THE PREPARATORY SURVEY ON
THE DUONG RIVER WATER SUPPLY SYSTEM PROJECT
IN THE SOCIALIST REPUBLIC OF VIET NAM

FINAL REPORT

May 2012

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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TOKYO ENGINEERING CONSULTANTS CO., LTD
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PRICEWATERHOUSE COOPERS CO., LTD

Summary

This study aims to formulate the first Japan – Viet Nam (PPP) Project “The Duong River Water Supply System Project in The Socialist Republic of Viet Nam”. Based on the proposal originally submitted in 2008 by VIWASEEN, currently FS (basic study) is being undertaken by Viet Nam side, and Japan side proceeds to the Preparatory Survey. The Japanese opinions have been shared with VIWASEEN, HAWACO, and other related parties during several meetings.
This study has mainly focused on the following points, to improve the feasibility of the Project.

- Legal frameworks for PPP projects and investment conditions in Viet Nam
- Forecast of needs and demands for the project
- Water resource quality tests and analysis
- Design conditions and design summaries
- Construction and implementation schedule
- Initial environment influence study
- Economic and financial analysis
- Management and institution analysis

Based on these studies, Study Team continues examination to improve the feasibility of this Project in terms of technical, financial, and administrative aspects through meetings with the counterparts such as VIWASEEN, HAWACO and so on.
This report is composed of the following Chapters (1-8).

1. Resume of the Vietnamese economy status, and legal frameworks for PPP projects are summarized.

2. Water quality analysis

   This Chapter reports on the Duong River water quality tests. Duong River is the water source of this project, therefore tests are planned in both the rainy and dry seasons throughout the study. In this report, the results of water quality analysis, which were carried out during April, May, June, and August, 2011, are reported. Also, results of the water quality in Duong river basin, including the upper streams, are mentioned.

3. Examination of technical aspects

To set the fundamentals of this project, demand forecasts have been researched, and water supply area have been reconsidered after consulting the counterparts.

Water supply facilities plan based on safety, security and stability, as well as sustainable management maintenance plan has been proposed to maintain a long-term, reliable project. In terms of water treatment process, design criteria based on the results of the water quality analysis has been put into practice, then design and cost estimation has been worked out.

Based on the above plans, implementation schedule and O&M organization are proposed.

4. Confirmation of environmental and social considerations

This Chapter briefly describes legal frameworks and formalities, and study results of environmental consideration are summarized.

5. Investment environment

Comprehensive analysis of risks and its countermeasures are clarified based on the investigation results of Vietnamese political, economic and water related project situations for investment environment.

6. Economic analysis

Studies of extraction and quantification of economic costs, and potential variability in economic benefits are included in this Chapter.

7. Financial analysis

Pre-conditions for financial analysis are set.

8. Issues and Proposals on Management and System

The validity that investors have financial affordability to secure the stable and long-term operation is described. Countermeasures as investors for major risks are shown based on the result of risk analysis and quantification in chapter 5 and 7. The proposals to the government of both countries as necessary measures to secure the feasibility of this project are described.

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【Abbrevation】

Abbrevation	
BT	Build Transfer
BOO	Build Own Operate
BOT	Build Operate Transfer
BTO	Build Transfer Operate
CIT	Corporate Income Tax
CPI	Consumers Price Index
DARD	Department of Agriculture and Rural Development
DF	Deflator
DONRE	Department of Natural Resource and Environment
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
E/N	Exchange of Notes
EPC	Engineering, Procurement, Construction
ERAH	Environmental Protection Agency Hanoi
EXR	Exchange Rate
F.C.	Foreign Currency
FIRR	Financial Internal Rate of Return
FIRR-E	Equity Internal Rate of Return
FIRR-E	Project Internal Rate of Return
FS	Feasibility Study
FTA	Free Trade Agreement
FY	Fiscal Year
GDP	Gross Domestic Product
HAIDEP	The Comprehensive Urban Development Programme in Hanoi Capital City
HAPI	Ha Noi Department of Planning and Investment
HAWACO	Ha Noi Water Business Company
HPC	Hanoi People`s Committee

Abbrevation	
IMF	International Monetary Fund
IS	Investment, Stock
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
km	Kilometer
L.C.	Local Currency
LCC	Life-Cycle Cost
lpcd	Liter per capita per day
m^3/day	Cubic Meter per Day
M/P	Master Plan
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
MOH	Ministry of Health
MONRE	Ministry of Natural Resource and Environment
MOU	Memorandum of Understanding
MPI	Ministry of Planning and Investment
MOF	Ministry of Finance
MWRI	Ministry of Water Resource and Irrigation
NRW	Non-Revenue Water
NIURP	National Institute of Urban and Regional Planning
O&M	Operation and Maintenance
ODA	Official Development Assistance
PPI	Producer's Price Index
PPP	Public Private Partnership
PPP	Purchasing Power Parity
SBV	State Bank of Vietnam

Abbrevation	
SCADA	Supervisory Control And Data Acquisition
SIBOR	Singapore Interbank Offered Rate
SOCBs	State Owned Commercial Banks
SOE	State Owned Enterprise
SPC	Special Purpose Company
UFW	Unaccounted-for Water
UNDP	United Nations Development Program
UNICEF	The United Nations Children's Fund
USD(US$)	United States Dollers
VAT	Value Added Tax
VDB	The Vietnam Development Bank
VEA	Viet Nam Environment Administration
VGF	Viability Gap Funding
VIWASEEN	Vietnam Water Supply Sewerage and Environment Construction Investment Corporation
VINACONEX	Vietnam Construction and Import-Export Corporation
VND	Vietnamese Dong
WTO	World Trade Organization
WTP	Water Treatment Plant
WB	The World Bank

1. The Background and Necessity of the Proposed Project

1.1 Socioeconomic Situation in Viet Nam

The socioeconomic situation in according to the Ministry of Foreign Affairs in Japan is shown below.

Economic indicator	Socioeconomic situation
① Main industries	Agriculture, forestry and fisheries industry, mining, and light industries
② GDP	101.6 billion USD (about 12 trillion JPY) (Nominal value:Viet Nam statistical general bureau in 2010)
③ GDP per capita	1,169 USD (Viet Nam statistical general bureau in 2010)
④ Economic growth rate	6.78％(2010) (The previous year period: 5.32%.)
⑤ Inflation rate	11.75％（Compared with the previous year) (average index of year: 9.19%)
⑥ Unemployment rate	2.88 ％ （ Viet Nam statistical general bureau in 2010 ）（Underemployment rate 4.5%）
⑦ Trade value（2010）	(a) Export: 71.6 billion USD (25.5% decrease compared to the previous year) (b) Import: 84 billion USD (20.1% decrease compared to the previous year)
⑧ The main trade articles (2010）	(a) Export: crude oil, needlework goods, footwear, and marine products, etc. (b) Import: machine equipment and oil, steel, and cloths, etc.
⑨ Trading partners （2009）	(a) Export: The United States, Japan, China, Switzerland, and Australia *Switzerland is due to the special factor of a large amount of export of gold. (b) Import: China, Japan, South Korea, Taiwan, and Thailand
⑩ Exchange rate	About 19,500 VND = 1 USD (January, 2011)
⑪ Investment performance from	18.6 billion USD (In 2010, 17.8% decrease compared to the previous year)

	foreign country (authorization amount)	
⑫	General economic condition	(a) The result of Doi Moi began to show in 1989, and high economic growth of 9% continued in 1995-1996. However, in 1997, with the influence of Asian economic crisis, the foreign direct investment decreased suddenly, and the growth rate in 1999 had decreased to 4.8%. (b) In the 2000's, the direct overseas investment increased well, and the average economic growth rate in 2010 achieved 7.26%. The positive finance and the monetary expansion of the government succeeded even during the world economic crisis in 2009, and in 2010 reached 6.8% - exceeded the initial goal (6.5%). However, for situations like the unstabilization and a rapid grow of prices and the national currency, the macro-economics is opaque. The government has been enumerating the stabilization of macroeconomics and counter-inflation measures as a high-priority issue for the economic management in 2011. (c) Recently, Viet Nam is promoting a further market-oriented economic reform and integration into international economy and accomplished to WTO in January, 2007. But still, matters like chronic trade deficit and immature investment environment, etc. remains a concern.
⑬	External debt balance （2010）	44.5 billion USD
⑭	Foreign-Currency reserves （2010）	12.4 billion USD

The economic environment change is analyzed as follows.

1.1.1 The Change of Real GDP in Viet Nam

The GDP change of Viet Nam (the GDP of 1999 year is assumed to be 100) shows rapid growth compared to the United States of America (USA) and Japan (the currency is converted into the USD).

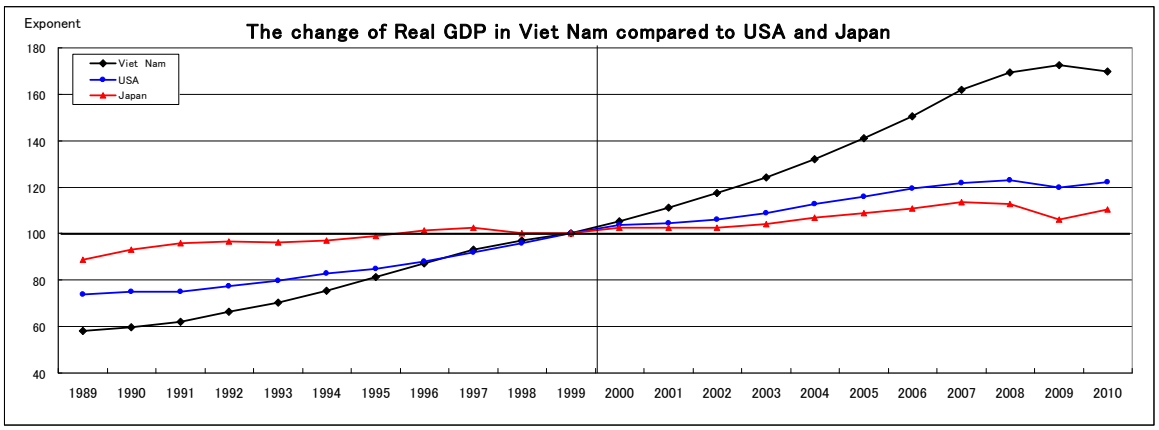


Figure 1.1.1 GDP Change of Viet Nam

The GDP real value was 74.2 billion USD in 2010(The GDP nominal value was 101.6 billion USD), and the scale is about 20 percent of Japanese GDP as shown in Figure 1.1.2 and Figure 1.1.3 below. The decreasing tendency is observed in the growth rate after attaining a peak of 8.46% in 2007.

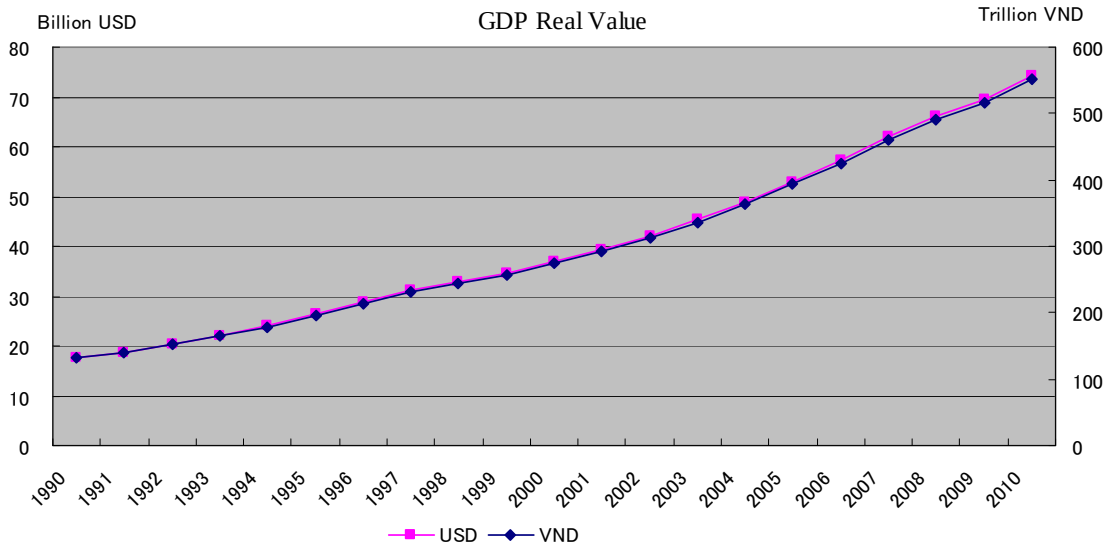


Figure 1.1.2 Transition of Real Value

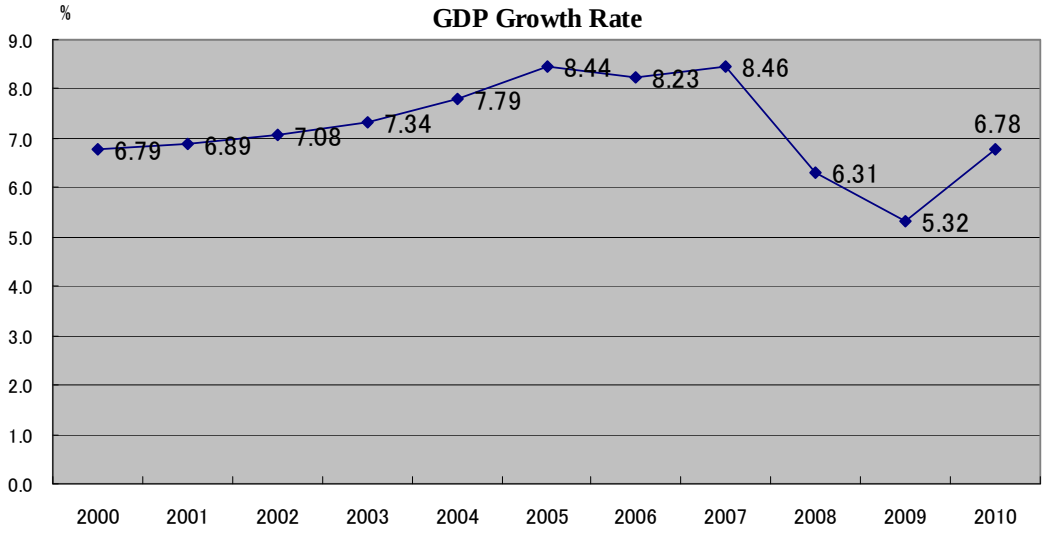


Figure 1.1.3 Growth Rate

1.1.2 Transition of Index Number of Prices of Viet Nam

In this research, three indices (the gross domestic product deflator, the producer price index, and the consumer price index) are taken up about prices of Viet Nam. The use of the analysis result of these data to the financial analysis is done according to the content.

(1) GDP Deflator

The plot of the gross domestic product deflator of Viet Nam as an index that shows price changes is presented in Figure below. It is understood that the regulation in the USD base and the yen base changes comparatively stably.

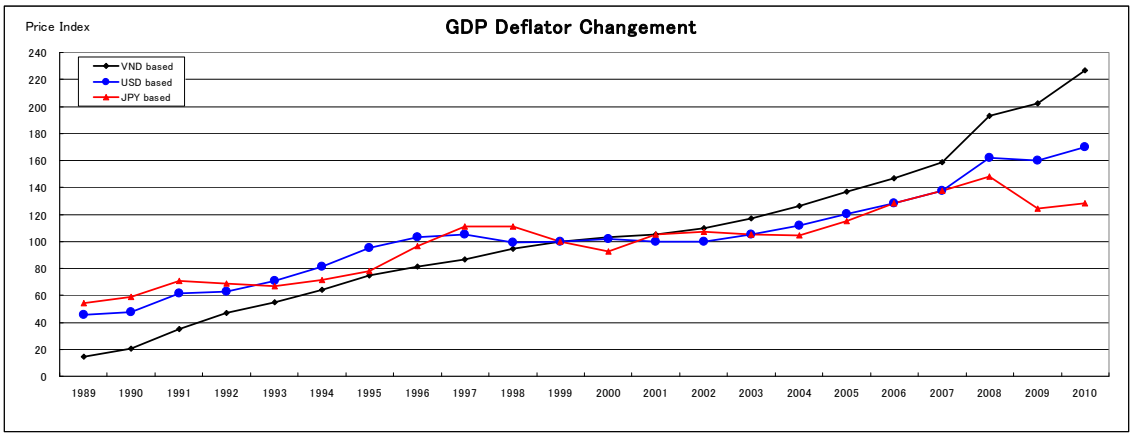


Figure 1.1.4 GDP Deflator Change

The transition of the gross domestic product deflator of referred industry and construction sector falls below the total gross domestic product deflator a little as shown in the figure.

The gross domestic product deflator is 8.32% and the GDP deflator of industry and construction sectors is 7.71% considering the average rate of growth during 11 years from 2000 to 2010.

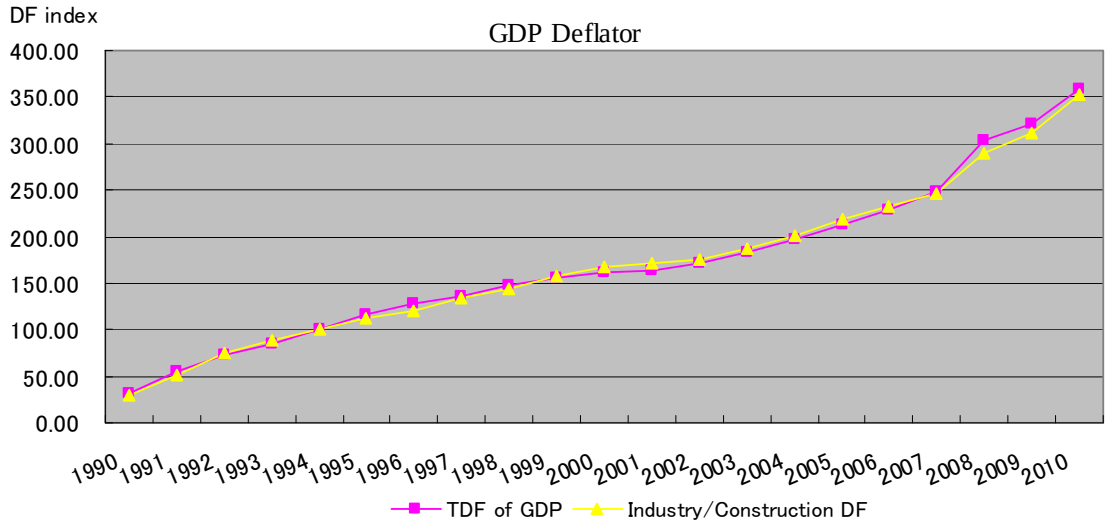


Figure 1.1.5 GDP Deflator

(2) Producer Price Index(PPI)

The change of index number of prices concerning producer described in "Viet Nam statistical general bureau" of Vietnamese government is plotted as shown in Figure 1.1.6 below.

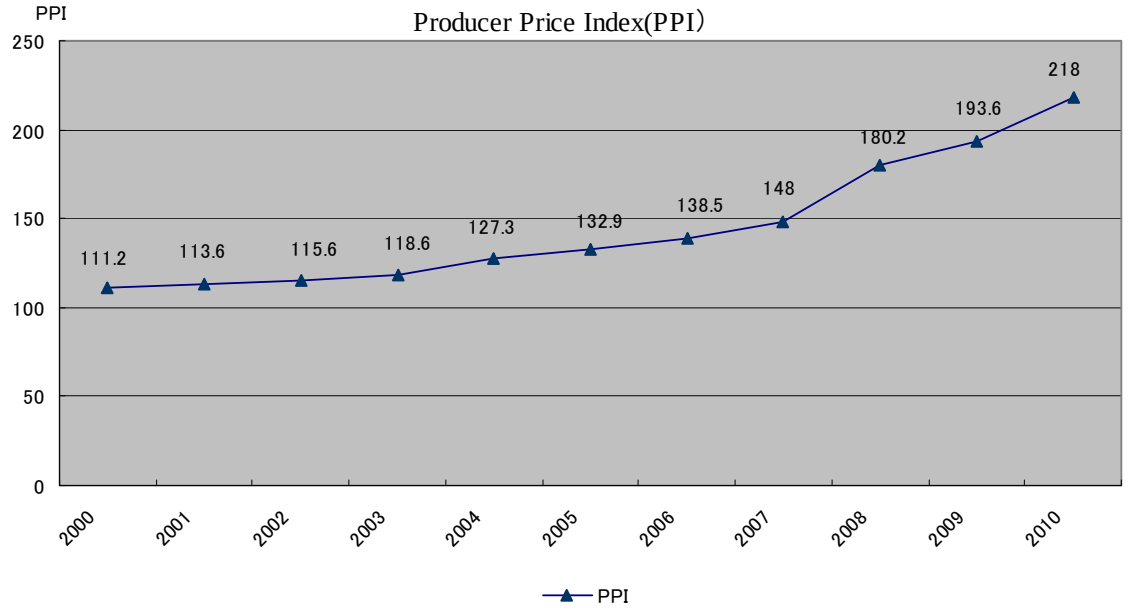


Figure 1.1.6 Producer Price Index

The average increase during 11 years from 2000 to 2010 is 6.96%/year. The average increase in the producer price index during corresponding period in case of the USA and Japan that is related to the financial analysis of this business is as follows.

- The USA: 3.84% / year
- Japan : 0.06% / year

（Data Source：Sekai no Tokei (International Statistical Compendium) in 2012）

(3) Consumer Price Index(CPI)

The changes in consumer price index according to the latest Vietnamese government "General statistics" are shown in Figure 1.1.7 below.

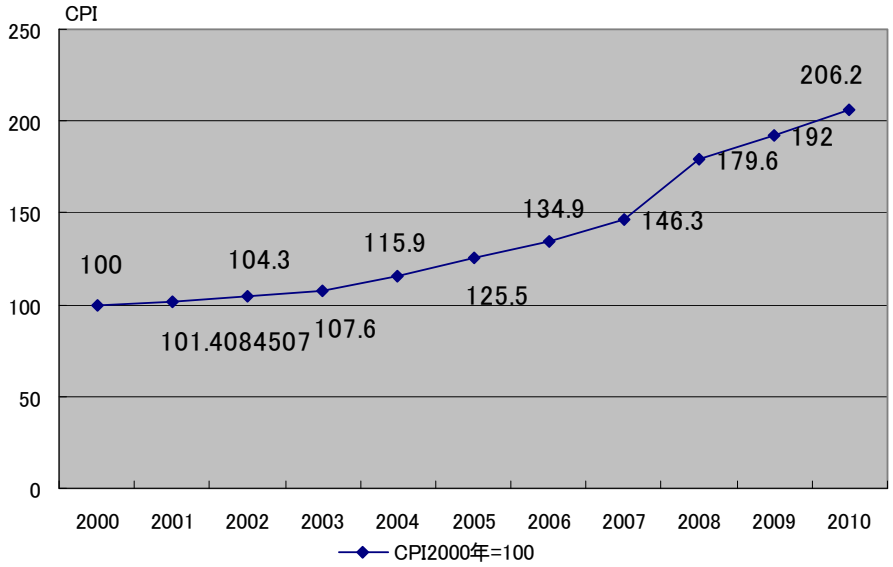


Figure 1.1.7 Consumer Price Index

The average rise from 2000 to 2010 is 6.80%/year. The average rise during 6 years from 2005 to 2010 is 10.43%.

1.1.3 Change of Purchasing Power Parity in Viet Nam

When the change of the purchasing power in the comparison with the USA and Japan to evaluate the value of Vietnamese currency VND is plotted as graph, the following points are observed. The value of the currency shows the tendency to decrease compared with the USA and Japan. This indicates that the cost spent to buy one unit of the product has risen more in Viet Nam (Value of money has decreased oppositely) than the USA and Japan compared to the prices rise and the exchange fluctuation in the USA and Japan.

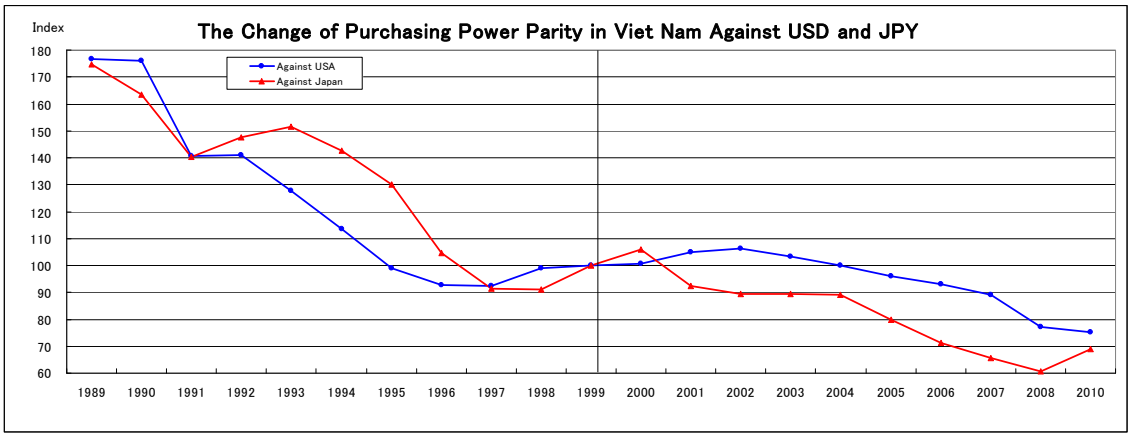


Figure 1.1.8 Purchasing Power

The relation of exchange and purchasing power parity of VND to the JPY and the USD are as shown in the figures below. These figures show that the real power value of money of VND is induced by policy against JPY and USD. In this case, the risk of the possibility of inducing the exchange movement exists besides the function of the market.

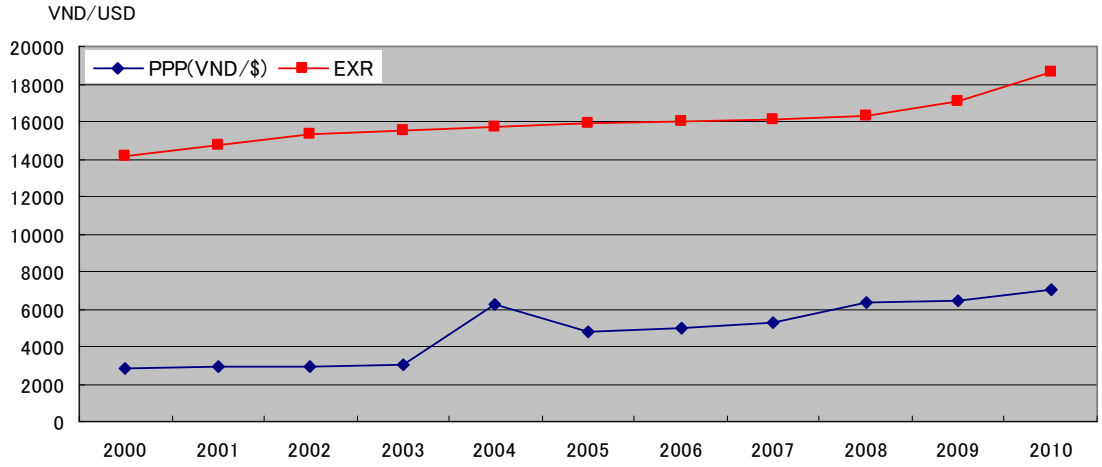


Figure 1.1.9 Relation of Exchange Rate and Purchasing Power Parity (VND/USD)

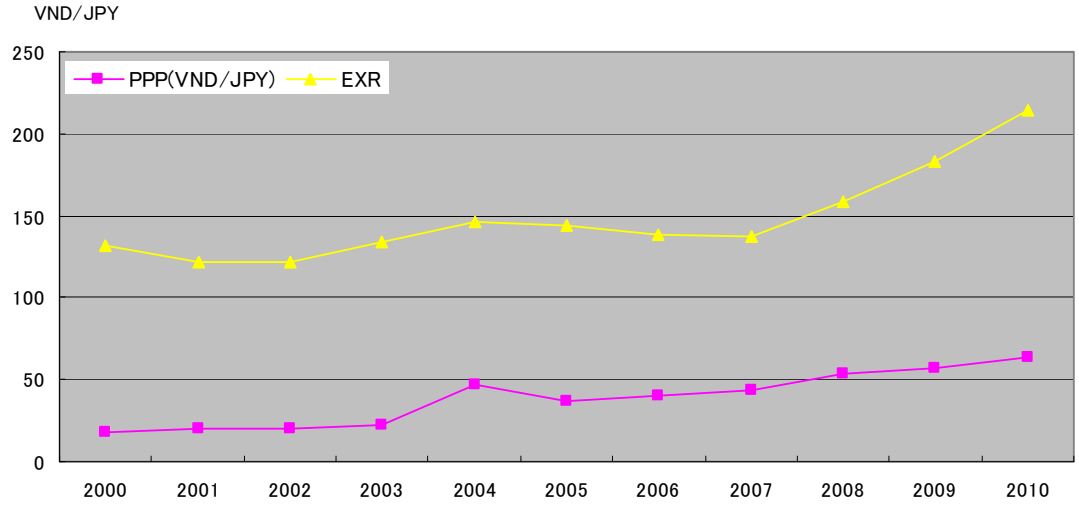


Figure 1.1.10 Relation of Exchange Rate and Purchasing Power Parity (VND/JPY)

The devaluation of VND/USD and VND/JPY from 2000 to 2010 is as follows.

- The devaluation of VND/USD: 2.76% / year
- The devaluation of VND/JPY : 4.97% / year

1.1.4 Interest Rate Change of Vietnamese Don (VND)

The change in interest rate of Vietnamese Don is shown in Figure 1.1.11. With a high inflation in 2008 the interest rate rose greatly too, but settled down in 2009. However, the level of 8%/year is higher compared with near zero interest rates of the USA and Japan. In the funding by the money market rate at this level, the feasibility of the water service project with high publicity is not easily expected.

Especially, the interest rate of the government bond that becomes the standard of the long-term yield for ten years has soared in recent years.

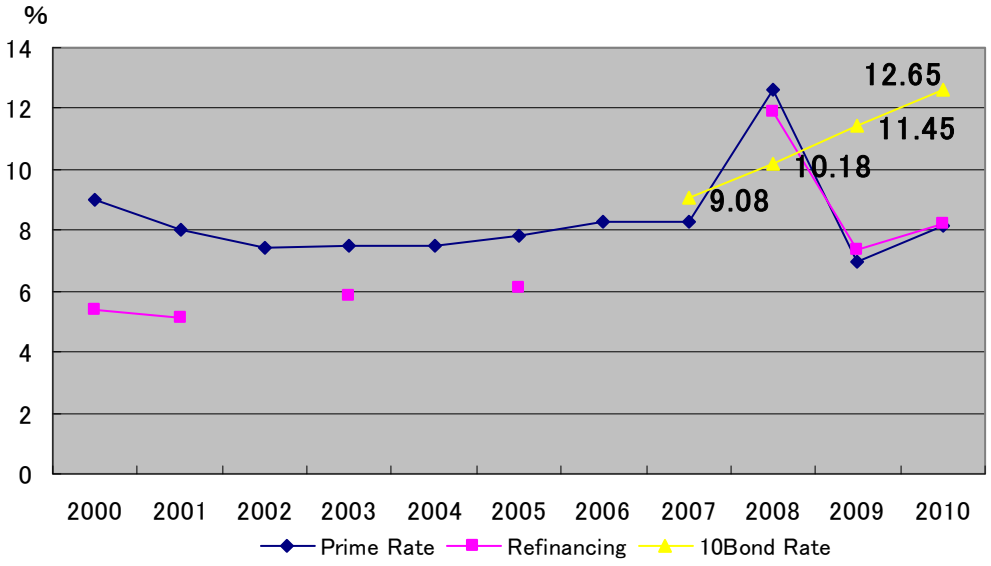
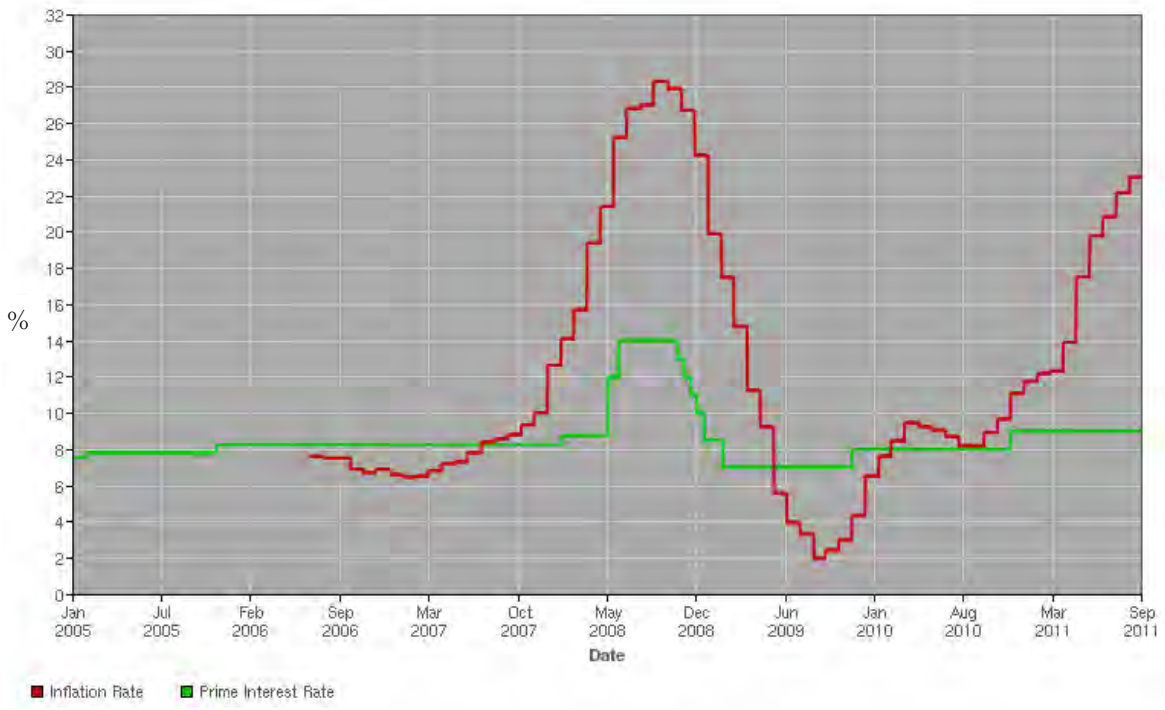


Figure 1.1.11 Interest Rate

1.1.5 Interest Rate and Inflation Rate Trend Analysis

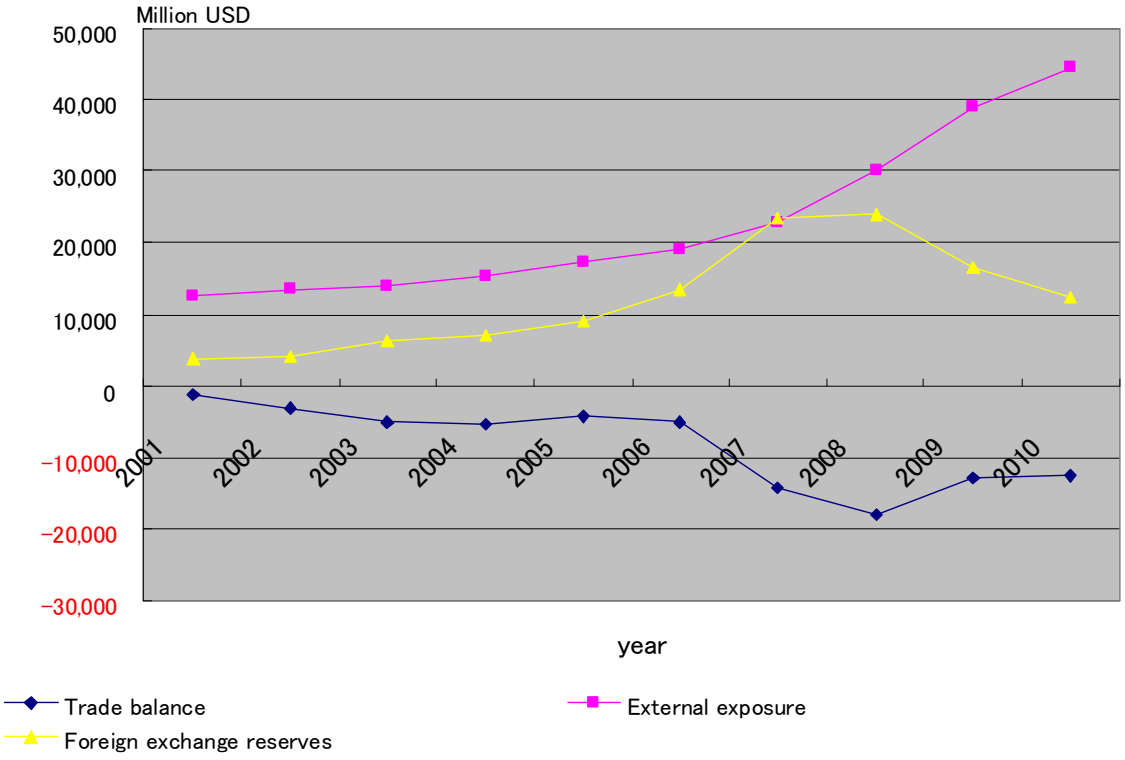
As shown in Figure 1.1.12, sharp rise of inflation rate in 2008 was once calmed down by tight-money measures controlling prime rate. After a short while of normalization, however, the inflation rate has been rising again since 2010, for which sufficient monetary policy is yet to be effected.

Current high inflation is reportedly due to the increasing trade deficit, the increasing foreign debt and the decreasing foreign currency reserve as shown in Figure 1.1.13. These economic factors caused frequent VND devaluation and increased imported goods price level. It is therefore that some effective measures for export promotion and leveling down of the import amount should be urged.



（Data Source：ADB Asis Bond Outline）

Figure 1.1.12 Transition of Interest Rate and Inflation Rate



（Data Source：JETRO Basic Economic Indices）

Figure 1.1.13 Transition of Trade Balance, Foreign Debt and Foreign Currency Reserve

1.1.6 The Transition of Ha Noi City Water Rate

Water rate revisions have been carried out nine times in last 20 years in Ha Noi City. The change of the water rate compared to the price rise is shown in Figure 1.1.14. The charge in 2009 is same as it is applied now. The water rate was left untouched because prices changed comparatively stably around 2000. After 2005, the water rate has been left untouched although the prices have gone up rapidly. If the new water tariff application is approved by HPC, the water tariff will meet the price growth.

The water rate is expected to synchronize with the price hike and is expected to be revised frequently in the future.

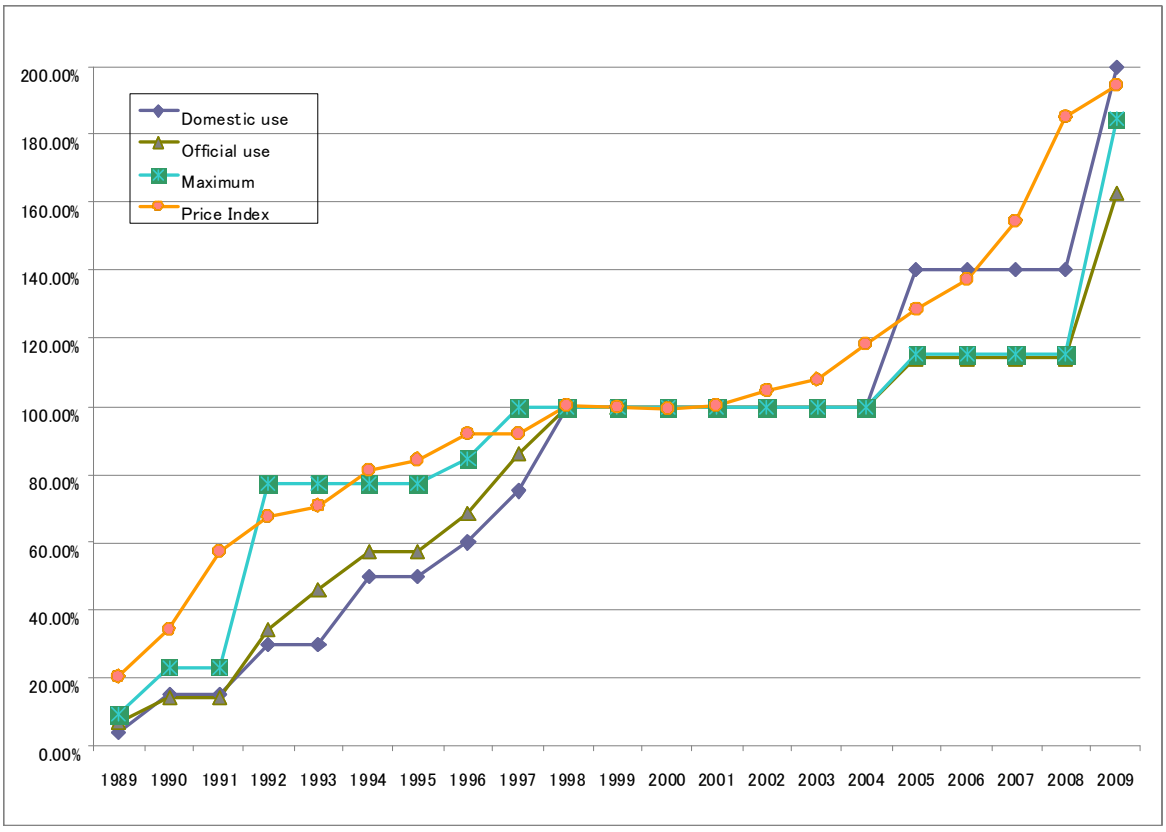


Figure 1.1.14 Water Rate Change in Hanoi

1.2 Outline of the Water Sector in Viet Nam

1.2.1 Government Agencies Related to Water Supply Sector

The Government of Viet Nam is managing the water resources in the country. For the use of river water as a source of water supply, permission should be obtained from the Ministry of Agriculture and Rural Development or People's Committee. In the Water Resources Law, regulations and laws related to river basin management, management of surface and groundwater, and their quality and quantity related laws have been defined.

Ministries involved in water sector are listed in Table 1.2.1.

The relationship among these agencies is summarized below. All the strategy and the policy concerning the water supply services in the urban and rural areas require approval from the Prime Minister. Ministries concerned possess power concerning the policy, and submit major project to obtain the approval of the Prime Minister. At present, in case of the special urban water supply projects with capacity of 30,000 m^3/day or more and water supply projects for smaller cities with capacity of 10,000 m^3/day or more needs mutual agreement in the form of the document from the Ministry of Construction.

On the other hand, People's Committee in each prefecture takes the responsibility for investment projects of 200 billion VND or less. Projects which cost 200 billion VND or more needs approval from the office of the Prime Minister. In all the cases, City Water Supply Corporation is responsible for the water supply services, the operation, and management of the water treatment plant and water distribution networks.

Table 1.2.1 Government Agencies in Viet Nam Related to Water Supply Projects

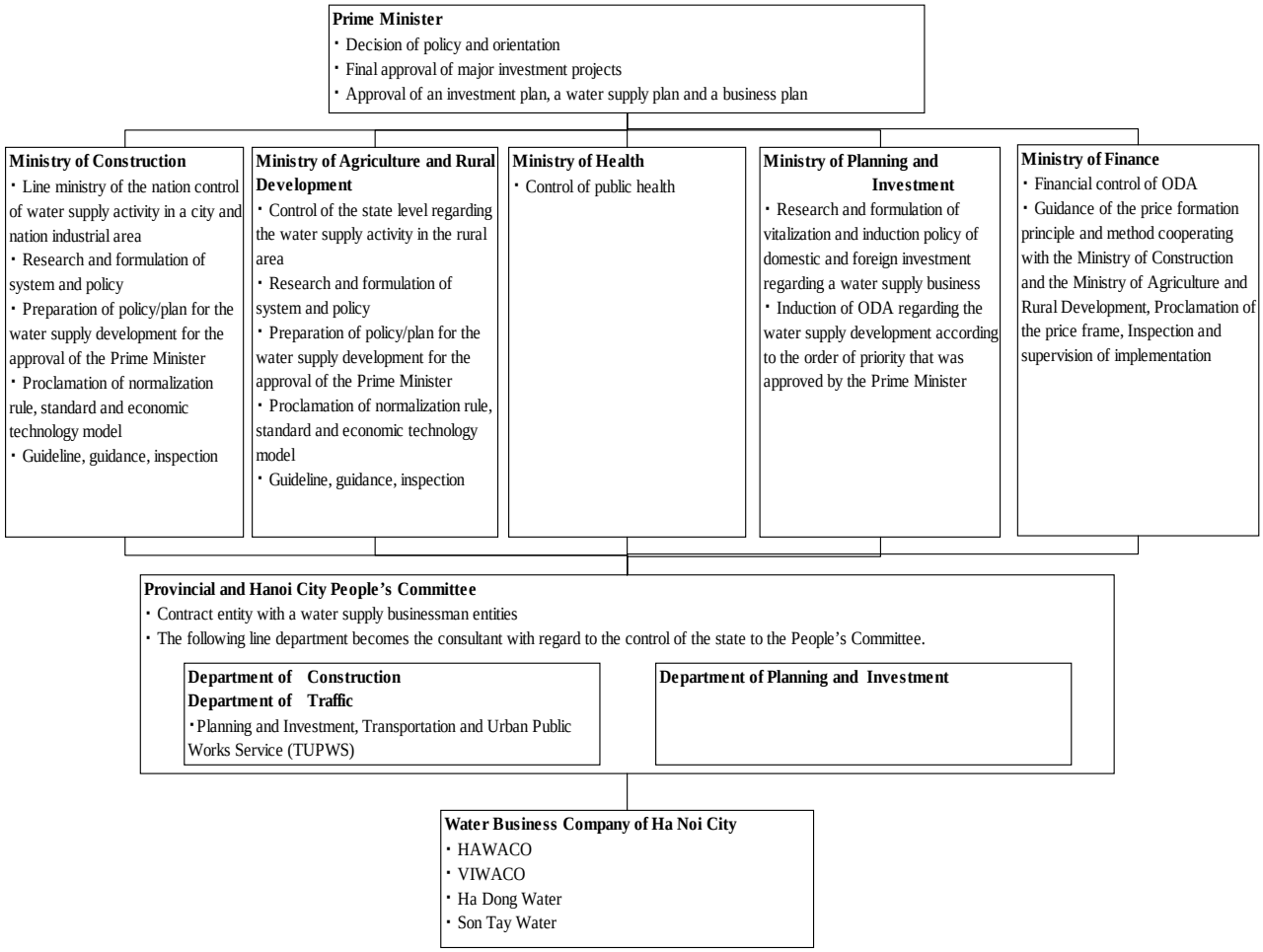
Organization	Functions
Prime Minister (PM)	Policy decisions related to the national strategy on water projects, final approval of major investment projects, the approval of water supply planning projects and investment plans
Ministry of Planning and Investment (MPI)	State budget allocations, approval of major investment projects in MPI: domestic and foreign investment to improve water supply services in accordance with the priorities of the Government approval of the ODA and implementation
Ministry of Finance (MOF)	Distribution of state funds, setting the annual target areas,

Organization	Functions
	regulation of the accounting: financial management of ODA related to water, the promulgation of the water tariff frame, inspection, and supervision of the implementation
Ministry of Health (MOH)	Management of public health (drinking water quality management)
Ministry of Natural Resources and Environment (MONRE)	Water resources, water use, pollution control
Ministry of Science and Technology (MOST)	Standards and technical management of the water sector
Ministry of Construction (MOC)	State Administration of specialized areas of water supply activities and national industrial city: Submission of the Government's policy research, preparation of plans for approval of the Government policies, guidance and inspection
Ministry of Agriculture and Rural Development (MARD)	Specialized ministry for rural water supply
Hanoi People's Committees (HPC)	Entity responsible for execution of water projects, Ha Noi City.
Department of Natural Resources and Environment (DONRE)	Specialized agencies on the registration for land use for construction of the water treatment plant and the permission for discharge to water body
Hanoi Authority for Planning and Investment (HAPI)	Specialized agencies on the investment in the water supply business activity of the People's Committee
Hanoi Transportation and Urban Public Works Service (TUPWS)	Ha Noi City water project planning, water management corporation
Hanoi Water Limited Company (HAWACO)	Water services enterprise of central area of Ha Noi City
Fresh Water Business and Construction Investment JSC (VIWACO)	Water services enterprise of southwestern area of Ha Noi City
Ha Dong Water One Member Limited Liability Company (Ha Dong Water)	Water services enterprise of Ha Dong District and southwestern area of Ha Noi City
Son Tay Water supply Company (Son Tay Water)	Water services enterprise of western area of Ha Noi City

1.2.2 Relationship Chart for the Ministries Related to Water Supply Services

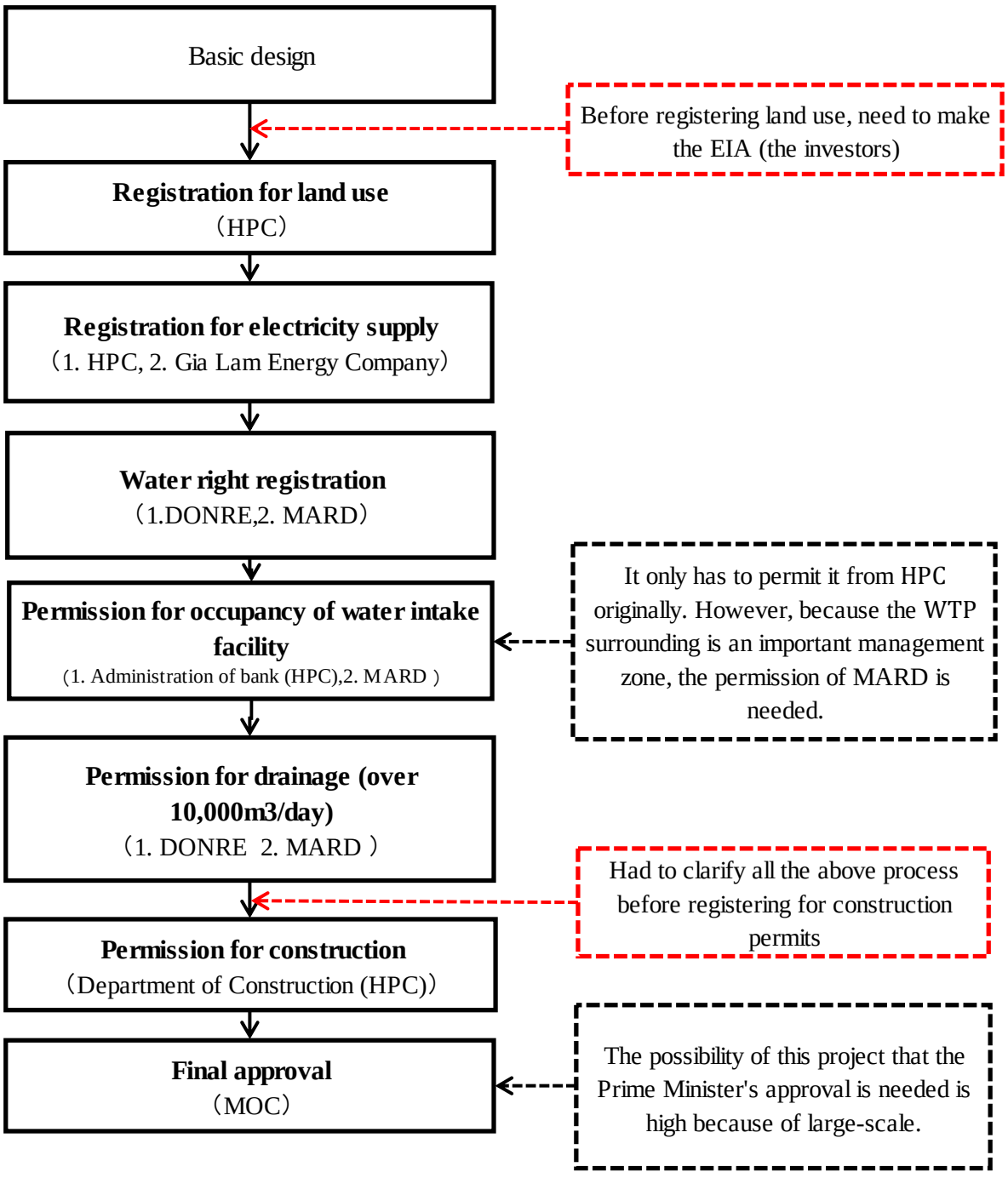
Since this project is private financing public service project, it is necessary to be approved by MOC, MPI and PM for final approval.

Figure 1.2.1 shows the relationship chart for the Ministries related to Water supply Services.
Figure 1.2.2 shows the procedure for project approval.



(Source: Compiled based on information through discussion with several local Agencies)

Figure 1.2.1 Relationship Chart for the Ministries Related to Water Supply Services



(Source: Compiled based on information through discussion with several local Agencies)

Figure 1.2.2 Procedure for Project Approval

1.3 Legal Frameworks Related to Water supply Business Under Public-Private Partnership

1.3.1 Legal Frameworks Related to Water Supply Project

(1) Legal Frameworks

The legal frameworks of Viet Nam related to water supply projects are listed in Table 1.3.1

Table 1.3.1 Legal Frameworks Related to Water Supply

No.	Legal System and Number	Promulgating Agency	Overview
1	Law No.08/1998	Prime Minister	Water resources law: Main purpose setting policy on the use of water resources management, rights and duties to be abided by the government offices concerned and users
2	Decree No.179/1999	Prime Minister	Law related to policy and implementation of water resources law
3	Decision No.63	Prime Minister	Plans for the development of urban water supply for the year 2020
4	Directive No.04	Prime Minister	Clean water production, supply and consumption management
5	Decree No.117	Ministry of Construction	Decree on clean water production, supply and consumption of clean water
6	Circular No.01/2008	Ministry of Construction	Guidelines to implement Degree No.117
7	Decree No.149/2004	Prime Minister	Regulations on the licensing of exploration, exploitation and use of water resources and regulation of discharge of waste water into water sources
8	Circular No.2/2005	Prime Minister	Guideline to implement Degree No.149
9	Inter-Circular No.95/2009	Ministry of Finance	Pricing Principles, method for determination and authority to decide clean water consumption price
10	Circular No.100/2009	Ministry of Finance	Regulation of domestic use water tariff

11	Law No.59/2005	National Assembly	Investment Law
12	Decree No.108/2006	Ministry of Planning and Investment	Guidance for the implementation of investment law
13	Decision N0.1088/2006	Ministry of Planning and Investment	Document forms for implementing investment procedure
14	Law No.60/2005	National Assembly	Enterprise Law
15	Decree No.102/2010	Prime Minister	Enforcement regulation of Enterprise Law
16	Decree No.43/2010	Prime Minister	Business regulation
17	Law N0.13/2003	National Assembly	Land Law
18	Decree No.23/2003	Prime Minister	Regulation of transaction and distribution of foreign invested enterprises in Viet Nam
19	Circular No.09/2007	Ministry of Commerce and Industry	Guidance for Decree No.23
20	Circular No.05/2008	Ministry of Commerce and Industry	Amendment of Circular No.09
21	Decision No.10/2007	Ministry of Commerce and Industry	Roadmap of goods trading and activities directly involving goods trading
22	Law on Natural Resources Royalties No.45/2009	National Assembly	Law on royalties for natural resources utilization
23	Law on Corporate Income Tax No.14/2008	National Assembly	CIT Law
24	Decree No.124/2008	Prime Minister	Enforcement regulation of laws on corporate income tax
25	Circular No.130/2008	Ministry of Finance	Guidelines on/for implementing Degree No.124
26	Circular No.18/2011	Ministry of Finance	Amending and supplementing Circular No.130
27	Circular No.201/2009	Ministry of Finance	Guiding management of exchange rate difference in enterprises
28	Decree No.34/2008	Prime Minister	Regulations on recruitment and management of foreigners working in Viet Nam

29	Law No.04/2007	National Assembly	PIT Law
30	Decree No.50/2010	Prime Minister	Guidance to Law on natural resources royalties
31	Circular No.105/2010	Ministry of Finance	Guidance to Decree No.50
32	Circular No.134/2008	Ministry of Finance	Tax obligations imposed on foreign organizations/individuals doing business or having income in Viet Nam
33	Circular No.197/2009	Ministry of Finance	Supplement to Circular No.134
34	Circular No.203/2009	Ministry of Finance	Regulation on management, use and depreciation of fixed assets
35	Decree No.108/2009	Prime Minister	Decree on investment in the form of BOT, BTO or BT contract
36	Decree N0.24/2011	Prime Minister	Amendment of Decree No.108
37	Circular No.03/2011	Ministry of Planning and Investment	Guidance to Decree No.108
38	Decision No.71/2010	Prime Minister	Regulation on pilot investment in the Public-Private Partnership form
39	Decision No.134/2005	Prime Minister	Regulations on control of foreign loans and loan repayments
40	Decision No.272/2006	Prime Minister	Regulations on issuance and management of the Government guarantees for foreign loans
41	Circular No.04/2001		Guidelines on foreign exchange management with foreign invested enterprise and foreign parties participating in business cooperation contracts
42	Decision No.181/2007	Ministry of Finance	Decision on re-lending of the Government's foreign loan and assistance capital
43	WTO Commitment/2007		WTO Commitments
44	Law No.52/2005	National Assembly	Laws on environment protection
45	Law No.61/2005	National Assembly	Tendering Law
46	Circular No.186/2010	Ministry of Finance	Guidance on offshore remittance of profits earned by foreign organizations and individuals from their direct investment in Viet Nam

47	Circular No.108/2007	Ministry of Finance	Guidance on financial management mechanism applicable to Official Development Assistance projects and programs
48	Decree No.15/2011	Prime Minister	Regulations on provision and management of government guarantees

（Source: Overview of the discussions and collected information during field visit in Viet Nam）

(2) Laws Related to Water Tariff

1) City categories and water tariff price frames

For urban area water supply projects, cities are categorized as given in Table 1.3.2, and all laws follow this categorization

Table 1.3.2 City Categories

Category	Type	Population	Numbers
Special Class	Largest Cities	Over 1,500,000	Ha Noi, Ho Chi Minh
Category I	National Cities	500,000～1,500,000	3 Cities
Category II	Regional Cities	250,000～500,000	12 Cities
Category III	Provincial Cities	100,000～250,000	16 Cities
Category IV	District Towns	50,000～100,000	58 Towns
Category V	Townlets	4,000～50,000	612 Townlets

Source：Decision No.38/2005 “Water supply and Sanitation Strategy”

The World Bank in Viet Nam, 2006

According to the above categories, the water tariff price frame is set as presented in Table 1.3.3. The cities decide their tariffs following this frame. Table 1.3.4 shows the current water tariff practiced in Ha Noi City.

