Purchase Contract

1 Definitions
2 Term and Conditions Precedent
3 Responsibilities and Obligations of the Operator
4 Responsibilities and Obligations of Owner
5 Spare Parts
6 Improvements to Facility and Changes in Project Documents
7 Access to Site
8 Operational Issues
9 Financial Information
10 Repair and Maintenance Account
11 Contract Fee
12 Force Majeure and Emergencies
13 Default, Remedies and Termination
14 Indemnification and Limitation of Liability
15 Performance Security
16 Insurance
17 Governing Law and Dispute Resolution
18 General

Special clauses

1 Services
2 Critical Spare Parts
3 Environmental Policy
4 Fees
5 Performance Security
6 Insurance
7 Operator employees
8 Key performance Indicators
9 Termination Payment
10 Subcontractor acknowledgement and consent
11 Independent Technical Expert for Audit

Volume III: The Requirements

SCOPE OF WORKS

1. Description of the Works
2. Design Services
3. Design-Build Management
4. Building and Construction Services
5. Operation and Maintenance Services
6. Financial Scope: Operational Phase

TECHNICAL SPECIFICATIONS

1. Treatment Plant Specifications
2. Civil and Building Performance Specifications
3. Training Institute Specification
4. Tracking System Specification

REFERENCE

1. Risk Allocation
2. Medical Waste and Hazardous Waste Generation Rates
3. Topographical Survey report
4. Geotechnical Investigation Report

3.8 Environmental and Social Considerations

3.8.1 Relevant Laws and Regulations

Relevant laws and regulations in Cambodia relevant to environmental and social consideration are summarized in **Table 3.8.1**.

Table 3.8.1 Laws and Regulations Related to Environmental and Social Consideration in Cambodia

No.	Law and Regulation	Date
1	Law on Environmental Protection and Natural Resource Management	Nov. 1996
2	No. 72 ANRK.BK, Anukret (Sub-decree) on Environmental Impact Assessment (EIA) Process	Aug. 1999
3	No. 376 BRK.BST, Prakas (Declaration) on General Guideline for Developing IEIA/EIA Reports	Sep. 2009
4	Prakas (Joint Declaration) between MOE and MEF on Determination of Service Fee for EIA Reviewing and Monitoring	2000 2012
5	No. 215 BRK, Prakas (Declaration) on Registration of Consulting Firm for Studying and Preparing Environmental and Social Impact Reports	May 2014
6	No.27 ANRK/BK, Anukret (Sub-decree) on Water Pollution Control	Apr. 1999
7	No.36 ANRK.BK, Anukret (Sub-decree) on Solid Waste Management	Apr. 1999
8	No. 42 ANK/BK, Anukret (Sub-decree) on the Control of Air Pollution and Noise Disturbance	Jul. 2000
9	Law on Water Resources Management	Jun. 2007
10	No. NS/RKM/0208/007, Law on Protected Area Management (Protected Areas Law)	Feb. 2008

Source: JICA Survey Team based on an interview with MOE

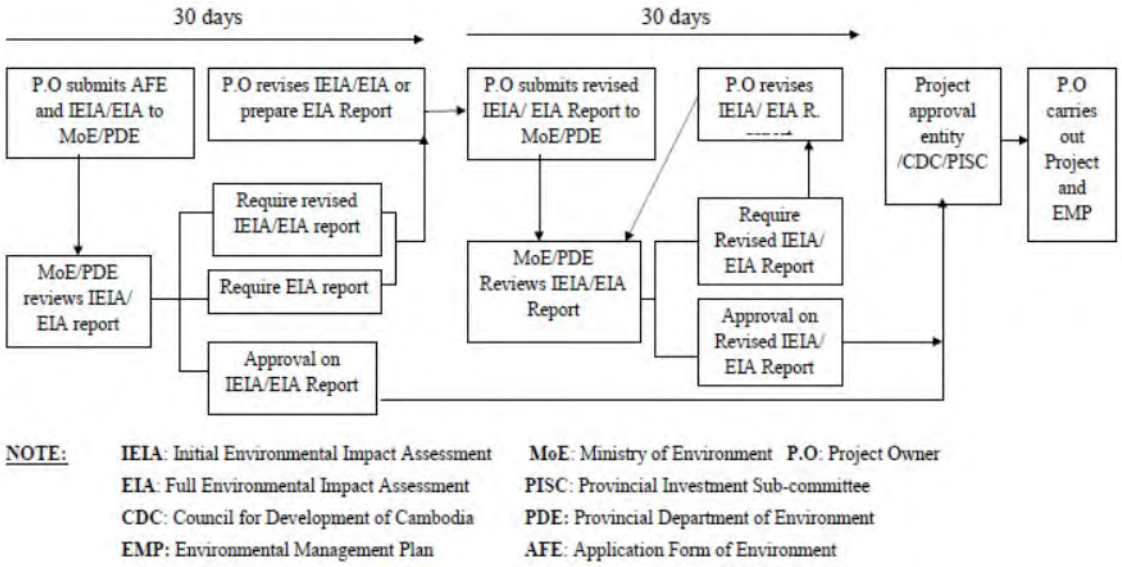
3.8.2 Comparison of JICA Guideline and Cambodian Laws and Regulations

There is no significant difference between JICA guidelines and Cambodian laws and regulations, except that in the latter, there is not as much emphasis on “strategy environmental assessment (SEA)”, “global warming”, “environmental monitoring form”, “information disclosure and stakeholder meeting”, and “alternatives comparison”.

3.8.3 IEIA/EIA Procedures

According to the Sub-decree on EIA Process (1999), an initial environmental impact assessment (IEIA) or an environmental impact assessment (EIA) is required if there are more than 10,000 users for a water supply project. Therefore, an IEIA/EIA will be necessary because the population served by the project will be about 120,000.

The IEIA/EIA procedure in Cambodia is presented in the following **Figure 3.8.1**.



Source: Declaration on General Guidelines for Developing IEIA/EIA Reports (2009)

Figure 3.8.1 IEIA/EIA Procedure in Cambodia

According to Declaration No.215 issued by MOE in 2014, the implementing agency shall hire a registered local consultant to conduct the IEIA/EIA. **Table 3.8.2** lists the 15 registered local consultants.

Table 3.8.2 Registered Local Consultants

Name		License		Contacting Information
		No.	Date	
1	E & A Consultant Co., Ltd.	358	2014-07-01	012-406-716
2	CES Co., Ltd.	359	2014-07-01	012-666-462
3	PPIC Co., Ltd.	517	2014-07-17	012-646-882
4	SBK Research and Development Co., Ltd.	518	2014-07-18	012-991-332
5	Creative Green Design Co., Ltd.	551	2014-08-01	0967-420-824
6	ENVIROTECH Service Co., Ltd.	561	2014-08-04	012-972-386
7	Green Environment Group Co., Ltd.	571	2014-08-05	085-222-221
8	SAWAC Consultants (Cambodia) Co., Ltd.	578	2014-08-06	012-360-743
9	RCBCC Co., Ltd.	727	2014-10-03	016-266-558
10	Key Consultants (Cambodia)	582	2015-06-29	012-824-628
11	SUSTINAT Green Co., Ltd.	687	2015-07-28	070-991-519
12	GIGB Business Investment Cambodia Co., Ltd.	1005	2015-10-26	077-653-525
13	Prey Kduoch Development Consultant	1345	2015-12-31	012-522-362
14	Beetle Environmental Solutions	810	2017-08-22	015-777-752
15	Cambo Consultant International (CCI)	894	2017-09-08	011-617-766

Source: JICA Survey Team based on the materials provided by MOE.

3.8.4 Land Acquisition and Water Right

PPWSA is the land owner of the site for the Ta Khmau WTP. Therefore, land acquisition and resettlement will be not required. However, the following issues should be considered:

1) Total area of the site is only 4,200 m^2 (including existing elevation tank, see the **Figure 3.8.2**). Some space-saving design will be necessary to accommodate the WTP with a capacity of 30,000 m^3/d.

Source: JICA Survey Team

Figure 3.8.2 Proposed Ta Khmau WTP

2) To construct the intake facility, additional land along the embankment of the Bassac River may need to be acquired. This issue should be discussed with MOWRAM.

PPWSA will apply to MOWRAM for the approval for raw water intake

3.8.5 Risk Analysis of Environmental and Social Impacts

JICA Survey Team conducted risk analysis based on existing information and field survey. The results are summarized in **Table 3.8.3**.

Table 3.8.3 Risk Analysis of Environmental and Social Impacts for Ta Khmau WTP

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
Social Environment				
1	Resettlement	D	D	The WTP will be constructed within an existing site.
2	Local economy (employment and livelihood etc.)	D	D	Water supply project will create positive impacts on the local economy due to increase of service level.
3	Land use and utilization of local resources	C	D	Some changes of land use may occur due to construction of intake facility. However, the area affected will be very limited.
4	Water usage/water right	C	C	Even at low flow (40 m^3/s), intake amount (33,000 m^3/d) will not have significant impact on water usage. MOWRAM approval has not been obtained yet.
5	Social institutions	D	D	Water supply system construction normally have limited negative impact on social institutions.
6	Existing social infrastructures and services (such as traffic etc.)	C	D	Traffic disruption (especially on National Road No. 2) may occur during construction. The impacts of traffic congestion should be examined. No pipeline installation is planned.
7	Poor households	C	C	Appropriate water tariff with consideration for the large number of low income users will be studied.
8	Indigenous, or ethnic people	D	D	No specific impacts for different ethnic groups are anticipated.
9	Misdistribution of benefit and damage	D	D	This is unlikely since the project will provide 100% service coverage to the area.
10	Local conflict of interests	D	D	This is unlikely since the project will provide 100% service coverage to the area.

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
11	Gender	D	D	Workload of women in collecting water from wells and public water taps will be reduced.
12	Children's rights	D	D	Health of children will be improved.
13	Cultural heritage	D	D	There will be no negative impact since no pipeline installation is planned and the WTP will be built at an existing site.
14	Infectious diseases such as HIV/AIDS	C	D	Potential but mitigable risk of infectious diseases such as HIV/AIDS due to influx of construction workers.
15	Accidents (risk etc.)	C	D	During construction, safety measures will be taken to prevent accidents. SPC will transfer Japanese O/M know-how to PPWSA staff to ensure safe operation of the facilities.
Natural Environment				
16	Geographical features	D	D	The change of topography and geology due to excavation and landfill (several m) will be limited.
17	Ground subsidence	D	D	No ground subsidence is expected.
18	Bottom sediment	D	D	During construction of the intake, bottom sediment may be disturbed for only a very short-period.
19	Biota and ecosystem	D	D	The project site does not encompass primeval forests, tropical rain forests, or ecologically valuable habitats.
20	Meteorology (global warming)	D	D	Power consumption at distribution pumping station is expected to be reduced because the WTP is closed to the service area.
21	Landscape	D	D	The scale of the proposed facilities is small. The impact is considered to be negligible.
22	Protected areas	D	D	There is no protected area in Phnom Penh.
Pollution				
23	Air pollution	D	D	During construction, limited dust and exhaust gas may be generated by construction equipment, vehicles, and excavation activities. During WTP operation, no negative impact on air pollution is expected because no SO_2, NO_2, CO, or dust, will be discharged.
24	Water pollution	C	C	During construction, water pollution may occur due to construction of intake facility and discharge of wastewater from construction sites. During WTP operation, backwash water and wastewater from the administration building will be discharged into the Bassac River or nearby drainage system.
25	Soil pollution	D	D	No impact is expected since there is no sludge disposal on land.
26	Waste	C	D	During construction, construction wastes will be disposed of at a landfill site, therefore, the impact of the project will be very limited.
27	Noise and vibration	C	D	There are no hospitals, schools and residence around the construction site. Pumps will be housed in the pumping station.
28	Offensive odor	D	D	No odor will be produced.

Note;
P & C: Planning and construction
A: Significant negative impact is expected. B: Negative impact is expected to some extent.
C: Light negative impact is expected D: Negative impact is negligible.
Source: JICA Survey Team and PPWSA.

The issues that should be investigated in the coming preparatory survey and proposed study methods are summarized in **Table 3.8.4**.

Table 3.8.4 Issues and Study Methods

No.	Issues	Study Methods
1	Land use	Confirming with MOWRAM about construction of intake facility.
2	Water usage/water right	1) Confirming with PPWSA about obtaining MOWRAM approval for raw water intake from Bassac River. 2) Confirming water use situation downstream.

No.	Issues	Study Methods
3	Existing social infrastructures and services (such as traffic etc.)	1) Measuring traffic flow at National Road No. 2. 2) Assessing the impact of construction on traffic. 3) Proposing mitigation measures to minimize traffic disruption.
4	Poor households	1) Confirming current water tariff for poor households. 2) Survey affordability. 3) Proposing appropriate water tariff with consideration for low income households.
5	Infectious diseases such as HIV/AIDS	1) Collecting existing information on prevalence of infectious diseases of construction workers. 2) Proposing proper precautions.
6	Accidents (risk etc.)	1) Collecting information from PPWSA in similar projects. 2) Preparation of suggestions and preventive measures for environmental management plan (EMP).
7	Water pollution	1) Collecting information on water quality of Bassac River (especially for SS). 2) Collecting information on water pollution in similar projects from PPWSA. 3) Estimating the impact of discharge of backwash water to Bassac River. 4) Proposing mitigation measures on water pollution control.
8	Waste	1) Collecting information on location, type, capacity and leachate measures of existing solid waste disposal sites. 2) Estimating the quantity of construction wastes from the project
9	Noise and vibration	1) Measuring noise levels near the WTP site. 2) Estimating the noise level along the perimeter of the site during construction. 3) Proposing mitigation measures.
10	Alternatives treatment process	1) Examining different water treatment processes (especially for pre-treatment methods).

Source: JICA Survey Team

3.9 Key Components of Preparatory Survey

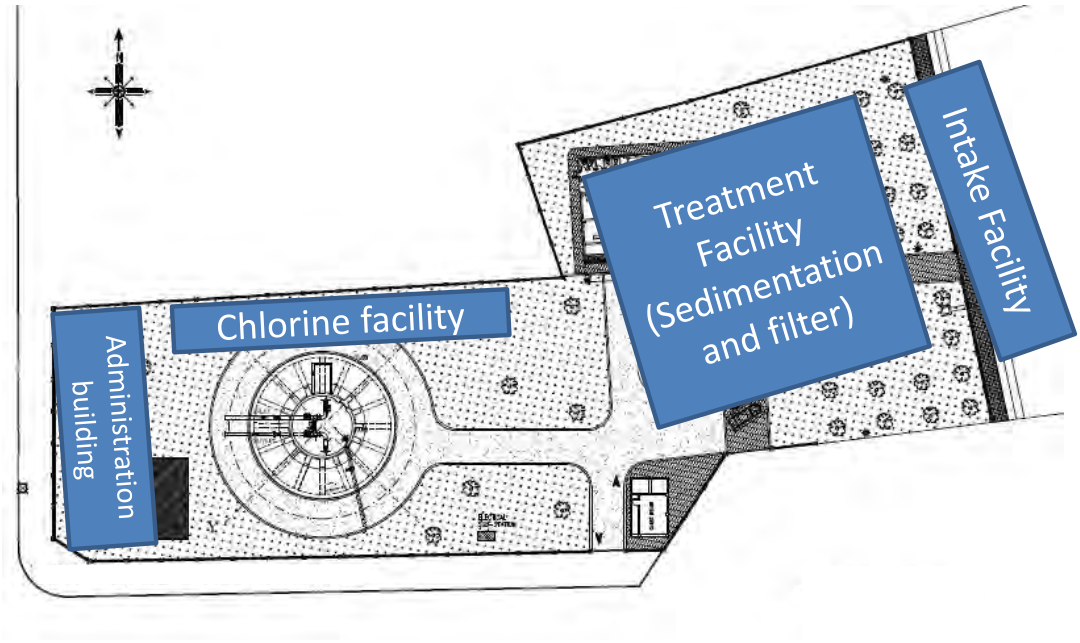
3.9.1 Project Scope

The project scope for Ta Khmau WTP is presented in **Table 3.9.1** according to the format for application for Grant Aid.

Table 3.9.1 Requested Project Scope

Item		Details
Facility	Intake Station	Intake pump station with the capacity of 33,000 m^3/d
	Raw Water Transmission	Conveyance pipe DCIP φ600mm, 100m
	Water Treatment Plant	Capacity: 30,000 m^3/d with solar power system
	Distribution Facility	Distribution pumping station
	Distribution Monitoring System	Flow meter, pressure gauge, telemetering system, monitoring system
Equipment	Water Quality Testing	Jar tester, distillation apparatus, turbidity meter, laboratory table, residual chlorine analyzer, UPS, pH meter, portable conductivity meter, reagents, glassware etc.
	Mechanical Equipment	Vibration checker
	Equipment for Service Connection	Socket fusion equipment, material and equipment for service connection
Others		Operation and maintenance and OJT training

Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.9.1 Proposed Ta Khmau WTP

(1) Site for Ta Khmau WTP

As shown in **Figure 3.9.1**, the project includes intake, water treatment and chlorination facilities and an administration building, all to be constructed within a limited area.

(2) Foundation

Pile foundation will be required for the Ta Khmau WTP to be constructed at the western bank of the Bassac River.

(3) Drain Facility

There is no space for sludge drying beds. Backwash and sedimentation sludge will be discharged into the river.

(4) Pre-treatment Facility

Because of the high level of ammonia nitrogen and organic matter in the Bassac River, the application of pre-treatment will be necessary.

3.9.2 Important Considerations

(1) Water Intake

1) MOWRAM Approval

The flow rate of the Bassac River is sufficient to accommodate the required intake volume. In the Preparatory Survey, hydrologic data for both wet and dry seasons should be obtained from MOWRAM to verify the flow rates and confirm that the necessary water volume is available. Furthermore, agreement for taking water for the project should be reached between MOWRAM and PPWSA.

2) Suitable Water Quality

T The water quality of the Bassac River is deteriorating. The Preparatory Survey should verify water quality by reviewing water quality data from PPWSA. At the same time, a river water quality survey should also be performed. Parameters including ammonia nitrogen, COD, BOD, should be evaluated.

(2) Treatment Capacity, Process, and Construction Site

1) Pre-treatment and Sludge Treatment

The current survey concludes that pre-treatment of the intake water may be necessary. Currently PPSWA disposes sludge from sedimentation tanks and backwash water from its 4 treatment plants into nearby rivers. Necessity of pre-treatment and sludge treatment will need to be verified with PPWSA.

2) Considerations for Facility Construction on Limited Land

A vertical configuration is required for the Ta Khmau WTP because of the limited space which is already occupied by some buildings and the elevated tank. The site is located along the Bassac River.

3) Soil Survey

A soil survey will be necessary to confirm subsurface conditions and the location of the supporting strata, especially because the vertical configuration will add to the load and likely require a pile foundation.

(3) Items to be Conducted by PPWSA:

1) Distribution Network and House Connections

Treated water from the Ta Khmau WTP will be distributed via PPWSA networks. The Preparatory Survey will verify if the existing distribution system can handle 30,000 m^3/d, or if expansion of the network will be required.

Home owners will pay for the house connections (including costs of service pipe and water meter). PPWSA must promote house connections to achieve the projected served population.

2) Unexploded Ordinances (UXOs)

Landmines and UXOs had been discovered in intake and treatment plant sites f other projects. Close consultation with PPWSA as well as Cambodian Mine Action Center (CMAC) is required to determine if there are any UXOs in the area, and take appropriate measures.

3) Bill Collection Office Relocation

A bill collection office is located at the construction site. In consultation with PPWSA, to make room for the WTP, it is proposed that this would be relocated to a site facing the National Road. Agreement on the relocation will need to be reached in the Preparatory Survey.

(4) Utilization of the Elevated Tank

Due to the limited land available, construction of a new service reservoir is not possible. Effective use

of the existing elevated tank will need to be considered.

(5) Environmental and Social Considerations

Large-scale land acquisition and involuntary resettlement is not expected in this project. Nevertheless, minor impacts on the environment and society are possible. This project probably falls under Category B, according to the JICA “Guidelines for Environmental and Social Considerations (April 2010)”. The Preparatory Survey will look at the level of impact based on environmental and social considerations, the mitigation measures and monitoring plans. In consultation with relevant organizations in Cambodia, a draft environmental checklist according to the JICA Environmental Guidelines will be prepared.

