

**SOCIALIST REPUBLIC OF VIETNAM
HANOI PEOPLE'S COMMITTEE**

**PREPARATORY STUDY ON
CONSTRUCTION PROJECT FOR
YEN XA WASTEWATER TREATMENT PLANT
(PPP INFRASTRUCTURE PROJECT STUDY)**

FINAL REPORT

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

**NIPPON KOEI CO., LTD.
ORIX CORPORATION
WATER AGENCY INC.
PRICEWATERHOUSECOOPERS CO., LTD.
YOKOHAMA WATER CO., LTD.**

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- VND/US\$ = 20,944
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- JPY/VND = 0.00397

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Chapter 1 Introduction

1.1 Background and Objectives of the Study

1.1.1 Background

The water environment in Hanoi is in critical condition, because of rapid increase in population, increase of wastewater generation, and insufficient capacity of sewerage system. In the present situation, the Government of Japan has provided a loan for “Hanoi Drainage Project for Environmental Improvement” to develop the sewerage and drainage system. Moreover, “Second Hanoi Drainage Project for Environmental Improvement” has been under the implementation stage. However, the sewerage system in Hanoi has not been developed well, and additional projects which will require new funds are necessary.

Hanoi People’s Committee (HPC) and the Japan International Cooperation Agency (JICA) had discussions on the possibilities of Public-Private Partnership (PPP) projects in the field of wastewater and sludge treatment, and have agreed to jointly conduct a preparatory study for Yen Xa Wastewater Treatment Plant (WWTP) Construction Project.

In the Minutes of Meetings between HPC and JICA, on 2nd March, 2011, HPC and JICA agreed upon the scope of works of the Preliminary PPP Study for Yen Xa WWTP Construction Project.

In the letter (No.: 1887/UBND-KHDT) issued by HPC on 21st March, 2011, HPC assigned relevant organizations to perform necessary actions for the Preliminary PPP Study for Yen Xa WWTP Construction Project, as presented below;

- To assign the Department of Construction (DOC) to be main partner for the Preliminary PPP Study for Yen Xa WWTP Construction Project, to undertake HPC’s tasks specified in the Memorandum and, to instruct the Hanoi Drainage Project Management Board (PMB) to cooperate and support the JICA Study Team during the implementation process.
- To assign the Hanoi Authority for Planning and Investment (HAPI) to proceed project registration formalities in accordance with the applicable regulations on management of ODA Loan, to coordinate with DOC and other relevant offices in performance of assigned responsibilities and authority.
- Other relevant offices shall be responsible for coordination and support to the JICA Study Team during the course of project implementation.

1.1.2 Objectives of the Study

(1) Original Objectives

The title of the Study is “Preparatory Study on Project for Yen Xa Wastewater Treatment Plant in Hanoi” (herein referred as the Study), and the original scope of the Project consisted of the constructions of 1) Pipe Network, 2) Yen Xa Wastewater Treatment Plant and 3) Bio-solid Processing Facilities for dewatered sludge to be generated in Yen Xa WWTP. The original objective is to study the possibility of utilization of private fund for implementation of the Project. (Refer to Table 1.1.1)

Table 1.1.1 Scope of Study on Yen Xa WWTP Construction Project

	Construction	O&M
1) Pipe Network	○	○
2) Yen Xa WWTP	○	○
3) Sludge Processing Facility	○	○

Source: JICA Study Team

(2) Additional Objectives

After many discussions with relevant Vietnamese organizations and JICA, the additional objectives of the Study have been prepared as below;

- 1) Study on the establishment of O&M Company for five WWTPs (Yen So WWTP, Ho Tay WWTP, Bay Mau WWTP, Phu Do WWTP and Yen Xa WWTP) and Yen So Bio-solid Processing Center (BPC), and negotiation with Hanoi Sewerage and Drainage Company (HSDC) on the conditions of establishment of the O&M Company to be established by HSDC and related Japanese companies. (Refer to Table 1.1.2)
- 2) Study on sludge processing in Hanoi, and propose a BOT scheme project of Yen So BPC. (Refer to Table 1.1.2)

Table 1.1.2 Scope of Study on Sewerage System Development in Hanoi

	Construction	O&M
1) Five WWTPs	-	Establishment of O&M Joint Company
2) Yen So BPC	BOT Scheme Project	

Source: JICA Study Team

1.2 Current Situation of Wastewater Treatment and Sludge Disposal in Hanoi

1.2.1 Sewerage System Development in Hanoi

Hanoi City is the capital of the Socialist Republic of Vietnam, the center of politics, economy and culture of the country. The urbanization speed of the capital has continuously accelerated during the past years. However, the development of the infrastructure including urban sewerage and drainage system is slower than the urbanization.

At present, the wastewater of the city is collected through the pipeline, culvert and channel system and then discharged into channels, lakes and four major rivers, namely Kim Nguu, Set, To Lich and Lu Rivers. Such wastewater disposal methods have seriously polluted the water environment of these channels, lakes and rivers, and deteriorated the sanitary and the living condition of Hanoi City, especially in dry seasons when only wastewater is flowing in these rivers and channels. Due to wastewater infiltration, the risk of groundwater pollution is also rather high. In addition, Hanoi City is a large source of pollution to the Red River and the Nhue River because of un-treated wastewater discharge.

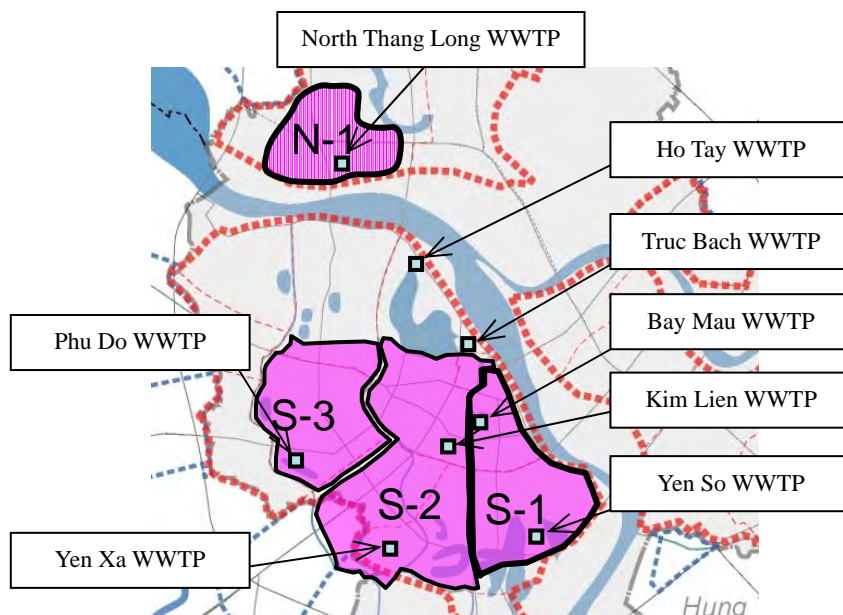
In order to improve these environmental situations, it is strongly required to immediately provide suitable wastewater treatment capacity to meet large amount of wastewater generated in Hanoi. However, a comprehensive public wastewater treatment system for the whole of Hanoi City has not been established to date.

Only small-scale systems have been established and operated, such as: two pilot projects at Truc Bach WWTP and Kim Lien WWTP, whose treatment capacities are 3,000 and 4,800 m³/day respectively, and North Thang Long WWTP with a treatment capacity of 38,000m³/day. These WWTPs were constructed through an ODA loan project. Bay Mau Lake WWTP with treatment capacity of 14,000 m³/day is now in the stage of detailed design/ implementation, and will be operated starting 2014. It is also an ODA loan project.

However, large-scale systems are planned to be established. Yen So WWTP with a capacity of 200,000 m³/day is now under construction and will be operated from April, 2012. It is an build transfer (BT) project carried out by Gamuda (a Malaysian private company). Yen Xa WWTP with a capacity of 270,000 m³/day is now under financial arrangement stage and is planned to be completed in 2017. It is supposed to be an ODA loan project. The completion of these WWTPs will rapidly increase wastewater treatment capacity in Hanoi.

In addition, Phu Do and Ho Tay WWTPs, whose treatment capacities are 84,000 m³/day and 15,000 m³/day respectively, are planned to be constructed through the BT scheme. The investor of Phu Do WWTP is a joint company of Phu Dien, SFC Vietnam and Royal Securities, while

the investor of Ho Tay WWTP is a joint company of Phu Dien and SFC Vietnam.



Source: JICA Study Team

Figure 1.2.1 Location of WWTPs in Hanoi

Table 1.2.1 Summary Data of Wastewater Treatment Plants in Hanoi

WWTP		Capacity (m ³ /day)	Basin	Situation	Financial Source	Expected Operation Start Year
1	Truc Bach	2,300	-	Operation	ODA	-
2	Yen So	200,000	S-1	Construction	BT	2012
3	Bay Mau	14,000		Waiting for EPC	ODA	2014
4	Kim Lien	3,700		Operation	ODA	-
5	Yen Xa	270,000	S-2	Financial Arrangement	ODA	2018
6	Phu Do	84,000	S-3	Waiting for EPC	BT	2016
7	North Thang Long	42,000	-	Operation	ODA	-
8	Ho Tay	15,000	-	Waiting for EPC	BT	2014
Total		631,000				

Source: JICA Study Team

1.2.2 Wastewater and Sludge Generation Forecast

With the rapid increase of wastewater treatment capacities in Hanoi in the future, as shown in Figure 1.2.1, the amount of sludge generation will also increase. Figure 1.2.2 shows the forecast of sludge generation amount, for eight wastewater treatment plants, namely, Truc Bach, Kim Lien, North Thang Long, Yen So, Bay Mau, Ho Tay, Phu Do and Yen Xa WWTPs.

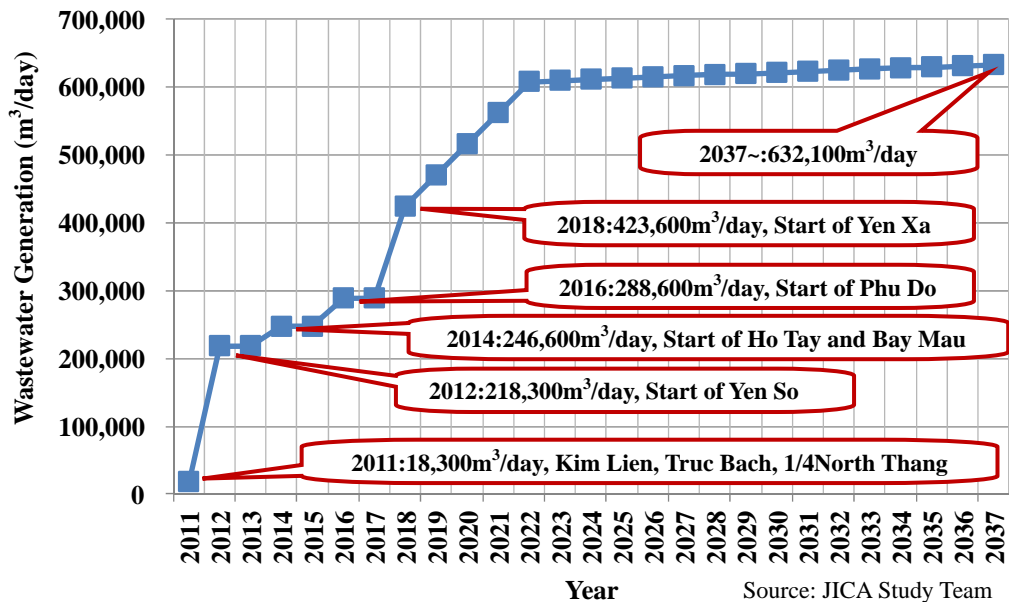


Figure 1.2.1 Forecast of Wastewater Treatment Amount in Hanoi

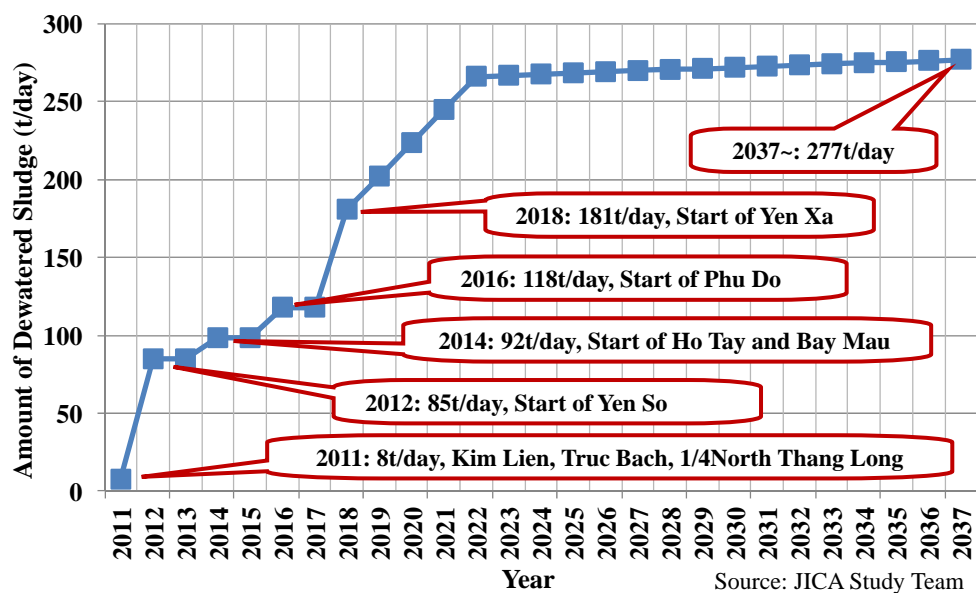


Figure 1.2.2 Sludge Generation Forecast

The sludge generated from current operating WWTPs are disposed at Nam Son Landfill site and Tieu Ky disposal site. The proposed extension of Nam Son Phase 2 will not accept sludge waste. Though HAPA is now carrying out a study on permanent sludge disposal site, there is still no conclusion. Finding a disposal site within the city limit or its vicinity for the entire amount of future sludge seems to be almost impossible. Under these situations, it is required to reduce the amount of sludge waste and promote sludge processing (reuse/recycle). This will increase the service life of scarce landfill site, ensure proper sludge management and enhance sludge reuse/ recycle.

1.3 Financial Source for Sewerage System Development

1.3.1 General

Under the ODA and BT schemes, the HPC is not required to bear the initial construction costs, but only the O&M, repair, and replacement costs. The annual service charge for the full operation of the 5 WWTPs is estimated at US\$ 0.248/m³ on the average.

Under the BOT scheme, the HPC should bear all costs. The annual service charge for the BPC is estimated at around 133 US\$ per 1ton of dewatered sludge, which is equivalent to US\$ 0.058/m³ of wastewater treatment.

It can be considered that the financial sources of the above service charges come from the sewerage tariff income and HPC general budget.

1.3.2 Current Sewerage Tariff System

Table 1.3.1 and 1.3.2 shows the water and sewerage tariff structure for both domestic and non domestic uses. Even if the water user is not connected to the sewerage system, the environmental protection fee is charged at 10% of the water tariff. In the Study, the environmental protection fee is called as “Sewerage Tariff”, because it is allowed for wastewater treatment. The current sewerage tariffs are set between US\$ 0.017 and 0.050 /m³ (VND 347 – 1043/m³). The average tariff level is estimated at around US\$ 0.020/m³.

If the service charge for the five WWTPs is paid by the sewerage tariff income, the sewerage tariff should be increased by around 12 times. However, it seems be un-realistic at present.

Table 1.3.1 Water and Sewerage Tariff for Domestic Use(unit: VND/m³)

No.	Water Usage Level of Household (m ³ /month/HH)	Tariff before Tax & Fee	VAT (5%)	Environmental Protection Fee/ Sewerage Tariff (10%)	Payment Tariff
1	First 16m ³	3,478.26	173.91	347.83	4,000
2	Above 16m ³ to 20m ³	4,086.96	204.35	408.70	4,700
3	Above 20m ³ to 35m ³	4,956.52	247.83	495.65	5,700
4	Above 35m ³	8,173.91	408.70	817.39	9,400

Source: Decision No. 119/2009/QĐ-UBND

Table 1.3.2 Water and Sewerage Tariff for Non-domestic Use(Unit VND/m³)

No.	Usage Purpose	Tariff before Tax & fee	VAT (5%)	Environmental Protection Fee/ Sewerage Tariff (10%)	Payment Tariff
1	Water usage for Administrative organizations	4,956.52	247.83	495.65	5,700
2	Water usage for Implementation organizations	4,956.52	247.83	495.65	5,700
3	Water usage for public purpose	4,086.96	204.35	408.70	4,700
4	Water usage for Manufacturing units	6,086.96	304.35	608.70	7,000
5	Water usage for Business and Service units	10,434.78	521.74	1,043.48	12,000

Source: Decision No. 120/2009/QĐ-UBND

1.3.3 Financial Situation of HPC and Affordability of Sewerage Sector

(1) Overview of Financial Situation of HPC

Table 1.3.3 summarizes the estimated budget (revenues and expenditures) for Hanoi Province and city from 2010 to 2012.

Based on the table, the revenue for the state budget in the province increases by approximately 28% p.a. for the past 3 years. Of the revenue for the state budget, 35% to 40% was allocated to the equated expenditure with the local budget. The amount of the equated expenditure with the local budget in 2012 was estimated at VND 53.4 trillion (USD 2,545 million, using 21,000 VND/USD as exchange rate hereinafter). The amount of the equated expenditure with the local budget allocated to HPC (Hanoi city) in 2012 was VND 32.0 trillion (USD 1,524 million).