Table 1.3.3 Water Tariff Price Frame

Category	Minimum tariff(VND/㎥)	Maximum tariff（VND/㎥)
Special Class, Category I	3,000	12,000
Category II, III, IV, V	2,000	10,000
Agriculture	1,000	8,000

Source：Decision No.100/2009 ;”On the consumption price frame of clean water for daily life”

MOF, July 2009

Table 1.3.4 Water Tariff Applied in Ha Noi City (2009)

Consumed Amount	Without tax (VDB)	VAT(5%)	EPF(10%)*	Include tax（VDB）
Up to 16m3	3,478	173	347	4,000
16 ㎥ - 20m3	4,086	204	408	4,700
20 ㎥ - 35m3	4,956	247	495	5,700
Over 35m3	8,173	408	817	9,400

*: Environment Protection Fee (EPF) is regulated by Law on Environment Protection, 2005

Source: Decree No.119/2009(Clean water tariffs inside Hanoi district), field study

1.3.2 Approval Process for Privatization of Water Supply Project

On the basis of collected information through discussion with related agencies, the approval process for privatization of water supply projects is presented as flow diagram in Figure 1.3.1

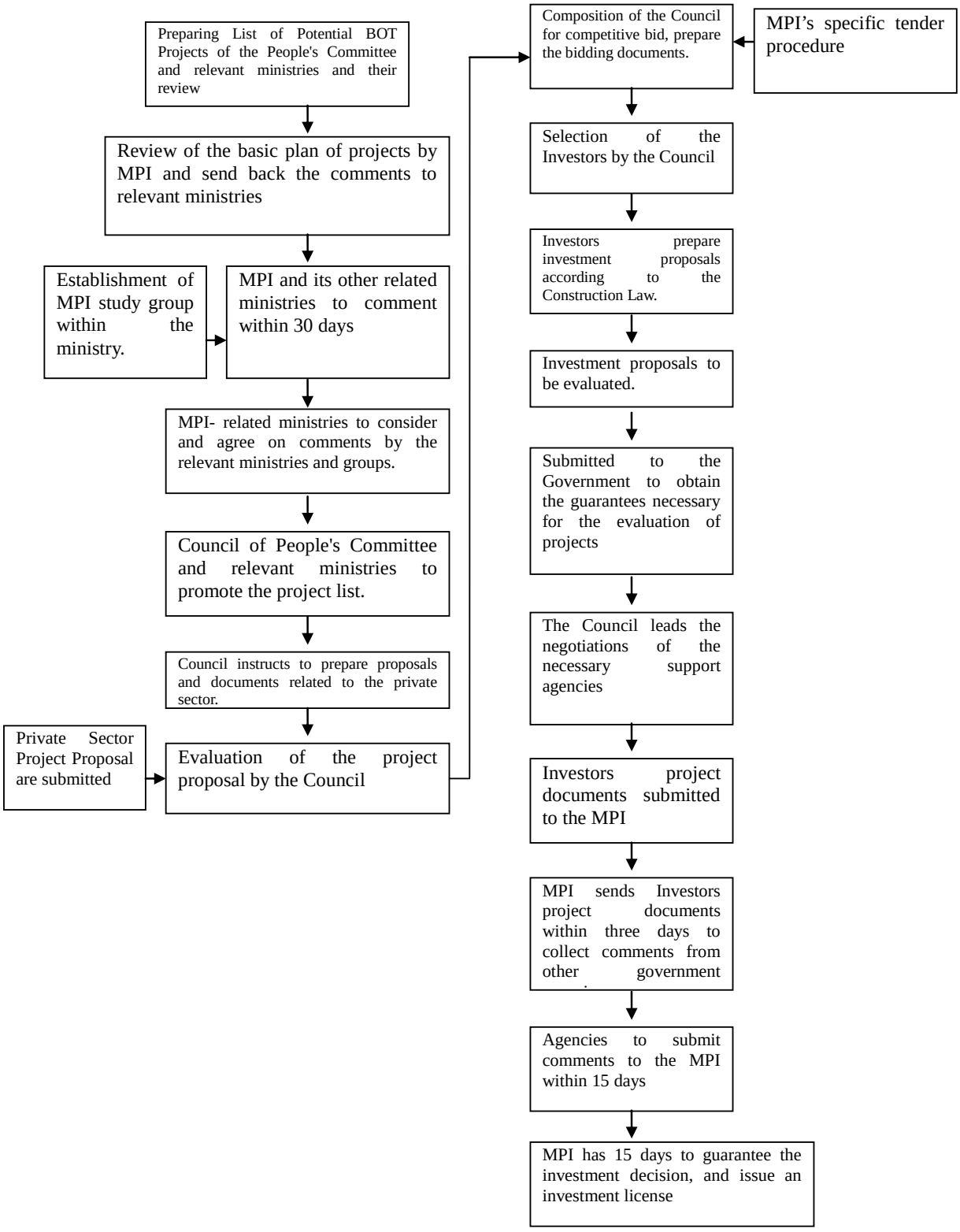


Figure 1.3.1 Flow Diagram of Approval Process for Privatization of Water Supply Projects as Per Government Ordinance No.37

1.3.3 JICA PSIF (Private Sector Investment Finance)

In cabinet decision "New growth strategy" on June 18, 2010, "after researching and evaluating both success and failure examples of the past, and reconstructing risk examination and management system, Japan International Cooperation Agency (JICA) shall restart overseas investment and accommodation (PSIF) to correspond to matters with high development effect", was declared.

The outlines of PSIF are as follows.

(1) Finance Technique
Direct financing and investment

(2) Loan and Finance Subjects
Corporations in our country or the developing world (individual firm, SPC, and fund)

(3) Object Field
- MDG, poverty reduction (BOP business, microfinance, etc.)
- Infrastructure and growth acceleration (PPP infrastructure business etc.)
- Climate change measures
(Projects, which are covered by existing financial institutions, are excluded.)

(4) Loan Terms (Yet to be decided, the following are opened).
- Loan condition :Basically, Loan and deeds
- Loan ratio: Basically 70 % of total investment cost, maximum is 80 %, if it is approved (depends on the project characteristics)
- The redemption term : Basically, 20 years, maximum 25 years.
- Period of deferment : Basically, 5 years
- Annual interest rate : based on 1.7 % (fiscal loan fund condition), the interest rate is decided so as to achieve more than 25 % of grant element.
- Security (mortgage), Guarantee : JICA will request.
- Loan currency was yen in the past. September, 1972, foreign currency loan was introduced. This was due to the rapid increase of the foreign currency reserve of Japan, and the policy to reduce the exchange risk by promoting foreign direct investment.

(5) Investment

- Method: Direct investment to local companies. Invest rate is to be under 25%, thus lower than the main stockholder.

1.4 Outline of Natural Condition in Greater Hanoi

This region experiences temperate zone climate, and from May to October rainy season occurs. It is hot and humid in summer, whereas the winter is dry and cold.

In Hanoi, the average temperature is 16℃ in January and 29℃ in July, the average humidity is 84 - 86%, and the annual average precipitation is 1,704mm. Comparatively, the distinction at the dry season and the rainy season is remarkable, and the amount of mean monthly rainfall in the rainy season is 238mm, about twice of Japan. Especially, influence on the construction is feared because there is precipitation of 250mm or more from July to September. As for the number of rainy days, it rains about 15 days a month during March to September.

Moreover, it is necessary to avoid the construction that relates to the water intake facilities and the river crossing parts of transmission pipeline in the rainy season because the river water level of Red River and Duong River may increase greatly.

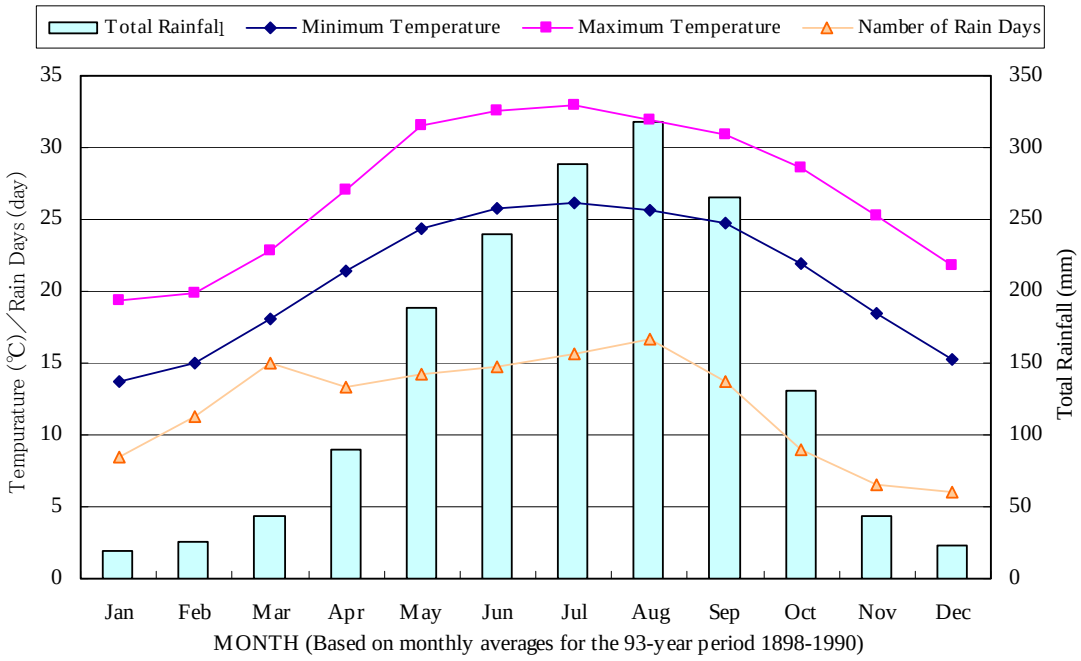


Figure 1.4.1 Monthly Mean Temperature and Rainfall in Ha Noi City

1.5 Needs of the Project

The existing WTP in Ha Noi City is mainly of small capacity and uses groundwater source, which is rather simple in terms of water treatment process (less expensive) in comparison to the water supply system using surface water source with high turbidity and of larger scale. Recently, because of too much use of groundwater for both drinking and industrial purposes, the subsidence (reported as 41mm/year), and water quality deterioration are severe in this area. For this, the Government of Viet Nam has shifted the policy from use of groundwater source to surface water source for these purposes.

As already mentioned, the Greater Hanoi includes capital city of New Hanoi and the surrounding 6 provinces. The Greater Hanoi is divided into two regions, the north and the south, by Red River. In the southern region, there are 15 large WTP (over 10,000m^3/day) operated by 4 water works. There also exists Da River water treatment plant, operated and managed by VINACONEX. Since the water treatment capacity of the Da River project is planned to be increased from 300,000m^3/day to 600,000m^3/day (and finally to 1.2 million m^3/day), it is expected to be able to respond to the increasing water demand of the southern region.

On the other hand, in the northern region, there are only 3 large WTP. It is difficult to expand the capacity to cover water demands in the northern region, because all WTP uses groundwater source.

In this situation, since many industrial parks and residential parks are under construction, water-resource development is a severe issue for catering to increasing water demand of this area.

Moreover, in the existing situation only about 60 percent of the water demand is supplied in rapidly growing Ha Noi City.

A plan by the Vietnamese government aims to construct water supply systems by 2015, and to supply sufficient clean water for each city and the industrial parks. Therefore, 300,000m^3/day scale of this project is urgent and needed.

No.	Name of Province
1	Lai Chau
2	Lao Cai
3	Ha Giang
4	Cao Bang
5	Lang Son
6	Bac Can
7	Thai Nguyen
8	Tuyen Quang
9	Yen Bai
10	Son La
11	Phu Tho
12	**Vinh Phuc → partially merged with Hanoi → The greater Hanoi**
13	**Hanoi → The greater Hanoi**
14	Bac Giang
15	**Bac Ninh → The greater Hanoi**
16	Quang Ninh
17	Hai Phong
18	**Hai Duong → The greater Hanoi**
19	**Hung Yen → The greater Hanoi**
20	**Ha Tay → wholly merged with Hanoi → The greater Hanoi**
21	**Hoa Binh → partially merged with Hanoi → The greater Hanoi**
22	Thai Binh
23	**Ha Nam → The greater Hanoi**
24	Nam Dinh
25	Ninh Binh
26	Thanh Hoa

1.6 Confirmation and Understanding of Environmental and Social Aspects

VIWASEEN is the enterprise that is responsible for preparing the FS report (including the EIA) of this Project and FS preparation is now ongoing. Detail of the EIA will be confirmed after submission of VIWASEEN's EIA.

The outline of the content confirmed with respect to the environmental and the social aspects is described as follows.

1.6.1 Current State of Water Environment

Water supply in Ha Noi City, which is the target area under this project, depends on groundwater sources mainly. However, rapid increase of water demand is expected, and occurrence of land subsidence and groundwater contamination has become a major concern to the Government of Viet Nam. In response to these conditions and to meet the increasing water demand, the Government has designated the utilization of river surface water sources as a basic policy. Also, the government has set forth the policy of utilizing private sector in the field of urban water supply service. In regard to this policy, it is stated that the price hike of water tariff is approved by the government, as for radical price rising, it is concerned that social problems are arising. However, the existing level of water tariff does not result into full cost recovery, therefore problems exist in the management.

Through the implementation of this project, it is expected that the negative impacts of land subsidence and groundwater contamination could be avoided or mitigated. At the same time, the effective use of the abundant water resource will ensure promotion of public welfare. It is expected that the maintenance of social fairness of water tariff could be assured with the application of PPP business scheme and reform of the water supply services through privatization.

1.6.2 Land Subsidence

(1) General Description

According to the report of "Water supply Plan for Hanoi Metropolitan Area", National Institute of Urban and Rural Planning, Ministry of Construction, June 2007, land subsidence rate is reported as 15 - 23 mm/year, the area with maximum land subsidence is located in southern part of Ha Noi City. With alluvial formation, which consists of the sand and the gravel stone, etc., of the Red River bank, the investigation of subsidence is not done. According to the past records, around Thanh Cong area, the ground level subsided by 44.77 mm in year 2000, and by 40.88 mm in year 2003. Around Mai Dich, the subsidence during 1998 to 2003 varied in the range of 1.2 - 4.3mm/year. In addition, the circumstance of land subsidence monitoring is done by measurement. As for past subsidence rate, it was observed as 13 - 18mm/year from the measurement result which is obtained through leveling survey around Tay Lake and the Red River. The distribution chart indicating subsidence is shown in Figure1.6.1.

In some areas of Ha Noi City, it is a well-known fact that land subsidence has become intensified with the excessive pumping of groundwater. It is anticipated that if the groundwater is used at the same pace, the problem of land subsidence will accelerate and also result into the depletion of groundwater to significant level in near future. Water supply services for domestic non-commercial sector and water for industrial use in Ha Noi City still to a greater extent depends on groundwater. It is confirmed that, presently there are over 170,000 of large and small wells, and they are mainly concentrated on the right bank of Red River and in southern part of city. The inhabitants and organizations are digging wells and pumping the groundwater without any plans. In addition, in recent years, there have been rapid advancement in development of the road pavement and concrete, and it has made it difficult for rainwater to infiltrate underground. Furthermore, there are few cases in which the groundwater is polluted by the influx of untreated municipal sewage.

In 2007, "The Comprehensive Urban Development Programme in Hanoi Capital City of the Socialist Republic of Viet Nam" was formulated by JICA. In this programme, to cater to the increased water demand and urbanization, and also, in order to prevent the above-mentioned land subsidence and water pollution of groundwater, it was proposed that the capacity of water treatment plant should be increased and there is a necessity to shift from groundwater to surface water sources.

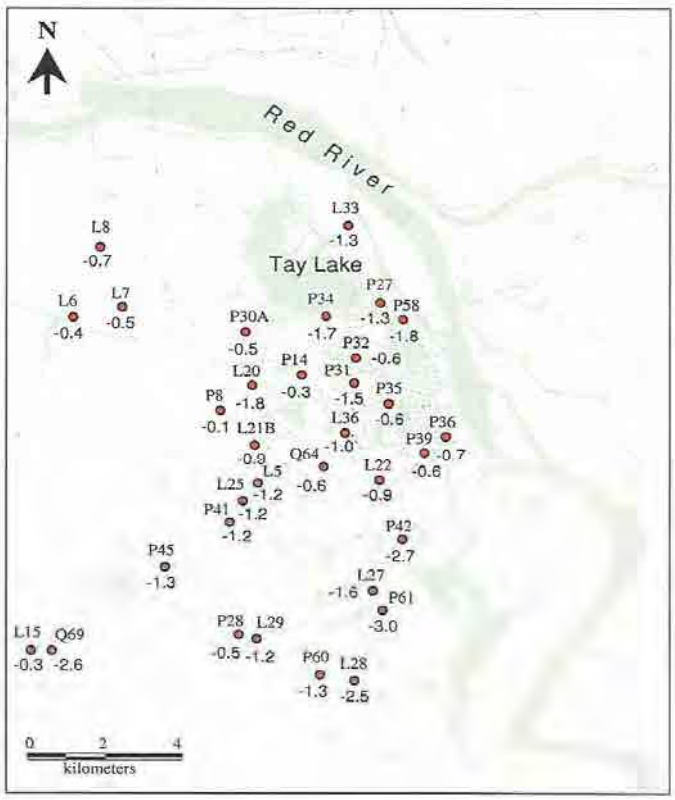


Figure 10. Locations of benchmarks listed in Table 1. Numerals represent annual rates of subsidence revealed by leveling survey in the period 1994-1995.

（Source：Spatial Distribution of Subsidence in Hanoi Detected by Jeres-1 Sar interfero & Metry）

Figure 1.6.1 Situation of Subsidence

1.6.3 Groundwater Contamination

In terms of the groundwater contamination, ammonia and arsenic are problems. As for pollution by ammonia, quantitative data was unavailable. Instead, reference has been made to the report “Arsenic pollution that extends to Asia” published by Asian Arsenic Network (AAN) for information on the arsenic pollution.

(1) Description

Arsenic contamination in Viet Nam was first reported in 2000. It was reported that arsenic had been detected in a limited region around Hanoi in groundwater. Afterwards, UNICEF carried out an investigation related to the arsenic pollution in entire Viet Nam from 2000 to 2002, and published a report in 2004. For the survey, 25 (out of the total 60) prefectures were selected nationwide and water samples were collected from 18,000 wells selected randomly. The result of this survey indicated that in more than 1 % of the wells located in 9 prefectures, the arsenic concentration exceeded 0.05ppm, in another 1 % wells located in 10 prefectures, the concentration exceeded 0.01ppm. Of the 9 prefectures with arsenic pollution, 7 are located in the Red River basin.

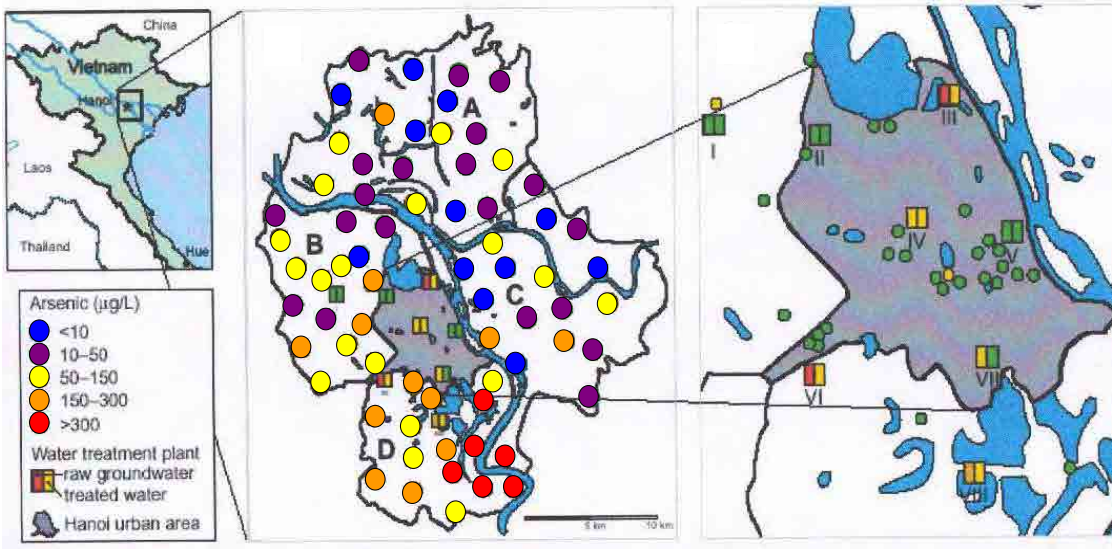
As for the cases of arsenic pollution in entire Viet Nam, neither the concentration nor the areas affected are severe compared to Bangladesh. However, there is a region located in the Ha Nam prefecture in the southern part of Hanoi where the arsenic pollution is intense. The confirmation of diseases caused by arsenic has not been investigated by the government agency yet. However, it is said that there are patients in the Ha Nam prefecture and Mekong region Duong Thap prefecture.

(2) Investigation of Hanoi University

From the reports, it is understood that groundwater contamination in this area is due to presence of ammonia, manganese, iron and arsenic. Regarding arsenic problems in the region, Hanoi University reported as described below.

According to the pollution distribution chart of the Hanoi prefecture (Figure 1.6.2), the concentration tends to be low in the left bank region of Red River, whereas it is higher in the right bank region. It is clear that the arsenic concentration is high in southern part of right bank of Red River.

The decrease in the groundwater level of Ha Noi City is thought to be one of the main factors. The total groundwater use in the Hanoi region is about 550,000 tons/day, composed of 400,000 tons/day from 8 public wells, 120,000 tons/day from the 500 privately-owned wells, and 35,000 tons/day from the suburb well installed by UNICEF. The total groundwater uses in 12 surrounding prefectures is reported as 1.15 million tons/day (Figure 1.6.2).



（Source：Pham Hung Viet and others, 2001）

Figure 1.6.2 Arsenic Pollution Situation in Hanoi

Figure 1.6.2 shows that in the Study Area, the south of Hanoi area is polluted by arsenic. Hanoi Water supply Company is gradually reducing the water supply from the water treatment plants in the south area, where the source of water is polluted. In the future, these treatment plants are expected to be abandoned.

(3) Investigation of UNICEF

UNICEF, since 2001, carried out a nationwide sample survey and published the results as report ("Arsenic Contamination in Vietnam" UNICEF 2004b) in October, 2004. The prefectures with arsenic pollution of 0.01mg/L or more are shown there. The arsenic pollution is concentrated in Red River and the Mekong River according to the pollution map. Table 1.6.1 shows the Red River pollution level based on the UNICEF report.

On the whole, arsenic contamination of well water is low in case of Viet Nam compared to other countries. However, in case of Ha Nam, the pollution level is of the same level as Bangladesh. Fortunately, the use of well water in Ha Nam has been for short duration (less than 10 years), and patients with symptoms causes by arsenic have not been reported yet. However, if immediate countermeasures are not undertaken, serious health hazards may occur.

Table 1.6.1 Arsenic Pollution Situation of Red River Basin

	Sample	0.01 ㎎/L or more		0.05 ㎎/L or more	
		Sample	%	Sample	%
Ha Noi	824	414	49.3	199	23.3
Ha Tay	1,368	638	46.6	338	24.7
Hung Yen	3,384	700	20.7	310	9.2
Ha Nam	7,042	4,517	73.4	3,534	62.1
Nam Dinh	605	156	21.3	104	13.8
Ninh Binh	75	26	34.7	8	10.7
Thanh Hoa	347	17	4.9	17	4.9

(Source: UNICEF 2004b)

(4) Results of interview with water works

In Pre-FS, the survey was conducted by People's Committee and the Water Works, etc. to investigate about groundwater and surface water pollution. (Table 1.6.2)

It revealed problems concerning the water quality in many regions. In this survey, many residents surrounding the project site reported worries about health hazard and groundwater pollution.

Table 1.6.2 Interview Results for Groundwater Quality

Prefecture	Results
Thong Tin (Then Ha Tay Province)	The groundwater source for WTP is contaminated by arsenic. The level of arsenic in some cases is as high as 50μg/L. River water is also contaminated by arsenic.
Pho Xuyen (Then Ha Tay Province)	Groundwater is contaminated by arsenic and others. Hospitals use contaminated groundwater. River water is also contaminated by arsenic.
Bac Ninh Province	Groundwater and surface water in the south of Duong River is contaminated with agricultural chemicals. In north part, iron and manganese concentration is high in groundwater. The water in Do River and other two rivers is also contaminated. High demand for safe and clean drinking water.

1.6.4 Social Environment

Rapid economic and industrial growth in Greater Hanoi has also resulted into accelerated increase of population in the metropolis. The population of Greater Hanoi has increased to about 6.5 million in 2009.

The water supply system of Ha Noi City has been augmented and upgraded many times in past, also including the projects under the financial assistance of Finland, Japan International Cooperation Agency (JICA), and the World Bank, depending on the needs. Even after implementation of projects for improvement of water supply services in the northern and southern part of Hong River in Hanoi, the urban water supply system is currently unable to meet the increasing demand.

There are no sensitive areas such as national parks, nationally-designated protected areas (coastal areas, wetlands, areas for ethnic minorities or indigenous people, and cultural heritage, etc.): Natural environment such as primary forests in tropical areas, habitats of important ecological values (coral reefs, mangrove wetlands, etc.), habitats of rare species, areas in danger of salt-accumulation or soil erosion, areas with remarkable tendency towards desertification, etc.; and areas with unique archaeological, historical or cultural values, etc., in and around the site of candidate proposed area for facilities to be undertaken in this project.

2. Water Quality Analysis

2.1 Purposes

Water Quality of Duong River was analyzed to determine its characteristics for process designing, especially sedimentation basin and chlorination methods. The followings survey was carried out in dry season and rainy season (April to August, 2011).

2.1.1 Water Resource Survey

The proposed Water Treatment Plant (Duong River WTP) utilizes Duong River water as water source. Duong River is tributary of Hong River, which has some tributaries, as shown in Figure 2.4.1. Some upstream tributaries of Hong River and dams are surveyed.

2.1.2 Duong River Water Quality Analysis

To analyze the characteristics of raw water quality (Duong River) is extremely important for accurate designing of the process and chemical dosing, etc. Especially, water characteristics, mainly turbidity, in the rainy season (May to October) and dry season (November to April) are important factors for the design of Water Treatment Plant.

2.1.3 Water Quality Analysis

Since the turbidity is expected to be high (past 10 years average is about 300 mg/L as SS and this value will largely influence on the construction cost for a planned water treatment plant), so coagulation and sedimentation & rapid sand filtration system is necessary. To determine the appropriate process, Jar-Test was carried out about 180 times to select coagulant type, appropriate dosing rate, and mixing condition of the coagulant. Also, chlorination is necessary to supply safe water, thus chlorine consumption demand are tested.

2.2 Survey Contents

2.2.1 Water Resource Survey

Dams and some rivers in upstream were visited and water quality was examined.

2.2.2 Duong River Water Quality Analysis

(1) Study on Water Quality of Duong River

Research Name	Item of Examination	Examination Method	Purpose of the Research
Daily examination of raw water	General items (pH, turbidity etc.) and particle size of raw water etc.	Daily sampling and examination of Duong River water	To collect data on Duong River water quality in rainy and dry season
24hours continuous sampling survey	General items (pH, turbidity etc.)	24 hours continuous sampling and examination of Duong River water	To collect data on hourly variation of Duong River water quality and grasp the influence of pollutant by human activity in upstream area
Consignment examination of raw water and treated water	Drinking water quality standard items pesticides, water treatment evaluation items	Consignment examination of Duong River water by Japanese examination laboratory	To collect data on micro pollutants of Duong River water, and water quality items influencing water treatment efficiency

(2) Water Treatment Process Evaluation Items

Item	Reason for Selecting the Parameter
Soluble manganese	Expected to make supplied water black in color in distribution pipe due to reaction of soluble manganese with free chlorine in water
Soluble aluminum	To collect data on the concentration of soluble aluminum in using aluminum salt as coagulant
Ammonia-nitrogen	Expected to consume free chlorine as disinfectant in water upon reacting with ammonia-nitrogen
Trihalomethane formation potential	To collect data on the concentration of trihalomethane produced by reaction of free chlorine with organics available in Duong River water

2.3 Survey Schedule

(1) Dry Season

1st Survey: April 12 to April 24, 2011

2nd Survey: May 22 to June 4, 2011

(2) Rainy Season

3rd Survey: June 26 to July 9, 2011

4th Survey: August 7 to August 20, 2011

2.4 Results of the Analysis

2.4.1 Water Resource Survey

(1) Situation

Figure 2.4.1 to 2.4.3 show the result of the survey. Hong River, begins in China's Yunnan province, is about 1,200 km long, and enters Viet Nam at Lao Cai Province. Then, Hong River (Thao River named before joint) joints (about 250km downstream from Lao Cai point) Da River (downstream of Hoa Bin Dam) around Co Do City, which is about 40 km in North-South from Ha Noi City and joints Lo River (downstream of Tac Ba Dam) around Viet Tri City. The length of Hong River in Viet Nam is about 500 km.

(2) Analyzed Data

The results are shown in Table 2.4.1 to 2.4.3.

Turbidity and potassium permanganate ($KMnO_4$) consumption value of Tac Ba Dam water are low, however electric conductivity is relatively high. Lo River water at Viettri Bridge, downstream of Tac Ba Dam, has higher turbidity than that of Tac Ba Dam, however, $KMnO_4$consumption value is not increased, thus it could be concluded that Lo River water is less chance of pollution by human factors.

On the other hand, water quality of Hoa Bin Dam is close to that of Tac Ba Dam. Water quality of Da River (downstream of Hoa Bin Dam) at effluent of Hoa Bin Dam is almost same quality as the junction with Hong River. Therefore, Da River is also less chance of pollution by human factors ($KMnO_4$consumption value and turbidity are low).

The turbidity of Hong River (Thao River) before joining Da River and Lo River is about 150, which is relatively higher than that of Da River or Lo River. However, the turbidity of Hong River after joining two rivers is about one forth of that before joining. Duong River water, which is tributary of Hong River, has same characteristics of Hong River after joining two rivers. Thus, pollution by human factors for Duong River is also less chance, which can be seen in the above, namely Da River and Lo River water quality.

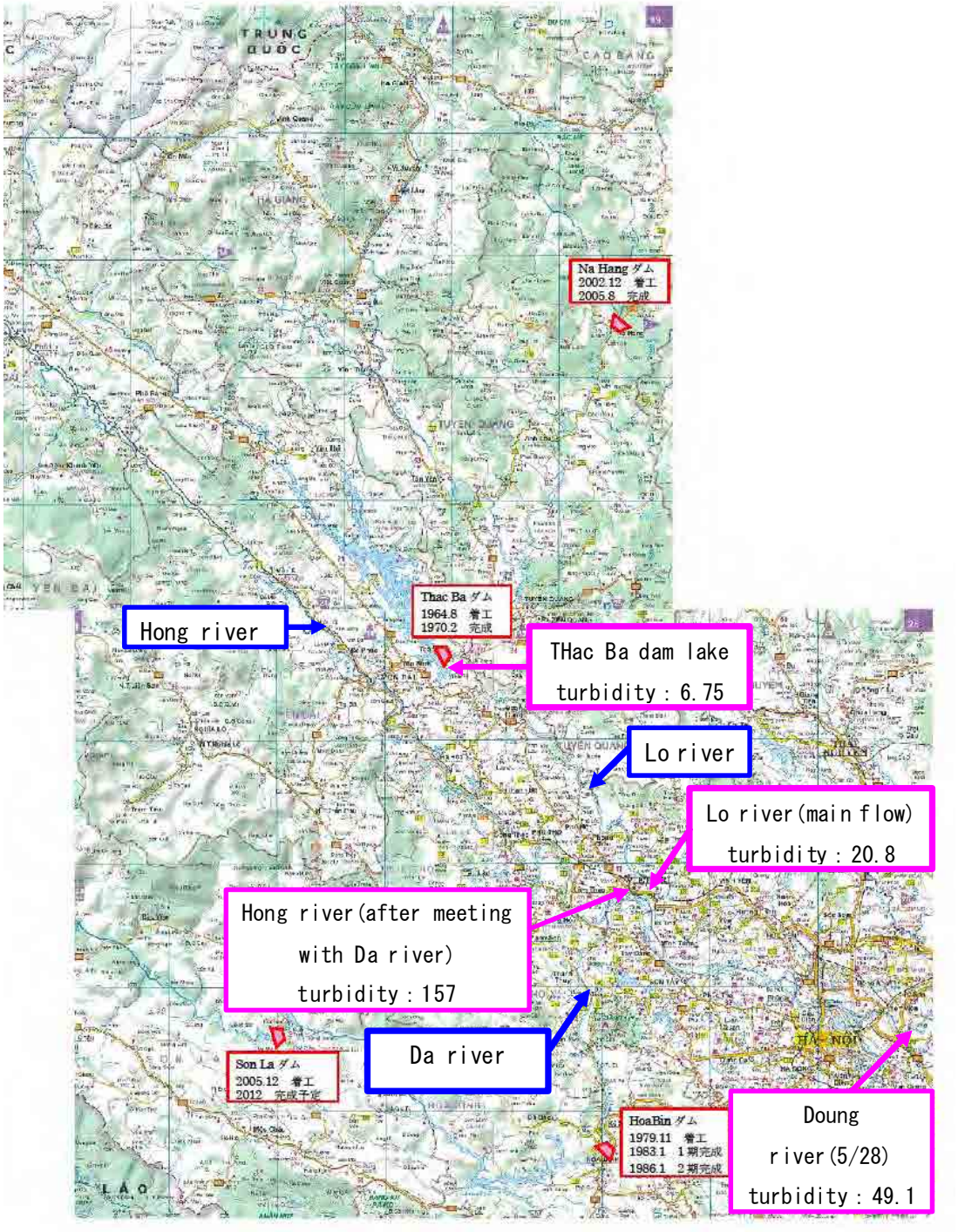


Figure 2.4.1 Location of Water Resource Survey on May 27

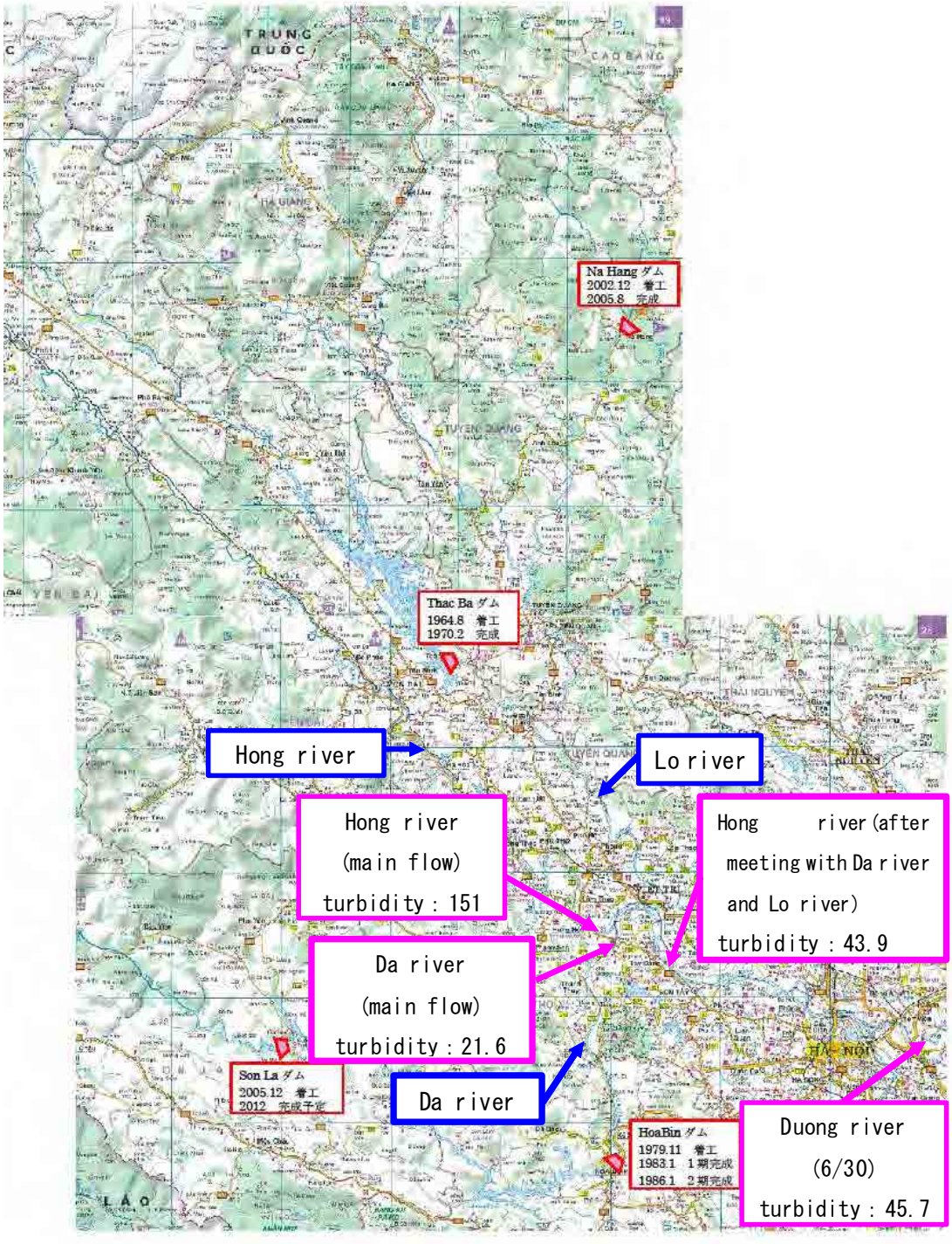


Figure 2.4.2 Location of Water Resource Survey on June 29

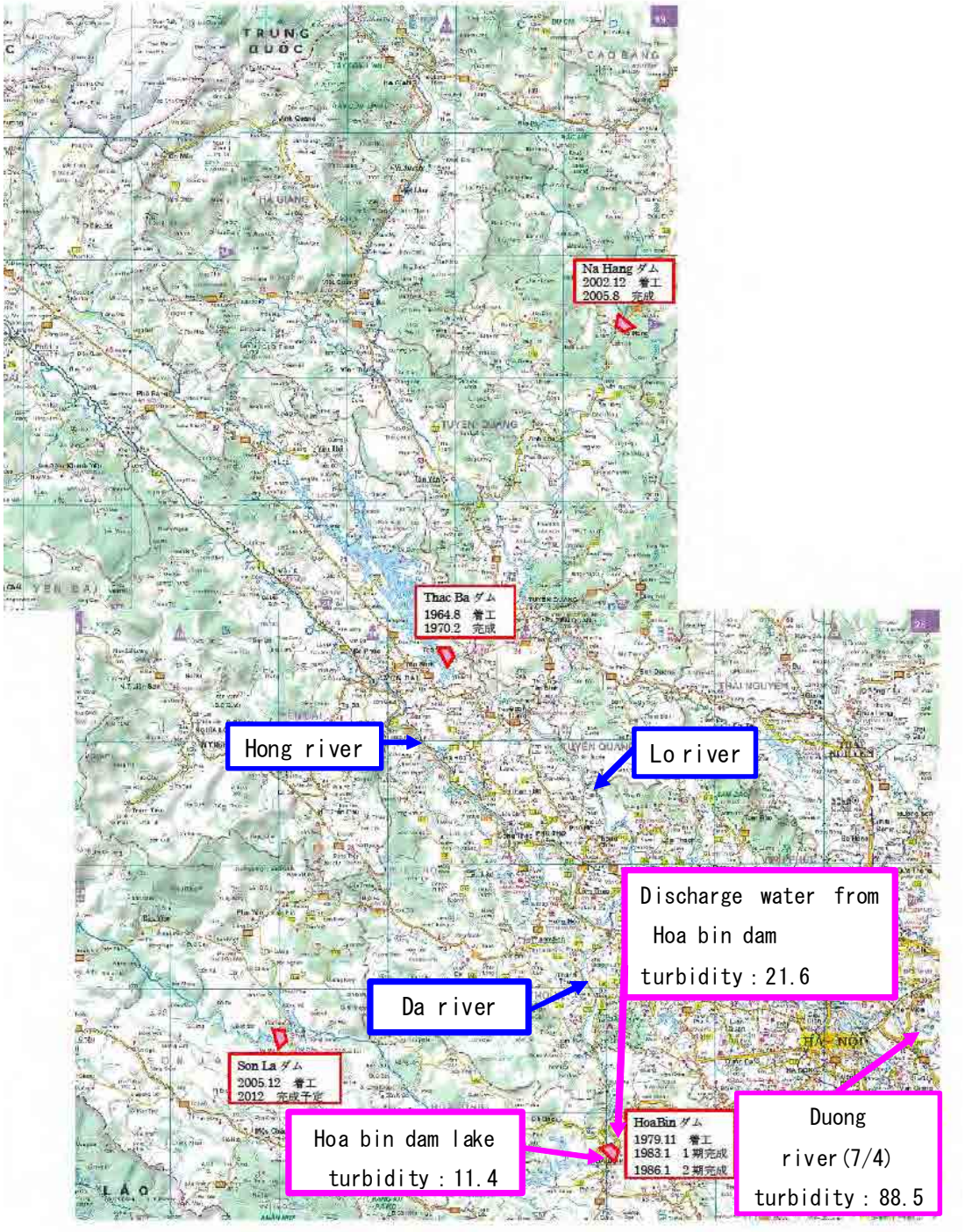


Figure 2.4.3 Location of Water Resource Survey on July 4

Table 2.4.1 Result of the Water Resource Survey (Date: 2011/05/27)

Sampling location	Turbidity (degree)	pH	Electrical Conductivity (μS/cm)	$KMnO_4$ Consumption Value (mg/L)
Thac Ba Dam Lake	6.75	8.43	188	5.1
Lo River （main flow）	20.8	7.96	204	4.3
Hong River (after meeting with Da River)	157	7.86	165	16.9
Duong River (5/28)	49.1	8.00	192	8.6

Table 2.4.2 Result of the Water Resource Survey (Date: 2011/06/29)

Sampling location	Turbidity (degree)	pH	Electrical Conductivity (μS/cm)	$KMnO_4$ Consumption Value (mg/L)
Hong River (main flow)	151	8.03	136	21.2
Da River （main flow）	21.6	7.92	184	4.1
Hong River (after meeting with Da River and Lo River)	43.9	7.97	177	8.8
Duong River (6/30)	45.9	8.01	175	7.4

Table 2.4.3 Result of the Water Resource Survey (Date: 2011/07/04)

Sampling location	Turbidity (degree)	pH	Electrical Conductivity (μS/cm)	$KMnO_4$ Consumption Value (mg/L)
Hoa bin Dam Lake	11.4	8.45	178	5.3
Discharge water from Hoa bin Dam	21.6	7.82	188	5.0
Duong River (7/4)	88.5	7.92	181	14.1

(3) Overall Observations

The water quality of Doung River and Hong River after joining two rivers (Da River and Lo River), which are downstream of Hoa Bin and Tac Ban Dams, is influenced by the water quality of Hong River (Thao River), Da River and Lo River. Especially, turbidity of Duong River is strongly influenced by Hong River (Thao River) at rainy season.

2.4.2 Duong River Water Quality

(1) Sampling Point

Proposed Intake point of Duong River WTP Site.

(2) Survey Period

Table 2.4.4 Survey Period

Survey	Period	Daily Sampling	24 hours Continuous Sampling
First Survey	April 14(Thr) - April 22(Fri), 2011	Every day, except April 17 (Sun)	April 19 at 10:30 am-April 20 at 10:30 am Every one hour Sampling
Second Survey	May 23 (Mon) - June 3 (Fri), 2011	Every day, except May 27 (Fri) and May 29 (Sun)	May 31 at 10am-June 1 at 10am Every one hour sampling
Third Survey	June 27 (Mon) - July 8 (Fri), 2011	Every day, except June 29 (Wed) and July 3 (Sun)	Not carried out, because enough data was obtained before.
Forth survey	August 8 (Mon) - August 19 (Fri), 2011	Everyday	Not carried out, because enough data was obtained before.

(3) Water Quality Evaluation Items

Table 2.4.5 Water Quality Evaluation Items

Survey	Examination item
Daily Sampling	Water temperature, ambient temperature, turbidity, color, pH, electric conductivity, potassium permanganate($KMnO_4$) consumption value, bacterial number, E.coliform, suspended solid(SS)
24 hours Continuous Sampling	Water temperature, ambient temperature, turbidity, color, pH, electric conductivity, potassium permanganate($KMnO_4$) consumption value

Consignment Examination in Japan	Drinking water quality standard items in Japan (28 items), agricultural chemicals (3 items), water treatment target items(14 items)

(4) Results of Daily Sampling in Survey Period

1) Water Temperature and Ambient Temperature

Water Temperature at First Survey was steady at 23C, 24 to 27C at Second Survey, 28C at Third Survey, 29C at Forth Survey (Figure 2.4.4). There was almost no rain fall at First Survey. There was a small rain fall on May 23 during Second Survey. During Third Survey and Forth Survey, there were rain fall in the daytime and/or at the night, thus ambient temperature varied from 26 to 39C.

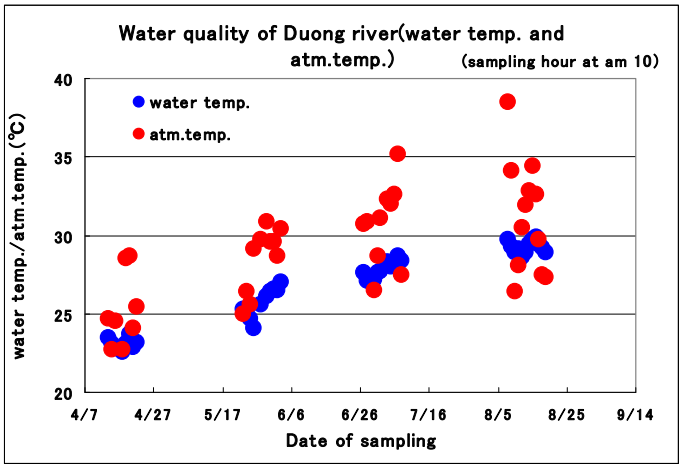


Figure 2.4.4 Water Temperature and Ambient Temperature of Duong River Water

2) Turbidity and pH

The pH value was very steady 7.8 to 8.1 during all Survey periods.

Turbidity results are shown in Figure 2.4.5, gradually increasing; 21 to 30 degree in First survey, 20 to 50 degree in Second Survey, 42 to 141 degree in Third Survey and 32 to 87 degree in Forth Survey. Also, large fluctuation was observed in Third Survey and Forth Survey. Relatively high turbidity in Third Survey and Forth Survey is due to rain fall in upstream area, however the rain fall magnitude, place and time are not known. In future, information of rain falls in the Hong River Basin and turbidity is to be examined.

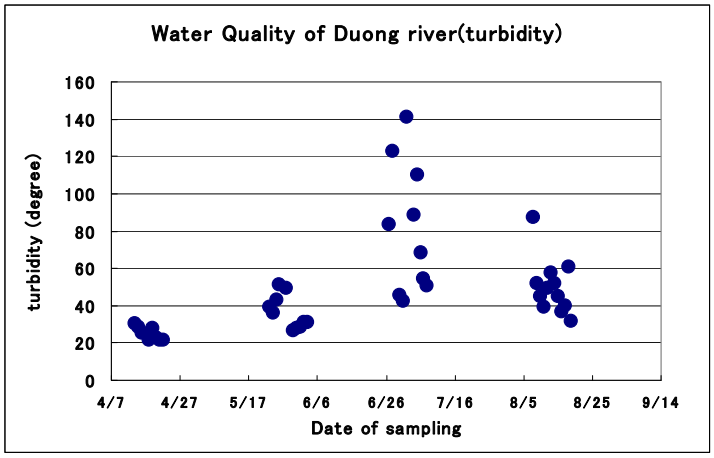


Figure 2.4.5 Turbidity of Duong River Water

3) Electrical Conductivity

Summary of Electrical Conductivity results are as follows;

First Survey : 199 - 209μS/cm
Second Survey : 192 - 202μS/cm
Third Survey : 174 - 198μS/cm
Forth Survey : 165 - 177μS/cm

When it is rainless, the electric conductivity is around 200μS/cm, When the rain comes, it is about 170μS/cm (less than 200μS/cm), which may be influenced by Hong River water quality, because electric conductivity of Hong River is lower than that of Duong River.

4) KMnO4 Consumption Value (mg/L): Potassium Permanganate Consumption Value

KMnO4 consumption value is an index for organic matter in the water, this value is important as same as turbidity, which is an index for inorganic matters. $KMnO_4$ consumption value is measured from Second Survey.

The results are as the follows (Figure 2.4.6);

Second Survey : 4.3mg/L - 8.6mg/L
Third Survey : 6.4mg/L - 12.7mg/L
Forth Survey : 5.6mg/L - 8.3mg/L

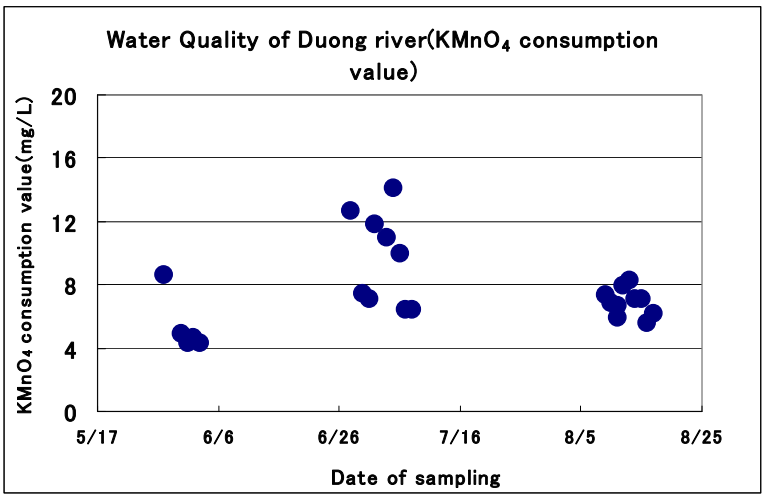


Figure 2.4.6 $KMnO_4$ Consumption Value of Duong River Water

Figure 2.4.7 shows correlation between $KMnO_4$ consumption value and turbidity. It was observed relatively high correlation (R2 value is 0.8395). Thus, it is quite reasonable to judge that most of KMnO4 consumption value comes from turbidity.

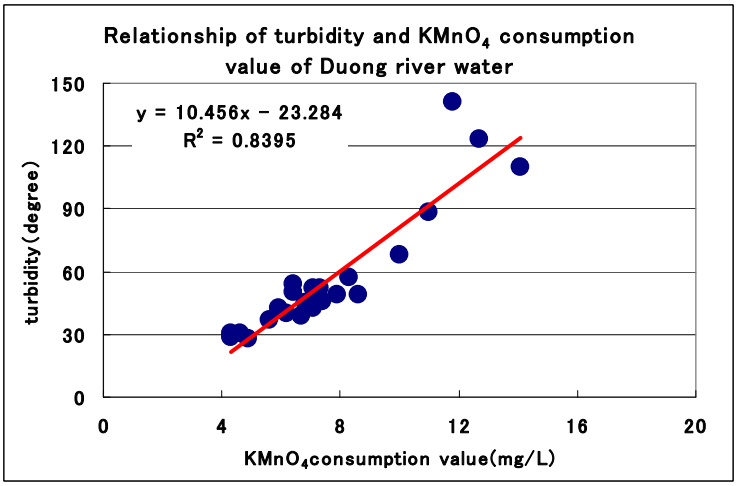


Figure 2.4.7 $KMnO_4$ Consumption Value of Duong River Water

5) Suspended Solid（SS）

In Vietnamese Water Quality Standard for Surface Water (QCVN08:2008/BTNMT), SS is one of Indexes not turbidity (degree). Therefore, Study Team examined relationship between SS and turbidity (degree), which is shown in Figure 2.4.8. It can be seen that correlation is strong and SS is about 1.8 times of turbidity (degree).

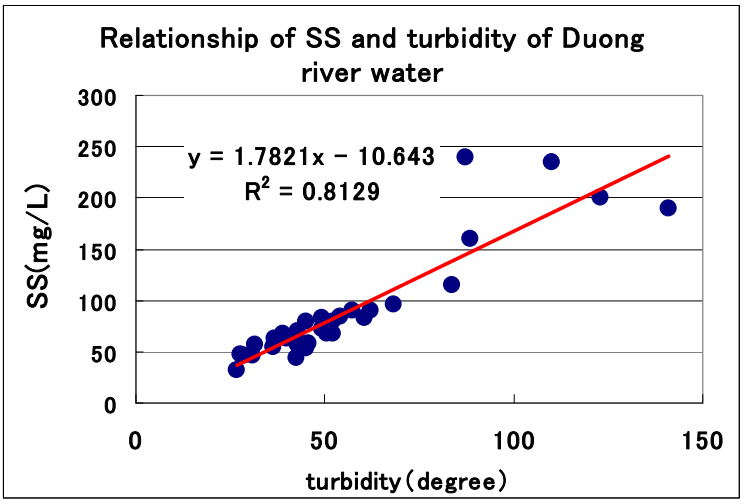


Figure 2.4.8 Relationship of Turbidity and SS (Suspended Solid) of Duong River Water

3. Examination of Technical Scale of the Proposed Project

3.1 Purpose of the Project

The main purpose of the proposed project is constructing water supply system infrastructure for the economic and social development of Hanoi urban area and contributing to the improvement of economic and social power of various provinces and prefectures in the north of Hong River (Red River) and the elimination of water shortage in the Ha Noi City center located in the south of Red River.

Another purpose of the proposed project is contributing to the capacity development of Viet Nam water supply corporations and the development of capital markets, by proposing technical transfer of Japanese maintenance, management technology and long term low interest financing.

3.2 Demand Forecast of the Project

3.2.1 Situation Around the Proposed Project

The proposed project consists of a water supply project having a policy of wholesale to Water Works, so the project will be operated with the income from the contract with Water Works receiving water from this Project. However, if the demand evaluation is not carried out appropriately, it will affect tremendously the management of Water Works and private corporations and, consequently, endanger the sustainability of the project. Therefore, it is necessary to reexamine the certainty of demand evaluations that constitute the basis of the project planning, based on the Pre-FS results and the report contents of ongoing FS survey by VIWASEEN and set Supply Area and water supply volume taking the project efficiency and the project effectiveness into consideration.

However, Study Team come to know that HPC (Ha Noi People's Committee) is preparing a master plan for Ha Noi City water supply (called "Ha Noi City water supply plan", hereafter) in parallel with this survey in Ha Noi City which is estimated to account the largest demand in the proposed project after the launch of the research. This will draw up " Ha Noi City water supply plan for 2030 and a vision up to 2050" until June, 2011, according to the decision of the Office of the Prime Minister (Decision 1655/QD-TTg) of September, 2010 and will be considered as a plan superior to the proposed project. Therefore, the present research should be carried on attentively considering the evolution of Ha Noi City water supply plan and was obliged to start the research with the possibility that the project target scope setting that constitutes the basis of the basic frame setting may change.

Based on FS survey report proceeded by VIWASEEN, the demand was estimated from data collected independently by JICA Study Team and the demand certainty was verified in order to set the basic frame.

3.2.2 Target Area

The target scope of the proposed project shall be decided in response to the contents of FS survey by VIWASEEN.

As the target scope of the proposed project covers Ha Noi City and its surrounding provinces, Bac Ninh Province and Hung Yen Province, just like last year's research, and the FS survey report by VIWASEEN, the target scope of the proposed project is decided (Figure 3.2.1).

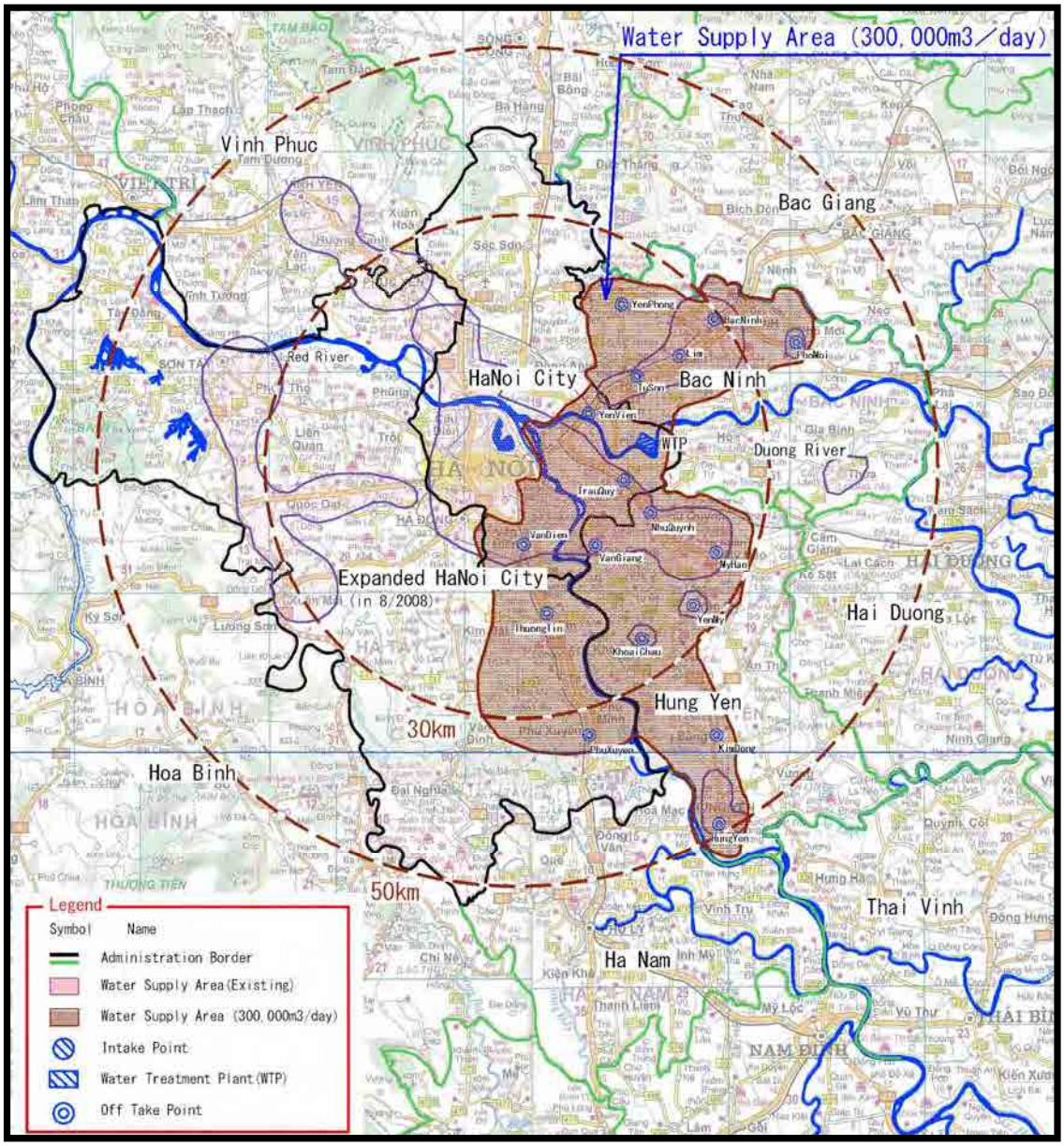


Figure 3.2.1 Target Area

3.2.3 Overall Conditions of Water Supply Business in the Research Target Area

(1) Ha Noi City

As of 2009, total area of Ha Noi City is 334,470 ha and its population 6,448,837. The water supply reaches 70 to 85% penetration in urban area and 40 to 60% in rural areas, and the maximum water supply volume per day attains 683,000 m^3/day.