The Cambodian Ministry of Environment requires that a registered consultant perform an IEIA or EIA for the water supply project, if the served population is more than 10,000. This requirement for the project will be verified with PPWSA and MOE.

(6) Integration of Design Build and O&M

By placing an integrated order of the design construction and maintenance management operations, the contracted business operators will be able to achieve a balance between revenue and lifecycle costs.

In an extreme case, there are ways to reduce the cost of life cycle; one method is by leveraging a lot of cheap labor costs and cheap initial investments, and other method is reducing labor costs by automating operations with high initial investments. How it is preferable to conduct business is determined by various factors, such as the possibility of efficiency based on the know-how of the member companies and using the scale of economy cooperated with other businesses. Therefore, the business proposal competition will work by entrusting the design construction operation of the facility to the private sector comprehensively.

In order to make such a competition work appropriately, it is necessary to convert the tender documents into a form of comprehensive consignment of the design and construction operation of the facility. This is a switch from the order of goods to the order of services. In the previous grant aid scheme, the quality of the facilities is secured by prepared design documents and selecting the general contractor by the lowest bidding price, and subsequent supervision of the construction of the facility according to the design document. However, this method does not allow for any competition for innovative measures and unique techniques to produce the same results. On the other hand, if there is no framework or regulations, it is impossible evaluate the different proposals fairly.

The procurement method to address such problems is through the formulation of an output specification. This procurement method allows budding operators to freely determined how to achieve the required output.

There is often a confusion between "output specification order method" and "performance order method".

"Performance order", by stating the performance of means and techniques in general, it enables the selection of different manufacturers and models, it being assumed that means and methods are already defined. In addition, even where drawings and model numbers are not provided, as the performance is defined by the same means and methods, as well the "input specification" which establishes the drawings and product models, there are many factors where price competition is possible.

On the other hand, where the required output specification established in the design and build requirement they are formulated to enable monitoring of output. Therefore, it is possible to determine whether the facility is performing to the specified output requirements, when it is not delivering this output or durations of periods of non-performance to output. In this way, in the output specification, the idea of purchasing a service can be used.

In other words, in the standard grant aid scheme, Commissioning Test was important to make sure that the facility was in order when the facility was hand over to the implementation agency. The monitoring test to check whether the facility is functioning properly or not is more important because it is the business operator who leases the same facilities for the business operation. Based on this concept, it is important to formulate bid documents with an output specification which can be monitored.

In parallel with the formulation of such an output specification, it is necessary to formulate a contract, a tender document. We recommend in the case of the design build of the facility, it is important to use standardized contracts such as FIDIC Silver book, to be developed in the Feasibility study phase.

In addition, the example of bidding documents for water utilities using the output specification is not found in Japanese PFI procurements, however various guidelines for implementing the Water supply business in PPP are available in the public domain, one of the examples of the output specification is introduced as follows.

Water and Sanitation Program: TOOLKIT : Structuring Private-Sector Participation (PSP) Contracts for Small Scale Water Projects by Victoria Rigby Delmon May 2014

(http://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/ppp_testdumb/documents/Global_Final%20Toolkit%20for%20Structuring%20PSP%20in%20Small%20Scale%20Projects.pdf)

This toolkit is focused on a small water supply development plan that targets a population of 1,000 to 10,000, and created for the Water Supply Authority to contract with private operator and with consultants supporting water authorities. Although the size of the targeted water supply business is different, it is easy to understand how the output specification is formulated in the procedure, and how the output specifications relate to the contracts in the tender documents.

(7) Confirmation of Integrated Procurement on Japanese Grant Aid for PPP Project including Bulk Water Purchase Contract

As described in 3.6 Confirmation and Analysis on Concerned Laws and Regulation, the Japanese Grant Aid for PPP project which consist of EPC contract and bulk water purchase contract (and lease contract) can be conducted by one integrated procurement. Also, there is possibility that Public Procurement Law exception clause (Article 3) which makes possible Japan-tide procurement is applied to both EPC contract and bulk water purchase contract based on the rational interpretation of the articles. However, the confirmation to MEF is required during the following preparatory survey since there is no clear article on this case.

Also, it is highly recommended to stipulate in E/N and or G/A that the above-mentioned contracts are to be procured integratory and one private company (or consortium) would be selected. This would reduce the risk to be questioned about the applicability of Public Procurement Law exception clause for both EPC contract and bulk water purchase contract. In the preparatory survey, the detail contents of stipulations in E.N and or G/A should be considered.

3.9.3 Project Outline

General information and the timeline for the construction of the water treatment system in Ta Khmau District is summarized in **Table 3.9.2**.

Table 3.9.2 Construction of WTP in Ta Khmau District (Draft)

Implementation Agency	Phnom Penh Water Supply Authority (PPWSA)
Project Implementation	BTO (Build, Transfer & Operate) under Japanese Grand Aid-SPC scheme. Japanese company will construct the facilities, transfer these to PPWSA and rent them at a nominal price, operate and maintain these for a certain period of time to recover the initial investment and O/M costs by the sale of bulk water
Facilities	Intake: pumping station, raw water transmission lines Water treatment (30,000 m^3/d): pre-treatment, mixing, coagulation and sedimentation, rapid filtration etc. Distribution: service reservoir, distribution pump, distribution pipeline and flow meter for bulk water measurement Items undertaken by Cambodian side: distribution network
Equipment	Water quality analysis equipment Tools for O & M of mechanical & electrical equipment
Consulting Service	Preparatory Survey for project development, preparation of specification for selection of qualified SPC and monitoring of the operation status of the WTP, facility design at the F/S level and costs estimation for comparing with the proposal by SPC, support for bidding document preparation, bid evaluation and contract procedure, construction monitoring etc.
Schedule	1) From the commencement of the Preparatory Survey to signing contract: about one and a half years 2) Detailed design and construction: approximately 3 years 3) Period of operation and maintenance and supply of bulk water to PPWSA: 10 years

Source; JICA Survey Team

4. Project for Construction of Water Treatment Plant in Bakheng (I & II)

4.1 Information Required for Loan Project

Japanese Loan Aid supports sustainable and stable economic developments. To qualify the project must meet the following criteria:

a. Consistent with national plan, priority and urgency
b. Demonstrate soundness in terms of achievement of objectives
c. Well advanced implementation plan
d. Demonstrate capability of the executing agency to implement the project
e. Demonstrate the ability to build consensus among stakeholders including local residents
f. Have special provision for low income groups

4.2 Project Necessity

(1) Existing WTPs and Distribution Network

(2) Existing WTPs

1) History of Development Assistance

The major projects for construction, expansion and rehabilitation of WTPs are summarized in **Table 4.2.1**. Japan and France have been the main donors.

Table 4.2.1 Major Development Assistance

Year	Donor	Project
1995	Japan	Rehabilitation of Phum Prek WTP (100,000m^3/day) and Distribution Networks
1995	France	Rehabilitation and expansion of Chamcar Mon WTP (10,000m^3/day)
1997	France	Expansion of Chamcar Mon WTP (20,000m^3/day)
2001	WB	Rehabilitation of Chroy Changvar WTP (65,000m^3/day)
2003	France	Expansion of Chroy Changvar WTP (130,000m^3/day)
2003	Japan	Expansion of Phum Prek WTP (150,000m^3/day) and rehabilitation of old facilities
2013	Japan/France	Construction of Niroth WTP (130,000 m^3/day) by co-financing
2017	France	Expansion of Niroth WTP (260,000m^3/day)
On-going	France	Rehabilitation and expansion of Chamcar Mon WTP (52,000m^3/day) (construction period; 2017-2019)

Source: JICA Survey Team

The Government of France is supporting the on-going rehabilitation and expansion of Chamcar Mon WTP.

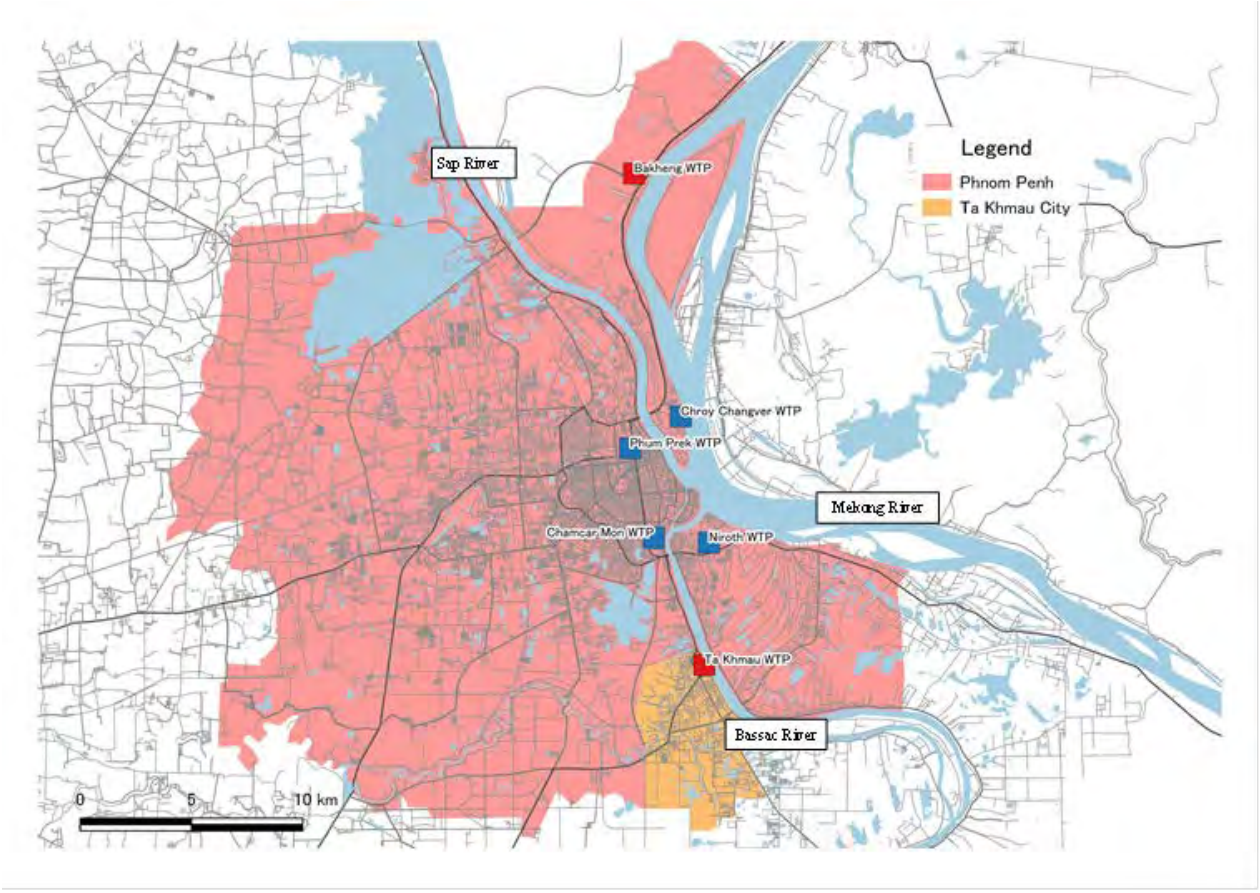
2) Key Characteristics of Existing WTPs

Key characteristics of existing WTPs are shown in **Table 4.2.2** and their locations are shown in **Figure 4.2.1** .

Table 4.2.2 Key Characteristics of WTPs

Item	Phum Prek WTP	Chamcar Mon WTP	Chroy Changvar WTP	Niroth WTP
Production Capacity	150,000m^3/d	52,000m^3/d (from 2019)	130,000m^3/d	260,000m^3/d
Water Source	Sap River	Bassac River	Mekong River	Mekong River
Raw Water Facility	Intake tower Intake pump with VFD	Intake Intake pump with VFD	Intake tower (2) Intake pump with VFD	Intake Intake pump with VFD
Treatment Facility	Horizontal flow sedimentation, Rapid sand filer, Coagulant: PAC, Pre-chlorination and disinfection: NaClO, SCADA System Solar system	Lamella settler, Rapid sand filer, Coagulant: PAC, Pre-chlorination and disinfection: NaClO, SCADA System	Lamella settler, Rapid sand filer, Coagulant: PAC, Pre-chlorination and disinfection: Cl_2 gas (to be changed to NaClO in 2019) SCADA System	Lamella settler, Rapid sand filer, Coagulant: PAC, Pre-chlorination and disinfection: Cl_2 gas (to be changed into NaClO in 2019) SCADA System
Transmission and Distribution Facility	Reservoir Treated water pumps: 9 units (to be upgraded to VFD by 2018)	Reservoir Treated water pumps: 3 units with VFD	Reservoir Treated water pumps: 8 units (3 with VFD)	Reservoir Treated water pumps: 12 units with VFD

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.2.1 Locations of Existing WTPs

(3) WTP Operation

1) Phum Prek WTP

Phum Prek WTP, located in the northern part of Phnom Penh City, uses the Sap River as its raw water source. Its 1992 capacity of 56,000 m^3/d, was increased to 100,000 m^3/d in 1995 and 150,000 m^3/d in 2003, using Japanese grant aid. In 2012, solar power generation system was installed, using the same funding source. Phum Prek WTP also houses the headquarters of PPWSA and its training center.

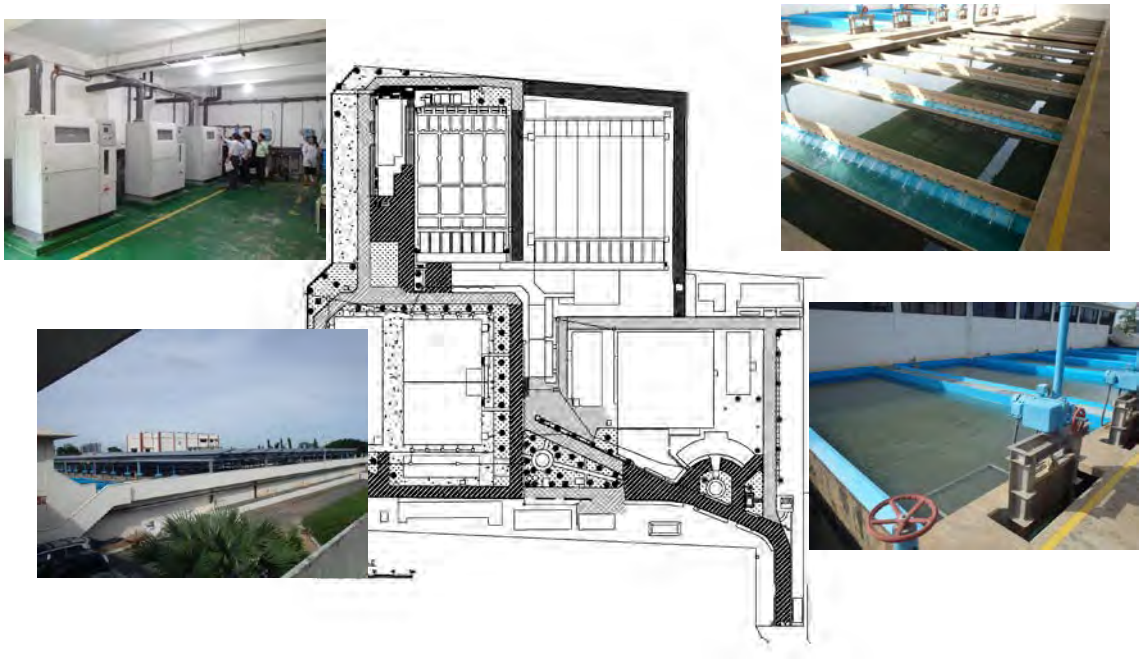
The treatment process is as follows: pre-chlorination→mechanical mixing→ horizontal flow sedimentation→rapid sand filtration→post-chlorination. PAC has replaced the use of alum and lime. Sodium hypochlorite (NaClO) has been used instead of chlorine (Cl_2) gas for disinfection since 2016.

The plant output over the last six years is presented in **Table 4.2.3** and the layout is shown in **Figure 4.2.2**.

Table 4.2.3 Output of Phum Prek WTP

	2012	2013	2014	2015	2016	2017
Total production, m^3/d (ave.)	166,534	162,246	143,935	147,462	164,352	128,486

Source: PPWSA



Source: JICA Survey Team

Figure 4.2.2 Layout of Phum Prek WTP

Sodium hypochlorite consumption is given in **Table 4.2.4**.

Table 4.2.4 Sodium Hypochlorite Consumption at Phum Prek WTP

	2012	2013	2014	2015	2016	2017
Salt (kg/year)	-	-	-	-	244,850	359,750
Sodium Hypochlorite (kg/year)	-	-	-	-	6,365	17,575

Source: PPWSA

2) Chamcar Mon WTP

Chamcar Mon WTP is in the southern part of Phnom Penh City. Its water source is the Bassac River. The WTP, constructed in 1957, was rehabilitated in 1997 to a capacity of 20,000 m^3/d. The expansion of this facility started in 2017, and the capacity will be increased to 52,000 m^3/d by 2019.

The treatment process is as follows: pre-chlorination→mechanical mixing→Lamella settler→rapid sand filtration→post-chlorination. PAC will be used as coagulant, and sodium hypochlorite (NaClO) for disinfection.

The output of the Chamcar Mon WTP over the last six years is presented in **Table 4.2.5** and the layout is shown in **Figure 4.2.3**.

Table 4.2.5 Output of Chamcar Mon WTP

	2012	2013	2014	2015	2016	2017
Total Production m^3/day (ave)	14,218	13,624	10,137	12,356	10,520	5,462

Source: PPWSA

Source: JICA Survey Team

Figure 4.2.3 Layout of Chamcar Mon WTP

3) Chroy Changvar WTP

Chroy Changva WTP is in the eastern part of Phnom Penh. Its water source is the Mekong River. The 65,000 m^3/d WTP was constructed in 2002 using World Bank loan. In 2009 the capacity was expanded to 130,000 m^3/d using French aid. Treated water is distributed by two transmission mains (DN 700 mm), crossing the Sap River along the Cambodia Japan Friendship Bridge.

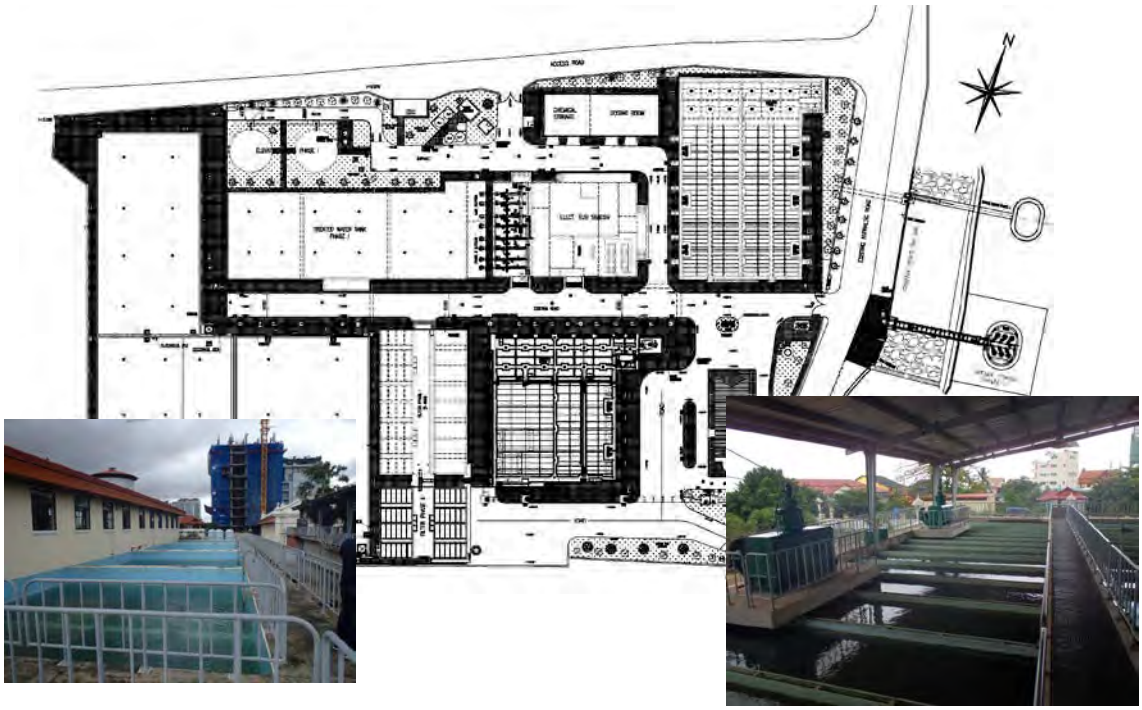
The treatment process is as follows: pre-chlorination→mechanical mixing→Lamella settler→rapid sand filtration→post-chlorination. PAC is used as coagulant, and sodium hypochlorite (NaClO) will replace chlorine (Cl_2) gas in the disinfection process.