Among the sub-items of expenditure, the expenditure for investment and development and the frequently expenditure are two major sub-items. The percentages of amounts of the two

sub-items both exceed 40% in 2012 budget. In the HPC (Hanoi city) level, the amounts of the two sub-items are approximately VND 14 trillion (USD 700 million) each.

(2) Affordability for Sewerage Sector

Under the condition of full operation of the 5 WWTPs and the BPC (from 2022), the annual service charge for the O&M Joint Company (JC) and the BOT Project was estimated at around US\$ 66 million (2011 price), which is around 4% of the annual budget of HSDC in 2012. This indicate that costs necessary to maintain the five WWTPs and the BPC were not estimated to have a significant share in the HPC's budget, and be absorbed in the increase of the fiscal revenue of HPC.

Table 1.3.3 Summary of HPC Budget (2010, 2011 and 2012)

Source: HPC

	(Unit: Billion VND)					
	Total			HPC		
	Estimation in 2010	Estimation in 2011	Estimation in 2012	Estimation in 2010	Estimation in 2011	Estimation in 2012
Revenue						share
REVENUE FOR THE STATE BUDGET IN THE PROVINCE						
(Growth %)						
Revenue from export and import activities	7,620	10,600	10,850			7.4%
Domestic revenue	76,027	101,666	131,915			90.2%
Revenue from crude oil	5,100	3,200	3,500			2.4%
Budget revenue in province	34,831	43,614	53,440			36.5%
(Growth %)		25.2%	22.5%			
Expenditure						
Equated expenditure with the local budget	34,831	43,614	53,440	23,501	27,837	32,011
Expenditure for investment and development	15,316	18,249	22,142	12,489	13,745	14,831
Expenditure for due-loans	1,270	560	10	1,270	560	10
Reimbursement for housing and land	70	82	150	70	82	150
Frequently expenditure	14,759	21,431	26,638	9,567	11,380	14,174
Creation of source for wage reform(3)	1,051	650	2,886	586	650	1,548
Reserve budget	-	1,088	1,604	-	839	1,287
Budget repayment for upper level	-	1,544	-	-26	1,544	-
Reserve budget (2)	1,000	-	-	770	-974	-
Expenditure for local goal programs and national goal programs	1,354	-	-	1,354	-	-
Expenditure from the added source and other tasks from the budget of the city	-	-	-	-2,591	-	-
Expenditure for financial fund	10	10	10	10	10	10
Expenditure through revenue of the budget management	1,507	1,804	2,078	1,507	1,804	2,078
						6.5%

Chapter 2 Outline of Project Scheme

2.1 Necessity of Projects

As described in Chapter 1, in order to improve the environmental condition in Hanoi, five new wastewater treatment plants are planned to be constructed in Hanoi. Accordingly the total wastewater treatment capacity will be increased from the current 48,000 m³/day to 631,000 m³/day. In the view of this, large amount of sludge will be generated, however no permanent sludge disposal site has been located, and a temporary disposal site is still used reluctantly. Under these situations, the following issues shall be considered.

- Smooth implementation of wastewater treatment plants development (particularly, Yen Xa WWTP, because other plants are under implementation)
- Establishment of suitable operation and maintenance system for new developing wastewater treatment plants in Hanoi, especially two large scale wastewater treatment plants; Yen Xa and Yen So WWTPs, which cover 74% of the total capacity.
- Establishment of a sludge processing system, in order to reduce sludge generation amount and promote sludge recycling

2.2 Study on Yen Xa WWTP Construction Project

2.2.1 Availability of Financial Source (ODA loan, private Fund, etc.)

(1) Possible Financial Sources

The possible financial sources could be considered as below;

Table 2.2.1 Public and Private Financial Sources Options

	Interest Rate	Repayment Period	Possibility
(1) Public Fund Option			
1) Government Subsidy (ODA Loan)	-	-	Possible, if JICA will provide ODA loan.
2) HPC General Account	-	-	No plan
3) Hanoi City Bond	VND: 15%(?)	5- 15 years	Difficult to issue it
(2) Private Fund Option			
4) Private Financing (Foreign Banks)	US\$: 5-7%	5-15 years	Possible to consider it
5) Private Financing (Local Banks)	VND: 15%	5-15 years	Possible to consider it
6) PSIF (Direct Lending to SPC)	JPY: 2-3%	20-25years	Possible to consider it
7) PSIF (Two Step Loan)	VND: 15.5%	20-25 years	Possible to consider it

Source: JICA Study Team

Government Subsidy/ ODA loan

In case that the Vietnamese central government subsidizes construction of large scale infrastructure to HPC, the government has to arrange a low interest loan from foreign countries, such as Japanese ODA loan.

The ODA loan is long term loan provided by the Japanese Government. The borrower of ODA loan is in principle limited to governments. Therefore, if the government subsidy is required, the government shall borrow the ODA loan, and make HPC to construct the infrastructure with the ODA loan, and shall transfer the assets to HPC at completion of the Project. The successful loan arrangement is the condition of the government subsidy for the Project.

HPC General Account/ Hanoi Municipality Bond

The HPC has issued the municipal bond several times, of which repayment period is not long (not more than 15 years), and now it is difficult to issue it, because of lack of acceptance market of municipal bond in Vietnam.

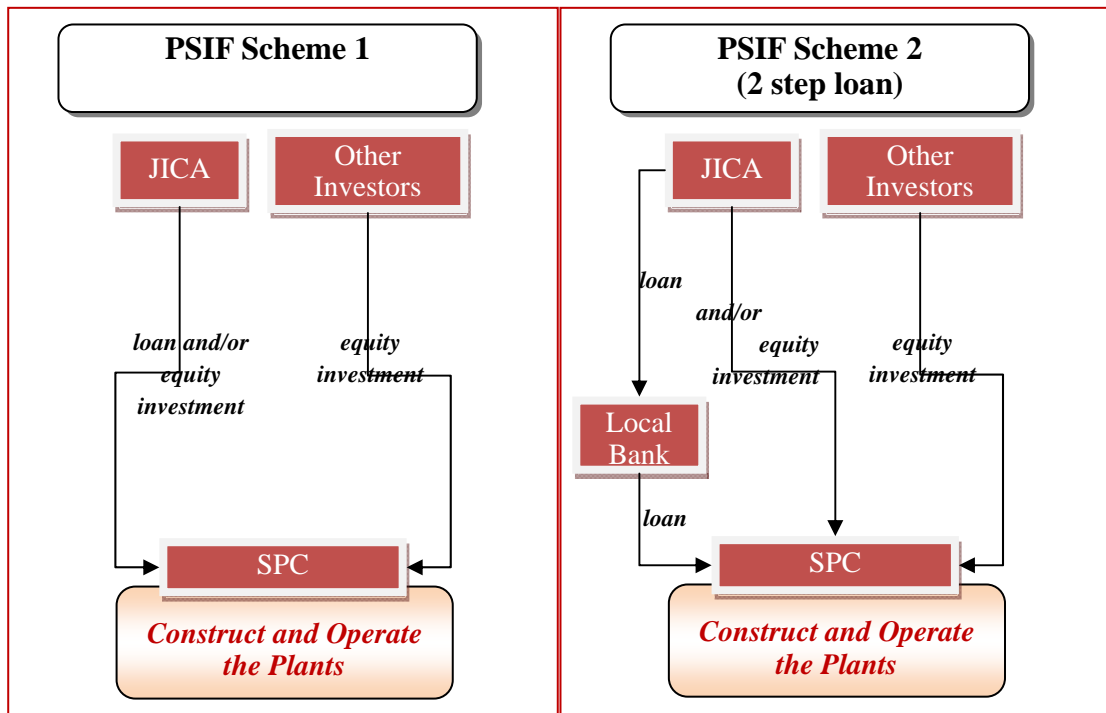
So far, HPC does not consider expenditure from HPC General Account and issue of Municipal Bond for initial investment of the sewerage system development. The HPC general account and the Hanoi municipality bond seem not suitable for financial source of the Project

PSIF (Private Sector Investment Fund)

PSIF is JICA's financing program under which JICA shall provide long term loan or make equity investment to private sector entities. The maximum tenor of the loan is said to be 25 years with 5 years' grace period. In case of the equity investment, it appears that the maximum shareholding percentage of JICA through PSIF does not exceed 25%. The currency of the PSIF is limited to Japanese Yen. This, however, does not necessarily mean that the yen loan is always provided to the private sector entities. JICA may provide PSIF financing to the local bank, which provide financing to the private sector entities. This scheme is called "2 step loan". In this 2 step loan scheme, the currency of the loan to be provided by the local bank may be the local currency.

If PSIF is used to fund the initial investment of the infrastructure, an SPC (special purpose company) to construct and operate the infrastructure may need to be established and the SPC shall obtain financing and/or equity investment under the PSIF scheme.

The following charts illustrate the 2 schemes under which PSIF shall be provided.



Source: JICA Study Team

Figure 2.2.1 Two Types of PSIF Scheme

Private Financing

Private financing from foreign or domestic banks or investors may also be one of the possible financial sources. In this case, such foreign or domestic banks or investors are supposed to lend money or make investment to the entity to construct and operate the plants. Like the “PSIF” case as described above, an SPC (special purpose company) may need to be established and the SPC shall obtain financing and/or equity investment under this scheme.

In general sense, a private fund is more expensive than public fund, because private fund shall bear risk premium of project implementation by themselves.

With regard to the type of the private equity investors, there are roughly two types of investors, namely, strategic investors and financial investors. Strategic investors usually regard it more important to expand their business by making equity investments in entities or projects. On the other hand, financial investors usually regard it more important to get equity return. Strategic investors are usually engaged to actual business, while financial investors typically function as “fund managers” which gather money from individuals or corporations, invest it to equity investments, get return from such investments within certain period of time, and distribute the return to the individuals and corporations.

(2) Consideration on Financial Sources for Financing

Table 2.2.2 illustrates comparison of the possible loan sources. Note that PSIF is divided

into two categories (Direct Lending and two step loan), and Private financing is also divided into two (Foreign bank loan and Local bank loan). In the table, we tried to evaluate item by item the features of each financial source and put the colors for each item according to the criteria (such as “Most favorable”, “Favorable”, “Neutral/ Unable to evaluation”, “May not be favorable”), from the viewpoint of favorability to the project.

Based on the evaluation, ODA loan could be regarded as one of the most favorable financing source, since i) it could be provided with very long tenor and low interest rate and ii) it may be the most common source for Vietnamese Government to fund the infrastructure projects. However, there are also several conditions in order to utilize ODA loan for a project. First, feasibility study must be completed before signing the ODA loan agreement for the project. Second, the project must be regarded as “high priority” project in the Vietnamese Government if ODA loan is used for the project. In addition, ODA loan is the loan to the Vietnamese government. This means that ODA loan is counted as the public debt of Vietnamese government, and that it always has responsibility to fully repay the loan even in case the project does not work well. On the other hand, PSIF, which could also be regarded as favorable financing source (although may not be so favorable as ODA loan), is the loan to the project, not to the government. This would mean that PSIF may not be repaid if the project does not work well and does not bear cash flow as originally designated.

Considering the above, choice of loan sources may be considered as follows:

- If a project is regarded as a “high priority” project by Vietnamese Government, and feasibility study was finished, ODA loan may be considered as first choice of financing sources. We consider that YenXa WWTP project would meet these conditions.
- If a project is not regarded as a “high priority” project by Vietnamese Government, or feasibility study was not finished, PSIF may be considered as first choice of financing sources.

(3) Consideration on Financial Sources for Equity investment

Table 2.1.3 illustrates comparison of the possible sources of equity investment. Note that ODA loan and Hanoi City Bond are not included here because these sources do not include equity investment. Similarly, note that equity investment would be necessary only if PSIF or private loan by foreign/domestic banks is selected as the source of loan.

In the table, private financing (private equity investment) is divided into two (Strategic investors and financial investors). Like “loan sources” as discussed above, we tried to evaluate item by item the features of each financial source and put the colors for each item according to the criteria (such as “Most favorable”, “Favorable”, “Neutral/ Unable to evaluation”, “May not be favorable”), from the viewpoint of favorability to the project.

Based on the evaluation and among the three possible sources of equity investment, financial investors' investment may be first excluded, since this would not be realistic and would not have merits.

Between the other 2 sources, namely, PSIF equity investment and strategic investors' equity investment, PSIF would possibly require lower return. But availability of PSIF as the source of equity investment would be limited.

Considering the comparison discussed above, the investment of strategic investors may be considered as the first choice of sources of equity investment. Since Japanese strategic investors are interested in the construction and operation of the sludge processing project, to obtain equity investment from those investors (and to obtain PSIF for the loan portion) would be the realistic choice to materialize the sludge processing project.

Table 2.2.2 Financing Sources - Loan

Financial Source	ODA loan	PSIF (Direct Lending to SPC)	PSIF (2 Step Loan)	Hanoi City Bond	Private Financing (Foreign Banks)	Private Financing (Local Banks)
Tenor	Very Long (max: 40 years)	Long (max: 25 years)	Long (max:25 years but depending on the local bank)	Medium (** years as per the bond in 20xx)	Long/Medium (may not be longer than 20 years)	Medium/Short (may be shorter than foreign banks' loan)
Currency of loan	JPY	JPY	VDN	VDN	USD/JPY	VDN
Interest Rate	Very Low (around 1%)	Low (1.8% plus margin)	Medium/High (may be between 10 to 15 %)	Medium	Medium (may be around 5 to 7% in case USD)	High (may be around 15% or higher)
Availability	Subject to priority of the project for Vietnamese Government	Available as long as economically viable	Available as long as economically viable and acceptable by local bank	May take longer time for issuance	May take longer time to find banks	May take longer time to find banks
Other Remarks	The loan constitutes the debt of the Vietnamese government		If local banks have few experience of project, this scheme may be difficult.			If local banks have few experience of project, this scheme may be difficult.

Remarks: * Data for “ODA loan” is from JICA’s home page

* Interest rate for PSIF is from Japanese MOF’s home page (Interest Rate for 25 years’ Fiscal Investment and Loan Program)

* Above data are estimates from the current financial market and shall change. It is not certain that one can secure financial sources based on the conditions above.

* The colors in each item mean the following (based on our “trial” base evaluation)

Most favorable	Favorable	Neutral / Unable to evaluate	May not be favorable
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Source: JICA Study Team

Table 2.2.3 Financing Sources – Equity Investment

Financial Source	PSIF	Private Financing (Strategic Investors)	Private Financing (Financial Investors)
Required return	Low/Moderate (As a governmental agency, required return may be low or moderate.)	Moderate/High (Depending on the position of the project in light of the business strategy of the investor)	High (Since the return of investment is the main purpose of investment, high return may be required.)
Period of investment	Long/Middle (As a governmental agency, relatively long term investment would be expected, although depending on the exit strategy)	Long/Middle (As a business partner, relatively long term investment would be expected, although depending on the exit strategy)	Middle/Short (Depending on the requirement of the fund, exit in a short period may occur.)
Transfer of know how	Middle (Certain transfer of know how may be expected, although transfer of business know how may be limited.)	High (As a business partner, transfer of know how may be expected)	Low (Basically, transfer of know how may not be expected)
Availability	Limited if PSIF loan is used If PSIF loan is used as the funding source of the project, availability of PFIF equity investment may be limited) In addition, investment may possibly be minor.	High if strategic investor is positive (If there are strategic investors who are positive to materialize the project, possibility would be high to obtain equity investment from them)	Low (Financial market in Vietnam might need to be developed further to smoothly obtain investments from financial investors.)

Remarks: * Above data are estimates from the current financial market and shall change. It is not certain that one can secure financial sources based on the conditions above.

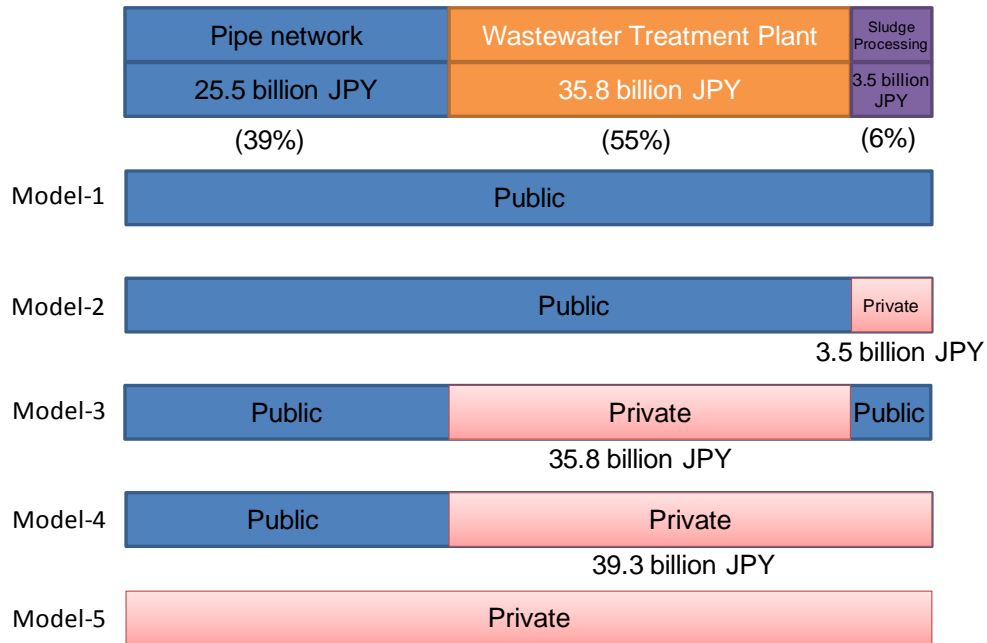
* The colors in each item mean the following (based on our “trial” base evaluation)

Most favorable	Favorable	Neutral / Unable to evaluate	May not be favorable
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Source: JICA Study Team

2.2.2 Alternative Study on Combination of Private and Public Sector

The Project is divided into three portions, “Pipe Network”, “Wastewater Treatment Plant” and “Sludge Processing Facility”. JICA Study Team provided PPP 5 Models for alternative study to select portions to be carried out by private sector.