The water supply business is composed of four (4) business entities: HAWACO (Ha Noi Water Works) manages and operates in Old Ha Noi City, Son Tay Water Supply Corporation around Son Tay City, Old Ha Tay Province, Ha Dong Corporation in Old Ha Dong City and VIWACO Corporation (sells water from Da River Water Treatment Plan and operates transmission pipelines and distribution network) in peripheral areas of Old Ha Noi City. Particularly, HAWACO divides its management area into 6 distribution districts and each one is managed by its affiliated company.

The general outline of HAWACO, one of the business entities of the proposed project and the largest client, is described below.

- HAWACO

  The water supply of Old Ha Noi City has been divided into north and south by Red River flowing through the middle of the city; the south of Red River, corresponding to the center of Ha Noi City has been managed by Hanoi Water Business Company, predecessor of HAWACO, and the north of Red River by Hanoi Water Business Company 2. However, in June 2008, the two companies were merged to form actual HAWACO when Ha Noi City was planned to be enlarged (August 2008).

  Actually, the Old Ha Noi City is managed in a lump by HAWACO and the management area covers 8 districts in the city and surrounding 5 prefectures. As of 2009, water supply reaches 92.94% penetration in districts (Ba Dninh District, Hai Ba Trung District, Dong Da District, Hoan Kiem District, Cau Giay District, Ho Tay District, Long Bien District, Hoang Mai District) covering almost all of the area, while it reached 4 - 60% penetration in neighboring 5 prefectures (Gia Lam Prefecture, Dong Anh Prefecture, Soc Son Prefecture, Tu Liem Prefecture, Me Linh Prefecture) which is still lower than the districts (Table 3.2.1).

It controls 22 Water Treatment Plants in total (12 large scale plants and 10 small plants) offering treatment capacity of 614,000 m^3/day to provide water supply services to approx. 2,754,000 habitants.

The general outline of HAWACO water supply business is shown in Table 3.2.2.
The evolution of distribution performance and revenue rate during 2005 to 2010 is shown in Figure 3.2.2.

Table 3.2.1 Water Supply Penetration in HAWACO Managed Area (Neighboring 5 Prefectures)

Area	Coverage Ratio (%)	Remarks
Tu Liem Pref.	60	
Gia Lam Pref.	17	
Dong Anh Pref.	14	
Soc Son Pref.	4	
Me Linh Pref.	－	*Inadequate by HAWACO

*Not including small one and private well

Table 3.2.2 General Outline of HAWACO Water Supply Business

Company Name	Ha Noi Water Limited Company(HAWACO Co., Ltd)
Established	June 2008
Administrative Area	Dong Da, Ba Dinh, Hai Ba Trung, Cau Giay, Ho Tay, Long Bien, Gia Lam, Dong Anh, Soc Son, Me Linh (All of areas of above 6 districts and 4 prefectures) Hoang Mai, Thanh Xuan, Thanh Tri, Tu Liem (In some areas of above 2 districts and 2 prefectures)
Administrative WTP	【Large scale water treatment plant】 1. Yen Phu WTP （1997） 90,000m^3/day 2. Ngoc Ha WTP （1992） 32,000m^3/day 3. Ngo Si Lien WTP （1992） 47,000m^3/day 4. Mai Dich WTP （1991） 60,000m^3/day 5. Cao Dinh WTP （2005） 60,000m^3/day 6. Luong Yen WTP （1991） 50,000m^3/day 7. Tuong Mai WTP （1992） 30,000m^3/day 8. Ha Dinh WTP （1994） 30,000m^3/day

	9. Phap Van WTP （1989） 30,000m^3/day 10.Nam Du WTP （2006） 60,000m^3/day 11.Gia Lam WTP （1996） 30,000m^3/day 12.Bac Thang Long WTP （2004） 25,000m^3/day Total of above (12) WTPs : 544,000m^3/day 【Small scale water treatment plant】 1. Bach Khoa WTP 2,000m^3/day 2. Quynh Mai WTP 3,000m^3/day 3. Van Don WTP 6,000m^3/day 4. Thuy Khue WTP 4,000m^3/day 5. Don Thuy WTP 12,000m^3/day 6. Bach Mai WTP 6,000m^3/day 7. Kim Lien WTP 6,000m^3/day 8. Gia Lam Air Port WTP 9,000m^3/day 9. Dong Anh WTP 12,000m^3/day 10.Nguyen Khe WTP 10,000m^3/day Total of above (10) WTPs : 70,000m^3/day *All of above are groundwater using

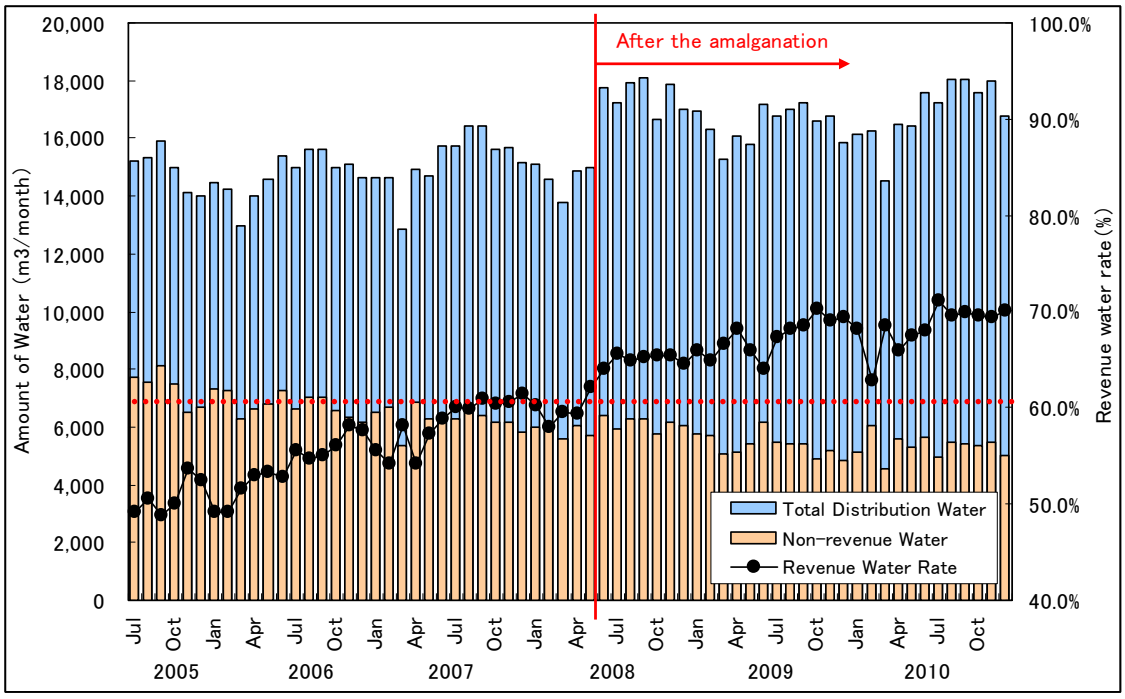


Figure 3.2.2 Evolution of HAWACO Distribution Performance and Revenue Rate 2005 to 2010

The maximum distribution amount in HAWACO jurisdiction is approx. 18,100,000 m^3 per month (≒603,000 m^3/day), where the city center distribution occupies about 91% with approx. 16,400,000 m^3 per month (≒547,000 m^3/day). The revenue rate has been about 50% in 2005, which has improved annually, realizing about 70.0% (term maximum 71%) as of December 2010. Actually, HAWACO is exerting effort to improve the revenue rate and, hereafter, it is expected that the revenue rate will be further improved.

Retrench of leakage rate (increase of revenue rate) is an important factor for water supply management. In the future, it is promising to transfer Japanese technologies, both software and hardware, such as leakage survey, water distribution blocking and leakage rate cutback planning, using Japanese funds.

(2) Bac Ninh Province

In Bac Ninh Province, Bac Ninh Water Supply and Sewerage LTD., Company, subsidiary organization of Bac Ninh People's Committee, manages and operates the water supply business of the entire Bac Ninh Province. Bac Ninh Water Supply and Sewerage Ltd., Company operates actually 4 underground water treatment plants. Besides the Company, private enterprises operate several water treatment plants.

Bac Ninh Water Supply and Sewerage LTD., Company is now preparing a master plan for the entire province with the objective of providing at least one water treatment plant in all cities and prefectures.

Though the exact water supply penetration rate and population remain unknown, it is claimed that it reached approx. 14.5% and approx. 130,000 habitants as of 2009.

Water treatment plant operation situation of Bac Ninh Province is shown in Table 3.2.3.

Table 3.2.3 Existing Water Treatment Plant Situation in Bac Ninh Province

No.	Area	Name of WTP	Construction Year	Capacity (m3/day)	Organization
1	Bac Ninh City	Bac Ninh WTP	1995	16,000	Bac Ninh Province
2	Tu Son	Tu Son WTP	－	5,000	VIWASE
3	Tien Du	Lim WTP	2008	2,000	Bac Ninh Province
4		Tien Son WTP	－	－	VSIP
5	Que Vo	Que Vo WTP	2000	1,800	Bac Ninh Province
6	Luong Tai	Luong Tai WTP	2001	2,500	Bac Ninh Province
	Total			27,300	

(3) Hung Yen Province

In Hung Yen Province, Hung Yen Water Works, subsidiary organization of Hung Yen People's Committee, mainly manages and operates the water supply business of the entire Hung Yen Province. Besides, the Environmental Public Health Center of the Ministry of Agriculture and private companies exert independent water supply business in respective community (prefecture, village, etc.). Therefore, at present, water supply business is mainly operated commune level by commune and there is no water supply business entity that would administrate the entire province. Consequently, in the actual situation, there is no organization for grasping exactly the actual situation of water supply business of the entire province and for preparing future water supply plan.

19 large and small water treatment plants are in operation and many small plants are now under construction.

Though the exact water supply penetration rate and population remain unknown, the hearing results tell that it reached approx. 7% and approx. 79,000 habitants as of 2006.

Water Treatment Plant operation situation of Hung Yen Province is shown in Table 3.2.4.

Table 3.2.4 Existing Water Treatment Plant situation in Hung Yen Province

No.	Area	Name of WTP	Construction Year	Capacity (m3/day)	Organization
1	Hung Yen City	Hung Yen WTP	2002	5,000	Hung Yen City
2	Khoai Chau	Phung Hung WTP	2010	3,000	Environmental Health Center
3		Khoai Chau WTP	2002	980	Hop DeCo., Ltd
4		Binh Minh WTP	2008	996	Environmental Health Center
5	An Thi	An Thi WTP	2006	780	Environmental Health Center
6		Hong Quang WTP	1999	580	Environmental Health Center
7	My Hao	Pho Noi WTP	1999	3,000	Vietecco Nam Long
8		Bach Sam WTP	2007	885	Environmental Health Center
9		Di Su WTP	2005	970	Environmental Health Center
10	Van Lam	Nhu Quynh WTP	2001	1,000	VIWASE
11		Chi Dao WTP	2001	880	Environmental Health Center
12	Van Giang	Van Giang WTP	2003	980	Environmental Health Center
13	Yen My	Yen My WTP	2006	1,290	Environmental Health Center
14	Tien Lu	Thuy Loi WTP	2005	718	Local
15	Kim Dong	Luong Bang WTP	1998	560	Local
16		Tien Quan WTP	2003	300	Local
17		Ngoc Thanh WTP	2005	600	Local
18	Phu Cu	Tran Cao WTP	2004	720	Local
19		Quang Hung WTP	2002	880	Environmental Health Center
	Total			24,119	

3.2.4 Demand Forecast and Basic Frame Flow

The most important matter in setting the basic frame of this research is to make it a high certainty plan all the way reflecting the demand of water receiving entities, because it concerns the water supply business.

Therefore, it is necessary to discuss about the demand with water receiving entities to which water will be distributed, and also necessary to verify whether the certainty of such demand is high, on the basis of FS survey results of VIWASEEN.

Moreover, as mentioned before, the Ha Noi City water supply plan, superior to the proposed project, is being prepared. It is necessary to review within the scope of the contents of Ha Noi City water supply plan, all the way confirming its contents.

Based on the discussion above, demand forecast and basic frame setting up on this research shall be carried out as shown in Figure 3.2.3.

Among water supply plans by other donors in the proposed project target area, including Ha Noi City water supply plan, those requiring coordination of contents are described below.

- Ha Noi City water supply plan (being prepared)

  As mentioned above, it was decided by the Office of Prime Minister in September 2010 to prepare a master plan of Ha Noi urban area water supply for 2030 to be executed by Ha Noi City People's Committee. It is now under examination to be authorized in June 2011.

  As Ha Noi City water supply plan is superior to the proposed project, it is necessary that the contents of this Project be in harmony with the abovementioned plan.

- Gia Lam Prefecture pipeline network maintenance plan

  It concerns a pipeline network maintenance plan in Gia Lam Prefecture prepared by Ha Noi City People's Committee and HAWACO in October, 2010. The contents of the pipeline network maintenance plan are considered to have a great influence on the proposed project, because Water Treatment Plants of the proposed project will be constructed in Gia Lam Prefecture.

Hence, in the present research, it is necessary to plan so that the plant maintenance becomes efficient, based on the contents of the Gia Lam Prefecture pipeline network maintenance plan.

- Various plans in other prefectures

  It is necessary to check water supply plans, water treatment plant expansion plans or other future plans in Bac Ninh Province, Hung Yen Province and so on, which will be related to the target area of this project. If there is any such plans, it is important to reflect their contents in this research.

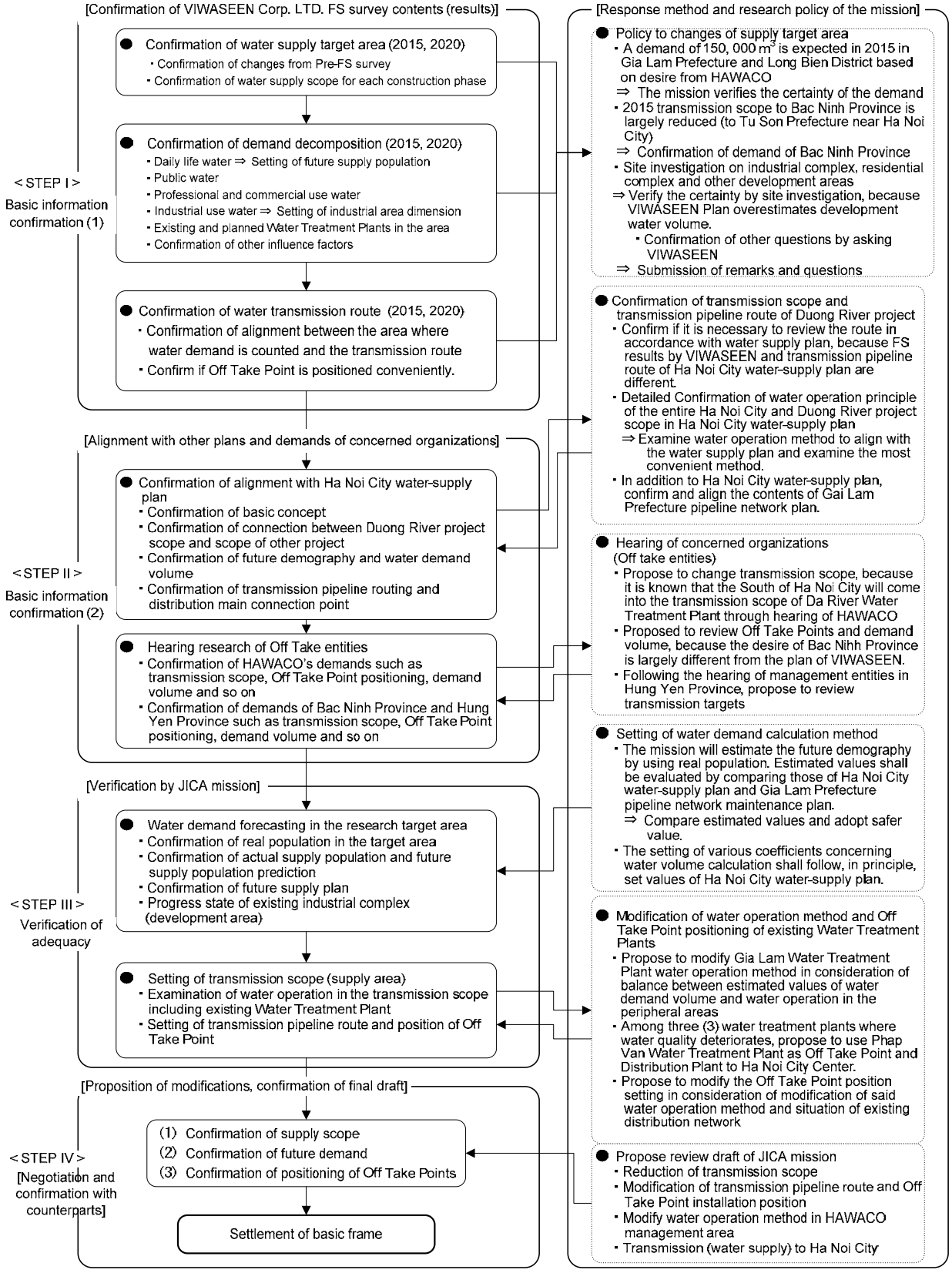


Figure 3.2.3 Flow of Demand Forecasting and Basic Frame Setting

3.2.5 Confirmation of Basic Conditions

(1) Ha Noi City Water Supply Plan (master plan)

In September 2010, according to the decision of the Office of the Prime Minister (Decision 1655/QD-TTg), Ha Noi People's Committee started to prepare Hanoi capital region global plan for the enlarged Ha Noi City (Development plan for 2030 and vision up to 2050) which is to be completed by June, 2011. This Hanoi capital region global plan including HAWACO water supply plan (called Ha Noi City water supply plan, hereafter), as major assumption, the future Ha Noi City water business shall be carried out following the Ha Noi City water supply plan, and therefore, the present proposed project should also be carried out in line with the Ha Noi City water supply plan, which is superior to the proposed project.

Ha Noi City water supply plan was submitted to the Office of the Prime Minister at the beginning of this year (2012) and waiting for the approval (JICA Study Team confirmed this situation in April, 2012). Therefore, Ha Noi City water supply plan is not opened to the public.

(2) FS Survey Report by VIWASEEN

Actually, VIWASEEN is carrying out FS survey of Duong River project in parallel to preparation of said Ha Noi City water supply plan. As for today, three workshops have been held. Besides VIWASEEN, HAWACO, METAWATER, local consultants and other key agencies have participated to discuss the contents of FS survey.

Though the research is now in the phase of preparing final report, it is difficult to say that alignment with said Ha Noi City water supply plan and accommodation of demand certainty, off take point installation point, off take method and so on are sufficient. It is considered that further examination will be required in this respect.

At present, subjects that need to be examined are as follows.

1) Coordination with concerned organizations such as HAWACO

It is considered that alignment of off take point and off take volume with HAWACO which occupies the majority of the demand in the Phase 1 is not sufficient and it will be necessary to negotiate in detail with HAWACO in respect of examination of delivery method at the off take point and ground setting of off-take volume.

Table 3.2.5 FS Survey Report by VIWASEEN

Items	Volume（m3/day）	
	2015	2020
Water demand (total)	161,968	388,731
Existing WTP capacity	69,000	143,000
Supply from Duong River WTP	92,968	245,731
Load factor（k=1.2）	111,562	294,877
Duong River WTP treatment capacity	150,000	300,000

Details are as below.

- Phase 1（2015）

【Ha NoiCity】

Gia Lam Province, Long Bien Ward and areas along Route 179.

【Bac Ninh Province】

Domestic and iindustrial areas of Tu Son District

【Hung Yen Province】

Eco Park of Van Giang District

- Phase 2（2020）and Phase 3（2030）

【Ha NoiCity】

Domestic areas of Gia Lam・Long Bien・Yen Vien, Dong Anh District, Soc Son District, Thuong Tin District, Phu Xuyen District

【Bac Ninh Province】

Cho City (Yen Phong District) and other industrial areas of the District, Lim City (Tien DuProvince), Que Vo Districtindustrial areas, Tu Son District agricultural areas, Bac NinhCity

【Hung Yen Province】

Van Giang District, Van Lam District, My Hao District, Yen My District, Hung YenCity

The above Phase 1 area is concentrated in the Gim Lan District, Long Bien District to meet the demands of HAWACO. Since the areas desired are close to the Doung River WTP, the water supply area for Phase 1 is reducted.

3.2.6 Project Demand Forecasting and Proposal of Basic Frame

In order to resolve the aforementioned issues, JICA Study Team examines the water demand and transmission pipeline plan, based on FS survey of VIWASEEN which has entered the final phase, consideration of Pre-FS evolution, Ha Noi City water supply plan which is now being prepared, and discussion with the concerned organization. And JICA Study Team proposes the most appropriate planning.

(1) Research Principles of Water Supply Scope

1) Ha Noi City

HAWACO, most important receiving entity in the proposed project, is now waiting for the decision of contents by Ha Noi City water supply plan and its inside policies are not unified in respect of global water operation including water supply scope of Duong River project.

Consequently, JICA Study Team has set and proposed water demand and water supply area, based on results of discussion with HAWACO, existing contents of water supply plan and of Gia Lam Prefecture pipeline network maintenance plan and so on.

Research principles of Duong River Water Treatment Plant supply outline of principles reviewed based on discussion results is presented in Figure 3.2.4.

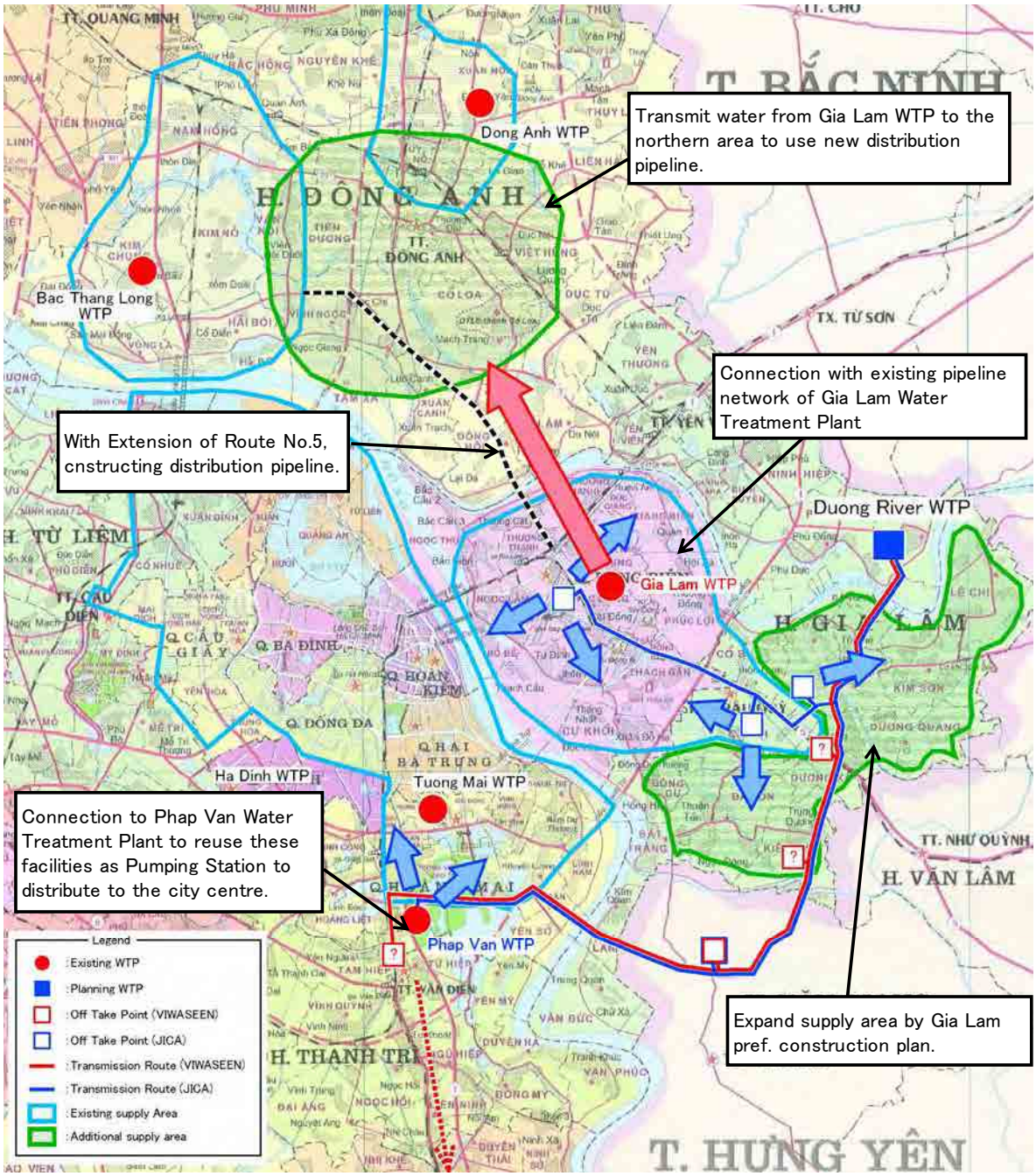


Figure 3.2.4 Water Operation Principles in Doung River Water Treatment Plant and North of Hanoi

2) Bac Ninh Province

Discussion with the Bac Ninh Province Water Works, which administrates water business of the entire province, was carried out in order to understand the situation of water demand and set water supply scope in Bac Ninh Province.

Principles proposed for Duong River Water Treatment Plant supply scope in Bac Ninh Province has been set based on the outcome of the discussion.

Following the review by the research, all off takes shall be executed at one off take point at the same position both for Phase 1 and Phase 2, thereby considerably reducing both number of off take points and length of transmission pipeline extension.

Besides receiving water from Duong River Water Treatment Plant, Bac Ninh Province plans to build four water treatment plants in the province and to prepare actually a master plan for proceeding a consolidated water supply maintenance including reception from Duong River Water Treatment Plant. (The master-plan does not mention receiving water from Duong River.)

Outline of operation principles reviewed based on said hearing results and proposal contents is shown in Figure 3.2.5.

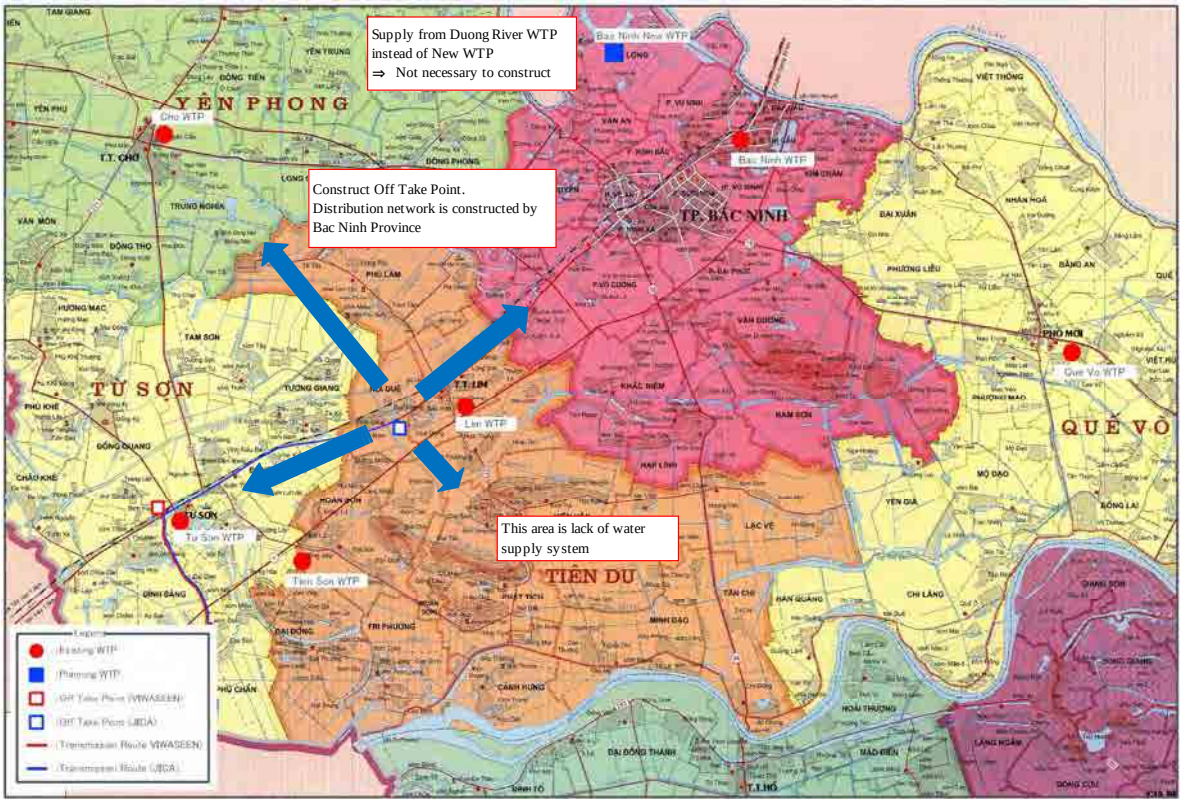


Figure 3.2.5 Water Operation Principles of Bac Ninh Province in the Proposed Project

3) Hung Yen Province

Reports of VIWASEEN expects increased water demand in future in Hung Yen Province due to industrial complex development along the Route No. 5 and, therefore, anticipates a demand of approx. 80,413 m^3/day as the main client of the Phase 2 of the proposed project.

Similar to VIWASEEN, JICA Study Team also expects increased water demand in future due to industrial complex development along the Route No. 5 and accordingly has made a research on water demand.

However, in Hung Yen Province there is no operator managing water supply business of the entire province and no enterprise preparing a master plan. Therefore, in this research, a hearing was performed mainly in Hung Yen City Water Works on supply scope and water demand.

Hearing was held in the following water supply administrations in the frame of this research:

- Hung Yen City Water Works: Hung Yen Water Treatment Plant (Hung Yen City)
- Bitecco Nam Long: Pho Noi Water Treatment Plant (My Hao Prefecture)
- VIWASE: Nhu Quynh Water Treatment Plant (Van Lam Prefecture)

Through this review proposal, transmission target up to the Phase 2 is limited to Eco Park housing complex of Van Giang Prefecture which is, at present, receiving water from Ha Noi City. However, future demand expansion is expected in the center of Van Lam Prefecture, My Hao Prefecture, Yen My Prefecture and areas along Route No.5 because of industrial complex development and, moreover, a sufficient volume may not be obtained if there is a shortage of groundwater. Therefore, it is proposed to install junction pipeline at the Route No. 5 allowing future extension to Hung Yen Province, without maintaining transmission pipeline.

Summarized operation principles reviewed based on said hearing results and proposal contents is shown in Figure 3.2.6.

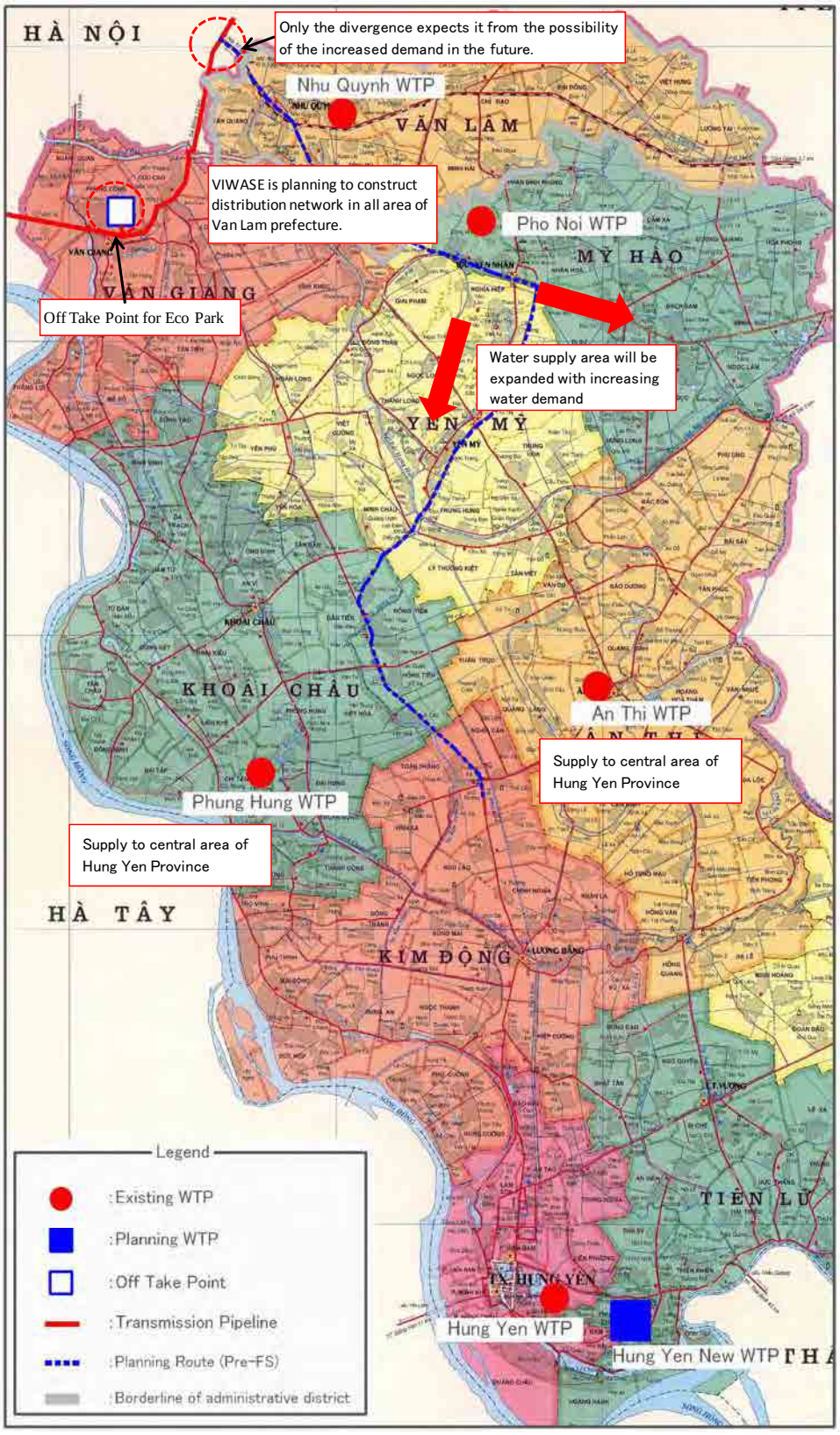


Figure 3.2.6 Water Operation Principles of Duong River Water Treatment Plant and Hung Yen Province

(2) Water Demand Forecast

Water demand is calculated as follows based on discussed basic principles and considerations earlier.

1) Estimation of future population

Future population shall be estimated only for Ha Noi City. In this proposed project, scope of Ha Noi City supply will cover Gia Lam Prefecture, Long Bien District east of Ha Noi City and HAWACO Supply Area in the center of Old Ha Noi City, based on the results of discussion.

Real population during 2005 to 2009 in target area is shown in Table 3.2.6.

Table 3.2.6 Real Population in Target Area

Area	District	Dimension (km2)	Item	Population (1,000 people)					Annual increasing ratio (%)
				2005	2006	2007	2008	2009	
Center of Ha Noi	Ba Dinh	9.25	Total Population	217.7	220.4	222.2	223.8	225.0	0.83%
			Served Population	202.5	205.0	206.6	208.1	209.3	
			Population Density	23.5	23.8	24.0	24.2	24.3	
	Tay Ho	24.01	Total Population	112.4	116.5	120.7	125.1	131.0	3.91%
			Served Population	104.5	108.3	112.3	116.3	121.8	
			Population Density	4.7	4.9	5.0	5.2	5.5	
	Hoan Kiem	5.29	Total Population	153.9	152.1	150.3	148.6	147.0	-1.14%
			Served Population	143.1	141.5	139.8	138.2	136.7	
			Population Density	29.1	28.8	28.4	28.1	27.8	
	Cau Giay	12.03	Total Population	190.7	195.3	206.6	215.6	227.8	4.56%
			Served Population	177.4	181.6	192.1	200.5	211.9	
			Population Density	15.9	16.2	17.2	17.9	18.9	
	Tu Liem	75.33	Total Population	289.8	298.1	331.9	355.2	394.7	8.09%
			Served Population	173.9	178.9	199.1	213.1	236.8	
			Population Density	3.8	4.0	4.4	4.7	5.2	
	Thanh Xuan	9.08	Total Population	208.8	211.4	216.4	221.7	224.9	1.88%
			Served Population	194.2	196.6	201.3	206.2	209.2	
			Population Density	23.0	23.3	23.8	24.4	24.8	
	Dong Da	9.96	Total Population	352.6	356.8	361.1	365.5	371.0	1.28%
			Served Population	327.9	331.8	335.8	339.9	345.0	
			Population Density	35.4	35.8	36.3	36.7	37.2	
	Hai Ba Trung	10.09	Total Population	290.3	310.5	311.2	310.0	292.9	0.32%
			Served Population	270.0	288.8	289.4	288.3	272.4	
			Population Density	28.8	30.8	30.8	30.7	29.0	
	Hoang Mai	39.81	Total Population	235.7	255.5	267.3	330.9	337.2	9.68%
			Served Population	219.2	237.6	248.6	307.7	313.6	
			Population Density	5.9	6.4	6.7	8.3	8.5	
East of Ha Noi	Long Bien	59.93	Total Population	186.4	195.1	204.3	220.8	227.1	5.08%
			Served Population	173.4	181.4	190.0	205.3	211.2	
			Population Density	3.1	3.3	3.4	3.7	3.8	
	Gia Lam	114.73	Total Population	207.9	213.3	218.8	224.5	232.2	2.81%
			Served Population	35.3	36.3	37.2	38.2	39.5	
			Population Density	1.8	1.9	1.9	2.0	2.0	

（Source：Ha Noi Statical Data Year Book 2009）

The future population of 2015 to 2030 is estimated using values presented in table 3.2.6, and the results are presented in Table 3.2.7.

The upper row in each case in the table indicates the estimated values in this research and the lower row gives estimated values of the water supply plan. As for Gia Lam Prefecture, population is compared within the Supply Area, because the whole prefecture is not included in the Supply Area. Moreover, the city center is defined as

one Supply Area (except for Tu Liem Prefecture) in the water supply plan; consequently, future population is estimated only as global population.

Concerning the estimation method, as recent demographic evolution tends to increase linearly, it is estimated by linear approximation, supposed that the actual trend will continue for the moment. R^2 values in the approximation formula are all high as 0.96 or more.

Table 3.2.7 Estimation of Future Population

Area	Existing Population (1,000 people)	Estimated Populations (1,000 people)			R^2
	2009	2015	2020	2030	
Center of Ha Noi (8) districts	1956.8	2,276.6	2,532.7	3,044.8	0.9694
		1,768.5	1,727.8	1,656.0	
Long Bien district	227.1	267.2	297.1	356.9	0.9943
		272.1	317.0	426.0	
Gia Lam prefecture	109.6	151.9	179.7	235.4	0.9826
(Water supply Area)		167.4	180.0	247.0	

*The upper row in each category in the table indicates estimated values by Study Team and the lower row estimated values in Ha Noi City water supply plan.

The results of Table 3.2.7 for Center of Ha Noi(8) district indicate that the estimated values in this research exceed remarkably the estimated values of the water supply plan. This is because, in the water supply plan, it is intended to limit future population influx through development limitation area in four districts of Ba Dinh, Hoan Kiem, Dong Da and Hai Ba Trung, on account of actual sudden increase, and thereby to decrease artificially the future population. Therefore, concerning the future population, it will be reasonable to adopt relatively small estimated values of the water supply plan to avoid excessive water demand forecast.

In respect of Long Bien District, estimated values of the water supply plan came slightly exceeds the estimates in this research, by about 70 thousands habitants in 2030. The detail cannot be confirmed because the estimation method of the water supply plan is unknown, but it can be supposed that various factors such as future development population, etc. are anticipated. As the present research aims at setting a basic frame up to 2020, it will be evaluated only with estimated values up to 2020 and relatively small estimated values of JICA Study Team will be adopted.

As for Gia Lam Prefecture, a large disparity between the estimated values in this research and estimated values of the water supply plan was not marked. Therefore, the present estimated values shall be adopted, because the detail of target Supply Area is not clarified in the water supply plan.

Based on above discussion, the final future population is set as shown in Table 3.2.8.

Table 3.2.8 Set Values of Future Population

Area	Estimated Population (1,000 people)		
	2015		2015
Center of Ha Noi 8 districts	－	1,727.8	1,656.0
Long Bien district	267.2	297.1	356.9
Gia Lam prefecture (Planning Water supply Area)	151.9	179.7	235.4

*Method of Population calculation in case of Gia Lam Prefecture

2) Water Supply Service Ratio

Water supply service ratio is set based on Ha Noi City water supply plan.

At present, water supply reaches approximately 93% in average for districts, and for certain districts, it has already reached almost 100%. Ha Noi City water supply plan targets 100% coverage in 8 districts in the city center by 2020 and 95% for Long Bien District, therefore, the present estimation is also made considering these levels of service ratio.

On the other hand, the actual water supply coverage of Gia Lam Prefecture is low at approximately 17% of the total population. However, the exact water supply service ratio is unknown, because water is supplied village by village for certain districts. Moreover, at present, 9 districts are totally deprived of water supply in Duong River south area which is included in water supply target area, but these districts will be supplied with water, as mentioned above, by the future pipeline maintenance plan. Gia Lam Prefecture pipeline maintenance plan targets 90% service ratio in 2015 and 95% in 2020 in water supply target districts, while Ha Noi City water supply plan targets 90% coverage by 2020.

Following safer targets of Ha Noi City water supply plan, this estimation aims at 90% coverage ratio in 2015 and 2020.

Table 3.2.9 Water Supply Coverage Ratio in Ha Noi City (Planned)

District	2015	2020
Center of Ha Noi 8 districts	－	100%
Long Bien district	95%	95%
Gia Lam prefecture (Planned Water supply Area)	90%	90%

（Source：Ha Noi City water supply plan）

3) Supply Unit (daily average supply per capita)

So far, future supply unit has been set based on water supply facility construction standard of MOC (Ministry of Construction) (TCXDVN 33 2006). However, actual supply units often do not meet the mentioned construction standard, so the importance of reviewing the basic unit setting is discussed in Ha Noi City water supply plan which is now being prepared.

Units and adopted values in the present Ha Noi City is shown in Table 3.2.10. In the present estimation, basic unit setting will follow set values of Ha Noi City water supply plan and Gia Lam Prefecture pipeline maintenance plan that are set based on achieved values.

Table 3.2.10 Basic Unit Set Value

（unit:Lpcd）

Area		2010		2015			2020		
		Existing	WS	GL	HN	WS	GL	HN	WS
Center of Ha Noi (8) district		150	165	－	－	－	－	170	200
Long Bien district		130	165	145	－	－	－	160	150
Gia Lam prefecture	Urban	130	80	130	－	－	－	140	150
	Rural	60	60	100	－	－	120	120	100

* The figures in bold represents adopted values in the estimation

* Symbols in the table represent the following meaning.

GL：Gia Lam Prefecture pipeline maintenance plan

HN：Ha Noi City water supply plan,

WS：Water supply facility construction standard（TCXDVN 33 2006）

4) Setting of other coefficients

Besides abovementioned service ratios and supply unit, it is necessary to set various coefficients in order to calculate water demand. These coefficients are set as shown in the following table, according to the values adopted in the Gia Lam Prefecture pipeline maintenance plan and Ha Noi City water supply plan which have set the values based on Water supply facility construction standard (TCXDVN 33 2006).

Table 3.2.11 Setting of Various Coefficients Necessary for Water Demand Estimation

No.	Item		2015	2020
a)	Domestic use	common	Served Population × Lpcd	
b)	Public use	Central Area	－	18％ of a)
		Long Bien	15％ of a)	18％ of a)
		Gia Lam	10％ of a)	15％ of a)
c)	Commercial use	common	10％of a)	
d)	Manufacturing use	Central Area	5％ of a)	
		Long Bien	5％ of a)	
		Gia Lam	7％ of a)	
e)	Industrial use	common	22m3/ha	
f)	Water leakage	Central Area	－	30％ of a) - e)
		Long Bien	25％ of a) - e)	25％ of a) - e)
		Gia Lam	22％ of a) - e)	22％ of a) - e)
g)	Loading Ratio	Central Area	20％ of total above	
		Long Bien	20％ of total above	
		Gia Lam	30％ of total above	

（Source：Water supply facility construction standard TCXDVN 33 2006, Ha Noi City water supply plan, Gia Lam Prefecture pipeline maintenance plan）

5) Demand Forecast Results

Results of water demand calculation of each area for 2015 and 2020 based on settings discussed earlier are shown in Table 3.2.12 and Table 3.2.13.

Concerning water demand of Bac Ninh Province, water volume corresponding to the construction of new water treatment plant is set as follows, based on planned contents of the Decision No. 1580-QD-UBND.

- 2015 (Phase 1): 10,000 m^3/day
- 2020 (Phase 2): 30,000 m^3/day

【2015】

From Table 3.2.12, water demand in 2015 is expected to be approximately 162,000 m^3/day.

In Ha Noi City, demand only in Long Bien District and Gia Lam Prefecture required by HAWACO is approximately 110,000 m^3/day, which is far below 150,000 m^3/day. Therefore, the JICA Study Team proposed earlier to stop the operation of Phap Van Water Treatment Plant presenting water quality problems and to use it as Distribution Facility (Pumping Station), by anticipating transmission to Phap Van Water Treatment Plant to be connected after traversing Red River, as the transmission to the center of the city. As water volume for stopping the operation, 30,000 m^3/day corresponding to the existing water treatment capacity shall be anticipated as demand and thereby, approximately 140,000 m^3/day come to be anticipated only for Ha Noi City as the Phase 1 water demand.

【2020】

From Table 3.2.13, approximately 392,000 m^3/day of demand is anticipated for 2020 and, of that, approximately 340,000 m^3/day of water demand is anticipated in Ha Noi City. Demand of only Gia Lam Prefecture and Long Bien District is approximately 170,000 m^3/day, the remaining 170,000 m^3/day are all for the center of Ha Noi City.

Water demand without existing water treatment capacity is anticipated for the center of Ha Noi City; as for three (3) Water Treatment Plants where the operation will be suspended (Phap Van, Tuong Mai, Ha Dinh), the suspension is excluded from the anticipated deduction.

Moreover, in 2020, demand volume will exceed largely the planned water treatment capacity of 300,000 m^3/day, but the lack will be compensated by Red River Water Treatment Plant, because Red River Water Treatment Plant which is also a surface water system large scale water treatment plant and is expected to operate at that time. Even if Red River Water Treatment Plant operation starts late, it will be recovered without problem by three water treatment plants including Duong River Water Treatment Plant, because backup from Da River Water Treatment Plant is available.

Table 3.2.12 Water Demand in Ha Noi City in 2015 (Phase 1)

No.	Area	Population	Coverage Ratio (%)	Served Population	Domestic Use		Public Use		Commercial Use		Manufacturing Use		Industrial Use			Total (Qtt)	Leakage Water		Average Daily Supply	Loading Ratio	Maximam Daily Supply	Accounted by VIWASEEN (m3/day)
					Lpcd	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	m3/ha	Area (ha)	Demand (m3/day)		Consumption Ratio	Demand (m3/day)				
	【Ha Noi City】																					
1	Central Area of Ha Noi																Capacity of Phap Van WTP				30,000	(0)
2	Long Bien	267,200	95%	253,840	145	36,807	15%	5,521	10%	3,681	5%	1,840				47,849	25%	11,962	59,811	1.20	71,773	(36,000)
	Garden City Residential Park	6,600	10%	660	145	96	15%	14	10%	10	5%	5				125	10%	13	138	1.20	166	(216)
	High Tech Park	39,500	5%	1,975	145	286	15%	43	10%	29	5%	14				372	10%	37	409	1.20	491	(11,519)
	Sai Dong New Residential Park	10,000	10%	1,000	145	145	15%	22	10%	15	5%	7				189	10%	19	208	1.20	250	(2,916)
	Long Bien Industrial Park												22	300	6,600	6,600	10%	660	7,260	1.00	7,260	(16,301)
3	Trau Quy	30,120	90%	27,108	130	3,524	10%	352	10%	352	7%	247				4,475	22%	985	5,460	1.30	7,098	(60,000)
	Hanoi-Dai Tu Industrial Park												22	20	440	440	10%	44	484	1.30	629	(1,267)
4	Co Bi	11,700	90%	10,530	130	1,369	10%	137	10%	137	7%	96				1,739	22%	383	2,122	1.30	2,759	including of 3
5	Da Ton	14,620	90%	13,158	100	1,316	10%	132	10%	132	7%	92				1,672	22%	368	2,040	1.30	2,652	(2,064)
6	Dang Xa	11,110	90%	9,999	100	1,000	10%	100	10%	100	7%	70				1,270	22%	279	1,549	1.30	2,014	(1,547)
	Dang Xa Residential Park	5,000	25%	1,250	145	181	10%	18	10%	18	5%	9				226	10%	23	249	1.00	249	(2,316)
7	Dong Du	5,560	90%	5,004	100	500	10%	50	10%	50	7%	35				635	22%	140	775	1.30	1,008	(607)
8	Duong Quang	13,740	90%	12,366	100	1,237	10%	124	10%	124	7%	87				1,572	22%	346	1,918	1.30	2,493	(820)
9	Duong Xa	12,570	90%	11,313	100	1,131	10%	113	10%	113	7%	79				1,436	22%	316	1,752	1.30	2,278	(2,028)
10	Kieu Ky	12,570	90%	11,313	100	1,131	10%	113	10%	113	7%	79				1,436	22%	316	1,752	1.30	2,278	(1,786)
	Kieu Ky Service Centre												22	55	1,210	1,210	10%	121	1,331	1.00	1,331	(247)
11	Kim Son	14,910	90%	13,419	100	1,342	10%	134	10%	134	7%	94				1,704	22%	375	2,079	1.30	2,703	(0)
	Hapro Industrial Park												22	60	1,320	1,320	10%	132	1,452	1.00	1,452	(2,880)
	Hapro Residential Park	3,500	90%	3,150	145	457	10%	46	10%	46	5%	23				572	10%	57	629	1.00	629	(1,021)
12	Le Chi	15,200	90%	13,680	100	1,368	10%	137	10%	137	7%	96				1,738	22%	382	2,120	1.30	2,756	(0)
13	Phu Thi	9,360	90%	8,424	100	842	10%	84	10%	84	7%	59				1,069	22%	235	1,304	1.30	1,695	(910)
	【Bac Ninh Province】																					
14	Lim																Water Demand of Bac Ninh Province				10,000	(10,080)
	【Hung Yen Province】																					
15	Eco Park Residential Park	136,000	25%	34,000	145	4,930	15%	740	10%	493						6,163	10%	616	6,779	1.20	8,135	(39,838)
	Total	619,260		432,189		57,662		7,880		5,768		2,932			9,570	83,812		17,809	101,621		162,099	(194,363)

Center of Ha Noi City	30,000	m3/day (Above 1)
Lon Bien District	79,940	m3/day (Above 2)
Gia Lam Prefecture	34,024	m3/day (Above 3-13)

Total volume of not supplyed area	21,208	m3/day
Total volume of deveroping area	10,873	m3/day

Table 3.2.13 Water Demand in Ha Noi City in 2020 (Phase 2)

No.	Area	Population	Coverage Ratio (%)	Served Population	Domestic Use		Public Use		Commercial Use		Manufacturing Use		Industrial Use			Total (Qtt)	Leakage Water		Average Daily Supply	Loading Ratio	Maximam Daily Supply	Accounted by VIWASEEN (m3/day)
					Lpcd	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	Consumption Ratio	Demand (m3/day)	m3/ha	Area (ha)	Demand (m3/day)		Consumption Ratio	Demand (m3/day)				
	【Ha Noi City】																					
1	Central Area of Ha Noi	1,727,800	100%	1,727,800	170	293,726	18%	52,871	10%	29,373	5%	14,686				390,656	30%	117,197	507,853	1.20	609,424	
2	Long Bien	297,100	95%	282,245	160	45,159	18%	8,129	10%	4,516	5%	2,258				60,062	25%	15,016	75,078	1.20	90,094	
	Garden City Residential Park	6,600	100%	6,600	160	1,056	18%	190	10%	106	5%	53				1,405	10%	141	1,546	1.20	1,855	
	High Tech Park	39,500	100%	39,500	160	6,320	18%	1,138	10%	632	5%	316				8,406	10%	841	9,247	1.20	11,096	
	Sai Dong New Residential Park	10,000	50%	5,000	160	800	18%	144	10%	80	5%	40				1,064	10%	106	1,170	1.20	1,404	
	Long Bien Industrial Park												22	700	15,400	15,400	10%	1,540	16,940	1.00	16,940	
3	Trau Quy	35,640	90%	32,076	140	4,491	15%	674	10%	449	7%	314				5,928	20%	1,186	7,114	1.30	9,248	
	Hanoi-Dai Tu Industrial Park												22	40	880	880	10%	88	968	1.30	1,258	
4	Co Bi	13,840	90%	12,456	120	1,495	15%	224	10%	150	7%	105				1,974	20%	395	2,369	1.30	3,080	
5	Da Ton	17,300	90%	15,570	120	1,868	15%	280	10%	187	7%	131				2,466	20%	493	2,959	1.30	3,847	
6	Dang Xa	13,150	90%	11,835	120	1,420	15%	213	10%	142	7%	99				1,874	20%	375	2,249	1.30	2,924	
	Dang Xa Residential Park	5,000	90%	4,500	160	720	18%	130	10%	72	5%	36				958	10%	96	1,054	1.20	1,265	(183,204)
7	Dong Du	6,570	90%	5,913	120	710	15%	107	10%	71	7%	50				938	20%	188	1,126	1.30	1,464	
8	Duong Quang	16,260	90%	14,634	120	1,756	15%	263	10%	176	7%	123				2,318	20%	464	2,782	1.30	3,617	
9	Duong Xa	14,880	90%	13,392	120	1,607	15%	241	10%	161	7%	112				2,121	20%	424	2,545	1.30	3,309	
10	Kieu Ky	14,880	90%	13,392	120	1,607	15%	241	10%	161	7%	112				2,121	20%	424	2,545	1.30	3,309	
	Kieu Ky Service Centre												22	55	1,210	1,210	10%	121	1,331	1.00	1,331	
11	Kim Son	17,650	90%	15,885	120	1,906	15%	286	10%	191	7%	133				2,516	20%	503	3,019	1.30	3,925	
	Hapro Industrial Park												22	140	3,080	3,080	10%	308	3,388	1.30	4,404	
	Hapro Residential Park	3,500	100%	3,500	160	560	18%	101	10%	56	5%	28				745	10%	75	820	1.30	1,066	
12	Le Chi	17,990	90%	16,191	120	1,943	15%	291	10%	194	7%	136				2,564	20%	513	3,077	1.30	4,000	
13	Phu Thi	11,070	90%	9,963	120	1,196	15%	179	10%	120	7%	84				1,579	20%	316	1,895	1.30	2,464	
	【Bac Ninh Province】																					
14	Lim																Water Demand of Bac Ninh Province				30,000	(108,104)
	【Hung Yen Province】																					
15	Eco Park Residential Park	136,000	50%	68,000	160	10,880	18%	1,958	10%	1,088						13,926	10%	1,393	15,319	1.20	18,383	(39,838)
	Total	2,404,730		2,298,452		379,220		67,660		37,925		18,816			20,570	524,191		142,203	666,394		829,707	(331,146)

【Existing WTP】

No.	Item	Capacity (m3/day)
1	Yen Phu WTP	90,000
2	Ngoc Ha WTP	32,000
3	Ngo Si Lien WTP	47,000
4	Mai Dich WTP	60,000
5	Cao Dinh WTP	60,000
6	Luong Yen WTP	50,000
7	Nam Du WTP	60,000
8	Small scale several WTPs	39,000
	Total	438,000

∴Defferent total volume of demand from existing WTP capacity 391,707 (m3/day)

Center of Ha Noi City	171,424	m3/day (Different above 1 from capacity of existing WTP)
Lon Bien District	121,389	m3/day (Above 2)
Gia Lam Prefecture	50,511	m3/day (Above 3-13)

(3) Off Take Points and Off Take Method

1) Ha Noi City

Four (4) off take points shown in Table 3.2.14 are set for Ha Noi City according to the aforementioned principles. As for off take method, if pipeline is connected directly, not only transmission pumping cost and pipeline cost increase due to chronicle variation of distribution volume, but also it is feared that water quality accident or pipeline rupture may affect downstream distribution network, therefore, it is recommended to deliver at off take tank.

Therefore, all of off take points shall be provided with an off take tank and, as for Phap Van Water Treatment Plant, off take shall be realized at the distribution reservoir in the plant.

It is to be noted that the off take tank shall be installed by the receiving entity (HAWACO).

Locations of respective off take point and distribution area are shown in Figure 3.2.7.

Table 3.2.14 Composition of Off Take Point Water Volume

Off take Point	Supply Area	Water Demand (m3/day)		Condition of Distribution Network Construction
		2015	2020	
1.Phu Thi（Sui）	Total	13,991	23,665	
	Dang Xa	2,263	4,189	Planning
	Duong Quang	2,493	3,617	Planning
	Kim Son	4,784	9,395	None
	Le Chi	2,756	4,000	None
	Phu Thi	1,695	2,464	Planning
2.Trau Quy	Total	20,033	26,846	
	Trau Quy	7,727	10,506	Existing
	Co Bi	2,759	3,080	Existing
	Da Ton	2,652	3,847	Planning
	Dong Du	1,008	1,464	Planning
	Duong Xa	2,278	3,309	Planning
	Kieu Ky	3,609	4,640	Planning
3.Sai Dong	Total	79,940	136,389	
	Long Bien	79,940	121,389	Existing
	Central area of Ha Noi	－	15,000	Existing
4.Phap Van WTP	Central area of Ha Noi	17,901	64,717	Existing

Off take Point setting location are shown in Figure 3.2.7.