The output over the last six years is presented in **Table 4.2.6** and the layout is shown in **Figure 4.2.4**.

Table 4.2.6 Output of Chroy Changvar WTP

	2012	2013	2014	2015	2016	2017
Total Production m^3/day (ave)	151,077	140,076	131,853	143,272	153,998	118,684

Source: PPWSA



Source: JICA Survey Team

Figure 4.2.4 Layout of Chroy Changvar WTP

4) Niroth WTP

Niroth WTP is in the southeastern part of Phnom Penh. Its water source is the Mekong River. Niroth I with a capacity of 130,000 m^3/d was built in 2013 with financing from Japan and France, and the capacity was expanded to 260,000 m^3/d in 2017 using French aid.

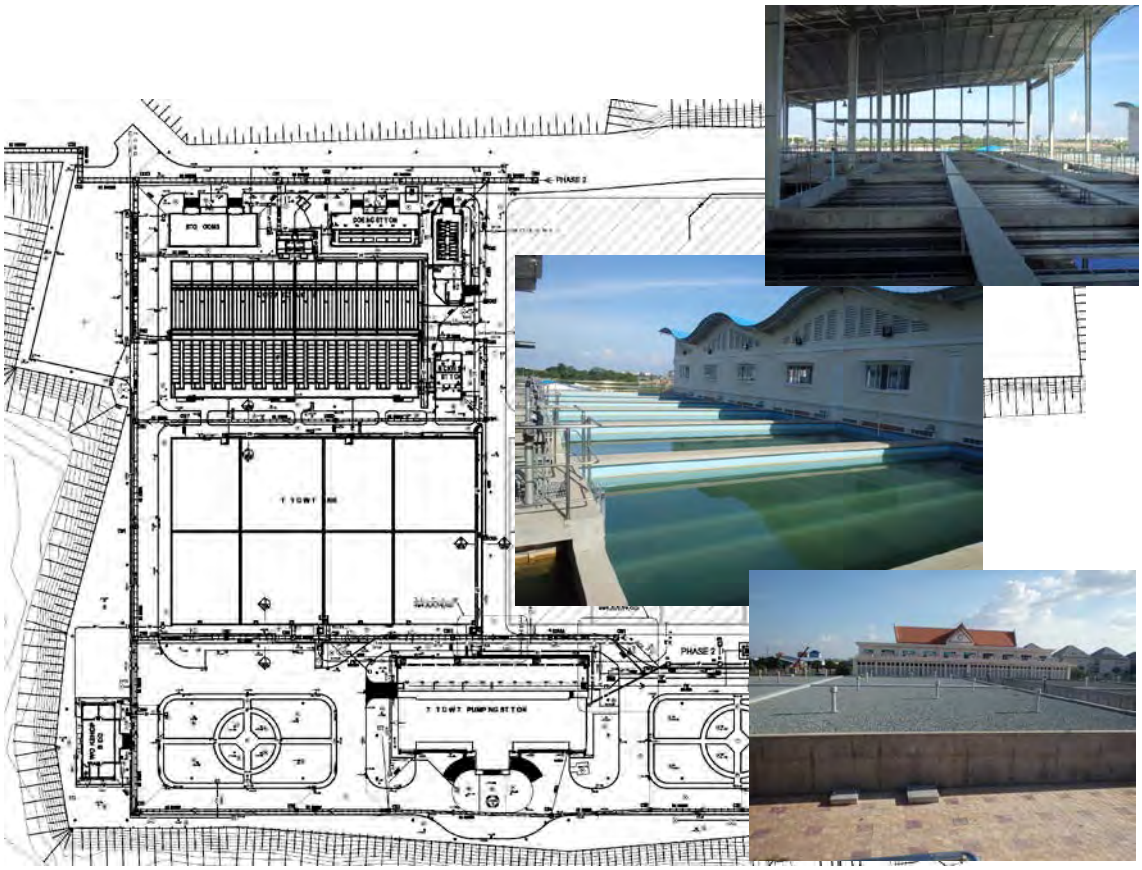
The treatment process is as follows: pre-chlorination→mechanical mixing→Lamella settler→rapid sand filtration→post-chlorination. PAC is used as coagulant, sodium hypochlorite (NaClO) will replace chlorine (Cl_2) gas in the disinfection process.

The output over the last six years is presented in **Table 4.2.7** and the layout is shown in **Figure 4.2.5**.

Table 4.2.7 Production of Niroth WTP

	2012	2013	2014	2015	2016	2017
Total Production m^3/day (ave)	-	55,230	123,807	143,894	159,443	187,897

Source: PPWSA

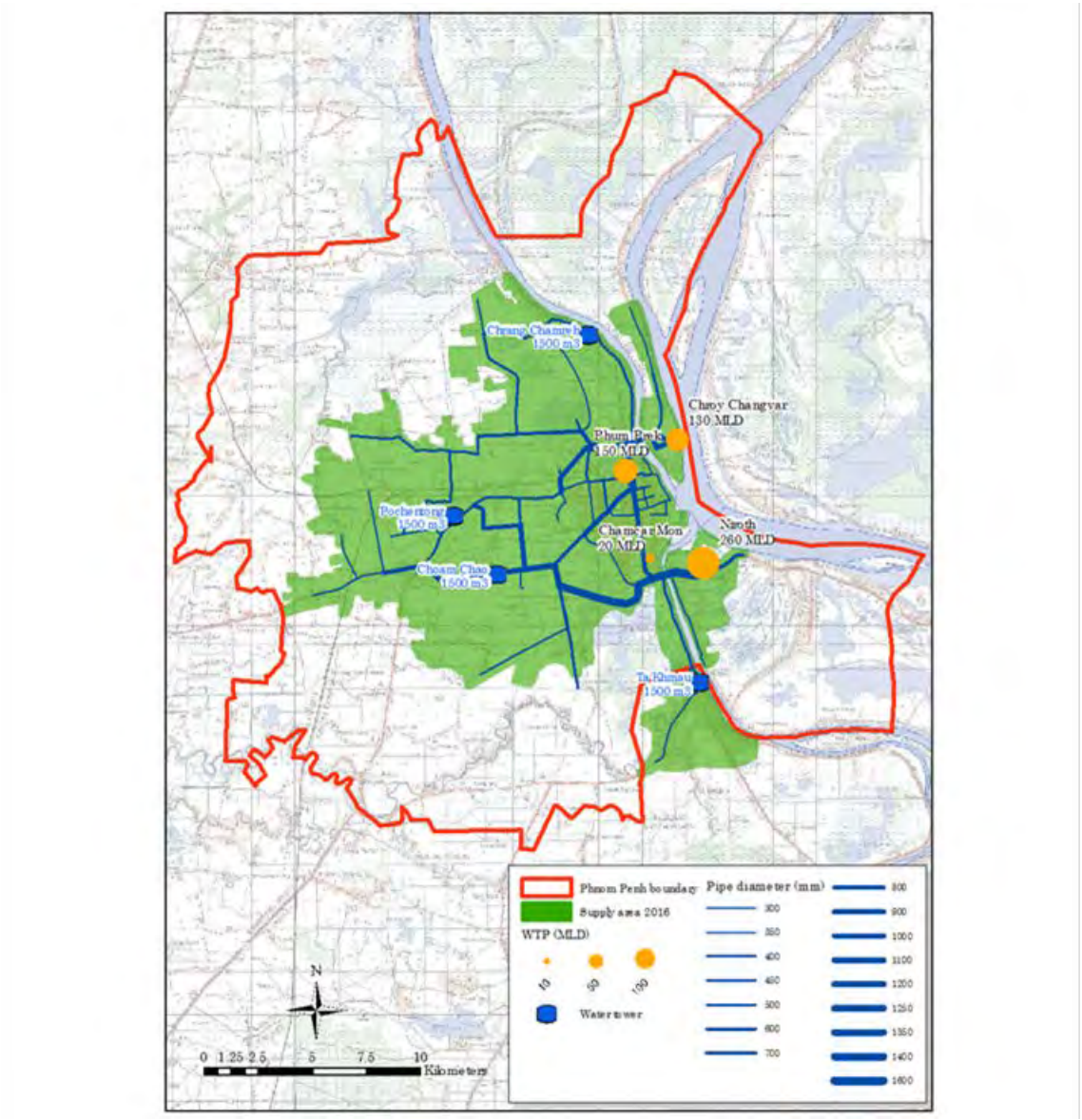


Source: JICA Survey Team

Figure 4.2.5 Layout of Niroth WTP

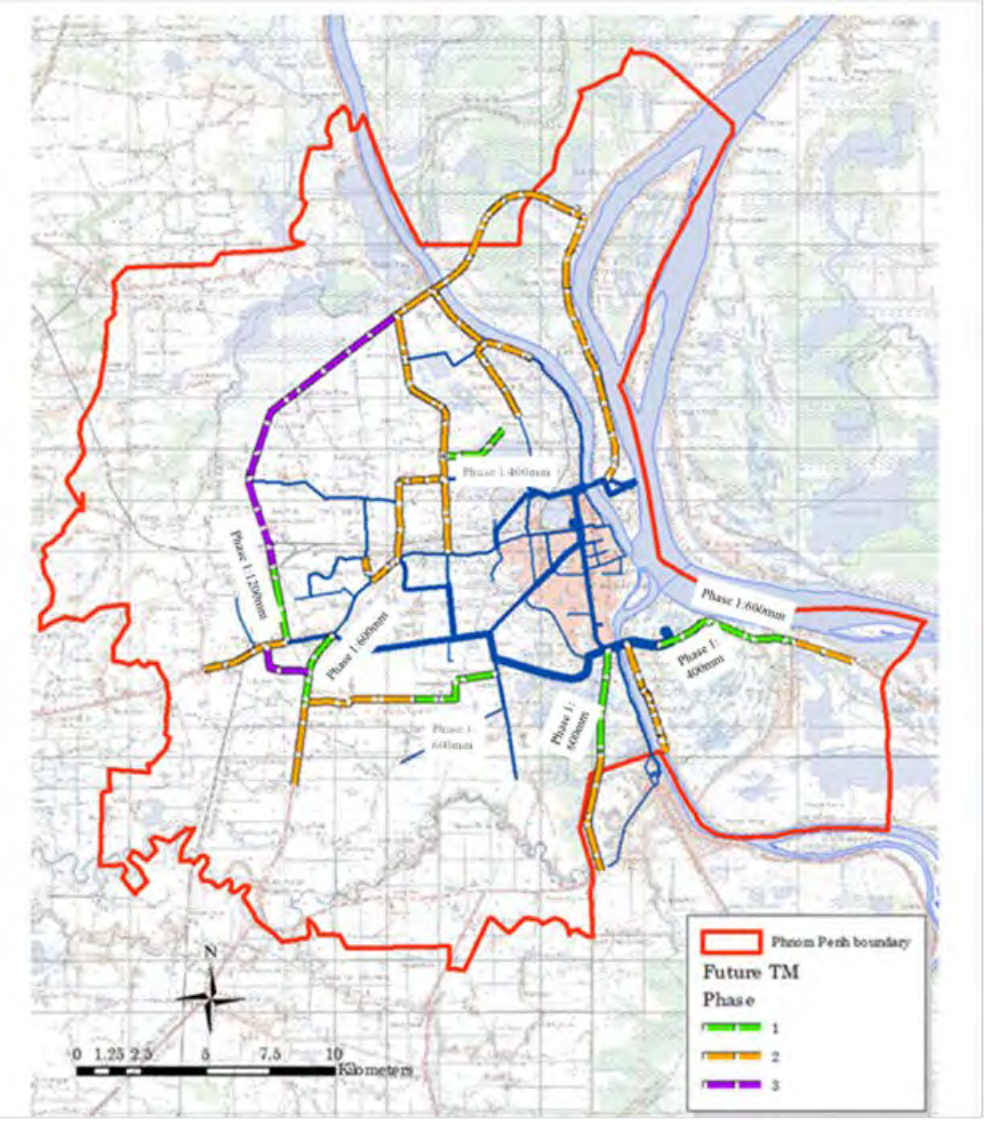
5) Transmission and Distribution Networks

The transmission and distribution networks in Phnom Penh have been expanded for many years, and the transmission network (diameter over 300 mm) is about 220 km (see **Figure 4.2.6)**. It will be further expanded in three stages as shown in **Figure 4.2.7**. At the first stage, 20 km will be added to the primary transmission mains by 2019 as shown in **Table 4.2.8**.



Source: Third Master Plan 2016-2030

Figure 4.2.6 Existing Transmission Network



Source: Third Master Plan 2016-2030

Figure 4.2.7 Stage 1 Primary Transmission Mains Expansion (2017-2018, Concurrent with Chamcar Mon WTP Expansion)

Table 4.2.8 Stage 1 Primary Transmission Mains Expansion

	Primary Transmission Mains Program		Total Length	Annual Length
Phase 1:	TMs to be laid during construction of Chamcar Mon WTP (2017-2018)		20.9km	10.5km/year
	Location	Diameter(mm)	Length(m)	
	Camko	400	1,300	
	Hun Sen	600	4,100	
	Kob Srov	1,200	2,900	
	NR1	600	3,200	
	NR1	400	2,500	
	NR3	800	1,200	
	NR3	600	1,800	
	South Loop Pipe	600	3,900	

Source: Third Master Plan 2016-2030

The total length of the distribution network is about 2,700 km (as of 2016), and it has grown by about

150 km per year. **Table 4.2.9** shows the distribution network in Phnom Penh.

Table 4.2.9 Phnom Penh Distribution Network

	2012	2013	2014	2015	2016
Length of distribution network (km)	2,010	2,158	2,319	2,463	2,658
Length of network added (D>50mm)(km/year)	113	148	161	144	196

Source: PPWSA

4.2.2 Measuring Project Outcome

The indicators shown in **Table 4.2.10** will be used to analyze the project outcome. It is expected that the water supply quantity will increase and public health will improve.

Table 4.2.10 Analysis of the Project Outcome

Indicators		Unit	Baseline (2016)	Target Year (2030)	Remarks
Operation	Water supply quantity	m^3/d	560,000	1,057,000	Total capacity of all WTPs
	Pressure	Bar	0 (West area)	2	Pressure of transmission mains
	NRW	%	8	10	
Effect	Connection number	no.	300,000	550,000	
	Serviced Sangkat	no.	82	92	

Source: JICA Survey Team.

(1) Capacity of WTPs

As shown in **Table 4.2.11**, new Bakheng WTP with a capacity of 390,000 m^3/d will contribute about 80% of the total capacity of new WTPs**.**

Table 4.2.11 Capacity Summary of WTPs

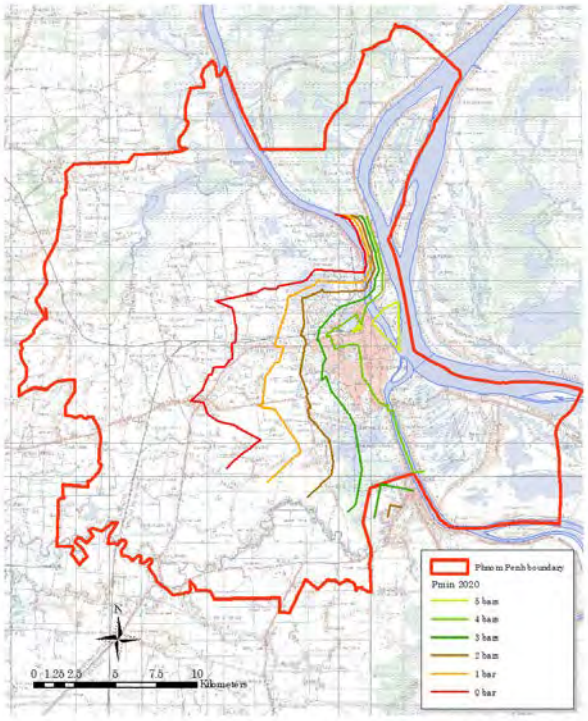
WTP		Capacity (m^3/d)	Remarks
Existing	1) Phum Prek WTP	150,000	
	2) Chamcar Mon WTP	20,000	
	3) Chroy Changvar WTP	130,000	
	4) Niroth WTP	260,000	
	Sub-total (A)	**560,000**	
New or Expansion	5) Chamcar Mon WTP	32,000	Expanding from 20,000 to 52,000 m^3/d by 2019
	6) Ta Khmau WTP	30,000	Expected by Japanese Aid
	7) Bakheng WTP	390,000	Bakheng I: 195,000 m^3/d by 2022 Bakheng II: 195,000 195,000 m^3/d by 2024
	8) Phum Prek WTP	45,000	Expanding from 1500,000 to 195,000 m^3/d by 2022
	Sub-total (B)	**497,000**	
Ground Total in 2030 (A+B)		**1,057,000**	

Source: Third Master Plan 2016-2030 (Mar. 2017)

(2) Water Pressure

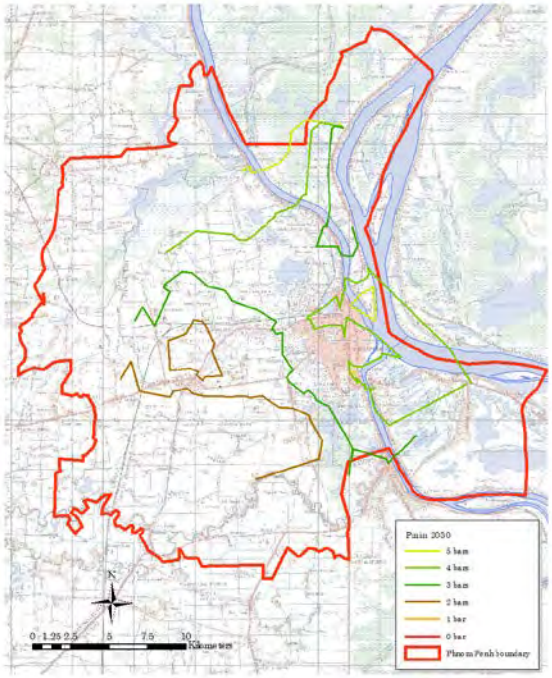
As shown in **Figure 4.2.8**, at present the water pressure in the western part of Phnom Penh is low, and after 2030 the minimum water pressure in the end of distribution mains will be more than 20m as shown in **Figure 4.2.9** with the expansion of distribution mains. In addition, about 200 km of

distribution pipelines will to be installed every year by 2025 and more than 100 km every year from 2026 to 2030. It is estimated that without construction of Bakheng WTP, a lack of water pressure in the end of distribution mains would be occurred.



Source: Third Master Plan 2016-2030

Figure 4.2.8 Current Water Pressure of Distribution Mains

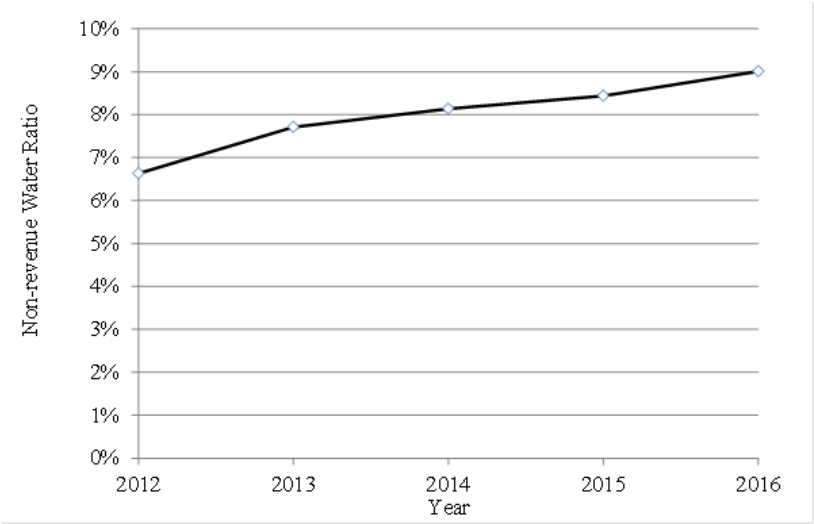


Source: Third Master Plan 2016-2030

Figure 4.2.9 Water Pressure of Distribution Mains in 2030

(3) NRW

In Third Master Plan, NRW rate in the future (after 2020) is set as 10%. Regarding the NRW, in the past it decreased to about 6% level, but in 2016 the value was 9% as shown in **Figure 4.2.10**. Although the NRW may increase due to increase of the leakage caused by aging of existing distribution networks (total 2,658km), it seems possible to keep the NRW at 10% level in future considering the technology level of PPWSA and expansion program of distribution networks (total 2,440 km from 2017 to 2030).