Source: JICA Study Team

Figure 2.2.2 Scope Sharing and Costs of PPP 5 Models

In the progress of the Study, The Study Team proposed Model-4 as the best option for the PPP scheme of the Project, because of the following reasons;

- 1) The policy of Vietnamese Government does not prefer to use public funds for all of the initial investment cost of the Project. In order to reduce amount of public debts, and introduce effective management of private sector, it is preferred to use certain amount of private fund for the initial investment.
- 2) The construction and management of pipe network portion is not suitable for private sector. The pipe network has not only function of wastewater collection, but also has function of rainwater drainage for keeping safety life in Hanoi. In addition, private sector can hardly to control road traffic and road condition during construction stage, and can hardly utilize their know-how and technologies during operation period in the field.
- 3) On the other hand, effectiveness of wastewater treatment is highly depending on technology and know-how to be applied, private sector is expected to contribute effective construction and management. It is expected to reduce total life cycle cost and safety operation by using competent private companies for construction and

management.

- 4) HPC hopes participation of private companies in the field of construction and management of sludge recycling facility by using high technology and know-how with long term experience, particularly in Japan.

The Project of Yen Xa Wastewater Treatment Plant includes the constructions of 1) Pipe Network, 2) Yen Xa Wastewater Treatment Plant and 3) Sludge Processing Facility. As a conclusion of many discussions in the Study, it is proposed that the project will be constructed and operated by the following scheme:

Table 2.2.4 Implementation of Yen Xa WWTP Construction Project

Model-1

	Construction	O&M
1) Pipe Networks	Contractor to be selected under ODA Scheme	HSDC
2) Yen Xa WWTP		O&M Company to be appointed by HPC
3) Sludge Processing Facility		

Model-2

	Construction	O&M
1) Pipe Networks	Contractor to be selected under ODA Scheme	HSDC
2) Yen Xa WWTP		O&M Company to be appointed by HPC
3) Sludge Processing Facility	SPC to be selected under BOD Scheme	

Model-3

	Construction	O&M
1) Pipe Networks	Contractor to be selected under ODA Scheme	HSDC
2) Yen Xa WWTP	SPC to be selected under BOD Scheme	
3) Sludge Processing Facility	Contractor to be selected under ODA Scheme	O&M Company to be appointed by HPC

Model-4

	Construction	O&M
1) Pipe Networks	Contractor to be selected under ODA Scheme	HSDC
2) Yen Xa WWTP	SPC to be selected under BOD Scheme	
3) Sludge Processing Facility		

Model-5

	Construction	O&M
1) Pipe Networks	SPC to be selected under BOD Scheme	
2) Yen Xa WWTP		
3) Sludge Processing Facility		

Source: JICA Study Team

2.3 Consideration of Sewerage System Development in Overall Hanoi

2.3.1 Proposal for Overall Hanoi

As shown in Tables 2.3.1 and 2.3.2, three WWTPs have been operated, and four WWTPs are under implementation stage. In Section 5.1, only “Ye Xa WWTP Construction Project” is focused and discussed. Considering sewerage system in overall Hanoi, it is required to consider establishment of O&M system for five WWTPs (Yen So, Ho Tay, Bai Mau, Phu Do and Yen Xa) that is planned to be constructed by 2018, and sludge recycling project to receive dewatered sludge from all WWTPs shown in Table 2.3.1-1.

As for wastewater pipe network in Hanoi, it is planned to be developed by public works of HPC.

Table 2.3.1 Development Schedule of WWTP in Hanoi

WWTP		Capacity (m ³ /day)	Situation	Scheme	Commencement of Operation
Under Operation					
1	Truc Back	3,000	Operating	ODA	-
2	Kim Lien	4,800	Operating	ODA	-
3	North Thang Long	42,000	Operating	ODA	-
Implementation of Project					
4	Yen So	200,000	Under Construction	BT	2012
5	Ho Tay	15,000	Signing of Contract	BT	2013
6	Bai Mau	13,300	Bidding	ODA	2014
7	Phu Do	84,000	Signing of Contract	BT	2015
Under Study					
8	Yen Xa	270,000		ODA	2018
Total		632,100			

Source: JICA Study Team

The Study focus on the following issues;

- 1) Construction target is “Wastewater Collection Network” and “Wastewater Treatment Plant” in Ten Xa WWTP Construction Project, and “Yen So Bio-Solid Processing Center”
- 2) O&M target is five WWTPs (Yen So WWTP, Bai Mau WWTP, Phu Do WWTP, Ho Tay WWTP, Yen Xa WWTP) and one Bio-Solid Processing Center.
- 3) Target of sludge in sludge recycling project is sludge generated from eight WWTPs (Truc Back WWTP, Kim Lien WWTP, North Thang Long WWTP, Yen So WWTP, Bai Mau WWTP, Phu Do WWTP, Ho Tay WWTP, Yen Xa WWTP)

As the conclusion of the studies mentioned in Sections 5.2.3, 5.2.4 and 5.2.5, the following project scheme is proposed for effective and smooth implementation of sewerage system development.

Table 2.3.2 Proposal of Japanese Private Company Participation

Target	Construction Stage	O&M Stage
Yen Xa WWTP	To be constructed under ODA Loan Scheme	New O&M Joint Company to be established by HSDC and Japanese Private Company
Yen So WWTP	Under construction under BT Scheme	
Bai Mau WWTP	To be constructed under ODA Loan Scheme	
Phu Do WWTP	To be constructed under BT Scheme	
Ho Tay WWTP	To be constructed under BT Scheme	
Bio-Solid Processing Center	Contractor to be appointed by SPC, which will be established by Japanese Private Company	O&M Company to be appointed by the SPC

Source: JICA Study Team

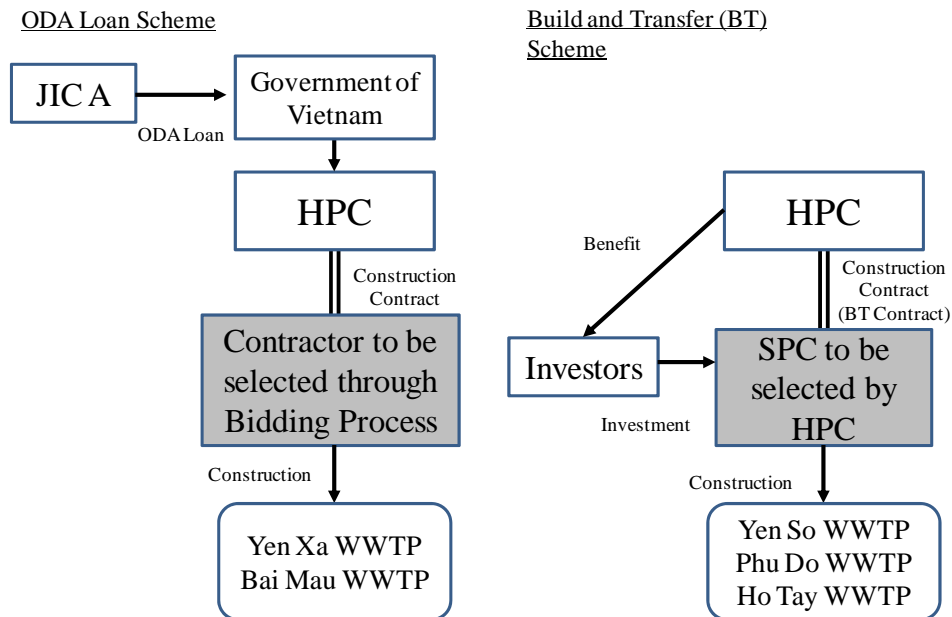
HPC intends to apply ODA Loan for construction of Yen Xa WWTP, and request MPI for financial arrangement for it. To give advantage to the Yen Xa WWTP Project for selection of ODA loan project, it is preferable that Japanese private company would participate in O&M of Yen Xa WWTP and BOT project of Sludge recycling facility.

In order to realize effective development and operation of sewerage system development in Hanoi, the Study Team has carried out the study on the following projects;

- ✓ Implementation of Yen Xa WWTP Construction Project (including construction of Wastewater Collection Network and WWTP) under ODA Loan scheme
- ✓ Establishment of O&M Joint Company with HSDC
- ✓ Implementation of BOT Project for Sludge Recycling

2.3.2 Option of Construction Project Scheme of Wastewater Treatment Plan

As shown in Table 2.3.1-2, Yen Xa WWTP and Bai Mau WWTP are planned to be constructed by ODA loan scheme, and Yen So WWTP, Ho Tay WWTP and Phu Do WWTP are planned to be constructed by BT scheme. The organization chart for both schemes are shown in Figure 2.3.2-1.



Source: JICA Study Team

**Figure 2.3.1 Organization Chart for Construction
under ODA Scheme and BT Scheme**

2.3.3 Option for Establishment of O&M Company

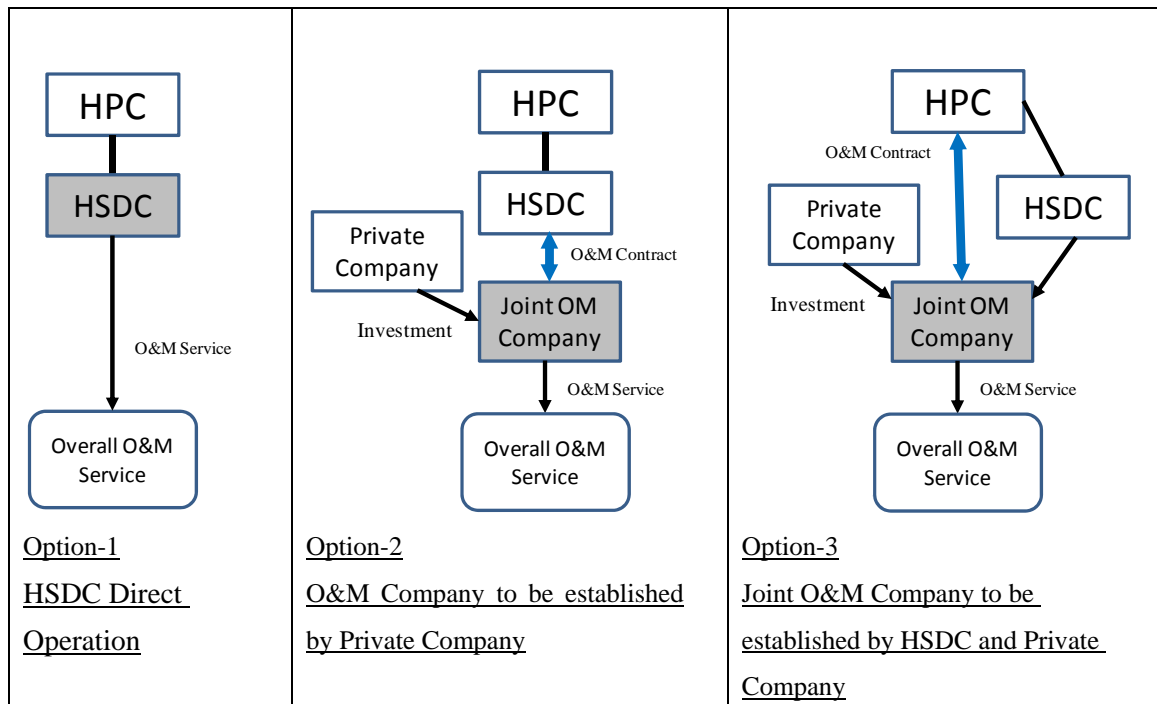
For effective and successful operation and maintenance of Yen So WWTP, Yen Xa WWTP and sludge recycling facility, one organization had better to manage overall operation, because each operation works are closely related, and high technical skill and knowledge are required for the overall operation and maintenance.

There are several options of establishment of O&M company as below

Option-1 HSDC Direct Operation

Option-2 Joint Company to be established by HPC (HSDC on behalf of HPC) and private companies (including Japanese private company)

Option-3 Joint company to be established by private companies (including Japanese Companies), of which operation is under contract with HSDC



Source: JICA Study Team

Figure 2.3.2 Options of Establishment of O&M Company

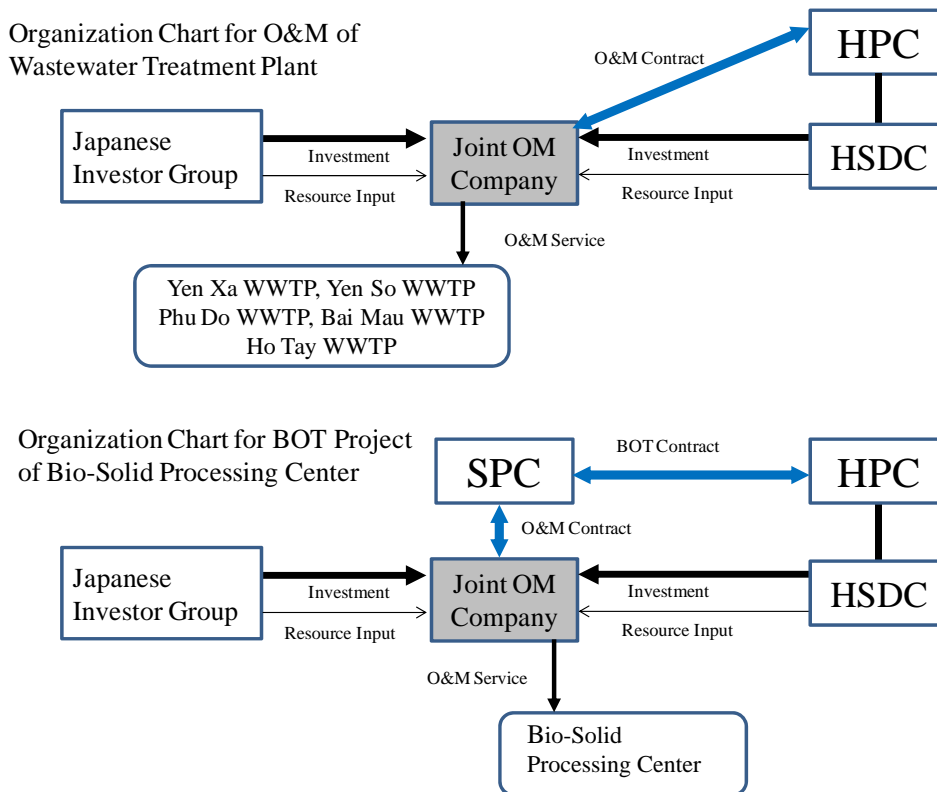
The Study Team proposed Option-3, because of the following advantages of Option-3. HPC basically agreed on this idea, and issued the letter on 1st December, 2011, which assigned HSDC to study and propose options for establishing a Joint Company with the participation of a Japanese company to do O&M of Yen Xa WWTP and other WWTPs in Hanoi

The advantages of Option-3 are recognized as below;

- ✓ Utilization of high technical and management skill and know-how from Japanese private companies
- ✓ Easy acceptance of technical transfer from Japanese Public Sector
- ✓ Utilization of human resources and know-how of HSDC
- ✓ High possibility of business development to the fields of O&M service in other municipalities, engineering service, training service and construction works

2.3.4 Option of Scope of Works of O&M Joint Company

The scope of service of the JC, which are considered, can be divided into two types of works. One is O&M of wastewater treatment plants, which will be under contract with HSDC, and another is O&M of Bio-Solid Processing Center, which will be under contract with SPC for the BOT project for Sludge Recycling Project. (See Figure 5.2.4-1)



Source: JICA Study Team

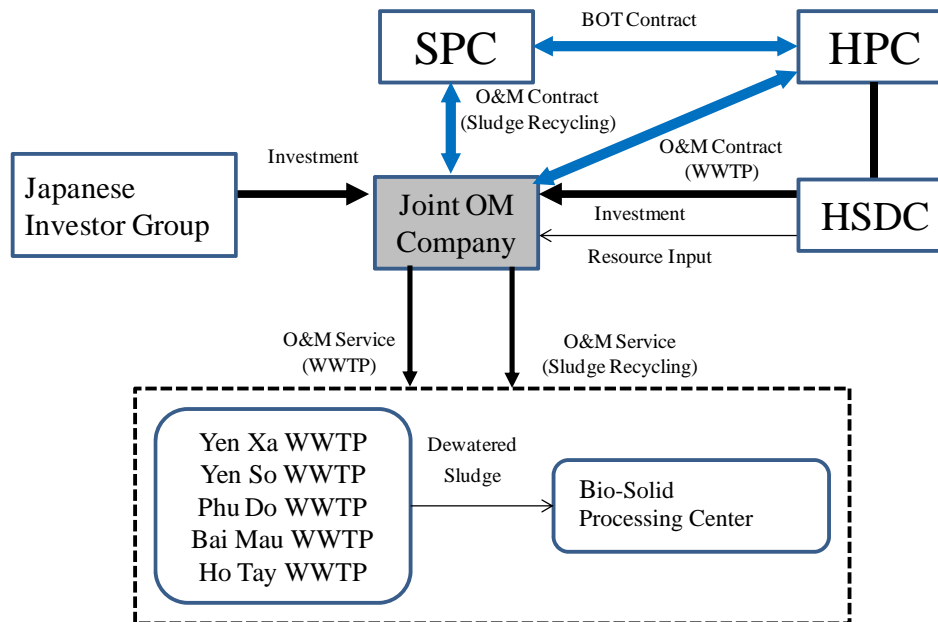
Figure 2.3.3 Organization Charts for O&M Service for WWTPs and Bio-Solid Processing Center

There are two points to be discussed as below;

- 1) Merits and demerits of the cases of “One company will manage O&M of WWTPs and Bio-Solid Processing Center” and “Two different companies will manage O&M of WWTPs and Bio-Solid Processing Center, respectively”
- 2) Merits and demerits of the cases of “SPC will manage O&M of Bio-Solid Processing Center by themselves.” and “SPC will subcontract O&M service of Bio-Solid Processing Center.”