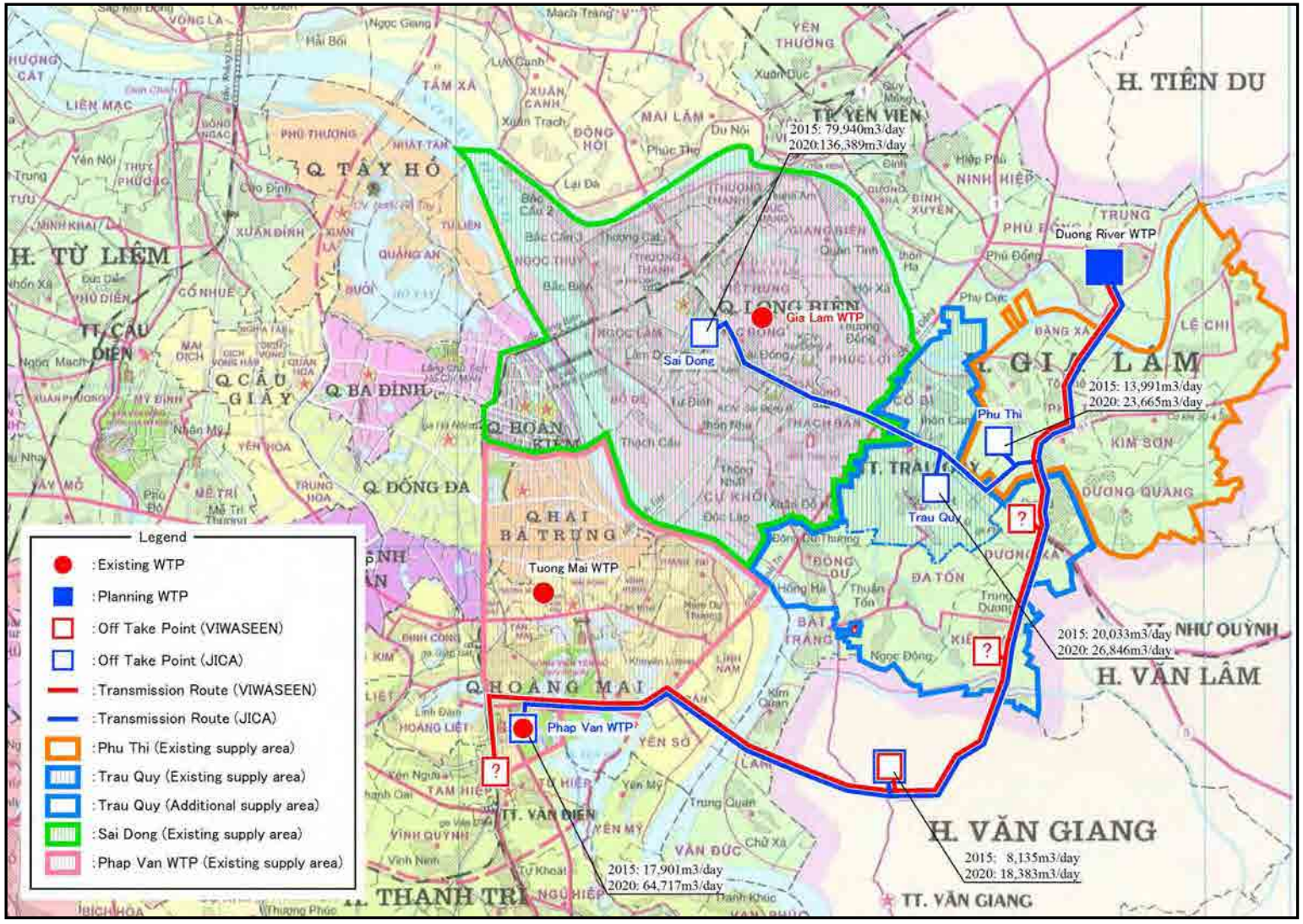


Figure 3.2.7 Off Take Point and Distribution Area

2) Bac Ninh Province

As for off take point location and off take method of Bac Ninh Province, the off take point shall be installed near Lim, Tien Du Prefecture, on negotiation with Bac Ninh Province Water Works.

Study Team received the response that both off take tank and delivery by pipeline are good as off take method, therefore off take tank shall be adopted similar to the case of Ha Noi City.

It was agreed that off take tank, distribution pump or other facilities shall be prepared by Bac Ninh Province Water Works.

3) Hung Yen Province

As for off take point location and off take method of Hung Yen Province, Study Team received the response that the client is a housing complex which will install independently its own off take tank (and possibly its own water treatment facility) through a hearing at the time of Pre-FS survey; therefore the delivery shall be performed by directly connecting pipelines.

It is necessary to negotiate with Eco Park Management Company about the delivery point, but the delivery shall be exerted in Eco Park, because the transmission pipeline will be laid in the vicinity of Eco Park.

4) Off Take Point location and off take volume

Principles set in said 1) to 3) and off take volume at the Off take Point are shown in Table 3.2.15.

Moreover, transmission route chart including final review is shown in Figure 3.2.7.

Table 3.2.15 Off Take Volume by Off Take Point Basin

No.	Off take Point	Water Demand (m3/day)		Method of off take
		2015	2020	
①	Lim	10,000	30,000	Reservoir Tank
②	Phu Thi	13,991	23,665	〃
③	Trau Quy	20,033	26,846	〃
④	Sai Dong	79,940	136,389	〃
⑤	Eco Park	8,135	18,383	Direct Connection
⑥	Phap Van WTP	17,901	64,717	Connect to Existing Tank
	Total	150,000	300,000	

3.2.7 Basic Frame of the Proposed Project

Based on results of surveys and examinations, the basic frame of the proposed project is set as described below.

Supply target area includes one City and two Provinces as the result of FS survey report of VIWASEEN, but the supply target area of the Phase 2 is proposed to be largely reduced. This is the result of consideration of the intention of HAWACO, communication with other Water Works (VIWACO, Ha Dong Water supply Company, and so on) and the demand certainty. Especially for Hung Yen Province, large scale water consumption cannot be expected and, for Bac Ninh Province, only one off take point will be enough corresponding to the demand. These factors have influenced the result considerably.

This means that the transmission pipeline extension would be shortened, and this is considered to reduce risks concerning the transmission pipeline construction. Moreover, as the scale of transmission target area is reduced, larger becomes the proportion that the demand of Ha Noi City occupies in the proposed project, and this fact allows improving demand certainty and business profitability in the urban area of Ha Noi City where economical disparity still exists.

In the future, it is necessary to proceed to more concrete contract negotiation (adjustment of tariff, water volume and so on). Moreover, depending on the situation, it may become necessary to enlarge, reduce or otherwise review the Supply Area or modify supply water volume.

Regarding Basic Frame, it will be discussed and finalized in the expected Shareholders meetings, which was started from March, 2012 occasionally. In the meeting, it was mostly agreed that Supply Area up to Phase 2 could be only Hanoi City.

- Scale of Water Treatment Plant
  Phase 1: 150,000 m^3/day
  Phase 2: 300,000 m^3/day

- Target Supply Area
  Phase 1: Ha Noi City (Long Bien District, Gia Lam Prefecture, the center of Ha Noi City)
  Bac Ninh Province (transmission to the proximity of Lim town, Tien Du Prefecture)
  Hung Yen Province (Housing complex of Van Giang Prefecture)
  Phase 2: Same as in case of Phase 1

- Length of transmission pipeline
  Phase 1: approx. 45.6km Phase 2: Same as in case of Phase 1

- Number of Off Take Point
  Phase 1: 6 (4 in Ha Noi City, 1 in Bac Ninh Province and 1 in Hung Yen Province)
  Phase 2: Same as in case of Phase 1

Note) If the Water Supply Area is only Ha Noi City, the transmission pipeline length is about 20.6 km.

Final target Supply Area of this research is shown in Figure 3.2.8. and target water volume of Duong River Water Treatment Plant is presented in Table 3.2.16.

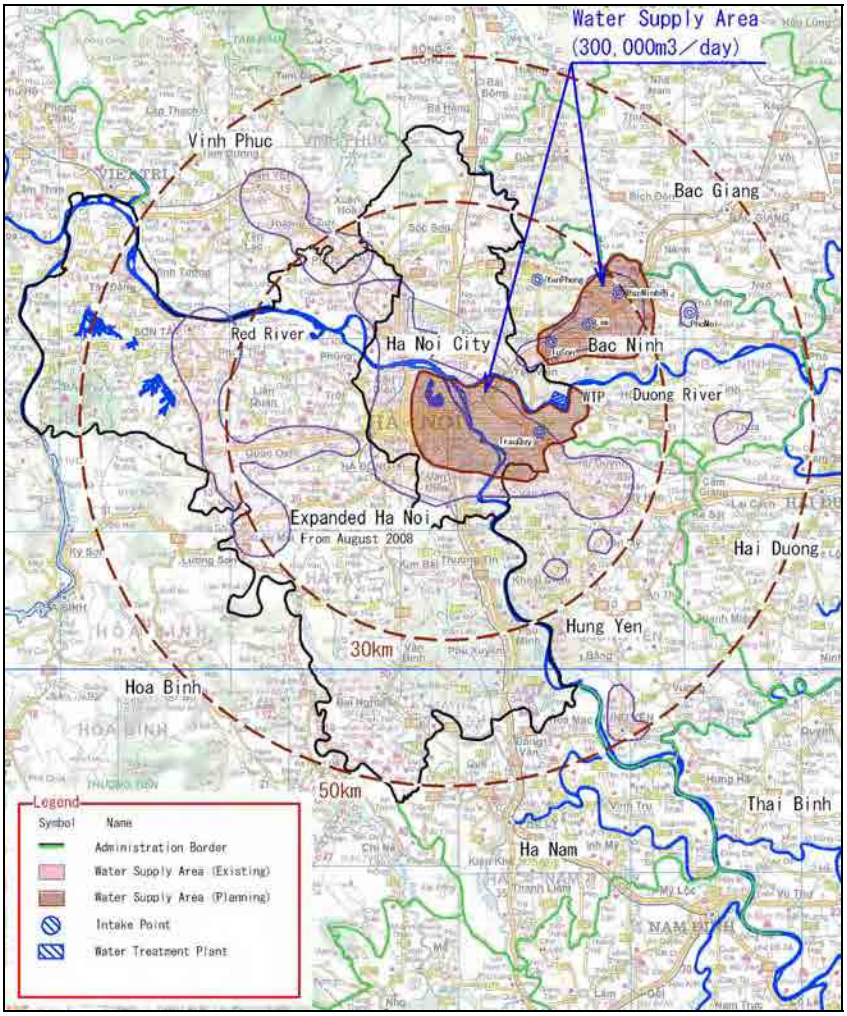


Figure 3.2.8 Supply Area of the Proposed Project (Reviewed)

Table 3.2.16 Target Water Volume of Duong River Water Treatment Plant

Item	2015	2020
Water demand (thousand m^3/day)	162.1	829.7
Capacity of Other Water Treatment Plants (existing, planned, thousand m^3/day)	0.0	438.0
Shortage in water available (thousand m^3/day)	162.1	391.7
Duong River Water Treatment Plant (thousand m^3/day) is proposed to provide	150.0	300.0
	Phase 1	Phase 2
Planned water volume (thousand m^3/day)	150.0	300.0

3.3 Proposal of Appropriate Scope of Project

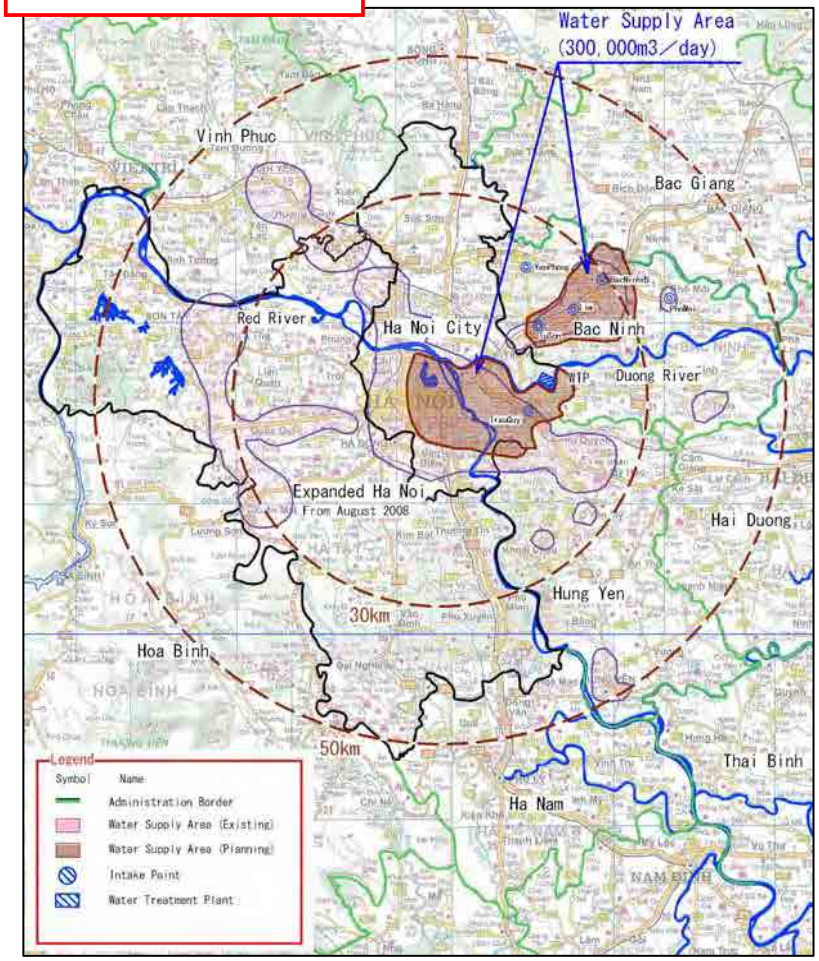
3.3.1 Overview of Project

The proposed project is meant for supplying water to one city and two (2) provinces to meet the increasing water demand of the Hanoi metropolitan area. The construction, operation and maintenance of water treatment plant with design water treatment capacity of 300,000 m^3/day (Phase 1: 150,000; Phase 2: 150,000 m^3/day), and maintenance of transmission pipelines of overall length 46 km are to be implemented as a Japanese-Vietnamese PPP venture in this project using the surface water of the Duong River as the water source.

Besides the water supply business units of the Bac Ninh Water supply Authority and HAWACO, industrial parks and residential parks form part of the main water receiving locations.
An overview of the project is given below. (For details, see Figure 3.3.1)

- Design Water Treatment Capacity
  - Phase 1：150,000m^3/day
  - Phase 2：300,000m^3/day
- Water Supply Area
  - Phase 1：Ha Noi City（Long Bien and Gia Lam and Central area of city）
    Bac Ninh Province（Surrounding Lim Town in Tien Du Prefecture）
    Hung Yen Province（Residential Park in Van Giang Prefecture）
  - Phase 2：Same as in case of Phase 1
- Length of Transmission pipeline
  - Phase 1：about 45.6 km　　Phase 2：common with Phase 1
- Number of Off Take Points
  - Phase 1：6 points
  - Phase 2：common with Phase 1

Water supply area (300,000m3/day)



Transmission Pipeline and Off Take Point

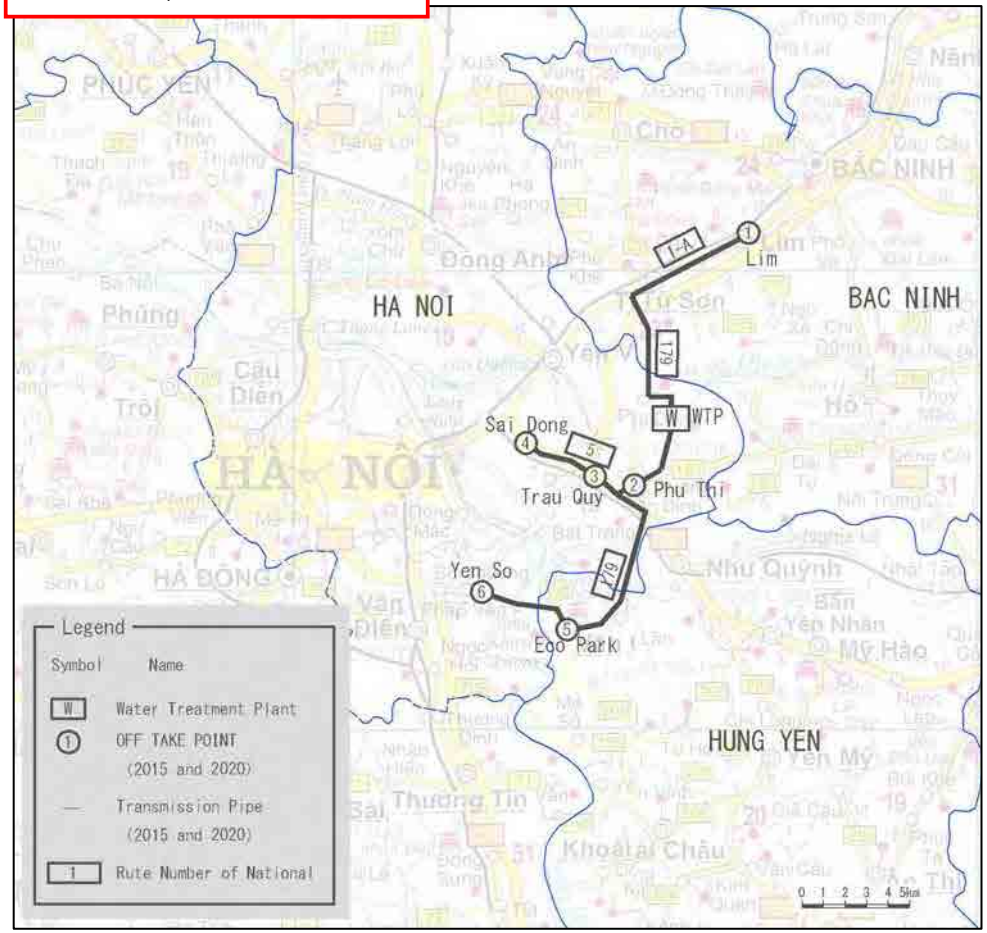


Figure 3.3.1 Outline of This Project

3.3.2 Proposed Scope of Project

As shown in Figure 3.3.2, the scope of the proposed project includes the construction, operation and maintenance of water treatment plant and transmission pipelines. The project is to be implemented after forming the SPC.

Clearly defining the sharing of public roles by the Japanese and Vietnamese sides are important from the viewpoint of the PPP project. The role of the Japanese industry is to propose treatment technologies for treating river water of high turbidity, construction of facilities, and responsibility of operation and maintenance. The assumption for capital procurement is that public funds (with the cooperation of authorities) and private funds will be effectively utilized, and new finances will be procured to ensure long-term viability of the project.

The proposal for these water treatment technologies and finances will contribute to the growth of water supply works and development of capital markets in Viet Nam.

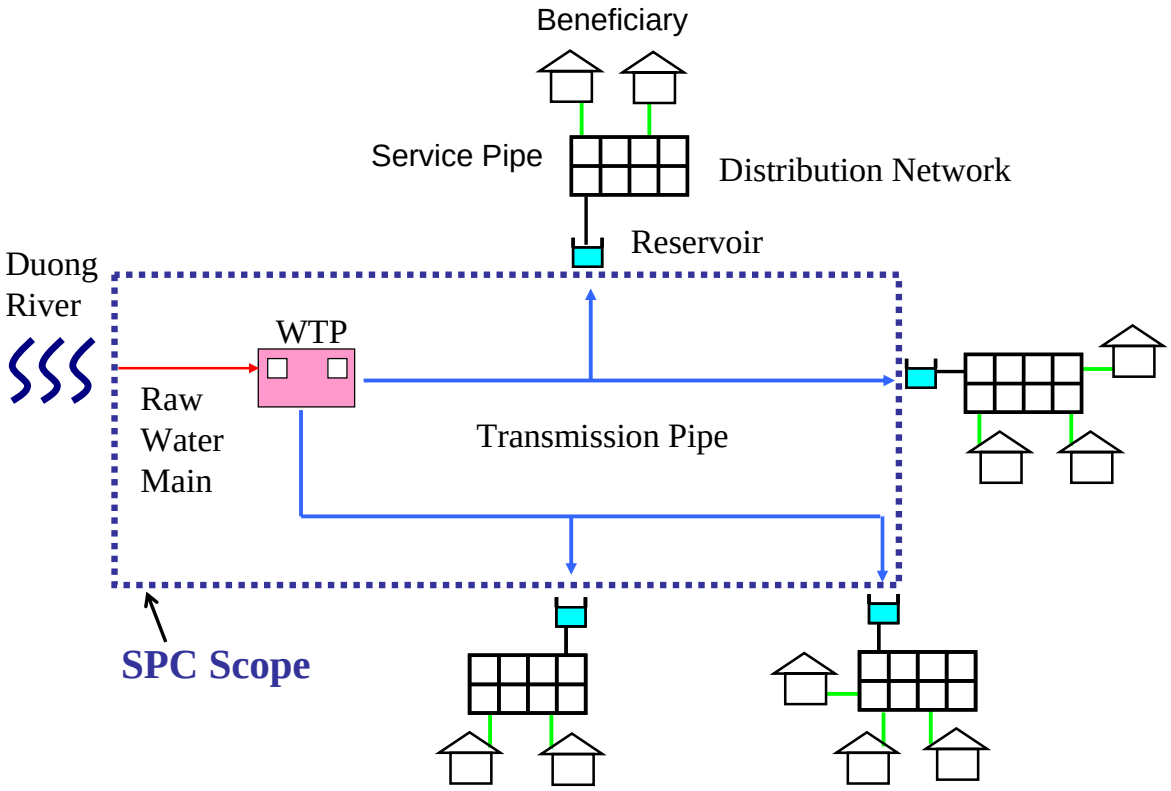


Figure 3.3.2 Concept of the Proposed Project

3.3.3 Selection of Construction Site for Water Treatment Plant

From the results of field survey during the pre-feasibility study, the land to be used for water treatment plant (WTP) construction was selected as shown in Figure 3.3.3. However, according to the plan by VIWASEEN, the main implementing agency in this study, and based on the outcome of confirmation on site, the proposed site for construction of WTP was changed because there was a possibility of several houses to be affected and decided as shown in Figure 3.3.3 .

The main considerations for the selection are as given below.

- Proposed site is to be such that relocation of residents does not occur.
- Proposed site is to be such that routine operation and maintenance, and installation of facilities are easy and the facilities can be extended in the future.
- Land acquisition inclusive of site for expansion of WTP in the future (600,000 m^3/day) is necessary.

Considering the points mentioned above and studying the installation of facilities mentioned later, the land use of proposed site for WTP construction appears to be ideal and is shown in Figure 3.3.3.

Site photographs and details of environmental impact studies are given in Chapter 4. Details of facilities plan, site area and so on, are described in Section “3.5 Design.”

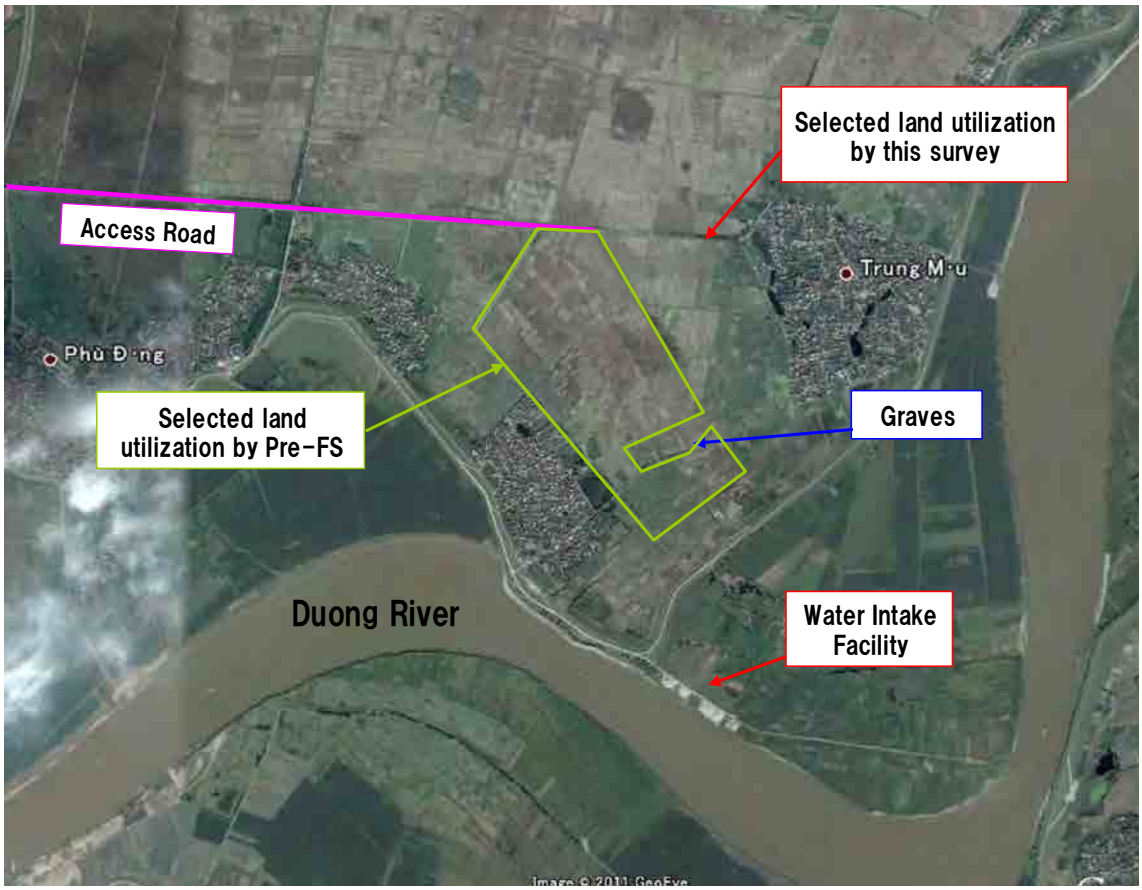


Figure 3.3.3 Proposed Construction Sites for Water Treatment Plant and Intake Facilities

3.3.4 Proposed Project Implementation Period

The scale of the project is large, and the cost of construction requires capital of 23,000 million yen (Phase 1 and Phase 2: 300,000m^3/day), so the construction work has to be spread over several years.

The project is divided into different construction stages progressively to achieve additional 300,000 m^3/day of the facilities' capacity from the water demand estimates.

The Phase 1 construction period was proposed as 2012 to 2014, in response to the strong wishes of the Hanoi Water Works and the water demand trends, aiming to start supply in 2015 (at the rate of 150,000m^3/day).

On the other hand, completion of phase 2 (total capacity is 300,000m^3/day) is requested in the year of 2019, according to water demand estimates; however, there are many uncertainties in the expansion of actual demand. Therefore, the period should be fixed after considering the actual project results of Phase 1. Accordingly, the construction period of Phase 2 is planned from 2018 to 2019 in the finanded analysis, however it is subject to changes.

The project period inclusive of operation and maintenance is proposed as 30 years in maximum; the project implementation period divided into phases for financed model is shown in Table 3.3.1.

Table 3.3.1 Scope of Project Implementation and Estimated Period

Item	Project Scale	Concession Year	Year of starting Operation	Termination of the Concession
Phase 1	150,000m^3/day	2012	2015	2042
Phase 2	150,000m^3/day	2018	2020	2042

3.4 Setting the Design Criteria

The basic design criteria required in "3.5 Conceptual Design" described later in this chapter, are set here.

3.4.1 Target Year

The target year of this proposed project is set as given below, based on "3.3.5 Proposed Project Implementation Period."

- Phase 1: 2015
- Phase 2: 2020

3.4.2 Basic Water Capacity

The basic water capacity in this proposed project is as given below, according to "3.2 Project Demand Prediction" and "3.5 Conceptual Design."

- Phase 1: 150,000 m^3/day
- Phase 2: 300,000 m^3/day

3.4.3 Treated Water Quality Standards

Design treated water quality is to conform to the drinking water quality standards of Viet Nam.

The important items in the standards are given below.

Table 3.4.1 Important Items in Drinking Water Quality Standards of Viet Nam

No	Standard items	Unit	Maximum water quality standard	Experiment process
1	Color	TCU	15	TCVN 6185 - 1996 (ISO 7887 - 1985) or SMEWW 2120
2	Taste・Odor	-	No aberration	Sense, or SMEWW 2150 B và 2160 B
3	Turbidity	NTU	2	TCVN 6184 - 1996 (ISO 7027 - 1990) or SMEWW 2130 B
4	pH	-	6.5 - 8.5	TCVN 6492:1999 or SMEWW 4500 - H^+
5	Hardness, as $CaCO_3$	mg/L	300	TCVN 6224 – 1996 or SMEWW 2340 C
14	Chloride ion	mg /L	250 300(**)	TCVN6194 - 1996 (ISO 9297 - 1989) or SMEWW 4500 - Cl^- D
20	Iron (Fe^{2+} + Fe^{3+})	mg/L	0.3	TCVN 6177 - 1996 (ISO 6332 - 1988) or SMEWW 3500 – Fe
22	Manganese	mg/L	0.3	TCVN 6002 - 1995 (ISO 6333 - 1986)
26	Nitrate	mg/L	50	TCVN 6180 - 1996 (ISO 7890 -1988)
27	Nitrite	mg/L	3	TCVN 6178 - 1996 (ISO 6777-1984)
30	Sulfate ion	mg/L	250	TCVN 6200 - 1996 (ISO9280 - 1990)
32	Oxygen consumption （$KMnO_4$ consumption）	mg/L	2	TCVN 6186:1996 or ISO 8467:1993 (E)
90	Residual chlorine	mg/L	0.3 - 0.5	SMEWW 4500Cl or US EPA 300.1
108	Standard plate count	MPN/100ml	0	TCVN 6187 - 1,2:1996 (ISO 9308 - 1,2 - 1990) or SMEWW 9222
109	Escherichia coli or fecal coliforms	MPN/100ml	0	TCVN6187 - 1,2: 1996 (ISO 9308 - 1,2 - 1990) or SMEWW 9222

（Source：Environment board・Standard of drinking water quality 2009）

3.4.4 Duong River Intake Water Level

The intake planned water level of the Duong River water treatment plant is determined based on the data of the past ten years.

Figure 3.4.1 shows a graph of the change in water level of the Duong River (water source for this Project), in the 10-year period from 2002 to 2009.

Also, Figure 3.4.2 shows a graph of the monthly maximum and minimum water levels in Duong River.

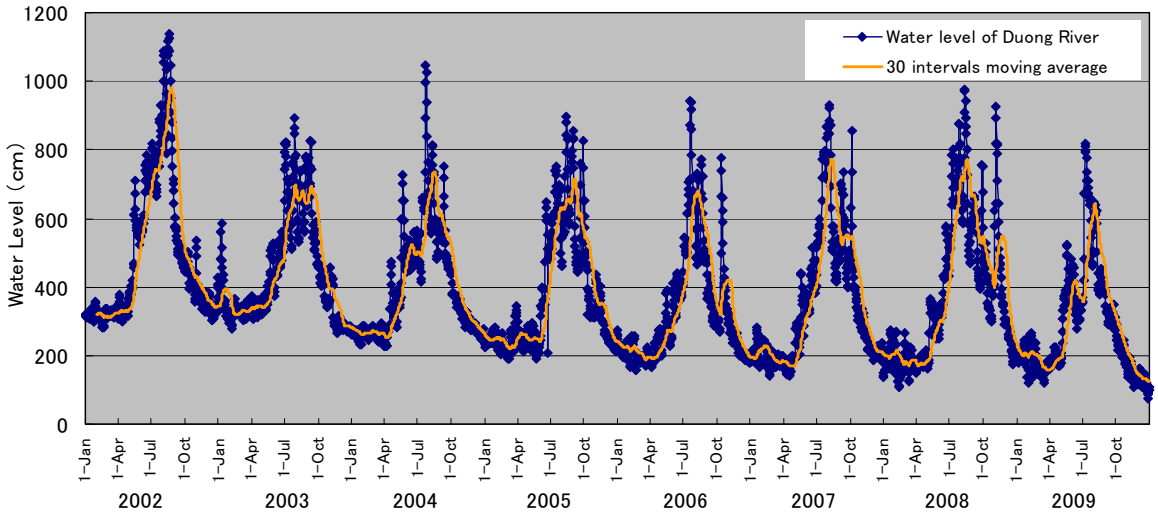


Figure 3.4.1 Change in the Daily Water Level of Duong River with Time (2002 to 2009)

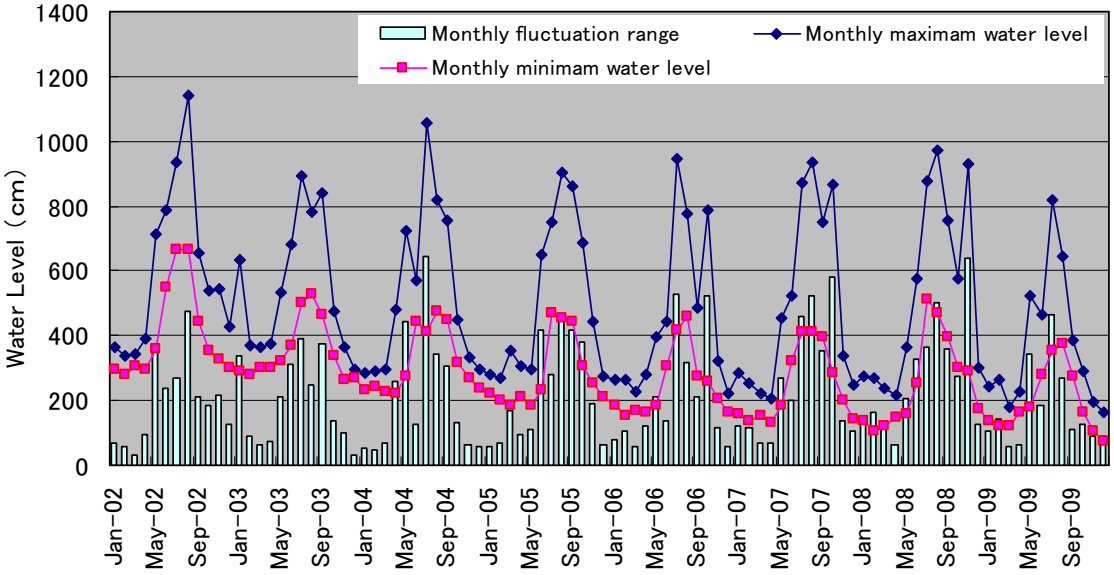


Figure 3.4.2 Change in the Monthly Maximum and Minimum Water Levels with Time (2002

to 2009)

From the Figures, it can be observed that in the past ten years, the water level of the Duong River has shown a decreasing trend. The maximum water level was 11.42m in 2002, but in recent years, this level has dropped to below 10m. The same is the case with minimum water level too; the level in 2002 was 2.80m, but in 2009 it has dropped to as low as 0.75m.

However, observing the data for the last five years, except for 2009, the water level has generally been steady. In view of the above, it can be concluded that the decreasing trend in the water level of the Duong River will not continue henceforth as was the case from 2002 to 2005. Although there is a change in level for a specific year because of weather conditions in the upstream area, or because of construction and operation of dams, generally the water level is estimated to remain steady.

Based on the above reasoning, the intake design water level of the Duong River water treatment plant is set as given below.

Table 3.4.2 Duong River Intake Water Level (Set Value)

Item	Water Level (evaluation)	Setting reason
Maximum water level	11.5m	Due to maximum level (2002) 11.42m
Minimum water level	0.5m	Due to minimum level (2009) 0.75m
Fluctuation Range	11.0m	Difference of the above figures

The annual variation in the actual water level of rivers for the planned water level mentioned above is given in the table below; the variation in level is seen to be about 8m in practice. Large-scale variation in water level affects the operation of the water intake pump; therefore, measures on the pump side are considered necessary for stable intake of water.

Table 3.4.3 Annual Variation in the Water Level (2002 to 2009)

(Unit: m)

	2002	2003	2004	2005	2006	2007	2008	2009	Ave
Fluctuation Range	8.62	6.29	8.34	7.18	7.92	8.00	8.66	7.43	7.80

3.4.5 Off Take Point Water Receiving System

(1) Scope of Responsibility for the Proposed Project

The proposed project is a water supply project, so the scope of the project envisages transmission pipelines also. Flow meters are to be installed at each off take point, and the distance up to the first valve after the flow meter will be the scope of responsibility for SPC.

In addition to flow meter at each off take point, various kinds of water quality instruments will be installed, and water quality will be monitored with the aim of adhering to the required water quality.

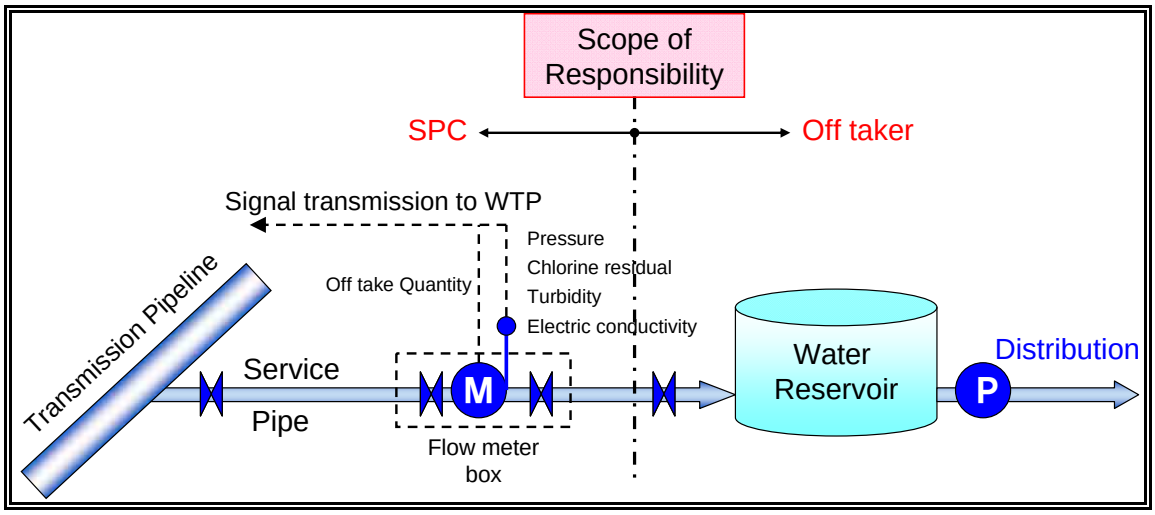


Figure 3.4.3 Scope of Responsibility for the Proposed Project at Each Off Take Point

(2) Water Transmission Mode

The basic water transmission mode shall be constant supply mode wherein a constant supply of water is transmitted to each off take point.

3.5 Design

3.5.1 Design Overview

An overview of design of facilities is given in Table 3.5.1.

Table 3.5.1 Facilities to be Designed

Facility	Designed scale		Remarks
	Phase 1	Phase 2	
Water Intake	150,000m3/day	300,000m3/day	* Construct only equipment in Phase 2
Water Conveyance			
Water Treatment			
Wastewater Treatment			
Water Transmission			* Construct only equipment in Phase 2
Transmission Pipeline	L=45.6.km	―	
Distribution Pipeline	―	―	*only Planning

3.5.2 Design Policy

(1) Basic Concept of Design of Water Treatment Plant

The water treatment plant will be the first water treatment plant in Viet Nam to be constructed, managed and operated as a clean water supply project after the establishment of special purpose company (SPC) by JICA and private enterprises.

For this reason, the construction of facilities should form a stable supply base in response to diversified needs of the customer and changes in the social circumstances in recent years, and aim for a stable and safe water treatment plant, which is also a modern water treatment plant that accounts for the global environment and the regional environment.

Making full use of the privileged environment of the Japanese-Vietnamese PPP, efforts will be made to enhance the operation and maintenance level in the Hanoi Water Works through transfer of technology related to Japan.

Taking the above points into consideration, the basic concept of the water treatment

plant is described below, and the design of the water treatment plant is carried out.

"Building a modern water treatment plant worthy of Viet Nam, a country that continues to grow"

(2) Targets and Issues/Measures Related to Design

The four targets mentioned below are set aiming an advanced water treatment plant to suit the needs of the century, and accordingly various issues and measures are proposed.

Target	Policy
Water treatment plant offering steady supply	**Ensuring a stable water source**
	・Ensuring stable intake volume taking a large river such as the Duong River as the water source
	Stable facilities with adequate margin
	・Ensure efficient spare capacity
	・Ensure clear water reservoir capacity that enables effective water operations
	・Ensure sludge treatment facilities that can thoroughly treat large volume of sludge
Secure and safe water treatment plant	**Ensure stable supply of drinking water**
	・Realization of facilities that can cope with high turbidity as measure for water quality of Duong River
	・Water treatment process that enables measures such as Cryptosporidium or trihalomethane measures to be adopted
	・Continuity by installing automatic water quality analysis instruments at the water treatment plant and the point-of-entry water quality monitoring
	・Water source measures by installing oil fence
	Ensuring safe operation and maintenance
	・Elimination of dangerous chemicals by using sodium hypochlorite
Appropriate operation and maintenance	**Introduction of energy conserving, low carbon and highly efficient monitoring and control system**
	・Effective operation and management of various pumping equipment
	・Efficient operation and maintenance by dosing chemicals effectively in response to changes in water quality
	Crisis management measures to prevent water quality accidents
	・Turbidity control to prevent leakage of Cryptosporidium
	・Use of fish monitoring tanks as a measure against unexpected water quality accidents
	Transfer of operation and maintenance technology by Japan
	・Build-up of an O&M system for assigning Japanese engineers at the required locations
	・Employee training and fostering by Japanese engineers with rich experience, and establishing a remote support system (from Japan)
Environmentally friendly treatment plant	**Introduction of energy conserving techniques**
	・Efficient pump operation by inverter control
	・Use of highly efficient transformers
	・Use of filter basin washing system that does not require power from pump
	Effective use of sludge
	・Effective use of treated sludge
	Considerations of the surrounding environment
	・Installing open green belts

(3) Summary of Basic Items

Considering these policies, the basic items related to the intake facilities and water treatment plant are set and summarized in the form of Tables3.5.2 to 3.5.6.

Table 3.5.2 Summary of Basic Items (1/4)

<table>
<tr><th>Type</th><th>Item</th><th>Basic items</th><th>Concepts of basic items</th><th>Remarks</th></tr>
<tr>
<td>Basic particulars
Basic items</td>
<td>1.Design water flow</td>
<td>
[Phase 1]
(1) Design intake capacity: 159,000 m3/day
(2) Design supply flow: 150,000 m3/day (Daily maximum water supply flow)
125,000 m3/day (Daily average water supply flow)
104,000 m3/day (Daily minimum water supply flow)
(3) Water treatment capacity: The design water flow of each facility is as given in the table below.
<table>
<tr><th colspan="2">Item</th><th>Planned Inflow</th><th>Planned Outflow</th></tr>
<tr><td rowspan="3">Phase 1</td><td>Intake pumping station</td><td>159,000</td><td>159,000</td></tr>
<tr><td>Grit chamber</td><td>159,000</td><td>156,000</td></tr>
<tr><td>Raw water pumping station</td><td>156,000</td><td>156,000</td></tr>
<tr><td rowspan="5"></td><td>Dividing well</td><td>165,000</td><td>165,000</td></tr>
<tr><td>Mixing, flocculation, sedimentation basins</td><td>165,000</td><td>162,000</td></tr>
<tr><td>Rapid sand filter</td><td>162,000</td><td>154,500</td></tr>
<tr><td>Distribution reservoir</td><td>154,500</td><td>150,000</td></tr>
<tr><td>Transmission pumping station</td><td>150,000</td><td>150,000</td></tr>
</table>
[Phase 2]
(1) Design intake capacity: 318,000 m3/day
(2) Design supply flow: 300,000 m3 /day (Daily maximum water supply flow)
250,000 m3/day (Daily average water supply flow)
208,000 m3/day (Daily minimum water supply flow)
(3) Water treatment capacity: The design water flow of each facility is as given in the table below.
<table>
<tr><th colspan="2">Item</th><th>Planned Inflow</th><th>Planned Outflow</th></tr>
<tr><td rowspan="3">Phase 2</td><td>Intake pumping station</td><td>318,000</td><td>318,000</td></tr>
<tr><td>Grit chamber</td><td>318,000</td><td>312,000</td></tr>
<tr><td>Raw water pumping station</td><td>312,000</td><td>312,000</td></tr>
<tr><td rowspan="5"></td><td>Dividing well</td><td>330,000</td><td>330,000</td></tr>
<tr><td>Mixing, flocculation, sedimentation basins</td><td>330,000</td><td>324,000</td></tr>
<tr><td>Rapid sand filter</td><td>324,000</td><td>309,000</td></tr>
<tr><td>Distribution reservoir</td><td>309,000</td><td>300,000</td></tr>
<tr><td>Transmission pumping station</td><td>300,000</td><td>300,000</td></tr>
</table>
</td>
<td>
Setting the design intake volume
3% is estimated as water for miscellaneous work (including water for fire extinguishing in the water treatment plant). 2% is estimated as raw water loss including drainage from the grit chamber and evaporation loss. 1% is estimated as the sludge drying bed loss.

* Design water flow of the water intake pumping station
Water flow inclusive of 6.0% of the design supply flow.
* Design water flow of the grit chamber
Water flow inclusive of 6.0% of the design supply flow.
* Design water flow of the raw water pumping station
Water flow inclusive of 4.0% of the design supply flow.

Setting the design water treatment capacity
The treated water required for work at the water treatment plant (sedimentation basin sludge, water for washing the filter basin, chemical dissolving water, cooling water for equipment, cleaning water, etc.), water for miscellaneous work, and other loss volumes are assumed to be 10% of the daily maximum water supply flow based on the past results of water treatment in Japan (sedimentation basin 2%, filter basin 5%, others 3%).

* Design water flow of dividing well, receiving well, sedimentation basin
Water flow inclusive of 10.0% of the design supply flow.
* Design water flow of filter basin
Water flow inclusive of 8.0% of the design supply flow.
* Design water flow of distribution reservoir
Water flow inclusive of 3.0% of the design supply flow.

[Treatment surplus capacity]
Surplus capacity will not be considered for this water treatment plant. If the number of systems (number of basins) increases, the treated water flow will be reduced, and the capacity of the facilities will be improved by operation and maintenance of facilities such as by establishing appropriate chemicals injection rate in water treatment, and the inadequacy will be compensated.
</td>
<td></td>
</tr>
</table>

Table 3.5.3 Summary of Basic Items (2/4)

<table>
<tr><th>Type</th><th>Item</th><th>Basic items</th><th>Concepts of basic items</th><th>Remarks</th></tr>
<tr><td rowspan="2">Basic particulars
Basic items</td><td>2. Design raw water quality</td><td>1) SS (Suspended Solid)
Average turbidity: 450 mg/L (Facility design value)
: 240 mg/L (Annual sludge calculated value)
Maximum turbidity: 1,830 mg/Ll (Facility design value)
Minimum turbidity: 20 mg/L (Facility design value)

2) Turbidity (Inflow into Dividing well)
Average turbidity : 62 degree
: 33 degree
Maximum turbidity : 254 degree
Minimum turbidity :11 degree</td><td>[SS of raw water]
The SS of raw water was set based on the data of the past five years.
The average SS shows a decreasing trend in recent years. Barring exceptional years, the average during the rainy season in the last three years was almost equivalent to the average of five years. For this reason, the average value of turbidity of eight years was used.
The values of high SS by year and by season were observed but there was no clear trend of change with time. Henceforth also, the water quality is expected to change with the same level presently as in the past. However, low SS shows a decreasing trend in recent years; therefore, on this side, the water quality was set to change by the same level as in the past three years.

[Turbidity of raw water]
The turbidity of raw water was set based on the conversion data of SS of inflow into dividing well after sedimentation at Intake facility and Sedimentation Basin, and has also been set as design index of water treatment facilities.

[SS-turbidity conversion ratio]
The turbidity will be obtained by dividing SS (obtained from the results of water quality analysis) by SS-turbidity conversion ratio 1.8.</td><td>When turbidity of river water near intake exceed 1,830mg/L water intake from rivers will be regulated.</td></tr>
<tr><td>3. Dosing rate</td><td>1) Coagulants (liquid PAC)
<table>
<tr><td>Setting the coagulant injection rate</td><td>Turbidity
degree（kaolin）</td><td>Dosing rate
PAC mg/L</td></tr>
<tr><td>Average
(Annual)</td><td>33</td><td>30</td></tr>
<tr><td>Average
(Rainy season)</td><td>62</td><td>30</td></tr>
<tr><td>Maximum</td><td>254</td><td>50</td></tr>
<tr><td>Minimum</td><td>11</td><td>20</td></tr>
</table>
2) Hypochlorite
<table>
<tr><td rowspan="2">Item</td><td colspan="3">Dosing rate</td></tr>
<tr><td>Maximum</td><td>Average</td><td>Minimum</td></tr>
<tr><td>Pre-chlorination</td><td>0.5</td><td>0.3</td><td>0</td></tr>
<tr><td>Intermediate chlorination</td><td>3.0</td><td>2.0</td><td>1.5</td></tr>
<tr><td>Post chlorination</td><td>1.0</td><td>0.6</td><td>0.2</td></tr>
</table></td><td>Need for pH adjustment
・ The average pH value of raw water was very steady about 8.0 during all season. Although the pH value showed a decreasing trend from 7.4 to 7.8 at the PAC injection rate of 30mg/L, this change was within the range of correct coagulation pH values, and it was concluded that there was no need to adjust the pH value at the turbidity of 11 to 240 degree in the tests this time.</td><td>Set based on Chapter 2.</td></tr>
</table>

Table 3.5.4 Summary of Basic Items (3/4)

<table>
<tr><th>Type</th><th>Item</th><th>Basic items</th><th>Concepts of basic items</th><th>Remarks</th></tr>
<tr><td rowspan="3">Basic particulars
Basic items</td><td>4. Sludge settling percentage and sludge concentration</td><td>1) Sludge settling percentage
Sludge settling percentage — Water intake: 40% of raw water (40%); Grit chamber: 60% of water intake (24%); Sedimentation basin: 100% of grit chamber (36%)
2) Concentration of wastewater sludge
<table>
<tr><th>Treatment process</th><th>Type</th><th>Conc.</th><th>Solids per unit volume</th></tr>
<tr><td rowspan="3">Sedimentation basin sludge</td><td>Annual average</td><td>3%</td><td>30 kg/m^3</td></tr>
<tr><td>Rainy season average</td><td>2%</td><td>20 kg/m^3</td></tr>
<tr><td>Maximum</td><td>7%</td><td>70 kg/m^3</td></tr>
<tr><td rowspan="3">Sludge basin sludge</td><td>Annual average</td><td>3 %</td><td>30 kg/m^3</td></tr>
<tr><td>Rainy season average</td><td>2%</td><td>20 kg/m^3</td></tr>
<tr><td>Maximum</td><td>7 %</td><td>70 kg/m^3</td></tr>
<tr><td rowspan="3">Thickening tank sludge</td><td>Annual average</td><td>5%</td><td>50 kg/m^3</td></tr>
<tr><td>Rainy season average</td><td>5%</td><td>50 kg/m^3</td></tr>
<tr><td>Maximum</td><td>10%</td><td>100 kg/m^3</td></tr>
</table></td><td>・ For sludge settling percentage from the result of water quality analysis, 40% sludge of raw water were considered to settle in the intake pump station, it needed a retention time of two hours, while 60% sludge of the intake pumping station were considered to settle in the grit chamber, and it needed a retention time of ten hours.
・ The concentration of sludge from the sedimentation basin after wastewater treatment was set considering safety factors based on the differences in turbidity and reduction in case of underwater sludge collection system referring to the results of water treatment plants with central sludge collection system in Japan. The grit chamber desludging was assumed to be two times that of the sedimentation basin.</td><td>Set based on Chapter 2.</td></tr>
<tr><td>5. Schedule of construction of facilities</td><td>Facilities are planned to be constructed in two phases. The first phase is based on supply rate of 150,000 m^3/day x 1 system and the second phase is based on a rate of 150,000 m^3/day x 1 system.</td><td>Facilities that are to be constructed in Phases 1 and which will be used in Phase 2 are as below.
・ Intake
・ Intake pump building
・ Grit chamber
・ Raw water pump building
・ Dividing well
・ control building (600,000 m^3/day facility common to both Phases)
・ Pump building
・ Chemical feeding building
・ Intake pipeline, raw water mains and transmission pipeline</td><td></td></tr>
<tr><td>6. Disaster measures</td><td>・ Ensure earthquake resistance of the facilities.
・ As measure against flooding due to typhoons, heavy rains, etc., develop land at a higher elevation than the surrounding land.</td><td>・Structural design to consider seismic factors of Viet Nam.
* The developed land elevation accounting for measure to prevent flooding is to be generally 1.0 m higher than the existing ground level.</td><td></td></tr>
</table>

Table 3.5.5 Summary of Basic Items (4/4)

Type	Item	Basic items	Concepts of basic items	Remarks
Basic particulars Basic items	7. Intake system	・ The intake system from the Duong River will be a system in which water is drawn in by channel into the water intake pump station for the high water channel outside the dike. ・ The system will take in water by pump because of the relation between the Duong River water level and the elevation of the water treatment plant. ・ A grit chamber will be installed to reduce the load of the water treatment plant so that the raw water supplied to the water treatment plant is stored, and the coarse suspended solids matters sedimented and removed. ・ The system will take in raw water by pump because of the relation between the water level of the grit chamber and the elevation of the water treatment plant.	・ Status of whether the pumping station outside the dike can be installed or not need to be discussed beforehand with the river management personnel ・ Measures to be taken to ensure that pump building is not inundated during a flood. ・ The grit chamber is to be installed having raw water storage function in order to account for the intake limitations during high turbidity and stoppage of intake due to water quality accidents. ・ The capacity of the grit chamber is to be at least adequate for 10 hours (combined volume of 12 hours flow with water intake facility). ・ Based on the scale of the grit chamber, it is likely to be a dug chamber, so the raw water will be pumped to the water treatment facilities by pump.	Set based on Chapter 2.
	8. Water treatment flow	The water treatment system will be a chemical settling and rapid sand filtering system.	・ At this point of time, no advanced treatment is necessary to ensure purified water quality. ・ Although a specific treatment is not needed against the THM formation since the concentration is only one-fifth of Japanese water quality standards, intermediate chlorination will be added because it will decrease the possibility of THM and TOC formation. ・ As a measure against cryptosporidium, filter basin will be a facility that can slow down and start slowly.	
	9. Wastewater treatment flow	For wastewater treatment, an environmentally friendly closed system will be used that circulates the wastewater and reuses it without discharging it into the river.	・ Polymer is not used during water treatment, therefore, water quality problems do not exist during circulation of wastewater and so a closed system is adopted. ・ Wastewater from the sedimentation basin is stored and regulated in the sludge basin, conveyed to the thickening tank, and then to the sludge drying beds where dehydration takes place. ・ The filter basin wash water drainage is returned to the dividing well from the wash water drainage basin. ・ The supernatant of the thickening tank is returned to the wash water drainage basin.	

(4) Facility Arrangement Plan

1) Arrangement policy and constraints

The site of the water treatment plant is located at Phu Dong, Gia Lam Province, Ha Noi City, on the east side of National Route 1, one of the main highways in Viet Nam . The north side of the premises is facing an access road and there are Duong River and the water intake facility in the south of the premises.

In considering the aforementioned conditions, arrangement of each facility in the premises will be planned. The basic policy and constraints on facility arrangement are as follows.

- The front gate should be located so as to face the access road and facilities with access to visitors etc. should be arranged together in the northern part of the premises to the extent possible.
- Plant facilities should be arranged together in the southern part of the premises to the extent possible since the water intake facility is located in the south and confusion in traffic lines in the premises needs to be avoided.
- Facilities should be arranged utilizing the alignment of the existing road running through the middle of the premises.
- The flow of water should be considered in facility arrangement so that total length of pipes may be shortened to the extent possible.
- The shape of a site for future use (600,000 m^3/day) should be considered so that it may be used for another purpose in the future depending on the situations.

2) Facility Arrangement Plan

Figure 3.5.1 shows the facility arrangement plan determined based on the aforementioned arrangement policy and constraints. Figure 3.5.2 shows water level relationship for water treatment system.