Source: JICA Survey Team

Figure 4.2.10 Variation of NRW

(4) Connections

As shown in **Table 4.2.12**, the number of new connections per year is around 20,000, it is possible for PPWSA to increase connections from current rate up to 550,000 connections in total by 2030. Therefore, there are satisfied connections to consume the water from new Bakheng WTP (390,000 m^3/d).

Table 4.2.12 Connections

	2012	2013	2014	2015	2016
Total Connections	234,225	252,315	270,812	289,024	310,835
Connection per year	-	18,090	18,497	18,212	21,811

Source: PPWSA

(5) Serviced Areas

As shown in **Table 4.2.13**, out of 102 communes in Phnom Penh and Ta Khmau District, 82 communes were receiving water supply from PPWSA in 2016, and this figure will increase to 92 by 2030.

Table 4.2.13 Serviced Areas (Present and Future)

	Sangkat	2016	2030		Sangkat	2016	2030
	Khan Daun Penh				**Khan Dangkao**		
1	Sras Chak	1	1	52	Pong Teuk	1	1
2	Wat Phnom	1	1	53	Prey Veng		1
3	Phsar Chas	1	1	54	Prey Sar	1	1
4	Phsar Kandal I	1	1	55	Dangkao	1	1
5	Phsar Kandal II	1	1	56	Choeung Ek	1	1
6	Chey Chum Neas	1	1	57	Prateas Lang		1
7	Chaktomuk	1	1	58	Sak Sampov		1
8	Boeng Raing	1	1	59	Kraing Pong Ro		1
9	Phsar Thmey I	1	1	60	Spean Thma		
10	Phsar Thmey II	1	1	61	Prek Kampes		
11	Phsar Thmey III	1	1	62	Tean		
	Khan 7 Makara			63	Roluos		
12	Monorom	1	1	64	Kong Noy		
13	Mittha Pheap	1	1		**Khan Por Sen Chey**		
14	Veal Vong	1	1	65	Ka Kab	1	1
15	O'Russey I	1	1	66	Samraong Krom	1	1
16	O'Russey II	1	1	67	Trapeang Krasang	1	1
17	O'Russey III	1	1	68	Chom Chao	1	1
18	O'Russey IV	1	1	69	Phloeung Chhes Roteh	1	1
19	Boeng Praleth	1	1	70	Kantoak	1	1
	Khan Chamcar Mon			71	Kambol	1	1
20	Tonle Bassac	1	1	72	Boeng Thom		
21	Boeng Keng Kang I	1	1	73	Euv Leuk		
22	Boeng Keng Kang II	1	1	74	Snor	1	1
23	Boeng Ken Kang III	1	1		**Khan Sen Sok**		
24	Olympic	1	1	75	Teuk Thla	1	1
25	Tuol Svay Prey I	1	1	76	Phnom Penh Thmey	1	1
26	Tuol Svay Prey II	1	1	77	Khmuogn	1	1
27	Tom Nob Teuk	1	1	78	Kraing Thnong	1	1
28	Tuol Tom Poung I	1	1		**Khan Chroy Changvar**		
29	Tuol Tom Poung II	1	1	79	Chroy Changvar	1	1
30	Boeng Trabek	1	1	80	Prek Leap	1	1
31	Phsar Daeum Thkov	1	1	81	Prek Tasek	1	1
	Khan Tuol Kok			82	Koh Dach		
32	Boeng Kak I	1	1	83	Bak Khaeng		1
33	Boeng Kak II	1	1		**Khan Chbar Ampov**		
34	Teuk Loak I	1	1	84	Chbar Ampov I	1	1
35	Teuk Loak II	1	1	85	Chbar Ampov II	1	1
36	Teuk Loak III	1	1	86	Niroth	1	1
37	Phsar Depot I	1	1	87	Prek Pra	1	1
38	Phsar Depot II	1	1	88	Veal Sbov	1	1
39	Phsar Depot III	1	1	89	Prek Aeng		1
40	Phsar Daeum Kor	1	1	90	Kbal Kaoh		1
41	Boeng Salang	1	1	91	Prek Thmey		1
	Khan Russei Keo				**Khan Prek Pnov**		
42	Svay Pak	1	1	92	Kok Roka	1	1
43	Chraing Chamreh I	1	1	93	Samraong		1
44	Chraing Chamreh II	1	1	94	Po Nhea Pon		
45	Kilometre No 6	1	1	95	Ponsang		
46	Russei Keo	1	1	96	Prek Phnov		1
47	Tuol Sangkae	1	1		**Ta Khmau City**		
	Khan Mean Chey			97	Daeum Mean	1	1
48	Stoeng Mean Chey	1	1	98	Ta Khmau	1	1
49	Boeng Tumpun	1	1	99	Prek Russei	1	1
50	Chak Angre Leu	1	1	100	Kompong Samnanh	1	1
51	Chak Angre Kraom	1	1	101	Ta Kdol	1	1
				102	Prek Hour	1	1
					TOTAL	82	92

Source: Third Master Plan 2016-2030

4.2.3 Breakdown on Funding Sources

Project cost for Bakeng I and II is summarized in **Table 4.2.14**.

Table 4.2.14 Project Cost for Bakheng I and II

Item		Total (USD)	Loan (USD)	PPWSA (USD)	Remarks
Bakheng I	Water Treatment Plant (WTP)	126,342,500	88,557,000	37,785,500	Including intake, TWTM and Sap River crossing
	Phum Prek Rehabilitation	9,088,800	8,010,900	1,077,900	
	Primary Transmission Mains	38,216,100	25,477,400	12,738,700	DN: >400mm
	Secondary Transmission Mains	9,548,100	6,365,400	3,182,700	DN: 250-350mm
	Distribution Mains	25,037,200	14,428,200	10,609,000	DN: <250mm
	Institutional Improvements	3,182,700	2,121,800	1,060,900	
	Consultant Services	8,682,400	8,682,400	-	
	Taxes	4,994,100	-	4,994,100	
	Contingencies	33,014,700	23,046,500	9,968,200	
	Sub-total	**258,106,600**	**176,689,600**	**81,417,000**	
Bakheng II	Water Treatment Plant (WTP)	53,585,400	39,694,400	13,891,000	
	Phum Prek Rehabilitation	17,954,100	13,220,800	4,733,300	
	Primary Transmission Mains	26,533,300	17,702,200	8,851,100	DN: >400mm
	Secondary Transmission Mains	5,064,800	3,376,500	1,688,300	DN: 250-350mm
	Distribution Mains	13,281,000	7,653,500	5,627,500	DN: <250mm
	Institutional Improvements	1,688,300	1,125,500	562,800	
	Consultant Services	4,904,600	4,904,600	-	
	Taxes	2,075,700	-	2,075,700	
	Contingencies	18,454,700	13,151,600	5,303,100	
	Sub-total	**143,541,900**	**100,829,100**	**42,732,800**	
Total		**401,648,500**	**277,518,700**	**124,149,800**	

Source: JICA Survey Team based on Third Master Plan 2016-2030 (Mar. 2017)

The loan required for Bakheng I is about 177 million USD. PPWSA's investment is 81 million USD, or 30% of the total (258 million USD). The portion for construction is about 89 million USD, making up 50% of the total. The project includes intake, WTP and distribution network construction.

The loan required for Bakheng II is about 101 million USD. PPWSA's investment is 43 million USD, or 30% of the total. The portion for construction is about 40 million USD, making up 40% of the total.

The considerable size of the loan may require co-funding from Japan and France, similar to the Niroth WTP project. As the F/S for Bakheng WTP is still in progress, the portion to be contributed by each lender has yet to be discussed and determined.

4.3 Confirmation of the Project Scope

4.3.1 Project Scope

The 2030 water demand of 1,093,000 m^3/d cannot be met with the current production capacity of 625,000 m^3/d, even with the addition of Chamcar Mon WTP (52,000 m^3/d) expansion and the new Ta Khmau WTP (30,000 m^3/d). The construction of the Bakheng WTP is necessary. The project will be implemented in two stages (Bakheng I and Bakheng II). The project scope is presented in **Table 4.3.1**.

Table 4.3.1 The Project Scope of Bakheng WTP

Item	Scope	Construction Period	Remarks
Bakheng I	• Intake, • Raw water transmission main (DN1,800mm, 1.6km), • WTP (195,000 m^3/d), • Treated water transmission mains	2019 to 2022	If water demand increases faster than planned prior to tendering for Bakheng I, the total capacity may be increased to 455,000

Item	Scope	Construction Period	Remarks
	(DN2,000mm, 7.9km) • Sap River crossing (DN 2,000 mm, pipe bridge)		(=390,000+ 65,000) m^3/d.
Bakheng II	• WTP (195,000 m^3/d)	2023 to 2024	
Total Capacity	390,000 m^3/d		

Source: Technical Feasibility Study Report (Draft version of Nov. 2017)

As of November of 2017, the F/S for Bakheng WTP project is still in progress. Therefore, the project outlines are summarized based on the update information of the F/S and Third Master Plan 2016-2030.

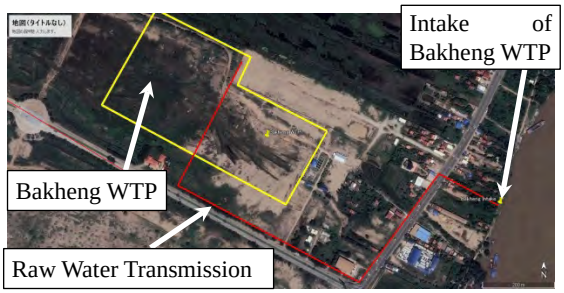
4.3.2 Intake and Raw Water Transmission

The proposed raw water source (**Figure 4.3.1**) is the Mekong River according to the Third Master Plan and Technical F/S Report (draft Nov. 2017). The plan for intake and raw water transmission is summarized in **Table 4.3.2**, and raw water source and the route proposed for transmission is shown in **Figure 4.3.1**.

Table 4.3.2 Bakheng Raw Water Intake and Transmission

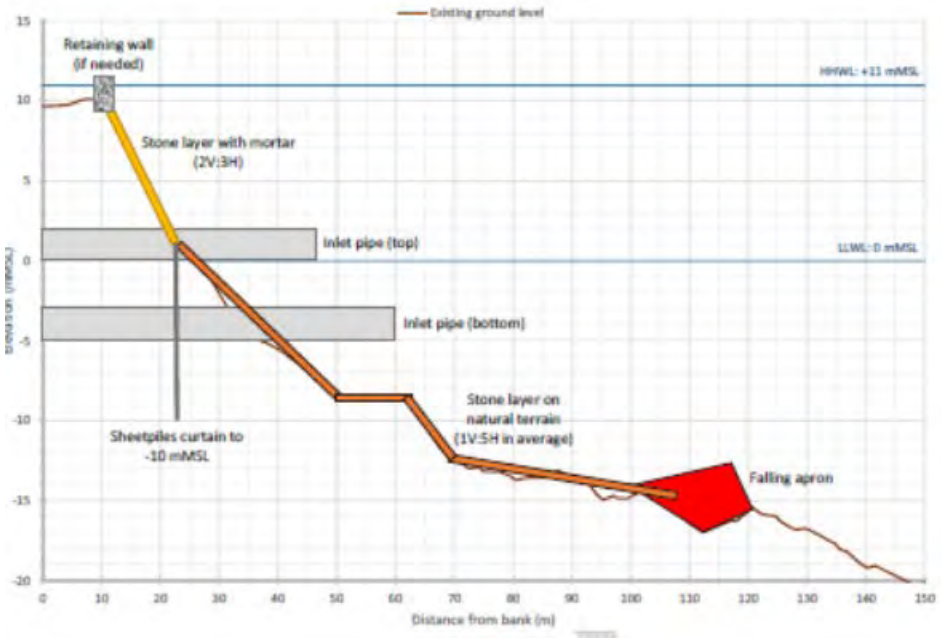
Item			Number	Contents	Remarks
Bakheng I	Intake	Intake Tower	1	406,000 m^3/d	DN 2,000 mm×2 pipes (see **Figure 4.3.2**)
		Intake Pump	4+1	3,100 m^3/h, 21m	Vertical shaft, variable speed.
	Raw Water Transmission		1	DN1,800*1.6km	Ductile iron (DI) pipe
Bakheng II	Intake	Intake Tower	-	-	Constructed within Bakheng I
		Intake Pump	4+1	3,100 m^3/h, 21m	Vertical shaft, variable speed.
	Raw Water Transmission		-	-	Constructed within Bakheng I

Source: Technical F/S Report (Draft Nov. 2017)



Source: Technical Feasibility Study Report (Draft version of Nov. 2017)

Figure 4.3.1 Raw Water Source and Transmission for Bakheng WTP

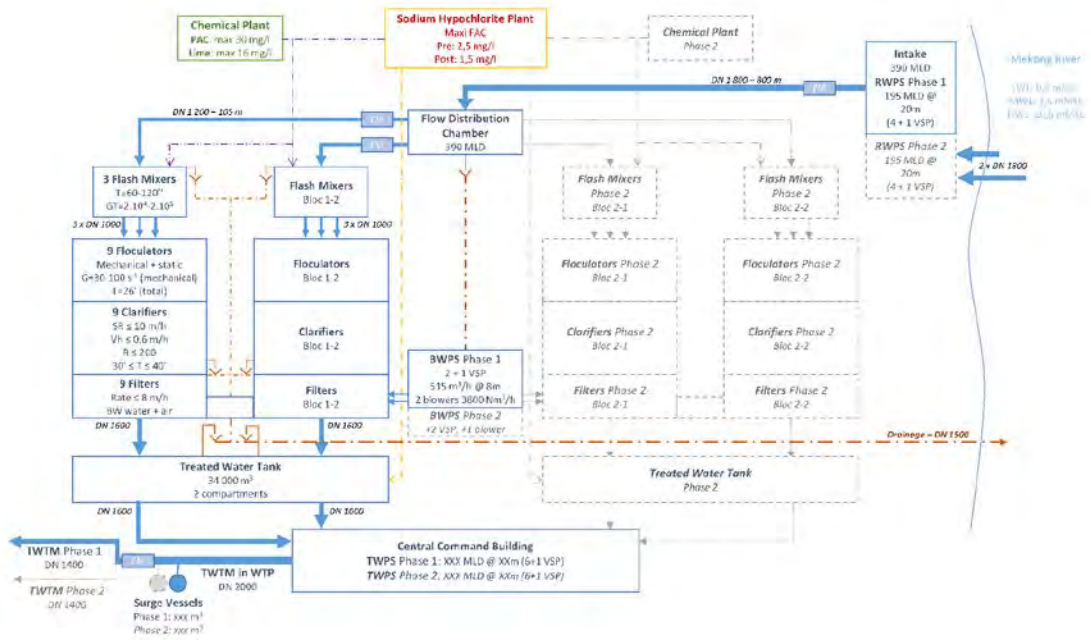


Source: Technical Feasibility Study Report (Draft version of Nov. 2017)

Figure 4.3.2 Section of Intake Pipe for Bakheng WTP

4.3.3 Water Treatment Plant

The treatment process for the Bakheng WTP is shown in **Figure 4.3.3** and the various treatment facilities are summarized in **Table 4.3.3**.



Source: Technical Feasibility Study Report (Draft version of Nov. 2017)

Figure 4.3.3 The Treatment Process Diagram of Bakheng WTP

Table 4.3.3 Bakheng WTP Treatment Facilities

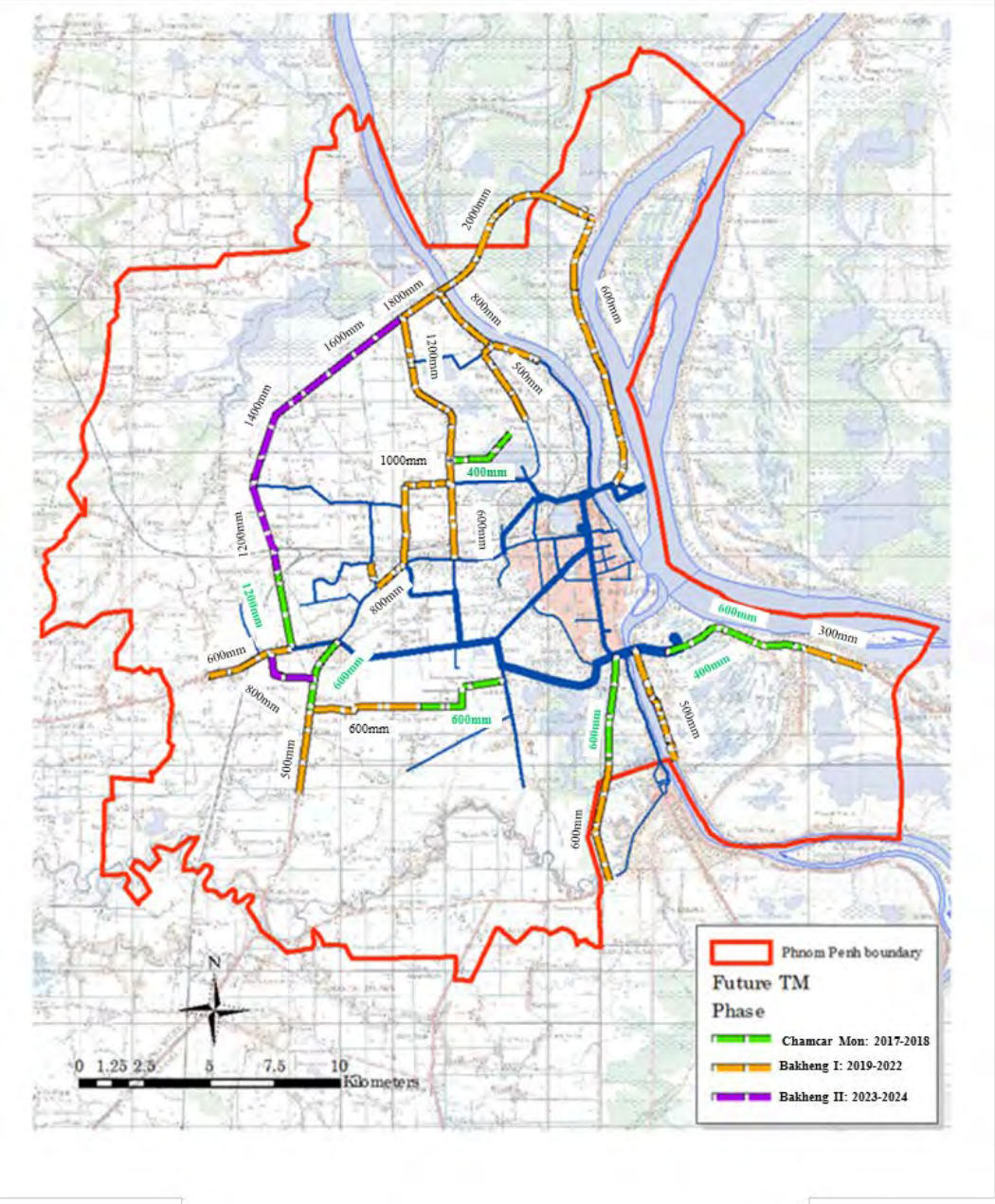
Item		Number/Type	Contents	Remarks
Bakheng I	Flow Distribution Chamber	1	395,000 m^3/d	Sized for Bakheng I and II
	Flash Mixer	3*2 series	1-2 min	
	Flocculation Tank	9*2 series	20-30 min	Mechanical type (vane stirrer)
	Sedimentation Tank	9*2 series	64 min	Lamella settling, turbidity<5 NTU
	Rapid Sand Filer	9*2 series	192 m/d (ave.) 220 m/d (max)	Filter area: 64 m^2/each filter Backwash: air and water
	Treated Water Tank	2	22,500 m^3	5.5 hours of the WTP capacity
	Backwash Pumping Station	1		Sized for Bakheng I and II
	Pumping Station	1	395,000 m^3/d	Sized for Bakheng I and II
	Treated Water Pump	6+1	2,600 m^3/h, 69m	Variable speed
	Coagulant	PAC	12 (max 30) mg/L	
	pH Adjustment	Lime	10 (max 40) mg/L	Probably not applied.
	Pre-chlorination	NaClO	1.5 (max 2.5) mg/L	On-site preparation
	Post-chlorination	NaClO	1 (max 1.5) mg/L	On-site preparation
	Building for Chlorination	1		Sized for Bakheng I and II
	Building for Lime and PAC	1		
Bakheng II	Flow Distribution Chamber	-	-	Constructed during Bakheng I
	Flash Mixer	3*2 series	1-2 min	
	Flocculation Tank	9*2 series	20-30 min	Mechanical type (vane stirrer)
	Sedimentation Tank	9*2 series	64 min	Lamella settling, turbidity<5 NTU
	Rapid Sand Filer	9*2 series	192 m/d (ave.) 220 m/d (max)	Filter area: 64 m^2/each filter Backwash: air and water
	Treated Water Tank	2	22,500 m^3	5.5 hours of the WTP capacity
	Pumping Station	-	-	Constructed during Bakheng I
	Treated Water Pump	6+1	2,600 m^3/h, 69m	Variable speed
	Coagulant	PAC	12 (max 30) mg/L	
	pH Adjustment	Lime	10 (max 40) mg/L	Probably not applied.
	Pre-chlorination	NaClO	1.5 (max 2.5) mg/L	On-site preparation
	Post-chlorination	NaClO	1 - 1.5 mg/L	On-site preparation
	Building for Chlorination	-	-	Constructed during Bakheng I
	Building for lime and PAC	1		

Source: Technical F/S Report (Draft Nov. 2017)

Sludge from sedimentation tanks and backwash water will be discharged into the Mekong River via an existing drainage channel.