The Study Team proposes the option “one company will manage O&M of WWTPs and Bio-Solid Processing Center”, because the option has larger merit than another option in the sense of effective O&M. However, it depends on decision of SPC to be selected for the BOT Project.

Figure 2.3.4 shows the organization structure in the case “the JC manage the O&M works of both facilities”.



Source: JICA Study Team

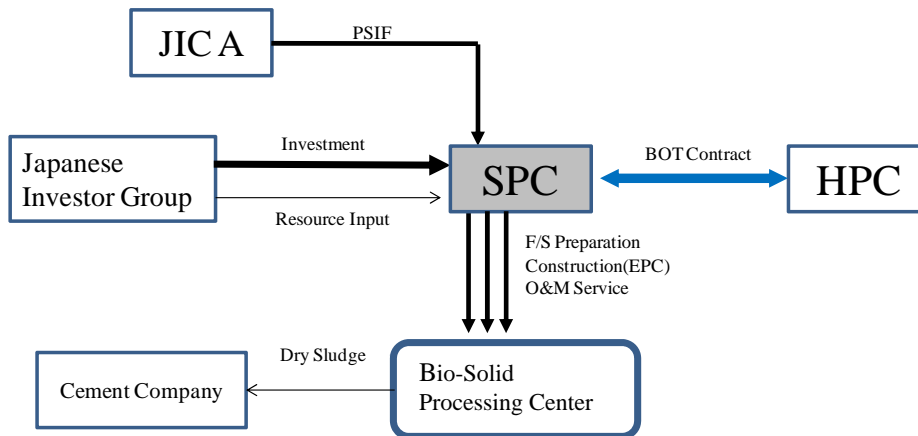
Figure 2.3.4 Organization Charts for O&M Service for WWTPs and Bio-Solid Processing Center

2.3.5 Options of Implementation of Sludge Recycling Project

The BOT scheme is proposed for the sludge recycling facility project, considering the following reasons;

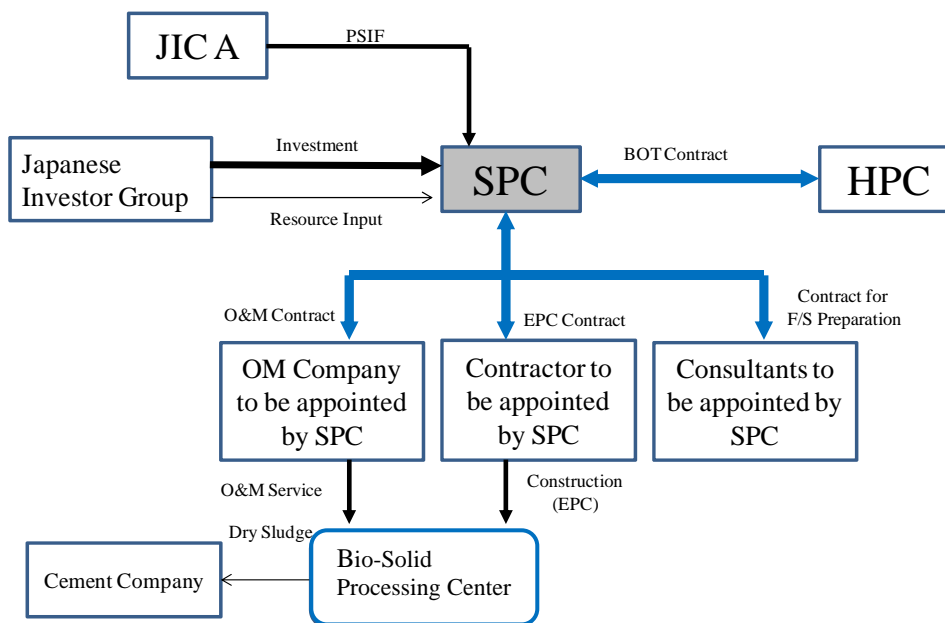
- ✓ Initial investment cost could be provided by private companies
- ✓ HPC is requested to pay back the investment gradually in long period (20 years)
- ✓ New technology could be transferred from private companies
- ✓ Overall management skill and know-how of sludge recycling could be transferred from Japanese public and private sectors.
- ✓ Integrated process of the design, construction and operation maintenance could be managed under private companies' responsibility

As mentioned in Section 2.3.4, there are two options of organization charts of BOT Projects. The Option-1 is "SPC manage O&M of Bio-Solid Processing Center by themselves" as shown in Figures 2.3.5-1, and the Option-2 is "SPC subcontracts O&M service of Bio-Solid Processing Center to other company" as shown in Figure 2.3.5-2. The Study Team proposes the Option-2, from the view point of merit of diversification of risk.



Source: JICA Study Team

☒ 2.3.5 Organization Chart of BOT Project (Option-1)



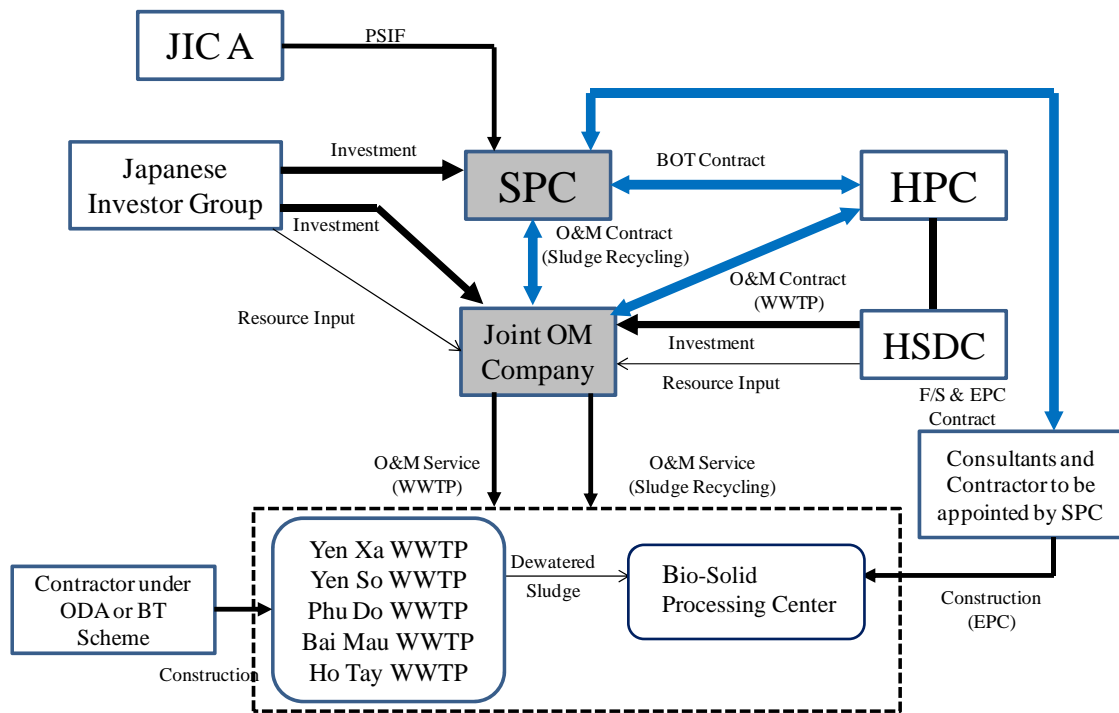
Source: JICA Study Team

☒ 2.3.6 Organization Chart of BOT Project (Option-2)

2.3.6 Proposed Organization Structure

As explained in 2.3.4, it is preferable that one company will manage not only O&M of WWTPs, but O&M of Bio-Solid Processing Center, also, because both O&M works are highly depending on each other.

However, an investor group for the BOT Project will be selected through the procedure under BOT law. The SPC to be established by the investor group selected may not subcontract O&M works to the JC.,



Source: JICA Study Team

Figure 2.3.7 Organization Structure of Proposed Project Scheme

2.4 Implementation Schedule

The implementation schedule of Yen Xa WWTP Project and relevant projects are shown in Figure 2.4.1.

Chapter 3 Construction of Yen Xa WWTP

3.1 Background and Benefits of the Project

3.1.1 Background

Yen Xa WWTP is the biggest wastewater treatment plant in the Hanoi Urban Development Master Plan up to 2020 (1998 MP). However, The fund for Yen Xa WWTP Construction Project has not been provided.

The F/S of Yen Xa WWTP Construction Project was carried out in “Feasibility Study for Construction Project of Central Large-Scaled Wastewater Treatment Plants for Hanoi Environmental Improvement” (F/S of Large-Scaled WWTPs), which was prepared in March, 2009 and revised in December, 2012. The Project has been in the long list of ODA loan request, though it has not been in the short list yet.

3.1.2 Benefits of the Project

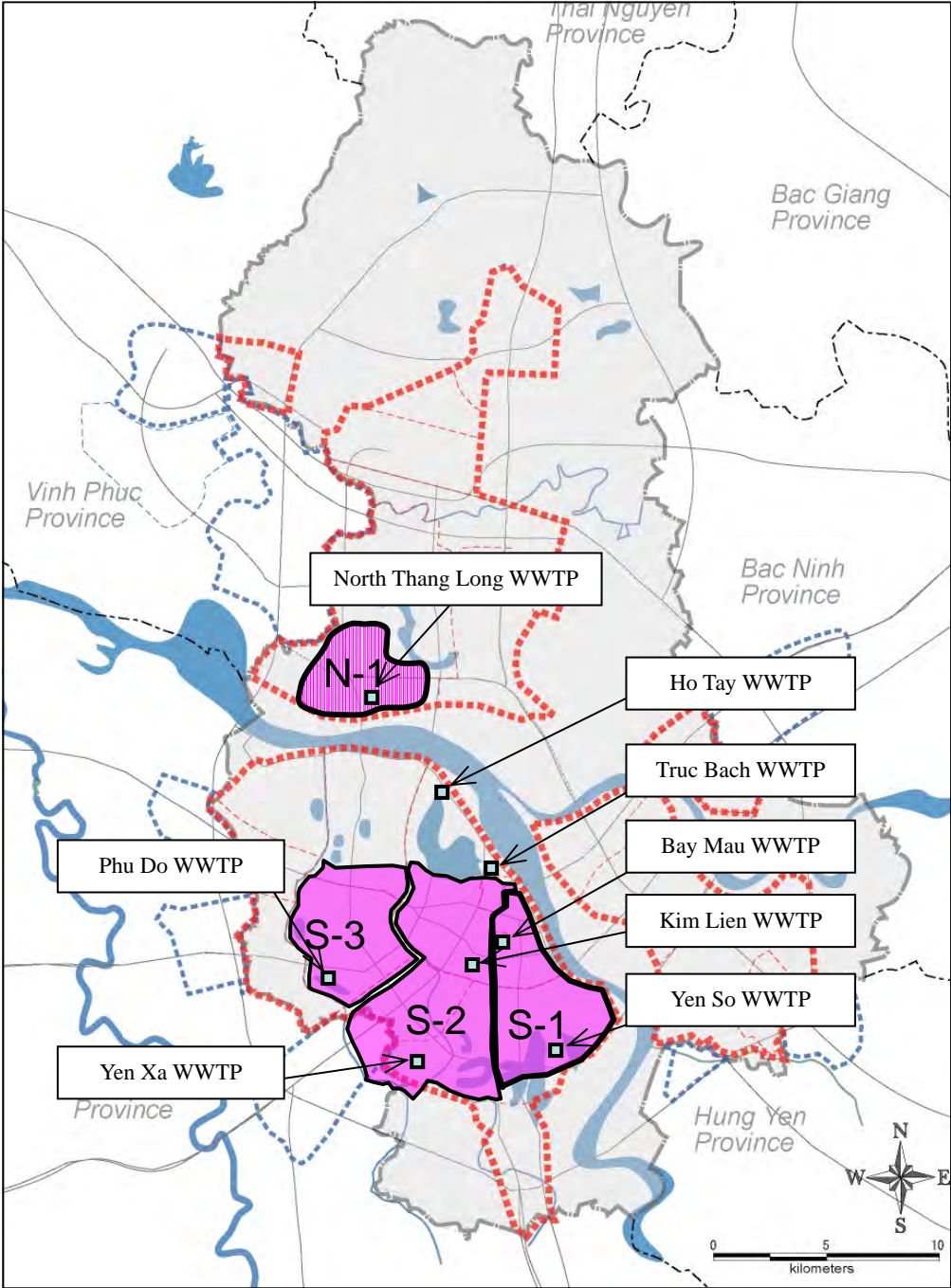
The Yen Xa WWTP Construction Project is planned to cover 4,874 ha o the service area, and could treat 270,000 m³/day of wastewater, which is discharged to To Lich River reaching to Nhue River.

The Project will bring many fold benefits, including 1) Drastic water quality improvement in To Lich and Nhue Rivers, 2) Health benefit to the nearby residents, 3) Reduction in pollution load in downstream area including Red River catchments, 4) Improvement of living condition along the To Lich and Nhue Rivers, 5) Possibility of new development including industrial and commercial expansion in S3 area; and 6) Ensuring sustainability of overall growth of Hanoi Capital City.

3.2 Outline of the Project

3.2.1 General Description of Yen Xa WWTP Service Area

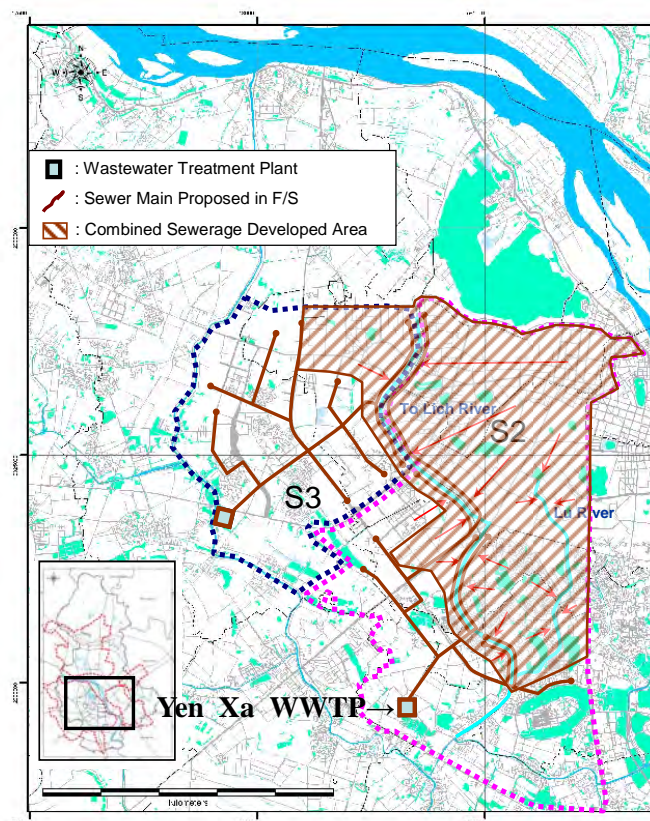
Currently, there are 3 operating WWTPs in Hanoi city. In addition, there are a number of WWTPs which are either in the planning/ designing stage or under construction. Location and extent of each WWTP are shown in Figure-3.2.1.



(Source: HSDPMB)

Figure-3.2.1 Location of 8 WWTPs in Hanoi

The Yen Xa WWTP basin is S-2 area. The Figure-3.2.2 shows the location of Yen Xa WWTP and sewer mains in S-2 Area.



(Source: HSDPMB)

Figure-3.2.2 Layout Plan of S-2 Area proposed in F/S

The general outline of Yen Xa WWTP basin is shown in Table-3.2.1.

Table-3.2.1 General Outline of Yen Xa WWTP Basin

Item	Value
Area (ha)	4,874
Service Population	900,000
Daily Average Wastewater Generation (m ³ /d)	231,660
Daily Maximum Wastewater Generation (m ³ /d)	268,726
Capacity of WWTP (m ³ /d)	270,000

(Source: HSDPMB)

3.2.2 Legal Basis of the Study

(1) Laws and Regulations

Laws and regulations associated with the project are as follows:

- Regulations on Investment and Construction Management issued together with the Government’s Decree No. 52/1999/ND-CP dated 08th July 1999, Decree No. 07/2003/ND-CP dated 30th January 2003 and Decree No. 12/2000/ ND-CP dated 05th May

2000.