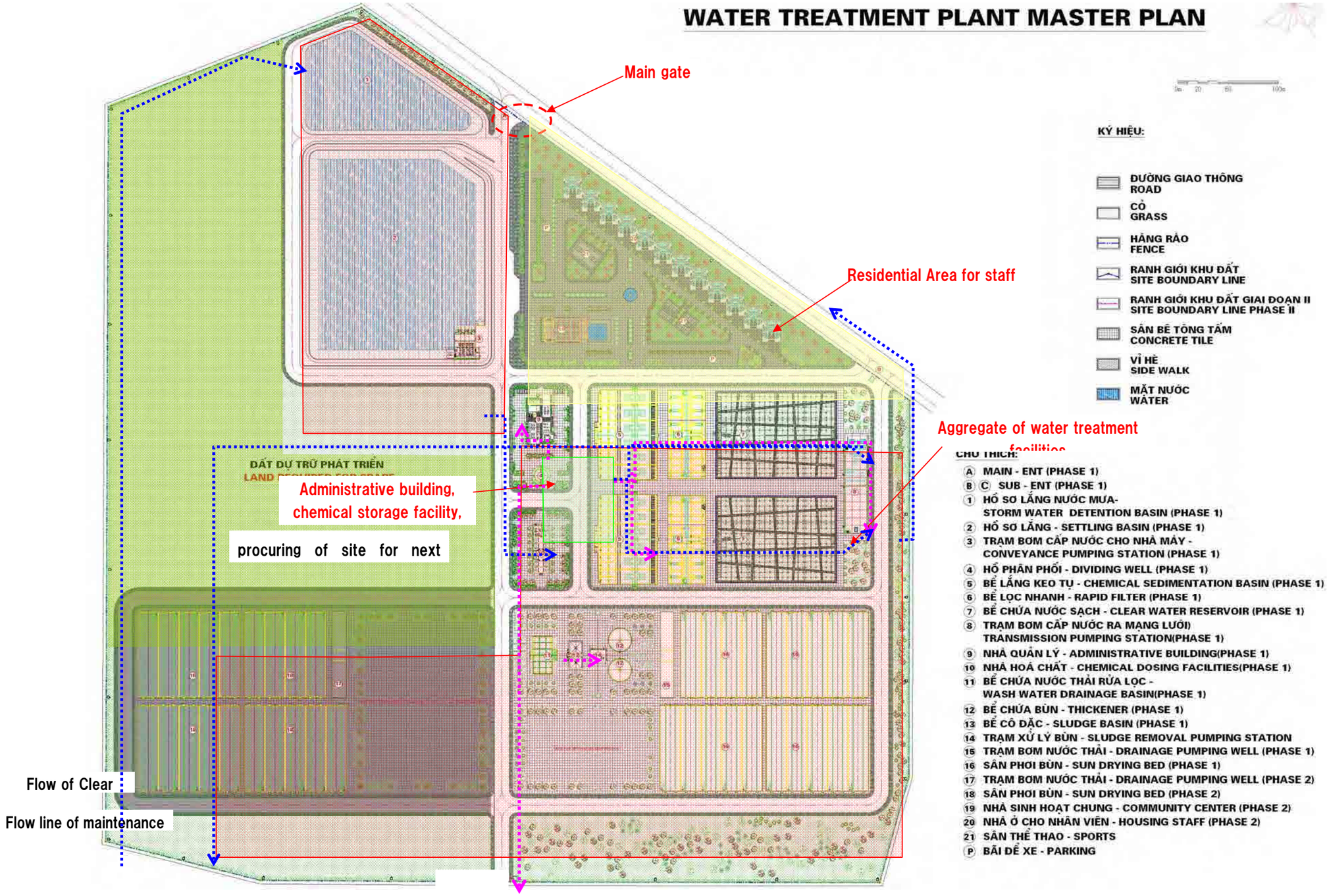


Figure 3.5.1 Facility Arrangement Plan

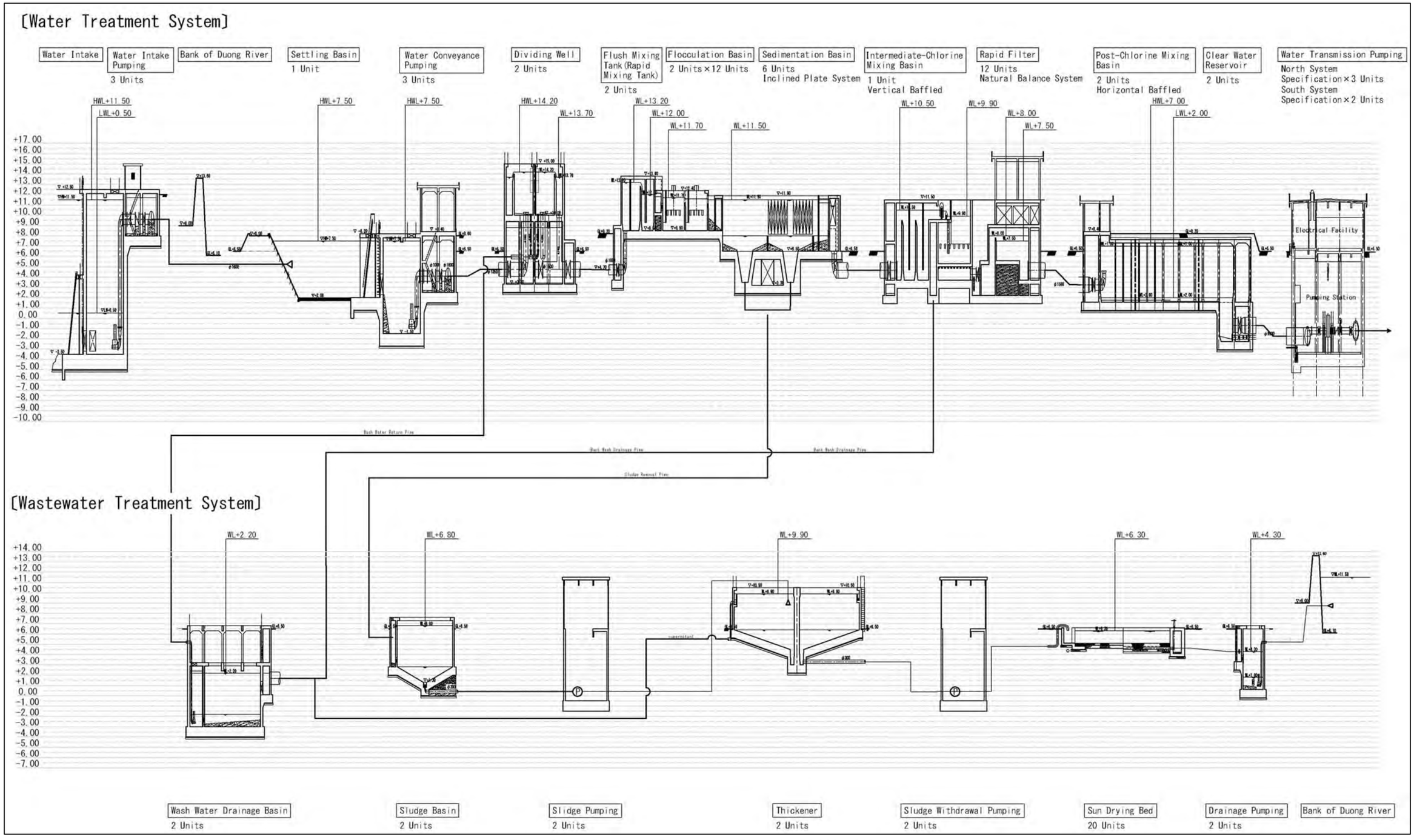


Figure 3.5.2 Water Level Relationship (Phase 1: 150,000 m3/day)

3.6 Estimation of the Project Cost

3.6.1 Preconditions of Cost Calculation

The Cost has been calculated considering the following conditions and assumptions.

- The project schedule is shown in the next section. (Phase1: 3 years, Phase2: 2 years) Therefore the cost of increase or decrease has not been included.
- The exchange rate considered for cost estimation is 1 dollar = 81.64 yen = 20,000VND (1 yen = 245 VND) as of year 2010.
- Project cost is based on the calculation during this investigation period, and the possible Inflation and exchange fluctuations are considered for the Financial Analysis.
- Total cost is the sum of the construction and the operation and maintenance. The construction cost is composed of the direct cost as the cost of construction and the indirect cost as the cost of measurement and geological investigation, site expense, design consultancy and physical contingencies, water right application fees, and cost on installation of power line (outside of WTP).
- Cost is divided into local cost (LC) and foreign cost (FC). Further, the FC is divided into US and Japanese Yen portion considering procurement possibility.
- The cost of measurement and geological investigation and site expense is based on existing plan. The design consultancy expense is assumed to be Phase 1: 2%, Phase 2: 1% of the cost of construction.
- The physical contingency is added to the direct cost and indirect cost as 10%.

3.6.2 Preconditions of Construction Expense Calculation

The construction expense has been calculated based on the following conditions.

- The procurement is possible in Viet Nam; hence the basis of architectural materials, the labor, and engineering works-construction machinery is through local procurements.
- The mechanical and electrical equipment is also considered to be procured from Viet Nam. However, procurement from Japan and third country is taken into consideration, on the assumption that the quality performance, the economy, and the ease of maintenance, etc are defined.
- General construction except of the special parts is entrusted to the local companies.
- In case of pipelines installation, at the location of River crossing, the pipe-thrusting technology practiced in Japan might be applied.

- The unit price of construction by the local construction trader is used and calculation is based on multiplication standard of Viet Nam.
- The Water tariff and taxes will be exempted by Decree No.108/2009 (Decree on investment in the form of BOT, BTO or BT contract) and therefore has not been included in cost.

3.6.3 Construction Expense

The construction cost is estimated at about 22.7 billion yen. This part of the project mainly focuses on Phase 1 and Phase 2 of the entire project and project planning and cost estimates are prepared accordingly. The breakdown of the estimated cost is shown in Table 3.6.1 to Table 3.6.3.

Table 3.6.1 Initial Cost According to Period

Item	L. C.	F. C.		Total (JPY: ¥1,000)
	VND (Mil. VND)	JPY (¥1,000)	USD ($1,000)	
Phase1	1,730,096	2,974,711	84,072	16,900,000
Phase2	721,840	1,346,326	18,464	5,800,000
Total	2,451,937	4,321,037	102,536	22,700,000

3.6.4 Operation and Maintenance Cost

The operation and maintenance cost is calculated considering the following conditions.

The operation and maintenance cost is composed of costs on labor, chemical, electric power, maintenance, and other miscellaneous expenses. The breakdown of the operation and maintenance cost is shown in Tables 3.6.2 and 3.6.3.

Table 3.6.2 Operation and Maintenance Cost (Until beginning of Phase 2)

Item	Operation / Management cost (JPY: ¥1,000)							
	Construct 1st Year	2nd Year	3rd Year	Operate 1st Year	2nd Year	3rd Year	4th Year	5th Year
Total	69,100	58,600	160,200	577,400	498,300	488,400	469,300	556,100

Table 3.6.3 Operation and Maintenance Cost from the Beginning of Phase2

Item	Operation / Management cost（JPY: ¥1,000）					
	6th year	7th year	8th year	9th year	10th year	From 11th year*
Total	773,600	880,500	712,300	781,800	905,600	810,760

(*Average of the 6th – 10th year)

➢ Additional Requirements of cost calculation

- It is required to discuss the cost based on Vietnamese standard such as electric power and chemical in detail with Viet Nam companies.
- About the cost of chemical, dosing ratio should be set up after water survey one year.
- Sludge treatment fee is calculated for the entire sludge disposals. Re-use of the sludge shall be considered.
- Cost for SPC office establishment is assumed on this FS, although detailed discussion with Viet Nam side is required.Sludge treatment fee is calculated for the entire sludge disposals. Re-use of the sludge shall be considered.

＜Installing Effect of energy saving equipment＞

Electric Power Cost is saved about 10% by installing energy saving equipment, which contributes 3% reduction of total O&M Cost. Also, 1,726 t/year of CO_2 reduction is expected.

Energy saving equipment: Siphon type rapid sand filtration, High-effective transformer, Inverter pump

3.7 Phased Execution Plan

The construction cost of this project is large. Also, the construction period is longer and huge investment to the scale of 22.7 billion yen (Phase 1 and Phase 2) has to be made for long duration.

Initially, the project will include construction of facilities with capacity to cover 300,000m^3/day of the total water demand. The execution schedule is planned in two phases, Phase 1 and Phase 2 in consideration of construction conditions and the funding plan.

The business period including the control of maintenance is supposed 28 years with Phase 1 and Phase 2. The construction period of Phase 1 is planned for three (3) years. The construction schedule for Phase 2 is planned two (2) years. It is better that the construction period of Phase 2 is decided after seeing the supply situation of Phase 1 (150,000 m3/day). In financial analysis, phase 2 is planned in 2018 and 2019 (or 2015 and 2016).

Figure 3.7.1 shows the execution schedule of the project in different phases.

Figure 3.7.1 Execution Schedule

(Agreement is needed between Japanese and Vietnamese Sides)

Item	Content		Design	Start Year for Phase 1: Phase 1 Construction	Phase 1 Construction	Phase 1 Construction	Phase 1 Operation	Phase 1 Operation	Phase 1 Operation	Start Year for Phase 2: Phase 2 Construction	Phase 2 Construction	Phase 2 Operation	Phase 2 Operation	Phase 2 Operation			Final Year
Water intake and raw water transmission facility	Civil/Architecture			←	—	→												
	Machanical/Electrical				←	—	→				←	—	→					
Water treatment facility	Civil/Architecture			←	—	→					←	—	→					
	Machanical/Electrical				←	—	→				←	—	→					
Transmission pipe	North Area	WTP - Node1'			←	→												
		Node1' - Node1				←	→											
	South Area	WTP - Node2			←	—	→											
		Node2 - Node3'			←	—	→											
		Node3' - Node3			←	—	→											
		Node3 - Node4			←	—	→											
		Node3' - Node5			←	—	→											
		Node5 - Node6			←	—	→											
		Crossing point (Duong River)		←	—	→												
		Crossing point (Hong River)				←	→											
Indirect construction	Land Acquisition			←	→													
	Measurement, Geological survey			←	→			←	→									
	Detail Design			←	—	→		←	—	→								
Percentage of each construction year in the direct cost				8%	53%	39%				52%	48%							
Construction period				Phase 1 (150,000m3/day)					Phase 2 (150,000m3/day)									
Supply capacity							150,000m3/day					300,000m3/day						
Management period							30 years											

3.8 Proposal for Operation Management

At the present stage, EPC is considered as Figure 3.8.1. VIWASEEN and METAWATER will maximize their strength in the construction cost and EPC, that is, the strength of VIWASEEN in experiences of civil & architectural engineering and construction in Viet Nam and that of METAWATER in electrical & mechanical engineering and construction. For the maintenance management, HAWACO and Metawater may consider to establish a joint venture company to transfer the Japanese overall of maintenance management. O&M Company could be incorporated into SPC.

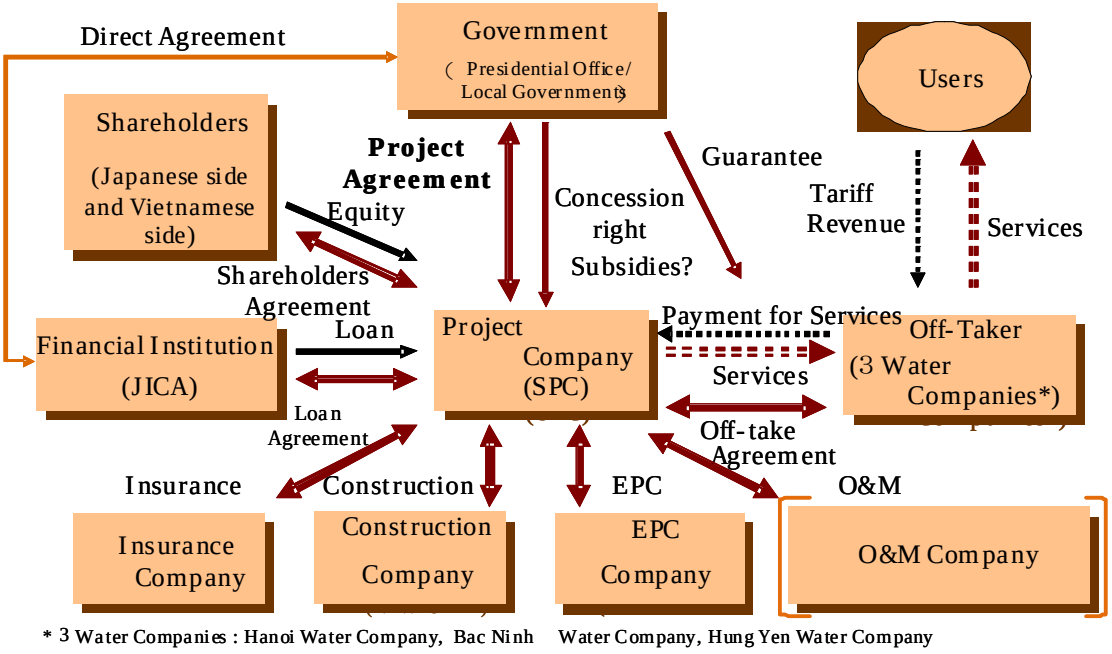


Figure 3.8.1 Proposed Project Structure

The off takers are planned to be HAWACO for Ha Noi City, and Bac Ninh Water Supply Company for Bac Ninh province. Details for off take contract are still to be considered, however take or pay is expected to be the basic principle. The followings are contracts, which are considered at this stage and will be examined further.

(1) Concession agreement among Vietnamese Government, and SPC.
(2) Off take contract
(3) Shareholder agreement
(4) EPC agreement between the SPC and EPC contractor
(5) Support agreement between the Vietnamese Government and SPC *
(6) Electricity supply contract
(7) Material supply contract
(8) Insurance contract
(9) O&M contract between SPC and O&M company
(10) Loan agreement between JICA and SPC
(11) Government to Government (JICA) Direct agreement
(12) Other administrative approvals

* O/M is also considered to be carried out in the SPC, in such a case, this contract is not needed.

3.9 Investigation Into the Operation and Maintenance Management System

3.9.1 Basic Policy of the Maintenance Management System

In the large water treatment plant that uses the high turbidity Duong River as its source, the water quality standards of the Vietnam National Technical Standards on Drinking Water Quality (Circular No. 04/2009/TT-BYT) will be adhered to. Upon also taking into account the relevant laws and ordinances, safe and secure operations will be achieved with Japanese technology and this technology and expertise will be passed on to Vietnamese officials.

In order for Vietnamese officials to be able to personally maintain and operate the Duong River Water Treatment Plant, Japanese engineers will draft a maintenance management system and water treatment operational plan that will also take into account the local culture and social system. The maintenance of continuous water quality as well as safe and stable operations will be achieved by Vietnamese officials.

Table 3.9.1 Laws and Ordinances on Operation and Maintenance Management

Law and ordinance	Issuing date	Content
Decree No.117/2007 of the Government	11/7/2007	Clean water production, supply and consumption
Circular No.01/2008 of the Ministry of Construction	2/1/2008	Guiding the implementation of Decree No.117/2007 of Government
Decision No.16/2008 of the Ministry of Construction	31/12/2008	Regulation on water supply safety assurance
Decision No.1929 of the Prime Minister	20/11/2009	Orientations for Development of water supply in Vietnam's urban centers and industrial parks up to 2025
Decision No.2147 of the Prime Minister	24/11/2010	National plan for non revenue water production up to 2025

3.9.2 Investigation Into the Local Maintenance Management System

(1) Operational Management Tasks

In this project, a centralized monitoring control system will be constructed and after understanding the situation of the plant (equipment operating conditions, water quality, water level, capacity etc.), the necessary information will be collected into one place. This will make it possible to monitor the entire facility with just a small number of people.

However, the operational status of the entire facility will be understood based on processing information, such as water quality and capacity, and so the monitoring tasks of the water treatment plant will demand strong judgment ability grounded on knowledge and experience, for example whether the equipment is being operated properly or whether or not there is an abnormality in the processing conditions. Furthermore, this will play an important role in the maintenance and continuation of a safe and stable water supply, such as determining the conditions of changes in water quality and fluctuations in demand as well as taking an appropriate and prompt course of action.

In particular, the quality of the Duong River, which is the source, has high turbidity throughout the year and there are cases where the maximum turbidity exceeds 3,000 degrees. This means that adjustments to the chemical dosing rate and equipment operation for these changes in water quality will become necessary, so it will be essential to constantly monitor the status of the water quality.

The scope of the principal operational monitoring work is shown:

- Monitoring and operation of the water treatment process and drainage process through CRT
- Processing conditions, adjustments to the chemical dosing ratio from water quality data and equipment operation
- Water intake volume in response to demand for water supply, regulation and management of the transmission volume
- Monitoring of the processing state in each process by inspections
- Monitoring, operation and hygiene tasks that accompany preservation and maintenance tasks
- Working solutions and communication with related officials during an anomalous occurrence

In addition, important points to pay attention to in performing these tasks are given:

- Prevention of operational errors
- Prevention of errors in the assessment of situations
- Coordination with preservation and maintenance tasks and also water quality management tasks
- Construction of a system that can constantly monitor and operate the facility status, 24 hours a day, 365 days a year

A system will be implemented with staff divided into groups of four working in shifts and carrying out continuous monitoring 24 hours a day, 365 days a year, under the direction of the person in charge of operations monitoring, in order to clarify the chain of command.

In addition, it is necessary to prevent human error by operations monitoring staff always working in teams of two or more and mutually checking each other's work.

(2) Maintenance Inspection Tasks

In order to be able to always operate the water treatment plant facility in a normal state, it will become important to implement maintenance inspections of electrical equipment and mechanical equipment and through this reliably maintain functions intended of this facility. Therefore, it is necessary for those that have acquired expert knowledge and techniques to carry out these inspections.

The following is the scope of the maintenance inspection tasks:

- Early detection of abnormalities and their indications in equipment through patrol inspections
- Periodic maintenance inspections, maintenance and life extension of equipment functions through maintenance work
- Management of periodic inspections and other tasks by experts
- Minor repair work

Furthermore, according to the performance of these tasks, the following points are important to note:

- Maintenance of work safety
- Acquisition of qualifications necessary for these tasks
- Tasks grounded in the expertise and techniques of electrical equipment and mechanical equipment
- Prompt and accurate judgments and responses

Considering these conditions, a maintenance inspection system will be constructed consisting of electrical and machinery teams under the direction of the person in charge of maintenance preservation. A maintenance team with specialized skills will be created. This will enable the acquisition of highly specialized techniques and they will appropriately respond when there is equipment breakdown or an emergency at the facility. They will acquire technological strength so that they can investigate the causes

of these problems and they will be able to perform safer and more secure operations

Thus, equipment inspection patrols will be carried out by maintenance staff based on the instructions of each electrical and machinery engineer.

(3) Repair Tasks

In order to maintain and extend the original function of equipments, it is important to implement periodic inspections as well as replace equipment parts and consumable goods. Type and duration of each repair work are considered according to the method recommended by the manufacturer, in consideration of the actual consumption condition and trouble frequency of each equipment in order to formulate a realistic work plan and ensure implementation.

(4) Water Quality Management Tasks

1) Outline of National Standards for Quality of Drinking Water

The standards for drinking water quality in Vietnam adhere to circular No. 04/2009/TT-BYT *Vietnam National Technical Standards on Drinking Water Quality* published by the Ministry of Health, dated June 17, 2009. This circular came into effect on December 1, 2009, and it is understood to be a replacement for the current standards in 1329/TC-BYT.

These regulations cover agencies, organizations and households that develop and sell clean water and also facilities that supply over 1,000m^3 per day of water for living. Thus, it is important to make a water-quality test plan that follows these standards and construct a system that is capable of testing water quality.

2) Water Quality Management Techniques

It is very important to conduct water quality management in each process, in order for it to be possible to appropriately respond to changes in the quality of raw water based on clean water always meeting quality standards, protecting its sanitary safety and keeping it in good condition.

In the World Health Organization (WHO), the concept of Hazard Analysis and Critical Control Point (HACCP) has been introduced which has been established in the food manufacturing sector in the *2004 WHO Water-quality Guidelines (Third Edition)*. This proposes a Water Safety Plan (WSP) which will see the construction of a water supply system that will conduct hazard assessments and hazard management at all stages, from the water source to the tap, and which will reliably supply safe water.

In Japan, based on these techniques, the Ministry of Health, Labour and Welfare formulated the *Guidelines for Water Safety Planning* and the Japan Water Works Association compiled water safety planning case data in typical water treatment processes. In small and medium sized business entities as well, it has become possible to formulate comparatively simple plans.

Heading into the future, in order to also supply safe and high quality tap water, it is vital to formulate, manage and operate a water safety plan for this project.

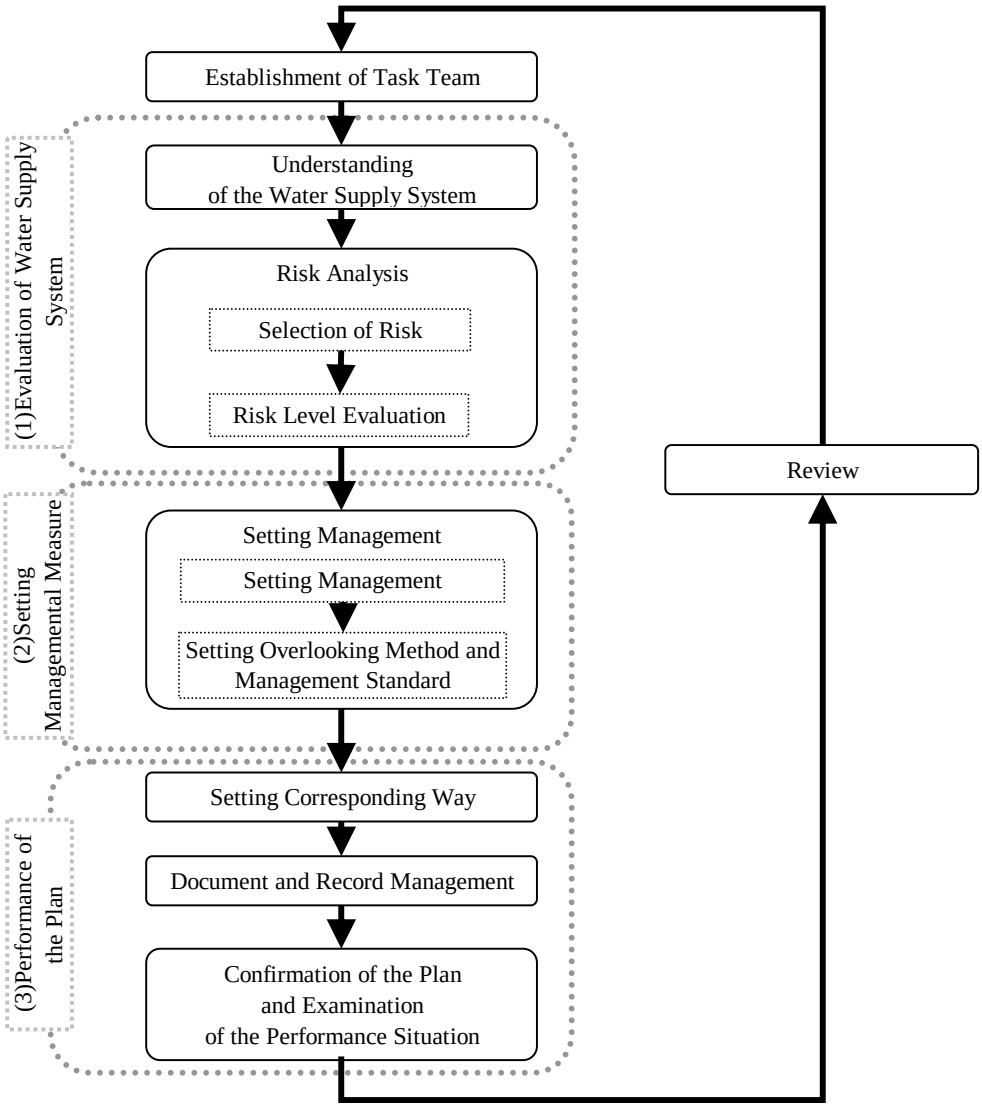


Figure 3.9.1 Flowchart of the Water Safety Plan Formulation and Operation
(Source: Excerpt from the Ministry of Health, Labor and Welfare's *Guidelines for Water Safety Planning*)

3) Water Quality Management System

Ensuring and supplying high quality and safe tap water is one of the most important challenges from the aspect of ensuring national public health. Therefore, it is necessary to construct a water quality management system.

Along with monitoring the water quality along the flow of the water supply system and taking an appropriate response to meet those conditions, in the event that there are fears about the safety of tap water, a system is required which quickly takes the best course of action.

The project details that are demanded in water quality management are listed:

- Formulation of a water quality management plan based on *National Standards for Quality of Drinking Water*
- Formulation of a water quality inspection plan
- Water quality inspection and inspection results analysis
- Determination of the chemical dosing ratio in all water treatment processes in response to the quality of raw water
- Management of water quality data
- Investigation of necessary operational methods to maintain and improve water quality.

Moreover, in performing the tasks, it is necessary to consider the following points.

- Compliance with the inspection items and frequencies as specified
- Prompt investigations to determine the cause of a problem and a clear course of action to take in the event of an abnormality occurring
- Ensuring the reliability of water quality inspection results

To satisfy these conditions, water quality management tasks will be carried out by one person responsible for water quality management and also expert engineers. Furthermore, in order to strictly manage water quality, it is essential to establish an organization with experts that independently perform these tasks and which is given a strong authority.

(5) Drainage Management Tasks

The sludge in the sediment basin and the wash water drainage in the filtered basin that is emitted from the water treatment process are separated into liquids and solids by the drainage processing facility, the sludge concentration is increased and it is then naturally dried in a sun drying bed. The cake moisture ratio at that time is expected to be around 70%. Furthermore, the merit of sludge treatment cost reduction by application of sludge dehydrator in future shall be considered.

(6) Pipeline Management Tasks

Transmission pipeline accidents don't just occur due to sudden loss, reduction and turbid water; they can also be caused by secondary disasters, such as road collapse, traffic disorder and flooded housing. The social impact has a large effect. In order to prevent these in advance, periodic inspections and maintenance are important and it is necessary to establish frequent patrols and inspections and systematically conduct them.

The scope of the transmission pipeline maintenance tasks is displayed below:

- Management of transmission pipeline information and management of pipeline maps
- Patrol inspections of the entire transmission pipeline around once a week by a maintenance vehicle
- Detection of leakages, signs of leakages and events that lead to leakages by patrols
- Verification of operation conditions of all water distribution equipments such as distribution points, gate valves placed on distribution pipes
- Water quality tests (residual chlorine concentration, turbidity, etc.)
- Detection of water theft

Inspection patrols that include booster pump stations will be conducted in the form of one person with full responsibility for the transmission pipeline, who will manage these tasks, and an inspection team.

(7) Security System

In the event of a terrorist attack such as poison injection on the water supply facility (for example a substance being thrown into the source of water), it would create an extremely serious situation where people’s lives and physical safety would be threatened and it would also paralyze people's daily lives and urban activities.

Therefore, this project considers the comprehensive construction of a security system which utilizes both the strong points of machines that are durable, continuous and accurate by installation of surveillance cameras inside the facility and that of humans that have accurate judgment ability and flexible behavior by stationing of security guards.

(8) Operation and Maintenance Management System

The tasks implemented in this project will be carried out at an early stage in a system with Vietnamese workers. Therefore, we propose the following personnel system. The initial on-site start-up will see a support system created by Japanese engineers and then a technology transfer to Vietnamese personnel will take place. Then, while matching the degree of technical mastery of Vietnamese employees, the number of Japanese engineers will be progressively reduced and an early-stage independent work system by Vietnamese staff will be implemented.

Moreover, also in case of entrusting an external expert with the Operation and Maintenance Management Tasks, it is planed to build a technical support system by Japanese engineers, in order to early stabilization of administration and improvement of quality of this water treatment plan.

3.9.3 Human Resource Development Plan

The following is necessary for the concept that in a few years' time there will be a personnel system with Vietnamese employees themselves capable of maintaining and operating the facility and also for the support method of Japanese engineers.

- The chief supervisor will be a Vietnamese employee from the outset and they will receive education with the help of Japanese engineers so that they are capable of making determinations by themselves
- A maintenance management system will be established by Vietnamese personnel from the commencement of operations
- In case an abnormality occurs, a maintenance unit will be constructed that can deal with the problem themselves

Moreover, a support system will be provided that ensures a structure that supports safe and stable operations and maintains work quality, even after the Vietnamese employees have become able to carry out maintenance and operations themselves.

- Systematic support from Japan (remote supervision, cameras, conferencing etc.)

- Maintenance and improvement of work and technology quality by monitoring from Japan
- Technical improvements and technological exchange through periodic training in Japan

When constructing the maintenance management system, the system will be built taking note of the need to ensure water quality, maintenance of work quality and so that it is possible to sustain operations by Vietnamese personnel in the future.

(1) Concept of the Support System

It has been determined that at the outset of the commencement of operations, support from Japanese engineers will be indispensible, because the equipment calls for advanced technical skills. However, in a system where Japanese engineers will be taking a central role, there is a possibility this could hamper the independence of Vietnamese staff.

Therefore, from the outset of the operations of this project, a chain of command will be determined to establish an operational system with Vietnamese personnel. We propose a system where Japanese engineers will provide assistance and guidance from the dimensions of each task group, for example management, operation, maintenance and water quality control.

The technology transfer from Japanese engineers will take place for those responsible for each task and care will be taken not to disrupt the Vietnamese chain of command.
Some of the points in technical assistance are indicated:

- A technical support system and method that doesn't disrupt the Vietnamese staff structure and chain of command
- Japanese engineers will place stress on taking a position of assistance and will provide technical support so that Vietnamese officials can independently carry out operations
- Technical assistance that allows Vietnamese officials to make determinations and work (experience) for themselves

Taking note of these points, we believe it is best to have a system where Japanese engineers provide support so that in a few years' time, Vietnamese officials will be able to operate the water treatment plant.
The following is the planned numbers of Japanese engineers for O&M when Japan takes the initiative of the management.

Table 3.9.2 Planned Numbers of Japanese Engineers

Elapsed Year	Phase 1				
	1st Year	2nd Year	3rd Year	4th Year	5th Year
Number of Japanese Engineers	8	4	3	1	1

Elapsed Year	Phase 2				
	6th Year	7th Year	8th Year	9th Year	After 10th Year
Number of Japanese Engineers	4	3	1	1	1

The first year when facilities start to be used is considered that the Vietnamese staff may have less knowledge about O&M of coagulation-sedimentation and rapid filtration system. Therefore 8 Japanese engineers will be put into and they will provide trainings and technical supports on 24 hours schedule. Also for the 6th Year when phase 2 will be launched, more Vietnamese staff will join O&M with enhancement of the facilities. Thus the number of Japanese engineers will be increased temporarily and will be reduced step by step depending on the level of proficiency of Vietnamese staff.

(2) Technological Exchange

Technological exchange and On the Job Training (OJT) that will be conducted through local operations is one effective way for technology transfer. However, for the engineers that are transferred, there is also the aspect that it will be difficult to understand the nature and background of this technology. Moreover, in order to also proactively incorporate new technology that is making advances day by day, we propose to introduce a regular training system in Japan.

Points on the training in Japan are shown here:

- By experiencing and understanding Japanese infrastructure and culture, the comprehension of the nature of technology transferred will be caused.
- In addition to specific technologies, there will be personal experience of Vietnamese officials of the way Japanese water service engineers work and high motivation.
- Expertise and technology outside of local equipment that will be important in the future for Vietnamese officials will be a part of training in Japan.

Based on the training plan, training opportunities will be provided to several people every year in Japan and by getting to actually see and touch cutting-edge technology, we expect further technological advances along with increased individual motivation.

3.9.4 Technological Support of Large-scale Water Treatment Plants and Safe Operation System

(1) Technological Management and Support System by Remote Supervision

In order to carry out the safe operation of a large-scale water treatment plant that uses the surface water of the Duong River, which has high turbidity throughout the year, it requires Japan's sophisticated technology. It is also vital to construct structures and systems where expert engineers can provide ongoing technological support, assistance and cooperation.

In Japan, there are companies that are constructing remote support centers with expert engineers that support the operation maintenance management tasks in water treatment plants.

Taking advantage of this structure, we propose a technological support system by transmitting information, such as the monitor screen and images obtained by the Central Monitoring Room of the Duong River Water Treatment Plant and combining tools such teleconferencing at the same time. With this system, it will be possible to pick up the current local situation, even in Japan. Furthermore, we believe that while striving for a real-time community with on-site staff, it cause enable to reasonably provide Japanese technical support by working to solve problems.

Expert engineers in water supply have been posted to the Support Center and are implementing many technological assistances such as measures and support methods to cope with a variety of problems from the local site.

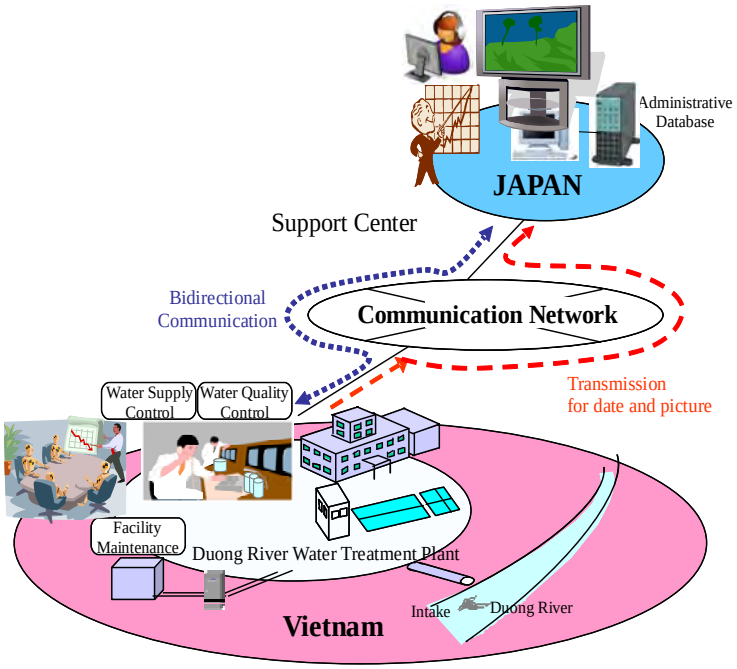


Figure 3.9.2 Image of the Support System by the Remote Surveillance System

(2) Monitoring System

It is important to periodically confirm that the quality of water meets *Vietnam National Technical Standards on Drinking Water Quality* (Circular No. 04/2009/TT-BYT) and that operations are being accurately performed based on the Water Safety Plan as well as ensuring the quality of water and maintaining and improving business quality. Therefore, we aim to maintain and improve technological and business quality by conducting regular on-site visits by Japanese expert engineers.

The points for on-site visits are given below:

- Whether management and operations are possible based on established protocol and standards
- Whether activities are being conducted that will lead to constant improvements in business and quality
- Whether the PDCA cycle is being followed and the quality of service continues constantly

This monitoring will be conducted annually and will observe and offer guidance on the quality of maintenance management tasks and the management and operation conditions from various perspectives, including: ① The condition of water quality management, ② the facility operating conditions, ③ the status of implementation of on-site tasks and ④ the status of utilities procurement.

Furthermore, in future, it may also be required water distribution management systems and water leakage management systems, implemetations of stituation surveys by Japanese companies that already have water technologies including their applicability are considered to be effective.

4. Confirmation of Environmental and Social Considerations and Study on the Required Measures

4.1 Introduction

(1) Background

The Greater Hanoi is formed of capital Hanoi and surrounding six provinces namely Bach Ninh, Hung Yen, Hai Duong, Vinh Phuc, Ha Nam, and Hoa Binh. The metropolis plays significant role in the development and economy of the region and country as a whole. Serving as one of the economic centers of Country, the population of newly expanded Ha Noi City has increased to about 6 million. It is essential to maintain the pace of development of infrastructures and services for increased population in tune with the economic growth and to continue sustainable development. In this respect, development of infrastructure in the Greater Hanoi is very important as a national strategy. The improvement of water supply services is one among these services and infrastructures.

The water supply system of Ha Noi City has been augmented and upgraded many times in the past, also including the Projects under the financial assistance of Finland, Japan International Cooperation Agency (JICA), and the World Bank, depending on the needs. Even after implementation of projects for improvement of water supply services in the northern and southern part of Hong River in Hanoi, the urban water supply system is currently unable to meet the increasing demand. It is reported that only 38% of population of newly formed Greater Hanoi is covered with the existing water supply system.

For the improvement of water supply services in Hanoi “The Comprehensive Urban Development Program in Hanoi Capital City (HAIDEP)” was prepared as a part of city planning by JICA in March, 2007. According to this program, by 2020, the population is estimated to increase to 4.5 million, and corresponding water demand is estimated as 1.8 million m^3/day. Also, in June 2007, a long-term plan namely “Hanoi metropolitan area water service plan” was prepared by National Institute of Urban and Regional Planning (NIURP) of the Ministry of Construction (MOC).

To improve the existing condition of water supply services, the Government of Viet Nam has a plan to carry out two major Water supply Projects for the Greater Hanoi by using privatization. Of these, one is for southern part of Hong River (Da River Project) and the other is for northern part of Hong River (Duong River Project, this project). Da River water supply project is already started with capacity of 600,000 m^3/day by Viet Nam Construction and Import Export Corporation (VINACONEX, a State owned enterprise) in 2007 under the Build, Own, and Operate (BOO) scheme. Under the Da River project, water is planned to supply to the western areas of Hanoi, Ha Tay, and Hoa Binh (southern part of Hong River area) using 70 km of transmission pipeline.

To supply the water to the northern part of Hong River, Duong River project was proposed by the Viet Nam Water supply, Sewerage and Environment Construction Investment Corporation (VIWASEEN, a State owned enterprise) in April, 2008. Under this project, the water is planned to be supplied to Ha Noi City, Bach Nihn, Hai Duong and Hung Yen originally. Responding to this proposal, the Prime Minister's Office requested VIWASEEN to carry out more study on Duong River Project in August, 2008. The original proposal of the VIWASEEN's 2008 Plan (bulk water supply) is as follows:

Table 4.1.1 Original Proposal of VIWASEEN Plan

Phase	Target Year	Capacity (m^3/day)	Length of Transmission Pipelines (km)
1	2015	150,000	80
2	2020	150,000	120
	2025	300,000	200
Total		600,000	

In March 2009, Japan External Trade Organization (JETRO) carried out a "Study on the PPP Project Formation for Hanoi Water supply System in the Socialist Republic of Viet Nam". Under this Study, water supply improvement plan was prepared for the metropolitan area of Hanoi using the surface water source from Duong River. The proposed water supply facilities included water treatment plant with a capacity of 300,000 m^3/day and 200km of pipelines. Possibility of adopting PPP for implementation of this Project was also analyzed. Based on the result of the JETRO Study, this Project preparation is carried out by JICA to improve the situation of water supply services in the north of Red river and some parts in the south of Red river in Hanoi.

To improve the living environment in Hanoi and its neighborhoods through improvement of water supply services, this Preparatory Survey is undertaken for provision of water treatment plant, raw water and clear water pumping stations, and transmission up to the off take points. The purpose is to use raw water from the river and provide treated water to the population that still do not have access to treated water supply. As a part of this Study, Environment and Social Considerations is also made to ensure social and environmental soundness of the Project. For this purpose, a brief environmental impact assessment report is prepared.

(2) Objective of the Environmental and Social Impact Assessment

The purpose of the Environmental and Social Impact Assessment is to ensure that proposed project components are environmentally and socially sound and sustainable and that the environmental consequences of the project are recognized at early stage and taken into account in the project design.

The major objectives of this part of the Study are to establish baseline data on environmental and social conditions of the project area, to predict the impacts on relevant environmental and social attributes due to the construction and operation of the proposed water supply facilities, to suggest appropriate and adequate mitigation measures to minimize/reduce adverse impacts, and to prepare environmental mitigation and monitoring plan.

This Report is prepared specially for use by the VIWASEEN to carry out complete environmental impact assessment and prepare Environmental Impact Assessment (EIA) report, to be submitted to the Department of Natural Resources and Environment (DONRE) for appraisal and approval before the implementation of the Project. The Report is composed of Information on Legal and administrative framework, Description of proposed project, Identification of impacts during construction and operation stages and related mitigation measures, and Environmental management plan including mitigation and monitoring.

In the joint meetings between Japanese and Vietnamese sides, which was started from March, 2012, it was almost agreed that Supply Area up to Phase 2 was only Hanoi City. However, in this chapter, Bach Ninh and Hun Yen Study area is included.

4.2 Administrative and Legal Framework

(1) Administrative Framework

There are several Ministries and Departments that play key roles during the preparation and implementation of the water supply projects and services in urban and rural sectors (Table 4.1.2). The government agencies related to water supply projects include Ministry of Planning and Investment, Ministry of Construction, Ministry of Agriculture and Rural Development, Ministry of Natural Resources and Environment, Viet Nam Water supply, Sewerage and Environment Construction Investment Corporation, Department of Natural Resources and Environment, Hanoi Department of Agriculture and Rural Development, Hanoi People's Committee, etc. Functions of some of these Ministries and Agencies are described below.

Table 4.2.1 Agencies Related to Environmental and Social Considerations and Other Permissions for this Project

Organization	Functions concerning Environmental and Social Considerations and Other Permissions related to this Project
Ministry of Natural Resources and Environment (MONRE)	– Management of land, water, and mineral resources, geology, environment – Formulation of policies related to environment management – Monitoring of national environmental status – Approval of EIA for projects approved by National Assembly, the Prime Minister, or inter-ministerial or inter-provincial projects
Department of Natural Resources and Environment (DONRE)	– Management of land, water, and mineral resources, geology, environment on regional basis – Registration for land use – Registration for water rights – Permission for occupancy of intake facilities – Permission for WTP effluent discharges – Appraisal and approval of EIA report for this Project
Ministry of Planning and Investment (MPI)	– Planning and investment – State budget allocation – Domestic and foreign investment to improve water supply services – Approval of the ODA project on behalf of the Government
Ministry of Construction (MOC)	– Management of construction; architecture, planning construction of urban technical infrastructure, industrial parks, economic zones – Developing urban housing and offices, business property, building materials – State management over public services – Guiding and supervising the issuance, and extension of construction permits – Guides and examines the selection of contractors in construction activities – Appraisal of the investment projects for construction works, evaluation of technical designs and cost estimates of construction works – Provides guidance with respect to inspection of the work in construction, evaluation, technical design, design drawing and estimate of construction work – Final approval of this project before applying for construction permit
Ministry of Agriculture and Rural	– Management in the fields of agriculture, forestry, fishery, salt production, irrigation/water services and rural development nationwide

Organization	Functions concerning Environmental and Social Considerations and Other Permissions related to this Project
Development (MARD)	– Management of construction, exploitation, usage and protection of hydraulic works, and water supply and drainage works in rural areas – Management of river basins; the exploitation, usage and integrated development of rivers in accordance with the master plans and action plans – Management of dike construction and protection, headwork for prevention of floods and typhoons – Efforts to prevent and combat flush flooding, floods, typhoons, drought, and landslides along riversides and coastal areas – Permission for occupancy of intake facilities in this Project to be discussed with Department of Agriculture and Rural Development (DARD)
Hanoi People's Committee	– To sign with seal the approval of EIA report – To sign with seal the Permission for Construction under this Project
Hanoi Authority for Planning and Investment (HAPI)	– Specialized Agency on investment in the water supply business activity of the People's Committee
Viet Nam Water supply, Sewerage and Environment Construction Investment Corporation (VIWASEEN)	– Investor for implementing investment project of Duong river Water supply System and Water Treatment Plant – VIWASEEN is the owner of the this Project and therefore shall prepare the EIA report, either by itself or through hired consultants, to be submitted for appraisal and approval

Source: Based on interview with the related agencies, web-pages, etc.

(2) Ministry of Planning and Investment

The Ministry of Planning and Investment (MPI) of Government of Socialist Republic of Viet Nam is the organization responsible for performing the functions of State management over planning and investment, including advices on strategies, planning and plans on national socio- economic development, mechanism and policies for general economic management and some specific fields, domestic and foreign investment, industrial parks and export-processing zones, management of official development assistance (ODA) source, bidding, enterprises, and business registration throughout the country; and perform the State management over public services in the fields under its management as prescribed by law. The Ministry also submits to the Government and/or the Prime Minister overall strategies, planning, projects, long- term, five-year and annual plans on national and territorial socio-economic development.

With respect to the domestic and foreign investment, the Ministry is responsible for the following activities:

- To submit to the Government planning, plans and lists of domestic investment projects and projects calling for foreign investment capital

- To coordinate with the Ministry of Finance and concerned ministries and

branches in inspecting and evaluating the efficiency of capital investment in capital construction works

- To evaluate investment projects; to license projects according to its competence; to authorize the licensing under the Prime Minister's regulations; to perform uniform management over the licensing of foreign investment projects in Viet Nam and Viet Nam's investment projects in foreign countries

- To assist the Government in managing activities of domestic investment, foreign direct investment in Viet Nam and Viet Nam's investment in foreign countries.

With respect to the ODA management, the responsibility of the Ministry includes:

- To act as a principal body in ODA attraction, coordination and management; to guide managing agencies in formulating lists and contents of programs and projects prioritized for ODA mobilization; to sum up and submit list of ODA-funded programs and projects to the Prime Minister for approval

- To prepare and organize the mobilization and coordination of, ODA sources in compatibility with the strategies and planning on ODA attraction and use

- To prepare contents of, and conduct negotiations, on international framework treaties on ODA; to represent the Government in signing international framework treaties on ODA with donors

- To guide concerned units and organizations to prepare ODA-funded programs and projects; to assume the prime responsibility and coordinate with the Ministry of Finance in determining forms of using ODA capital to be allocated by the State budget; to evaluate and submit to the Prime Minister for approval documents of ODA-funded programs and projects falling under the Prime Minister's approving competence

- To monitor and support the preparation of contents of, and negotiations on, specific international treaties on ODA with donors

- To coordinate with the Ministry of Finance in elaborating plans on ODA capital disbursement and annual plans on reciprocal capital for ODA-funded programs and projects entitled to allocations from the budget sources; to join the Ministry of Finance in the work of capital disbursement and the

mechanism for debt repayment and retrieval of ODA loan capital

- To monitor and evaluate ODA-funded programs and projects.

The organization chart of the Ministry is illustrated below in Figure 4.2.1. All the departments are headed by the Director General and these departments assist the Minister in performing the State management functions.

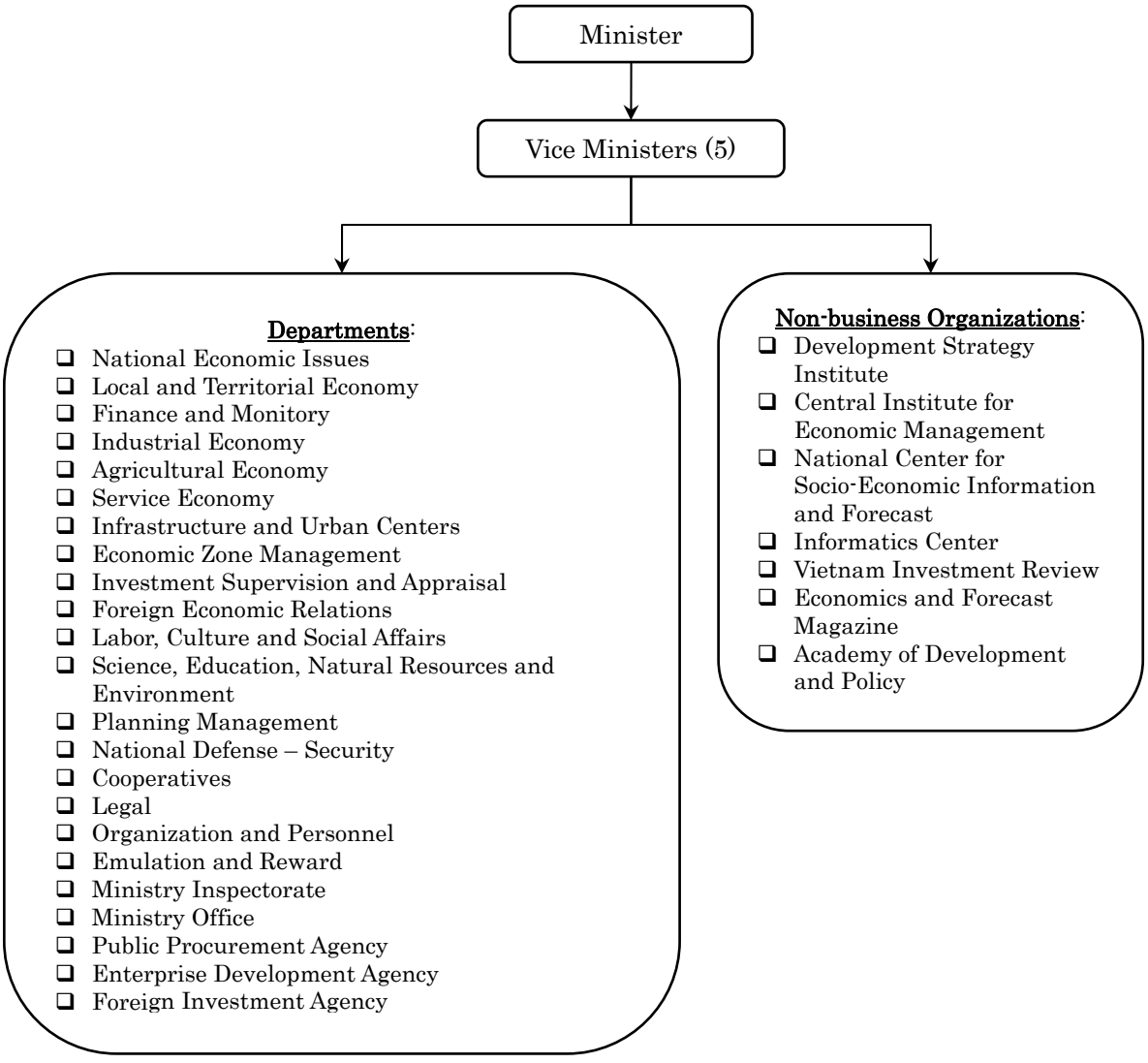


Figure 4.2.1 Organization Chart of MPI

This project involves foreign investment and therefore shall require approval from the MPI before obtaining several rights and agreements and before processing land acquisition for the Project.

(3) Ministry of Construction

The Ministry of Construction of the Government of Socialist Republic of Viet Nam is the organization that performs the function of State management of construction; architecture, planning construction of urban technical infrastructure, industrial parks, economic zones, developing urban housing and offices, business property, building materials, and State management over public services in accordance with the law.

The Ministry is responsible for guiding and supervising the implementation of the provisions of law in the construction field and for guiding and supervising the issuance, extension, adjustment, and recovery of construction permits in accordance with law. The MOC also guides and examines the selection of contractors in construction activities in accordance with the Construction Law and laws on tendering and is also responsible for guidance and examination of the quality control of construction works.

The MOC also carries out, whenever assigned by the Government, appraisal of the investment projects for construction works, evaluation of technical designs and cost estimates of construction works; and provides guidance with respect to inspection of the work in construction, evaluation, technical design, design drawing and estimate of construction work in accordance with the management of investment projects in construction. The organization chart of MOC is presented in Figure 4.2.2 below.

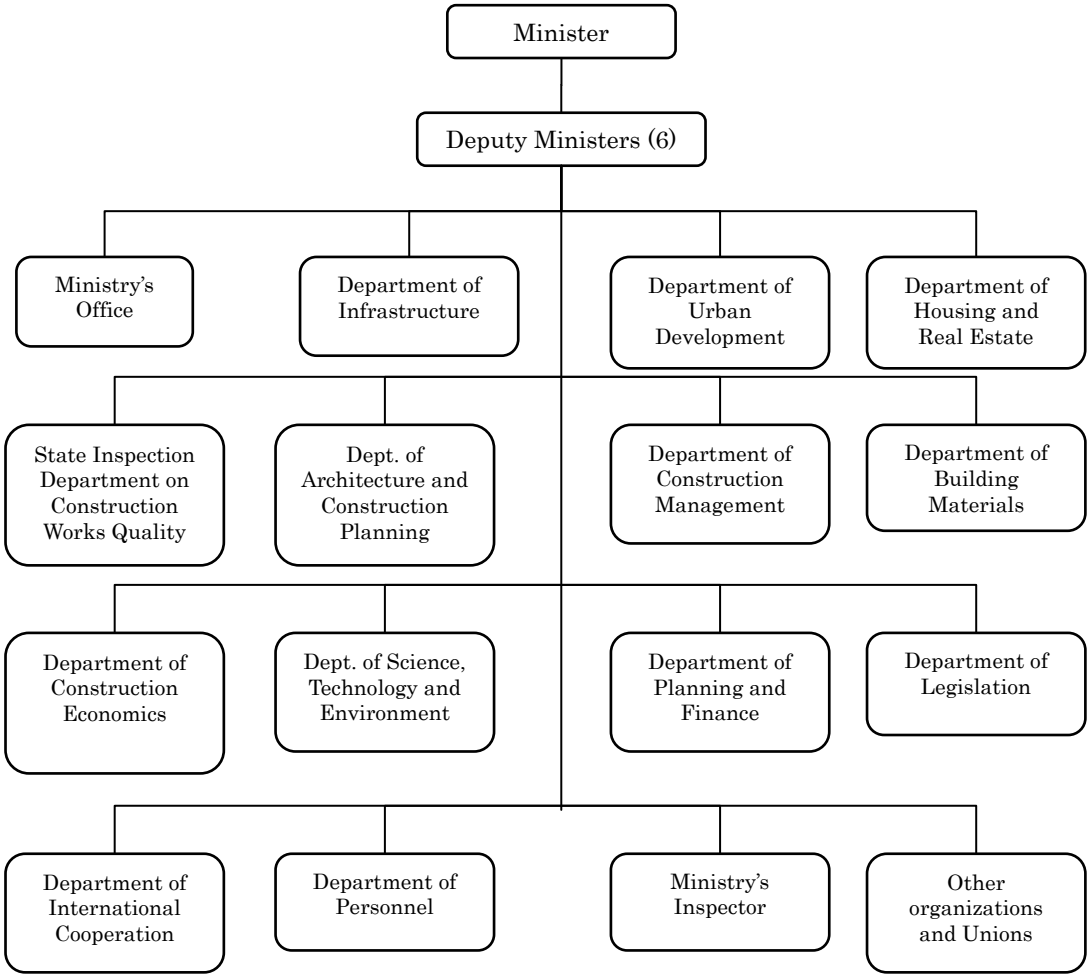


Figure 4.2.2 Organization Chart of MOC

In the normal procedure of Project approval, this project also requires approval from the Ministry of Construction before its implementation. The Project is submitted to the MOC and under this Ministry, Administration of Technical Infrastructure processes the documents.

(4) Ministry of Natural Resources and Environment

The Ministry of Natural Resources and Environment (MONRE) plays a key role in the management of land, water resource, mineral resources, geology, environment, hydro-meteorology, survey and mapping, seas and islands, and other public services that are under the Ministry management. The Ministry has several departments and divisions to take care of related resources.

Viet Nam Environment Administration (VEA) is a subsidiary body under the Ministry of Natural Resources and Environment (MONRE) to advise and assist the Minister of the MONRE in the field of environment management and to provide public services in

compliance with the laws.

Department of Water Resources Management is an organization under Ministry of Natural Resources and Environment, which functions to provide assistance to the Minister in implementing state management on water resources including rain water, surface water, ground water, and sea water within the territorial land and sea of the Socialist Republic of Viet Nam.

The MONRE is responsible for providing the conditions and guidelines for environment service agencies. The MONRE is authorized to organize councils or chose service organizations for appraisal of the environment impact assessment report or strategic EIA report, in respect of projects decided or approved by the National Assembly, the Government or the Prime Minister or inter-provincial or inter-ministerial projects.

The MONRE, in coordination with concerned ministries and branches, is responsible for guiding formulation methods for identifying national environmental standards which need to be promulgated for environmental protection.

The MONRE is responsible for, in coordination with concerned ministries, ministerial level agencies and provincial level People's Committee, submitting to the Prime Minister the decision on list of establishments causing serious environmental pollution on a scale beyond the handling competence or ability of ministries, ministerial level agencies and provincial level People's Committee. The MONRE shall specifically guide the inspection and supervision of the handling of such polluting establishments.

The MONRE is also responsible for organizing national environmental status monitoring. For this purpose, the Ministry shall formulate a national environment monitoring master plan and submit it to the Prime Minister for approval, and direct the collection and management of environment monitoring data.

In case of water supply projects, if the capacity of the project is greater than 500,000 m^3/day, the EIA requires approval from the MONRE. Otherwise the EIA requires approval from local agency such as Department of Natural Resources and Environment (DONRE). The organization chart of MONRE is presented in Figure 4.2.3.

Under the MONRE, Viet Nam Environment Administration (VEA) was established in 2008 to advise and assist the Minister of the MONRE in the field of environment management and to provide public services in compliance with the laws. The VEA is responsible for development of laws and regulations, policies, strategies, national target plans, programs, and projects on environment. It is also responsible for organizing implementation of measures to prevent, mitigate and respond to environmental contamination and for controlling environmental quality. It also implements nationwide survey, monitoring, assessment of biodiversity, assessment of trans-provincial or transboundary degraded ecosystems and proposes measures to conserve, rehabilitate and maintain sustainable use of biological resources. It is responsible for assessment and appraisal of EIA report on behalf of the MONRE. It is also responsible for preparation and management of environmental database and for implementation of environmental awareness programs, etc. The organization chart of VEA is presented in Figure 4.2.4.