4.3.4 Transmission Network

Primary transmission mains (diameter >400 mm) are shown in **Figure 4.3.4**.



Source: JICA Survey Team based on Third Master Plan 2016-2030

Figure 4.3.4 Primary Transmission Mains

Table 4.3.4 describes the size, length and pipe material of the primary transmission mains.

Table 4.3.4 Primary Transmission Mains

DN (mm)	Length (m)		Remarks
	Bakheng I (2019 - 2022)	Bakheng II (2023 - 2024)	
400	2,000		Ductile iron (DI) pipe
500	10,300		DI pipe
600	31,200		DI pipe
800	6,600	2,500	DI pipe
1,000	2,600		DI pipe
1,200	7,200	3,700	DI pipe
1,400		6,700	DI pipe
1,600		2,300	DI pipe

DN (mm)	Length (m)		Remarks
	Bakheng I (2019 - 2022)	Bakheng II (2023 - 2024)	
1,800	1,700		DI pipe
2,000	7,900		Steel pipe. Treated Water Transmission Main may be changed to DN 1,400 for Bakeng I and DN 1,600 for Bakheng II
Total	**69,500**	**15,200**	
Annual Length	17.4 km/year	7.6 km/year	

Source: JICA Survey Team based on Third Master Plan 2016-2030 (Mar. 2017) and Technical F/S Report (Draft Nov. 2017)

In 2016, less than 10 km of primary transmission mains were installed. During 2019-2022 (Bakheng I), 17 km will be installed every year.

The following issues related to treated water transmission mains (TWTM, 7.9 km) should be noted:

1) PPWSA has yet to make the final decision on the use of single-stage (one DN 2,000 mm) or 2-stage (one DN 1,400 mm in Bakheng I and one DN 1,600 mm in Bakheng II) TWTM. Single-stage with the length of 8 km carries some degree of safety risk for transmission.

2) Pipe bridge method is proposed for the Sap River crossing, after comparing with siphon, tunnel and horizontal directional drilling methods. Only single-stage (one DN 2,000 mm) is considered for the design of the pipe bridge

4.3.5 Application of Japanese Technologies

The following Japanese technologies or products will be used in the Bakheng WTP project:

- High-efficiency pumps
- Pre-stressed concrete (PC) tank
- Trenchless technology (TT)
- Buried objects survey
- Methods of pipe branch/connection without suspension of water supply
- High-efficiency sludge collection and treatment
- High performance control valve, and
- SCADA system

The description and advantages of these technologies are summarized in **Table 4.3.5**.

Table 4.3.5 Japanese Technologies Possible to be Applied for Bakheng Project

Category	Specific Features	Overall Advantage	Japanese Advantage	Category
Pump	1) Intake pump 2) Distribution pump	1) Energy saving 2) Can distribute treated water directly even when the water cannot be distributed by gravity	1) High reliability due to extensive experience in Cambodia 2) High quality due to sufficient quality control 3) Excellent durability compared to the pumps made in other countries 4) Energy saving due to high-efficiency	Intake and distribution facilities
PC tank	1) Construction of top slab by dome method 2) Wall fixing method with bottom slab	1) Waterproofing is reliable and re-painting or re-covering is unnecessary 2) Leakage will be prevented at connection	1) High reliability due to extensive experience 2) Minimal delay with careful schedule management 3) Meticulous safety management 4) Reliable quality management	Distribution facility

Category	Specific Features	Overall Advantage	Japanese Advantage	Category
		point of wall and bottom slab		
Trenchless Technology (TT)	Pipe jacking	Avoid open cut at congested locations or special crossings	1) High reliability due to extensive experience 2) Minimal delay with careful schedule management 3) Meticulous safety management 4) Reliable quality management 5) Construction accuracy over long distances and curve propulsion as well as soft ground conditions	Transmission mains and distribution pipelines
Buried objects survey (using TT)	For detecting UXOs	Underground metal obstacles can be detected to prevent contact with unexploded ordinances	Not available from other overseas companies	Transmission mains and distribution pipelines
Methods for pipe branch / connection	Non-disruption to water supply method	Suspension of water supply is not necessary when pipe branch connections are made.	1) High reliability due to extensive experience for large diameter pipes 2) Minimal delay with careful schedule management 3) Meticulous safety management 4) Reliable quality management	Transmission mains and distribution pipelines
Sludge collector	Sludge collection for sedimentation tank	Automated process	1) High collecting capacity 2) Compact drive unit 3) Lower replacement intervals for worn parts	WTP
Sludge treatment	Filter press for sludge dewatering, long time type	1) Reduce health risks with use of fewer chemicals 2) Lower sludge disposal cost due to efficient dewatering	1) Energy-saving high-efficiency dehydrator 2) High reliability due to extensive experience 3) Wide selection from many manufacturers 4) Meticulous safety management 5) Reliable quality management and after sale service	WTP
Control valve	Two stage open and close butterfly valve	Space-saving with no bypass pipe	1) High reliability due to extensive experience 2) Reliable quality management 3) Not available from other overseas companies	Distribution pipelines
SCADA system	1) Monitoring and control for process facilities 2) Monitoring and control for comprehensive water transmission system 3) Monitoring and control for distribution system	Automatic/manual monitoring and control	1) Meeting various needs based on experience and accumulation of research 2) Preventing accidents or issues in the process /transmission /distribution by prediction of future event by effective utilization of meta data 3) Minimal delay with careful schedule management 4) Reliable quality management and after-sale services	All facilities

Source: JICA Survey Team

4.4 Environmental and Social Considerations

PPWSA hired a registered local consultant (Sustain Green Co., Ltd.) to conduct IEIA for the Bakheng WTP project. As of November of 2017, IEIA is still on-going.

4.4.1 Land Acquisition and Water Rights

PPWSA acquired 15 ha of land for the construction of the Bakheng WTP. Resettlement will be not required. The location is shown in **Figure 4.4.1**.

Source: JICA Survey Team

Figure 4.4.1 Proposed Bakheng WTP

PPWSA will apply to MOWRAM for approval for raw water intake.

4.4.2 Risk Analysis of Environmental and Social Considerations

The risk analysis of environmental and social impacts conducted by JICA Survey Team is summarized in **Table 4.4.1**.

Table 4.4.1 Risk Analysis of Environmental and Social Impacts for Bakheng WTP

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
Social Environment				
1	Resettlement	D	D	The land has been acquired by PPWSA.
2	Local economy (employment and livelihood etc.)	D	D	Water supply project will create positive impacts on local economy due to the increase in service level.
3	Land use and utilization of local resources	C	D	Some changes to land use may occur due to the construction of the intake facility. However, the area affected will be very limited.
4	Water usage/water right	C	C	The intake amount (390,000 m^3/d) will not have significant impacts on Mekong River water usage, even at low flow (2,600 m^3/s). MOWRAM approval has yet to be obtained.
5	Social institutions	D	D	The impact on social institutions is considered negligible.
6	Existing social infrastructures and services (such as traffic etc.)	C	D	The construction of pipelines along public roads may cause traffic disruption. The impacts should be examined.
7	Poor households	D	D	Low income households will not have to collect water from wells or public water taps. They will also benefit from lower unit price of water.
8	Indigenous, or ethnic people	D	D	No specific impacts are expected for various ethnic groups.
9	Misdistribution of benefit and damage	D	D	No such negative impact is expected because there will be 100% water supply coverage.
10	Local conflict of interests	D	D	No such negative impact is expected because there will be 100% water supply coverage.
11	Gender	D	D	Workload of women for collecting water from well and public water taps will be reduced.
12	Children's rights	D	D	Health of children will be improved.
13	Cultural heritage	C	D	Although WTP construction will not be within heritage

No.	Issues	Risk Evaluation		Comments
		P & C	Operation	
				sites, the impacts of pipeline installation should be considered.
14	Infectious diseases such as HIV/AIDS	C	D	Potential risk of infectious diseases due to influx of construction workers should be evaluated.
15	Accidents (risk etc.)	C	D	During construction, measures should be taken to prevent accidents. During operation, standard operation procedures should be prepared.
Natural Environment				
16	Geographical features	D	D	The change of topography and geology due to excavation and backfill will be quite limited.
17	Ground subsidence	D	D	None expected.
18	Bottom sediment	D	D	During construction, bottom sediment at the intake site may be disturbed only for a very short-period.
19	Biota and ecosystem	D	D	The project site does not encompass primeval forests, tropical rain forests, or ecologically valuable habitats.
20	Meteorology (global warming)	D	D	Energy saving measures will be taken.
21	Landscape	D	D	The scale of the proposed facilities is small. The impact is considered to be negligible.
22	Protected areas	D	D	There is no protected area in Phnom Penh.
Pollution				
23	Air pollution	D	D	During construction, limited amounts of dust and exhaust gas may be generated by equipment, vehicles, excavation activities. During operation, no SO_2, NO_2, CO, or dust will be discharged.
24	Water pollution	C	C	During construction: water pollution may occur at the intake facility and from wastewater discharge from construction sites. During operation: backwash water and wastewater from administration building will be discharged into the Mekong River.
25	Soil pollution	D	D	No impact is expected because there will be no sludge disposal on land.
26	Waste	C	D	During construction, construction wastes will be disposed at a landfill site.
27	Noise and vibration	D	D	The WTP is surrounded by wasteland. During construction, the impact is negligible.
28	Offensive odor	D	D	No odor sources are identified.

Source: JICA Survey Team.

The following items should be confirmed in the Preparatory Survey when reviewing the IEIA/EIA report:

1) MOE approval of IEIA/EIA report

2) Land use for intake construction

3) MOWRAM approval for raw water intake from the Mekong River

4) Mitigation measures on traffic disruption during WTP construction and installation of pipelines

5) Preventive measures for infectious diseases such as HIV/AIDS for construction workers

6) Measures to protect cultural heritage during construction

7) Preventive measures for accidents

8) Estimation of the impact of discharging backwash water into the Mekong River and mitigation measures, and

9) Estimation of the quantity of construction wastes and disposal method.

4.5 Items to be Considered in Preparatory Survey

4.5.1 Information Required for Japanese Loan Aid Project Preparation

This Data Collection Survey has gathered the basic information for implementing "The Project for Construction of Water Treatment Plant in Bakheng I & II" using Japanese Loan Aid. The Preparatory Survey will confirm the following:

(1) Project Priority and Urgency

"The Project for Construction of Water Treatment Plant in Bakheng I & II", is essential for improving the water supply situation in Phnom Penh. The F/S for Bakheng I is underway and the project is expected to be financed by AFD. Phnom Penh will face inadequate water supply, therefore the priority and urgency of the project is high.

(2) Project Outcome and Effectiveness

According to the Third Master Plan, four WTPs will be constructed or expanded by 2030 to meet water demand at that time. New Bakheng WTP, is one of them, and will be constructed in two stages. The capacity of each stage is 195,000 m^3/d (max day). The capacity added by, "The Project for Construction of Water Treatment Plant in Bakheng I & II" is pivotal in meeting the water supply targets for 2030 (total production capacity of 950,000 m^3/d in average or 1,090,000 m^3/d in maximum day, water pressure of 2 bar in all serviced area, NRW of 10%, and total connection of 550,000).

(3) Maturity of the Project

The land for the intake facility and the WTP has already been acquired. The F/S is underway. Therefore, project is sufficiently mature to proceed.

(4) Capability of the Implementing Agency

PPWSA has worked on the Niroth WTP construction with co-financing from Japan and France, and therefore, has the ability to implement the Bakheng WTP project.

(5) Agreements among Stakeholders

IEIA on the Bakheng WTP project is being conducted in parallel with the F/S. Stakeholder consultations will be carried out. The Preparatory Survey will confirm the consensus among stakeholders.

(6) Consideration for Low-income Households

The Third Master Plan aims to improve water supply service for all residents of Phnom Penh by 2030 by supplying treated water to the areas not being served and improving supply situation at existing

serviced area. The Preparatory Survey will confirm that low income households will have equal access to the service.

4.5.2 Additional Items to be Considered for Japanese Loan Aid

Table 4.5.1 lists the items required for application for Japanese loan aid.

Table 4.5.1 Items to be Considered for Preparation of Loan Project

Category	Requirements	Specific Actions
1) Adequacy of Basic Planning	Identify served population in service area, and service ratio	・ Set service area and target year ・ Confirm that supply capacity will meet the projected demand ・ Review of F/S prepared by the Third Master Plan
	Estimate demand for each category, non-revenue water ratio and peak factor	
2) Facility Requirements	Determine facility size, intake facility, water treatment plant, transmission facility, elevated tank	・ Study available water sources (possible intake amount) based on hydrogeological data, flow quantity survey, seek consensus among concerned parties. ・ Determine water rights and agreement on intake point ・ Assure safe water quality ・ Prepare facility drawings, water supply system flow diagrams, system diagram of transmission facility. ・ Recommend NRW reduction measures ・ Prepare implementation schedule and determine cost reduction measures
	Determine if existing facilities can be effectively utilized	
	Review land requirement & availability	・ Determine whether land acquisition is required for intake facility and elevated tank etc..
3) Project Scope	Determine scope, including technical, financial and institutional capability of executing agency	・Confirm project implementation strategy and schedule; operation & maintenance plan, financial plan, disbursement schedule, water tariff structure. ・Possibility for applying Japanese technologies to Bakheng WTP project. ・Possibility for applying “Japanese Loan Project with Condition of Operation and Maintenance by SPC Scheme” and “Design-Build Scheme”
4) Project Schedule	Estimate time required for implementation	
5) Project Cost	Construction and operation & maintenance costs	
6) Project Organization	Establish specific project organization, operation & maintenance structure, responsibilities and assignments	
7) Operation & Maintenance Structure		
8) Water Tariff	Determine tariff structure	・ Set appropriate water tariff
9) Environmental Issues and Mitigation Measures	Noise, vibration, water pollution, disposal of sludge from treatment process (soil contamination) during construction stage and after the start of operation	・ Conduct environmental assessment and recommend mitigation measures
10) Economic Evaluation and Financial Analysis	Analyze Internal Rate of Return (IRR)	・ Calculate IRR with consideration of operation & maintenance costs (running costs)

Source: JICA Survey Team.

Appendices

1 Member List of the Survey Team

Name	Job title	Occupation
Mr. Takehiko OGA	Chief Consultant/ Water Supply Engineer	Nihon Suido Consultants Co., Ltd.
Mr. Masashi YAYAMA	Deputy Chief Consultant/ Water Supply Engineer	Water and Sewer Bureau, Kitakyushu City
Mr. Koichi YAMASHITA	Financial Specialist	Koei Research & Consulting Inc.
Mr. Hiroshi KUMAGAE	Public-Private Partnership Specialist	Crown Agents Japan Ltd.
Mr. Takahiro NAKATA	Water Supply Facility Engineer	Nihon Suido Consultants Co., Ltd.
Ms. Risa KIKUCHI	Legal Analysis Specialist	Koei Research & Consulting Inc.
Mr. Ryunan MATSUE	Environmental and Social Considerations Specialist	Nihon Suido Consultants Co., Ltd.

2 Survey Schedule

Item	2017			2018	
	Oct	Nov	Dec	Jan	Feb
Preparation in Japan					
Survey in Cambodia					
Reporting in Japan					
Submission of Draft Final Report			△		
Briefing to Cambodia Side					
Submission of Final Report				△	
Key Meeting with Cambodian Side		●	●		

3 Application Form

(Sheet 2-6.)

Application Form for Grant Aid from Japan

Modification version in June of 2010

1. Country:
   The Royal Government of Cambodia

2. Date (dd/mm/yy):
   //**

3. Requesting Department/Ministry
   (1) Name of the ministry in charge of this application
   Ministry of Industry & Handicraft
   (2) Name and official position of the person in charge of this application
   Dr. Sim Sitha, Director General of Phnom Penh Water Supply Authority
   (3) Postal address, Telephone/Fax number, E-mail address
   #45 street 106, Phnom Penh 12202, Cambodia
   Telephone number; +855-23-427-657
   E-mail address; admin@ppwsa.com.kh

4. Project/program title
   The Project of Construction of Water Treatment System in Ta Khmau District

5. Background of the request
   (1) The sector of the proposed project
   Ta Khmau District, the capital city of Kandal Province, is located about 11 km south of Phnom Penh Capital.
   Prior to 2004, the Bassac River, which flows in the eastern part of Ta Khmau District, and ground water was used for water supply in the district.
   (2) Current situation and problems of the sector
   Water supply in Ta Khmau showed quantitative issues in responding to rapidly increasing water demand and water quality problems caused by arsenic from well water sources.
   At the time, The Royal Government of Cambodia (hereinafter referred as RGC) instructed Phnom Penh Water Supply Authority (hereinafter refer as PPWSA) to supply water to the area as a provisional solution to these issues.

PPWSA had sufficient capacity to do so as a result of the completion of the Niroth Water Treatment Plant. In 2004, PPWSA started to directly supply to district after preparing water distribution facilities to Ta Khmau District.

PPWSA is currently facing a situation of executive water demand, and must enhance and expand water supply facilities, such as the construction of a new water treatment plant, in order to deal with the increase in water demand in Phnom Penh Capital. PPWSA is also facing difficulties in continuing to have sufficient capacity to supply water to Ta Khmau District in the future.

PPWSA has implemented the subsidize domestic water connections to the low income residents since 1999 until present, with the different discounts and payment scheme of 30%, 50%, 70% and 100%. And from 2013, PPWSA has started to make connection to low-income resident at least 10% of the total connections installed each year until 2020 under the policy "Water for All".

(3) Relationship between the project/program and any national development plan

*National Strategic Development Plan

"The vision of the RGC for the development of urban water supply is "100% of urban population to have access to safe, affordable and sustainable water supply by 2025".

(4) The project/program and any sector development plan

*Phnom Penh Water Supply Authority Third Master Plan Period 2016-2030

"To allow a sustainable expansion of the Greater Phnom Penh Water Supply System (GPPWSS), and to reach 100% coverage by the end of the period".

6. Objectives of the project/program

(1) Overall goal

The citizen of Ta Khmau District is supplied to clean, safety, enough and affordable water.