- Construction Law promulgated by the President's Order 26/2003/L/CTN dated 10th December 2003.
- Environmental Protection Law 52/2005QH11 issued on 29th November 2005.
- Prime Minister's Resolution No. 05/2002/NQ-CP dated 24th April 2002 regarding the implementation of 2002 socio-economic plan.
- Decision No. 108/QD-TTg dated 20th June 1998 on the Approval of Revised Master Planning of Hanoi Capital up to 2020.
- Decision No. 5227/QD-UBND dated 28th December 2007 on the Approval of Consulting Service Contract to the Second Hanoi Drainage Project for Environmental Improvement.
- Contract of Consultancy Service No. 01-CS/PMB-NK/2007 dated 07th August 2007 on "Second Hanoi Drainage Project for Environmental Improvement" between TUPWPMB and the Consultants.
- Decision No. 653/QD-UBND dated 15th February 2008 on the Approval of the Task for Investment Preparation for the Construction of the Central Large-Scaled Wastewater Treatment Plans for Hanoi Environmental Improvement (2010 - 2015).
- Decree No. 88/2007/ND-CP dated 28th May 2007 by the Government on Urban and Industrial zone Sewerage (including wastewater tariff setting).
- Decision No. 22/QD-BTNMT dated 18th December 2006 on the Obligatory Application of Vietnamese Standards on Environment.
- Decree No. 16/2005/ND-CP dated 07th February 2005 by the Government on the Management of investment projects on the construction of works, and Decree No. 112/2006/ND-CP dated 29th September 2006 amending and supplementing a number of articles of Decree No. 16/2005/ND-CP.
- Decree No. 131/2006/ND-CP dated 9th November 2006 by the Government regulating the management and utilization of Official Development Assistant (ODA).
- Law on standard and technical regulation No. 68/2006/QH11 dated 29th June 2006
- Circular No. 04.2007/TT-BKH dated 30th July 2007 by the Ministry of Planning and Investment guiding the implementation of Management and Utilization of ODA.
- Decision No. 48/2008/QD-TTg dated 3rd April 2008 guiding the formulation of Feasibility Study Report – for Projects using ODA from the 5 assigned banks.
- Decision No. 04/2008/QD-BXD dated 3rd April 2008, regulating regional and urban

planning and rural residential planning.

- Decision No. 04/2008/QD-BTNMT dated 18th July 2008, regulating national technical regulation on environment
- Decision No. 16/2008/QD-BTNMT dated 31st December 2008, regulating national technical regulation on environment

(2) Standards

Table-3.2.2 is a list of technical or environmental standards which are associated with the sewerage project.

Table-3.2.2 Vietnamese Environmental Standards

Code of Standard	Name of standard
20 TCVN 51-84	Design Criteria of Exterior and Project Drainage Network
TCVN 5999:1995	Water quality – Sampling – Guidance on sampling of wastewater (ISO 5667-10:1992)
TCVN 5298:1995	Requirements of the use of wastewater and sludge for watering and fertilizing purpose
TCVN 5524:1995	Water quality - General requirements for protecting surface water against pollution
TCVN 5525:1995	Water quality - General requirements for protection of underground water
QCVN 08:2008/BTNMT	National technical regulation on surface water
TCVN 5945:2005	Industrial wastewater – Discharge standards
QCVN 14:2008/BTNMT	National technical regulation on domestic wastewater
TCVN 6984:2001	Water quality – Standards for industrial effluents discharged into river water for protection of aquatic life
TCVN 7222:2002	Water quality – General environmental requirements for central domestic (municipal) wastewater treatment plants
TCVN 5937:1995 – 5940:1995	Air quality
TCVN 5948:1999	Acoustics - Noise generated by road traffic means when speeding up - Permitted maximum noise level
TCVN 5949:1998	Acoustics - Noise in public and residential areas - Permitted maximum noise level
TCVN 6962:2001	Vibrations and seismism – Vibrations caused by construction and industrial production activities – Permitted maximum levels for the environment of public places and populated areas
QCXDVN01:2008/BXD	Vietnam Building Code - Regional and urban planning and rural residential planning

(Source: HSDPMB)

3.2.3 Wastewater Collection System

Yen Xa WWTP basin (S-2 area) is located in the southwest area of Hanoi. Currently, most wastewater generated in S-2 area flows out to To Lich Liver through the existing drainage lines. Therefore, the combined sewerage system is proposed as the wastewater collection system for S-2 area. Some overflow chambers are planned to be located by each outlet towards To Lich Liver. Wastewater and rainwater are planned to be collected to Yen Xa WWTP.

Diameter of wastewater collecting lines are planned to be between 400mm to 2,400mm, and the total length are planned to be approximately 52.8km.

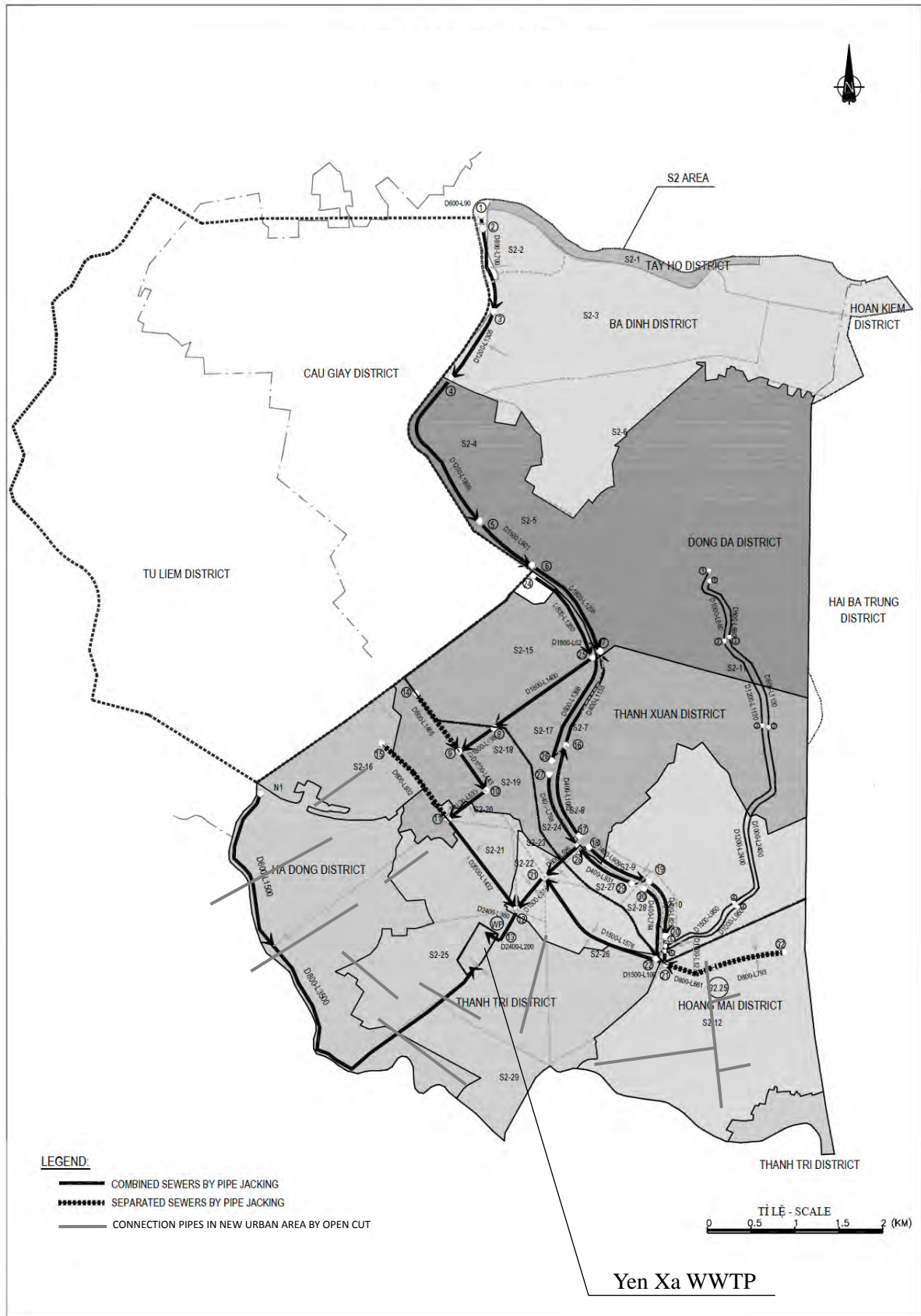
The breakdown list of sewer lines of S-2 area is shown in Table-3.2.3.

Table-3.2.3 Breakdown List of Sewer Lines in Yen Xa WWTP Basin (S-2 Area)

Area	Method	Diameter (mm)	Length(m)	Total(m)
1. Intercepting System for To Lich River and Main Sewer				
Combined Sewerage Area	Pipe Jacking Method	400	7,236	23,944
		600	1,924	
		800	2,070	
		1,200	3,204	
		1,500	3,220	
		1,800	4,144	
		2,000	1,432	
Separated Sewerage Area	Pipe Jacking Method	600	2,397	3,851
		800	1,454	
Total				27,795
Overflow Chambers (for Combined Sewer)				154 Locations
2. Intercepting System for Lu River				
Combined Sewerage Area	Pipe Jacking Method	600	860	10,680
		800	1,130	
		1,000	4,210	
		1,200	3,530	
		1,500	950	
Total				10,680
Overflow Chambers (for Combined Sewer)				138 Locations
3. Sewer Pipes for Ha Dong and New Urban Area				
Ha Dong Area (Combined)	Pipe Jacking Method	600	1,800	5,300
		800	3,500	
New Urban Area (Separated)	Open Cut Method	400	8,000	9,000
		600	1,000	
Total				14,300
Overflow Chambers (for Ha Dong Area)				40 Locations

(Source: HSDPMB)

Proposed layout plan of sewer lines in S-2 area is shown in Figure-3.2.3.



(Source: HSDPMB)

Figure-3.2.3 Proposed Layout Plan of Sewer Lines in S-2 Area

3.2.4 Wastewater Treatment Plant

(1) Design Conditions

Design conditions of Yen Xa WWTP are shown as below.

- 1) Location of WWTP: Trung, Thuong and Chua Nhi hamlet, Thanh Liet commune, Thanh Tri district
- 2) Site area: 13.0ha (130,000m²)
- 3) Wastewater collection system: combined sewerage system (however, separated sewerage system for some parts)
- 4) Wastewater treatment process: Conventional activated sludge process – AO operation
- 5) Sludge treatment process: Thickening followed by dewatering.
- 6) Discharging water body: Nhue River

Design water qualities and design wastewater flow are shown in Table-3.2.4 and 3.2.5.

Table-3.2.4 Design Water Qualities

Items	Influent (mg/L)	Effluent (mg/L)	Removal Ratio (%)
BOD	200	20	90
SS	150	20	87
Ammonia (as N)	30*	8	73
T-N	50	24	52
T-P	5	4.8	4
Coliform	-	5,000	-

(Source: HSDPMB) Note) *: 60% of T-N

Table-3.2.5 Design Wastewater Flow of Yen Xa WWTP

Items	Unit			Remarks
	m ³ /d	m ³ /m	m ³ /s	
Daily Average	220,400	153.06	2.5509	Dry weather flow
Daily Maximum	270,000	187.50	3.1250	Dry weather flow
Hourly Maximum	545,700	378.96	6.3160	Wet weather flow

(Source: HSDPMB)

(2) Layout Plan

Layout plan of Yen Xa WWTP is shown in Figure-3.2.4.



Figure-3.2.4 Overall Layout Plan of Yen Xa WWTP (Source: HSDPMB)

3.3 Project Implementation Schedule

(3) Layout Plan

This schedule was proposed on the assumption that JICA and Vietnamese government will make the loan agreement in the first half of 2012.

- 1) Funding arrangement for project: January.2013 – April.2012 (4 months)
- 2) Selection of consultant: May.2013 – April.2014 (12 months)
- 3) Detailed design: May.2014 – June.2016 (29 months)
- 4) Selection of contractor: June.2015 – November.2017 (30 months)
- 5) Construction stage: August.2016 – December.2020 (53 months)
- 6) Test operation: May.2019 – December.2021 (24 months)

Chapter 4 Proposal of Establishment of Joint Company

4.1 Necessity

It is preferable that one organization will carry out operation and maintenance of the five WWTPs and Yen So Bio-Solid Processing Center (BPC), because their operation works are closely related to each other. In addition, high technical skills and knowledge are required for the overall operation and maintenance, therefore it is proposed for HPC/HSDC to establish an O&M joint company with Japanese private companies, which have enough technical skills and financial sources.

The planned tasks of the O&M joint company (JC) is not only to perform the O&M of the five WWTPs and the Yen So BPC in Hanoi, but also to develop the engineering services, training services and construction works, by using their own technical skill and knowledge.

4.2 Contents of Service of Joint Company

Initial Stage

At the initial stage, the tasks of JC are the O&M works for the following facilities;

- Ho Tay WWTP (Operation from January 2014, Total capacity: 15,000 m³/day)
- Yen So WWTP (Operation from April 2014, Total capacity: 190,000 m³/day)
- Bay Mau WWTP (Operation from July 2014, Total capacity: 13,300 m³/day)
- Phu Do WWTP (Operation from January 2016, Total capacity: 84,000 m³/day)
- Yen Xa WWTP (Operation from January 2018, Total capacity: 270,000 m³/day)
- Bio-Solid Processing Center (Operation from January 2016, Total capacity: 185 m³/day of dewatered sludge)

The O&M works includes daily operation and maintenance, and periodical repair and replacement of equipment. The contract period of the above mentioned O&M service is by December 2037.

Development Stage

JC is expected to expand the following business fields;

- O&M of other WWTP in Hanoi;
- O&M of WWTP in other municipalities;
- Training services for O&M and engineering services in the sewerage sector for other municipalities; and
- Construction works.

4.3 Legal Basis of the Study

For the Study on the establishment of the Joint Company, the following laws and regulations are referred to;

- ✓ Decision No. 71/2010/QD-TTg, Promulgating the regulation on pilot investment in the public-private partnership form (Pilot PPP Law)
- ✓ Law No. 59/2005/QH11, On Investment (Investment Law)
- ✓ Decree No.108/2006/ND-CP, Providing Detailed Provisions and Guidelines for Implementation of a Numbers of Articles of Law on Investment
- ✓ Law No. 60/2005/QH11 on Enterprise (Enterprise Law)
- ✓ Decree No. 88/2007/ND-CP, on Urban and industrial-park water drainage
- ✓ Circular No. 09/2009/TT-BXD, Defining detailed guidelines to implement some contents of Decree 88/2007/ND-CP
- ✓ Decree 102-2010-ND-CP Providing detailed guidelines for implementation of a number of articles of the Law on Enterprises
- ✓ Decree 43-2010-ND-CP on Enterprise registration
- ✓ Decision 1088-2006-QD-BKH Decision issuing standard forms for conducting investment procedures in Vietnam

4.4 Organization and Staffing of Joint Company

As for the organization and staffing of the company, there are two options, namely, Joint Stock Company and Limited-liability Company. As a result of the discussions between HSDC and the Study Team, the structure of a limited-liability company is proposed at the initial stage. Considering the additional fund requirement for future expansions of the company, the structure may be changed to a joint stock company in the near future.

The details of the company are shown in the following appendixes;

Appendix-A1: Checklist for the Establishment of O&M Joint Company

Appendix-A2: Term Sheet of O&M Joint Company

At the initial stage, the Joint Company is planned to carry out O&M works of five WWTPs (Yen So WWTP, Yen Xa WWTP, Bai Mau WWTP, Phu Do WWTP, Ho Tay WWTP) and the Bio-Solid Processing Center. The JC will consist of seven offices, which are Headquarter, five site offices for the WWTPs and one site office for Bio-Solid Processing Center. The Member of Council (MC) consists of three members, as representatives of the investors. The proposed required staffs and the corresponding number for each office is as shown in Table 4.4.1, 4.4.2 and 4.4.3.

Table 4.4.1 Administration Staff of Joint Company (Headquarter)

Position	Nationality	Status	Origin
[MC]			
Chairman (HSDC)	Vietnamese	Full-time	HSDC
Representative of ORIX	Japanese	Part-time	ORIX
Representative of Water Agency	Japanese	Part-time	WAC
[Headquarters]			
General Directors	Japanese	Full-time	ORIX
Deputy General Director/Chief of Financial Affairs	Japanese	Full-time	ORIX
Deputy General Director/Chief of General and Personnel Affairs	Vietnamese	Full-time	HSDC
Chief Accountant	Vietnamese	Full-time	HSDC
Chief of Technical Affairs	Japanese	Full-time	WAC
General Staff (General and Personnel Affairs)	Vietnamese	Full-time	Recruitment
General Staff (Financial and Technical Affairs)	Vietnamese	Full-time	Recruitment
General Staff(Secretary & Interpreter)	Vietnamese	Full-time	Recruitment

Source: JICA Study Team

Table 4.4.2 Required Operation Staff for Five WWTPs

	Works items	Jobs Category	Staff Number				
			Yen Xa WWTP	Yen So WWTP	Bai Mau WWTP	Phu Do WWTP	Ho Tay WWTP
1	Director	Wastewater Treatment	1	1	1	1	1
2	Vice Director	Machines	1	1		1	
3	General Affairs	Manager	1	1		1	
		General	1	1	1		1
		Sub total	2	2	1	1	1
4	Water Treatment	Manager	1	1	1	1	1
		Water Analysis	2	2	1	2	1
		Monitoring & Control	12	12	4	4	4
		Daily check & Round	3	3	1	2	1
		Sub total	18	18	7	9	7
5	Maintenance	Manager	1	1		1	
		Water Treatment	4	4	1	1	1
		Sludge Treatment	3	3	1	1	1
		Sub total	8	8	2	3	2
6	Sludge Treatment	Manager	1	1		1	
		Operation	12	12		1	
		Daily check & Round	2	2	1	1	1
		Sludge Disposal					
		Sub total	15	15	1	3	1
7	Guards	Manager	1	1			
		Guards	4	4	4	4	4
		Environmental Equip.					
		Sub total	5	5	4	4	4
Total			50	50	16	22	16

Source: JICA Study Team

Table 4.4.3 Required Operation Staff for Yen So BPC

	Works items	Jobs Category	Numbers
1	Director	Wastewater Treatment	1
2	General affairs	Manager	1
		General	0
		Procurement	0
		Sub total	1
4	Drying Beds	Manager	1
		Water analysis	0
		Monitoring & Control	0
		Daily Check & Round	2
		Sub total	3
5	Maintenance	Manager	1
		Drying Beds	0
		Drying Machines	1
		Sub total	2
6	Drying Machines	Manager	1
		Operation	8
		Daily Check & Round	3
		Sludge Disposal	0
		Sub total	12
7	Guards	Manager	0
		Guards	4
		Environmental Equip.	0
		Sub total	4
Total			23

Source: JICA Study Team

4.5 Proposed Schedule for Establishment of O&M Company

In February 2012, the schedule for the establishment of JC was proposed as presented below, and the HSCD together with Japanese proponents commenced negotiation for establishment of the JC. In December, 2012, it was concluded that the negotiation was suspended, because both sides could not agree on several points of the conditions for the establishment.