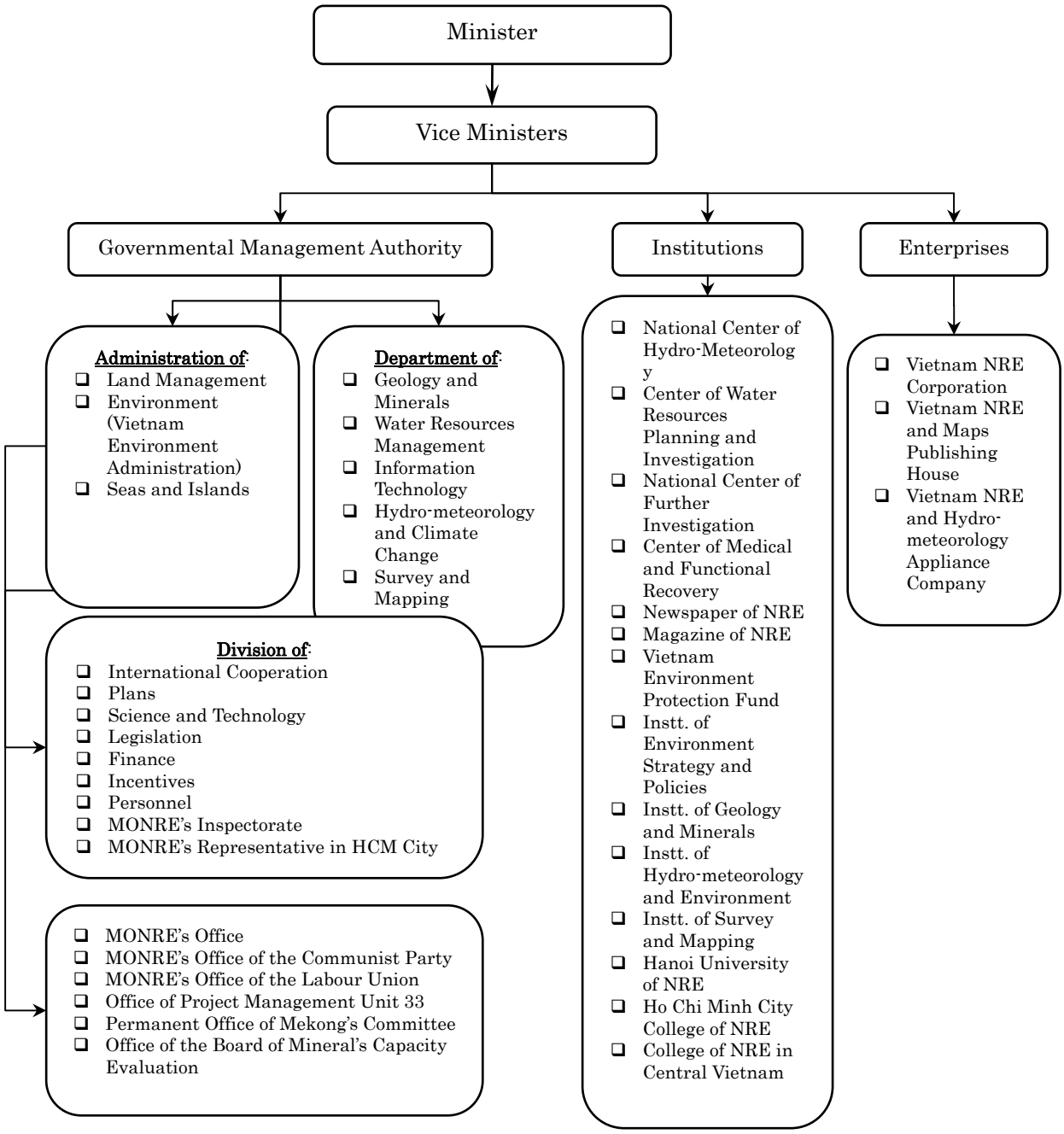


Figure 4.2.3 Organization Chart of MONRE

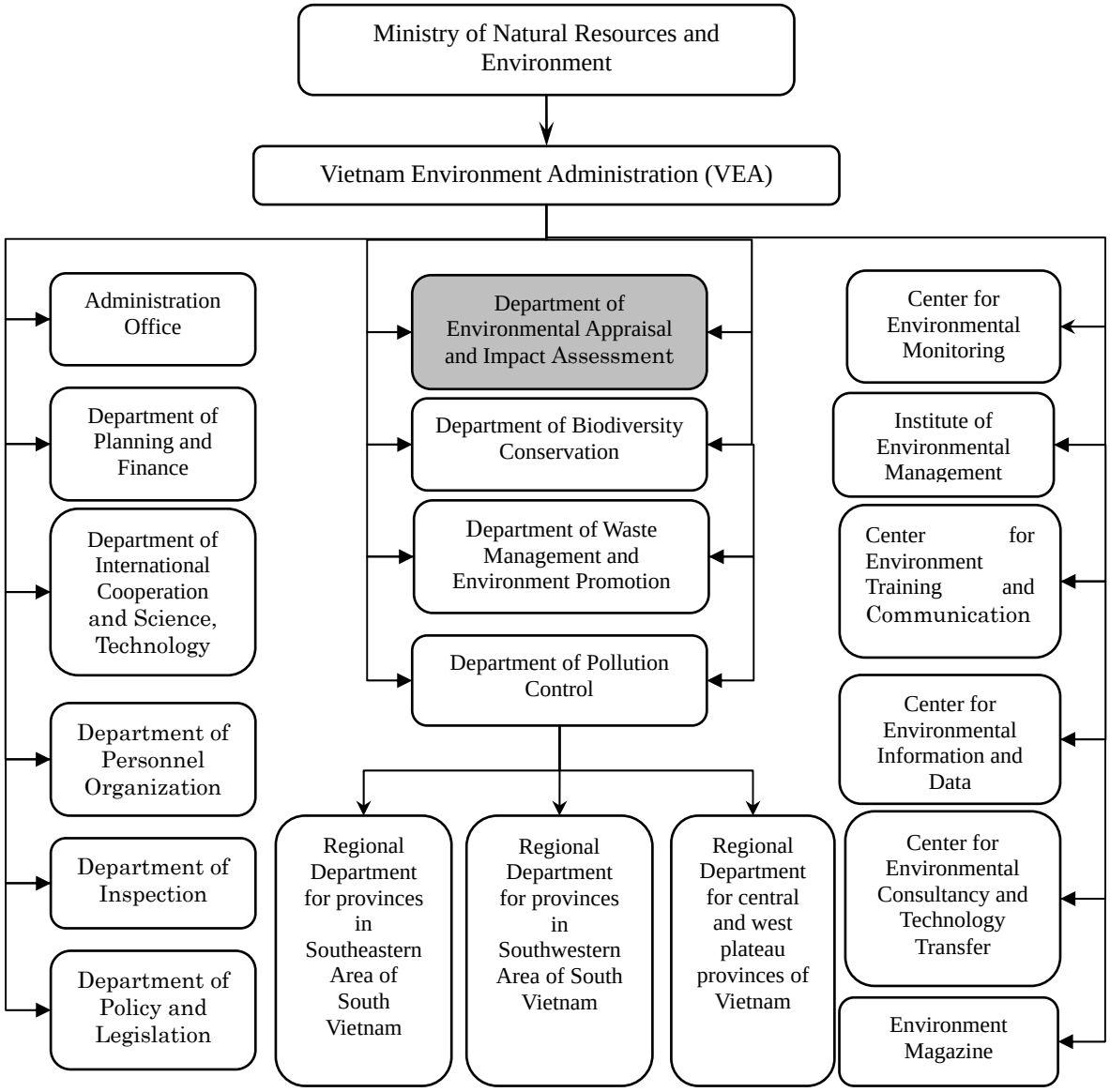


Figure 4.2.4 Organization Chart of VEA

(5) Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MARD) is a governmental agency performing state management functions in the fields of agriculture, forestry, fishery, salt production, irrigation/water services and rural development nationwide in Viet Nam, including state management functions with regard to delivery of public services and management of the State's ownership of rural state owned enterprises in accordance with legal documents.

The MARD is responsible for submitting development master plans and strategies; annual, five-year and long-term plans as well as key programs and projects within the Ministry's mandated areas to the Government and Prime Minister, and to Guide, supervise and be responsible for and organize the implementation of legal documents, strategies, master plans, programs, projects, standards, techno-economic norms relating to agriculture, forestry, salt industry, irrigation/water services and rural development.

In the field of water resources, the role of MARD is to unify the management of construction, exploitation, usage and protection of hydraulic works, and water supply and drainage works in rural areas; to unify the management of river basins; the exploitation, usage and integrated development of rivers in accordance with the master plans and action plans approved by authorized agencies; and to unify the management of dike construction and protection, headwork for prevention of floods and typhoons, and efforts to prevent and combat flush flooding, floods, typhoons, drought, and landslides along riversides and coastal areas.

In this Project, the intake facilities (pipes and pumping facilities) are to be constructed within the embankments of the Duong River and pipelines are to cross the embankments. Therefore, permission would be needed from either the MARD or the Department of Agriculture and Rural Development (DARD) for occupancy of the intake facilities.

The organization chart of MARD is presented below in Figure 4.2.5.

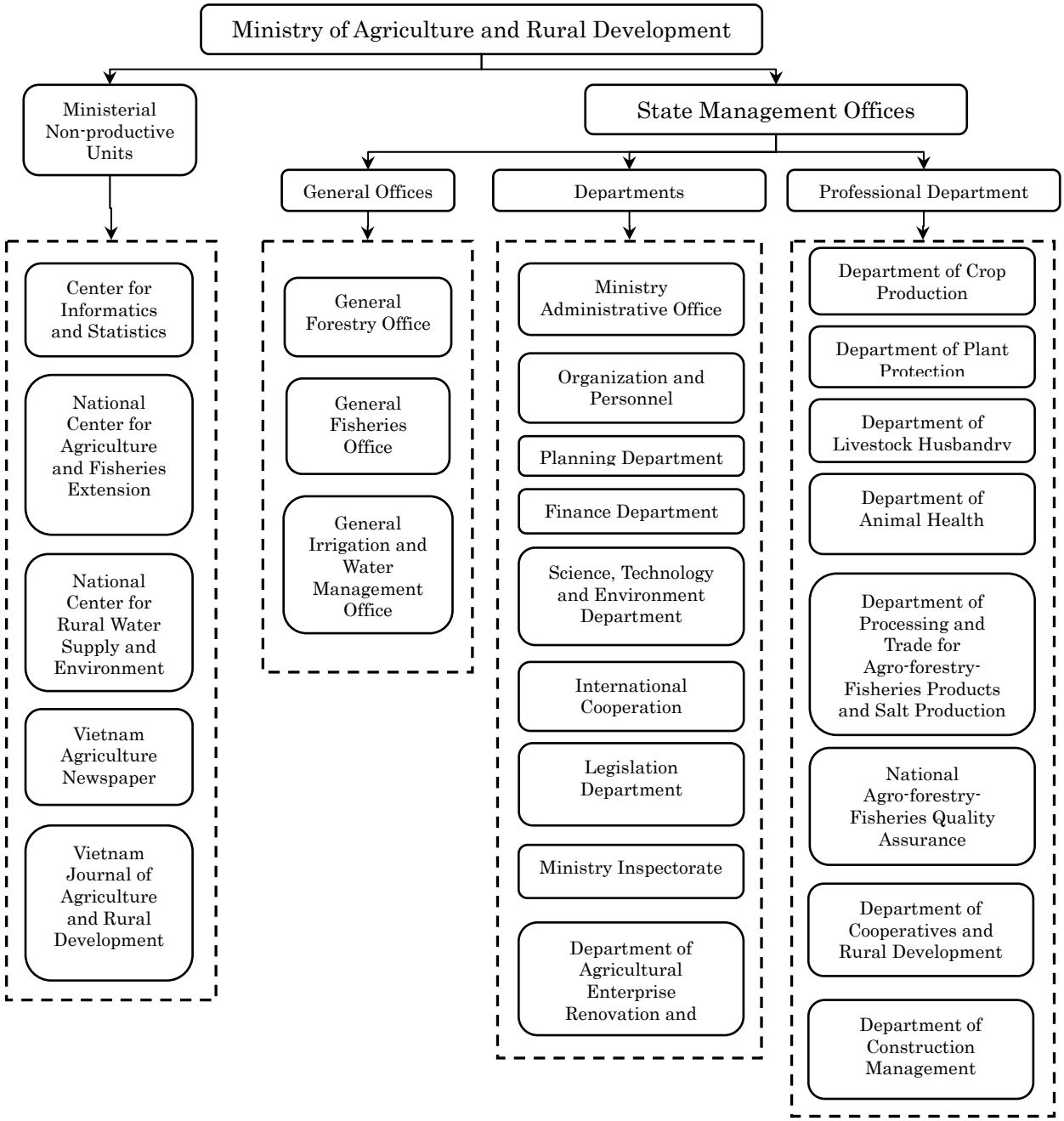


Figure 4.2.5 Organization Chart of MARD

(6) Department of Natural Resources and Environment

The Department of Natural Resources and Environment (DONRE) is an agency under Hanoi People's Committee (HPC) overall management and is also professionally directed by MONRE. The DONRE plays significant role in providing management assistance to HPC in sectors including land, water resources, minerals, climate, meteorology, survey and mapping in Hanoi.

In this Project, raw water shall be withdrawn from Duong river and the effluent from the sedimentation basin of water treatment plant is proposed to discharge into River on daily basis. For this purpose, water right registration and permission for discharge into river would be required. These permissions are processed by Departments in DONRE. Also, preparation and approval of EIA report shall be required at the Feasibility Study stage of this Project. In this regard, the EIA report shall be prepared by the Project owner and submitted to the DONRE for approval and appraisal. Environmental Protection Agency under DONRE is responsible for appraisal of the EIA report submitted by the project owner. Based on this appraisal of DONRE, the HPC approves the EIA report of the project.

The DONRE on behalf of HPC is also responsible for Registration of the Land use for the Project.

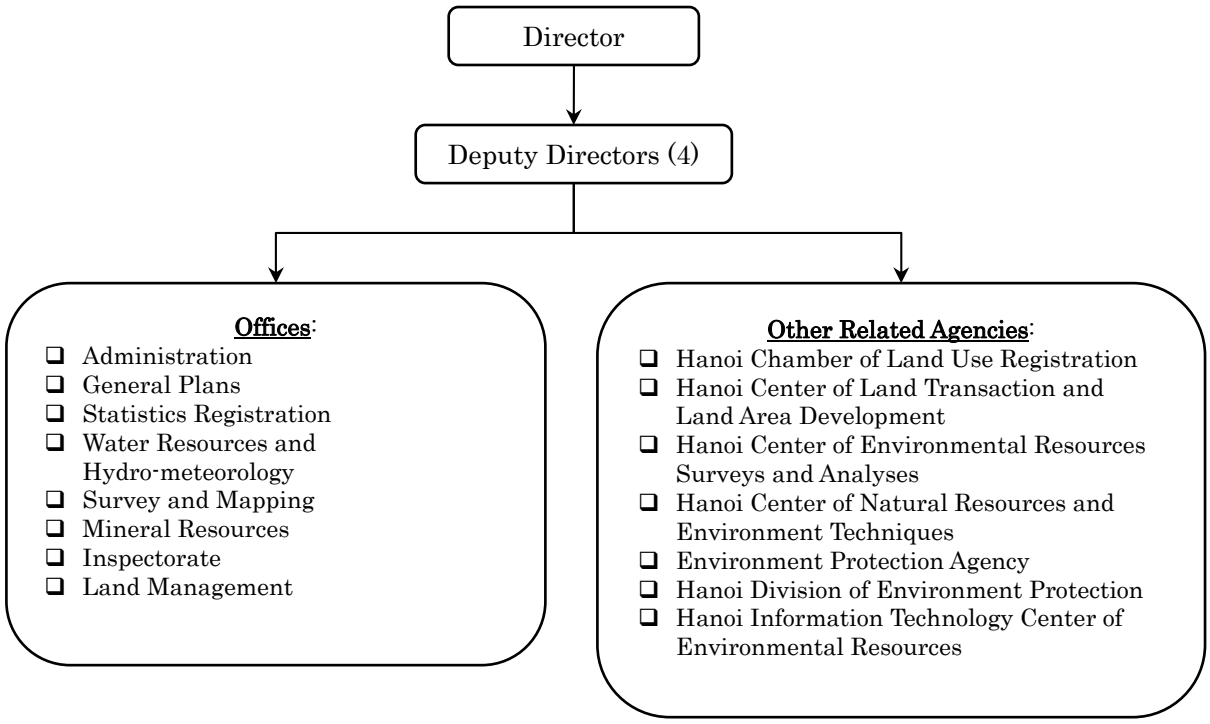


Figure 4.2.6 Organization Chart of DONRE

(7) Viet Nam Water Supply, Sewerage and Environment Construction Investment Corporation

Viet Nam Water supply, Sewerage and Environment Construction Investment Corporation (VIWASEEN), established in October 2005, is a state-owned enterprise under Ministry of Construction operating in the form of Mother-Member Company. VIWASEEN was reorganized from independent state-owned companies of Ministry of Construction including Water supply and Sewerage Construction Company (WASEENCO), Water supply and Sewerage Construction and Investment Company (WASECO), Water supply and Sewerage Consultancy Company No.2 (WASE). At present, VIWASEEN is one of the leading enterprises operating in design, construction, installation, import and export of equipment and materials for water supply and sewerage projects, civil and industrial works at different scales. With operation all over the country, VIWASEEN is a prestigious Enterprise in domestic sector on implementation of Water supply, Sewerage and Environment investment construction projects which are funded by international official support (ODA), other loan from international finance organization as ADB, WB, former JBIC, etc. and domestic mobilization capital.

Recently, the VIWASEEN has been renamed as Viet Nam Water and Environment Investment Corporation. In April 2010, the Prime Minister agreed with the proposal from the Ministry of Construction and approved VIWASEEN to be the Investor for implementing investment project of Duong River Water supply System and Water Treatment Plant.

The organization chart of VIWASEEN is presented in Figure below. It has 16 member companies with governing share hold by the mother company. VIWASEEN has 10 dependent members and has associated with several companies including Petro Viet Nam, etc.

For this project, if the VIWASEEN becomes the owner, it will be responsible for the preparation of the EIA, and its submission to the relevant organization for approval.

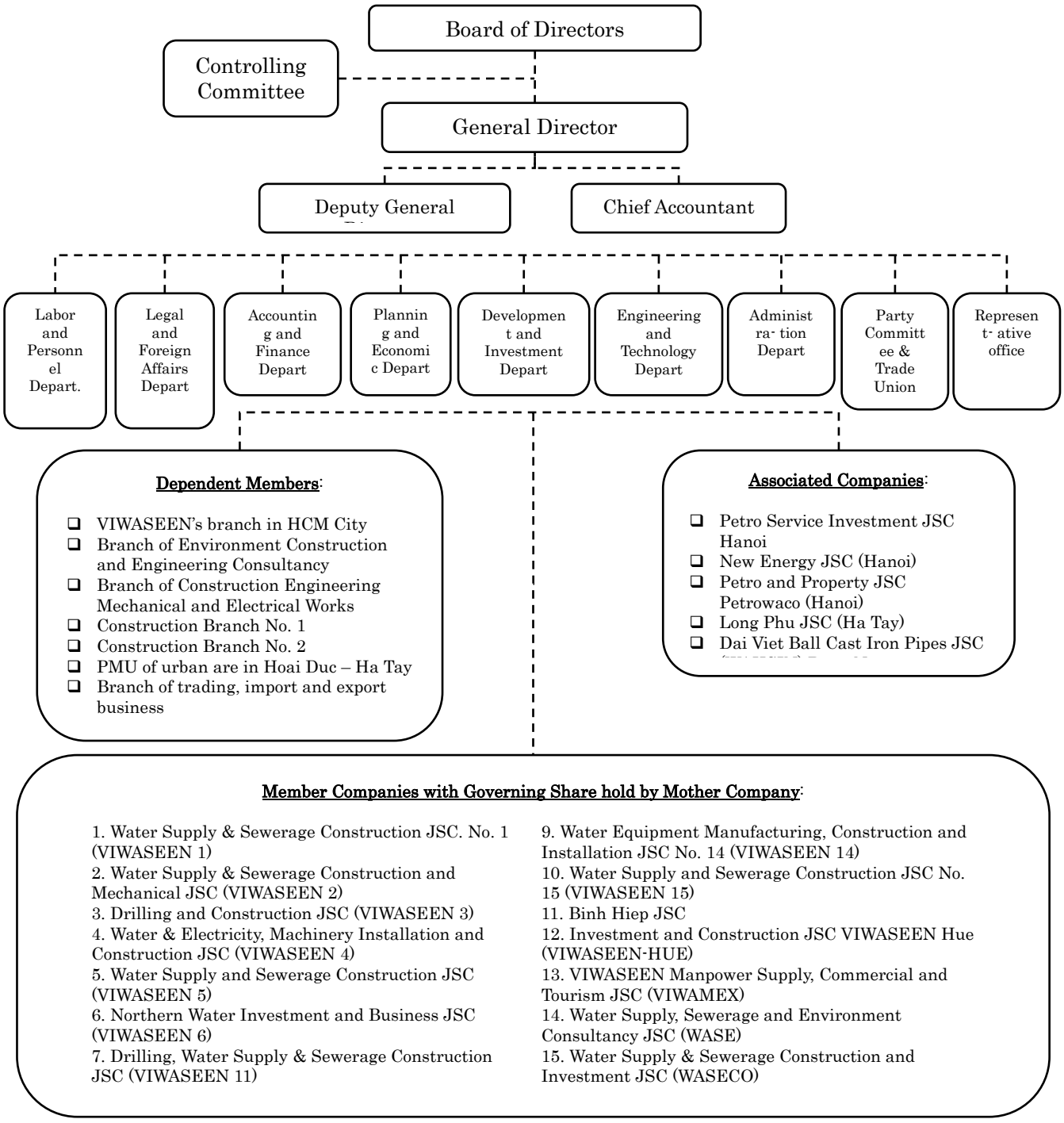


Figure 4.2.7 Organization Chart of VIWASEEN

(8) Legal Framework of Environmental and Social Consideration

Viet Nam is experiencing a rapid development and fast growth of industrial sector based on its economic development strategy. Socioeconomic development activities are causing pressure on environment. For sustainable development, policies have been formulated towards environmental protection and sustainable utilization of resources to

protect land, water and other natural resources. To address the protection and utilization of these resources, the Government of Socialist Republic of Viet Nam has formulated and promulgated several Laws and Regulations. Existing legal framework in Viet Nam related to environment and social issues, is briefly described in this section and some of these Laws are listed in Table 4.2.2.

Table 4.2.2 Relevant Laws and Decrees in Environmental and Social Sector

Laws	Contents
Law on Environmental Protection (No. 52/2005/QH11)	– Principles for formulation and application of environmental standards; Contents and systems of national environmental standards; – Objects, contents, appraisal and approval of strategic environmental assessment, and environmental impact assessment reports, and environmental protection commitments – Conservation and rational use of natural resources – Environmental protection in production, business and service activities – Environmental protection in urban centers and residential areas – Protection of marine, river and other water source environment – Waste management – Prevention of, response to environmental accidents, remedy of environmental pollution and rehabilitation of environment – Environment monitoring and information – Resources for environmental protection – International cooperation in environmental protection – Responsibilities of agencies for environmental protection – Inspection, handling of violations, settlement of complaints and denunciations related to environment, and compensation for environmental damage
Decree No. 80/2006/ND-CP; Detailing and Guiding the Implementation of the Law on Environmental Protection	– Environmental standards – Strategic environmental assessment, environmental impact assessment and environmental protection commitments – Environmental protection in production, business and service activities – Waste management – List of projects EIA report – MONRE to guide and organize the implementation of this Decree – List of projects to prepare EIA report include the project on exploitation of surface water with capacity greater than 10,000 m^3 per day. – Project exploiting surface water greater than 500,000 m^3 per day requires approval of EIA report from the MONRE.
Decree No. 21/2008/ND-CP; Amending and Supplementing Articles of Decree No. 80/2006/ND-CP	– Amendments were made to a number of articles of Decree No. 80/2006/ND-CP – List of projects to prepare EIA report presented in Decree No. 80/2006/ND-CP replaced by the list presented in this Decree – Projects to exploit surface water with capacity greater than 50,000 m^3 per day are required to prepare EIA report.
Circular No.	– Elaboration and appraisal of strategic environmental assessment

Laws	Contents
05/2008/TT-BTNMT; Guiding Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment	reports – Elaboration, appraisal and approval of EIA; Implementation, Examination and certification of the implementation of EIA – Elaboration, registration and certification of environmental protection commitment documents – Examination of and reporting on the appraisal and approval of EIA reports and certification of environmental protection commitment documents
Law on Land (No. 13-2003-QH11)	– Ownership of land, classification of land – Right of State with respect to land and State administration of land (including land use zoning and planning, allocation land, lease of land, Land recovery, Registration of land use rights, etc.) – Regime for use of all types of land (including agricultural, non-agricultural and unused land) – Rights and obligation of land users – Administrative procedures for administration and use of land – Land inspectorate, resolution of disputes, complaints and denunciations about land and dealing with breaches of Laws on Land
Decree No. 181/2004/ND-CP on Implementation of the Law on Land	– System of organization of land administration and services of land management and use – Land use zoning and planning – Allocation of land, lease of land, conversion of land use purpose, land recovery and land requisition – Registration of land use rights, formulation and management of cadastral files, issuance of certificates of land use right, and land statistics and land inventories – Land use rights in real estate market – Regime for use of agricultural land – Regime for use of non-agricultural land – Management of unused land and commissioning use of unused land – Rights and obligations of land users – Order and administrative procedures for management and use of land – Resolution of land-related disputes and complaints – Identifying and dealing with breaches of law on land by administrators
Decree No. 197/2004/ND-CP on Compensation, Support and Resettlement when Land is recovered by the State	– Compensation for land – Compensation for property – Support policies – Resettlement – Organization of implementation
Decree No. 149/2004/ND-CP on Licensing of Water Resources Exploitation, Extraction and Utilization and	– Licensing, extension, amendment, termination and revoking of permits on exploration, exploitation and utilization of water resources and wastewater discharge into water sources – Rights and obligations of licensing agencies, application receiving and managing agencies and permit holders – Process and procedure of licensing of exploration, exploitation and utilization of water resources and wastewater discharge into water

Laws	Contents
Wastewater Discharge in Water Sources	sources – According to this Decree, MONRE shall be the authorized Licensing Agency responsible to issue, extend, amend, terminate and revoke permits for using surface water and extracting 50,000 m^3/day or higher for purposes other than agriculture, and for wastewater discharge into water sources at a rate of 5000m^3/day or higher.
Circular No. 02/2005/TT-BTNMT Guiding the Implementation of the Decree No. 149/2004/ND-CP	– Authority and power to grant, renew, amend, suspend and revoke licenses; duration and extension of licenses – Procedure and processes for granting, renewing, extending and amending of licenses – Management of applications and licenses – Implementation arrangements

Source: English version of the relevant Laws/Decrees/Circulars

(9) Law on Environmental Protection

The Law on Environmental Protection (No. 52/2005/QH11) was promulgated by the President of Viet Nam in December 2005. This law has 15 chapters including a total of 136 articles. The law mainly describes about principles for formulation and application of environmental standards; Objects, contents, appraisal and approval of strategic environmental assessment, and environmental impact assessment reports, and environmental protection commitments; Conservation and rational use of natural resources; Environmental protection; Protection of marine, river and other water source environment; Waste management; Environment monitoring; and Resources for environmental protection.

Articles 18 to 23 of Chapter III, section 2 of this law describes about environmental impact assessment which indicates clearly that any project which utilizes natural resources on large scale is required to prepare environmental impact assessment reports. Also, according to Article 19, the project owner or a consultant hired by the project owner shall prepare the EIA report during the feasibility study stage. Article 20 describes the contents of the EIA report which shall include description of project construction activities, project area, schedule, etc.; assessment of environmental status of project site; environmental impacts; mitigation measures; environmental protection measures during project construction and operation; environmental monitoring; cost estimates for environmental protection works within total cost estimates of project; opinion of commune/ward or township people's committee; and citation of sources of figures, data, etc.

(10) Decree No. 80/2006/ND-CP and Decree No. 21/2008/ND-CP

The Decree No. 80/2006/ND-CP was issued by the Prime Minister in August 2006 and

provides details and guidance on the implementation of a number of articles of the Law on Environmental Protection. This decree comprises 25 Articles in 3 Chapters.
Appendix I of this decree includes the list of projects that are required to prepare EIA report and enumerates 102 projects. According to this list, any project on exploitation of surface water with capacity greater than 10,000 m^3/day is required to prepare EIA report. According to appendix II of this decree, any project exploiting surface water greater than 500,000 m^3/day requires approval of EIA report from the MONRE.

Decree No. 21/2008/ND-CP was issued by the Prime Minister in February 2008, to amend and supplement a number of Articles of the Decree No. 80/2006/ND-CP detailing and guiding the implementation of a number of articles of the law on environmental protection. It includes only 2 Articles. In this Decree, a new list of project that require to prepare EIA reports is presented including total 162 projects and this list replaces the list presented in Decree No. 80/2006/ND-CP. According to this list, a project on exploitation of surface water with capacity greater than 50,000 m^3/day is required to prepare EIA report.

(11) Circular No. 05/2008/TT-BTNMT

This Circular was issued in December 2008 by the Ministry of Natural Resources and Environment providing guidance related to Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment. It includes 6 Sections and describes in detail about elaboration and appraisal of strategic environmental assessment, EIA, and environmental protection commitment.

Section III of this Circular describes about EIA and includes explanation on elaboration of EIA, community consultation, submission of documents for EIA appraisal, appraisal of EIA report by appraisal council, finalization of EIA report, re-appraisal of EIA reports, approval of EIA reports, certification and sending of approved EIA documents, responsibilities of project owner after EIA approval, responsibilities of approving agency after EIA approval, etc.

(12) Law on Land

Law of Land (No. 13-2003-QH11) was enacted in 2003 by the National Assembly of Viet Nam replacing the 1993 Law on Land, the 1998 Amendment of Law on Land, and 2001 Amendment of Law on Land. The law includes 7 chapters and 146 Articles. The law, among other items, describes about the classification of land, right of State with respect to land and administration of land including planning and zoning, allocation, lease and recovery, and registration of land use right, etc.

According to Article 5 of this law, land belongs to the entire people with the State as the representative owner. It also describes that the State shall exercise the right to decide land use purposes by passing decisions and by considering and approving land use zoning and land use plans; to decide the quotas on allocation of land and on duration of land use; to decide allocation of land, lease of land, land recovery, and permission for conversion of land use purpose; and to determine land prices. According to Article 7(4) of this law, People's committees at all levels shall exercise the rights of the representative owner of land and State administration of land within their respective localities. Article 13 of this Law classifies the lands broadly into three categories: agricultural land, non-agricultural land, and unused land.

Article 38 of the law describes that the State shall recover land if it is to be used for objectives of national defense and security, national interest, public interest, or economic development. Article 39 indicates that the State shall carry out land recovery, pay compensation and carry out site clearance after land use zoning and planning have been proclaimed or when an investment project with land use requirements in conformity with the land use zoning and planning is approved by the competent State body. Article 44 of the law states that People's committees of districts, towns and provincial cities shall make decisions to recover land from family households, individuals, and communities of citizens.

Article 42 of the law explains about compensation against land acquisition and resettlement when recovery of residential land is carried out.

Decree No. 181/2004/ND-CP was issued by the Prime Minister in October 2004 on implementation of the Law on Land. It includes 14 chapters and 186 Articles.

(13) Decree No. 149/2004/ND-CP and Circular No. 02/2005/TT-BTNMT

Decree No. 149/2004/ND-CP was issued by the Prime Minister on the request of MONRE. This Decree explains on the licensing of water resources exploitation, extraction and utilization and wastewater discharge in water sources. It includes 5 chapters and 25 Articles.

Among major items, the Decree explains on licensing, extension, amendment, termination and revoking of permits on exploration, exploitation and utilization of water resources and wastewater discharge into water sources; Rights and obligations of licensing agencies, application receiving and managing agencies and permit holders; and Process and procedure of licensing of exploration, exploitation and utilization of

water resources and wastewater discharge into water sources.

According to Article 13 of this Decree, MONRE shall be the authorized Licensing Agency responsible to issue, extend, amend, terminate and revoke permits for using surface water and extracting 50,000 m^3/day or higher for purposes other than agriculture, and for wastewater discharge into water sources at a rate of 5000m^3/day or higher.

Article 7 of this Decree describes that the surface water utilization permit shall be issued initially for duration of 20 years from the date of its approval and can be renewed for up to 10 years. The wastewater discharge permit is issued for 10 years initially which can be extended for 5 years. Article 18 of Decree explains that the permit holders shall pay fee and charges and shall pay resource tax and fees for environment protection.

Circular No. 02/2005/TT-BTNMT was issued by MONRE to provide guidance for implementation of the Decree No. 149/2004/ND-CP regulating the licensing of water resources exploration, exploitation, and utilization and wastewater discharge into water sources.

(14) JICA Guidelines for Environmental and Social Considerations

The objectives of the JICA Environmental Guidelines (*Guidelines for Environmental and Social Considerations, April 2010*), are to encourage project proponents to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly.

JICA, which is responsible for ODA, plays a key role in contributing to sustainable development in developing countries and pays great attention to environmental and social impacts of project implementation. The measures for environmental and social considerations are implemented by ensuring a wide range of meaningful stakeholder participation and transparency of decision-making, as well as by working for information disclosure and by ensuring efficiency.

The JICA Environmental Guidelines is based on a policy, which stipulates that all projects it supports are carried out in an environmentally responsible manner and that projects must comply with all local environmental laws and procedures in addition to appropriate JICA guidelines. While encouraging the appropriate consideration of environmental and social aspects, it is JICA's policy to provide active support to

projects that promote environmental conservation and to projects that contribute to the protection of the environment, such as attempts to reduce greenhouse gas emissions.

JICA Environmental Guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents, etc. in order to facilitate the achievement of objectives. In doing so, JICA endeavors to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations. It includes mainly basic policies, objectives, basic principles, responsibility of JICA, requirement of project proponents, covered schemes, dissemination, Process of environmental and social considerations (including information disclosure, categorization, impacts to be assessed, consultation with local stakeholders, concern about social environment and human rights, laws, regulations and standards of reference, advice of the advisory committee for environmental and social considerations, decision-making by JICA, ensuring appropriate implementation of and compliance with the Guidelines); Procedure of environmental and social considerations (for projects on preparatory survey, loan aid, grand aid and technical cooperation projects, preliminary studies of grant aid undertaken by MOFA, and technical cooperation for development planning).

(15) JICA's Procedures of Environmental and Social Considerations for Loan Aid Projects

1) Environmental Review

JICA conducts an environmental review in accordance with the project category, and refers to the corresponding environmental checklists for each sector when conducting that review. If JICA does not conduct preparatory surveys, it classifies projects promptly after receiving official requests and discloses such categorization on its website. Also, JICA discloses the classification of projects based on detailed information on its website prior to the environmental review.

〔Categorization〕

JICA classifies projects into four categories (category A, B, C or FI) according to the extent of environmental and social impacts, taking into account an outline of project, scale of the project, site conditions, etc. Of the categories defined in the Guidelines, only categories A and B that are most related to this Project is discussed below.

① *Category A*: A project is classified as category A if it is likely to have significant adverse impacts on the environment and society. Projects with complicated or unprecedented impacts that are difficult to assess is also

classified under this category. In principle, this category includes projects in sensitive sectors, projects that have characteristics that are liable to cause adverse environmental impacts, and project located in or near sensitive areas. An illustrative list of such projects is provided in Appendix 3.

② *Category B*: A project is classified under this category if it is likely to pose potential negative environmental and social impacts that are less severe than those of Category A. In most cases, normal mitigation measures can be designed more readily for such projects. The impacts in this case are site-specific.

2) Procedure of Environmental Review

① *Category A Projects*

- Project proponents must submit EIA reports.
- If large-scale involuntary resettlement is expected, a Resettlement Action Plan (RAP) must also be submitted.
- If measures for indigenous people are required in project, an Indigenous People Plan (IPP) must be submitted.
- JICA publishes the status of host countries' submission of major documents related to environmental and social considerations on its website. Prior to its environmental review, JICA discloses EIA reports and other documents. EIA report is disclosed 120 days prior to concluding agreement documents.
- JICA undertakes its environmental reviews based on the EIA and other documents submitted by project proponents.
- In the review, potential positive and negative environmental impacts of project are examined. Also, necessary to avoid, minimize, mitigate, or compensate for potential negative impacts and measures to promote positive impacts are examined. JICA also examines the results of information disclosure and local stakeholders' consultation.
- JICA discloses the results of environmental reviews on its website after agreement documents are concluded.

② *Category B Projects*

- JICA undertakes its environmental reviews based on the information provided by project proponents and others.
- In the review, potential positive and negative environmental impacts of project are examined. Also, necessary measures to avoid, minimize, mitigate, or compensate for potential negative impacts and measures to

promote positive impacts are examined. When an EIA procedure has been conducted, the EIA report may be referred to but is not mandatory.

- JICA discloses EIA report and environmental permit certifications, RAPs, IPPs, when these documents are submitted by the project proponents.

- JICA discloses the results of environmental reviews on its website after concluding agreement documents.

3) Monitoring and its Confirmation by JICA

- JICA confirms with project proponents, etc. the results of monitoring the items that have significant environmental impacts, over a certain period of time, in order to confirm that environmental and social considerations are given due attention.
- Information necessary for monitoring confirmation by JICA must be supplied by project proponent, etc. by appropriate means, including in writing. When necessary, JICA may also conduct its own investigations.
- When third parties point out that environmental and social considerations are not being fully undertaken, JICA forwards such claims to project proponent and encourages them to take appropriate action.
- When necessary, JICA may request the cooperation of project proponent in conducting investigations in order to confirm the state of the undertaking of environmental and social considerations.
- If JICA judges that there is a need for improvement in a situation with respect to environmental and social considerations, it may ask project proponent to take appropriate actions in accordance with the agreement documents.
- JICA discloses the results of monitoring conducted by project proponent on its website to the extent that they are made public in project proponent. When third party requests further information, JICA discloses it, subject to approval by project proponent.
- If JICA conducts a detailed design study by itself, JICA carries out an environmental review for the target project before the commencement of the study. JICA reviews detailed resettlement action plans if necessary. JICA discloses the final report on its website.

(16) Environmental and Social Considerations Needed for Projects

The environmental and social considerations required for funded projects are stated in the Guidelines. It includes Underlying Principles; Examination of Measures; Scope of Impact to be Examined; Compliance with Laws, Standards and Plans; Social

Acceptability; Ecosystem and Biota; Involuntary Resettlement; Indigenous Peoples; and Monitoring. As stated in the Appendix 1 of JICA Environmental Guidelines, appropriate environmental and social considerations are undertaken, according to the nature of the project, based on the items described below.

1) Underlying Principles

Environmental impact which may be caused by a project must be assessed and examined from the earliest planning stage possible. Alternative proposals or minimization measures to prevent or reduce adverse impact must be examined and incorporated into the project plan.

Such examination must include analysis of environmental costs and benefits in as quantitative terms as possible and be conducted in close harmony with economic, financial, institutional, social and technical analysis of the project.

The findings of the examination of environmental and social considerations must include alternative proposals, mitigation measures and be recorded as separate documents or as a part of other documents. The EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impact.

For projects that have particularly large potential adverse impact or are highly contentious, a committee of experts may be formed to seek their opinions, in order to increase accountability.

2) Examination of Measures

Multiple alternative proposals must be examined to prevent or minimize adverse impact and to choose a better project option in terms of environmental and social considerations. In examination of measures, priority is to be given to the prevention of environmental impact, and when this is not possible, minimization and reduction of impact must be considered next. Compensation measures must be examined only when impact cannot be prevented by any of the aforementioned measures.

Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans, must be prepared; and costs of implementing such plans and systems, and financial methods to fund such costs, must be determined. Plans for projects with particularly large potential adverse impact must be accompanied by detailed environmental management plans.

3) Scope of Impact to be Examined

Environmental impact to be investigated and examined includes factors that impact human health and safety as well as the natural environment, such as: air, water, soil, waste, accidents, water usage, climate change, ecosystems, and fauna and flora. Social concerns include: involuntary resettlement of the affected population, local economy such as employment and livelihood, utilization of land and local resources, the indigenous people, equality of benefits and losses and equality in the development process, cultural heritage, landscape, gender, children's rights, local conflicts of interest, working conditions including occupational health, and communicable diseases such as HIV/AIDS.

In addition to the direct and immediate impact of projects, derivative, secondary and cumulative impacts are also to be examined and investigated to a reasonable extent. It is also desirable that the impact which can occur at any time throughout the project cycle be considered throughout the life cycle of the project.

4) Compliance with Laws, Standards and Plans

Projects must comply with laws, ordinances and standards related to environmental and social considerations established by the governments that have jurisdiction over project site (including both national and local governments). They are also to conform to environmental and social consideration policies and plans of the governments that have jurisdiction over the project site.

Projects must, in principle, be undertaken outside protected areas that are specifically designated by laws or ordinances of the government for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impact on designated conservation areas.

5) Social Acceptability

Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which the project is planned. For projects with a potentially large environmental impact, sufficient consultations with stakeholders, such as local residents, must be conducted via disclosure of information from an early stage where alternative proposals for the project plans may be examined. The outcome of such consultations must be incorporated into the contents of the project plan.

Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all of whom are susceptible to environmental and social impact and who may have little access to the decision-making process within society.

6) Ecosystem and Biota

Project must not involve significant conversion or degradation of critical natural habitats and critical forests. Illegal logging of forests must be avoided. Project proponents are encouraged to obtain certification by forest certification systems to prevent illegal logging.

7) Involuntary Resettlement

Involuntary resettlement and loss of means of livelihood are to be avoided where feasible, exploring all viable alternatives. When, after such examination, it is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with people who will be affected.

People to be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by the project proponents, etc. in timely manner. The project proponents, etc. must make efforts to enable the people affected by the project, to improve their standard of living, income opportunities and production levels, or at least to restore them to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting the means for an alternative sustainable livelihood, and providing the expenses necessary for relocation and the re-establishment of a community at resettlement sites.

Appropriate participation by the people affected and their communities must be promoted in planning, implementation and monitoring of resettlement action plans and measures against the loss of their means of livelihood. Also, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

For projects that will result into large-scale involuntary resettlement, action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and communities based on sufficient information made available to them in advance. Consultation should be carried out in form, manner, and language that are understandable to affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

8) Indigenous Peoples

Any adverse impacts on indigenous people are to be avoided through viable alternatives. In case when avoidance is not feasible, measure must be taken to minimize impacts and to compensate indigenous people for their losses.

When a project may have adverse impact on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of the relevant international declarations and treaties. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.

Measures for the affected people must be prepared as an indigenous peoples plan and must be made public in compliance with the relevant laws of the country. In preparing such plan, consultations must be held with the affected people based on sufficient information available to them in advance. Consultation should be carried out in form, manner, and language that are understandable to affected people. Also desirable is that the indigenous peoples plan include elements mentioned in the World Bank Safeguard Policy, OP 4.12, Annex B.

9) Monitoring

It is desirable that, after a project begins, the project proponents monitor: (i) whether any situations that were unforeseeable have arisen, (ii) whether the performance and effectiveness of mitigation measures are consistent with the assessment, and that they then take appropriate measures based on the results of such monitoring.

In cases where sufficient monitoring is deemed essential for the achievement of appropriate environmental and social considerations, such as the projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents must ensure that project plans include monitoring plans which

are feasible.

It is desirable that project proponents make the results of the monitoring process available to project stakeholders.

When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, it is desirable that a forum for discussion and examination of countermeasures be established based on sufficient information disclosure and include the participation of stakeholders in the relevant project. It is also desirable that an agreement be reached on procedures to be adopted with a view to resolving the problem.

(17) EIA Report Content required by JICA Guidelines

According to the Appendix 2 of JICA Guidelines, the following conditions should be met in preparation of the EIA Report for Category A Projects:

- When assessment procedures already exist in host countries, and projects are subject to such procedures, Project proponents, etc., must officially complete those procedures and obtain the approval of the government of the host country.
- EIA reports must be written in the official language or a language widely used in the country where the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.
- EIA reports are required to be made available in the country and to the local residents where the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and that copying be permitted.
- In preparing EIA reports, consultation with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records, etc. of such consultations must be prepared.
- Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project.

As stated in the Guidelines, EIA reports (for category A Projects) should cover the items enumerated below.

- Executive Summary
- Policy, legal and administrative framework
- Project description
- Baseline data
- Environmental Impacts
- Analysis of alternatives:
  - With project; and
  - Without project.
- Environmental Management Plan (EMP).
- Consultation.

(18) Environmental Impact Assessment according to Regulations in Viet Nam

The Law on Environmental Protection (No. 52/2005/QH11) describes about the necessity of carrying out environmental impact assessment. Articles 18 to 23 of Chapter III, section 2 of this law describes about environmental impact assessment which indicates clearly that any project which utilizes natural resources on large scale is required to prepare environmental impact assessment reports. Also, according to Article 19, the project owner or a consultant hired by the project owner shall prepare the EIA report during the feasibility study stage. Article 20 describes the contents of the EIA report which shall include description of project construction activities, project area, schedule, etc.; assessment of environmental status of project site; environmental impacts; mitigation measures; environmental protection measures during project construction and operation; environmental monitoring; cost estimates for environmental protection works within total cost estimates of project; opinion of commune/ward or township people's committee; and citation of sources of figures, data, etc.

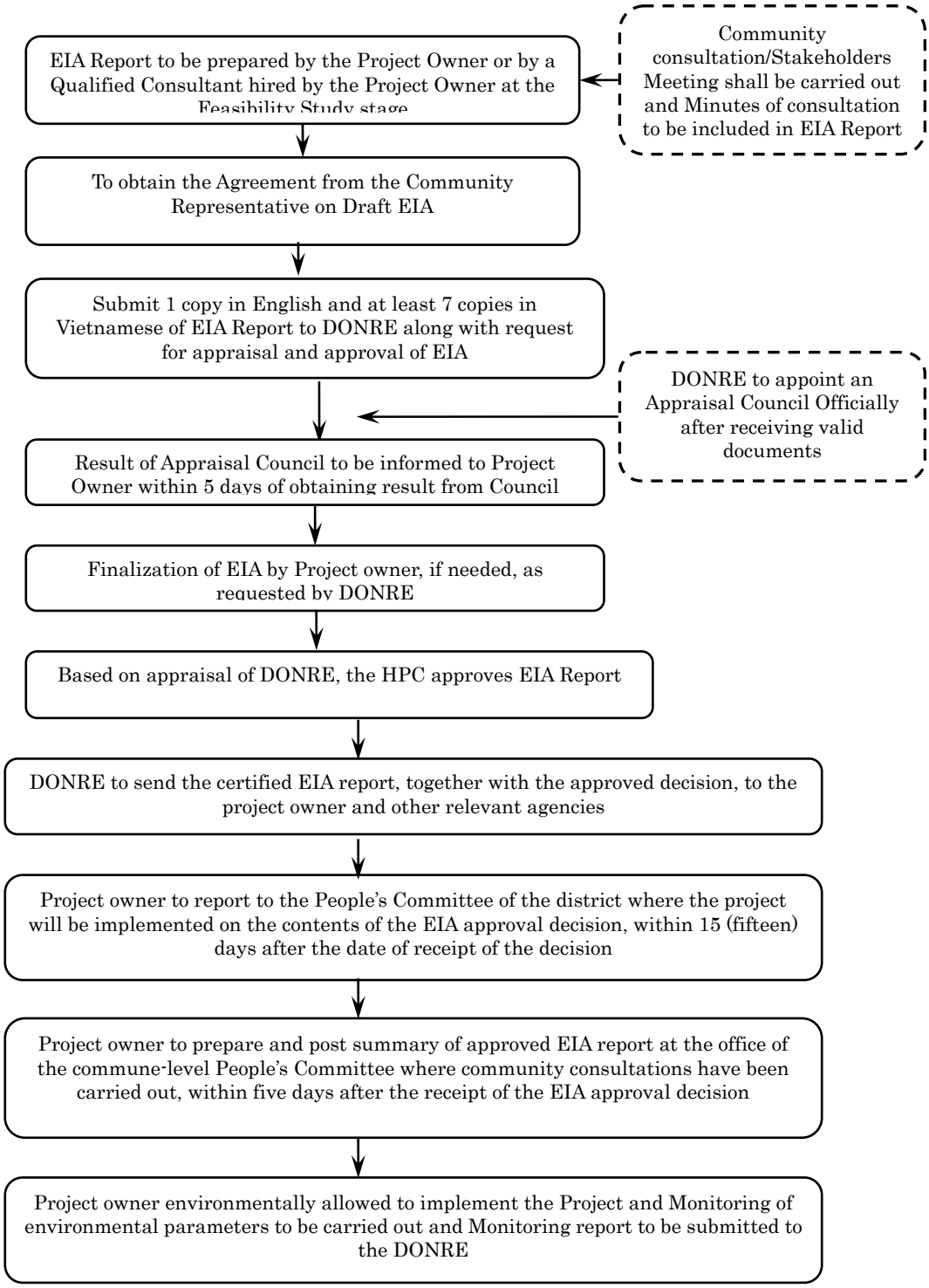
Decree No. 21/2008/ND-CP, issued in February 2008, details and guides the implementation of a number of articles of the law on environmental protection. In this Decree, a revised list of projects that require to prepare EIA reports is presented. According to this list, a project on exploitation of surface water with capacity greater than 50,000 m^3/day is required to prepare EIA report.

Circular No. 05/2008/TT-BTNMT was issued by MONRE to provide guidance related to Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment. Section III of this Circular describes about EIA and includes explanation on elaboration of EIA, community consultation, submission of documents for EIA appraisal, appraisal of EIA report by appraisal council, finalization of EIA report, re-appraisal of EIA reports, approval of EIA reports, certification and sending of approved EIA documents, responsibilities of project owner after EIA approval, responsibilities of approving agency after EIA approval, etc.

Proposed project in this Study includes construction of water treatment plant with a capacity of 150,000 m^3/day in the first phase and additional 150,000 m^3/day in the second phase and transmission pipelines for conveying treated water from the WTP to the off takes. The raw water for WTP is proposed to be withdrawn from Duong River. The amount of surface water that will be used in this Project is greater than 50,000 m^3/day, the limit defined in the list of projects provided in Decree No. 21/2008/ND-CP. Therefore, the project owner is required to prepare EIA report.

Based on the abovementioned laws and decrees and discussion with the organizations related to appraisal and approval of EIA, the procedure flow chart for EIA appraisal and approval is prepared and presented in Figure4.2.8.

Based on the discussion with the Hanoi Environmental Protection Agency of Department of Natural Resources and Environment (DONRE), the EIA report shall be submitted to the Special Department for EIA submission. According to the law, the EIA report shall be prepared at the feasibility study stage of the Project by the project owner or any competent consultant hired by the project owner. For this project, the EIA shall be appraised by the DONRE and based on the appraisal report of DONRE, the Hanoi People's Committee (HPC) shall approve the EIA. However, if the Project needs the approval from the Prime Minister, the EIA for this Project shall be appraised and approved by the Ministry of Natural Resources and Environment (MONRE).



Source: Based on the interview with the Hanoi Environment Protection Agency and Circular No. 05/2008/TT-BTNMT

Figure 4.2.8 Law-based EIA Appraisal and Approval Procedure

(19) Project Approval Procedure

Before the start of the implementation of the Project, approval of several permissions and registrations are required in case of Viet Nam. These approvals include Registration for land use, Registration for electricity supply, Water right registration, Permission for occupancy of intake facilities, Permission for discharge to water body, Permission for construction and the Final approval for project implementation. A procedure flow chart is prepared and presented in Figure 4.2.9.

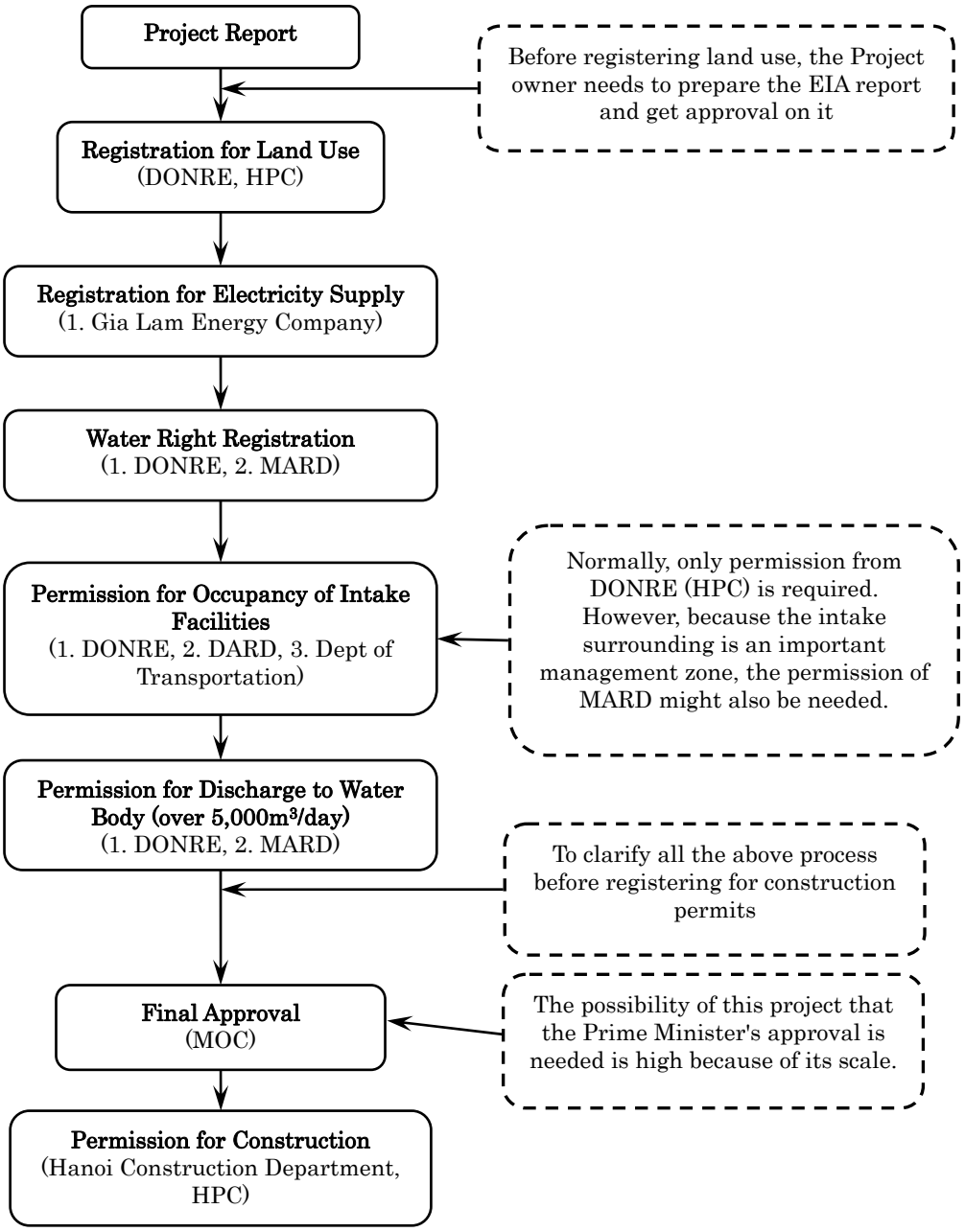
Several different organizations are responsible for providing permissions and carrying out registrations and the project owner should apply to these agencies for obtaining such approvals. These permissions and registrations are explained below.

It is important to mention here that to optimize the time, application procedures for multiple numbers of permissions or registrations could be taken up simultaneously. However, before obtaining the permission for construction, all the registrations and permissions should be obtained. Also, Final Approval must be obtained from the Ministry of Construction before obtaining the permission for construction from Hanoi Construction Department, HPC.

1) Registration for Land Use

The office of general plans is responsible for processing the registration of land use. For this purpose, the project owner should submit relevant documents (mentioned in Figure 4.2.10) along with the project report, investment permission from Department of Planning and Investment, decision of project approval from head of project owner, Agreement from HPC, etc.

If the submitted documents are found to be as per requirement, DONRE officially announces the Project area boundary and decision for land clearing. The local government related to the project area discusses with the landowners and HPC if necessary to decide the land prices based on the officially announced rates. Minutes of all the meetings are prepared while negotiation. Final price is announced and the price is paid by the Project owner. After local government reports completion of land clearing, DONRE reports to HPC for decision on land acquisition and decision to hire the land. Project owner pays the money to hire land and land use permission is issued by DONRE (on behalf of HPC) to the Project owner.



*HPC:	Hanoi People's Committee
*DONRE:	Department of Natural Resources and Environment
*MARD:	Ministry of Agriculture and Rural Development
*DARD:	Department of Agriculture and Rural Development
*MOC:	Ministry of Construction

Figure 4.2.9 Procedure of Project Approval

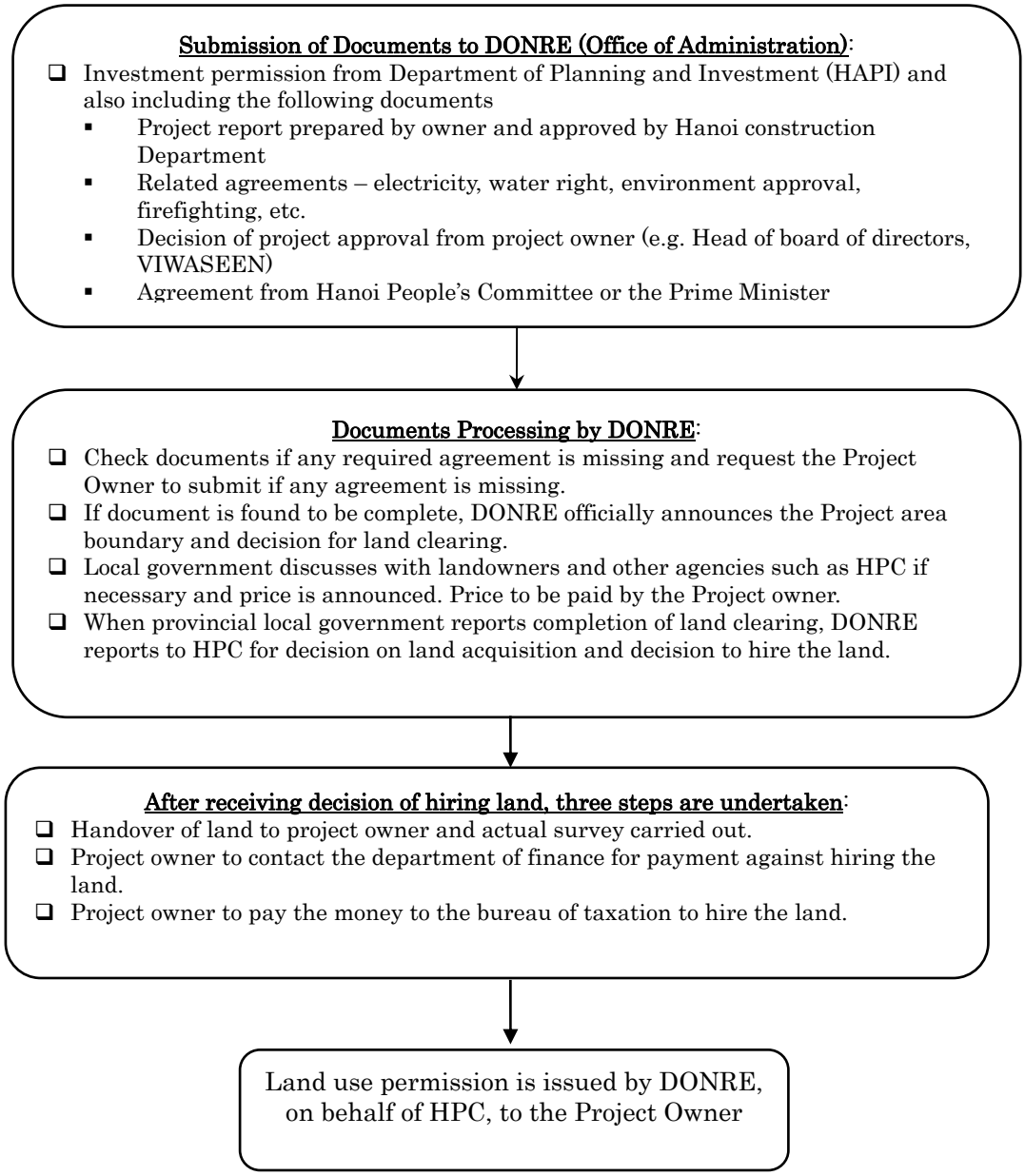


Figure 4.2.10 Procedure of Land Use Registration

2) Water Right Registration and Permission for Discharge to Water Body

In Viet Nam, according to Decree No. 149/2004/ND-CP and Circular No. 02/2005/TT- BTNMT, permission is needed for the exploration, exploitation and utilization of water sources and discharge of wastewater into water bodies. According to the law, the Ministry of Natural Resources and Environment is responsible to issue, extend, amend, terminate and revoke permits for extracting and using surface water more than 50,000 m^3/day, for purposes other than agriculture, and for wastewater discharge into water bodies at rate of 5,000 m^3/day or higher. Based on the discussion with the Department of Natural Resources and Environment (DONRE), the application for obtaining permission of water utilization and discharging into river in case of this Project is to be submitted to DONRE for approval. Office of Water Resources and Hydrometeorology within DONRE is responsible division for processing the water right registration and permission for discharge to water body.