(2) Project/program purpose

Since the population growth rate in the urban area of Kandal was 2.99% in the census conducted in 2008, the increase in water supply for Ta Khmau District was estimated at a population growth rate of 3.0%

Water demand for commercial and public facilities is estimated from the water supply performance of PPWSA.

Table-1 Water demand in project target areas

		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Population in Service Area	P	83,854	86,369	88,960	91,629	94,378	97,209	100,126	103,129	106,223	109,410	112,692	116,073	119,555
Population Served	P	63,500	68,243	72,986	77,729	82,472	87,215	91,958	96,548	101,138	105,728	110,318	114,908	119,498
Service Ratio	%	75.73%	79.01%	82.04%	84.83%	87.38%	89.72%	91.84%	93.62%	95.21%	96.63%	97.89%	99.00%	99.95%
Demand/Person Day	L/CD	146	146	146	146	146	146	146	146	146	146	146	146	146
Domestic	m3/D	9,263	9,954	10,646	11,338	12,030	12,722	13,414	14,083	14,753	15,422	16,092	16,761	17,431
Domestic Connection	Num	12,451	13,381	14,311	15,241	16,171	17,101	18,031	18,931	19,831	20,731	21,631	22,531	23,431
Business	m3/D	3,925	4,004	4,084	4,125	4,166	4,207	4,250	4,292	4,313	4,335	4,357	4,378	4,400
Business Connection	Num	2544	2595	2646	2673	2700	2727	2754	2781	2795	2809	2823	2838	2852
Institution	m3/D	562	562	562	569	569	565	577	577	577	585	585	585	585
Institutional Connection	Num	73	73	73	74	74	74	75	75	75	76	76	76	76
Total Demand	m3/D	13,749	14,520	15,292	16,032	16,765	17,495	18,240	18,952	19,643	20,342	21,033	21,725	22,416
Leakage forecast	m3/D	1100	1162	1223	1283	1341	1400	1459	1516	1571	1627	1683	1738	1793
Leakage Ratio forecast	%	8	8	8	8	8	8	8	8	8	8	8	8	8
Total leakage	m3/D	1100	1162	1223	1283	1341	1400	1459	1516	1571	1627	1683	1738	1793
Average Demand	m3/D	14,849	15,682	16,515	17,315	18,106	18,895	19,699	20,468	21,214	21,969	22,716	23,463	24,209
Rate of Loading	%	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0	83.0
Daily Maximum Demand	m3/D	17,891	18,894	19,897	20,862	21,815	22,770	23,734	24,661	25,559	26,469	27,368	28,268	29,168
Needs New Water Treatment	m3/D	17,891	18,894	19,897	20,862	21,815	22,770	23,734	24,661	25,559	26,469	27,368	28,268	29,168

The purpose of this project is supplying the clean, safety, enough and affordable water to citizen of Ta Khmau through new construction of the facility. The designing, construction, operation and maintenance will be carrying out by Japanese Special Purpose Company (hereinafter referred as SPC) comprehensibly. The contract condition, such as tariff, contract term and so on between PPWSA and SPC will be expected to be clear during the survey by an appropriate organization. SPC will grow up the Operators and Maintenance staffs through the operating term. Eventually, the exclusive rights of facility will be transferred to PPWSA.

7. Outline of the project/program

(1) Project/program type (please select from the items below)

2) Facilities + Equipment

With Operation, Maintenance and Training by SPC

(2) Appropriate amount of the request (US$) and a rough breakdown

Table-2 Cost Estimation

	Item	Cost (US$ or other currency)
Facilities	Intake Station	8.4 million
	Water Treatment Plant	23.1 million
	Sub-total	28.3 million
Equipment	Water Quality Analysis	0.1 million
	Sub-total	0.1 million
Soft (Non-physical) components		1.6 million
Design/Supervision		3.3 million
Grand total		36.5 million

(3) Location and related information

Fig.-1 Location of Ta Khmau Area

- Country scale map indicating the project/program site

Fig.-2 Targeted distribution area

- The communes in Ta Khmau shown in Table 3 are target areas for this project.

Table-3 Target Communes

No	Name of Commune	No	Name of Commune
1	Ta Kdol	4	Ta Khmau
2	Preak Ruessei	5	Preak Hou
3	Daeum Mien	6	Kampong Samnanh

- State/province/prefecture/city map indicating the project/program site

Fig.-3 Proposed Location of Treatment system

- Address of the project/program site, the access time from the capital or a major city, socioeconomic data on the administrative region (state/province/prefecture) or city where the site is located

  The center area of Ta Khmau area is located at the South East of Cambodia. It is 11km from Center of Phnom Penh along the National Road No.2. It takes around 1 hour from Phnom Penh by a car vehicle.

  Main job is Service and Handicraft in Ta Khmau area. Customer Statistic by category 2017 (active)

District	Cat.01	Cat. 11	Cat. 31	Cat. 32	Cat. 41	Cat. 42	Cat. 43	Cat. 44	Total
D13	10,900	2,314	60	1	0	0	141	50	13,466

01 Domestic and private usage
11 Commercial
31 ADM - Public administration
32 Autonomy
41 Wholesaler
42 PPWSA wholesaler
43 Room rental-wholesaler
44 Room rental-domestic

- Reasons for the selection of the site (the priority status of the sites, if plural)
  Ta Khmau District is located near the Phnom Penh Capital. The demand for clean water from citizen is increasing year by year. PPWSA provisionally supplies water to Ta Khmau District, but it is difficult to continue to have sufficient capacity to supply water in the future. According to Phnom Penh Water Supply Authority Third Master Plan Period 2016-2030, the water demand in Ta Khmau District, located closed to Phnom Penh Capital is expected to be continuously increasing year by year. It is the main reason of selection that PPWSA must install new supply system before lack of water.
- Landowner (private or public estate) and the right to use the land for the project
  Landowner of prospective place of the treatment plant is PPWSA.
- Situation of the proposed site (land inclination, drainage, electric power and water supply, telephone lines, etc.)
  The distance of Proposed place of the water treatment plant from National Road No.2 is 60m. Electricity is supplied by Electiricite du Cambodge. Drainage must be install by this project. It will be easy to access to Telephone line.
- Security situation
  The distance from Proposed location to the police station is around 150m. The security level is fare.

(4) Outline of the facility

- Lay out plan of the existing facility which would be rehabilitated/improved
  Use the 4,200m² site of the former water purification plant for water supply in Ta Khmau to be the construction site.
  Located at 11° 29'10"N and 104° 56'50"E (Fig.-4).

Fig.-4 Proposed Layout of Treatment system

Table-5 System Configuration

Intake Station Conveyance Pipe	Capacity 33,000m3/D Q= 22m3/min, H= 23m DCIP ϕ600mm, 100m
Treatment Facility	30,000m3/D With Solar Power System 146kW
Distribution Facility	Pump Q= 20m3/min, H= 50m
Distribution Monitoring System	Flow Meter, Pressure gage, Telemetering System, Monitoring System
Water Quality Equips	1 Set
Equips for EL $M	1 Set

Water flow is mentioned as bellow;
Raw water is surface water of Bassac River.
Bassac River → Intake Pumping station → Receiving well/Grid Chamber / → Chemical Injection (Pre-Chlorine, Coagulant, coagulation aid), Coagulation Basin → Sedimentation Basin, Rapid sand filtration, → Post chlorination → Clear water reservoir → Distribution
The water Quality and flow and pressure will be measured and record by the needs of operation and maintenance.

- Size of the site/facility and their photographs

- Facility' design, construction standards in the requesting country
  There are no standards in Cambodia.
  Construction work will base on the standard, such as ISO, EC, and so on.
  New facility will be composed of expansible structure for the water demand in the future.

- Country from which materials are potentially available for construction
  Cambodia Local; Cement, sand, Brick
  Import from Vietnam or Thailand; reinforcing steels, pipes, other materials

related construction work.
Japan and the counties which is belongs to WTO; another electrical and mechanical equipment

- Construction work will Estimated cost of construction (equivalent to 7.(2))
  36.5 million United State Dollars

(5) Outline of the equipment

Table-6 List of Equipment

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
	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
	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.

(6) Outline of the soft components

SPC will operate and maintain the new facility, so that targeted trainees are the new staffs of new system. They must understand the knowledge of new system to serve the safe water to people.

(7) Items for which the costs are borne by the requesting country (items and the budget)

Obligation of Government of Cambodia

- Land acquisition for water treatment plant and land preparation
- Getting approval of taking water
- Environmental and Social Consideration
- Investigation of Land Mines and Unexploded Ordnance

(8) Benefits/beneficiaries and the expected results of the project/program (qualitative or quantitative descriptions such as the population and areas that will benefit from the project

- Benefit for human life
  Over 98% of the people are accessing to clean and safe water in 2020.
- Benefit for Economic growth
  The spreading of clean water attracts the business and activates the economy of Ta Khmau.
- Benefit for water supply sector of Cambodia
  This project will be valuable case that Japanese technology will be utilized from construction to operation.
  Cambodia water sector will be able to use as the best show case of Japanese technology and to find new business partners.

8. Operation and maintenance of the facilities/equipment including the assignment of staff and the budget allocations after the completion of the project/program
SPC operates and maintains the new facility for 10 years.
SPC will employ most of new local staff members.
The operation will start in 2020.

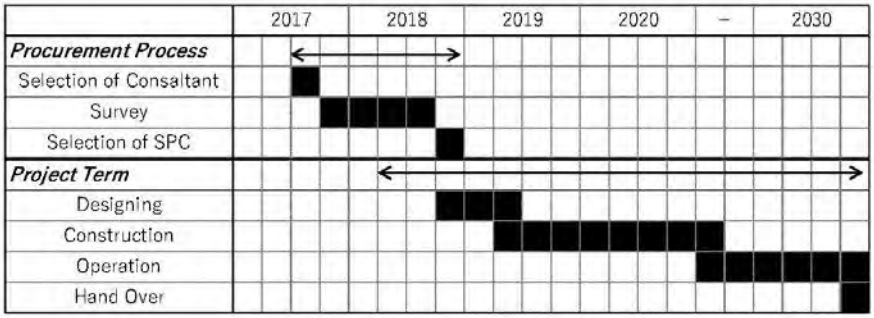


Fig-5 Project Implementation Plan

9. Implementing agency

(1) Title of the implementing agency

Phnom Penh Water Supply Authority

(2) Number of personnel

** Staff members, including a Director: 1030 as of Dec 2016

(3) Organization chart

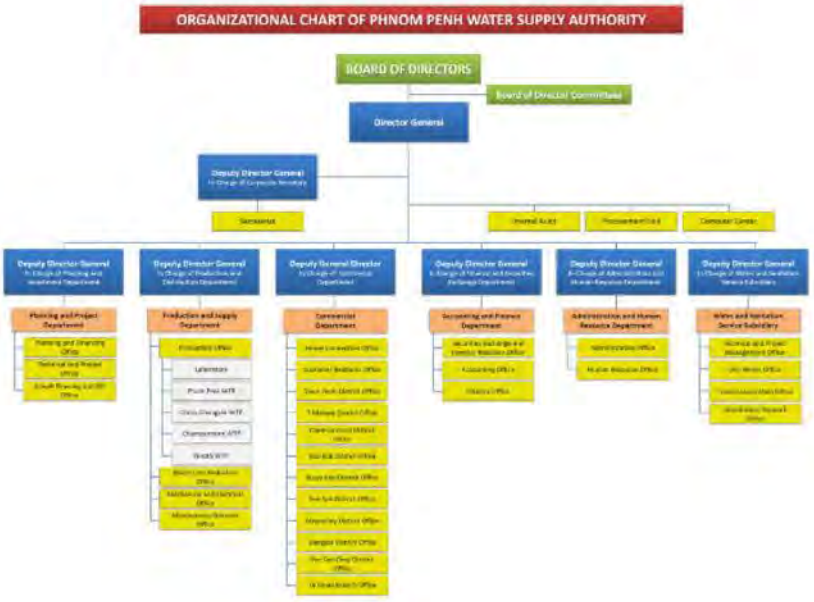


Fig-6 Organization Chart for existing system

(4) Income Statement for last three (3) years

No.	Description	2016 KHR'000	2015 KHR'000	2014 KHR'000
1	Revenue	198,179,874	191,348,246	156,542,849
2	Expense	(142,460,569)	(136,705,608)	(111,891,271)
3	Total income for the financial year	49,273,104	56,949,131	45,747,911

(5) Contents of the activities of the organization that relate to the request

10. Tax exemption

(In the Japan's Grant Assistance project, the custom duties, internal taxes and other fiscal levies which may be imposed in the recipient country should be exempted or borne by the recipient country's government.

(1) Names of the taxes to be exempted (customs duties, internal taxes, etc.)

* For the construction work

Import Tax, Tax on Profit, Minimum Tax, Withholding Tax, Tax on Salary, Value Added Tax, Property Transfer Tax, Patent Tax, Tax on Property

* For Operation and Maintenance

SPC will bear the same duty for operation and maintenance.

(2) If tax exemption is not applicable, specify any alternative methods

11. Relationship to other assistance schemes of Japan's ODA

The programs are mentioned only for Ta Khmau Water Supply.

(1) Study (Name of the study, year of implementation, relationship to the request)

(2) Technical cooperation (Name of the project, type (project, experts, training, etc.), year of implementation, relationship to the request, input from the Japanese side)

(3) Yen loan (Name of the project, year of implementation, relationship to the request)

(4) Grant aid other than the request (Name of the project, year of implementation, relationship to the request)

(5) Assistance from multilateral agencies (Name of the project, year of implementation, relationship to the request)

(6) Assistance from NGOs (Name of the project, year of implementation, relationship to the request)

12. Lessons learnt from past similar projects using Japanese grant aid

(1) Title of the past similar project

(2) Results of the related evaluation

(3) Follow-up situation

(4) Lessons learnt and feedback in relation to this request

13. Study year expected, Implementation year expected:

RGC expects that this project starts in 2017.

Study Year in 2018

Contract with SPC in 2019

14. Activities of other donor agencies in this sector

Please write the name of the donor agency, the year of implementation, type of assistance, and the contents of the assistance, if this is available.

15. Environmental and social considerations

(Please fill in the attached screening format)

(END)

Screening Format（Environmental and Social Considerations）

Please write "to be advised (TBA)" when the details of a project are yet to be determined.

Question 1: Address of project site

Ta Khmau District, the capital city of Kandal Province

Question 2: Scale and contents of the project (approximate area, facilities area, production, electricity generated, etc.)

2-1. Project profile (scale and contents)

Water supply system for targeted area

Capacity: 30,000 m^3/D

Water Resource: Bassac River

Facility: Intake Plant, Treatment Plant

2-2. How was the necessity of the project confirmed?

Is the project consistent with the higher program/policy?

✔YES: Please describe the higher program/policy.

（National Strategic Development Plan）

□NO

2-3. Did the proponent consider alternatives before this request?

□YES: Please describe outline of the alternatives

（ ）

✔NO

2-4. Did the proponent implement meetings with the related stakeholders before this request?

□Implemented ✔Not implemented

If implemented, please mark the following stakeholders.

□Administrative body

□Local residents

□NGO

□Others （ ）

Question 3:

Is the project a new one or an ongoing one? In the case of an ongoing project, have you received strong complaints or other comments from local residents?

✔New □Ongoing (with complaints) □Ongoing (without complaints)

□Other

Question 4:

Is an Environmental Impact Assessment (EIA), including an Initial Environmental Examination (IEE) Is, required for the project according to a law or guidelines of a host country? If yes, is EIA implemented or planned? If necessary, please fill in the reason why EIA is required.

✔Necessity (□Implemented ✔Ongoing/planning)

(Reason why EIA is required:)

☐Not necessary

☐Other (please explain)

Question 5:

In the case that steps were taken for an EIA, was the EIA approved by the relevant laws of the host country? If yes, please note the date of approval and the competent authority.

☐Approved without a supplementary condition	☐Approved with a supplementary condition	☐Under appraisal

(Date of approval: Competent authority:)

☐Under implementation

✔Appraisal process not yet started

☐Other ( )

Question 6:

If the project requires a certificate regarding the environment and society other than an EIA, please indicate the title of said certificate. Was it approved?

☐Already certified

Title of the certificate: ( )

☐Requires a certificate but not yet approved

✔Not required

☐Other ( )

Question 7:

Are any of the following areas present either inside or surrounding the project site?

☐Yes ✔No

If yes, please mark the corresponding items.

☐National parks, protection areas designated by the government (coastline, wetlands,

reserved area for ethnic or indigenous people, cultural heritage)

☐Primeval forests, tropical natural forests

☐Ecologically important habitats (coral reefs, mangrove wetlands, tidal flats, etc.)

☐Habitats of endangered species for which protection is required under local laws and/or international treaties

☐Areas that run the risk of a large scale increase in soil salinity or soil erosion

☐Remarkable desertification areas

☐Areas with special values from an archaeological, historical, and/or cultural points of view

☐Habitats of minorities, indigenous people, or nomadic people with a traditional lifestyle, or areas with special social value

Question 8:

Does the project include any of the following items?

✔Yes ☐No

If yes, please mark the appropriate items.

☐Involuntary resettlement (scale: households persons)

☐Groundwater pumping (scale: m3/year)

✔Land reclamation, land development, and/or land-clearing (scale: 0.4hectors)

☐Logging (scale: hectors)

Question 9:

Please mark related environmental and social impacts, and describe their outlines.

☐Air pollution

☐Water pollution

☐Soil pollution

☐Waste

☐Noise and vibrations

☐Ground subsidence

☐Offensive odors

☐Geographical features

☐Bottom sediment

☐Biota and ecosystems

✔Water usage

☐Accidents

☐Global warming

☐Involuntary resettlement

☐Local economies, such as employment, livelihood, etc.

✔ Land use and utilization of local resources

☐ Social institutions such as social infrastructure and local decision-making institutions

✔ Existing social infrastructures and services

☐Poor, indigenous, or ethnic people

☐Misdistribution of benefits and damages
☐Local conflicts of interest
☐Gender
☐Children's rights
☐Cultural heritage
☐Infectious diseases such as HIV/AIDS
☐Other (　　)
Outline of related impact:

[　　]

Question 10:

In the case of a loan project such as a two-step loan or a sector loan, can sub-projects be specified at the present time?

☐Yes ☐No

Question 11:

Regarding information disclosure and meetings with stakeholders, if JICA's environmental and social considerations are required, does the proponent agree to information disclosure and meetings with stakeholders through these guidelines?