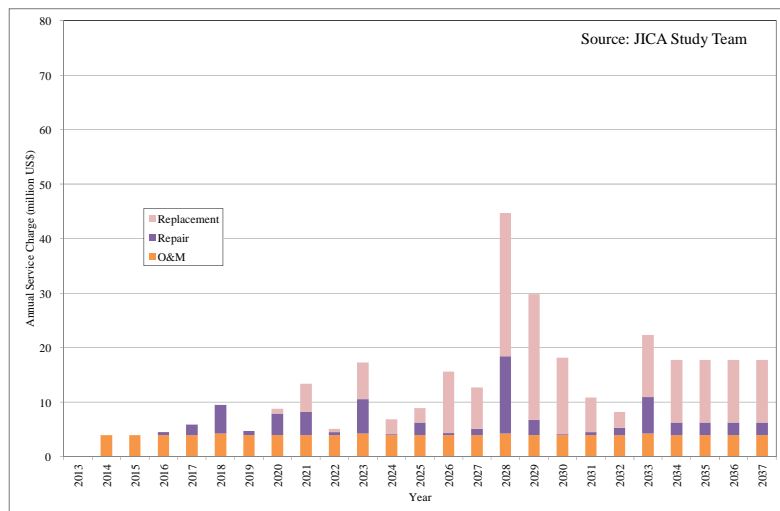
March 2012	Signing of Term Sheet to decide on Important Conditions (Appointment of Partner)
June 2012	Signing on Joint Venture Agreement, Charter, and O&M Service Agreement
July 2012	Submission of Application for Business Registration and Investment Certificate to HAPI
August 2012	Issuance of Business Registration and Investment Certificate by HPC (Establishment of Joint Company)
January 2013	Commencement of the Preparation Works for O&M Service of JC
January 2014	Commencement of O&M Service of JC

4.6 Estimate of Service Charge

4.6.1 Operational Expenditure

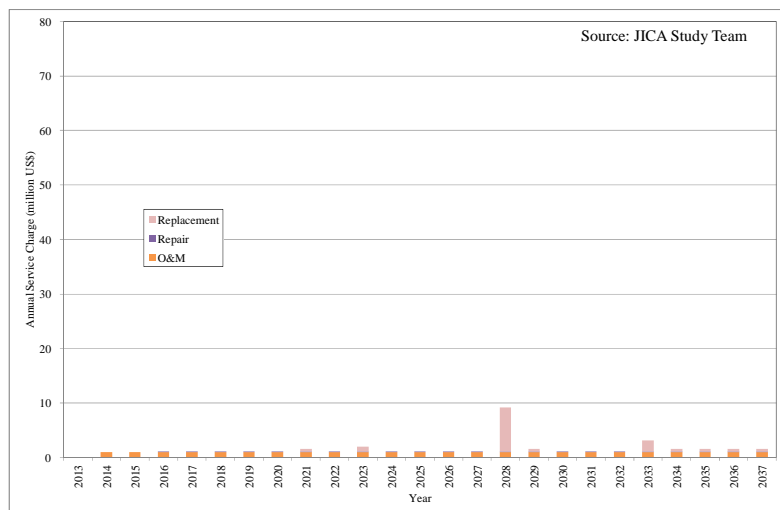
The Study Team estimated costs required in each operation year for the five WWTPs and the Yen So Bio-Solid Processing Center. The costs consist of daily operation and maintenance cost, repair cost for structures and equipments, and replacement cost of equipments. The results of cost estimate for the five WWTPs and the Yen So Bio-Solid Processing Center are shown from Figure 4.6.1 to Figure 4.6.6. As shown in these figures, a significant cost is replacement cost from the 15th to 17th year of operation period. Figure 4.6.7 shows the total expenditure for O&M, repair and replacement for the five WWTP and Bio-Solid Processing Center. According to the table, the expenditure in 2028, 2032 and 2033 is expected more than US\$ 70 million, which is equivalent to around VND 1,400 billion. Figure 4.6.8 shows the expenditure except for replacement cost.

As for the BPC, it will be implemented by BOT scheme, so the SPC will charge the service fee to HPC.



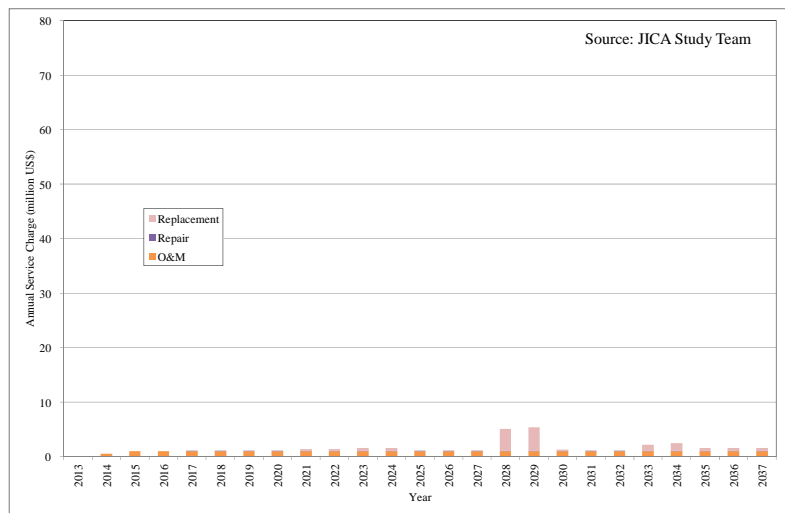
(million.US\$)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M		3.9	3.9	3.9	3.9	4.2	3.9	3.9	3.9	3.9	4.2	3.9	3.9	3.9	3.9	4.2	3.9	3.9	3.9	3.9	3.9	4.2	3.9	3.9	3.9
Repair		0.0	0.0	0.6	1.9	5.3	0.8	4.0	4.3	0.6	6.3	0.2	2.3	0.4	1.2	14.2	2.8	0.2	0.6	1.4	6.7	2.3	2.3	2.3	2.3
Replacement		0.0	0.0	0.0	0.0	0.0	0.0	0.9	5.1	0.6	6.7	2.7	2.7	11.3	7.6	26.3	23.1	14.0	6.3	2.9	11.4	11.5	11.5	11.5	11.5

Figure 4.6.1 JC Expenditure for O&M/Repair/Replacement of Yen So WWTP



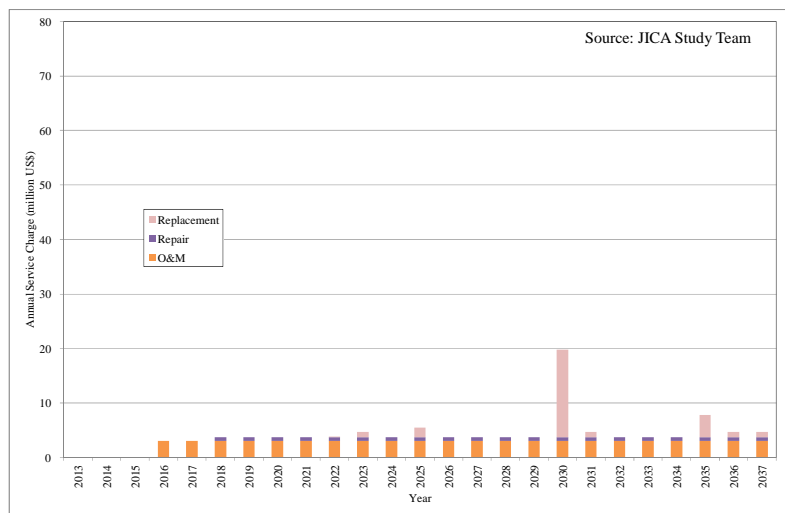
(million.US\$)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Repair		0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Replacement		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.9	0.0	0.0	0.0	0.0	8.1	0.5	0.0	0.0	0.0	2.0	0.5	0.5	0.5	0.5

Figure 4.6.2 JC Expenditure for O&M/Repair/Replacement of Ho Tay WWTP



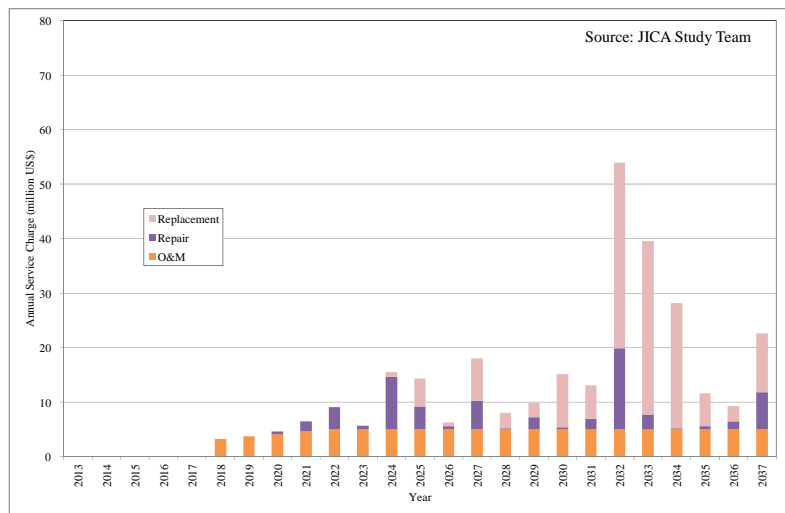
(million.US\$)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M		0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Repair		0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Replacement		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.5	0.5	0.0	0.0	0.0	4.0	4.3	0.2	0.0	0.0	0.0	1.0	1.3	0.5	0.5

Figure 4.6.3 JC Expenditure for O&M/Repair/Replacement of Bay Mau WWTP



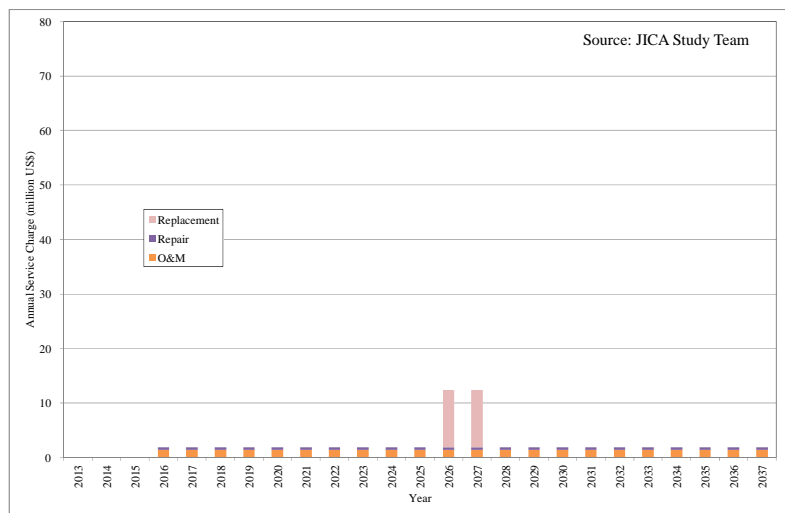
(million.US\$)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M				3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Repair				0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Replacement				0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0	0.0	1.8	0.0	0.0	0.0	0.0	16.1	1.0	0.0	0.0	0.0	4.1	1.0	1.0

Figure 4.6.4 JC Expenditure for O&M/Repair/Replacement of Phu Do WWTP



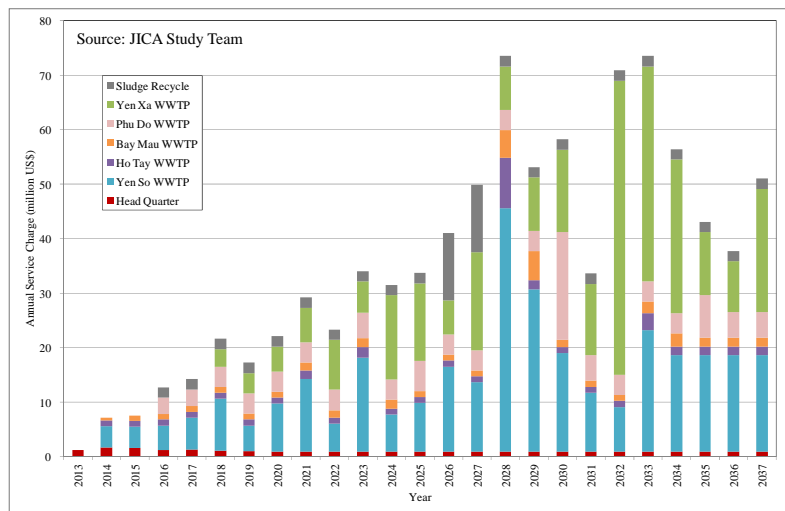
Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M						3.2	3.7	4.1	4.6	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Repair						0.0	0.0	0.5	1.8	4.1	0.7	9.6	4.2	0.6	5.2	0.2	2.2	0.4	1.9	14.9	2.7	0.2	0.6	1.4	6.8
Replacement						0.0	0.0	0.0	0.0	0.0	0.0	0.9	5.1	0.6	7.8	2.8	2.6	9.7	6.2	34.1	31.8	23.0	6.0	2.9	10.8

Figure 4.6.5 JC Expenditure for O&M/Repair/Replacement of Yen Xa WWTP



Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
O&M				1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Repair				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Replacement				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

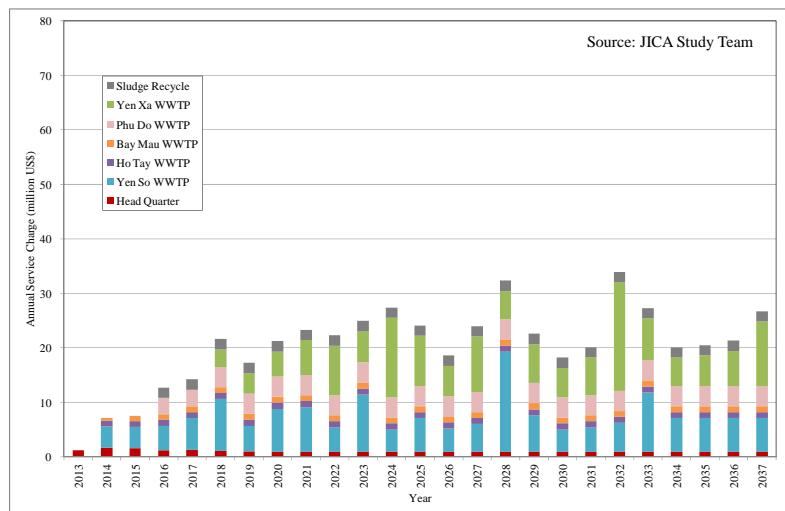
Figure 4.6.6 JC Expenditure for O&M/Repair/Replacement for Yen So BPC



(million.US\$)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	
Head Quarter	1.2	1.7	1.6	1.2	1.3	1.1	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	
Ho Tay WWTP		1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	
Yen So WWTP		3.9	3.9	4.5	5.8	9.5	4.7	8.8	13.3	5.1	17.2	6.8	8.9	15.6	12.7	44.7	29.8	18.1	10.8	8.2	22.3	17.7	17.7	17.7	17.7	
Bay Mau WWTP		0.5	1.0	1.0	1.1	1.1	1.1	1.1	1.4	1.4	1.6	1.6	1.1	1.1	1.1	5.1	5.4	1.3	1.1	1.1	2.1	2.4	1.6	1.6	1.6	
Phu Do WWTP		0.0	0.0	3.0	3.0	3.7	3.7	3.7	3.7	3.8	4.7	3.7	5.5	3.7	3.7	3.7	3.7	19.8	4.7	3.7	3.7	3.7	7.8	4.7	4.7	
Yen Xa WWTP		0.0	0.0	0.0	0.0	3.2	3.7	4.6	6.4	9.1	5.7	15.5	14.3	6.2	18.0	8.0	9.8	15.1	13.1	54.0	39.5	28.2	11.6	9.3	22.6	
Sludge Recycle		0.0	0.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	12.4	12.4	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Figure 4.6.7 Total Expenditure of JC (All Plants)



(million.US\$)

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Head Quarter	1.2	1.7	1.6	1.2	1.3	1.1	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Ho Tay WWTP	0.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Yen So WWTP	0.0	3.9	3.9	4.5	5.8	9.5	4.7	7.9	8.2	4.5	10.5	4.1	6.2	4.3	5.1	18.4	6.7	4.1	4.5	5.3	10.9	6.2	6.2	6.2	6.2
Bay Mau WWTP	0.0	0.5	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Phu Do WWTP	0.0	0.0	0.0	3.0	3.0	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Yen Xa WWTP	0.0	0.0	0.0	0.0	0.0	3.2	3.7	4.6	6.4	9.1	5.7	14.6	9.2	5.6	10.2	5.2	7.2	5.4	6.9	19.9	7.7	5.2	5.6	6.4	11.8
Sludge Recycle	0.0	0.0	0.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9

Figure 4.6.8 Total Expenditure of JC (Excluding Replacement)

4.6.2 Service Charge

The service charge is calculated based on the conditions as shown Table 4.6.1.