Department of Natural Resources and Environment is the implementing agency of the MONRE at provincial and city level and reports directly to the related provincial People's Committee.

3) Permission for Occupancy of Intake Facilities

Under this project, the intake pipes and pumps are to be installed within the embankment zone (floodplain zone) of Duong River. Also, the raw intake pipes and transmission pipes are to cross the dikes/embankments along Duong and Hong rivers. Therefore, permission shall be needed from the DONRE and Department of Agriculture and Rural Development (a provincial level office of MARD).

4) Registration for Electricity Supply

For operation of intake pumps, equipment at WTP, and transmission pumps, large amount of electricity shall be needed. Therefore, processing of registration for electricity supply should also be made at the Gia Lam Energy Company.

5) Final Approval of Project Implementation

Final approval on project is obtained from the Ministry of Construction (MOC). The Administration of Technical Infrastructure (ATI) is relevant department in MOC that takes care of obtaining the final approval of project from MOC. The Project owner submits the request to the MOC and the ministry requests ATI to process it before granting approval. The approval letter is finally signed by either

the Minister or the Deputy Minister. Based on the discussion with the ATI, procedure flow chars is prepared and presented in Figure 4.2.11.

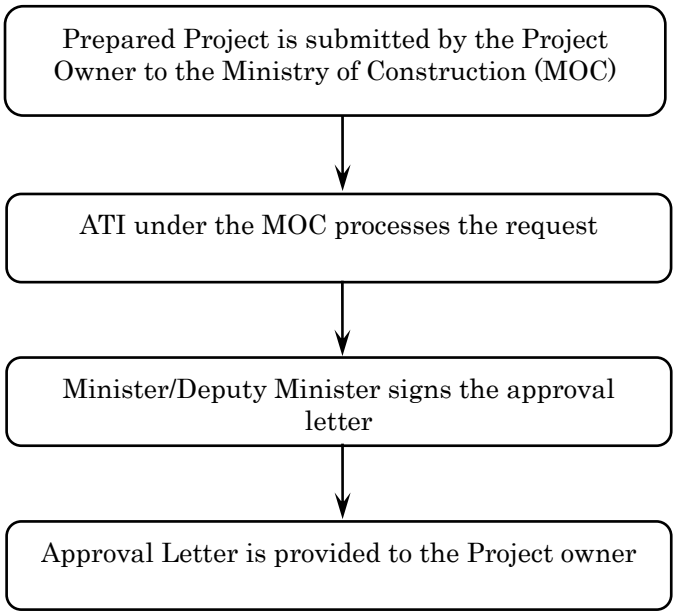


Figure 4.2.11 Procedure for Obtaining Final Approval

6) Permission for Construction

Hanoi Construction Department (HPC) is responsible for providing permission for construction of facilities. Office of Construction Permission and Management under the Hanoi construction department is responsible for processing the application. After obtaining the permission for construction, the constructions works for project can be started.

4.3 Project Description

(1) General

Rapid economic and industrial growth in Greater Hanoi has also resulted into accelerated increase of population in the metropolis. The population of Greater Hanoi has increased to about 6.5 million in 2009. However, provision of services and utilities including water supply has not been able to keep in pace with the rising population. There is lack of adequate water supply facilities which has resulted into poor level of water supply services.

(2) Existing Situation of Water Supply System

Water supply service in the projet area is as mentioned in "3.2.3 Overall Conditions of Water Supply Business in the Research Target Area".

(3) Project Objectives

The overall goal of this project is to improve quality of life through improvement in water supply services in Hanoi, Bac Ninh, Hai Duong, and Hung Yen areas, to cater to the increasing needs of domestic and industrial demands. Also, the objective is appropriate water resources management by moving from groundwater to river water sources. This can be achieved through construction of additional water treatment facilities using river water as raw water source. It is expected that outcome of this Study will be used for facilitating implementation of construction of water treatment facilities, transmission pipelines, and off takes. To accomplish these goals and objectives, this Study is undertaken in order to prepare project components to provide an additional capacity of 300,000 m^3/day of treated water in two phases. The proposed project shall include project cost and implementation plans and evaluation of the project. As a part of this Study, it is also required to prepare Environmental and Social Consideration report which can be used by the VIWASEEN to prepare EIA report and submit to DONRE/MONRE for its approval before implementation of proposed project activities.

(4) Description of Proposed Project

To improve the existing level of water supply services, the components of proposed project include water treatment facilities with a total capacity of 300,000 m^3/day, transmission pipelines, and six off takes. The facilities proposed to be constructed for water treatment include intake, raw water pumps, dividing wells, flush mixing tanks, flocculation tank, chemical sedimentation tanks, chlorine mixing tanks, rapid filter, chemical dosing facilities, clear water reservoir, water transmission pump, wash water drainage basin, sludge basin, thickener, sludge drying beds, electrical and instrumentation facilities, effluent pump, effluent channel from WTP to river, and administrative building. In addition, transmission pipelines with a total length of about 130 kms and off takes at six locations shall be constructed. The information on these facilities is presented in Table 4.3.1 and Table 4.3.2 below. Location map of main facilities in this Project is presented in Figure 4.3.1. The layout plan for proposed water treatment facilities is shown in Figure 4.3.2.

Table 4.3.1 Proposed Components Under this Project

Facility	Area (ha)	WTP	SR	Pump	Pipe	Major activities
1. Intake Facilities				●	●	・ Construction of intakes structures including Grit chamber, water intake pumps, and intake pipes ・ Operation and maintenance of intake pumps
2. Construction of new WTP with Total Capacity of 300,000m^3/day		●	●	●	●	・ Construction of WTP including dividing well, Flush mixing tank, Flocculation tank, Chemical sedimentation tank, Intermediate chlorine mixing tank, Chlorine dosing house, Rapid filter, Chemical dosing facilities, Clear water reservoir, Water transmission pump, Wash water drainage basin, Sludge basin, Thickener, Sludge drying beds, Electrical and instrumentation facilities, effluent pump, effluent channel from WTP to River, and administrative building. ・ Operation and maintenance of the treatment facilities
3. Water Transmission Facilities (Total length about 45km)			●	●	●	・ Construction of transmission pipelines crossing Rivers at 2 locations ・ Operation and maintenance of pipes
4. Off takes at 6 locations					●	・ Installation of pipelines, valves, and bulk water meters ・ Operation and Maintenance of off takes

Table 4.3.2 Information on Proposed Sites for Facilities Under this Project

No.	Facility	Location	Dimensions/Area of Location Required
1.	Intake Facilities	Gia Lam	
2.	Construction of new WTP (Capacity 300,000m^3/day)	Gia Lam	
3.	Water Transmission Facilities (Length about 45km)	– Bac Ninh: Tien Du, Tu Son – Hanoi: Gia Lam, Long Bien, Hoang Mai – Hung Yen: Van Giang	
4.	Off takes at 6 locations	1. Lim (Bac Ninh) 2. Duong Dinh (Gia Lam, Hanoi) 3. Tran Quy (Giam Lam, Hanoi) 4. Sai Dong (Long Bien, Hanoi) 5. Van Giang (Hung Yen) 6. Phap Van (Hoang Mai, Hanoi)	

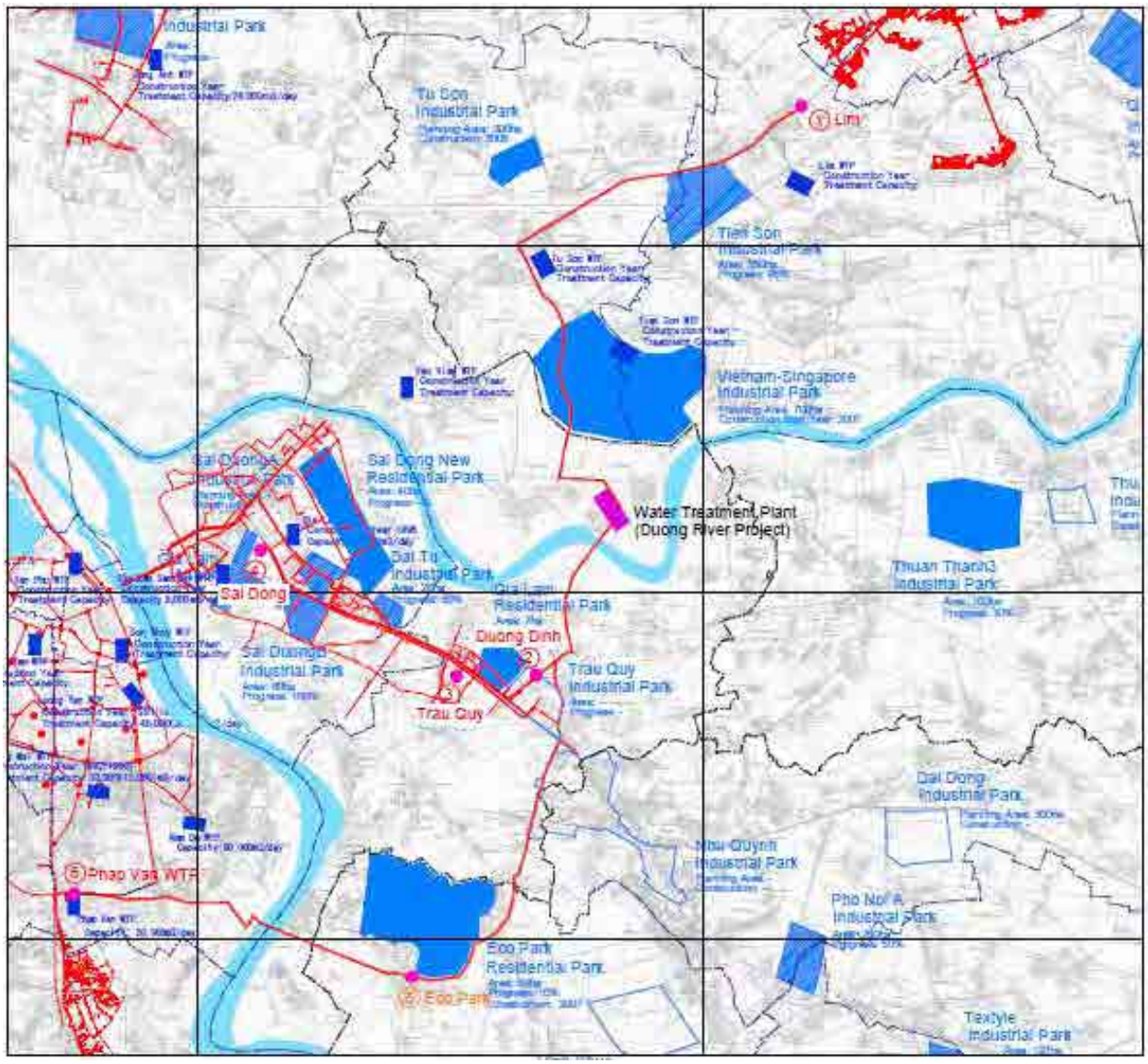


Figure 4.3.1 Location Map of Main Facilities Proposed in this Project

Total areal extent of 58.23 ha shall be required for the construction of water treatment facilities and about 15 ha for the laying of transmission pipelines. The land proposed for construction of water treatment facilities and some part of the proposed land for transmission pipelines is owned by the private owners. Therefore, land acquisition shall be required for the construction of the facilities under this Project. Some of the photographs showing proposed locations of intake, WTP, effluent channel, transmission pipelines, and off takes are presented in Figure 4.3.3 to Figure 4.3.6.

Figure 4.3.2 Proposed Water Treatment Facilities

4.4 Baseline of Environmental Data

(1) Physical Environment

Hanoi is the second largest and capital city of Viet Nam. The city has long been a center of political and cultural activities in Viet Nam. In past, Hanoi was located on the right bank of Hong River, however, now the urban agglomerates extends on both sides of the River. Hanoi is divided into 10 inner districts, 1 town and 18 suburban districts. It extends over an area of about 3,345 km^2 and has a population of approximately 6.47 million with population density of 1935 persons/km^2.

Hanoi is the economic center of Viet Nam. Industrial production in the city has experienced a rapid boom since the 1990s, with average annual growth of 15-20% during last two decades. As a whole, in Viet Nam, Agriculture contributes about 20% of Gross Domestic Product (GDP) and Industrial and Services sectors contribute about 40% each. The economic development and growing population has fueled rapid construction in the city. Rapid growth in population (almost 3.5% per year) has surpassed well ahead of city services and resulted into lack of adequate services in terms of homes, roads, electricity, telephone, water supply, and sewerage, etc. However, Hanoi has the highest Human Development Index among the cities in Viet Nam.

(2) General Description of Project Area

In general, the water supply projects are expected to have positive impacts in terms of improvement in water supply services in the project area and also with respect to improvement in the living environment in and around project area. However, it is important to envisage and analyze any potential negative impacts that could be caused by implementation of the project during pre-construction, construction and operation stages and to implement measures in order to mitigate negative impacts due to proposed project components.

There are two areas that are expected to experience minor adverse impacts by implementation of proposed project. Hence, in principle, these areas are set as the Scope of Study for preparation of this report. These areas include:

- The proposed site of water treatment and its supplementary facilities under this Study (the proposed area in Gia Lam, Figures 4.3.1 and 4.3.7)
- The sites proposed for alignment of transmission pipelines and off take points.

The baseline data is collected using the available data for Hanoi or the data for a relatively broader area in case when data for Hanoi is not available. Based on the collected information, in this part of the Study, the baseline data is described under the following categories.

- Physical Environment : Topography, Climate, and Pollutions (Water Pollution, Air Pollution, Noise)
- Biological Environment: Protected Area, and Flora & Fauna
- Socio-economic Environment: Population, Socio-economic indicator, Public Health, Cultural Heritage, Transportation

The area proposed for construction of water treatment facilities is located in Gia Lam in the northeastern part of Greater Hanoi away from the populated city area. The transmission pipelines and off take locations shall be located in the northern part of Duong River and in the central part of Greater Hanoi. The pipelines shall be aligned mainly along the roads and six off takes shall also be located near the roads in areas that are currently either fallow land or farming land.

(3) Topography

1) Topographical Feature

① Proposed Location of WTP in Gia Lam

The following are salient features related to topography of the area around the proposed location of water treatment plant in Gia Lam.

- Proposed site for water treatment plant is located in Gia Lam, in northeastern part of Greater Hanoi and to the north of Duong River.
- The topography of the land is relatively flat (altitude ranging from 4-8 m) and surrounded by road on the north side. Towards the eastern and western side of this area, there are some houses. To the south lies the Duong River and dikes on the river.
- The effluent from sludge lagoons in the WTP is to be discharged through channels into Duong River downstream of the intake location.

In the neighborhoods of the proposed location of WTP, there are a number of houses on the east, west and southwestern side of the site. At present, proposed site for WTP is occupied by farming lands. In these fields, rice is grown twice a year when plenty of water is available and in some of the fields vegetables are also grown during dry season. Also, the proposed site, for laying of raw water pipelines from Duong River to the location of WTP, is farming land in which rice is grown currently. These farming lands are owned by the private landowners and land acquisition will be required before the implementation of the Project. In some of these fields, few individual graves exist in present condition. Altogether, about 50 small graves are present including the very old earthen graves. The relocation of these graves shall be required at the stage of land acquisition and before land clearance.

② Transmission Pipelines

Main points related to topography in the areas where pipelines are to be laid are listed below.

- The transmission pipeline from WTP is proposed to be laid towards Tien Du, Tu Son areas of Ban Ninh (in north and east of WTP).
- Transmission towards south of Duong is to cross the embankments on Duong River and then pipe is to be laid towards south. On the way, one branch is to be laid towards west for carrying water to off takes proposed to be located in Duong Dinh, Tran Quy, and Sai Dong.
- The pipeline going towards south is to supply water to the off take point that is proposed to be located in Van Giang and after crossing Hong River to the off take point in Phap Van.
- At two locations, the transmission pipelines are proposed to cross rivers, one at Duong River and the other at Hong River. For crossing the rivers, pipe shall be laid through trenchless technology.
- The elevation in areas where pipelines are to laid varies from 3-12 m and the topography is almost flat except when Rivers and streams exist.

In most of the cases, the transmission pipelines are proposed to be laid underground either along the road or under the roads. Some of the stretches near Duong River and Hong River, where the pipelines is proposed to be laid, is occupied by the farming lands growing vegetables such as cabbage, etc. and fruits such as banana. These lands are owned/rented by the private owners. Therefore, land acquisition shall be required for these cases. For those parts, where pipelines is proposed to be laid along or under the roads, in some stretches, the houses are located close to the roads and appropriate measures will be required during construction to minimize disturbances.

③ Off take Points

Main points related to topography in the area where off takes are to be located are listed below.

- Off take 1 is located in Lim area of Bac Ninh beside the road and the location is mainly occupied by rice fields now. The area has almost flat topography and the elevation varies from 5-7 m in the area.
- Off take 2 is located near the gas station in Duong Dinh area of Gia Lam, Hanoi and the proposed area is either fallow or used for rice cultivation. The proposed area is flat with elevation ranging 5-7 m.
- Proposed site for off take 3 is located in Tran Quy area of Gia Lam, Hanoi and is presently a small pond having a lot of water hyacinth. The topography of the area is flat with elevation from 3-4 m.
- Off take 4 location is situated in Sai Dong area of Long Bien, Hanoi near the Helipad site and mainly occupied by the rice fields. There is also a big drain flowing nearby. Also, a big size pipeline exists in the area. The topography of the area is almost flat with elevation ranging 8-9 m.
- Off take 5 is located in Van Giang area of Hung Yen and is a part of industrial zone to be developed soon. The topography of the area is almost flat.
- Off take 6 is proposed to be located in Phap Van area of Hoang Mai, Hanoi.

(4) Climate

Hanoi experiences a warm humid subtropical climate with high precipitation. The city experiences typical climate of northern Viet Nam, where summers are hot and humid, and winters are relatively cool and dry. The project area experiences summer during May to September, which is relatively hot and humid, and majority of the annual rainfall (about 1,680 mm) occurs during this period. The winters are usually short and are relatively dry, and mild. In spring, light rain may occur.

The meteorological data in Hanoi is shown in Table 4.4.1 and Figure 4.4.1. This data is the average value based on the webpage of World Meteorological Organization. The outline of climate in this area is described based on this data.

1) Temperature

In the hottest of the summer months - June, July, and August - the average daily maximum temperature is 32.5°C, and the average daily minimum is 25.8°C. The average daily maximum temperature during December-February is about 20°C, and the average daily minimum is 14°C. Hence, in winter it is not very cold.

Table 4.4.1 Climate Data for Greater Hanoi

Months	Average High Temperature (°C)	Average Low Temperature (°C)	Relative Humidity (%)	Monthly Rainfall (mm)
January	19.3	13.7	72	18.6
February	19.9	15.0	84	26.2
March	22.8	18.1	82	43.8
April	27.0	21.4	82	90.1
May	31.5	24.3	81	188.5
June	32.6	25.8	74	239.9
July	32.9	26.1	79	288.2
August	31.9	25.7	78	318.0
September	30.9	24.7	76	265.4
October	28.6	21.9	75	130.7
November	25.2	18.5	66	43.4
December	21.8	15.3	73	23.4

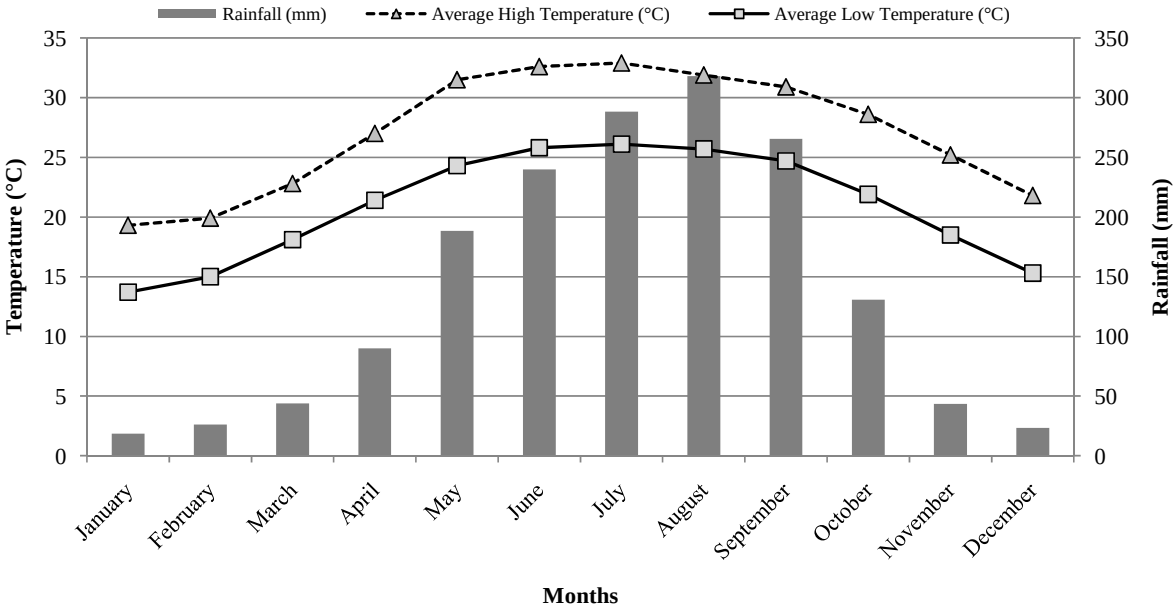
Source: World Meteorological Organization webpage

2) Relative Humidity

The average minimum and maximum of humidity is 66% and 84%, respectively. As a general trend, the relative humidity is high in winter and drops to the minimum at the end of summer and beginning of winter in November and December.

3) Rainfall

Based on the data presented in Table 4.4.1, it is observed that average monthly rainfall lies in the range of 18-318 mm. Average annual rainfall is about 1,680 mm. Usually, the rainy season starts in May and ends in October. During the period of highest rainfall, within duration of three months (July-September), the total rainfall is about 900 mm which is more than 50% of the total annual rainfall.



Source: World Meteorological Organization webpage

Figure 4.4.1 Rainfall and Temperature Data for Hanoi

4) Wind

On average, in winter, the wind blows from north and northeast and in summer the wind blows from southeast and south. The wind speed is about 1.5 to 2.5 m/s in Hanoi and its neighborhoods.

5) Evaporation

The seasonal variation in amount of evaporation is influenced by humidity, wind and precipitation. It has been observed that evaporation is small in the months of February, March, and April (about 2 mm/day). It has a tendency of becoming higher in summer and the maximum of average daily evaporation is 3-4 mm/day in June and July. Hence, there is not much of variation in daily evaporation.

(5) Water Pollution (Surface Water and Groundwater)

The existing status of water pollution in the project area is described under the heads of surface water and groundwater.

1) Surface Water Quality

Rapid urbanization and industrialization has resulted in growing demand for water uses. Many rivers run through Hanoi. Red River runs across the city and provides as a source of irrigation and water for domestic purposed and is also used as a means of transportation. Duong River is the second largest river in Hanoi. It is used for transportation and it supplies water for agricultural production and as a source of domestic water supply after treatment.

High levels of pollution have been reported in four streams passing through Hanoi including Kim Nguu, To Lich, Set and Lu attributed to the discharge of untreated wastewater both from industrial and domestic sectors. According to the State of Environment in Viet Nam, rivers are also found to be polluted with substances like Nitrogen and Phosphorus.

2) Groundwater

Most of the WTPs in Hanoi are of small capacity and use groundwater as water source. Due to increased demand and excessive utilization of groundwater for drinking and industrial purposes, severe deterioration in water quality has been observed in many areas. Decrease in groundwater level has resulted into increased salinity.

Investigations have been made by the UNICEF, and Hanoi University on level of groundwater contamination in Hanoi and nearby. Based on the reports that groundwater is contaminated in the area due to presence of ammonia, manganese, iron and arsenic. Based on the result of the UNICEF report, the level of arsenic contamination in groundwater in Red river basin is presented in Table 4.4.2. From the Table, it can be observed that even in case of wells in Hanoi, of the 824 wells sampled, in 23.3% cases the arsenic level exceeded 0.05 mg/L and in 49.3% of

wells sampled, the arsenic level exceeded 0.01mg/L.

Considering these factors, the Vietnamese Government is planning to move towards utilization of surface water rather than groundwater, for providing water supply services.

Table 4.4.2 Situation of Arsenic Pollution in Groundwater in Red River Basin

Item	No. of Sample	More than 0.01mg/L		More than 0.05mg/L	
		No. of Sample	%	No. of Sample	%
Hanoi	824	414	49.3	199	23.3
Ha Tay	1368	638	46.6	338	24.7
Hung Yen	3384	700	20.7	310	9.2
Ha Nam	7042	4517	73.4	3534	62.1
Nam Dinh	605	156	21.3	104	13.8
Ninh Binh	75	26	34.7	8	10.7
Thank Hoa	347	17	4.9	17	4.9

Source: UNICEF(2004)

(6) Air Pollution

Air quality in urban centers of Viet Nam is deteriorating in line with increased urbanization and industrialization. Most of the urban areas in Viet Nam are polluted by particulate matters (PM_{10}). In most urban centers, the average value of SO_2, CO, NO_2 concentration is lower than or approximates the acceptable limit. However, near the industrial areas sometimes, the values of SO_2 exceed the limit. With the increasing number of motorbikes and automobiles, transport waste has now added to the air pollution in Hanoi.

In Hanoi, the air quality is measured hourly at some monitoring stations. DONRE Hanoi is a lead agency mandated to regulate and manage air quality in Hanoi. Data based on the Lang monitoring station in 2007 is presented in Table 4.4.3 including the hourly average concentration of air quality parameters. However, during the congestion in streets of Hanoi, the air quality becomes worse.

Table 4.4.3 Monthly Average Concentrations in 2007 in Hanoi

($\mu g/m^3$)

Month	PM_{10}	NO_2	SO_2	CO	O_3
January	141.0	26.38	24.26	728.68	14.54
February	144.6	18.95	19.07	569.85	18.75
March	132.4	17.09	14.05	581.68	18.99
April	138.4	19.32	16.86	413.52	29.5
May	129.8	10.41	8.92	382.03	27.57
June	140.8	7.78	8.47	335.88	42.59
July	129.9	7.63	8.47	313.72	41.06
August	149.9	12.06	8.29	377.88	43.14
September	160.6	26.25	6.03	530.42	43.92
October	152.9	23.88	8.26	522.57	43.08
November	155.5	39.14	26.03	738.92	23.54
December	141.1	37.62	16.90	489.65	18.13

Source: Urban Air Quality Modeling and management in Hanoi, Vietnam, Phd Thesis, Ngo Tho Hung

(7) Noise

The acoustic environment in Hanoi is characterized by high noise levels mainly due to transport movements, construction activities, industry and daily living activities. Noise levels are relatively high throughout the day and night. Typical daytime noise levels in residential areas are 75-78 dB(A) and can reach 80-85 dB(A) near the major roads.

It has been reported based on monitored data on major roads in Hanoi that average noise levels during the daytime varies in the range of 64-80 dB(A) and during the evening it is in the range of 67-73 dB(A). This indicates that in most cases the noise levels are exceeding the maximum limits defined by TCVN 5949: 1998. Even near the locations of the educational institutions, the noise levels have been reported to be very high.

(8) Biological Environment

1) Protected Areas in Viet Nam

In Viet Nam, protected areas are designated in a variety of different ways. Special-use Forests (SUF) is commonly perceived as protected areas and include national parks, nature conservation areas (nature reserves and species/habitat conservation areas), and landscape conservation areas. There are 126 approved SUFs comprising 28 national parks, 48 nature reserves, 11 species/habitat protected areas, and 39 landscape-protected areas.

Also, there are 4 sites designated as World Heritage Sites: Ha Long Bay, My Son sanctuary, Hoi An ancient town, and Complex of Hue monuments. Two sites are designated as Man and Biosphere Reserve: Can Gio mangroves and Cat Tien.

There is one site designated as Wetlands of International Importance (Ramsar) which is Xuan Thuy Ramsar Reserve.

In addition, 68 sites have been proposed as Wetland Protected Areas, and 15 areas have been proposed as Marine Protected Areas.

A map showing protected areas around Hanoi has been shown in Figure 4.4.2.

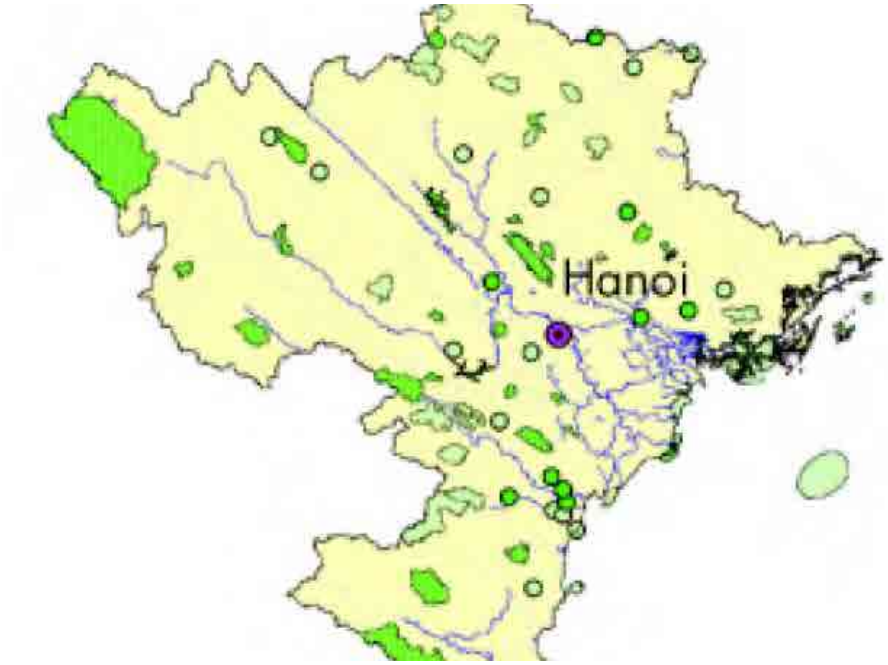


Figure 4.4.2 Protected Areas in around Hanoi

No protected areas exist in or near the proposed sites for project activities. Therefore, the project activities are not expected to have any impact on protected areas.

2) Existing Situation of Flora and Fauna

① Proposed Site of WTP in Gia Lam

Proposed location of WTP is occupied by the cultivated lands and in the present situation farming is practiced. The farmers mainly grow rice and vegetables in the fields. The effluent channel, to discharge supernatant from sludge settling basins, is proposed to be aligned along road from location of WTP to Duong River. Also, the raw water pipeline is to be laid in areas where farming is practiced. With the construction of the WTP and related facilities, these farming lands will be converted to location of facilities. However, any rare species of flora or fauna does not exist in the proposed area of WTP facilities. Therefore, project construction and operation activities are not expected to have any significant impact on flora or fauna. Moreover, after construction of facilities, plantation could be again undertaken along the boundary of the WTP complex and wherever possible.

② Transmission Pipelines

Major part of transmission pipelines is proposed to be aligned along roads, either under the roads or underground beside the roads. Some stretch of transmission pipelines is proposed to be laid in areas currently occupied by cultivated lands. In the fields in such areas, cabbage, banana, and other vegetables are grown seasonally. In the proposed area no rare species of flora or fauna occurs. Therefore, it is judged that proposed project shall not have negative impact on any flora and fauna in the proposed area for transmission pipelines.

③ Off take Points

In this Project, six off takes are proposed. Presently, the proposed areas of off takes are occupied either by cultivated land, or fallow land. In case of proposed site for off take 3, there exists a small pond which has water hyacinth. In most of the cultivated areas among proposed sites for off takes, presently rice is grown. Therefore, it is judged that there are no flora and fauna which should be considered to have potential negative impact at the sites of off takes.

(9) Socio-Economic Environment

1) Population

The population of Greater Hanoi is estimated at about 6.5 million. Average population density in 2009 is reported as about 2,000 persons/km^2, although the population density in core area of metropolis is considerably high.

The ethnic groups representing population in Hanoi include Kinh, Tay, Chinese, Muong, Nung, Thai, Dao, San Diu, San Chay, H'mong, Gia Rai and Khmer.

2) Socio-economics of Hanoi

The salient features of the socio-economic conditions in Hanoi are described below.

- GDP per capita (per capita gross domestic product) of Hanoi (USD 1,950) is almost about twice compared to the national average value (USD 1,052).
- The economy of Hanoi is mainly contributed by services, industrial and construction sectors (almost about 98.5%) and only 1.5% is contributed by agriculture sector.
- In Hanoi, the workforce comprises about 56% in tertiary sector and about 22% in primary and secondary sectors each. However, on national level, workforce in primary sector is dominant.
- The poverty ratio of Hanoi in 2008 was reported as 2.4%, which was lower compared to national average (13.4%) and value for Red River Delta (8.6%).
- The unemployment rate in Hanoi is still around 6% and is high compared to the national (4.65%) and Red River Delta (5.35%) figures.
- The condition of service level in health sector in Hanoi is better than the national average.

3) Public Health

Hanoi being c apital city and experiencing rapid urbanization and industrial development, is a densely populated city. The city faces several health issues including communicable diseases, issues related to the urban lifestyle and rapid socio-economic development. The data on basic health indicators have been reported as follows:

- Average life expectancy is about 76 years
- In 2004, infant mortality was reported to be 5.3% and corresponding value for children under 1 and 5 years of age was reported as 8.5% and 9.8%.

In the city, cases of respiratory diseases occur due to high level of air pollution, especially among the population living near the roads. The occurrence of diseases such as diarrhea, cholera, dysentery, dengue fever, hepatitis, etc., has also been

reported.

4) Cultural Heritage

Hanoi is rich in cultural and historical heritage despite rapid development and land use changes. There are numerous heritage structures throughout city, many of which are located around the traditional ancient quarter of Hanoi north of Hoan Kiem Lake, the ancient citadel complex and the Temple of Literature complex to the west. In addition, several pagodas and temples have been constructed recently located in the suburbs and outskirts of city. The Temple of Literature is a significant heritage that has been declared a World Heritage site in 2010.

5) Transportation (Access Road to WTP in Gia Lam)

Proposed site for construction of WTP is located in Gia Lam. An access road exists near the proposed site of the WTP. The width of the road is about 7m, and it is paved road of single-sided one lane. On both sides of the road, mainly cultivated lands exist. However, at some locations there are some residences.

It was observed that some big size trucks use the road, going through proposed WTP area, for carrying sand from Duong River to be used at construction sites in the city. Although, exact information on number of such large vehicles passing through this road is not available, these vehicles are not very frequently observed on this road.

Pedestrian are still very low in number with few small vehicle users. However, especially during the construction stage, traffic control is required for safe and smooth traffic. Also, caution shall be required while large and heavy vehicles are passing each other.

4.5 Impact Identification and Mitigation Measures

(1) Overall Impact Identification and Scoping Matrix

The first step in EIA is to identify potentially significant impacts due to implementation of proposed project components. The various aspects considered in impact identification of the project are as follows:

- Project components
- Project stages
- Impact generating activities
- Type of impact

Considering these factors, a matrix table has been used to identify the overall impacts. The matrix thus identifies the environmental parameters likely to be affected, and the activities responsible for this. The matrix for pre-construction stage, construction stage, and operation stage is shown in Table 4.5.1. For various activities, the scoping includes identification of impact on social, natural and pollution parameters. In the scoping matrix, the level of impact have been rated as A, B, or C depending on their degree of impact varying from serious to very low or unknown, respectively. The sign "+" and "-" have been used after these ratings to indicate the higher and lower strength, respectively.

Table 4.5.1 Result of Scoping for Project Components

Impact Items				Impact Factors by Stages																
				Pre-Construction		Construction									Operation					
	No	Likely Impacts	Overall Rating	Land acquisition/Compensation	Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation/Land Clearance	Alteration to ground by cut land, filling, etc.	Operation of Construction Equipment and Vehicles	Construction of Treatment facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	Construction of pipelines	Increase of Water supply	Increase of Discharged Water	Appearance/ Occupancy of Facility and related building structures	Operation of Treatment Facility	Operation of Off takes
Social Environment	1	Resettlement (or Loss of Properties)	B-	B-	B-		B-											
	2	Local economy such as employment and livelihood, etc.	B+	B+														
	3	Utilization of land and local resources	B-				B-	B-										
	4	Social institutions such as social capital and local decision-making institutions																
	5	Social infrastructures and services																
	6	Poor, indigenous and ethnic people (inclusive IDPs and refugees), gender and children rights																
	7	Misdistribution of benefits and damages																
	8	Cultural heritage (ex. Burial grounds)	B-	B-														
	9	Local conflict of interests																
	10	Water Usage, Water Rights or Common Rights																
	11	Sanitation	B												B			
	12	Hazards (Risks) Infectious diseases	B												B			
	13	Accidents	B						B		B		B					
Natural Environment	14	Topography and Geographical features																
	15	Soil Erosion																
	16	Underground water																
	17	Hydrological Situation																
	18	Coastal Zone																
	19	Flora, Fauna and Biodiversity	B-				B-											
	20	Meteorology																
	21	Landscape	B													B		
	22	Global Warming																
Pollution	23	Air Pollution (dust)	B					B	B	B							B	
	24	Water Pollution	B					B-							B		B	
	25	Soil Contamination																
	26	Waste	B							B							B	
	27	Noise and Vibration	B					B	B	B			B-				B-	B-
	28	Ground Subsidence																
	29	Offensive Odors																
	30	Bottom sediments																

Rating: A: Serious negative impact is expected. B: Some negative impact is expected. C: Extent of impact is unknown (Examination is needed. Impacts may become clear as study progresses.) No Mark: Little impacts are expected and IEE/EIA is not necessary. +: the strength of impact is bigger; - the strength of the impact is smaller.

(2) Foreseeable Adverse Impacts of Project at Various Stages

The implementation of Project is expected to have several positive impacts. During the construction and operation stages, working opportunities will be generated. In the operation stage, the project will facilitate supply of clean and hygienic water to citizen of Greater Hanoi in areas that are still not covered by water supply services. The provision of clean water will also result into reduction of waterborne diseases such as cholera, diarrhea, typhoid and skin and eye diseases. However, the project may cause some negative impacts.

The level of negative impact due to Project activities is shown in Table 4.5.2. In general, the magnitude of negative environmental and social impacts of the project activities is not serious.

The adverse impacts have been classified under three categories, namely pre-construction stage, construction stage and operation stage. Impacts during pre-construction and construction stage may be regarded as temporary or short-term whereas those during operation stage are likely to have long-term effects.

1) Pre-Construction Stage

During planning stage, the most significant impact is expected in the form of land acquisition and land clearance. The proposed site of WTP and a part of the proposed site for transmission pipelines, and proposed sites for off takes is occupied by farming lands where the owner grow rice, vegetables and fruits or are fallow lands. The land will need to be acquired after appropriate compensation to the owners and upon the agreement of owners. In some of the rice fields at the location of the proposed WTP, there exist individual graves. These graves would require relocation upon agreement with the responsible persons. After acquisition, the land clearance will be required. Also, registration of land use will be required by the project owner.

2) Construction Stage

During the construction stage, the most significant impact will be in the form of generation of dust, and noise by the construction vehicles. Also, during cutting and filling of land some dust is expected to be generated. The dust, noise and vibration are also expected to be generated during the operation of construction equipment. The construction of pipelines is to be carried out along roads that are wide and sometimes narrow also and have heavy traffic during daytime. For laying pipelines, ditch will be dug, except in the cases of crossing rivers where trenchless method will be applied. Therefore, traffic problem is expected and proper traffic management and construction management are required to mitigate these impacts.

Table 4.5.2 Expected Negative Impact Level of Project Activities

Major activities		Impact level	Main reasons
Pre-Construction	1. Land acquisition (Compensation)	B+	Areas required for construction of water treatment plant (WTP) is extensive and are mainly farming lands used for growing rice and vegetables. Also, some part of transmission pipelines is proposed to cross through farming lands for growing vegetables and fruits. Proposed land for construction of off takes are either fallow lands or farming lands. The proposed land belongs to private owners. Land acquisition will be required from owners after payments of appropriate compensation. In addition, at the location of WTP, rice fields also include few scattered graves which will require to be relocated in agreement with the owners. The clearance of land will also be needed upon acquisition. Also, registration for land use shall be required before the start of implementation stage.
	2. Land clearance	B+	
Construction	1. Cutting and filling land	B-	Cutting and filling of land may cause dust which could affect the surrounding area.
	2. Operation of equipment and heavy vehicles	B-	Construction machines may cause noise, vibration, dust and traffic accidents.
	3. Influx of construction workers, construction of base camp	B-	Many workers will come to the project site. Most construction workers and technicians may be hired from the surrounding villages, and other areas. The increased chance of interaction may spread infectious diseases through interaction.
	4. Construction of pipelines along roads	B+	The construction of transmission pipelines shall be carried out mainly along roads that are wide, and sometimes narrow also. The roads have heavy traffic during daytime. For installation of pipes, ditch shall be dug and therefore construction management and traffic management will require due attention to avoid traffic problem and accidents during construction.
Operation	1. Increase of discharged water (Wastewater)	B	Improvement in water supply is expected to cause increase in wastewater discharged by users. The increase of discharged wastewater may cause deterioration of water environment of the receiving bodies and living environment. Discharged wastewater may also create a suitable habitat for malaria-infected mosquitoes even during dry seasons.
	2. Operation of treatment facilities	B-	Operation of water treatment plant and pump may increase the level of noise and vibration. The effluent from WTP is to be discharged into Duong river. Discharged solid waste from water treatment plant may cause negative impact through its dumping.

Note: A: Serious impact expected; B: Certain impact expected
+: the strength of impact is bigger; - the strength of the impact is smaller.

3) Operation Stage

During the operation stage of Project facilities, operation of water treatment plant and pumps may generate noise. During the operation of WTP, effluent shall be discharged into Duong River on daily basis and dried sludge from sludge drying beds will be periodically removed to landfill sites. Therefore, it is important to monitor the quality of the effluent and the dried sludge in order to avoid pollution of receiving bodies. Also, with the operation of water supply facilities in this Project, increase in water uses is expected to generate increased wastewater. In long run, if generated wastewater is not collected and treated appropriately, it might cause pollution of receiving water bodies (river, streams, etc.).

(3) Mitigation Measures for Adverse Impacts during Pre-Construction, Construction and Operation Stages

During pre-construction stage of the project, land acquisition and clearance will be required for the proposed site of the WTP and in case of some stretches of the transmission pipelines. Major part of the proposed land for WTP are cultivated land owned by private owners and mainly rice and vegetables are grown in these fields. The farmers will lose their land. The impact could be minimized by appropriate measures such as compensation and opportunities of work, etc.

At the construction stage, impacts could be in terms of noise, vibration, increased traffic, dust and solid waste disposal. All these impacts could be mitigated through proper mitigation management at construction stage.

During the operation stage of WWTP, major impacts could be in the form of noise, sludge disposal, and discharge of effluent from sludge basins. These impacts can also be mitigated through monitoring and implementing countermeasures.

The impacts have been discussed in the previous Section. Major impacts are not expected either at construction stage or operation stage and only minor impacts are envisaged. These impacts could be mitigated or minimized through measures undertaken during construction and operation stages of the proposed Project. These measures have been discussed in detail and presented in the following Table 4.5.3 and Table 4.5.4.

Table 4.5.3 Proposed Mitigation Measures during Pre-Construction and Construction Stage of the Project

Items	Impacts	Mitigation Measures
<Land Acquisition and Clearance>	Farmers will lose farming lands.	• List of land owners to be prepared by Project owner. • Land owners to be compensated by similar land if available, otherwise to be compensated by appropriate land price by the project owner • During construction of facilities, affected land owners could be provided opportunity to work as workers, if possible.
<Landscape>	No significant impact expected	• Installation of information desk to collect complaints from residents and neighborhoods.
<Air Pollution>	Generation of particulates and exhaust gases	• Dust control through water sprinkling at construction site • Preventive maintenance of construction machineries and vehicles • Attentive operation and speed restrictions of construction vehicles and equipment • Monitoring of air pollution parameter before and after project • Arrangement of information desk and deployment of responsible person
<Noise and Vibration>	Generation of noise and vibration from heavy vehicles and equipment	• Announcement of construction schedule and contents at site • Attentive operation and speed restrictions of construction vehicles and equipment • Monitoring of noise and vibration parameters
<Flora and Fauna>	Few trees might be required to cut in the proposed location along the alignment of the pipes	• Cutting of trees to be avoided as much as possible • In unavoidable cases, new trees to be planted after construction completes.
<Traffic/ Public Facilities>	Carrying in and out of materials/construction waste can result into possible adverse impacts on health, air pollution level, and noise and vibration along access road Construction of pipelines along busy roads can cause traffic problems and accidents	• Announcement and public notification concerning construction contents and its schedule • Assigning of watchman or traffic control staff • Education on traffic rules for construction workers, drivers of water tankers and inhabitants • Covering the loading platform • Traffic management to be carried out appropriately with proper instruction near the site of construction.

Items	Impacts	Mitigation Measures
		• Management of pipe laying works to be carried out carefully if undertaken during daytime. Otherwise, laying could be carried out at night in areas where the generated noise does not disturb residents.
<Solid Waste>	Disposal of construction waste and soil	• Disposal at appropriate location such as landfill site, etc.

Table 4.5.4 Proposed Mitigation Measures during Operation Stage of the Project

Items	Impacts	Mitigation Measures
<Noise and Vibration>	Noise from blower, pumps, and generators is expected	• Facilities shall be installed inside buildings to reduce noise level significantly • Noise and vibration to be monitored
<Sludge Disposal>	Generated sludge will be from sedimentation tanks and not hazardous in nature	• Sludge removed from sedimentation tank shall be thickened using sludge tanks and thickener at WTP. • Thickened sludge will be dried in sludge drying beds and can be removed using trucks to be disposed of at appropriate landfill site. • Quality of dried sludge to be monitored.
<Discharge of effluent from sludge basin>	High level of pollutant in the supernatant of sludge tank will cause pollution in Duong river.	• Effluent quality to be monitored. • In case when effluent quality is worse than required discharge levels, corrective measures to be adopted.
<Water Pollution> <Public Health Condition>	With the increase in available water to the users, increase in wastewater discharge is expected within few years. If not collected and treated properly, it will result into poor sanitary and living environment.	• In long run, planning is required towards appropriate handling and disposal of generated wastewater.

It is recommended to establish a staff structure within the implementing agency that should be responsible for implementing these measures against potential negative impacts (except monitoring) considering the following points:

- In case of the adverse impacts during construction stage, the Contractor which is responsible for constructions shall carry out the measures on the basis of directions of Project owner which is responsible for construction management.
- Project owner shall be responsible for making decision on important issues.
- During the operation stage, the Project owner shall carry out mitigation measures against negative impacts.

4.6 Environmental Management Plan

(1) Construction of Sludge Treatment Facilities

The construction of facilities shall be constructed under this Project, for treatment of wastewater obtained after backwashing and from sedimentation tank at the WTP. These facilities shall include wash water drainage basin, sludge basin, thickener, and sludge drying beds. The cost of construction of these facilities is included in the total cost of the Project.

(2) Risk Analysis

During the operation stage, attention should be paid to the following aspects as Risk Analysis.

1) Power Supply

In the water treatment plant, starting with pumps for pumping of raw water, control panels, chemical dosing equipment, chlorination equipment, blower for backwashing, and many instruments are working by electricity. If power failure occurs, the instruments will stop, and consequently, the operation of water treatment plant will stop. If the operation of WTP remains interrupted for long time, it will influence the provision of safe water supply services.

As a countermeasure, the power supply to the WTP should be made on priority basis. Also, the provision should be made to receive power from electric generator facilities. It is expected that by considering these measures during facilities planning, negative impacts in case of power failure could be avoided or at least mitigated.

2) Electrical and Mechanical Equipment Failure

Operational disruption due to electrical and mechanical equipment failures can be avoided by the provision of spare parts and stand-by facilities available at site. Operation and maintenance instructions and manuals for emergency should be provided at the time of training of the operation staff in the water treatment plants.

3) Safety while using Disinfectant

In the treatment process at WTP, disinfection is planned to be carried out using sodium hypochlorite. Sodium hypochlorite is a strong oxidizer. Oxidation reactions are corrosive, and therefore, solutions burn skin and cause eye damage, in particular, when used in concentrated forms. The solutions contain more than 6% sodium hypochlorite by weight.

Also, depending on temperature and storage time, sodium hypochlorite degrades with time and degradation affects its strength.

Therefore, storage facilities should be appropriately planned. Also, the operators should be provided training for its safe use and storage, and steps to be undertaken in case of any accidents.

(3) Environmental Plan

When performing Environmental and Social Impact Assessment and evaluating the effect, it is also important to carry out monitoring in order to grasp the information on any new negative influence due to these activities. The monitoring plans and the responsible agencies are described below.

(4) Monitoring Plan

It is proposed to undertake following monitoring plans related to the negative impacts that has been described earlier. The monitoring plan is categorized under construction stage and operation stage. For preparing the monitoring plan, it is considered that during construction stage influence will be short duration and therefore it is important to have measurement result immediately rather than caring for the level of accuracy and accordingly measurement methods should be selected. However, in the operation stage it is required to evaluate the level of influence and make judgment. Also, it is required to find out if any new negative impact has come up during operation stage. Therefore, measuring method should be selected considering sufficiency in terms of accuracy and its simplicity in use. In case when new influence is expected in future, the measuring method should be improved based on the need of new impacts and desired accuracy or measured parameters. Monitoring programs for construction and operation stages are described below in Table 4.6.1 and Table 4.6.2.

1) Construction Stage

On the access road and construction site, the noise generated by operation of vehicles carrying materials in/out of construction site and due to use of heavy construction machines should be measured using a portable noise level meter. When complaints are received from residents in neighboring areas (although they are not located very near to construction site), the measurement result should be referred, and sound insulating wall should be installed if needed. Also, the reduction of operating speed of vehicles and sound reductions measures should be considered.

During construction activities, on the access road and the construction site, the particulates are generated by operation of vehicles carrying materials in/out and heavy construction machines. When complaints are received from residents at complaint window located on site, related to particulates in air due to project activities, the level of particulates along the access road and at construction site should be measured with a portable particulate measurement instrument. The measurement result should be referred and the frequency of water sprinkling should be reconsidered. In order to control the level of particulates in air, watering shall be carried out and measurement shall again be carried out in order to evaluate the effect. Monitoring program for construction stage is summarized in Table 4.6.1 below.

Table 4.6.1 Monitoring Program for Construction Stage

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Noise	−Access road −WTP −Off take locations	Noise (maximum level)	Arbitrary number of times during the construction period, especially when the level is high.	Project Owner	JPY 30,000 (Expenses on buying equipment for measurement)
Request and complaint from residents	−surrounding area of access road and construction sites	Contents and number of requests and complaints	During the construction, a reception counter to be installed to respond any time.	Project Owner	No expense
Air Quality	−Access road −WTP −Pipelines −Off takes	Suspended Particulates Matters	Arbitrary number of times during the construction period, especially when the level is high.	Project Owner	JPY 300,000 (Expenses on buying equipment for measurement)

* Personnel costs are not included.

The result of monitoring shall be recorded in the monitoring form. Formats which could be used for monitoring noise, surrounding environment and air quality during construction stage are presented in Table 4.6.2, Table 4.6.3 and Table 4.6.4 below.

Table 4.6.2 Monitoring Form for Noise (Construction Stage)

Item	Unit	Measured Value (Max.)	Vietnamese Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB		75dB (6:00~18:00hrs) 70dB (18:00~22:00hrs) 50dB (22:00~6:00hrs) 85~88 (for Trucks)***		85 dB**	

* Values according to the Noise standards in public and residential areas in Vietnam (TCVN 5949: 1995) for the case of small industries located in residential areas.
** Regulation value in Japan (during construction work period)
*** Values according to the Noise level standards for road motor vehicles in Vietnam (TCVN 5948: 1995).

Table 4.6.3 Monitoring Form for Surrounding Environment (Construction Stage)

Monitoring Item	Monitoring Results during Report Period
Number of requests and complaints	
Content of requests/complaints	

Table 4.6.4 Monitoring Form for Air Quality (Construction Stage)

Item	Unit	Measured Value (Max.)	Country's Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Suspended Particulate Matter (SPM)			0.2 mg/m^3 (24 hour average)			

* Values according to the Ambient Air Quality Standards in Vietnam (TCVN 5937: 2005)

2) Operation Stage

Periodical water quality measurement of inflow shall be performed. Also, water quality parameters should be measured periodically for treated water in the distribution facilities such as off takes. For the sample of off take, measurement should be carried out for presence of hazardous substances twice every year.

The level of noise shall be measured outside the buildings of the pumps, generator and, blower facilities, and at the boundary of WTP. Although, it is judged that there is no influence on the neighborhoods, especially measurement of sound level at night is recommended.

It is also important to monitor the quality of effluent discharged from the WTP into Duong River on monthly basis. Also, the quality of dried sludge needs to be monitored to avoid pollution. Monitoring program required at operation stage is summarized in Table 4.6.5.

Table 4.6.5 Monitoring Program for Operation Stage

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Water Quality	– Intake	pH, Turbidity Hazardous Substances (Fluoride, Fe, Mn, NO_2-N, NO_3-N)	Daily 2 times per year	Project Owner or Agency responsible for O&M of project facilities	Expenses on Analytical instruments and chemicals for monitoring will be required.
	– Distribution Facilities such as at Off takes	pH, Turbidity, Residual Chlorine E Coli Hazardous Substances (Fluoride, Fe, Mn, NO_2-N, NO_3-N)	Daily Weekly 2 times per year	Project Owner or Agency responsible for O&M of project facilities	Expenses on Analytical instruments and chemicals for monitoring will be required
	– Beginning or End of Effluent channel	pH, Temperature, BOD_5, COD, Suspended Solids (TSS), Total Coliforms, Fecal Coliforms, Residual Chlorine Oils and grease, Arsenic (As), Cadmium (Cd), Lead (Pb), Chromium (Cr), Copper (Cu), Zinc (Zn), Manganese (Mn), Nickel(Ni), Organic Phosphorus, Total Phosphorus, Iron (Fe), Tetrachloroethylene, Tin(Sn), Mercury(Hg), Total Nitrogen, Trichloroethylene, Ammonia as N, Fluoride, Phenol, Sulfide, Cyanide	Monthly Four times a year	Project Owner or Agency responsible for O&M of project facilities	Expenses on Analytical instruments and chemicals for monitoring will be required.

Object	Monitoring Location	Parameters	Frequency	Implementing Agency	Monitoring Cost*
Sludge Quality	Dried sludge from sludge drying beds	Zinc, Copper, Nickel, Cadmium, Lead, Mercury, Chromium, Molybdenum, Selenium, Arsenic	Two times a year	Project Owner or Agency responsible for O&M of project facilities	Measurement apparatus purchased for monitoring at construction stage can be used.
Noise	Outside the buildings of: －Pump －Generator －Blower, and WTP Site boundary	Noise (maximum level)	Monthly	Project Owner or Agency responsible for O&M of project facilities	Measurement apparatus purchased for monitoring at construction stage can be used.

* Personnel costs to be added.

The result of monitoring shall be recorded in the monitoring form. Format which could be used for monitoring water quality (both raw and treated water), effluent from WTP, and noise during operation stage is presented in Table 4.6.6 to Table 4.6.9 below.

Table 4.6.6 Monitoring Form for Raw Water Quality (Operation Stage)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Vietnamese Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-			6 – 8.5			
Turbidity	NTU						
Fluoride	mg/l			1.0 mg/l			
NO_2-N	mg/l			0.01 mg/l as NO_2			
NO_3-N	mg/l			10 mg/l as NO_3			
Mn	mg/l			0.1 mg/l			
Fe	mg/l			1.0 mg/l			

* Values according to the Surface Water Quality Standards in Vietnam (TCVN 5942: 1995)

Table 4.6.7 Monitoring Form for Supplied Treated Water (Operation Stage)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Vietnamese Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-			6.5 – 8.5			
Turbidity	NTU			2 NTU			
Residual Chlorine	mg/l			0.3~0.5		5**	
E. Coli	MPN/100 ml			0			
Fluoride	mg/l						
NO_2-N	mg/l			3 mg/l as NO_2			
NO_3-N	mg/l			50 mg/l as NO_3			
Mn	mg/l			0.3 mg/l			
Fe	mg/l			0.3 mg/l			

* Standard of drinking water quality 2009, Environment Board.
** In the WHO guideline, 5 mg/l is shown as upper limit.

Table 4.6.8 Monitoring Form for Effluent from WTP (Operation Stage)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Vietnamese Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-			6 – 9			
BOD_5	mg/l			30			
COD	mg/l			50			
Suspended Solids	mg/l			50			
Residual Chlorine	mg/l			1			
Total coliform	MPN/100 ml			3000			
Fecal coliform	MPN/100 ml						

* Values according to the Industrial Wastewater Discharge Standards in Vietnam (TCVN 5945: 2005)

Table 4.6.9 Monitoring Form for Noise (Operation Stage)

Item	Unit	Measured Value (Max.)	Vietnamese Standards*	Standards for Contract	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB		75dB (6:00~18:00hrs) 70dB (18:00~22:00hrs) 50dB (22:00~6:00hrs) 85~88 (for Trucks)***		40 dB**	

* Values according to the Noise standards in public and residential areas in Vietnam (TCVN 5949: 1995) for the case of small industries located in residential areas.
** Regulation value in Japan (during night time)
*** Values according to the Noise level standards for road motor vehicles in Vietnam (TCVN 5948: 1995).