✔Yes ☐No

4 List of Parties Concerned in the Recipient Country

Phnom Penh Water Supply Authority

-	H.E. SIM Sitha (PhD)	Director General
-	CHEA Visoth (PhD)	Deputy Director General, in charge of Corporate Secretary
-	SAMRETH Sovithiea	Deputy Director General, in charge of Planning and Investment Department
-	CHEA Visoth (PhD)	Acting Deputy Director General, in charge of Production and Distribution Department
-	NGIN Chantrea (Ms.)	Deputy Director General, in charge of Commerce Department
-	ROS Kimleang	Deputy Director General, in charge of Finance and Securities Exchange Department
-	CHAN Piseth	Deputy Director General, in charge of Administration and Human Resource Department
-	LONG Naro	Deputy Director General, in charge of Water and Sanitation Service Susidiary

Ministry of Industry & Handicraft (MIH)

-	H.E. EK Sonn Chan	Secretary of State
-	H.E. PRAK Prakat	Director General, General Department of Potable Water Supply
-	SRENG Sokvung (PhD)	Secretary of H.E. EK Sonn Chan, Director, Department of Technical and Project Management

5 Profit and Loss Statement

PL of PPWSA in Model B

(KHR 000)

Profit and Loss Statement	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Revenue																	
Water Sales	486,966,059	486,966,059	486,966,059	486,966,059	535,662,664	535,662,664	535,662,664	535,662,664	535,662,664	589,228,931	589,228,931	589,228,931	589,228,931	589,228,931	648,151,824	648,151,824	648,151,824
Construction service fees	13,151,605	13,546,154	13,952,538	14,371,114	14,802,248	15,246,315	15,703,705	16,174,816	16,660,060	17,159,862	17,674,658	18,204,898	18,751,045	19,313,576	19,892,983	20,489,773	21,104,466
Other income	15,622,946	16,091,635	16,574,384	17,071,615	17,583,764	18,111,277	18,654,615	19,214,253	19,790,681	20,384,401	20,995,933	21,625,811	22,274,586	22,942,823	23,631,108	24,340,041	25,070,243
Total revenue	515,740,610	516,603,847	517,492,981	518,408,788	568,048,676	569,020,256	570,020,984	571,051,734	572,113,406	626,773,194	627,899,522	629,059,640	630,254,561	631,485,330	691,675,915	692,981,638	694,326,532
Expenses																	
Depreciation and amortisation	-117,742,449	-121,274,722	-124,912,964	-128,660,353	-132,520,163	-136,495,768	-140,590,641	-144,808,361	-149,152,611	-153,627,190	-158,236,005	-162,983,086	-167,872,578	-172,908,756	-178,096,018	-183,438,899	-188,942,066
Electricity costs	-105,661,181	-108,831,016	-112,095,947	-115,458,825	-118,922,590	-122,490,268	-126,164,976	-129,949,925	-133,848,423	-137,863,876	-141,999,792	-146,259,786	-150,647,579	-155,167,007	-159,822,017	-164,616,677	-169,555,178
Salaries, wages and related expenses	-118,224,346	-121,771,076	-125,424,208	-129,186,934	-133,062,542	-137,054,419	-141,166,051	-145,401,033	-149,763,064	-154,255,956	-158,883,634	-163,650,143	-168,559,648	-173,616,437	-178,824,930	-184,189,678	-189,715,369
Raw materials for water treatment	-21,308,942	-21,948,210	-22,606,657	-23,284,856	-23,983,402	-24,702,904	-25,443,991	-26,207,311	-26,993,530	-27,803,336	-28,637,436	-29,496,559	-30,381,456	-31,292,900	-32,231,687	-33,198,637	-34,194,596
Raw materials for household water connections	-31,693,356	-32,644,156	-33,623,481	-34,632,185	-35,671,151	-36,741,285	-37,843,524	-38,978,830	-40,148,195	-41,352,640	-42,593,220	-43,871,016	-45,187,147	-46,542,761	-47,939,044	-49,377,215	-50,858,532
Repairs and maintenance	-23,118,657	-23,812,217	-24,526,583	-25,262,381	-26,020,252	-26,800,860	-27,604,885	-28,433,032	-29,286,023	-30,164,604	-31,069,542	-32,001,628	-32,961,677	-33,950,527	-34,969,043	-36,018,114	-37,098,658
Construction service expenses	-21,348,633	-21,989,092	-22,648,765	-23,328,227	-24,028,074	-24,748,917	-25,491,384	-26,256,126	-27,043,809	-27,855,124	-28,690,777	-29,551,501	-30,438,046	-31,351,187	-32,291,723	-33,260,474	-34,258,289
Other operating expenses	-24,034,801	-24,755,845	-25,498,520	-26,263,476	-27,051,380	-27,862,922	-28,698,809	-29,559,774	-30,446,567	-31,359,964	-32,300,763	-33,269,786	-34,267,879	-35,295,916	-36,354,793	-37,445,437	-38,568,800
Cash Injection to Ta Kmau (Model B)	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087
Total expense	-483,109,451	-497,003,422	-511,314,212	-526,054,326	-541,236,643	-556,874,429	-572,981,350	-589,571,477	-606,659,309	-624,259,776	-642,388,256	-661,060,592	-680,293,097	-700,102,577	-720,506,342	-741,522,219	-763,168,573
Operating profit	32,631,159	19,600,425	6,178,769	-7,645,537	26,812,033	12,145,827	-2,960,366	-18,519,744	-34,545,903	2,513,419	-14,488,734	-32,000,952	-50,038,535	-68,617,247	-28,830,426	-48,540,581	-68,842,041

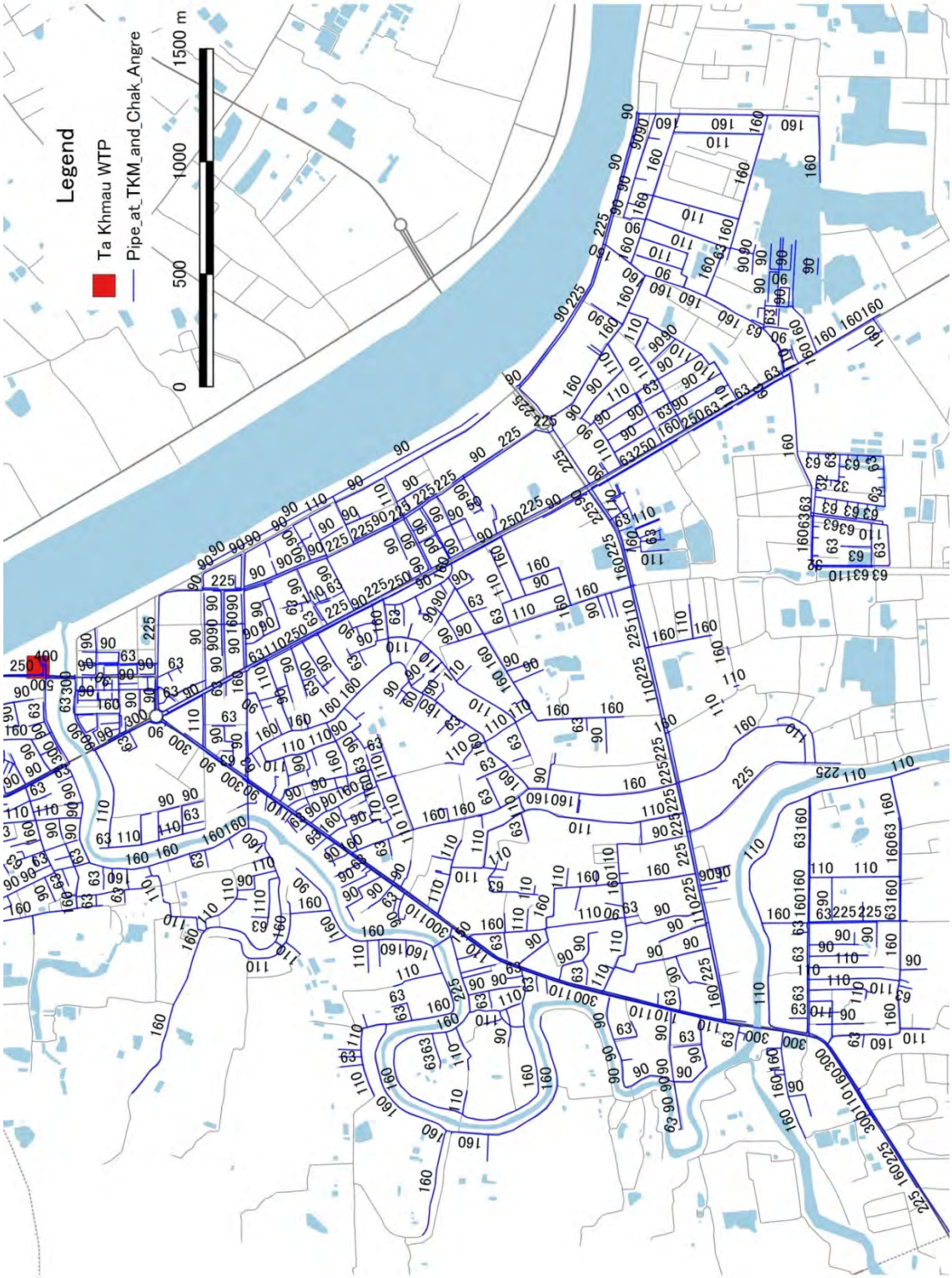
Profit and Loss Statement	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Revenue																		
Water Sales	184,358,901	193,642,909	231,207,933	243,520,074	259,780,606	275,003,885	290,080,826	334,951,157	349,905,661	363,630,811	374,823,490	386,026,404	433,062,648	442,696,417	442,696,417	442,696,417	442,696,417	486,966,059
Construction service fees	7,725,182	7,956,938	8,195,646	8,441,515	8,694,761	8,955,603	9,224,271	9,501,000	9,786,030	10,079,610	10,381,999	10,693,459	11,014,262	11,344,690	11,685,031	12,035,582	12,396,649	12,768,549
Other income	9,176,834	9,452,139	9,735,704	10,027,775	10,328,608	10,638,466	10,957,620	11,286,349	11,624,939	11,973,687	12,332,898	12,702,885	13,083,972	13,476,491	13,880,785	14,297,209	14,726,125	15,167,909
Total revenue	201,260,917	211,051,986	249,139,283	261,989,364	278,803,975	294,597,955	310,262,718	355,738,505	371,316,630	385,684,108	397,538,387	409,422,748	457,160,882	467,517,598	468,262,233	469,029,208	469,819,192	514,902,517
Expenses																		
Depreciation and amortisation	-38,183,804	-41,763,832	-45,858,588	-50,302,414	-55,271,087	-60,265,302	-65,476,394	-70,793,234	-76,172,545	-81,535,247	-86,566,278	-91,828,223	-96,461,594	-101,565,671	-104,612,641	-107,751,020	-110,983,551	-114,313,057
Electricity costs	-34,265,857	-37,478,547	-41,153,149	-45,141,005	-49,599,855	-54,081,625	-58,758,020	-63,529,312	-68,356,664	-73,169,113	-77,683,922	-82,405,951	-86,563,904	-91,144,263	-93,878,591	-96,694,949	-99,595,797	-102,583,671
Salaries, wages and related expenses	-38,340,083	-41,934,764	-46,046,278	-50,508,291	-55,497,301	-60,511,956	-65,744,376	-71,082,977	-76,484,304	-81,868,955	-86,920,577	-92,204,058	-96,856,393	-101,981,359	-105,040,800	-108,192,024	-111,437,784	-114,780,918
Raw materials for water treatment	-6,910,477	-7,558,388	-8,299,454	-9,103,694	-10,002,921	-10,906,770	-11,849,870	-12,812,108	-13,785,651	-14,756,189	-15,666,701	-16,619,004	-17,457,549	-18,381,281	-18,932,719	-19,500,700	-20,085,722	-20,688,293
Raw materials for household water connections	-10,278,136	-11,241,791	-12,343,998	-13,540,166	-14,877,610	-16,221,929	-17,624,626	-19,055,788	-20,503,765	-21,947,272	-23,301,501	-24,717,887	-25,965,076	-27,338,967	-28,159,136	-29,003,910	-29,874,027	-30,770,248
Repairs and maintenance	-7,497,366	-8,200,303	-9,004,305	-9,876,848	-10,852,444	-11,833,055	-12,856,249	-13,900,208	-14,956,432	-16,009,395	-16,997,235	-18,030,415	-18,940,174	-19,942,357	-20,540,627	-21,156,846	-21,791,551	-22,445,298
Construction service expenses	-6,923,349	-7,572,466	-8,314,913	-9,120,651	-10,021,553	-10,927,085	-11,871,942	-12,835,972	-13,811,329	-14,783,675	-15,695,883	-16,649,960	-17,490,066	-18,415,518	-18,967,984	-19,537,023	-20,123,134	-20,726,828
Other operating expenses	-7,794,471	-8,525,264	-9,361,127	-10,268,247	-11,282,503	-12,301,974	-13,365,716	-14,451,044	-15,549,124	-16,643,814	-17,670,800	-18,744,922	-19,690,734	-20,732,631	-21,354,609	-21,995,248	-22,655,105	-23,334,758
Cash Injection to Ta Kmau (Model B)			0	0	0	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087	-19,977,087
Total expense	-150,193,543	-164,275,354	-180,381,813	-197,861,314	-217,405,273	-257,026,783	-277,524,280	-298,437,729	-319,596,902	-340,690,749	-360,479,984	-381,177,508	-399,402,576	-419,479,132	-431,464,194	-443,808,807	-456,523,759	-469,620,159
Operating profit	51,067,374	46,776,632	68,757,470	64,128,049	61,398,701	37,571,172	32,738,437	57,300,777	51,719,728	44,993,359	37,058,403	28,245,240	57,758,306	48,038,466	36,798,040	25,220,401	13,295,433	45,282,358

6 Construction Cost of Ta Khmau WTP

	Item	Cost (US$ or other currency)
Facilities	Intake Station	8.4 million
	Water Treatment Plant	23.1 million
	Sub-total	28.3 million
Equipment	Water Quality Analysis	0.1 million
	Sub-total	0.1 million
Soft (Non-physical) components		1.6 million
Design/Supervision		3.3 million
Grand total		36.5 million

Source: PPWSA (2017) “Application Form for Grant Aid from Japan”

7 Existing Distribution Network in Ta Khmau District



8 Related Regulations

November 29, 2017

Nihon Suido Consultants Co., Ltd.
Mr. Takehiko Oga,

TMI Associates-Phnom Penh Office
TMI SOHGOH Ltd.
#445, 16th Floor, Phnom Penh Tower
Sangkat:Boeung Prolet, Khan: 7 Makara
Phnom Penh, Cambodia.
Tel: (855) 023 96 42 87
Fax: (855) 023 96 42 85
E-mail: yunagata@tmi.gr.jp

Report regarding the Legal Survey on Water Supply PPP Project

This report is to provide responses to the inquiries which we have received from you as of October 16, 2017 via an e-mail from Mr. Takehiro Oga. Our responses are divided in to two sections which are "Key Study Points" and "Area of laws&Regulations to be studied" as you have categorized in the file titled "171017_TOR_for_Local_Legal_Sepcialist".

1. Key Study Points

How to fit "The Project for Grant-PPP Scheme" under the laws and regulation of Kingdome of Cambodia?

1-1 Can the "Prakas on Procedure for Issuing, Revising, Suspending and Revoking Permit of Water Supply Business (herein after "Prakas on Business Permit")" be legal basis for this project? Is there any major regulation needs to be considered? (e.g. concession law, PPP policy paper)

TMI: We understand that the Prakas No. 461 dated on May 29, 2014 on Business Permit stipulates the target businesses which are required to apply for Business Permit, the mechanism of application for Business Permit, procedure for issuing, revising, suspending and revoking of business permit, procurement procedure of water supply business operation, and procedure for expansion of water supply area etc.(Article 2), and this Prakas is applied to all natural person or legal person who are public entities, public-private entities and private entities wishing to conduct water supply business (Article 4). Therefore, this project which is going to be conducted under Grant-PPP scheme is also subject to the application of this Prakas on Business Permit regarding its investment on the expansion of water supply business in Ta Kmau in accordance with the aforementioned Article 4. Particularly, it is required to obtain the applicable business permit from Ministry of Industry and Handicraft for WTP construction and applicable certificate of operation for WTP operation and service provision in order to legally conduct this project. Whether a separate permit is required for project is under the control of PPWSA shall be address in Q [1-3]. In addition, since this project is conducted under the Grant-PPP scheme, it must comply with other applicable laws and regulations namely Law on Concession, Law on Investment, Law on Public Finance System, Land Law, Law on Secure Transaction, Law on Taxation etc. The provisions of these laws and regulations related to the PPP scheme will be determined below.

1-2 Can PPWSA be a public contracting agency to conduct PPP? (85% of share is hold by MOEF but some stocks are listed.)

TMI: PPWSA, whose majority of shares is held by MOEF, is a public enterprise under the supervision of Ministry of Economic and Finance and Ministry of Industry and Handicraft as provided in the Law on General Status of Public Enterprise dated on May 28th 1996 which is promulgated by Royal Decree No. CS/RKM/0696/03. Currently, there is no legal framework regarding certain roles of relevant ministries/institutions on the implementation of public investment projects through PPP scheme; and Policy Paper on Public-Private Partnerships for Public Investment Project Management 2016-2020, dated on June 22, 2016 (herein called

"PPP Policy" which is considered the only legal framework on PPP, does not clearly define the definition of "state" which is a public partner in PPP. We further note that the Concession Law allows State-Owned entities to enter into Concession Contracts, however, this point is not made clear in the PPP framework. Since, PPWSA is under the technical guardianship of the MIH, there is a risk that MIH determines that MIH itself should become the public contracting agency in this project and appoint PPWSA to be implement agency, so in the event PPWSA needs to be the contracting party, it will be necessary to obtain official clearance of MIH regarding this point.

1-3 When PPWSA conducts PPP project, selected private operator needs to take new business permit based on Prakas on Business Permit even within the control of PPWSA?

TMI: According to Prakas No. 461 dated on May 29, 2014 on Business Permit, the investor who is going to conduct the water supply business is required to obtain a permit for WTP construction and a certificate of operation after the completion of WTP construction (Article 4 and Article 37). Therefore, when PPWSA conducts PPP project, it is required to obtain the aforementioned permit (it may be required to obtain a permit for the expansion of WTP instead since it has already operated its water supply business in Takmau) and certificate for the project. However, there is no regulation in this Prakas mentioning the case which WTP is operated by different entity; therefore, it is unclear whether selected private operator is required to apply for new business permit or certificate even when it is under the control of PPWSA. The PPWSA engages in the water supply business in the Phnom Penh Municipality under a license from the MIH. According to the meeting conducted on 8th November, 2017, the view of PPWSA and MIH is that since this project is to expand the capacity of water contribution by installing new equipment that will provide higher efficiency, this Project will be controlled by PPWSA and thus will not require a separate permit.

1-4 Can the non-grant portion of WTP construction be Japan-tied? How about operation portion? (in case that major part of WTP construction would be provided by grant from Government of Japan)

TMI: Please refer to the section regarding to the law on public procurement in the table set below.

1-5 What would be the legal basis of procurement of contractor? Procurement law in Cambodia or JICA?

TMI: According to the PPP Policy dated on June 22, 2016, there is no specific regulation on procurement procedure for Projects under PPP scheme, therefore, previous public investment projects through PPPs have been managed and implemented using the procedures of normal public investment projects as provided in the Law on Public Procurement of Cambodia dated on January 14, 2012 which is promulgated by Royal Decree No. NS/RKM/0112/004. According to Article 3 of this Law, it is applied to all public procurement transactions in the Kingdom of Cambodia regardless of the source of the resource "except for procurement transactions under the financing project by the Development Partners which shall be implemented in accordance with the guiding principles and procedures as provided in the financing agreement". If the agreement did not determine any guiding principles and procedures, the process of such procurement shall be implemented in accordance with the provisions of this Law. Accordingly, we believe that the legal basis of the procurement under this project can either be the Law on Public Procurement of Cambodia or Jica Guideline based on the provisions of their agreement. However, as mentioned above this point needs to be confirmed with MEF and MIH.