Table 4.6.1 Basic Conditions of Calculation of Service Charge

Items	Assumptions
Currency for Calculation	US \$
Period of Analysis	Operation Period: 23.75 years (Yen So WWTP) Operation Period: 24 years (Ho Tay WWTP) Operation Period: 23.5 years (Bay Mau WWTP) Operation Period: 22 years (Phu Do WWTP) Operation Period: 20 years (Yen Xa WWTP) Operation Period: 22 years (Yen So BPC)
Benefit	5% of expenses
Corporation Tax Rate	0% (1 st – 4 th year of the operation) 5% (5 th – 9 th year of the operation) 10% (10 th – 15 th year of the operation) 25% (from 16 th year of the operation)
Value Added Tax Rate	10 %

Source: JICA Study Team

The followings are the options considered in calculating the service charge:

- Option-1: JC is responsible for replacements and takes the risk of functional deterioration. JC will also perform the necessary replacement of the facilities with receiving “Pre-agreed” service charge. The service charge is arranged to be uniformity on yearly basis.
- Option-2: JC will do replacement works but does not take the risk of functional deterioration. JC will replace the facilities with the funds it will receive. The service charge is required to meet an amount that is actually spent plus the company’s profit (5%) on yearly basis.
- Option-3: JC will not be involved in any way in the replacement works.

The service charge based on each option is shown in Figures 4.6.9, 4.6.10 and 4.6.11. The Study Team proposed the Option-1 for the reason mentioned in Appendix-A3

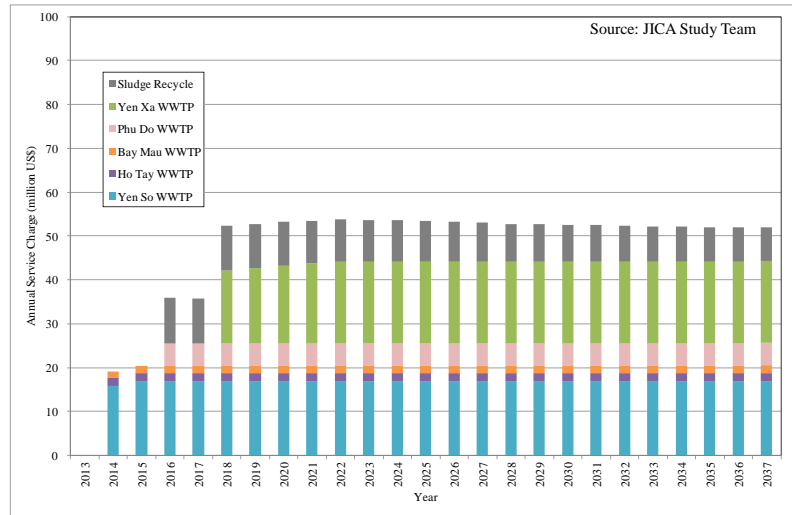


Figure 4.6.9 Service Charge (Option-1)

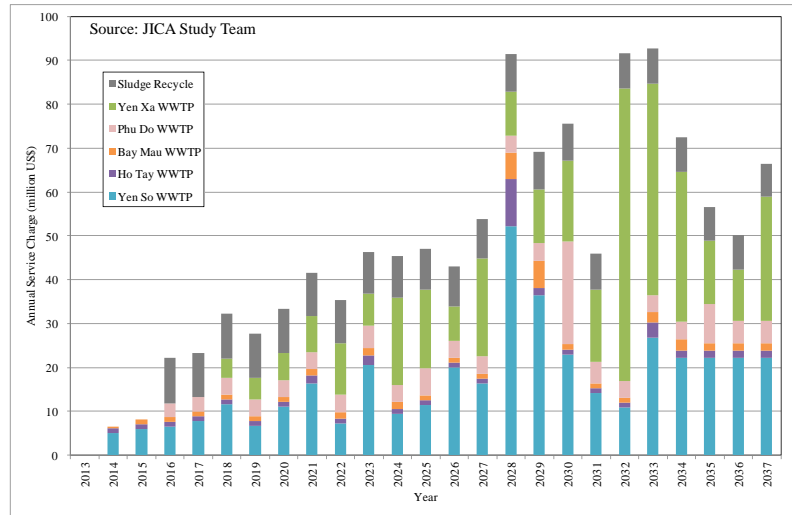


Figure 4.6.10 Service Charge (Option-2)

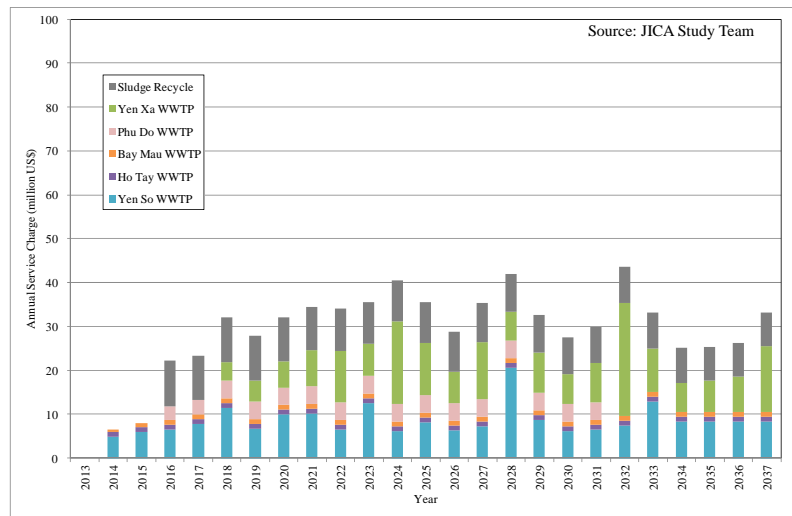


Figure 4.6.11 Service Charge (Option-3)

The charges for O&M service are summarized as below:

Average amount to be charged to HPC

- O&M of Yen So WWTP (US\$ 16.9 million/year, US\$ 0.246/m³)
- O&M of Ho Tay WWTP (US\$ 1.8 million/year, US\$ 0.403/m³)
- O&M of Bai Mau WWTP (US\$ 1.7 million/year, US\$ 0.447/m³)
- O&M of Phu Do WWTP (US\$ 5.2 million/year, US\$ 0.209/m³)
- O&M of Yen Xa WWTP (US\$ 18.3 million/year, US\$ 0.243/m³)

Average amount to be charged to SPC

The O&M of Yen So BPC is estimated at US\$ 8.9 million/year, US\$ 91.2/m³.

The details of financial analysis are shown in Appendix-A3. The proposed option is Case A1 in the appendix.

4.7 Share of Equity (Vietnamese and Japanese)

The required amount of initial equity of the JC is tentatively estimated to be US\$ 2.0 million, which consists of US\$ 0.4 million for preparation works for the company, and US\$ 1.6 million for initial 16 months of the company staff salary from the establishment of the company. As for the percentage of shareholding and initial investment by the Vietnamese and Japanese sides, both sides agreed that the Japanese side has the majority of shares, however, certain percentage has not been fixed yet, and is still under discussion. The Study Team proposes 65% for the Japanese side.

4.8 Participants of the Project

HPC requested HSDC to take necessary actions for the establishment of a joint company with Japanese partners. If HPC selects ORIX as a partner, ORIX will be in charge of financial arrangement, as well as arrangement of participations by other Japanese companies to the joint company.

4.9 Task and Risk Allocation

The risk matrix on the establishment of the JC is presented in Appendix-A4.

Chapter 5 BOT Project for Yen So Bio-solid Processing Center

5.1 Necessity of Sludge Processing Project

As discussed in Chapter 1, the sludge processing project is required because of the following reasons:

- To reduce the amount of landfill waste of dewatered sludge from WWTPs.
- To reduce the scale of new permanent sludge disposal site under planning
- To utilize resources (sludge) effectively

5.2 Necessities and advantages of Implementation through BOT Scheme

- The lifecycle cost of the Project could be reduced. Through BOT scheme, the SPC (which is established for the purpose of the Project) will attempt to minimize the lifecycle cost of the Project, because the SPC is required to carry out the design, construction, operation and maintenance as a package. The SPC will consider effective operation and maintenance from design stage.
- The latest technology and know-how for sludge processing could be introduced by the Japanese private companies.
- The initial investment cost could be provided by the Japanese private companies (SPC). Hence, HPC doesn't need to do any financial arrangement for the Project.

5.3 Contents of Services

The services of the BOT Project are considered as below;

- 1) To dry 185 m³/day of dewatered sludge generated from WWTPs in Hanoi
- 2) To reduce volume of sludge from 185 m³/day of dewater sludge (80% moisture contents) to around 37 m³/day of dry sludge (10% of moisture contents)
- 3) To provide suitable dry sludge to cement companies as an alternative fuel to coal
- 4) To provide reaming dry sludge for gardening of public green space, if not all the dry sludge can be used in cement factories.
- 5) To build Bio-Solid Processing Center for sludge drying, and operate it for 22 years, then transfer it to HPC.

The details of the Project are discussed in the Proposal for the BOT Project for Yen Xa Bio-Solid Processing Center, which is included as **Appendix-B1**. Draft of Terms and Conditions for Production and Offtake of Dry Sludge in Yen Xa BioSolid Processing Center is included as **Appendix-B2**.

It is proposed that HPC shall consider providing new laws and/or official introductions to utilize dry sludge in cement companies and construction works. If total amount of dry sludge to be provided by the SPC cannot be used in cement companies and gardening after exerted efforts of the SPC with HPC support, HPS is expected to consider receiving sufficient amount of dry sludge.

5.4 Related laws and Regulations

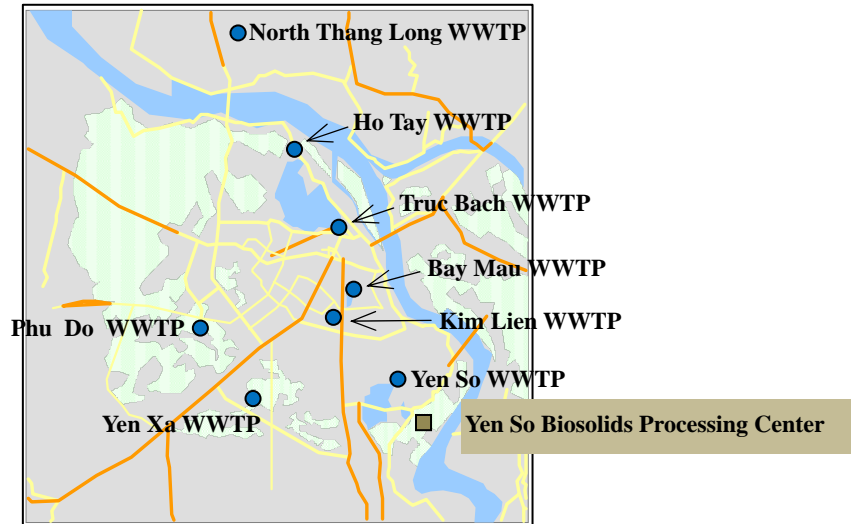
For the Study on the establishment of the Joint Company, the following laws and regulations are referred to;

- ✓ Decision 71/2010/QĐ-TTg, Promulgating the regulation on pilot investment in the public – private partnership form (Pilot PPP Law)
- ✓ Decree 108/2009/NĐ-CP - Decree On Investment In The Form Of Build-Operate-Transfer, Build-Transfer-Operate Or Build-Transfer Contract
- ✓ Decree No. 24/2011/NĐ-CP - Amending A Number of Articles of the November 27, 2009 Decree No. 108/2009/NĐ-CP on Investment in the Form of Build-Operate-Transfer Contract, Build-Transfer-Operate Contract, Build-Transfer Contract
- ✓ Law 61/2005/QH11 – Bidding Law
- ✓ Law No.16-2003-QH11 – Law on Construction
- ✓ Law 38/2009/QH12 - Law Amending and Supplementing a Number of Articles of the Laws Concerning Capital Construction Investment
- ✓ Decree 12-2009-NĐ-CP Management of investment projects for construction works
- ✓ Circular 03-2009-TT-BXD Providing detailed guidelines for implementation of a number of articles of Decree 12-2009-NĐ-CP on management of investment projects for construction works
- ✓ Circular 03-2011-TT-BKHDT Guiding implementation of Decree 108-2009ND-CP on investment on the basis of BOT, BTO and BT contracts

5.5 Principal Feature of Proposed Facility

5.5.1 Location and Layout of Proposed Facility

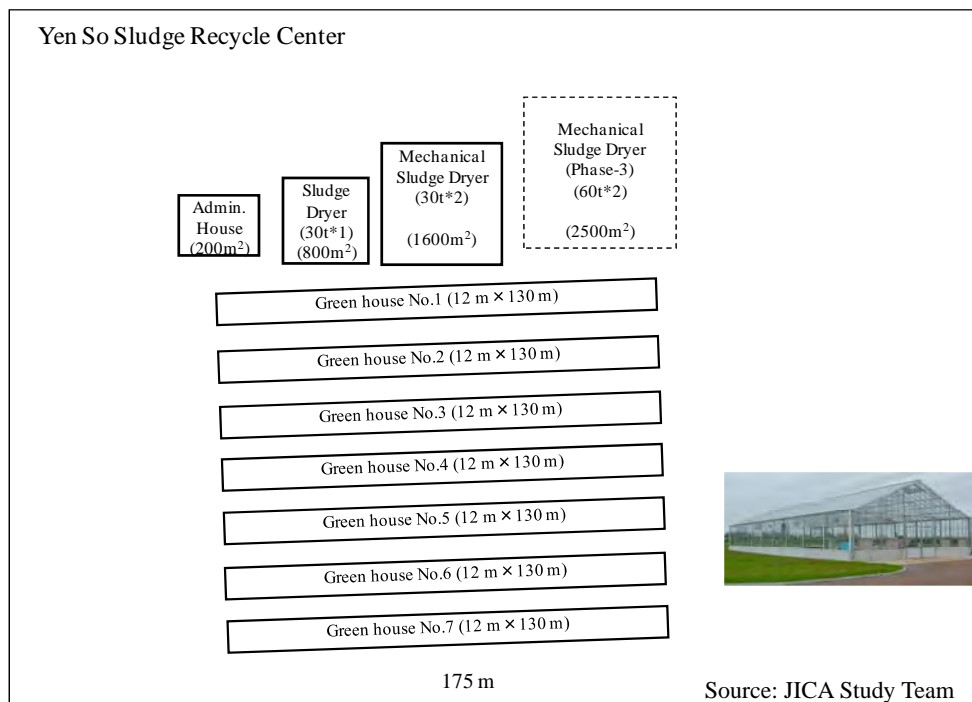
The expected location is Yen So Disposal Site as shown in Figure 5.5.1.



Source: JICA Study Team

Figure 5.5.1 Location Map

The layout plan of the sludge processing facilities at Yen So Disposal Site is proposed as shown in Figure 5.5.2. The required area of the site is about 3.3ha (around 180 m x 180 m). At the initial stage, it is proposed to construct seven (7) green houses, four (4) units of mechanical dryer and an administration house. At later stage, additional mechanical sludge dryer will be constructed for future demand.



Source: JICA Study Team

Fig.-5.5.2 Layout Plan of Sludge Processing Facility

5.5.2 Proposed Technologies

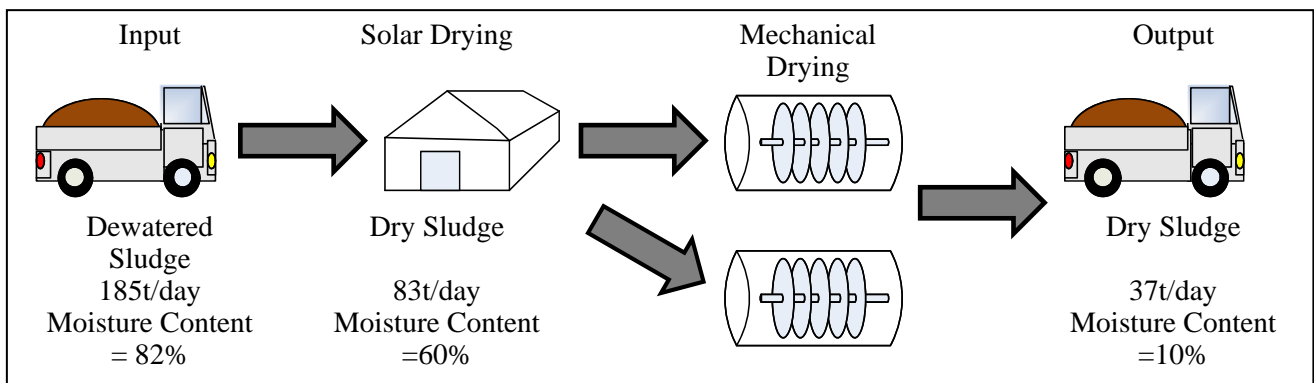
Design Condition

Because of the request from cement companies, output of the drying sludge should be with less than 10% of moisture contents, for usage as alternative fuel in a cement factory. As described in Appendix-B1, the capacity of the factory is estimated to be 185 m³/day of dewatered sludge. The proposed design conditions are presented as below;

Input of Dewatered Sludge: 185t/day of Dewatered Sludge (82% of moisture contents)

Output of Dry Sludge: 37t/day of Dry Sludge (10% of moisture contents)

The concept of hybrid process is illustrated in Figure 5.5.3.