(5) Institutional Setup

The fundamental information about the organization that should carry out monitoring activities is itemized below.

- The constructor shall carry out monitoring during construction stage, and shall report to the Project owner.
- WTP laboratory shall carry out monitoring during operation stage in principle.
- For the parameters that are difficult to be measured by the WTP laboratory of project owner, a suitable organization should be requested.

Establishment of an administrative unit is required in order to carry out the above monitoring. The Unit shall include members from organizations relevant to water supply system, organizations which take charge of environmental management, organizations which manage the water bodies, and local administrative organizations and residents. It is proposed to have proper coordination among these agencies for effective monitoring. Moreover, collected information on monitoring should be compiled in the form of a database that can be accessed by all related organizations whenever needed.

(6) Occupational Health and Safety Measures

During the construction and operation stage of the project, consideration should be given to workplace air quality, ambient temperature and humidity, noise limits, specific conditions on working in confined place, and general conditions on health and safety. The work involves working at high places and guidance on care to be taken while working in such places should be provided to workers. General health and safety practices should be followed by workers on site.

The following mitigation and management measures should be adopted to ensure that the health and safety of staff and any visitors at the site is not affected negatively during construction and operation stages:

- Development and implementation of an Operational Health and Safety Plan with appropriate training
- Provision of training in use of protection equipment and chemical handling (sodium hypochlorite)
- Clear marking of work site hazards and training in recognition of hazard symbols
- Development of site emergency response plans, and
- All personnel working or standing close to noisy areas or equipment will be required to wear noise protectors.

4.7 Conclusion

Implementation of proposed project is expected to have positive impact in the form of improved water supply services in parts of Greater Hanoi that still does not have access to safe water. However, some negative impacts are expected. In order to minimize or avoid the occurrence of such negative impacts, there are some points that need consideration.

(1) Items that need Careful Consideration

Although any major problem is not expected due to project components, there are some items that require careful examination during the construction and operation stages of the project implementation and are described below in brief.

1) Pre-construction Stage

Land acquisition is one of major items that need consideration during pre-construction stage of the Project. Also, the landowners must be compensated appropriately before implementation of Project starts.

2) Construction Stage

The adverse impacts during the construction stage are temporary and the influence is limited to the construction period. In particular, the attention is required towards the influence of traffic due to heavy vehicles carrying construction materials in and out of the construction site. The “arrangement of traffic control staff”, “sprinkling of water on the road”, etc. which are already described under the countermeasures against the environmental adverse impacts should be carried out appropriately. Also, the countermeasures for mitigation and elimination of other environmental adverse impacts, such as noise generation, air pollution, and solid waste disposal that may occur during construction stage, should also be undertaken as suggested.

3) Operation Stage

During the operation stage, countermeasures are needed against impacts due to noise, management and disposal of generated sludge, and discharge of effluent from sludge basin.

Appropriate countermeasures should be carried out to mitigate these impacts. Also, monitoring should be carried out and based on the degree of influence, decision should be made on suitable countermeasures and early implementation of such measures.

(2) Important Items to be Undertaken for Implementation of this Project

Important steps that need to be undertaken for implementation of this Project are listed below:

- The Project owner shall prepare the full EIA of the Project and submit it to the relevant division of the Department of Natural Resources and Environment (DONRE), or to the MONRE whichever application for this Project.
- Also, the Project Owner in coordination with other relevant Agencies should carry out the Land Acquisition which is very important for the implementation of this Project.
- There are several other Registrations and Permissions needed before implementation of the Project starts and all the procedure should be pursued by the Project Owner.
- The Stakeholders Meeting should be organized by the Project Owner to explain about the Project outline and objectives, facilities to be constructed and their locations, expected benefits and adverse impacts of Project activities at construction and operation stages, and mitigation measures to minimize the adverse impacts. Through the Stakeholders Meetings, the Project Owner shall obtain the understanding of the Stakeholders on the Project. The participants shall include representative of community owning the land at proposed location of the WTP, representatives of the local governments, and representatives from DONRE, People's Committee, Project owner, etc. The Minutes of Meetings of the Stakeholders Meetings should be prepared and presented along with the EIA report.
- In principal, the Project owner should carry out all activities of the proposed mitigation measures and monitoring plan during the construction and operation stages. The contractor shall carry out monitoring during construction stage, and shall report to the Project Owner. However, during operation stage, the monitoring of environmental parameters shall be carried out by the Project Owner or the Agency that is responsible for the operation and maintenance of the facilities under this Project.

- Implementation of monitoring plan shall be recorded and reported to the Department of Natural Resources and Environment (DONRE) and relevant authorities periodically, both during the construction and operation stages.

From the above mentioned points, it is concluded that suggested countermeasures should be undertaken to mitigate potential adverse impacts due to implementation of this project. With the mitigation of adverse impacts, this project is expected to have potential benefits in terms of improved water supply services and improvement of living environment in Greater Hanoi. Hence, it is recommended to undertake this project in the interest of environment and living conditions of the residents in the Project area.

5. Investment Environment (Risk Analysis)

In this chapter, JICA Study Team shall abstract major risks to be managed in this project and consider the countermeasures which constitute related agreements based on the political, economical and social environmental change and results of risk analysis from the preliminary feasibility study regarding this project conducted last year.

5.1 Project Risks Managed by Contracts

Public Private Partnership Project provides design, construction, operation and maintenance of facilities for a long term by defining appropriate and detail risk allocation between the public sector and the private sector. The allocation is reflected to project agreements and PPP realizes high quality public services at lower costs for the public sector and also ensures stable and lasting cash flows. Stable debt service derived from the project enables project financing for the private sector.

It is important to define all risks for the first step of risk analyses extracting associated risks in detail as much as possible depending on the characteristics of the project, understand the causes and structure the risk mitigation measures and countermeasures. Of these risk mitigation measures and countermeasures, Study Team estimated the required cost of risks which can be mitigated by economical measures (i.e. insurances and financial products). Furthermore, from the point of view of the investor, identified risks are evaluated as dual countermeasures by quantifying the incremental costs associated with realization of those risks or by conducting qualitative analyses if quantitative analyses are difficult for occasions that these risk mitigation measures and countermeasures are not conducted.

It is essential for any Public Private Partnership projects that a particular risk should be assumed by the party best able to manage and control that risk. Efficient risk management will lower the costs at the realization of those risks. Therefore, it is required to consider who is the most appropriate to manage risks rather than who is responsible

(1) Extraction of All Risks

It is important for risk management of projects to identify all key risks associated with the project at an early stage prior to detailed work on project documentation.

In extracting risk items, risks are categorized as commercial risks, financial risks and external factor risks, and commercial risks are further categorized as risks that affect revenues and those that affect costs (risk items extracted in UK HM Treasury's "Green Book" have been referred to in order to cover risks involved in an ordinary infrastructure PFI project).

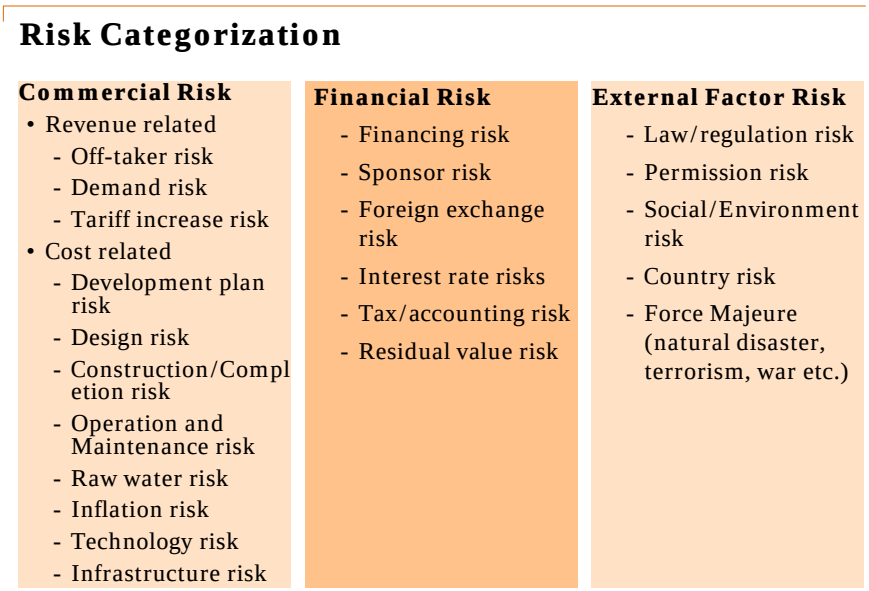


Figure 5.1.1 Risk Categorization

(2) Risks Associated with the Project

In reviewing the risks and for determining their importance, a three-staged evaluation has been performed on the level of impact the risks have on the project and the probability to abstract risks scored with "3". Importance that is comprehensively determined based on impact and probability has been categorized in scores from 1 to 3, according to the below matrix.

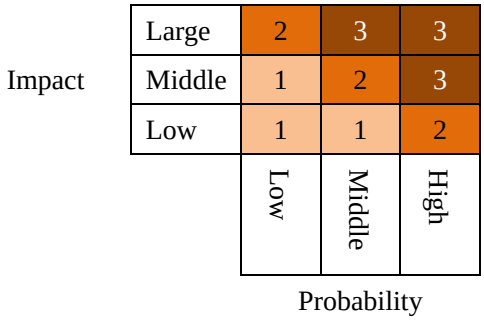


Figure 5.1.2 Risk Evaluation Scale

Table 5.1.1 shows the evaluated risks with 3 scored.

Table 5.1.1 Risk Matrix of the Expected Project

Project stage	Category 1	Category 2	Category 3	Risk
General	External Factor	Law/Regulation	Approval	SPC can't obtain necessary approvals.
	Financial	Interest rate		Interest rate
	Financial	Financing	Financing	Financing - SPC
	Commercial	Revenue	Demand	Demand lower than demand projection
	Commercial	Revenue	Demand	Contract with appropriate size
	Commercial	Revenue	Demand	Competitor
	Commercial	Revenue	Tariff revision	Payment Method
	Financial	Fluctuation in exchange	Currency	Currency
	Commercial	Revenue	Off-Taker Risk	Default in paying service payment
	Commercial	Cost	Development plan	Government Subsidy/ Capital Injection/ Development as public work
	Commercial	Cost	Infrastructure	Delay in GOV's work
Construction	Commercial	Cost	Inflation	Increase in Inflation
	Finance	Forex		changes in forex
Operation	Commercial	Cost	Inflation	Inflation rate increase
	Finance	Forex		changes in forex
	External Factor	Country risk	Forex	Overseas remittance

(3) Measures and countermeasures for the above listed risk require discussions and agreements between parties relevant to the project and action items have been provided. Risks mentioned in the above list are considered to have a significant impact on project feasibility and assumed to have a certain level of probability, and it is noted that mitigation measures should be identified at an early stage.

5.2 Contractual Scheme and Project Documents

(1) Basic project and contractual scheme is shown in the following figure. O&M Company could be incorporated into SPC.

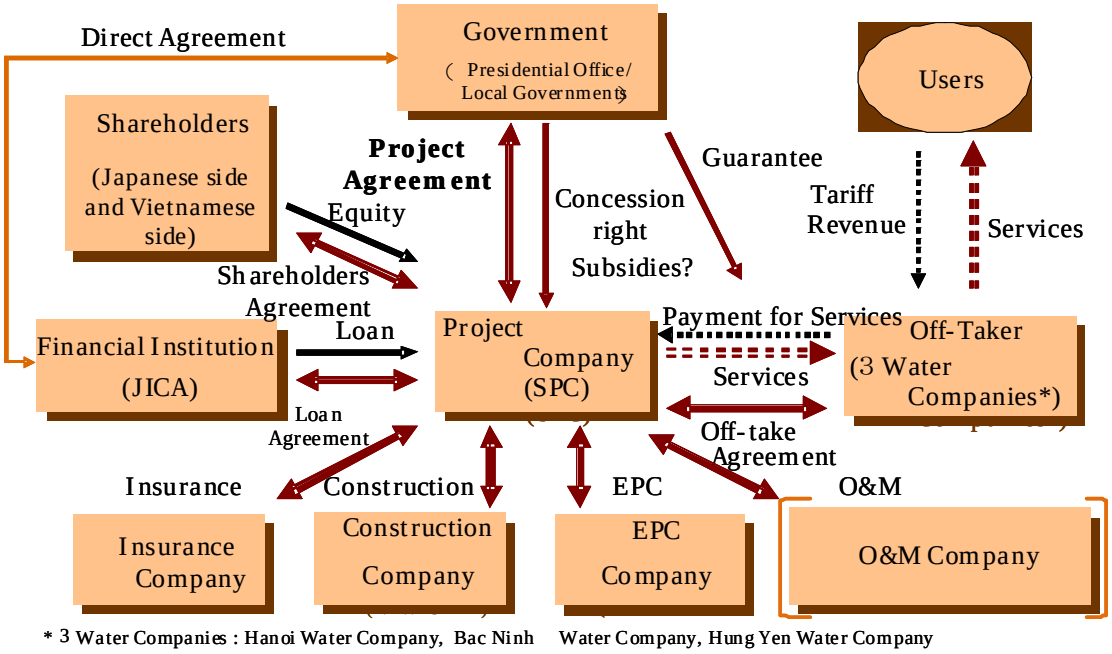


Figure 5.2.1 Proposed Project Structure

1) Parties to the Agreement

① Central Government

It is assumed that the central government is a counterpart of the project agreement. Presidential Office and Ministry of Construction (MOC) are the related organizations to the project. Concession right at the first stage was provided to VIWASEEN under the Presidential Decree issued by the Presidential Office, and concession right at the second stage is assumed to be provided by the Presidential Office to SPC. In addition, MOC is in charge of the urban water sector and it is estimated that MOC is a related organization on project details including development planning.【BOT Law Article 3】

In order to clarify the government support on authorization of concession rights and water rights, necessary approvals on design, construction, operation of facilities, financing and foreign exchange transactions, related infrastructures, land acquisitions etc., Project Agreement will identify the project details, project

term, service requirements, payment conditions and formula, measures identified in BOT law such as tax exemptions, and risk allocation between the Viestnam government and project company. 【BOT Law Article 38-45】

In case the project agreement is not contracted with the Presidential Office, but MOC, it will be negotiated to have a commitment from the Presidential Office separately.

② Local Governments

The project provides water services for Ha Noi City, Bac Ninh Province, Hung Yen Province and the final beneficiaries are people at those city and provinces (Currently, it is almost agreed that supply area up to phase 2 is only Ha Noi City). Although the project does not provide water services directly to these areas, it is necessary to confirm whether the project is in line with development plans of local governments, status of local infrastructure development and work sharing, support for local water companies and guarantee for off takers.

It is considered to include local governments as counterparts of project agreements.

③ Off taker

Off takers of the project are supposed to be Hanoi Water Company, Bac Ninh Water Company, and Hung Yen Water Company (Currently, it is almost agreed that supply area up to phase 2 is only Ha Noi City). SPC will contract log-term off take agreements with three water companies and agree on the volume, quality, and price of water supply. It is expected to have “Take or Pay” contract and the project company will not take demand risk. The performance guarantee of three off takers by local government will be negotiated.

④ VIWASEEN

VIWASEEN is a state owned company which holds a concession right, issued by the Presidential Office and is going to be a shareholder of SPC as well as sub contract construction. In order to assign the rights and obligations under the concession right currently held by VIWASEEN as a project contract stipulated under the BOT Law, a guarantee must be obtained from the Presidential Office. SPC will agree with VIWSEEN on assignment and condition of concession right

at the first stage under the shareholder's agreement. It is identified in construction agreement that VIWASEEN is in charge of construction, bears associated risks, and takes appropriate risk mitigation measures.

⑤ SPC

SPC is established as LLC and it to be a project company conducts design, construction, maintenance and operation of the project. Necessary measures to establish SPC will be taken according to BOT Law Article 27, and Enterprise law. Shareholders' Agreement defines role sharing and rights and obligation of share holders.

⑥ Financial Institutions

It is expected to have loans under Private Sector Investment and Finance of JICA. Equity will be defined under Shareholders' Agreement mentioned at 5) and the detail conditions of loans will be defined at Loan Agreement.

6. Economic Analysis

6.1 Extraction and Quantification of Economic Costs

Economic analysis has been carried out in accordance with the principles of the "Handbook for the Economic Analysis of Water supply Project, 1999 ADB" (hereafter referred to as the "ADB Handbook").

This section sets out the expected project and maintenance costs for this project, and also examines the economic value of these various costs based on the ADB Handbook.

(1) Economy Priced Project Costs

The economic analysis of the project captures the social value of the project costs and benefits, and evaluates the project's profitability. In doing this, due to the effects of systems and potential market mechanism inadequacies in relation to market prices in the target country, prices may not be legitimate, requiring the analysis to use a calculation of what the prices should be. For this purpose, the ADB Handbook sets out conversion factors for foreign currency, electricity costs and labor costs, in an attempt to set the economic price of project costs for financial analysis.

1) Conversion Rate Setting

① SERF: Shadow Exchange Rate Factor

Because the trade market includes inappropriate tariffs and export subsidies, as well as import quotas to protect domestic production, the Shadow Exchange Rate (SER) was developed. The SERF represents the ratio between the Official Exchange Rate (OER) and the SER when calculating international trade prices in local currency equivalents (SERF=SER/OER)

Here, based on the materials and reports published on ADB/JICA/JBIC websites, information has been gathered for the economic analysis of this domestic Vietnamese project, so that SERF values can be set. This was based on the criteria below.

Country of Analysis	Viet Nam
Year of Analysis	From Fiscal 2008
Target Areas for Analysis	Power/Energy, Water Resource Development/Public Health, Poverty Reduction

The results are listed below. The figures for each report have been determined based on the detailed methods and guidelines for SERF calculation in the "Guidelines for the Economic Analysis of Projects (ADB, 1997)".

Note that since the SERF has an inverse relationship with the Standard Conversion Factor (SCF) for the calculation of conversions of domestic prices to international prices, based on the SERF and SCF values for the following cases, in this study we have used the average SERF value of 1.08.

Table 6.1.1 Example of SERF and SCF Values

projects	SERF(shadow exchange rate factor)	SCF(standard conversion factor)	Field	Announced
Socialist Republic of Viet Nam: Song Bung 4 Hydropower Project Phase II-documents produced under TA	1.1		Electricity	2008.5
Second Northern Greater Mekong Subregion Transport Network Improvement Project: RRP Linked Documents		0.9	Transport	Unknown, Related Docs from Feb/Nov 2010 etc.
Greater Mekong Subregion Ben Luc-Long Thanh Expressway Project: RRP Linked Documents	1.04		Highways	Unknown, Related Docs from Feb 2010
Second provincial towns water supply and sanitation project		0.96	Water	2008.12
Strengthening water management and irrigation systems rehabilitation project		0.9	Water	2010.3

② SWRF: Shadow Wage Exchange Rate

Sometimes in the labor market there is a minimum wage system, which exceeds the true opportunity cost of labor. In such cases, it may be necessary to view the value produced by unskilled workers at some discounted rate compared to the actual amount of wages paid.

In the case of this project, given that labor costs have not been classified as a portion of construction costs, and given also that workers involved in maintenance are expected to be skilled workers, the SWRF has been set at 1.0.

③ Power Cost Conversion Rate

According to the ADB Handbook, with an understanding of the breakdown of the production costs involved in the use of electricity in the project (operating costs such as capital, labor etc.), as well as consideration of the SERF and SWRF, it is recommended that the market price of power costs is converted to its economic value.

However, since we are unable to estimate the electricity production cost, the conversion of electricity costs is not given further consideration.

2) Converting Project Costs to Economic Costs

Table 6.1.2, 6.1.3 demonstrate the project costs as economic prices, based on the above conversion rates.

Table 6.1.2 Economic Price of Construction Costs

	Total
	100 Mill VND
Phase1	40,425
Phase2	13,965

Table 6.1.3 Economic Price of Stage 1 Project Costs (Million VND)

	Phase1				Phase2			
	Total	fixed cost		variable cost	Total	fixed cost		variable cost
		yen basis	VND basis	VND basis		yen basis	VND basis	VND basis
2015	**149,139**	66,229	19,830	63,079	**0**	0	0	0
2016	**127,195**	44,407	18,955	63,832	**0**	0	0	0
2017	**126,048**	43,262	18,954	63,832	**0**	0	0	0
2018	**119,530**	36,864	18,833	63,832	**0**	0	0	0
2019	**143,857**	61,172	18,853	63,832	**0**	0	0	0
2020	**118,727**	36,180	19,463	63,084	**79,413**	16,396	2,080	60,937
2021	**156,379**	73,953	19,343	63,084	**73,893**	10,911	2,046	60,937
2022	**103,682**	21,257	19,342	63,084	**75,257**	12,240	2,080	60,937
2023	**118,849**	36,424	19,342	63,084	**81,204**	18,222	2,046	60,937
2024	**136,072**	53,646	19,342	63,084	**96,524**	33,508	2,080	60,937
2025	**100,702**	18,276	19,342	63,084	**72,564**	9,582	2,046	60,937
2026	**109,948**	27,522	19,342	63,084	**73,927**	10,911	2,080	60,937
2027	**103,184**	20,758	19,342	63,084	**75,223**	12,240	2,046	60,937
2028	**157,865**	75,440	19,342	63,084	**81,238**	18,222	2,080	60,937
2029	**191,630**	109,205	19,342	63,084	**96,490**	33,508	2,046	60,937
2030	**99,033**	16,608	19,342	63,084	**72,598**	9,582	2,080	60,937
2031	**102,751**	20,326	19,342	63,084	**73,893**	10,911	2,046	60,937
2032	**114,262**	31,837	19,342	63,084	**75,257**	12,240	2,080	60,937
2033	**112,558**	30,133	19,342	63,084	**81,204**	18,222	2,046	60,937
2034	**136,594**	54,169	19,342	63,084	**96,524**	33,508	2,080	60,937
2035	**142,594**	60,169	19,342	63,084	**72,564**	9,582	2,046	60,937
2036	**106,621**	24,195	19,342	63,084	**73,927**	10,911	2,080	60,937
2037	**111,646**	29,221	19,342	63,084	**75,223**	12,240	2,046	60,937
2038	**127,040**	44,614	19,342	63,084	**81,238**	18,222	2,080	60,937
2039	**141,524**	59,098	19,342	63,084	**96,490**	33,508	2,046	60,937

6.2 Extraction and Quantification of Economic Benefits

This section organizes the economic benefits of the first stage of this project, up to 2015.

Based on the fundamental principles of the ADB Handbook, these economic benefits have also been quantified, in accordance with, the conditions set for this project.

(1) Expected Benefits for Each Water Supply Zone

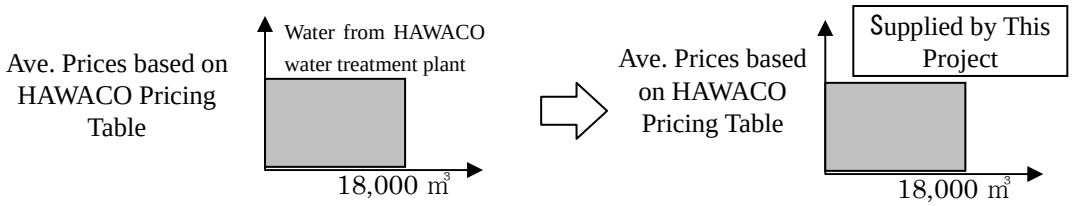
In this section, the benefits expected from the supply of water to each area has been examined.

1) Benefits for Central Ha Noi City

For Central Hanoi, along with deliberate policies to reduce the population, the plan is to not only supply water through this project, but also to invest in the renewal of water treatment plants held by other operators, and to ensure sufficient clean water to meet demand.

It is not possible to identify the beneficiaries of this project, since the project will share a portion of the already established water supply pipeline network. However, it is possible to say that for users that are connected to water supplies as of 2009, the switch in supply of 18,000 ㎥ from current water treatment plant operators to this project will benefit users with better quality water.

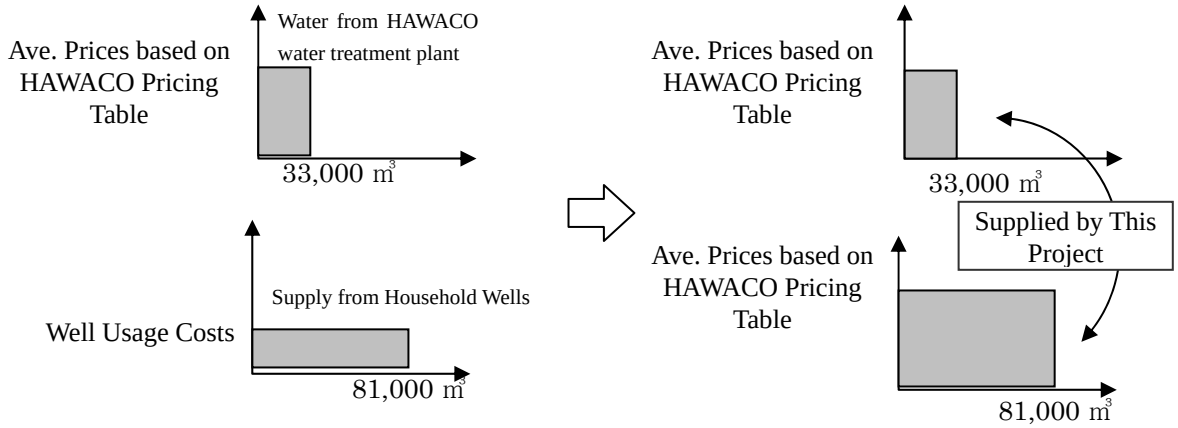
In this case, since there will be no change in circumstances for consumers that are already using HAWACO water services, water charges will be determined on the basis of their pricing table, irrespective of the actual source of the water.



2) Benefits for Eastern Ha Noi City

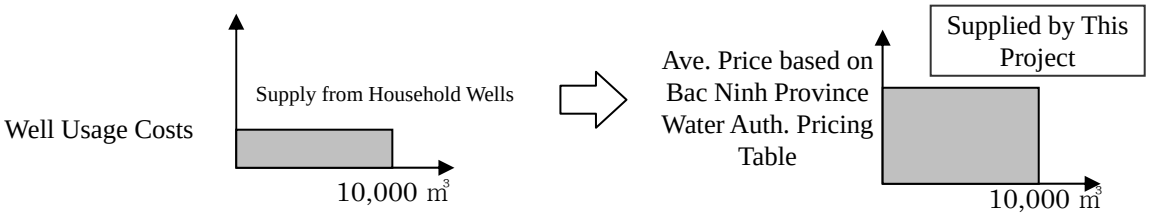
For Eastern Ha Noi, as of 2015 the source of all water will switch to this project.

As such, it is possible to classify the benefits into those for users that are receiving the 33,000 ㎥ of water supplied as of 2009, for whom switching to this project as the source of their water will result in the benefit of better water quality, and those that will have the benefit of increased water quality as a result of switching from household wells, as the water supply increases to 81,000 ㎥ to meet demand by 2015.



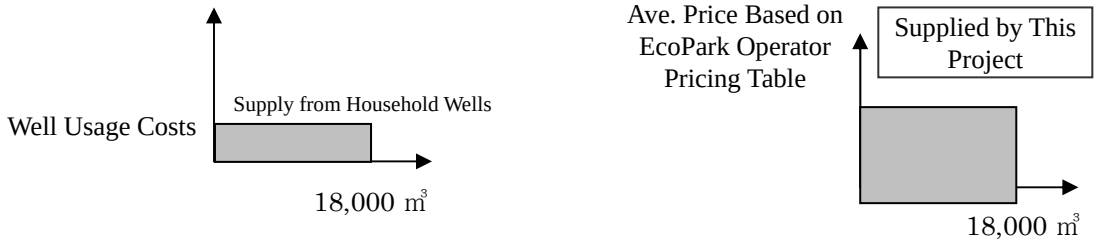
3) Benefits for Bac Ninh Province

For Bac Ninh Province, this project will supply about 10,000 ㎥ of water, providing benefit by increasing the number of water supply users.



4) Benefits for Hung Yen Province

EcoPark in Hung Yen Province is currently under development, and therefore water is currently not being supplied. As this development progresses, this project will be implemented, providing residents of EcoPark the benefit of receiving water without having to rely on household wells.



(2) Quantification of Economic Benefits

1) Basic Principles from ADB Handbook

According to the ADB Handbook, for areas that meet their water demand through public wells, the implementation of this project would typically provide the benefits of reduced water usage costs (A in the figure below), and the benefit of increased demand induced by the reduction in costs (B in the figure below).

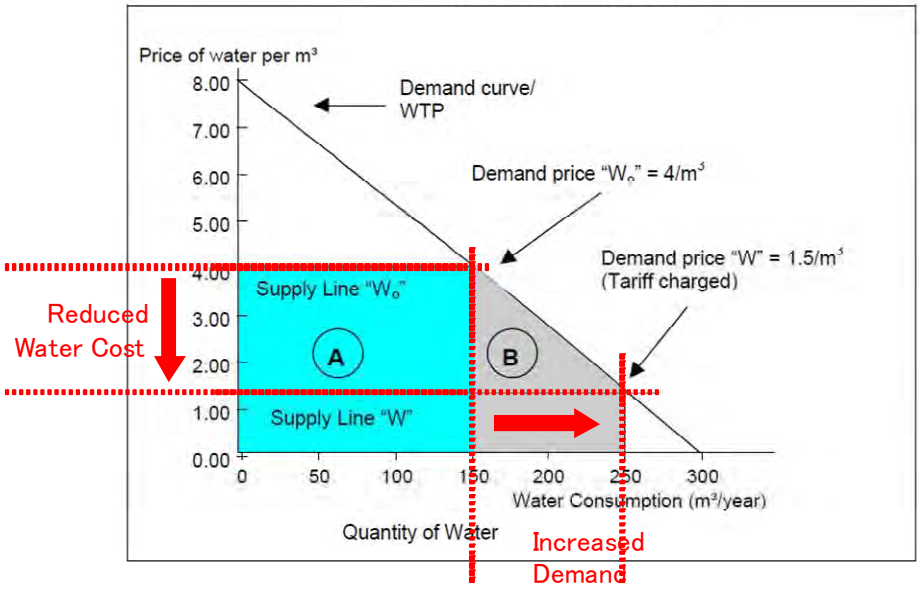


Figure 6.2.1 Benefits of Water Project (A+B)

In the former case, by stipulating that the traditional cost of using water (4/㎥) exists as one's Willingness to Pay (WTP), the difference between this and the actual price paid (1.5/㎥) can be considered as a benefit.

At the same time, in the latter case, given that at a cost of 4/㎥ the potential user had given up use, the WTP can be assumed to be somewhere between 1.5/㎥ and 4/㎥, with the difference between this and the actual price paid (1.5/㎥) considered as the benefit.

2) Comparisons with this Project

① Changes in Water Costs through Implementation of this Project

Viet Nam is a country with a policy for setting low water prices, making it difficult for water providers to recover the costs of operating from water rates. In a prior study ("2008 Report on the Promotion of Contributions to International Water Supplies", Labor & Welfare Ministry), it was reported that the average cost of water services in Ha Noi was around 3,500 ㎥ VND/, which is equivalent to approximately 3/4 of the cost of providing that water. Thus, for current water users, even if their water source is switched to this project, water charges are maintained around the current low cost level, resulting in no change to the cost of using water.

Moreover, since homes that are not connected to water supplies use household wells that do not require time to fetch the water, the cost of their water use is assumed to be less than water rates. However, as water quality continues to deteriorate around Ha Noi City as observed through the presence of arsenic in well water, it is expected that people will switch to the supplied water in order to ensure safe water.

Thus, since both water users and non-connected households prior to the implementation of this project are unlikely to see a reduction in water usage costs following implementation, it is not possible to set the WTP based on the cost of usage prior to implementation, as shown in the ADB Handbook.

② Changes in Demand through Implementation of this Project

In Ha Noi City and its surrounding, as demand for water is expected to increase owing to increased populations, and as the implementation of this project will not lead to reductions in water usage costs (as described above), there will be no cause for induced water demand.

3) Quantification in this Study

For water services in Viet Nam, current water usage costs (water rates and the cost of household wells) are lower than the operating costs of this project, which means that for this project, the benefit will be the non-cost factor of water quality. Thus, the value of the clean water provided through this project cannot be measured on the basis of water usage costs.

As such, with regard to the WTP for the high quality water supplied by this project, the benefit can be calculated as a representation of the cost to procure such water.

Note that this WTP represents the value of the higher quality water, which is considered to have a common value for both current users of the water system and current household well users.

(3) Setting Conditions for Quantifiable Benefits

1) Setting Maximum Amount of Payment

The supplied water is not only for domestic use, but may also be used for public, commercial or industrial purposes, etc. However, the scope of this project is to supply water to water suppliers, and since it is not possible to specify how the consumer will use the water, for the purposes of this study, it is assumed that all of the water supplied will be for domestic use.

The quality of the water supplied by this project is expected to be of a similar quality as water sold in plastic bottles. Thus, it can be expected that there will be consumers that have the same WTP for the water that will be supplied as they do for water that they purchase. Therefore, the maximum WTP is be set at 2 million VND/m^3, based on the general price of a 5 gallon bottle of water (at 2,000VND/L).

2) Setting Minimum Amount of Payment

This project will supply water through current water suppliers, and it can be assumed that consumers will at least be willing to pay the average unit prices that they currently pay to service providers.

According to "2008 Report on the Promotion of Contributions to International Water Supplies (Labor & Welfare Ministry)", average unit price of water in Ha Noi is about 3,500 VND/㎥, and according to HAWACO revenue data, their average price was 3,441 VND/㎥ in 2008, and 3,500 VND/m3 as of 2009. However, HAWACO are set to revise water charges in January 2010, and based on the average revision rate, the average price from 2010 will be set at 4,500 VND/㎥ (@3,500x129%=4,415) (see Table 6.2.1).

Table 6.2.1 Revision Rate for Water Charges

	Water Charges (2005-09)	Water Charges (2010-)	Revision Rate
To 16 ㎥/month	2,800	4,000	143%
16～20 ㎥/month	3,500	4,700	134%
20～35 ㎥/month	5,000	5,700	114%
From 35 ㎥/month	7,500	9,400	125%
Ave. Revision Rate			129%
Ave. Unit Price	3,500	4,500	-

3) Proportion of Consumers Willing to Pay Maximum Amount

Given below is the ratio of sources for drinking water and domestic use water according to the Living Standards Survey Report (Viet Nam Office of Statistics, 2008). The proportions of water purchased are 1.0% and 0.2%, representing a significantly low level compared to other sources. Thus, the proportion of consumers that have a maximum amount WTP will be close to zero, creating a demand curve where the average price will decrease across the board.

Table 6.2.2 Ratio of Sources for Drinking Water and Domestic Water (Central Viet Nam, 2008)

		Drinking Water	Domestic Use
Water supply	Private Taps	60.7	55.4
	Public Taps	5.4	5.1
Purchased Water			0.2
Pumped Wells			23.5
Wells			11.7
Other			4.1

Source: Living Standards Survey Report (Viet Nam Office of Statistics, 2008)

4) Quantification of Economic Benefits

From the above settings, the economic benefits of the water supply can be described by the trapezoid area shown in Figure 6.2.2 below.

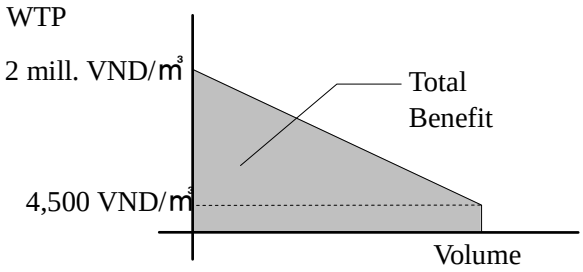


Figure 6.2.2 Assumed Total User Benefit

(4) Quantification of Economic Benefits

Based on the above conditions, with a leakage rate of 20% between the water receiving point and the distribution to consumers, the economic benefit for the term of the project (Development Period: 2012-2014; Operating Period: 25 years, from 2015-2039) can be quantified.

Note that the causes of benefit will differ based on the water supply area and conditions and whether or not households are currently connected to the water supply, but since the WTP is considered as the same for all consumers, the benefit obtained can be quantified in relation to the overall availability of the water supply.

Table 6.2.3 Quantification of Economic Benefits

	Planned Water Volume (1,000 ㎥/day)	Leakage (1,000 ㎥/day)	Avail. Water supply		Benefit (100 Mill. VND/yr)
			(1,000 ㎥/day)	(1 mill.㎥/yr)	
	a	B=a×20%	c=a-b	d=c×365÷1000	e
2012-14	0	0	0	0	0
2015-39	150	30	120	43.8	438,986

6.3 Economic Cost-Benefit Analysis

From the difference between the economic costs and benefits calculated as mentioned, the project's Net Present Value (NPV) can be calculated.

For guidance on setting social discount rates when calculating the NPV, the "Guidelines for the Economic Analysis of Projects (ADB, 1997)" is used as reference. These guidelines suggest that in principle a social discount rate of 12% is used when making ADB-based project evaluations.

Incidentally, for project evaluations prepared by ADB over the past 3 years, they have followed the above guidelines, and have used the social discount rate of 12% in their reports. Thus, this report also performs the analysis with a social discount rate of 12%.
As demonstrated in the Table below, the calculated NPV comes to 241 trillion VND (about 940billion yen).

Moreover, the Economic Internal Rate of Return (EIRR), which represents profitability based on the social costs and benefits, comes out at 222%. This implies that this project has sufficient social benefits.

Table 6.3.1 Calculation of Net Present Value and Economic Internal Rate of Return

	Benefit(B)	Annual Expenditure(C)	Annual Net Benefit（B-C）
	100 Mill. VND/yr	100 Mill. VND/yr	100 Mill. VND/yr
2012		13,475	-13,475
2013		13,475	-13,475
2014		13,475	-13,475
2015	438,986	1,491	437,494
2016	438,986	1,272	437,714
2017	438,986	1,260	437,725
2018	438,986	1,195	437,790
2019	438,986	1,439	437,547
2020	438,986	1,187	437,798
2021	438,986	1,564	437,422
2022	438,986	1,037	437,949
2023	438,986	1,188	437,797
2024	438,986	1,361	437,625
2025	438,986	1,007	437,978
2026	438,986	1,099	437,886
2027	438,986	1,032	437,954
2028	438,986	1,579	437,407
2029	438,986	1,916	437,069
2030	438,986	990	437,995
2031	438,986	1,028	437,958
2032	438,986	1,143	437,843
2033	438,986	1,126	437,860
2034	438,986	1,366	437,620
2035	438,986	1,426	437,560
2036	438,986	1,066	437,919
2037	438,986	1,116	437,869
2038	438,986	1,270	437,715
2039	438,986	1,415	437,570
Social Discount Rate			12%
Net Present Value (NPV)			241 Trill VND（9,403 Bill yen）
Economic Internal Rate of Return (EIRR)			222%

6.4 Potential Variability in Economic Benefits

Based on the cost-benefit analysis conducted in 6.6, it was confirmed that there are sufficient social benefits of this project. However, given that some bold assumptions have been used in the setting of the WTP for analysis purposes, there is some room for the economic benefits to change.

Here, the focus is on the EIRR value, and the maximum level for the WTP to ensure a specified level of profitability is calculated, making sure to clear the 12% level that is applied to ADB investment projects as the social discount rate, and the project's NPV is also calculated under these conditions.

Table 6.4.1 Maximum WTP Corresponding to EIRR (Economic IRR), and Project NPV

	EIRR	Maximum WTP		Project NPV	
Base Case	222%	2,000,000 VND/㎥	（100.0%）	241 Trill. VND	9,403 100 Mill. Yen
Case 1	15%	34,500 VND/㎥	（1.7%）	8,130 100 Mill. VND	32 100 Mill. Yen
Case 2	14%	32,500 VND/㎥	（1.6%）	5,685 100 Mill. VND	22 100 Mill. Yen
Case 3	13%	30,000 VND/㎥	（1.5%）	2,629 100 Mill. VND	10 100 Mill. Yen
Case 4	12%	28,000 VND/㎥	（1.4%）	183 100 Mill. VND	7,153 10,000 Yen

These results show that in relation to the base case from the price of purchased water, when the WTP set at the 1.4% level (Case 4) the EIRR clears 12%, and with the slight changes of the WTP in level from 1.5% to 1.7% (Cases 1-3) a certain amount of NPV can still be expected.

Therefore, even if the economic benefits are reduced through the WTP setting, from the perspective of profitability for the risk takers that are contributing to this project, it can be considered reasonable to expect a positive NPV for the project at a level of 14%-15% of EIRR.

7. Financial Analysis

In this chapter, Study Team shall consider the feasibility of the project from the standpoint of investor and discuss the project scope, financial terms, and payment conditions with the water purveyor to facilitate the project.

7.1 Case Description

(1) Phased Development

This project shall be developed in two stages ultimately aiming to build water treatment plants and related facilities which can purify 300 thousand m3 of water per day. At the first phase of this project, it is planned to build, operate and maintain a water treatment plant with the capacity of 150 thousand m3 of water per day and common facilities with the capacity of 300 thousand m3 of water per day.

(2) Case Study

Following case is analyzed. Note that “water treatment plant” includes water intake and raw water transmission facilities and “water conveyance system” includes booster pump and transmission pipe.

Other infrastructure which supports water provision such as water distributing pipes shall be developed by Ha Noi City.

SPC shall maintain and operate the water treatment plant and water conveyance system and all tariff revenues are assumed to be income stream for SPC.

Table 7.1.1 SPC

Case	Estimated Scenario	
	Build and Own of Water treatment plant	Build and Own of Water Conveyance system
1	SPC	SPC

7.2 Project Scheme

Following is the chart of project cash flow described in an above subchapter. O&M Company could be incorporated into SPC. About finance method, Bank Loan method is considered between JICA and SPC instead of direct loan method.

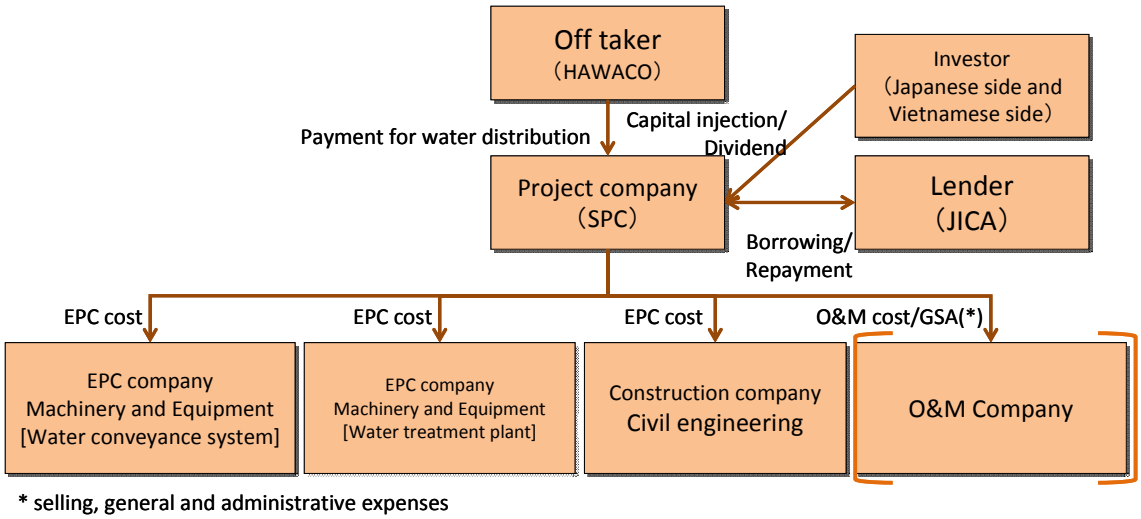


Figure 7.2.1 Project Cash Flow of Case 1

7.3 Major Assumption

(1) Corporate Structure

- SPC established as Joint Stock Company under BOT Law (Decree No.108/2009).
- Shareholders are expected to be Japanese investors 49% and Vietnamese investors 51%.

(2) Project Period

Ha Noi City plans this Project to develop Phase 1 in 2015 and Phase 2 in 2020 in the Master Plan. Therefore, in financial analysis, project stage follows Ha Noi City Master Plan. Project period is equal to the loan period (including construction period) provided by JICA. Initial investment of phase 1 shall be carried out between 2012 and 2014 and those of phase 2 shall be carried out between 2018 and 2019. Besides, one year for liquidation of SPC shall be scheduled.

(3) Earnings

As specified under Chapter 5, SPC's earnings are assumed to be the price for supplying drinking water to HAWACO. The below table outlines the structure of the payment mechanism and shows the relation with price fluctuation and foreign exchange.

Table 7.3.1 Outline of the Payment Formula

Earnings Item	
Capacity Payment	Charges for collecting invested amounts
	Operation fixed charges(with inflation)
	Operation fixed charges(without inflation)
Variable Payment	Operation variable charges(with inflation)
	Operation variable charges(without inflation)

(4) Initial Investment Costs

Initial investment costs include direct costs and indirect costs at 2011 price including finance costs. As for sensitivity analyses, cost down ratios of every 10% up to 30% are assumed.

Direct costs are estimated for civil engineering, mechanical and electrical work depending on each facility, (i) water intake and raw water transmission facilities, (ii) water treatment plants, and (iii) water conveyance system.

Indirect costs consist of design, survey, land compensation, water right application, leading wire contribution and start-up costs. All costs are allocated among each facility for calculation of costs by phases.

In addition, interest rate during construction of 2-3%, and financing costs (upfront fee, 1.5% of loan amount; and commitment fee. 1% of undisbursed amount) are included in the initial investment costs. All costs are estimated in nominal term with inflation.

(5) Rehabilitation Costs

Under the scenario conducting Phase 1 & 2, a certain percentage of mechanical and electrical work is estimated as rehabilitation cost invested in year 25 after commissioning of Phase 1 facilities. The cost is calculated as a nominal basis based on the inflation rate starting from year 1.

(6) O&M Costs

O&M costs and selling and general administrative expenses constitute the annual operation costs which are booked by adding the inflation rate (producer price index).

Table 7.3.2 Component of O&M Cost

Operation Costs		Remarks
O&M Costs	Fixed cost	Amount with inflation rate added to the amount planned in advance
	Variable cost	"Unit Price per cubic meter × Water Purification Capability × operation rate considering the inflation rate for that fiscal year on.

(7) Tax

1) Corporate Income Tax：CIT

① 10% corporate tax for water operator is applied although the standard rate of corporate income tax is 25%. 10% CIT is applied during the project period for the financial analyses because the period applied for can be extended to 30 years by conducting repair although the normal application period for 10% CIT is for 15 years. In addition, CIT exemption for four years from the year SPC gained profit first time and 50% of reduction of CIT another nine years are applied

② Loss carry forward of 5 years is applied.

2) Customs

Customs are exempted. (BOT Law Article 38)

3) VAT

Since VAT for water business is reduced at 5% (regular rate is 10%), VAT received can be lower than VAT paid. Assuming VAT is refunded in a timely manner, the financial analyses do not count this effect to SPC's cash flow. Cost shall increase by the amount "interest rate×1/4×initial investment amount", when tax refund delay by 3 months.

4) Right of Water Use

The law regulating royalty fee is currently under revision and the team reviews the details. The royalty fee for right of water use is not considered at the financial analyses. However, application fee is included as an indirect cost.

(8) Fee for Land Use

Fee for land use is exempted under BOT law and is not included in the analyses

(9) Deposit on Construction Completion

- Investment amount of up to VND 1.5 trillion, maximum 2% of the investment amount
- Investment amount of over VND 1.5 trillion, maximum 1% of the rest of investment amount

Cost shall increase by the amount "interest rate×years from signing of project agreement to construction completion×initial investment amount×approx 1%", when tax refund

delay by 3 months. Although this is not considered under this analysis.

(10) Financing Plan

Conditions for the financing plan will be the same for Phase 1 and 2 as specified below.

1) Equity

- Assumption that 20% of total financing amount

2) Loan

- Assumption that 80% of total financing amount
- Repayment period of 25 years

(11) Depreciation and Rehabilitation

- Assets for initial investments are depreciated during the BOT project period.
- Assets for rehabilitation investments are depreciated during the BOT project period.

(12) Inflation(Producer Price Index)

- Viet Nam : 6.4%/year
- The U.S. : 3.5%/year
- Japan : 0%/year

The above data are applied to the inflation of cost of civil engineering/ construction, equipment, electronics etc.

(13) Foreign Exchange Rate Fluctuation

Foreign exchange rate of 2010 is assumed as noted below and the fluctuation trend during 2000-2009 is applied for the future assumption of forex fluctuation.

1) Forex at base year (2010)

- VND/USD : 1USD=20,000VND
- VND/JPY : 1JPY=245VND
- JPY/USD : 1USD=81.64JPY

2) Fluctuation rate

- VND/USD : 2.0%/year
- VND/JPY : 3.7%/ year
- JPY/USD : -1.64%/ year

Fundamentally, if there is a difference in the interest rate of a currency between 2 countries, there will be a pressure for interest rate arbitrage and the foreign exchange rate will end up in a rate so that the value of the 2 currencies will be the same even when different interest rates are applied (interest arbitrage transaction). However, attention is required, as the application of such foreign exchange managed float system may produce a difference in the interest rate of 2 countries.

7.4 Cash Waterfall

SPC's cash waterfall which summarizes the previously mentioned assumptions. Dividend is of a realistic structure where the initial investment amount is redeemed at the time the SPC is liquidated, and where interim dividend will only be paid if the profit and loss statement is a positive figure and the required reserve is accumulated.

7.5 Analysis

The idea for the way to select the base case necessary for the coordination and negotiation between stakeholders is considered to promote the project

7.5.1 Selection of Base Case

Based on the analyses so far, it is necessary to select the base case for the negotiation between stakeholders to realize the project.

The base case shall be selected using EIRR, Minimum Cash, Minimum DSCR and average water sales price as a reference from the standpoint of project feasibility.

For the water companies, unit price for sale seem expensive when service is provided by private company if they compare with the current unit price for selling water, but it is important to discuss between the governments of Vietnam, Japan and international agencies on such possibility. It would be effective to introduce a subsidy for the portion that is expensive compared to the current level of charges depending on the case by indicating specific advantages that can be enjoyed.

In the calculation, the funding is set so that the cash and deposit in hand at the time of start of the operation period reaches a certain level.

In terms of minimum DSCR, it is said that project cash flow should be reviewed so that the minimum would be 1.2-1.5 in general (JICA Research Institute (2005), 'PPP (Public-Private Partnership)'). For this simulation, it is important to understand the level of the unit price for selling water, it almost means EIRR, to meet the specified DSCR on Loan agreement. However, it could not be concluded that the range between 1.3 and 1.5 is appropriate for DSCR referring general case because this project has high public interest. Putting much value on LLCR (Loan life coverage ratio) than DSCR is one option as well.

There are various kinds of views on the minimum EIRR for investors. One is the method in which EIRR shall exceed the amount calculated by adding up financing cost including equity and interest gap between domestic and international. Following formula shows the result using weighted average capital cost (WACC) of listed companies on the Tokyo Stock Exchange for

financing cost including equity and average of international interest-spread between JPY and VND during the last 5 years.

9.2% (WACC of listed companies on the Tokyo Stock Exchange) + 8.3% (8.9%(average interest rate of VND during the last 5 years) – 0.6%(average interest rate of JPY during the last 5 years)) = 17.5%

Table 7.5.1 Trends in Interest Rate of JPY and VND

(JPY：TIBOR 3month, VND：Policy rate by Central Bank, Unit：%)

	2007	2008	2009	2010	2011	5 years average
JPY	0.71	0.82	0.60	0.38	0.34	0.6
VND	8.3	12.0	7.0	8.0	9.0	8.9

Another way is referring targeted return by trading company which could vary by sector. It is generally defines as 15% to 25%.

In one scenario, Return of Investment (ROE) which exceeds minimum DSCR determined considering project risk and country risk could be set as minimum return for investors

Table 7.5.2 Average ROE of Listed Company in Japan

	Year 2008	Year 2009	Year 2010	Average
ROE	11%	12%	10%	11%

On the other hand, some says low EIRR is acceptable in the case with low risk in domestic PFI project. The level of EIRR depends on the project scheme and Study Team tentatively sets 15% as target EIRR because project structure for this project is under discussion.

Based on the above prerequisite, alternatives shall be narrowed down to 1 case taking account into the above mentioned points.

8. Issues and Proposals on Management and System

This chapter will describe proposals to the Vietnamese and Japanese Governments in order to realize risk sharing as proposed in Chapter 5 and make a feasible project structure.

8.1 Government Assistance

In this Chapter, Study Team proposes the following issues to the Government of both countries as necessary fundamental measures for this project.

8.1.1 Assistance Required from the Vietnamese Government and Japanese Government

The issues involved in Japanese companies investing in this project have been identified as follows:

(1) Government Approval to the Conversion of VIWASEEN's BOO Concession Right into a BOT Concession Right, and the Transfer of the Rights to a VIWASEEN-related SPC
VIWASEEN, a state-owned enterprise (SOE), has obtained a concession right as a BOO project from the Presidential Office. The project is currently positioned at a pre-F/S level. In order for Japanese companies to participate in this project, the project must be a BOT project instead of a BOO project in accordance with the Investment Law (Law No.59/2005/QH11). However, a BOT project must comply with Decree No.108/2009/ND-CP. Study Team has obtained approval from VIWASEEN to transfer the project into a BOT project upon participation by Japanese investors. Study Team proposes the governments to assist the presiding authority make a governmental decision to transfer and apply the BOO concession right granted to VIWASEEN as a BOT concession right to this project with VIWASEEN as the main party, in other words, to apply this to the VIWASEEN-related SPC.

(2) Guarantee on the Purchase of the Amount Water Purified up to 300,000m3/day
The SPC in this project will need to execute a Take or Pay Agreement between Water Company and SPC as for the supplied water by 150,000m3/day and 300,000m3/day in order to secure the project feasibility. Study Team proposes a guarantee from the Ministry of Construction (or Ha Noi City) for purchasing the amount of water to be supplied.

(3) Adjustments between this Project and the Pilot Projects under the PPP Law.

It was recently stated that the Red river water project in the northern part of Hanoi's metropolitan area was listed in the short list of pilot projects based on the PPP Law (Decision No.71/2010/QD-TTg) by the governmental authorities led by Ministry of Planning and Investing. It is also said that the excess portion of the Da river BOO water project that supplies water to the southern part of Hanoi's metropolitan area.

In the above case, the feasibility of this project could be negatively impacted depending on progress of the projects which are in a competitive position with this project. Thus, Study Team proposes that a guarantee be given to ensure this project.

(4) Adoption of a Method to the Payment System that Combines the "Capacity Payment" and "Variable Payment" .

For the payment system for the off take price, Japanese companies that will be investing in the project assume combining method of the "Capacity Payment" and "Variable Payment" which is currently actually being adopted by the electric generation IPP project in Vietnam.

The adoption of this method is based on the concept of how to manage "inflation risk" and "foreign exchange risk" that Japanese companies who are overseas investors, are exposed.

Under this project, funds that will be invested or loaned from Japan and mainly that compose the project's asset building portion, will be made in "Capacity Payment" on the assumption that the Japan side will bear the inflation risk and which is a fixed expense payment that does not consider inflation to secure the cash for repayment. The variable payment portion for which it is assumed that the off taker side will bear for Vietnam's inflation during the O&M period will be in "Variable Payment."

Next, for avoiding the "foreign exchange risk" that Japanese investors will be exposed to assuming Vietnam's macroeconomic situation under which it is experiencing high inflation caused by trade deficit, decrease in foreign reserves and the rise in import price. The Japanese investor side proposes the off take payment to be "denominated in USD and paid in VND."

(5) Payment Support for the Off Take Price (VGF system based on the output)

In Vietnam, water operators can propose an "Average Consumption Price" which is

determined by the average cost to provide the purified water that includes a profit, based on the Inter-Circular No.95/2009/TTLT-BTC-BXD-BNN, issued by ministry of finance (MOF) in 2009 regarding both wholesale and retail water charges. As it would be difficult for this project to secure necessary profitability according to the level of current water charges. The project will establish the off take price equivalent to water charges, in compliance with this Average Consumption Price.

The Average Consumption Price which will be the base case for this project will not fall within the range of Average Consumption Price for filtered water for the "special urban district" that Hanoi corresponds to as stipulated under Decision No.100/2009/ TT-BTC by MOF in 2009 (minimum 3,000VND/m3, maximum 12,000VND/m3), Study Team proposes the Vietnamese government's measures on purchase to be applied to this difference in amount.

(6) Clarification on the Position of the Project in the Metropolitan Development Plan and Confirmation of the Importance.

Arrangement for the marginal infrastructure system is prerequisite for the project by Government side. The risk at the project delay can not be controlled by private sectors. Therefore it is necessary to clarify the schedule assumed in the related governmental development plan, coordinate them and confirm its importance to consider the reasonable schedule of the project in the metropolitan development plan. Study Team proposes a governmental guarantee for the damages result from the delay in the project schedule due to Government side's delay.

(7) Encouragement the Consensus Building between the Sponsors by Governmental Support for the Vietnamese Sponsor.

This project will be conducted by SPC to be established by VIWASEEN that is a SOE that is granted BOO concession right by the Presidential Office, HAWACO who is a member of the off taker, Metawater, and JICA who are expected as Japanese investors. Therefore, consensus building is required among investors through the common financial analysis results to structure the project scheme, including scopes of the project, investment structure, financing conditions, profit sharing, risk sharing, etc. Study Team would like to propose requesting cooperation from VIWASEEN that has been granted the BOO concession right from the central government agency and HAWACO who is a member of the off taker, for the realization of the project.

(8) Establishment and Implementation of a Monitoring Agency for the Project by the Vietnamese and Japanese Governments

When the SPC is making a direct borrowing for this project, JICA may collect various data as a right under the loan agreement from the SPC each time for drawdown during the construction period on a monthly or annual basis, or regularly. Study Team proposes that JICA request the Vietnamese government for the establishment of a monitoring agency for the Vietnamese and Japanese governments to hold meetings each time a loan is disbursed during the construction period (quarterly, at minimum) and semi-annually after completion, and to engage proactively in actions to identify and rectify issues at an early stage, based on such data.

8.1.2 Assistance Required from the Japanese Government

Study Team proposes the following items to the Japanese Government.

(1) Payment Support for the Off Take Price (VGF system based on the output).

Study Team proposes the establishment of a fund through which the Japanese Government to provide fiscal assistance for the output-based VGF to the Vietnamese government as described above .

(2) Establishment and implementation of a monitoring agency for the project by the Vietnamese and Japanese Governments.

As proposed in the section 8.1.1 on the “Assistance required from the Vietnamese Government and Japanese Government”, Study Team proposes the Japanese government a leading role to establish a monitoring agency, based on JICA’s involvement. Study Team considers that fulfillment of obligation by Japan side and Viet Nam side defined in the contracts has the effect on the success and failure of the project. Therefore, it is important to establish the institution which guarantees the fulfillment of obligation which project members owe in the event of contractual failure of either party.