2. Area of laws & Regulations to be studied.

Category	Area of Law & Regulation	Points of Study
PPP/Procurement	Prakas on Procedure for Issuing, Revising, Suspending and Revoking Permit of Water Supply Business	Clarify if this Prakas would be legal basis of this project. Translation of whole regulation is required. *TMI: As provided above, this Prakas on Business Permit stipulates regarding the target businesses which are required to apply for Business Permit, the mechanism of application for Business Permit, procedure for issuing, revising, suspending and revoking of business permit, procurement procedure of water supply business operation, and procedure for expansion of water supply area etc and it is applied to all natural person or legal person who are public entity, public-private entity and private entity wishing to conduct water supply business (Article 4).* *Therefore, this project which is going to be conducted under Grant-PPP scheme is also subject to the application of this Prakas on Business Permit regarding its investment on the expansion of water supply business in Ta Khmau. Particularly, it is required to obtain the applicable business permit from Ministry of Industry and Handicraft for WTP construction and applicable certificate of operation for WTP operation and service provision in order to legally conduct this project.*
	Concession law	Clarify the current status of Concession law. If this law is still effective, whole law is required to be translated. *TMI: The purpose of this Law is to promote and facilitate the implementation of privately financed in the Kingdom of Cambodia in order to ensure the public interest and the fulfillment of the national economic and social objectives.* *"Concession" means any act attributable to the state whereby a competent institution entrusts to a private third party the total or partial implementation of an Infrastructure Project for which that institution would normally be responsible and for which the third party assumes a major part of the construction and/or operating risks or receives a benefit by way of compensation from government revenue or from fees and charges collected from users or customers. Such acts of the state will henceforth be considered*

6

Category	Area of Law & Regulation	Points of Study
		as "concession" under this Law regardless of the legal name used for the act (Article 3 of Law on Concession dated on October 04, 2007 which is promulgated by Royal Decree No. NS/RKM/1007/027). *All competent institutions entitled to undertake infrastructure projects within the eligible infrastructure sectors specified in this law which have been delegated the required institution in accordance with the laws of Cambodia have the power to enter into Concession Contracts for Infrastructure Projects falling within their respective spheres of competence and have the power to enter into ancillary or related agreements, including the purpose of facilitating any related Financing (Article 4 of Law on Concession dated on October 04, 2007 which is promulgated by Royal Decree No. NS/RKM/1007/027).* *Concession contracts in relation to infrastructure facility providing direct or indirect services to the general public may be entered into by the relevant institutions in the following sectors such as water supply and sanitation etc. (Article 5 of Law on Concession dated on October 04, 2007 which is promulgated by Royal Decree No. NS/RKM/1007/027).* *It can be read that the project conducted under Grant-PPP Scheme can be regarded as a concession under Article 3, so it is necessary to comply with this law.*
	Laws, Regulation, and Decree on Public Procurement	List up the laws and regulations regarding to public procurement. Clarify if there is any article describing PPP procurement. Does PPWSA need to follow this regulation (as state owned company)? What would be the relation between this regulation and "The Project for Grant-PPP Scheme". Can the procurement be Japan-tied for whole scope? If cannot, for what extent would be possible? *TMI: The purpose of this law is to ensure that the process of public procurement for procuring goods, civil works, repairs, engaging of services, engaging of consultancy services shall be done with transparency, accountability, fairness, effectiveness, quality, equality/equity, economy and with timeliness as well as to ensure that the public procurement system shall be uniform across the Kingdom of Cambodia. "Operation"*

6

Category	Area of Law & Regulation	Points of Study
		itself is not directly included in the above items, however in light of the purpose of this law which is to ensure transparency accountability and etc of the public procurement process, there is a possibility that the same process may apply to operation of projects as well. The purpose of this Law is to determine the rules, methods, procedures and structure for managing and implementing all public procurement transactions in the Kingdom of Cambodia (Article 1 and Article2 of Law on Public Procurement dated on January 14, 2012 which is promulgated by Royal Decree No. NS/RKM/0112/004). According to Article 3 of this law, this law shall extend a scope to implement all public procurement transactions in the Kingdom of Cambodia regardless of the source of the resources except for: *(i) Procurement transactions under the financing project by the development partners which shall be implemented in accordance with the guiding principles and procedures as provided in the financing agreement. If the agreement did not determine any guiding principles and procedures, the process of such procurement shall be implemented in accordance with the provisions of this Law;* *(ii) Any procurement affecting secrets in the national defense sector and public security shall require an approval/decision from the Prime Minister;* *(iii) Granting other concessions of state shall be implemented in accordance with the law and particular provisions. We believe that the project for Grant-PPP Scheme and the Japan-tied portion may fall under exception (i). However, we will need to further consult with relevant officials at MEF and MIH on this point due to the ambiguity of the wording in the law.*
	Law on Public Financial System	Is there any concerned articles which might affect to this project? *TMI: The Law on Public Financial System dated on May 20, 2008 which is promulgated by Royal Decree No. NS/RKM/0508/016 is refer to the law that plans annual state revenue and expenditure regulations pertaining to financial system and payments used to perform roles, and to undertake programs and responsibilities of ministries/ institutions at the national and sub-national levels in compliance with the provisions of the Constitution and the law on public financial system, and regulations on financial system determined by law. However, there is no specific concerned article which might affect to this project as PPP grant project.*
Water Supply	The Water Supply and Sanitation	Is there any description for PPP or cooperation with private?

Category	Area of Law & Regulation	Points of Study
	Regulatory Law of the Kingdom of Cambodia	*TMI: This law is not adopted and promulgate yet.*
	Law on Water Resources Management of the Kingdom of Cambodia	Is there any description for PPP or cooperation with private? *TMI: The general purpose of the Law Law on Water Resources Management of the Kingdom of Cambodia dated on June 29, 2007 which is promulgated by Royal Decree No. NS/RKM/0607/016 is to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people.* *This Law determines:* *- the rights and obligations of water users,* *- the fundamental principles of water resources management, and* *- the participation of users and their associations in the sustainable development of water resources.* *However, there is no any description for PPP or cooperation with private in this law.*
	National Policy on Water Supply and Sanitation	Is there any description for PPP or cooperation with private? *TMI: The aim of the strategy is to define the water supply, sanitation and hygiene services to be made available to people living in rural areas, and the institutional arrangements and financial, human and other resources needed to provide these services. However, there is no regulation in this policy mentioning for PPP or cooperation with private.*
	Policies of Department of Potable Water Supply of the Ministry of Mines, Industry and Energy (MIME) regarding water tariff	What is the tariff determination mechanism? Who would determine the tariff level? *TMI: The Prakas No. 069 dated on March 04, 2016 on Water Tariff Determination Mechanism has provided the water tariff determination mechanism into 2 methods.* *- Method 1: Cash Flow Method, this method is the settlement of including annual cash flow of water service provider into real value (basic year) for cash flow method to determine water tariff. However, this provision refer to water service supplier type "A". The water service supplier type "A" refer to any service provider which provided*

Category	Area of Law & Regulation	Points of Study
		water service from 2001 links. *- Method 2: Annity Method, this method is the settlement of average water tariff equal to income of water service provider divided to the amount of water that is planned for the yearly average. However, this provision refer to water service supplier type "B". The water service supplier type "B" refer to any service provider which provided water service equal or less than 2000 links.* *Ministry of Industry and Handicraft shall be the only one who has rights to determine the water tariff for those water service providers. According to the meeting with PPWSA on 8 November, 2017 and 14 November, 2017, PPWSA mentioned that the tariff determination for PPWSA was under the determination of Council Ministers of Cambodia and the above mentioned method will not apply for PPWSA. However, we have not found the sub-decree mentioned by PPWSA on this point. We will follow up regarding to this matter.*
Investment	The Law on Investment of the Kingdome of Cambodia (1994) Law on the Amendment to the Law on Investment (2003)	Is there any restriction for foreign investment? (e.g. maximum % of share for water sector project) Is there any tax incentive for foreign direct investment? *TMI: There is no restriction for foreign investment or maximum of share contribution for water supply sector.* *Yes, QIP's are entitled to a profit tax exemption. Profit tax exemption is composed of "Trigger period" + 3 years + Priority Period (Maximum total 9 years). However, investment activities not eligible for incentives for clean water supplies project with the investment capital less than USD 500,000 (five hundred thousand) referring to Article 15 of Sub Decree No. 111 ANK/BK dated on September 27, 2005 on the Implementation of the Law on the Amendment to the Law on Investment of the Kingdom of Cambodia.*
	Company Law Commercial Registration	Same question as above. *TMI: There is no restriction for foreign investment or maximum of share contribution for water supply sector. The foreign investor is able to hold 100% of shares to contribute in water supply sector.*

Category	Area of Law & Regulation	Points of Study
Tax	-Prakas No. 359 of Ministry of Economy and Finance (MEF) -Prakas No. 002 MEF on Implementation of Advance Ruling on Tariff Classification, Customs Valuation and Origin of the Goods -Instruction No 345 GDCE on Implementation of Advance Ruling on Tariff Classification -Instruction No 346 GDCE on Implementation of Advance Ruling on Customs Valuation -Instruction No 2175 GDCE on Implementation of Advance Ruling on Origin of the Goods	Is there any article which might give critical or important impact to the project? *TMI: Currently, we do not see any article which might give critical or important impact to the project. However, we will confirm official to find if there is any article which impact to this project.*
Foreign Exchange	Law on Foreign Exchange	Is there any foreign exchange restriction for Japanese yen? *TMI: Any foreign exchange operations and, in general, any operations carried out between residents and nonresidents are subject to the present law when they relate to:* *• payments for commercial transactions;* *• transfer; or* *• capital flows, including investment.* *There shall be no restrictions on foreign exchange operations through book entry including purchases and sales of foreign exchange on the foreign exchange market, transfers, all kinds of international settlements, and capital flows in foreign or domestic currency, between Cambodia and the rest of the world or between residents and nonresidents. However, such operations shall be undertaken solely through authorized intermediaries (Article 5 of Law on Foreign Exchange dated on August 22, 1997 which is promulgated by Royal Decree No. CS/RKM/0897/03). In addition, there is no foreign exchange restriction for Japanese Yen in Cambodia.*
Land	Land Law and law regarding rent of real estate Law on Land Road	Who will conduct land acquisition? (PPWSA or private for this porject?) What would be the issue of expropriation of land? Legal basis?

Category	Area of Law & Regulation	Points of Study
		TMI: As this project which is going to be conducted under Grant-PPP scheme within the control of PPWSA, PPWSA should be the party would be conducted land acquisition, as hearing from PPWSA confirmed. *"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 persons or legal entities or legal public entities, which includes land, buildings, and cultivated plants, and for construction, for rehabilitation or for expansion of public physical infrastructure which is for national and public interests (Law on Expropriation dated on 26 February, 2010 which is promulgated by Royal Decree No. NS/RKM/0210/003). Any expropriation of Land need to follow this Law on Expropriation.*
Finance	Law on the Issuance and Non-government Securities	Is there any restriction for PPWSA to issue the bond? *TMI: There is no restriction in relevant laws, however issuance of bonds are not common in Cambodia.*
	Law on Corporate Accounting Law on Accounting and Public accounting Audit and Accounting Profession	Shall PPWSA get any influence from public accounting? *TMI: The purpose of this law is to govern the accounting and auditing with effectiveness, transparency, and reliability in the Kingdom of Cambodia. According to Article 3 of the Law on Accounting and Auditing dated on May 11, 2016 which is promulgated by Royal Decree No. NS/RKM/0416/006, this law shall apply to public institutions, enterprises, not-for-profit entities, accountants and auditors. Since PPWSA is a state-owned company this law shall apply.*
Decentralization	Local Government Act or law regarding items which were transferred of power to local government	What is the relation between PPWSA and local/central government? *TMI: In 1959, PPWSA was officially established by Royal Decree No. 164NS dated March 24, 1960 signed by King Norodom Sihanouk, the King of the Kingdom of Cambodia, as a state treatment and business unit under the direct supervision of the Phnom Penh Municipality which is a local government, and was officially named "Phnom Penh Water Supply Authority". Since 2004, PPWSA has been transferred and under the technical guardianship of the Ministry of Industry and Handicraft by Sub-Decree No. 14, dated on 24 May, 2004 on transferring PPWSA to be under Guardianship of Ministry of Industry, Mines and Energy (MIME) which now is divided to Ministry of Ministry of Industry and Handicraft (MIH).* *The authorized representative of the MIME shall be the Chairman of board of directors and the authorized representative of the Phnom Penh Municipality shall be member of board of director (Article 2).*
Contract	Standard contract model regarding water supply project	Is there any example of RFP documents or contract model for water supply project? Is there any RFP or contract of PPP in the other sector? *TMI: Currently, we do not see any sample or contract model for water supply project under the law. We will confirm with the relevant officials to see whether there is any sample in practice.*
Other	Any other laws and regulations which might be concerned for the implementation of this project	- *Sub-Decree No. 111 ANK/BK dated on September 27, 2005 on the Implementation of the Law on the Amendment to the Law on Investment of the Kingdom of Cambodia;* - *Prakas No. 069 dated on March 04, 2016 on Water Tariff Determination Mechanism* - *Prakas No. 068 dated on March 04, 2016on Depreciation Rate for Production and Distribution of Clean Water* Service

December 28, 2017

Nihon Suido Consultants Co., Ltd.
Mr. Takehiko Oga,

TMI Associates-Phnom Penh Office
TMI SOHGOH Ltd.
#445, 16th Floor, Phnom Penh Tower
Sangkat:Boeung Prolet, Khan: 7 Makara
Phnom Penh, Cambodia.
Tel: (855) 023 96 42 87
Fax: (855) 023 96 42 85
E-mail: yunagata@tmi.gr.jp

Report regarding the Legal Survey on Water Supply PPP Project

This report is to provide responses to the inquiries which we have received from you as of December 06, 2017 via an e-mail from Koichi Yamashita. Our responses are divided as set below.

1. Questions

1-1 Regarding to Concession Law, Article 11 mentioned "The selection of the Concessionaire shall be carried out in accordance with the procedures provided for in the **Sub-Decree**." Did they already issue sub-decree?
Also, if there is any inconsistency between Procurement Law and Concession Law, would it be OK to just follow procurement law (Article 3 (i))?

TMI: This Sub-Decree is not issue yet. Since this Sub-Decree not yet issue, that would be possible to follow the Article 3(i) of the Law on Public Procurement in the case there is any inconsistency between the Law on Public Procurement and Law on Concession if there is any provision mentioning about guideline and/or procedure for procurement in the Exchanging Note (E/N) or Grant Aids Agreement.

1-2 If we need to follow Concession Law, do we need to apply and get approval from CDC (or MEF) for project implementation?

TMI: The Council for Development of Cambodia is the one stop service entity for obtaining authorizations required to implement an Investment Project in accordance with the Law on Investment. The Council for Development of Cambodia shall upon receipt of a request for a Qualified Investment Project to be implemented under a Concession Contract from a selected Concessionaire:

a. *Approve all investment incentives the Concessionaire is entitled to according to the Law on Investment of the Kingdom of Cambodia;*
b- *Specify all Authorizations required to be obtained for the Concession Project, the competent institutions responsible for the issuance of the Authorizations.*
c- *Obtain in a timely manner all required Authorizations as specified in this Article from the relevant institutions on behalf of the Concessionaire provided that all required information and documents have been duly supplied.*

1-3 Can private sector register Grant Aids amount as their capital?

TMI: According to Article 4 of Sub-Decree No. 111 ANK/BK dated on September 27, 2005 on the Implementation of the Law on the Amendment to the Law on Investment of the Kingdom of Cambodia, "Investment Capital" means the value of the investment indicated in USD currency excluding the value of land and working capital. Accordingly, we have set up a meeting with

CDC on 27th December, 2017, regarding this issue and the response from the official in charge was that, CDC does not have any interest in the source of the funds to comprise the investment capital, and accordingly, grant aids amount can be registered as the company's investment capital.
We also hereby note that, in order for the Grant Aid to be used as capital, it is also necessary to make sure that the Grant Agreement does not include any wording which may prohibit such Grant Aid being used for the capital of the private sector.

1-4 When PPP Scheme implementation what is the actual procedure?

TMI: Currently, there is no legal framework in accordance with the implementation of public investment project though PPP scheme, and Policy Paper on Public-Private Partnerships for Public Investment Project Management 2016-2020, dated on June 22, 2016 which is considered the only legal framework on PPP, does not clearly define the procedure for implementation. Nonetheless, since sub-decrees, legal instruments and operational management procedures to support the implementation of the Law have not been developed and enforced, Public-Private Partnerships (PPPs) have not been fully and effectively implemented. The current Government's policies on PPP transactions are to provide case-by-case procedures for public and private sector to perform their PPP project. It is necessary to individually consult with all relevant ministries/institution in order to implement the project. Implementation shall be conducted in accordance with specific advice regarding the project from relevant officers at this stage.

1-5 Do we need to follow PPP guideline or Sub-Decree which is stated in Article 11 of Law on Concession?

TMI: Since this Sub-Decree not yet issue, we need to follow PPP guideline for implementing PPP project in the Kingdom of Cambodia.

2.Additional TOR

2-1 Who are the concerned parties (Government Institutions) regarding water supply business (e.g. MIH, MEF, PPWSA, other)? What is the role of each parties? We would like to clarify the overall institutional framework. For example, we are still not clear about the role of MIH and Phonom Penh.

TMI: The concerned parties (Government Institutions) regarding water supply business are:

a. *Ministry of Economy and Finance (MEF), whose majority of shares, being the financial guardianship for PPWSA as provided in the Law on General Status of Public Enterprise dated on May 28th 1996 which is promulgated by Royal Decree No. CS/RKM/0696/03 and Sub-Decree No. 41 dated on 06th August, 1997 on the Implementation of the Law on Public Enterprise, the role of MEF:*
   - *To review and approve on budget for buying-selling and leasing property and other asset;*
   - *To receive any remaining asset after dissolution in proportion to the shareholding;*
   - *To receive any dividend declared by the PPWSA;*
   - *To review and approve on agenda for the meeting of board of directors propose by PPWSA;*
   - *To votes in any general meeting of the shareholders;*
   - *To review and approve on yearly plan.*

b. *Ministry of Industry an Handicraft (MIH), Since PPWSA is under the technical guardianship of the MIH, there is no legal framework regarding certain roles of this guardianship. According to the meeting with MIH conducted on 21st December, 2017, the role of MIH:*
   - *To control technical work in accordance with the operation of PPWSA;*
   - *To review and approve on yearly plan;*
   - *To votes in any general meeting of the board of directors;*
   - *To propose the Chairman of Board for PPWSA to Prime Minister (the Representative of MIH shall being the Chairman of Board of Directors).*

c. *Phnom Penh Water Supply Authority (PPWSA), According to the Sub-Decree No. 52 GNKR.BK dated on 19th December, 1996 and its Article, the role of PPWSA:*
   - *To produce and distribute water supply in Phnom Penh city and downtown area around Phnom Penh city;*
   - *To invest, build, expand, operate and maintain the production devices, water distribution and sanitation system;*
   - *To take all measures to increase production and service, and to ensure clean water quality to meet the demand for water consumption of household, commercial, service sector, and industries;*

- *To carry out businesses-services and other necessary tasks related to portable water and hygiene in domestic and overseas markets in accordance with the authority's board of directors resolutions and related laws;*
- *To implement the technical, commercial and financial cooperation with domestic and overseas development partners in order to expand and develop PPWSA in line with policies of the RGC;*
- *To ensure sustainable production, business and finance pertaining to social interests.*

d. *Phnom Penh Municipal Hall, Council of Ministers and Ministry of Interior are the concerned parties regarding to PPWSA. However, these ministries/institutes have no executive right in accordance with the operation of PPWSA. These ministries/institutes have only right to vote in any general meeting of the board of directors of PPWSA.*

2-2 What is all the necessary permits need to be obtained for PPWSA and private sector in order to implement this Grant-PPP Scheme?

TMI: The PPWSA engages in the water supply business in the Phnom Penh Municipality under a license from the MIH. According to the meeting conducted on 21st December, 2017, the view of PPWSA and MIH is that since this project is to expand the capacity of water contribution by installing new equipment that will provide higher efficiency, this Project will be controlled by PPWSA and thus will not require other permits.

2-3 Is there any guideline or manual related to PPP project issued by MEF? (e.g. Project Selection Guideline (PSG), Project of Development (PDF) etc.)

TMI: Currently, MEF has issue draft of Procurement Manual for Public-Private Partnership Projects for selection of consultants and private partners and draft of Procurement Manual for Public-Private Partnership Projects for selection of the private partners, as attached hereto. However, these manuals have not yet been finalized.

2-4 Can PPWSA be the public contracting for Grant Aids agreement? (Jica said PPWSA can't sign Grant Aids agreement with Jica. Only MEF who can sign this agreement with Jica).

TMI: PPWSA, whose majority of shares is held by Ministry of Economy and Finance (MEF), is

a public enterprise under the financial guardianship of MEF as provided in the Law on General Status of Public Enterprise dated on May 28th 1996 which is promulgated by Royal Decree No. CS/RKM/0696/03 and Sub-Decree No. 41 dated on 06th August, 1997 on the Implementation of the Law on Public Enterprise. Currently, there is no legal framework regarding certain roles of relevant ministries/institutions whose being a public contracting for grant aids agreement. Concerning to the meeting with PPWSA conducted on 21st December, 2017, PPWSA mentioned that PPWSA cannot be the public contracting for grant aids agreement. The MEF is responsible as a public contracting for grant aids agreement for on behalf Royal Government of Cambodia (RGC).

2-5 If MEF ask PPWSA to conduct the procurement, what is the legal background for this (assignment, appointment, delegation etc)?

TMI: According to the Standard Operating Procedures (SOP) dated on May 2012, the legal background of this identifying is "Designation". The MEF must confirm in writing the designation of a line ministry or other agency as the EA / IA, as clearly state that the guidelines and systems and procedures of both the RGC and the relevant DP must be adhered to. For its part, the designated EA / IA must confirm agreement to adhere to these in writing.

9 Water Quality (Ammonia Nitrogen)