Source: JICA Study Team

Figure 5.5.3 Hybrid Sludge Drying Process

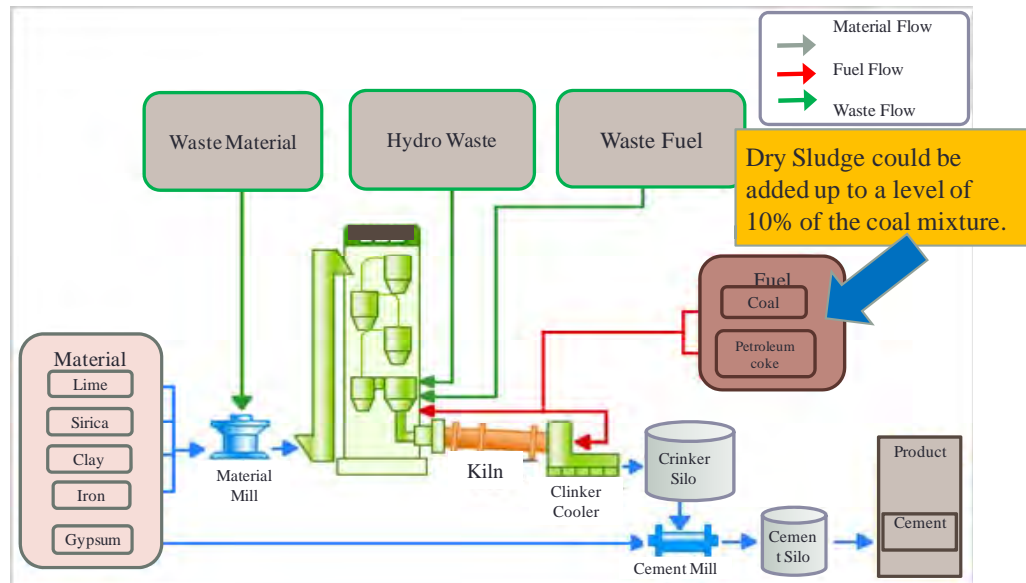
The design conditions of solar green house and mechanical sludge dryer in the hybrid process are shown in Table 5.5.2.

Table-5.5.2 Treatment capacity of sludge drying facilities

Facilities	Input	Output
Solar Green House (7 units)	Dewatered Sludge Volume: 185t/day Moisture Content: 82%	Dry Sludge Volume: 83t/day Moisture Content: 60%
Mechanical Sludge Dryer (4 units)	Dry Sludge Volume: 83t/day Moisture Content: 60%	Dry Sludge Volume: 37t/day Moisture Content: 10%

Source: JICA Study Team

It is proposed that the dry sludge will be used as an alternative fuel in a cement factory. The dry sludge could be added to a level of 10% of the coal mixture as shown in Figure 5.5.4. The Study Team has already contacted with But Son Cement Company and Sai Son Cement Company, and discussed on the possibility of dry sludge recycling.



Source: JICA Study Team

Figure 5.5.4 Sludge Recycling Process in Cement Factory

5.5.3 Construction and O&M Works of BOT Project

The work items of the project are categorized as construction works and operation & maintenance works as presented follow.

1) Construction Works

- a. Civil Works: Solar green house, administration house with storage, land preparation, road, general utilities, others
- b. Mechanical and electrical works: mechanical sludge dryer, wheel loader

Table-5.5.3 List of Construction Works and Equipment

Item	Unit	Quantity
1. Solar Green House		
(1) Civil Works		
1) Green House (12m x 130m x 7unit)	m ²	10,920
2) Concrete Foundation (Including Form Work and Reinforcement Work)	L.S.	1
(2) Electrical and Mechanical Works		
1) Wheel Loader	nos	3
2. Thermal Sludge Dryer		
(1) Electrical and Mechanical Works		
1) Drying Facilities (Capacity = 30t) (Heat Pump Style)	Unit	4
2) Wastewater Treatment Facilities	L.S.	1
(2) Civil Works		
1) House for Drying Facilities	L.S.	1
3. General Structures		
(1) Civil Works		
1) Land Preparation (Including Stripping of top soil, Embankment by imported sandy material and Disposal)	m ²	32,400
2) Concrete Foundation for Administration House (Including Form Work and Reinforcement Work)	m ³	100
3) Concrete for Retaining Wall (Including Form Work and Reinforcement Work)	L.S.	1
4) Road (Asphalt Pavement)	m ²	18,080
5) Fence	m	720
6) Gate	nos	1
7) Administration House	m ²	100
8) Storage	m ²	100
9) Track Scale	nos	1
10) Firefighting Station	L.S.	1
11) General Utilities (Including Electric Supply, Water Supply and Drainage Structure)	L.S.	1

Source: JICA Study Team

2) O&M Works

- a. To receive dewatered sludge from WWTPs, and to make dry sludge, and to be provided to cement companies
- b. To maintain all the equipments of the sludge processing facility

5.5.4 Preliminary Cost Estimate

The initial investment cost of the BOT Project is shown in Table-5.5.4. The Study Team is still considering about the phased development plan of the BOT Project. The initial investment cost will be re-calculated, before finalization.

Table-5.5.4 Initial Cost of Sludge Drying Facilities

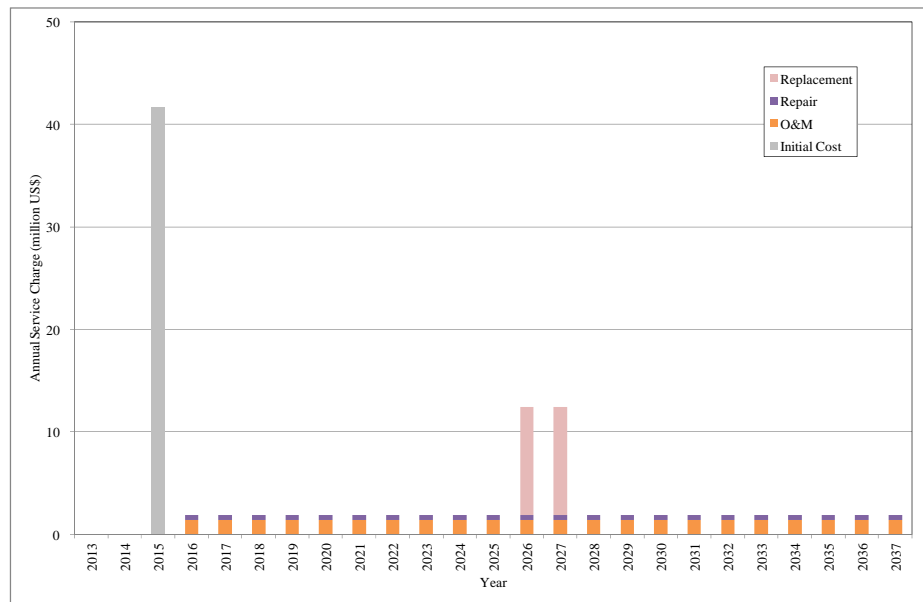
Item	Amount (1,000US\$)	Remarks
(1) Construction Cost		
1) Solar Green House	6,706	
2) Mechanical Sludge Dryer	25,618	
3) General Structures	2,116	
Sub-Total	34,440	
(2) Engineering Fee	3,444	10% of (1)
(3) Tax	3,788	10% of ((1)+(2))
Total	41,672	

Source: JICA Study Team

5.6 Service Charge

5.6.1 Operational Expenditure

The Study Team estimated costs required for the implementation of the BOT project for Sludge Processing Facility. The required cost includes costs for F/S preparation, design, construction, daily operation and maintenance, repair and replacement of equipments. The result of cost estimate is shown in Figure 5.6.1.



Source: JICA Study Team

Figure 5.6.1 Actual Expenditure of Construction/O&M/Repair of Sludge Processing Facility

5.6.2 Service Charge

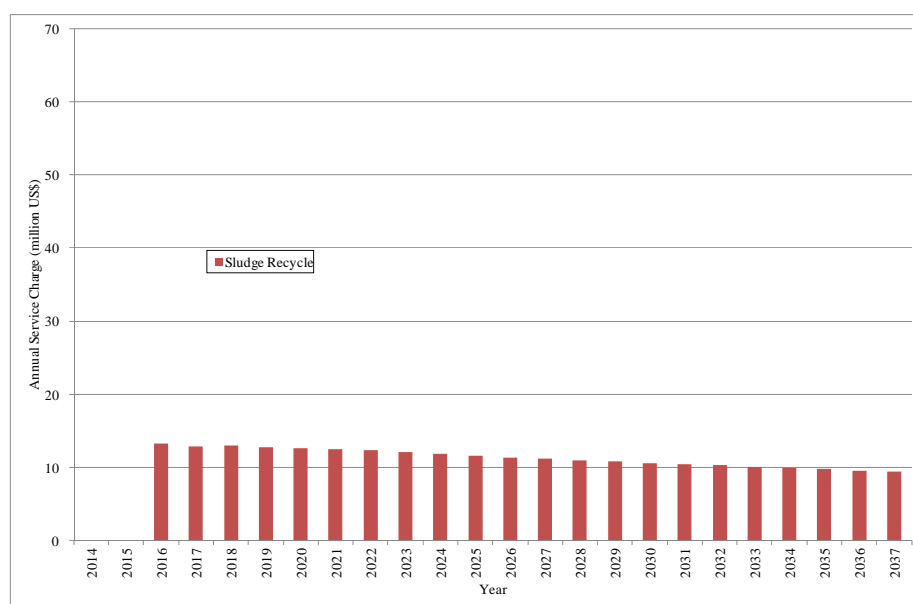
It is assumed that the Joint Company will charge to SPC its own O&M and repair costs plus profit which constitutes 5% of the total cost.

The service charge is calculated based on the conditions as shown in Table 5.6.1. It is arranged to be uniform on a yearly basis as shown in Figure 5.6.2. It will be charged to HPC by SPC.

Table 5.6.1 Basic Conditions of Service Charge Calculation

Items	Assumptions
Currency for Calculation	US \$
Period of Analysis	Construction Period: 1 year Operation Period: 22 years
Loan Repayment Period (PSIF)	Grace Period: 2 years Repayment Period: 18 years
Benefit	Equity IRR: 15% (excluding profit portion of the JC)
Loan Interest Rate (PSIF)	5%
Equity Return Rate (IRR)	15%
Corporation Tax Rate	0% (1 st – 4 th year of operation) 5% (5 th – 9 th year of operation) 10% (10 th – 15 th year of operation) 25% (from 16 th year of operation)
Value Added Tax Rate	10 %
Required Equity	US\$ 55.6 million (Project Cost: US\$ 41.7 million)
Debt to Equity Ratio	Debt (PSIF) 70%, Equity 30%

Source: JICA Study Team



Source: JICA Study Team

Figure 5.6.2 Service Charge to be paid by HPC for BOT of Sludge Processing Facility

The average service charge to HPC and payment for O&M cost to the JC are as presented below;

- Average Service Charge to HPC (US\$ 11.6 million /year, US\$ 137 /m³ of dewatered sludge)

- Expected Average Payment for O&M cost to the JC (US\$ 3.2 million /year, US\$ 40 /m³ of dewatered sludge)

5.7 Equity and Share

As shown in Table 5.5.4, the construction cost of the sludge processing facility is estimated as 41.7 million US\$. In addition, it is required to provide US\$ 3.75 million for expenditure in the initial stage of the Project in 2014 and 2015, and US\$ 10.15 million for surplus fund. The total required fund for the project is therefore estimated to be US\$ 55.6 million. It will be provided as follows;

Required Fund:	US\$ 55.6 million
Equity (30%) :	US\$ 16.7 million
Debt: PSIF (70%) :	US\$ 38.9 million

As for the share of equity, ORIX will arrange it with some Japanese companies.

5.8 Organization and Staffing

It is proposed that a Special Purpose Company (SPC) will be formed and will be the executor of the BOT scheme. The SPC will be comprised of a consortium of Japanese firms arranged by ORIX Corporation.

The tasks of the SPC after the establishment of the SPC, are presented below;

- 1) F/S preparation and approval (from October, 2013, to September, 2014)
- 2) Design and Construction (from October, 2014, to December, 2015)
- 3) O&M (from January, 2016, to December, 2034)

As shown in Figures 2.3.6 and 2.3.7, SPC will subcontract the above-mentioned tasks. The SPC will outsource F/S preparation and approval to Japanese and Vietnamese consultants, and outsource the design and construction works to a contractor through an Engineering, Procurement and Construction (EPC) contract. In addition, the SPC will also outsource O&M of the Yen So BPC to the O&M Company, which is supposed to be established by HSDC and a Japanese consortium.

Under these situations, the SPC is required to have management and administration staff only. The required staff of the SPC and their corresponding number is shown in Table 5.8.1.

Table 5.8.1 Required Staff of SPC

Position	Nationality/Status	Number
Chairman	Japanese/Full-time (cum Deputy General Director of JC)	1
General Director	Japanese/Full-time	1
Chief of Technical Affairs	Japanese/Part-time	1
General Staff	Vietnamese/Full-time	1

Source: JICA Study Team

5.9 Proposed Implementation Schedule

In February 2012, the implementation schedule of the BOT Project was proposed as presented below:

January 2012	Preparation of Preliminary Proposal of the BOT Project
March 2012	MOU for Selection of Investor of the BOT Project
March 2012	Submission of Proposal of the BOT Project
September 2012	Approval on addition to national BOT Project List by relevant ministries
December 2012	Selection of Investor of the BOT Project (Direct Appointment)
February 2013	Submission of Application for Business Registration and Investment Certificate to HAPI
March 2013	Issuance of Business Registration and Investment Certificate by HPC (Establishment of SPC)
April 2013 - September 2014 (18 months)	Implementation and Approval of Feasibility Study
September 2014 – December 2015 (16 months)	Implementation of EPC
January 2016 – December 2037 (22 years)	Commencement of Operation

However, the Japanese proponent could not propose the service charge acceptable to the Vietnamese side. The implementation of the BOT Project was therefore suspended.

5.10 Project Evaluation

5.10.1 Technical Evaluation

This is the first project for sludge processing in Vietnam. The Study Team proposes the Bio-solid Processing Center with hybrid process of sludge drying which consists of “Solar Green House” and “Mechanical Thermal Sludge Dryer”. As discussed in

Chapter 2, it is estimated that the cost of the process is reasonable and it will be operated effectively.

The offtaker of the Dry Sludge is proposed to be But Son Cement Company. At present, But Son Cement Company is positively considering the offtake of the Dry Sludge, however, the company is still considering conditions of the offtake, and it may take a few years to achieve the agreement through many discussions and technical considerations. Under these situations, relevant organizations are considering a plan for JICA technical assistance program on promotion of sludge processing activities for smooth implementation of the Project

5.10.2 Financial Evaluation

In the Study, the service charge of the BOT Project is estimated at US\$ 133 /ton of dewatered sludge, in order to achieve the Equity IRR of 15%. It is equivalent to US\$ 0.058 /m³ of wastewater. The service charge of wastewater treatment service (including replacement cost) is expected between US\$ 0.243 – 0.447 /m³ (US\$ 0.248 /m³ in average), which are depending on scale of WWTP. It means the service charge of the sludge processing is additionally required around 13 – 24 % of service charge of wastewater treatment. The Project FIRR (Financial Rate of Return) is estimated around 12 %. The Project shall be financially quite feasible, if the proposed service charge is accepted by HPC.

5.10.3 Economic Evaluation

At present, dewatered sludge is disposed (landfilled) at Nam Son Landfill Site and Tieu Ky Disposal Site. The cost of the landfill is low at present, however, it is supposed to be forbidden near future, because of land availability and environmental reason. In the Study, it is assumed that the landfill of the dewatered sludge will be forbidden and the dewatered sludge should be dried for decrease of the volume. Under these conditions, the Study Team proposed the BOT Project, which adopts the lowest cost method of sludge drying.

The service cost of the BOT Project is estimated around US\$ 133 /ton, which is much higher than the current disposal cost of dewatered sludge. In the current conditions in Hanoi, the landfill cost is estimated less than US\$ 50. If possible to disposal/ landfill dewatered sludge outside of the dyke in Hanoi, the economic benefit is not expected to meet the cost of the BOT Project. Only in the case that landfill site is not available, or the land cost become much more expensive, the economic benefit will meet the cost of the BOT Project, and the Project will become economically feasible.

5.10.4 Environmental and Social Evaluation

It is proposed that a Feasibility Study will be conducted after the approval of the BOT scheme. An Environmental Impact Assessment (EIA) will be carried out during the F/S. An Environmental Management Plan (EMP) will also be prepared to address any negative impact found.

A preliminary environmental assessment indicates the following positive and negative impacts.

The positive impacts of the Project include the following:

- The Project will ensure much better environmental disposal of sewage sludge compared to land filling.
- The Project will provide opportunities for resources recovery (fuel, soil nutrient).
- This project will also contribute to the reduction of global warming by reducing methane production as compared to land filling.

On the other hand, the Project will yield the following:

- Offensive odor if buffer zone is not maintained properly.

The project location is selected in a way to ensure the required buffer zone as required by Vietnamese law. Hence, odor will not be an issue.

5.10.5 Institutional Evaluation

The SPC is the executor of the BOT Project. The SPC will outsource the major works, such as F/S preparation and approval, design and construction, and O&M, to reliable companies, and the SPC will take all responsibilities of the works. The work performance will highly depend on the selection of the outsourcing companies. Therefore, outsourcing companies shall be selected carefully.